Humidity Cell Termination Report for the Copper Flat Project, New Mexico

Report Prepared for

THEMAC Resources Group Ltd.

Report Prepared by

SRK Consulting (U.S.), Inc.
SRK Project Number 191000.03
February 2014

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1 Introduction

SRK Consulting, Inc. (SRK) has undertaken a geochemical characterization study to assess the Acid Rock Drainage and Metal Leaching (ARDML) potential of the Copper Flat project, New Mexico. The results of the characterization program and subsequent numerical predictions are provided in the *Geochemical Characterization Report for the Copper Flat Project* (SRK, 2013a) and *Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico* (SRK, 2013b) report, prepared by SRK Consulting, Inc. As part of the characterization study, a kinetic testwork program was undertaken on 23 samples of waste rock/ore and nine samples of tailings material to determine the long-term leaching behavior of these materials. The cells were operated between 28 and 122 weeks and have now been terminated. This report presents the final results of the humidity cell testwork and termination testing and serves as an addendum to the main geochemical characterization report (SRK, 2013a).

2 Methodology

2.1 Sample Selection

Kinetic testing is necessary for the Copper Flat Project in order to assess the long-term weathering rates of sulfide minerals and to determine potential release rates for metal(loid)s, salts such as sulfate and changes in pH, particularly for those material types that demonstrated an uncertain potential for acid generation in the static Acid Base Accounting (ABA) and Net Acid Generation (NAG) tests (SRK, 2013a). The results of static geochemical testwork were used to select a sub-set of 23 waste rock and ore samples for kinetic testing. These samples were collected from coarse rejects and exploration core and from the existing waste rock dumps/pit walls on site and are considered representative of the range of geochemical behavior observed for the primary material types on site. Kinetic testing was also undertaken on nine samples of tailings material generated by the metallurgical testwork program. These nine tailings samples are representative of the different ore streams that will be generated during various stages of mine life. Tailings samples subjected to cyclone separation were not submitted for kinetic testing because these samples show a similar range in behavior to the lithology specific metallurgical tailings samples from the static test data (i.e., non-acid forming with low levels of metal(loid) release).

A full list of the waste rock, tailings and ore samples selected for kinetic testing is provided in Table 2-1 along with selected static testwork results.

Table 2-1: Samples Selected for Kinetic Testing

Material type	Primary lithology	Sample ID	Sulfide sulfur (wt%)	NNP (kg CaCO$_3$ eq/t)	NPR	NAG pH	Total NAG (kg H$_2$SO$_4$ eq/t)	Week terminated	Post-HCT mineralogy
Andesite	Andesite	SRK 0864	0.01	24.4	81.3	8.29	0	44	
	Andesite	SRK 0866	0.29	12.5	2.37	3.23	4.9	44	
Sulfide ore	Biotite breccia	604811	1.15	-3.9	0.89	8.42	0	44	
	Quartz Feldspar Breccia	604767	2.13	-49.9	0.25	3.21	17.3	86	x
	Biotite Breccia	604862	1.16	3.5	1.10	8.28	0	44	
	Biotite Breccia	604867	2.34	-46.2	0.37	4.24	0	44	
	Quartz Feldspar Breccia	604787	0.97	-0.2	0.99	8.00	0	56	
	Biotite Breccia	604854	1.4	-20.6	0.53	5.08	0	44	
	Quartz Monzonite	604562	1.53	-31.6	0.34	7.75	0	44	
	Quartz Monzonite	604669	0.63	-16.5	0.16	4.08	0	61	
	Quartz Monzonite	604656	0.59	33.4	2.82	8.20	0	44	
	Biotite Breccia	605033	0.9	1.1	1.04	8.30	0	44	
	Quartz Monzonite	604606	0.67	2.7	1.13	9.60	0	44	
	Quartz Monzonite	604653	0.77	2.3	1.10	8.38	0	44	
Sulfide waste	Quartz Monzonite	604673	0.41	-5.9	0.54	3.66	5.29	122	x
	Quartz Monzonite	605153	0.49	26.7	2.75	8.56	0	44	
	Coarse Crystalline Porphyry	CF-11-02, 367-408	0.63	-6.7	0.74	2.78	14.0	60	
Transitional ore	Biotite Breccia	SRK 0854	0.88	-21.5	0.22	3.77	11.0	96	x
	Quartz Monzonite	SRK 0867	0.77	-17.7	0.27	4.35	0	52	x
Transitional waste	Biotite Breccia	SRK 0872	1.05	-13.0	0.60	3.14	8.82	96	x
	Quartz Monzonite	604569	1.05	-14.8	0.55	8.33	0	44	
	Quartz Monzonite	SRK 0858	0.62	-15.3	0.21	3.15	9.22	61	x
	Coarse Crystalline Porphyry	CF-11-02, 0-27	1.4	-16.3	0.58	3.28	9.24	60	x
Tailings*	-	Cu. Ro. Tails	0.61	13.4	1.70	9.23	0	28	
	-	CF-11-02 (227-367)	0.03	20.0	34.3	-	-	52	
	-	CF-11-02 (52-117)	0.04	23.8	27.4	-	-	42	
	-	K-Spar Breccia 5+ Comp	0.19	26.4	4.26	-	-	52	
	-	Biotite Breccia 5+ Comp	0.14	24.6	4.90	-	-	42	
	-	Quartz Monzonite 5+ Comp	0.02	24.4	28.1	-	-	42	
	-	K-Spar Breccia 0-5 Comp	0.53	6.9	1.31	-	-	52	
	-	Quartz Monzonite 0-5 Comp	0.41	13.1	1.74	-	-	52	
	-	Biotite Breccia 0-5 Comp	0.39	13.4	1.77	-	-	52	

🟥 Indicates Potentially Acid Forming (PAF) characteristics

* HCTs were not run on the cyclone tailings as these showed the same geochemical behavior to the other tailings samples tested from the static test data.

2.2 Kinetic Testwork Methods

The kinetic testing method selected for this Project is the standard humidity cell test (HCT) procedure designed to simulate water-rock interactions in order to evaluate the rate of sulfide mineral oxidation and thereby predict acid generation and metals mobility (ASTM D-5744-96). Under ASTM methodology, the test follows a seven-day cycle and typically runs for a minimum of 20 weeks, unless uncertain chemistry requires that it be run longer to achieve steady state conditions. During the seven-day cycle, water is trickled over the rock. After draining, dry air is circulated through the cell for 3 days followed by humidified air at 25^{o}C for 3 days. On the seventh day, the sample is rinsed with distilled water and the extracted solution is collected for analysis following filtration at 0.45 µm. Key parameters including pH, alkalinity, acidity, electrical conductivity, iron and sulfate are measured on a weekly basis by McClelland Laboratories. For the first four weeks of testing, metals are measured on a weekly basis at WETLAB, after which the frequency of metals analysis is reduced to every fourth week. Leachate chemistry data collected during the HCT test are frequently compared with applicable water quality standards. However, it is recognized that the test results are not directly comparable to water quality standards due to the increase in surface area by crushing and the artificial control on weathering through a seven-day wet-dry cycle rinsing of the samples. The rate of water application relative to the surface area/mass ratio of rock vastly exceeds the actual precipitation rate that would be expected at the site, and the laboratory temperature conditions do not represent normal field variations. These variables accelerate the weathering process and therefore provide a conservative view of field scale leaching conditions.

The HCT results provide an estimate of the rate of leaching of constituents from a material and reflect accelerated weathering of mine material being exposed to alternating cycles of wetting and drying. The changes in these reaction rates through the course of the test can be used to estimate whether the sample will be net acid generating or net acid neutralizing, and what constituents will be mobilized from the material under long-term weathering and oxidation conditions. As such, HCT results can be used to refine predictions based on static test data.

The HCTs are executed until the majority of the mineral reactions that can be predicted from mineralogy or static testing have been observed. This is the point at which the leach rates are relatively constant and long term reaction rates can be defined. It does not equate to complete oxidation of sulfides within the cell. This endpoint is assessed by monitoring the release rates of key constituents such as pH, sulfate, acidity, alkalinity and iron as well as dissolved metals and metalloids. It is common practice to terminate cells when the release rates for these leachate parameters become relatively constant with time and there is no substantial change in the calculated release rate. For practical purposes this is taken as steady state element release.The ASTM Procedure for humidity cell tests (ASTM, 1996) calls for a minimum test duration of 20 weeks. However, there is no technical basis for this recommendation and in most cases with sulfide bearing materials, 20 weeks is insufficient to allow complete reaction of the sample material. Essentially, there is no established criteria for the termination of kinetic tests, rather the point at which HCTs should be terminated is project specific and will be determined by the physical and chemical characteristics of the samples and the objectives of the test (Mills, 1998). As such, some of the Copper Flat HCTs were run in excess of 120 weeks to confirm the long-term potential for acid generation and metal(loid) release.

2.3 Termination Testwork Methods

Following completion of the HCTs, termination testing was conducted on the test residues including multi-element analysis, ABA and NAG to define the geochemical processes that occurred as the materials were exposed to oxygen and water. Mineralogical analysis was also undertaken on seven samples of post-HCT material and one sample of pre-leach material to assess the speciation and textures of the sulfide minerals in the samples, and what influence this may have had on the test conditions in particular for those samples predicted to be acid generating from the ABA and NAG testwork that did maintained neutral conditions in the HCT. The samples selected for mineralogical analysis are detailed in Table 2-2.

The testwork methods are detailed in the SRK geochemical characterization report (SRK, 2013a) and include:

- Mineralogical analysis – using optical microscopy, scanning electron microscopy (SEM) and X-Ray Diffraction (XRD) analysis.
- Acid Base Accounting – using the Nevada modified Sobek method with sulfur speciation by hot water, hydrochloric acid and nitric acid extraction.
- Net Acid Generating testing – reports the final NAG pH and NAG value after a two-stage hydrogen peroxide digest.
- Multi-element analysis – using four-acid digest and ICP analysis to determine the total metal and metalloid chemistry for 48 elements (ALS Chemex Method ME-MS61).

Table 2-2: Samples submitted for mineralogical analysis

Sample ID	Details	Material type	Sample selection rationale
SRK 0854	HCT residue	Transitional ore	Mineralized material from the Sternberg lode, which developed moderately acidic pH conditions (pH 5) during the HCT program.
SRK 0858	HCT residue	Transitional waste	The only cell in the HCT program that developed truly PAF conditions. HCT results confirmed that active sulfide weathering was occurring in this cell.
SRK 0867	HCT residue	Transitional ore	Pre-HCT mineralogical data available. Included for comparison purposes.
SRK 0872	HCT residue	Transitional waste	Predicted PAF by ABA/NAG testwork, but neutral in HCT. Mineralogy required to confirm why no acid generation occurring.
604767	HCT residue	Sulfide ore	Predicted PAF by ABA/NAG testwork, but neutral in HCT. Mineralogy required to confirm why no acid generation occurring.
604673	HCT residue	Sulfide waste	Predicted PAF by ABA/NAG testwork, but truly acidic conditions did not develop in the HCT (although pH did decline over course of testwork).
CF-02 (0-27)	HCT residue	Transitional waste	Predicted PAF by ABA/NAG testwork, but neutral in HCT. Mineralogy required to confirm why no acid generation occurring.
CF-11-02 (0-27)	Original (pre-leach) sample	Transitional waste	Pre-HCT leached material for sample CF-02 0-27

2.4 Quality Control

Both McClelland and WETLAB laboratories operate internal QA/QC procedures to ensure adequate data quality. This includes the analysis of certified reference materials in addition to analytical blanks and duplicates. However, SRK also applies a number of QA/QC checks on the received data, including the calculation of ion balances to determine the balance of cations and anions in the generated solutions. A comparison of pH measurements from both McClelland and WETLAB is also carried out to assess data quality. The results of the quality control exercise are summarized in Figure 2-1 to Figure 2-2 and show generally good data quality, with ion balances almost uniformly within ±10% and good correlations between laboratory measurements. For pH, there is a slight difference in reported values between the two labs (Figure 2-2). This is only observed above pH 7.5 and shows a slight negative bias in the calibrated meters at McClelland Laboratories versus measurements for the same solutions at WETLAB. This is not considered significant since the WETLAB data were used in numerical predictions (SRK, 2013a; 2013b).

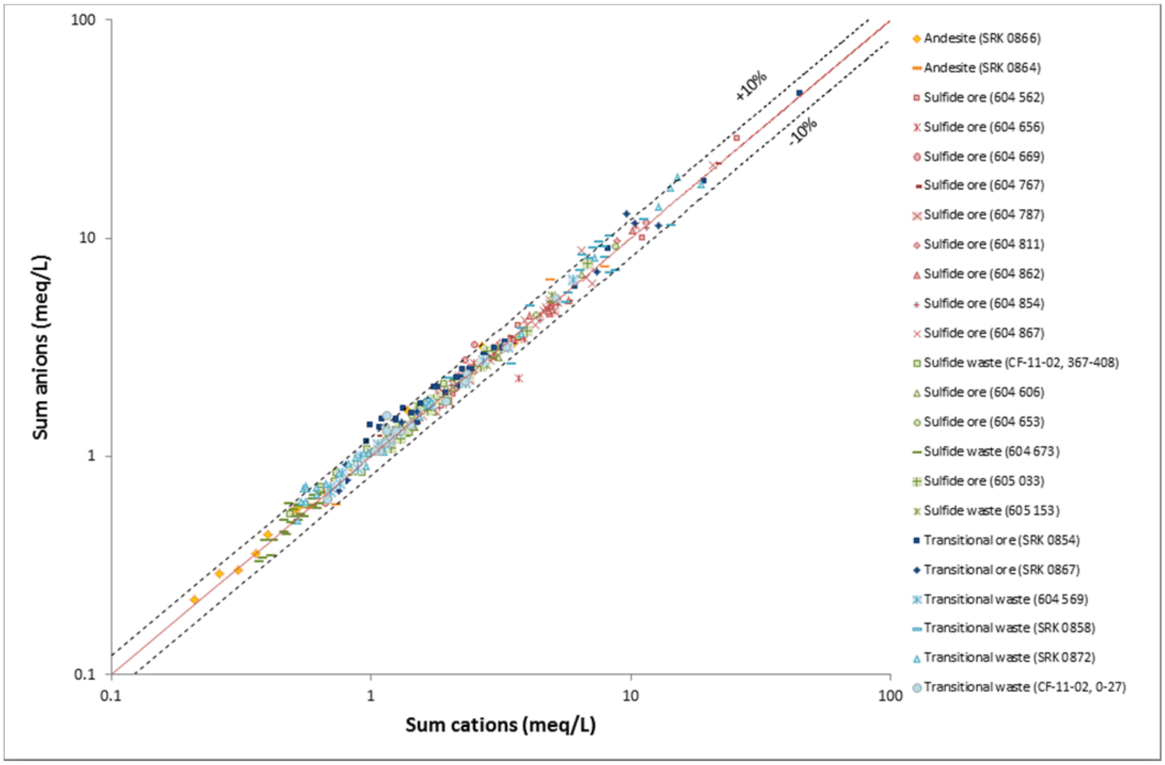

Figure 2-1: Ion balance plot for the HCT leachates

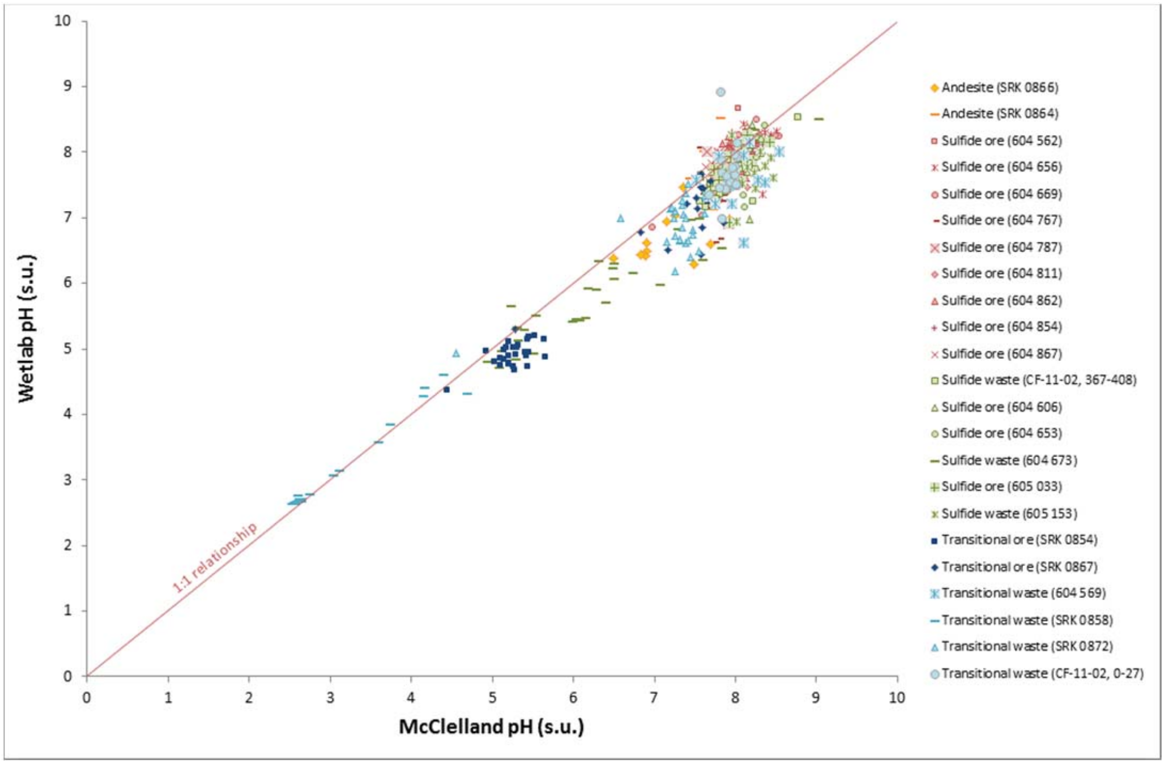

Figure 2-2: Scatter plot comparing McClelland pH and WETLAB pH for the HCT leachates

3 Kinetic Testwork Results

3.1.1 Waste Rock and Ore Samples

Humidity cell testing was carried out on 23 samples of waste rock and low grade ore. Thirteen of the cells reached steady state conditions and were terminated at week 44 and the remaining cells were terminated between week 52 and week 122. Time series plots of elemental release from the waste rock and ore samples are presented in Figure 3-1 to Figure 3-15. Laboratory reports were provided in the *Geochemical Characterization Report for the Copper Flat Project* (SRK, 2013a) for the test results available at that time. Laboratory reports for samples that continued after completion of the 2013 report are provided in Appendix A.

The trends of effluent pH for each of the cells are presented in Figure 3-1. This demonstrates that the majority of the cells produced circum-neutral to moderately alkaline pH leachates (pH 7 to 9) throughout the course of the testwork. Furthermore, the effluent pH was stable for most cells throughout the testwork period, indicating no onset of sulfide oxidation. Only two cells (SRK 0858 [transitional waste] and SRK 0854 [transitional ore]) produced acidic leachates (pH 2.5 to 5) from week zero onwards, which likely reflects the fact that material in these cells is from surface grab samples that were noted as having secondary copper sulfate salts on the material surface. These salts are readily-soluble and flushing during the leach cycle may generate acidic leachates and result in elevated sulfate and metals release. Indeed Figure 3-7 and Figure 3-8 show that cell SRK 0854 (transitional ore collected from the Sternberg lode) has particularly elevated sulfate and copper release at week zero, with up to 1,043 mg/kg and 376 mg/kg release, respectively. The Sternberg lode was a small mine that yielded 200 tons of copper ore between 1911 and 1934 (Raugust, 2003). Observations made during the field sampling program show that material within the Sternberg lode has significant chalcanthite ($Cu^{2+}SO_4.5H_2O$) and other secondary sulfate salts on the surface of the rock. Dissolution of this mineral during the HCT leach cycles is likely responsible for the low pH and elevated metals concentrations observed in the initial leachates from this cell. However, this sample is representative of material that will make up only a minor proportion of the overall waste rock.

The only other cell that showed an indication of active sulfide oxidation during the humidity cell testwork was cell 604673 (sulfide waste), which showed declining pH throughout the 122 weeks of testing from pH 8.30 at week zero to pH 4.94 at week 122. This was accompanied by increasing copper, uranium and zinc release from week 45 onwards, with these parameters being mobilized under the more acidic conditions. Despite the development of acidic conditions after continued testing, sulfide oxidation in this cell can be said to be slow, with effluent pH remaining above 5 s.u. through week 120. These slow rates of acid generation are supported by the behavior of many of the other HCT cells, where acidic conditions were not realized despite sulfide sulfur contents up to 2.34 wt% and predicted potentially acid forming (PAF) characteristics based on the ABA and NAG testwork results.

The leachates from most cells show elevated electrical conductivity (EC) during the first five weeks of testing, which corresponds to an initial flush of sulfate from the cells. However, iron release was below analytical detection limits for the majority of samples (Figure 3-4), indicating that the initial flush in sulfate concentrations is not related to sulfide oxidation but rather to the flushing of readily-soluble sulfate salts from the material surface. In contrast, the increase in effluent iron and sulfate concentrations in cell SRK 0858 (transitional waste) after week nine indicates the onset of sulfide oxidation in this cell. This is supported by the corresponding drop in pH and increase in effluent metal concentrations.

The iron speciation of the humidity cell effluents is shown in Figure 3-5 and Figure 3-6, which demonstrates that the solutions are typically characterized by a mixed valence (i.e. Fe^{2+}/Fe^{3+}) iron chemistry. The effluent Eh of the humidity cells is illustrated in Figure 3-3 and shows oxidizing conditions in all cells, with effluent Eh typically between 150 and 300 mV. Cells SRK 0854 (transitional ore) and SRK 0858 (transitional waste) show higher effluent Eh between 350 and 600 mV that can be related to sulfide oxidation reactions. This results in the generation of more oxidized species such as ferric iron and reflects the onset of sulfide oxidation in cell SRK 0858.

Metal release from the drill core samples was generally low throughout the testwork period, with many parameters being consistently at or near analytical detection limits in the leachates including aluminum, antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel and thallium. Metal release from the grab samples (i.e., transitional material collected from the existing waste rock dumps and pit walls) was higher, with detectable release of zinc, copper, manganese and molybdenum, particularly in the first 5 weeks of testwork. Again, this likely represents the flushing of soluble secondary salts from the material surface, which lowers the pH and increases the solubility of base metal ions. This is supported by the Ficklin plot presented in Figure 3-15, which shows that leachates from the majority of cells can be classed as near-neutral, low-metal waters based on effluent pH greater than 5.5 s.u. and Ficklin metal concentrations less than 1 mg/L. However, leachates from cells SRK 0854 (transitional ore) and SRK 0858 (transitional waste) can be classed as acid, high-metal waters based on Ficklin with total divalent metal concentrations up to 837 mg/L (Figure 3-12). Cell SRK 0858 generally exhibited the highest levels of reactivity, with the lowest effluent pH (<3 s.u.) and elevated release of iron, sulfate, aluminum, copper, molybdenum and zinc under these more acidic conditions.

Several of the sulfide ore samples showed elevated uranium and selenium release, particularly during the first ten weeks of testing. Uranium concentrations in the HCT leachates reached a maximum of 0.23 mg/L for cell 604767 (sulfide ore) in weeks 1 and 2, which is above the NMWQCC Human Health Groundwater Standard of 0.03 mg/L. However, uranium release in all cells fell below the NMWQCC groundwater standard by week 40. Similarly, selenium release reached a maximum of 0.04 mg/L in cell 604562 (sulfide ore) during the initial weeks of testing, which is close to the NMWQCC groundwater standard of 0.05 mg/L.

The Piper plot presented in Figure 3-16 shows that the leachates from most cells can be classed as either calcium + sulfate (Ca + SO_4) or calcium + bicarbonate (Ca + HCO_3) type waters, with calcium representing the major cation in solution and either sulfate or bicarbonate the major anion. The anion dominance reflects sulfide reactivity rather than sulfide abundance.

Figure 3-13 shows there has been a depletion of neutralizing potential (NP) in the HCT cells over the course of the testwork period. The consumption of NP was slow in the majority of cells, with samples still having over 80% of the initial NP remaining at week 40 (or over 70% of NP remaining at week 86/95/122 for the continued cells). This indicates that significant buffering was still available when the cells were terminated and/or that acid generation is limited or occurs at a slow rate. Only four cells (SRK 0867, SRK 0854, SRK 0858 and 604669) showed more rapid consumption of NP throughout the testwork, with cell SRK 0858 (transitional waste) showing complete consumption of NP by week 29, cell 604669 (sulfide ore) showing consumption of NP by week 50 and cell SRK 0858 (transitional ore) showing complete consumption of NP by week 82. The more rapid consumption of NP in these cells is related to the lower initial NP available (less than 6 kg $CaCO_3$ eq/ton) in these samples as well as the consumption of available NP through the buffering of acid. These results indicate abundant buffering exists in wallrock and waste rock at Copper Flat for the majority of rock types for a prolonged period of weathering. The slow rate of NP consumption in the HCTs further demonstrates low potential for acid generation with stable sulfides showing resistance to weathering in all samples except SRK 0858 that consumed 50% of the initial sulfide by week 60 (Figure 3-11).

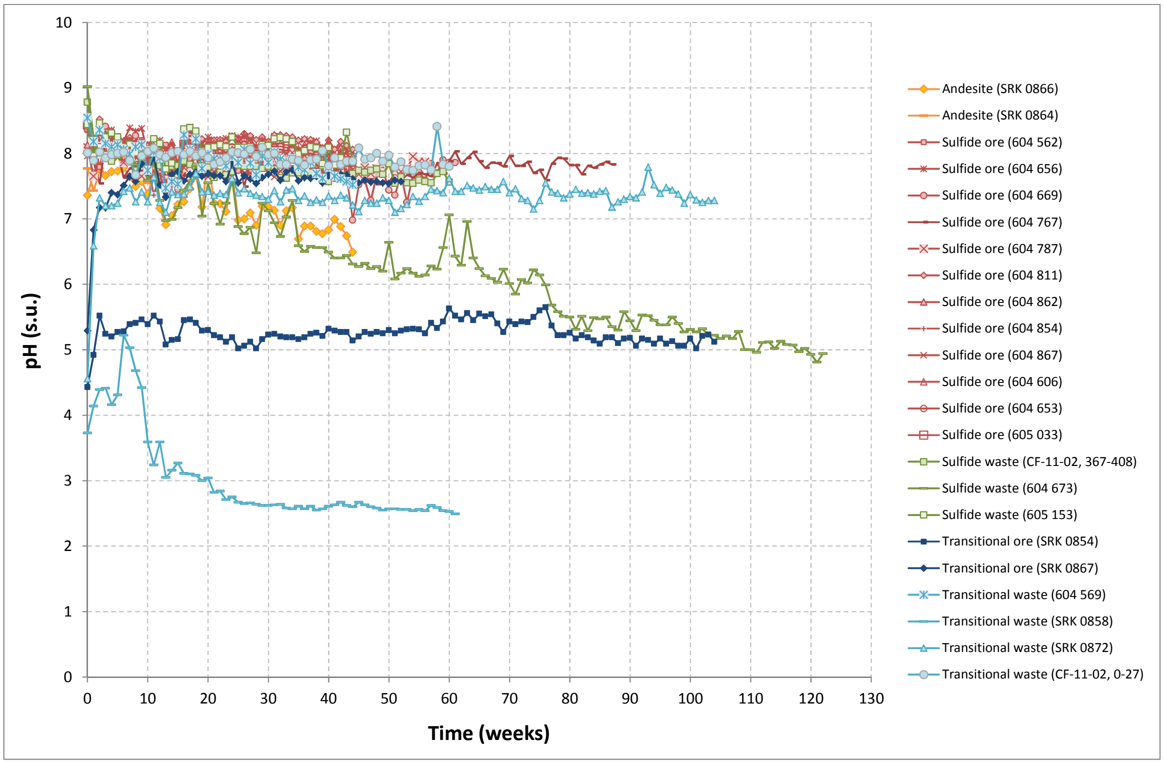

Figure 3-1: Waste Rock/Ore HCT Effluent pH

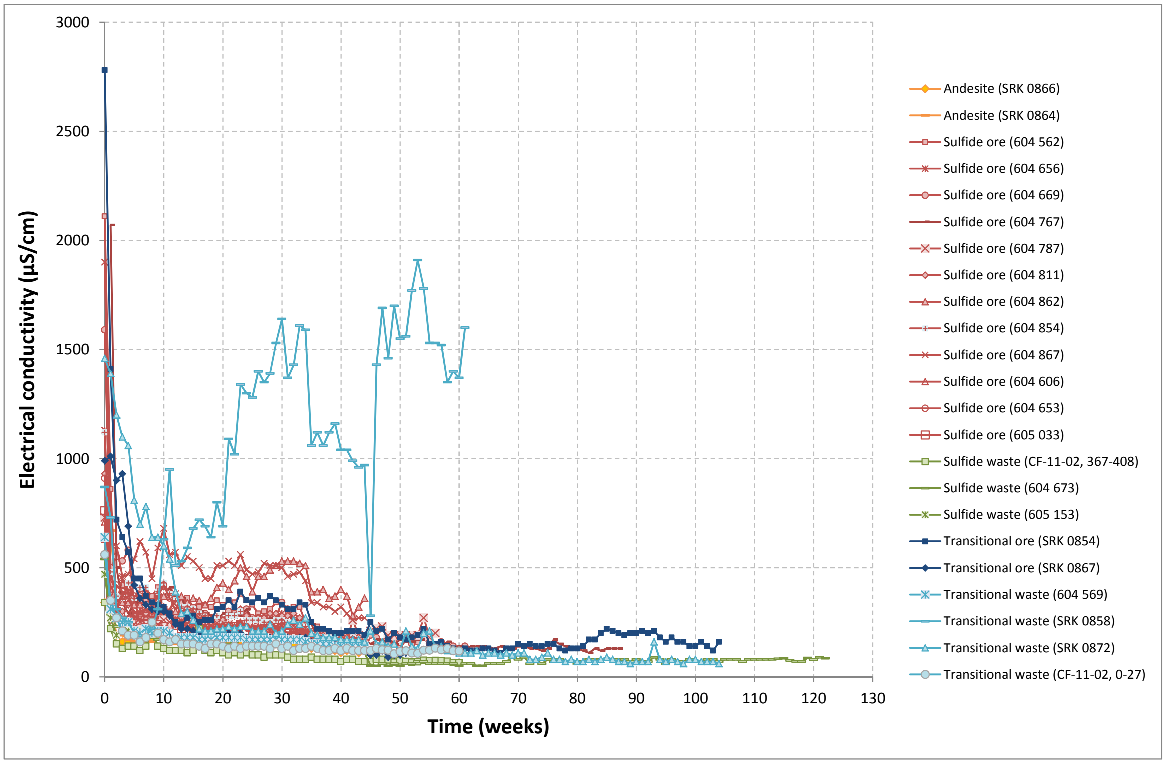

Figure 3-2: Waste Rock/Ore HCT Effluent Electrical Conductivity

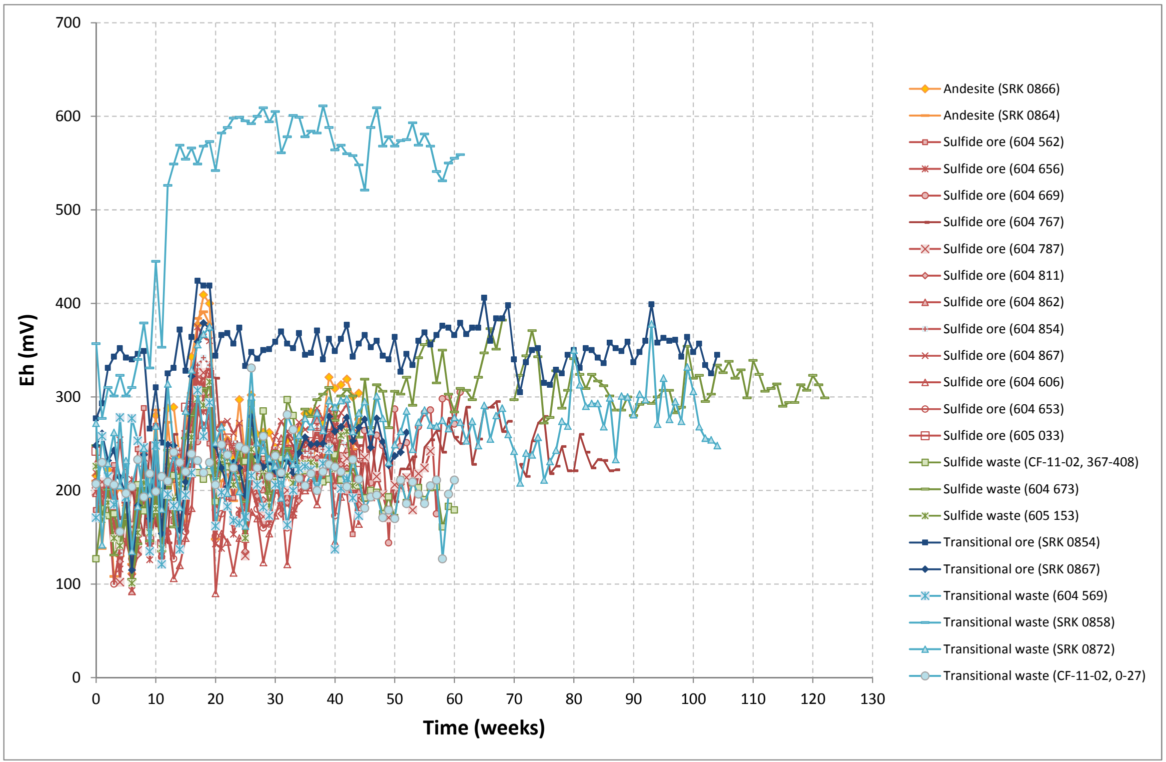

Figure 3-3: Waste Rock/Ore HCT Effluent Eh

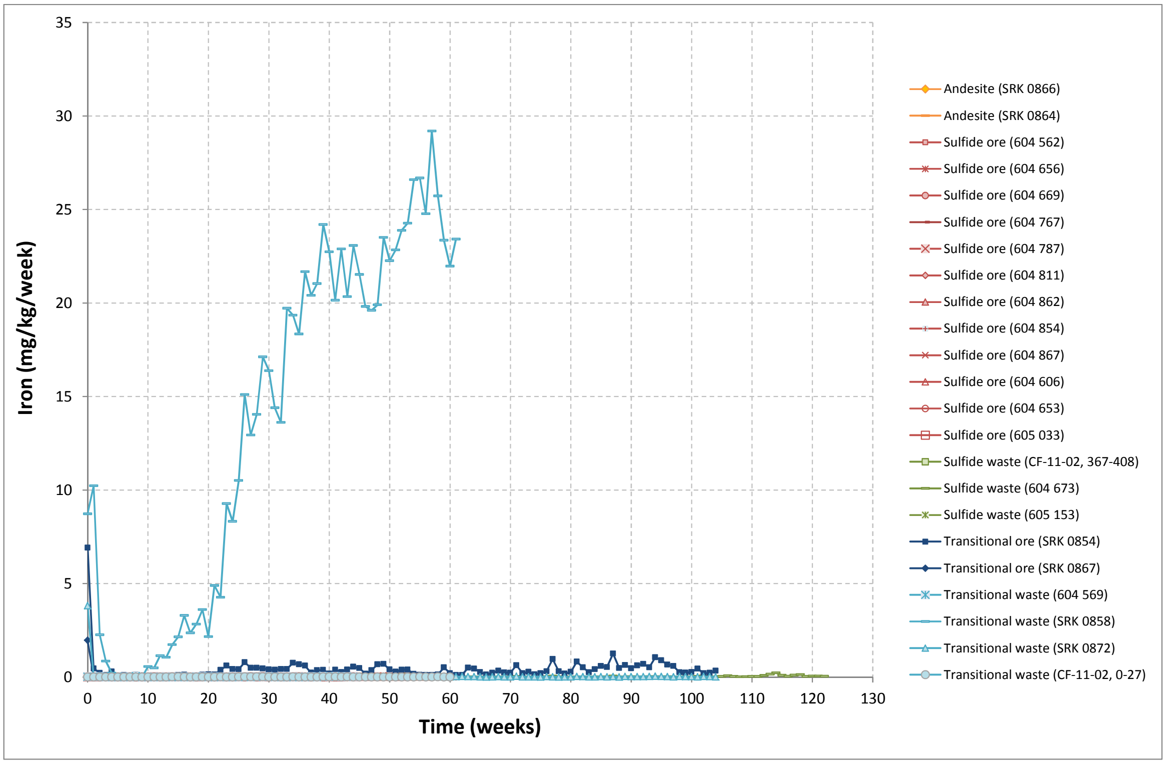

Figure 3-4: Waste Rock/Ore HCT Effluent Iron

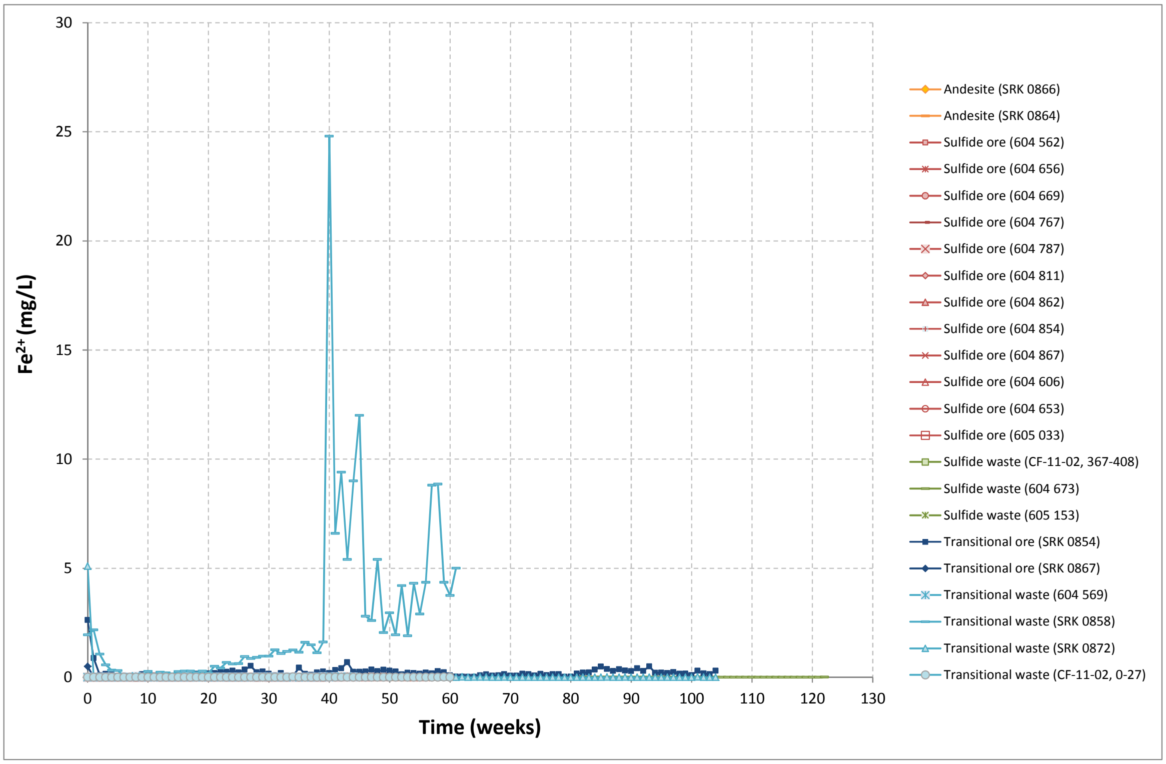

Figure 3-5: Waste Rock/Ore HCT Effluent Fe^{2+} (in mg/L)

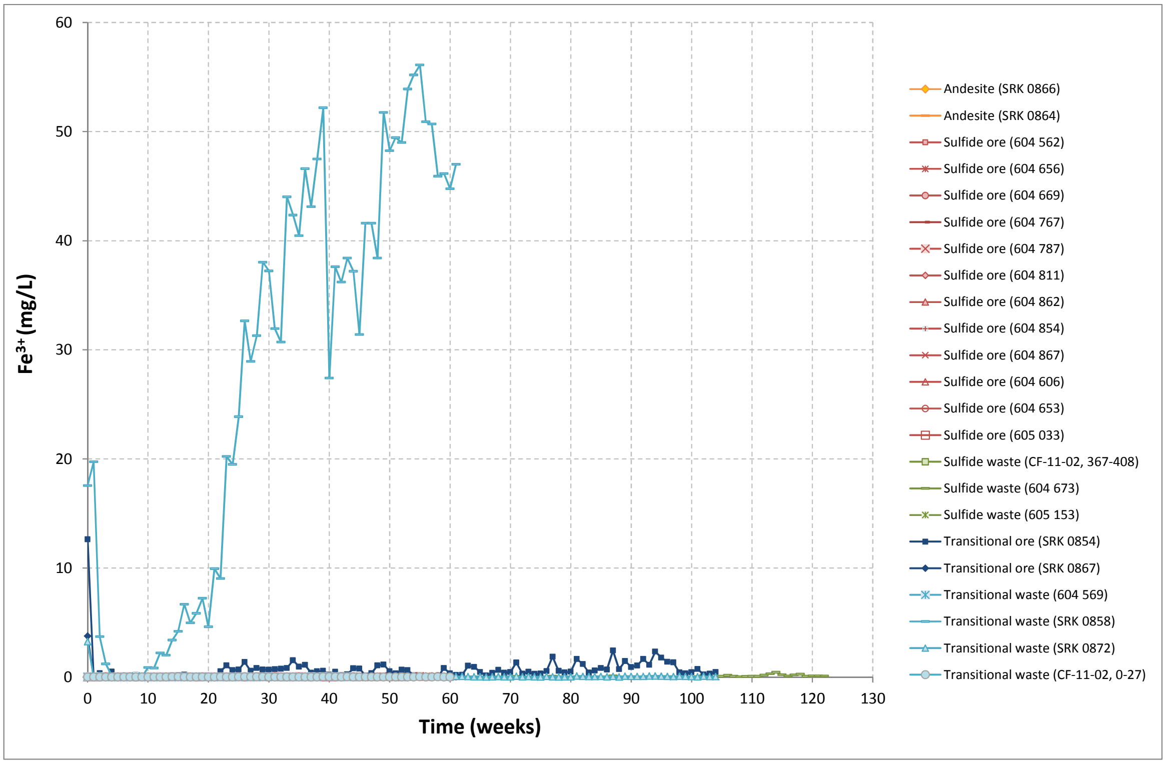

Figure 3-6: Waste Rock/Ore HCT Effluent Fe^{3+} (in mg/L)

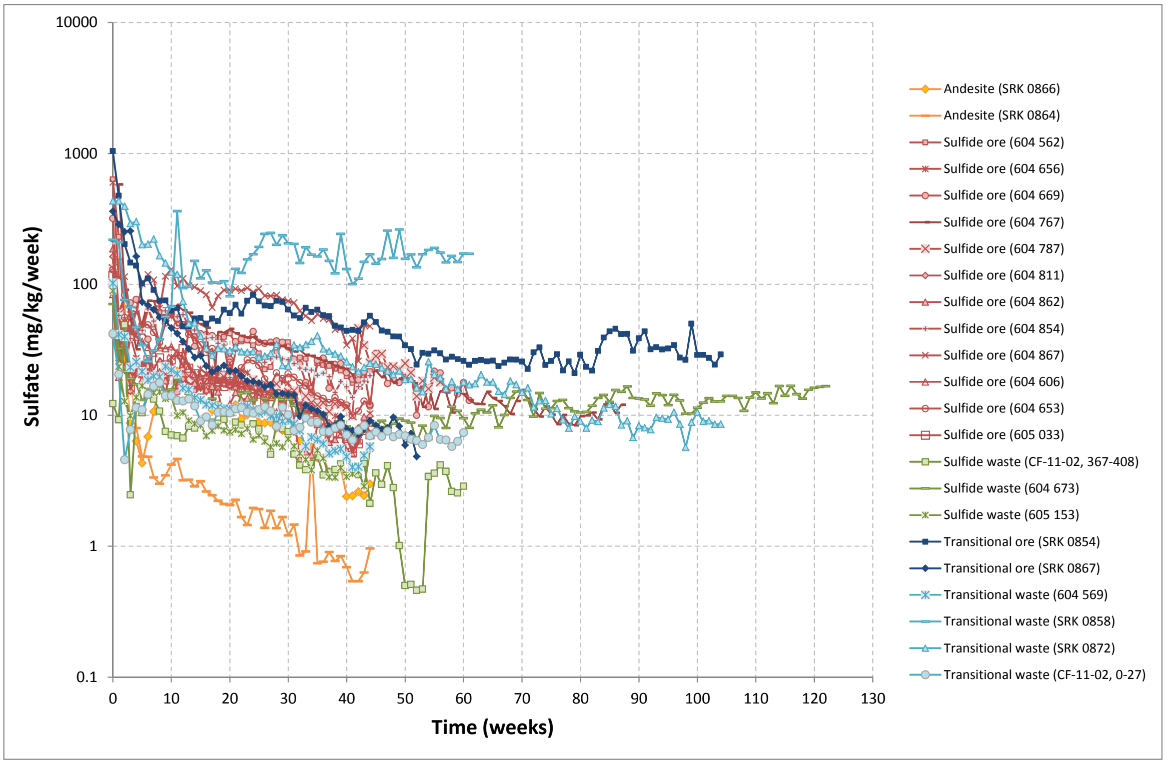

Figure 3-7: Waste Rock/Ore HCT Effluent Sulfate

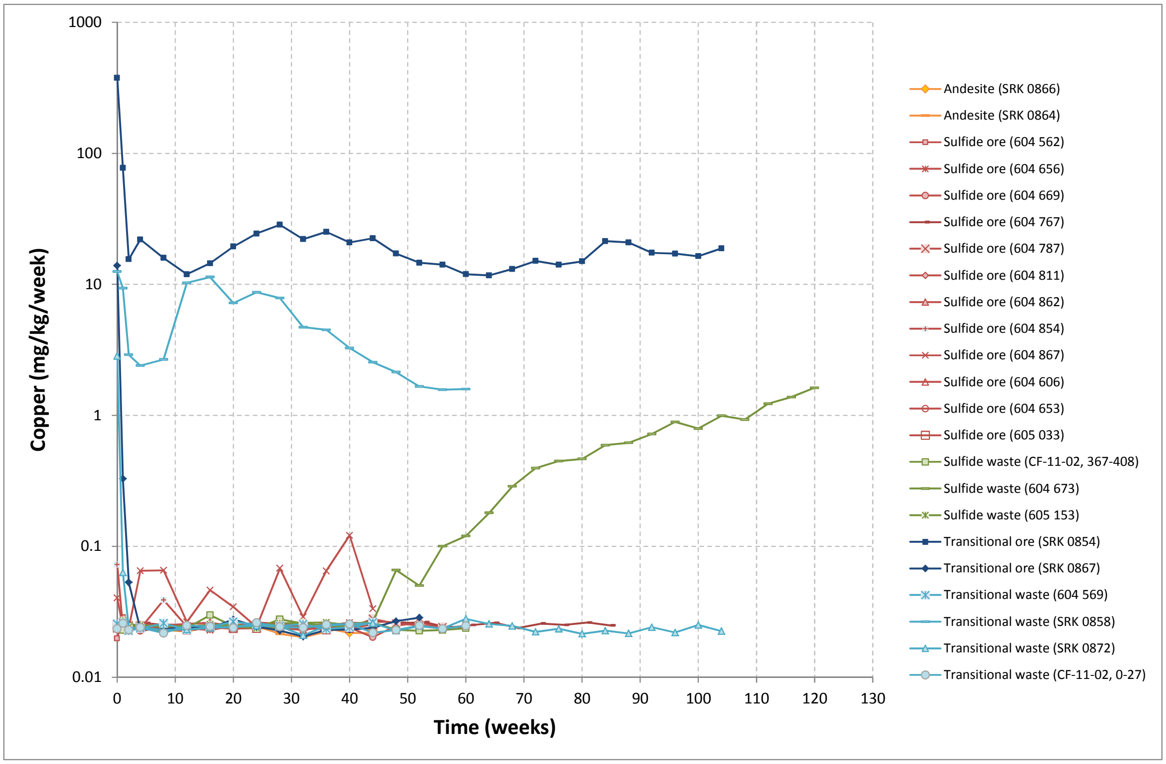

Figure 3-8: Waste Rock/Ore HCT Effluent Copper

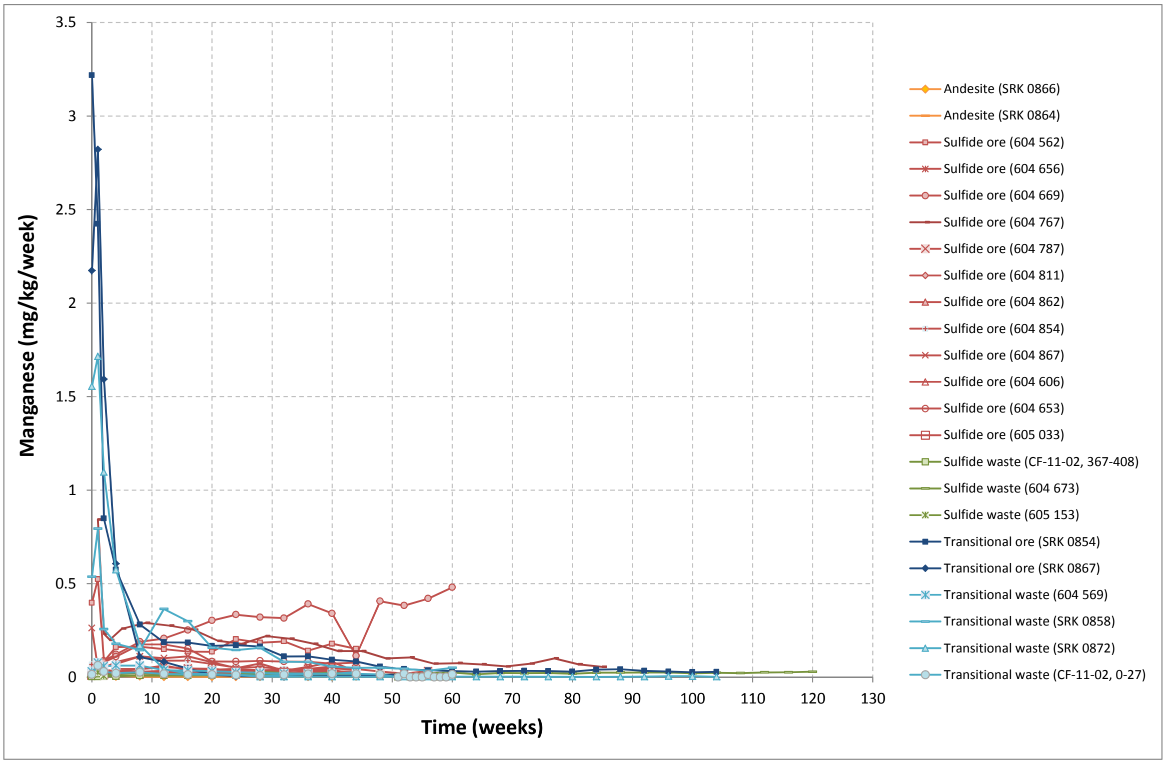

Figure 3-9: Waste Rock/Ore HCT Effluent Manganese

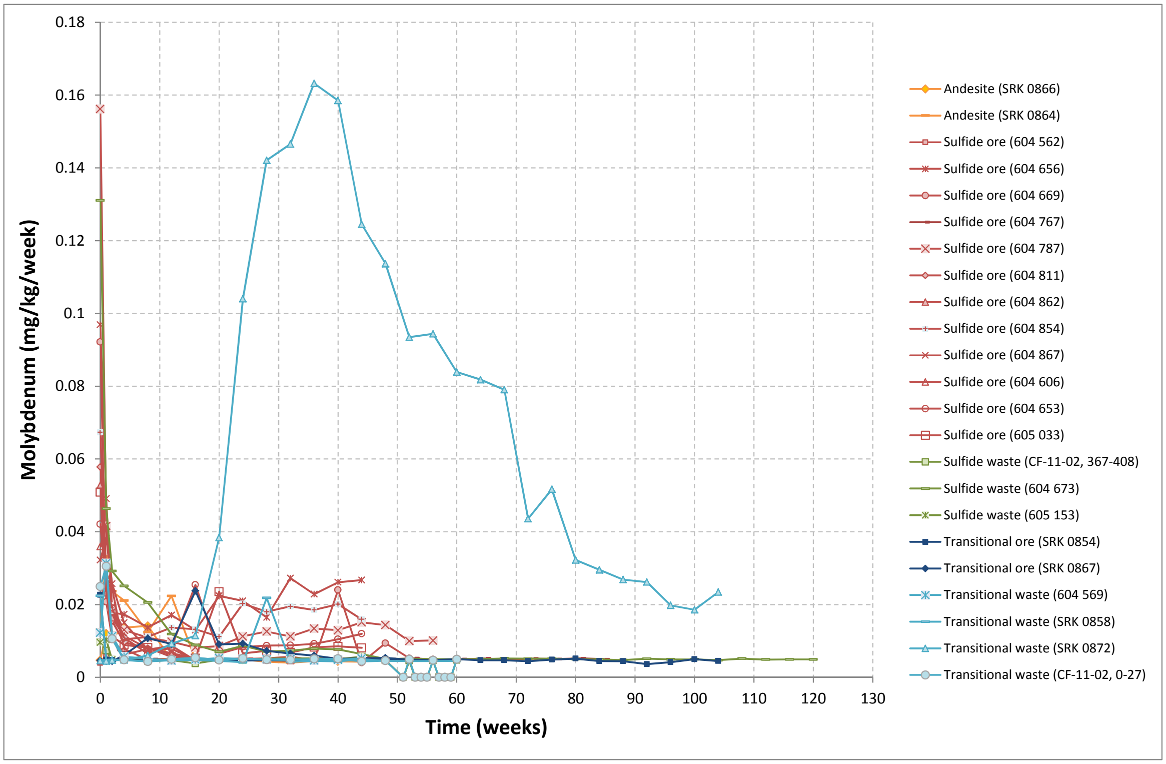

Figure 3-10: Waste Rock/Ore HCT Effluent Molybdenum

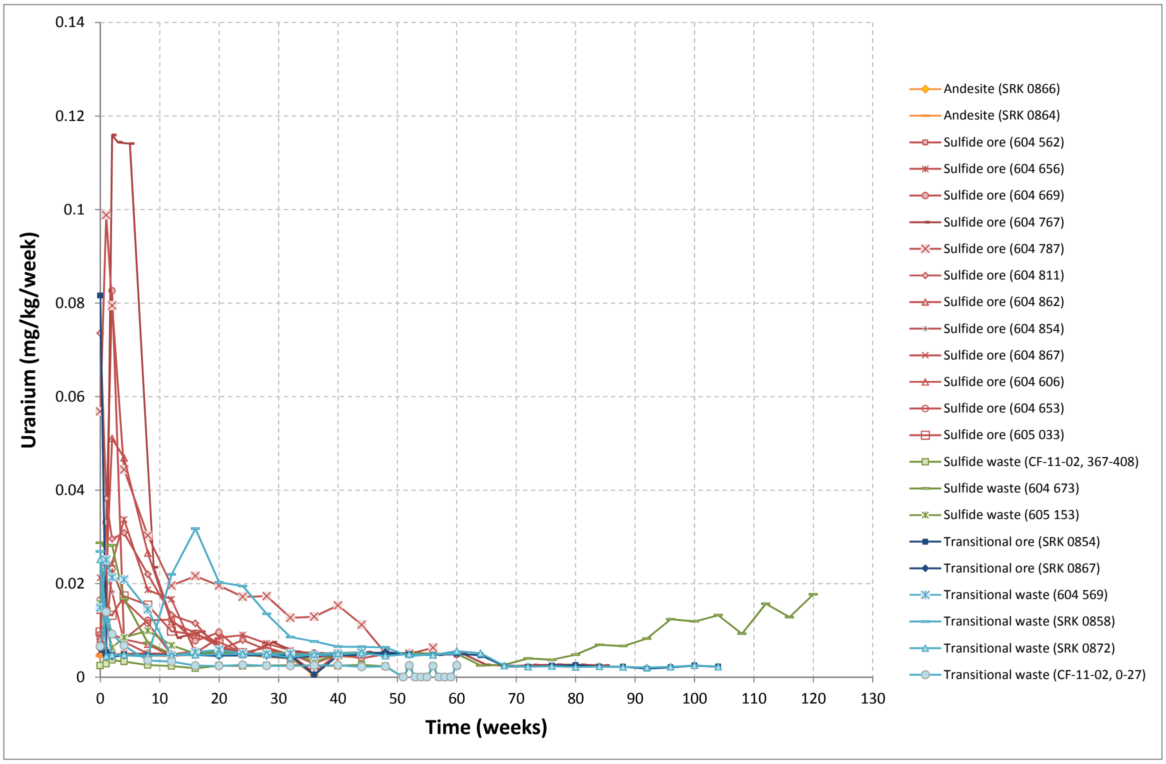

Figure 3-11: Waste Rock/Ore HCT Effluent Uranium

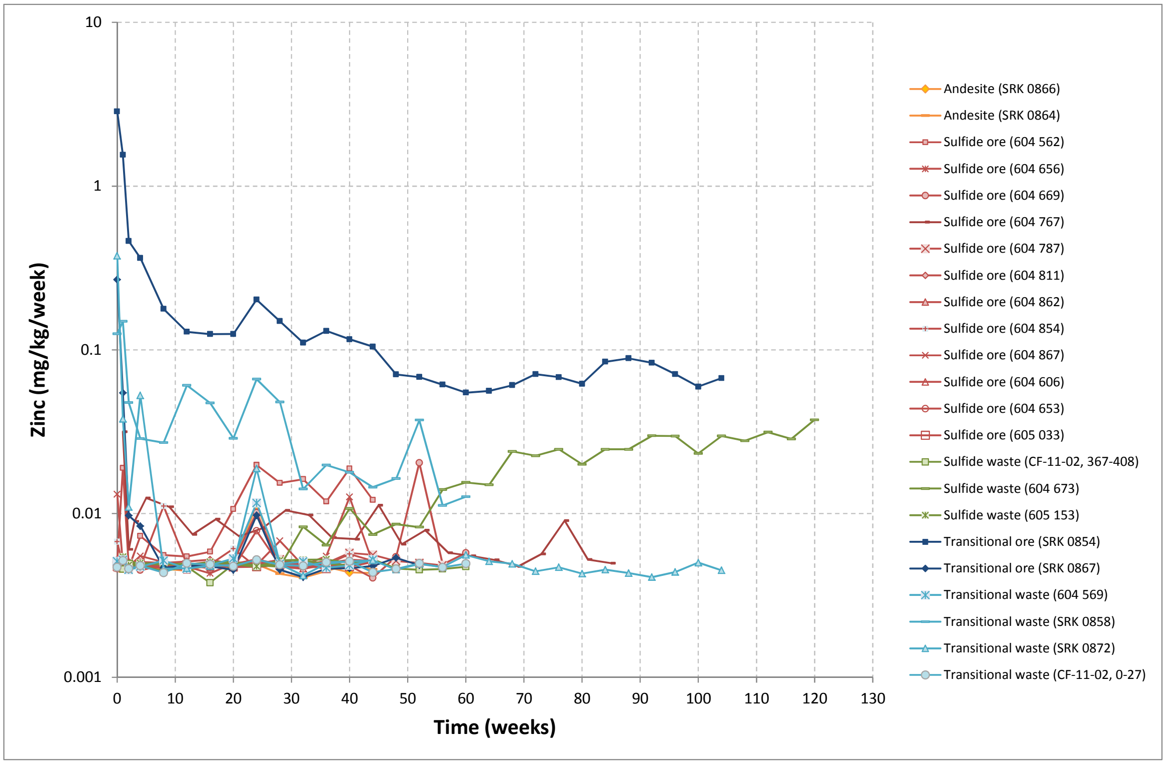

Figure 3-12: Waste Rock/Ore HCT Effluent Zinc

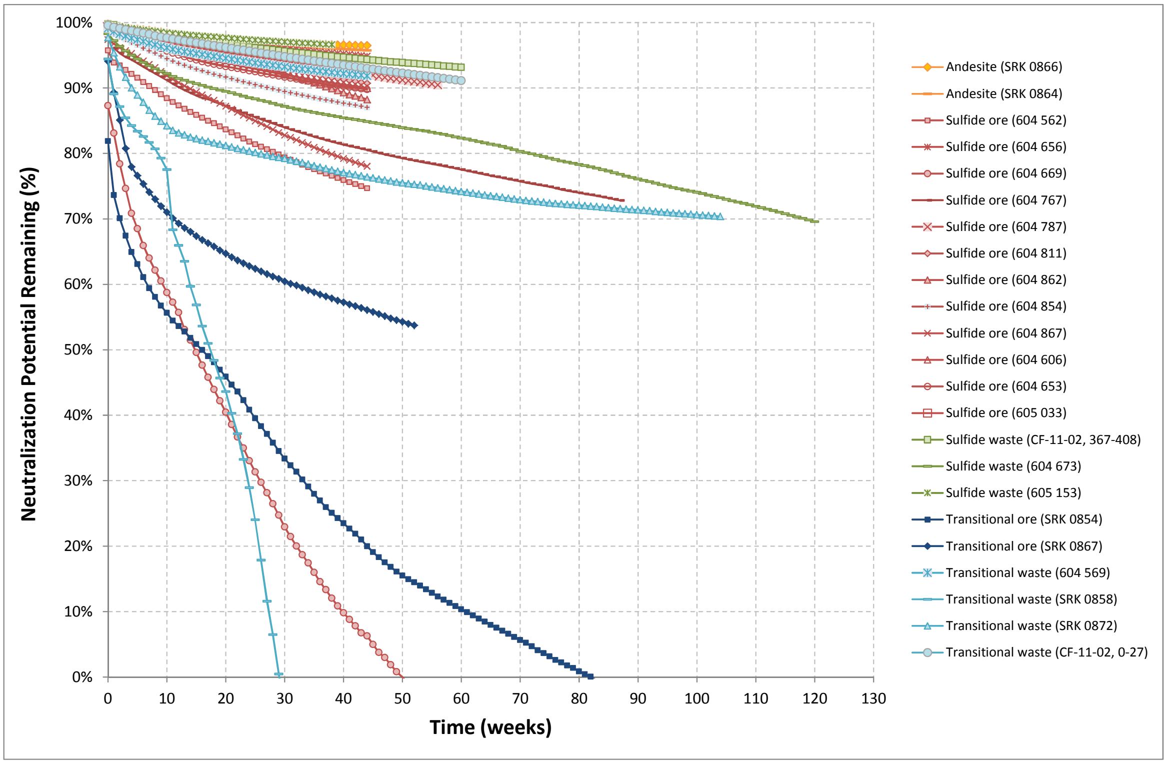

Figure 3-13: Waste Rock/Ore HCT Neutralization Potential Remaining

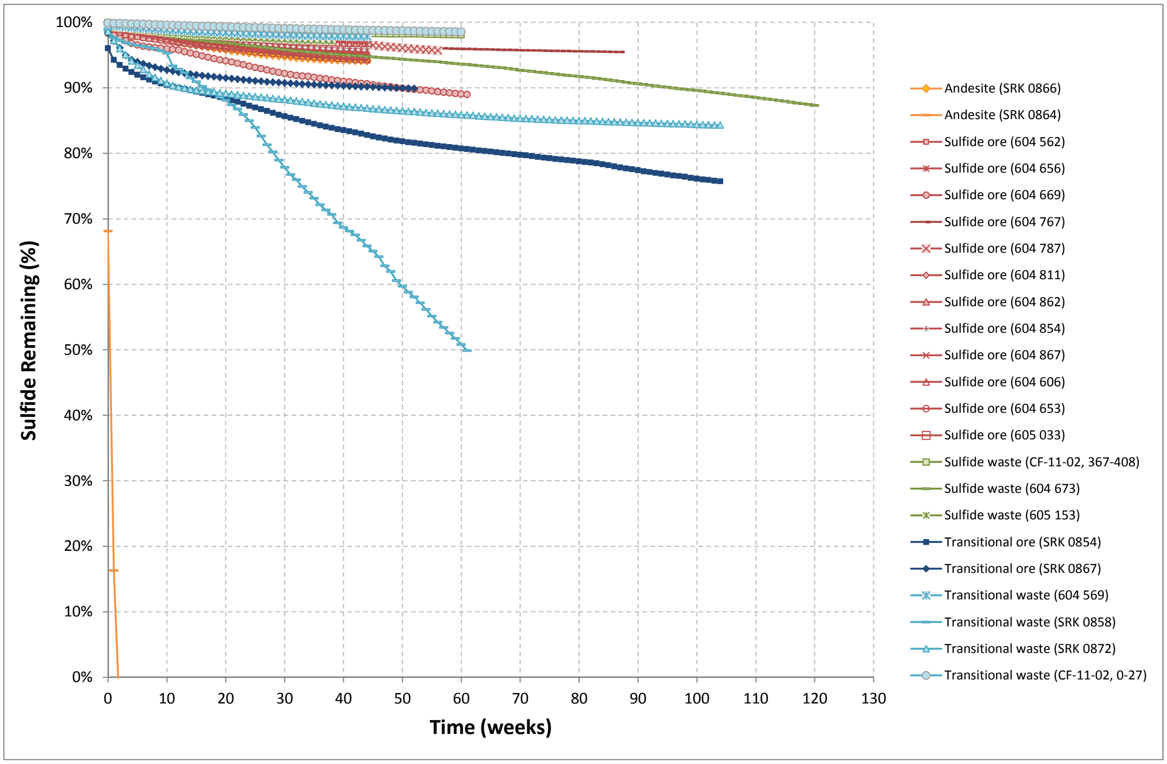

Figure 3-14: Waste Rock/Ore HCT Sulfide Remaining

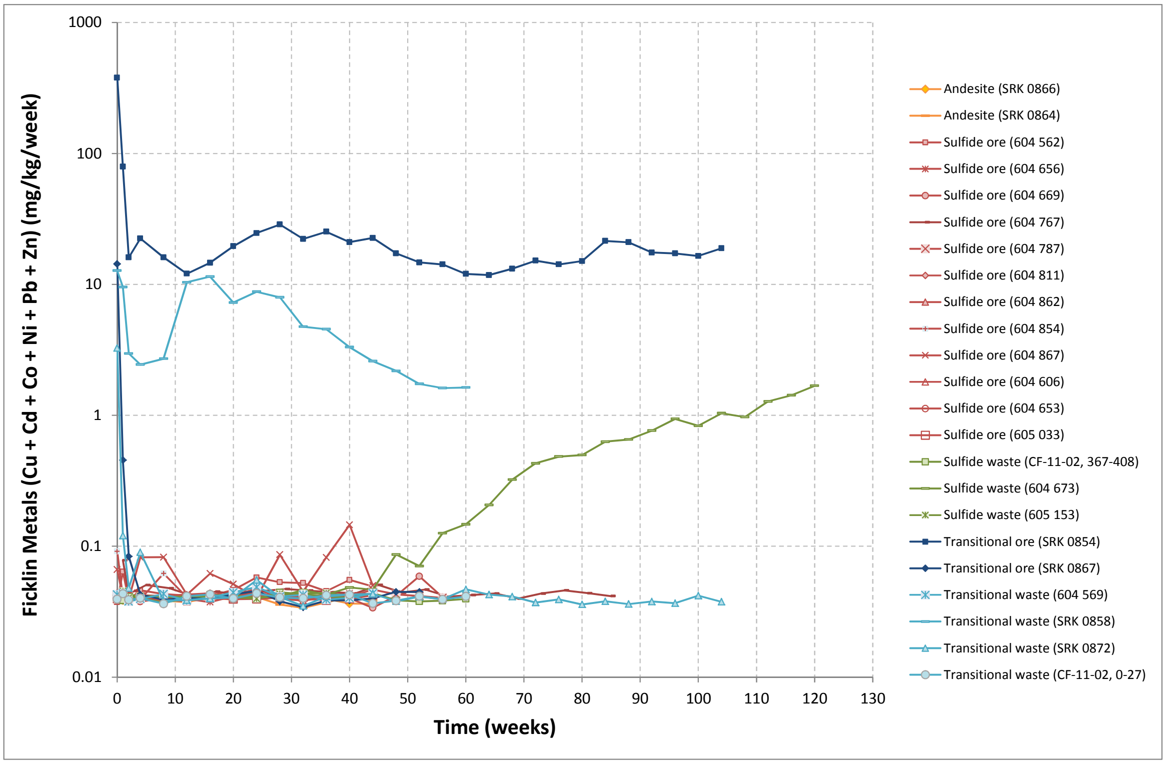

Figure 3-15: Waste Rock/Ore HCT pH vs. Ficklin Metal Release

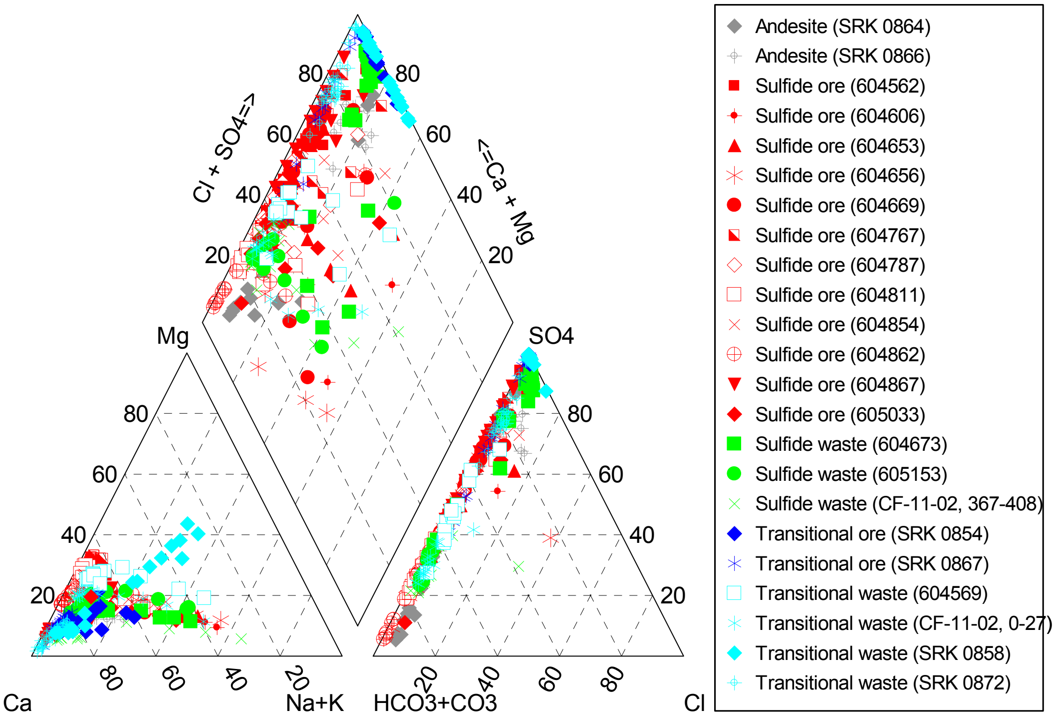

Figure 3-16: Piper Plot showing HCT Major Ion Chemistry

3.1.2 Tailings Samples

Humidity cell testing was carried out on nine samples of tailings material, including eight samples of flotation tailings and one sample of Cu. Ro. tailings. The Cu. Ro. tailings cell stabilized by week 28 and was terminated, but the flotation tailings samples were continued and were terminated between week 42 and week 52 when the effluent chemistry had stabilized and the test program had met the required objectives. The trends in effluent chemistry for the cells are presented in Figure 3-17 to Figure 3-28.

Effluent pH for all tailings cells was circum-neutral throughout the course of the testwork (Figure 3-17) and the cells generally showed low levels of metal(loid) release. The Cu. Ro. tailings sample showed effluent HCT chemistry that was generally consistent with the flotation tailings. Many parameters were consistently below analytical detection limits in the tailings cell leachates, including antimony, arsenic, cadmium, chromium, cobalt, copper, lead, nickel, selenium, thallium and zinc, indicating that these parameters are unlikely to be mobilized from the tailings material. The cells showed an initial flush of sulfate of up to 76 mg/kg/week, which likely relates to the release of soluble sulfate salts from the material surface. However, sulfate release from all cells declined to less than 20 mg/kg/week after 30 weeks of testing and effluent iron concentrations were also low (typically <0.02 mg/kg/week), indicating that no active sulfide oxidation is occurring in the cells (Figure 3-20, Figure 3-21).

Several of the cells showed an initial flush in effluent uranium during the first 20 weeks of testing, with release rates of up to 0.06 mg/kg/week from the K-spar breccia 5+ comp. flotation tailings sample (Figure 3-25). However, release rates from all cells declined to <0.02 mg/kg/week and stabilized after week 20. A spurious iron result was reported by the laboratory in week 40 for cell Quartz Monzonite 5+ Composite Flotation tailings (Figure 3-16). This result is either a laboratory error or due to flushing of iron hydroxide particles into the analyzed lixiviant for that cell. Either way it is not interpreted as a trend and does not affect the overall assessment of the HCT chemistry.

The tailings cells all had greater than 70% of the initial neutralization potential remaining after 52 weeks of testing (Figure 3-26). In addition, the rate of sulfide consumption was greater than that of NP depletion (Figure 3-27), indicating that acidic conditions are unlikely to develop.

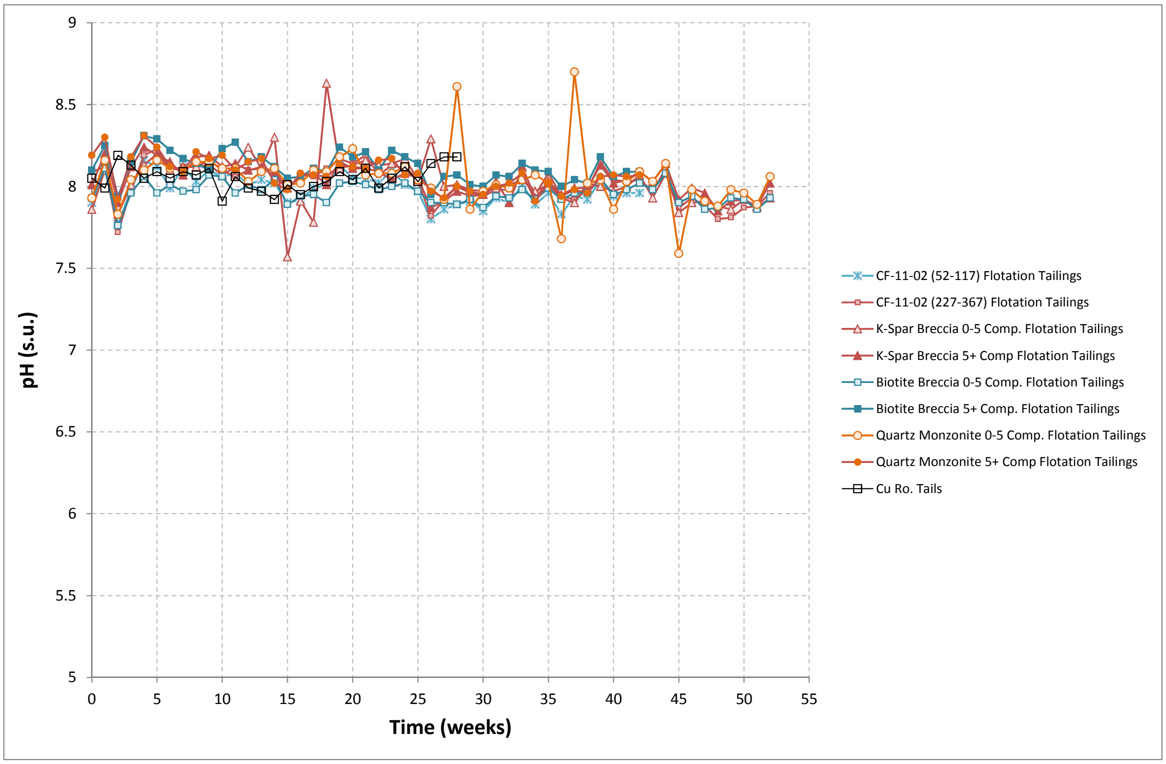

Figure 3-17: Tailings HCT Effluent pH

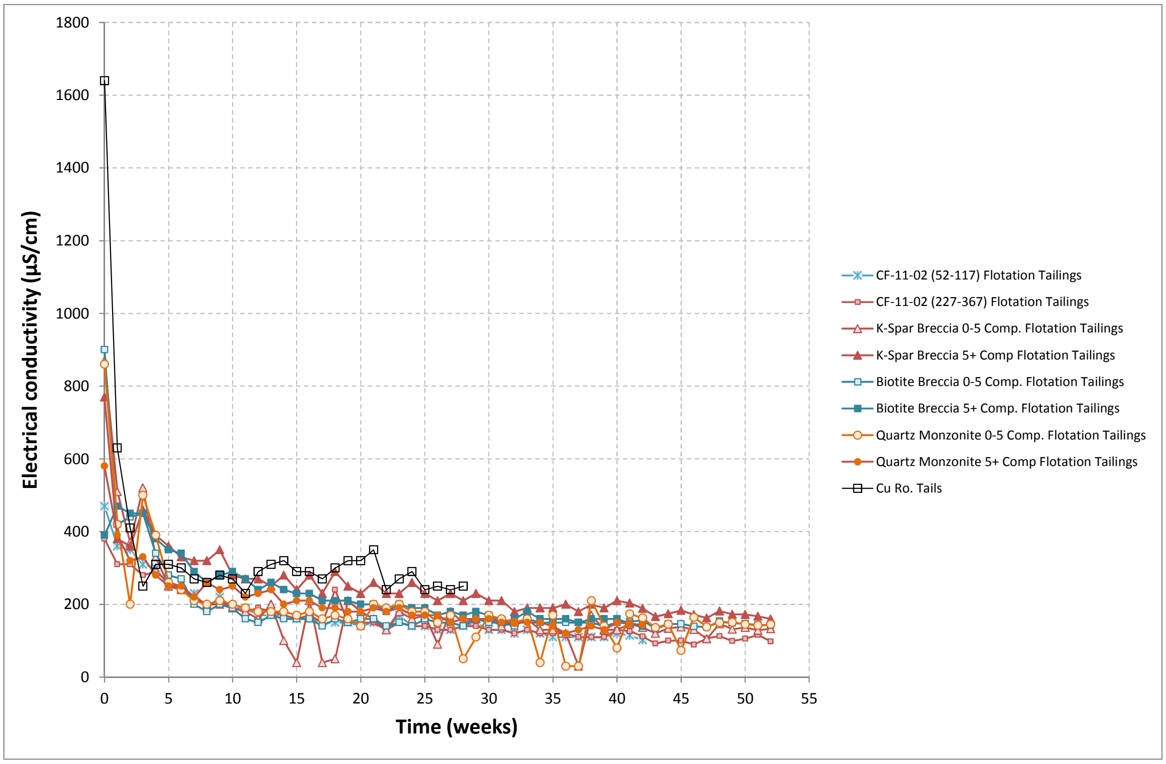

Figure 3-18: Tailings HCT Effluent EC

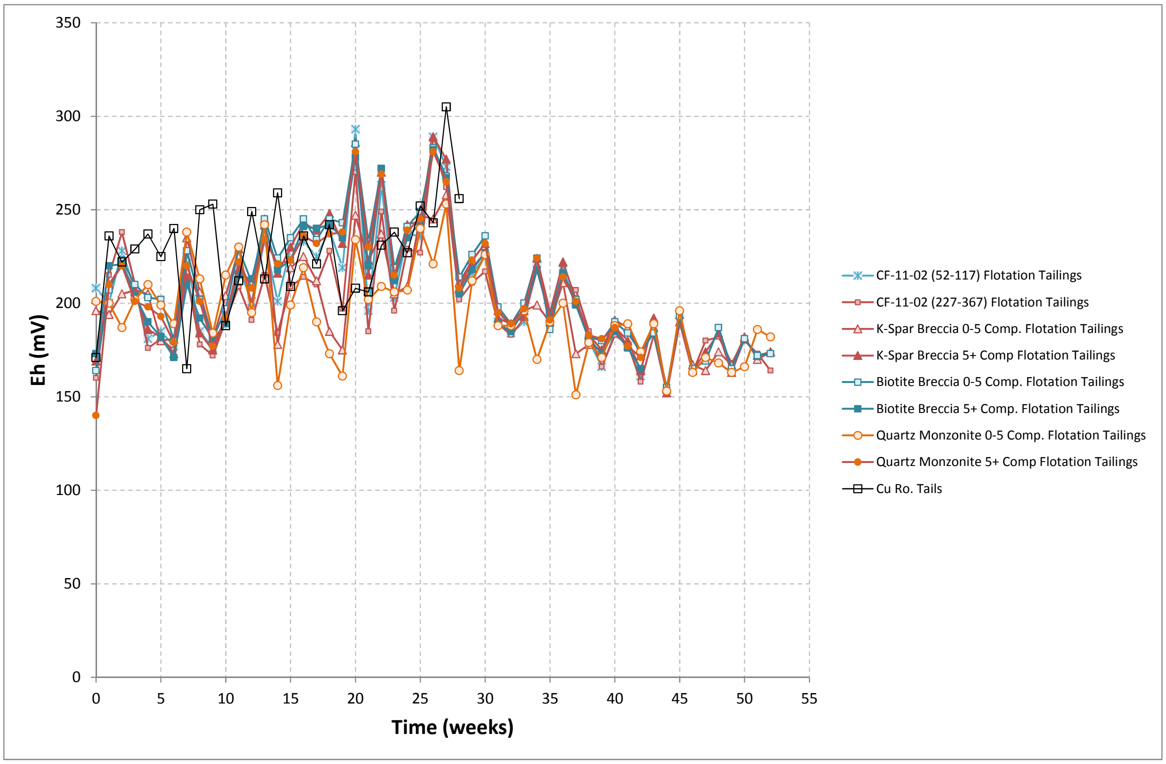

Figure 3-19: Tailings HCT Effluent Eh

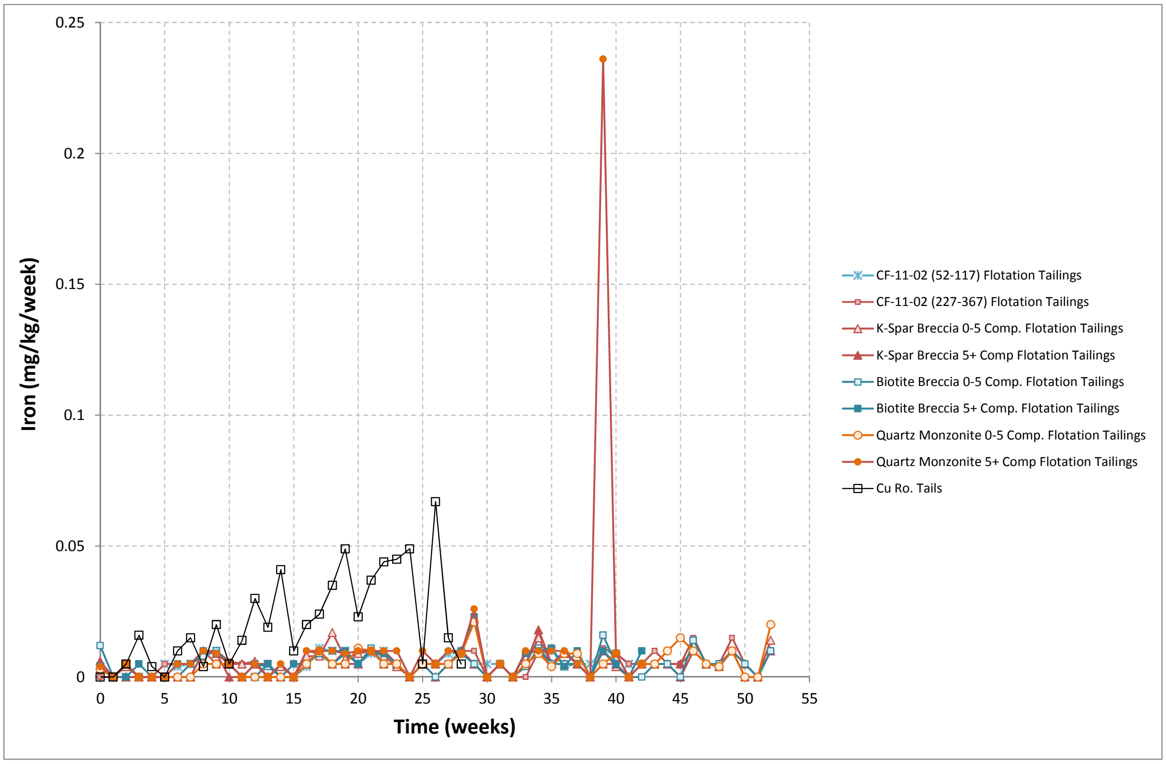

Figure 3-20: Tailings HCT Effluent Iron

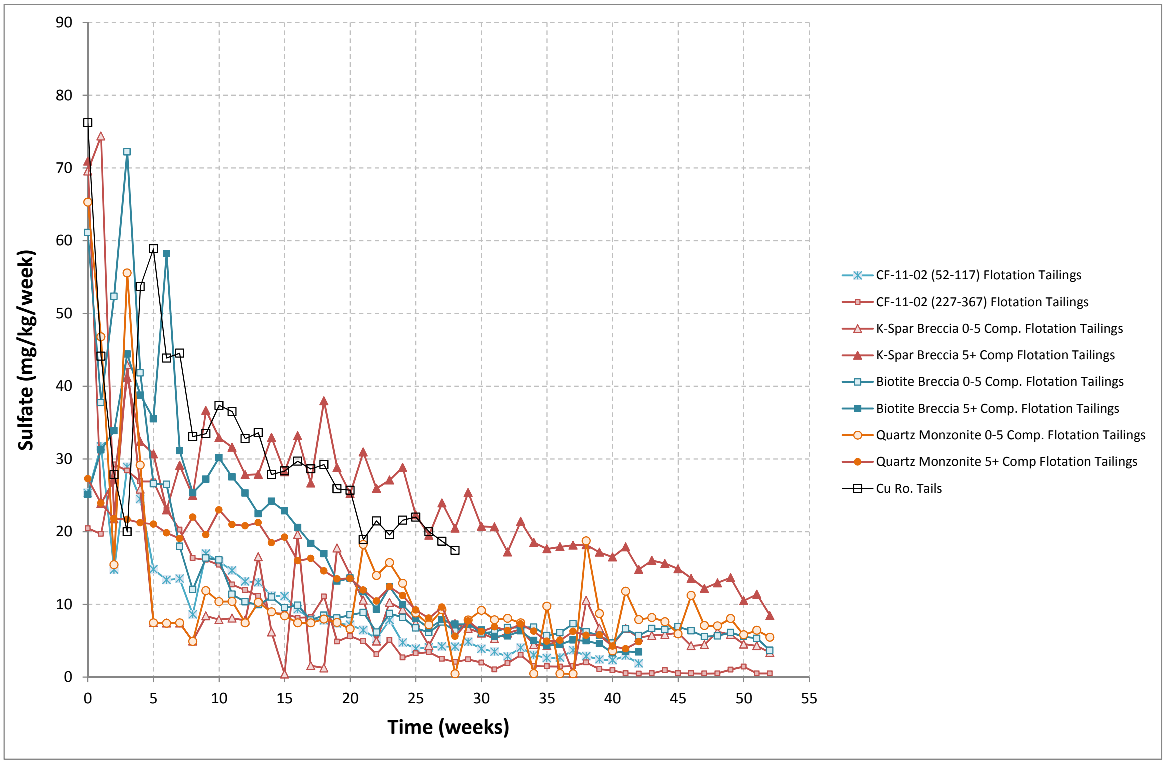

Figure 3-21: Tailings HCT Effluent Sulfate

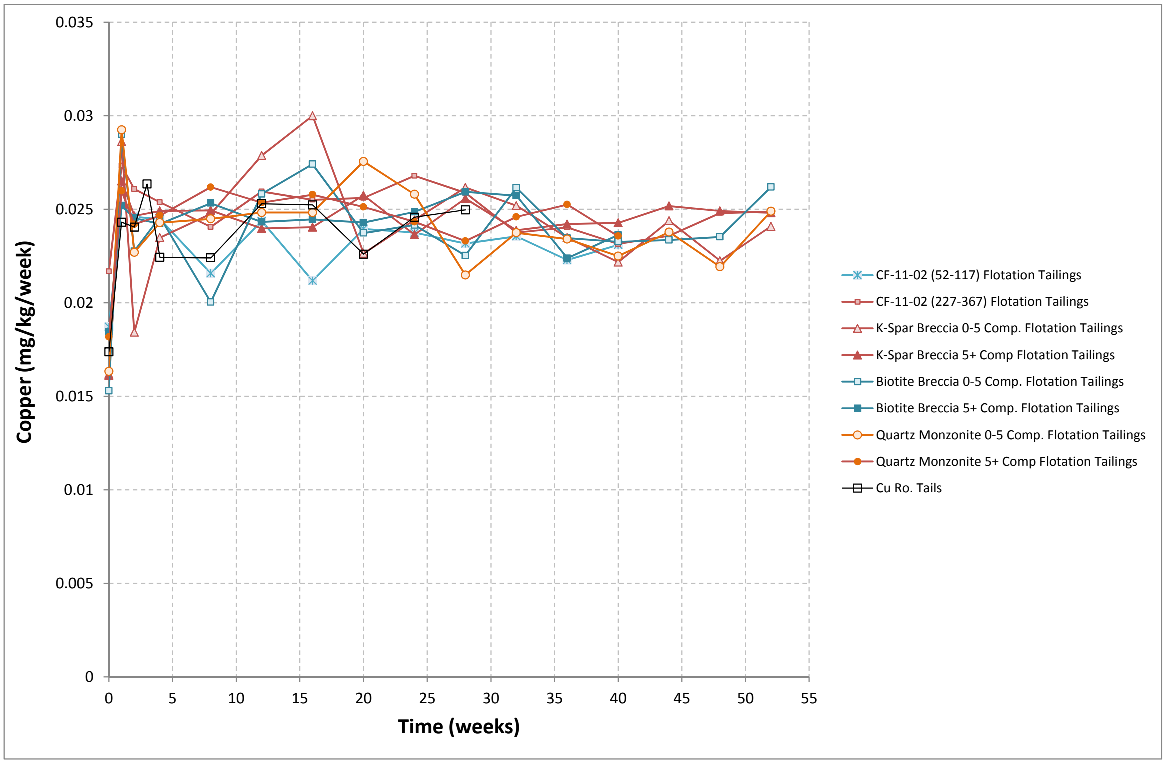

Figure 3-22: Tailings HCT Effluent Copper

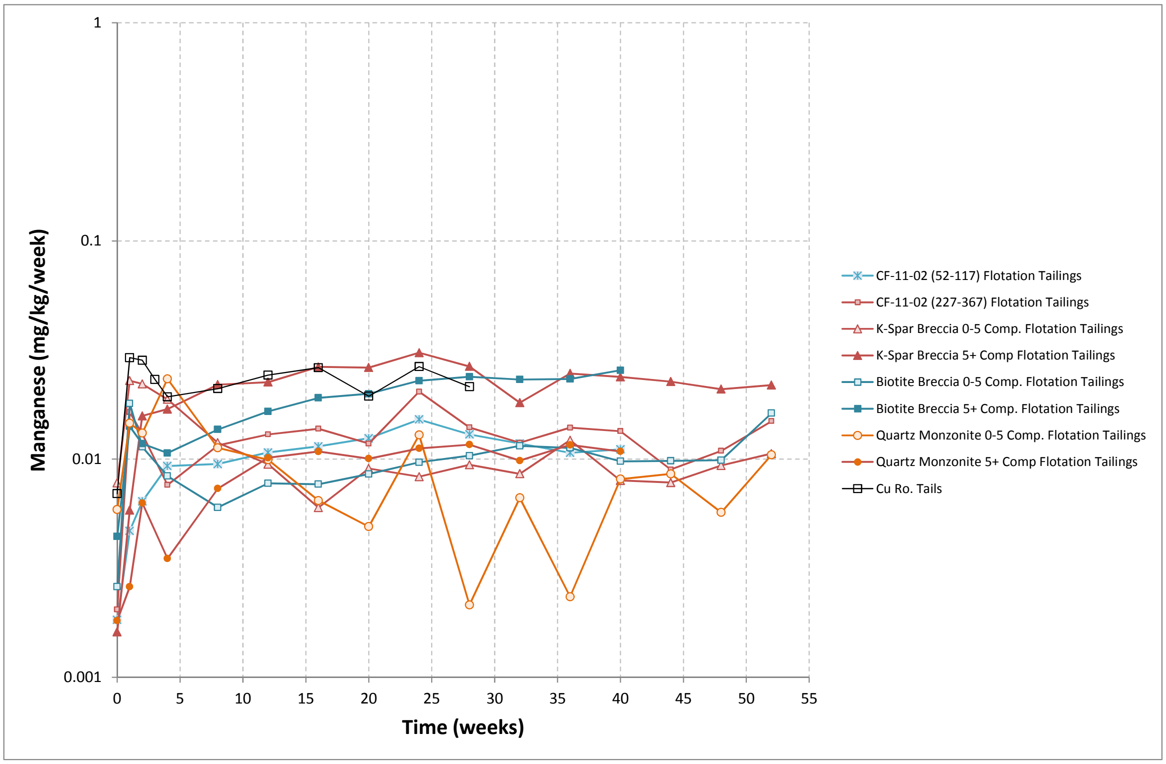

Figure 3-23: Tailings HCT Effluent Manganese

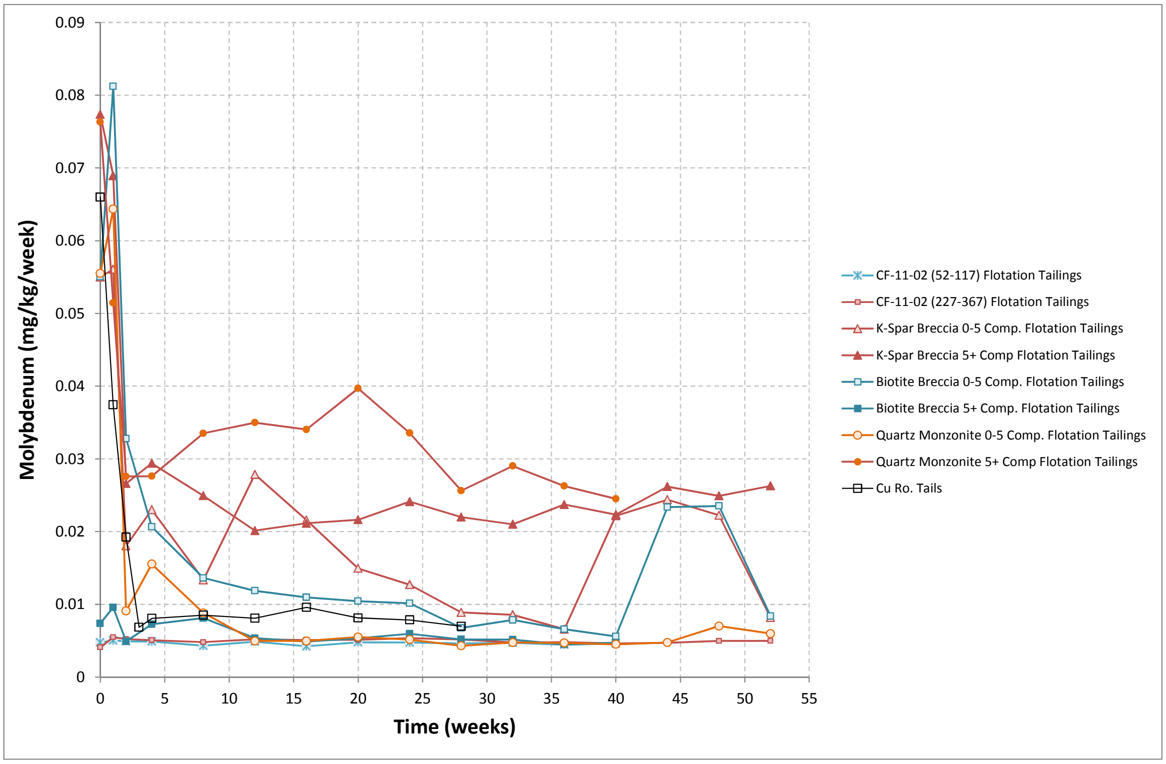

Figure 3-24: Tailings HCT Effluent Molybdenum

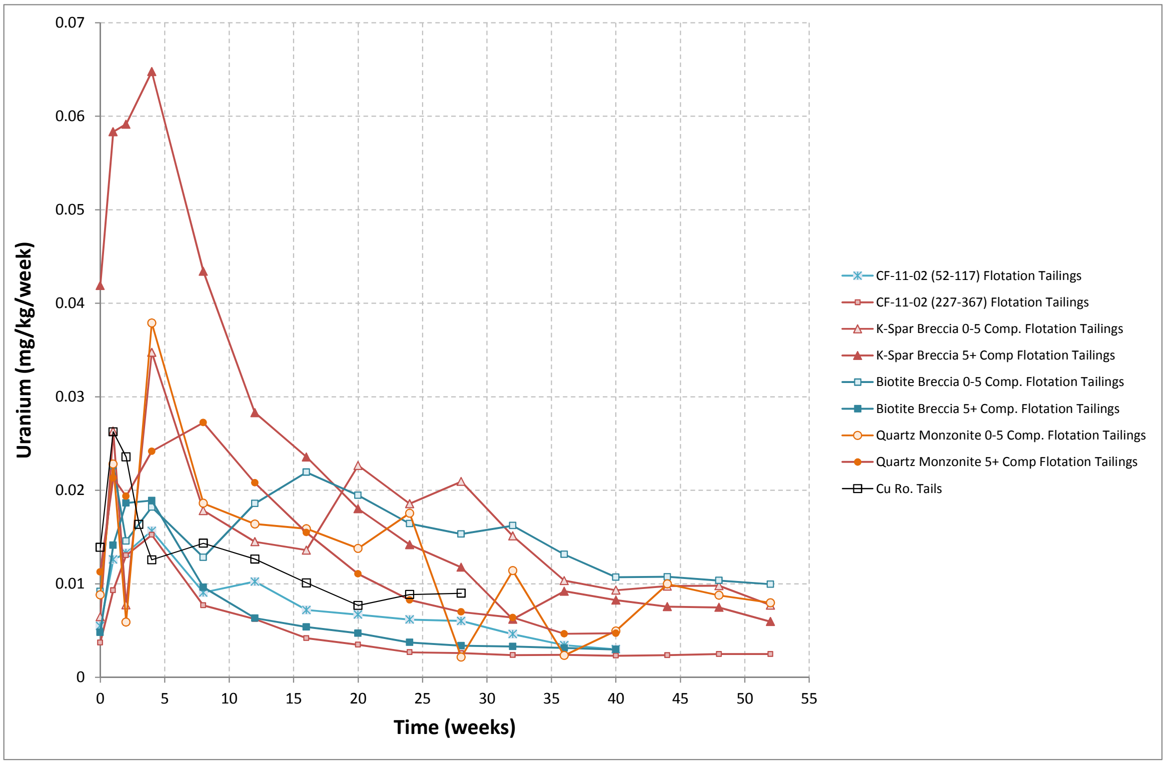

Figure 3-25: Tailings HCT Effluent Uranium

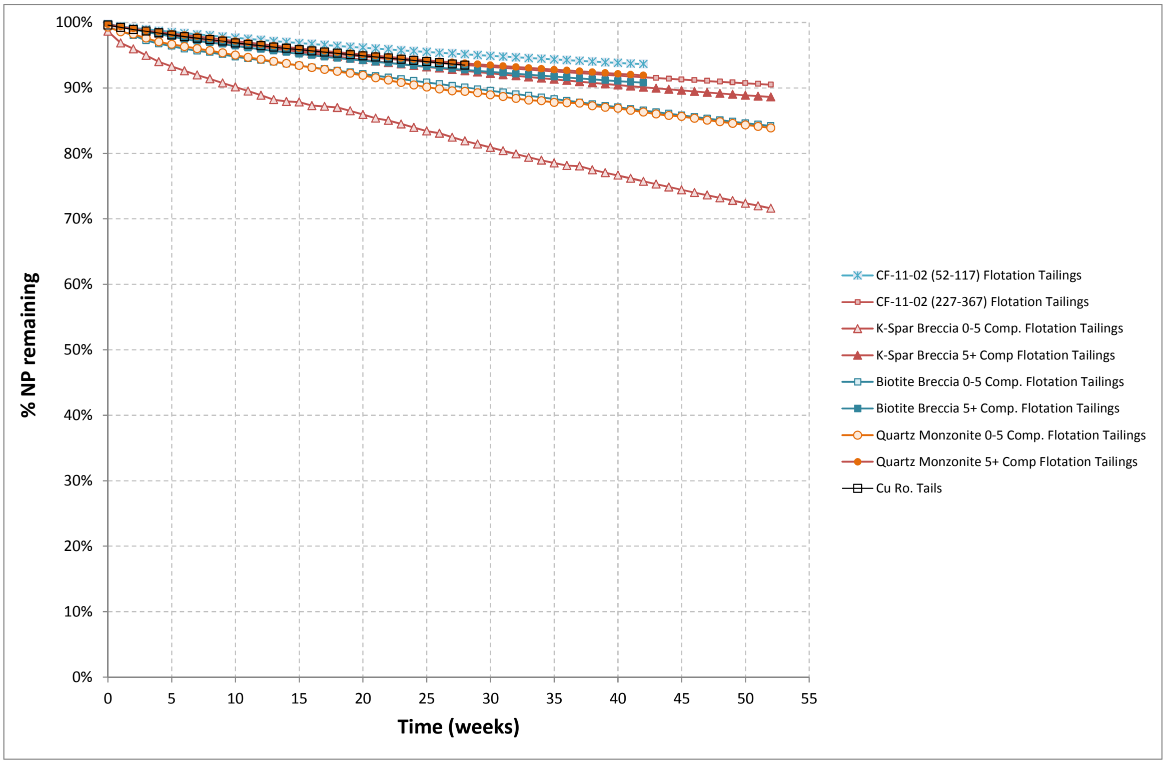

Figure 3-26: Tailings HCT Neutralization Potential Remaining

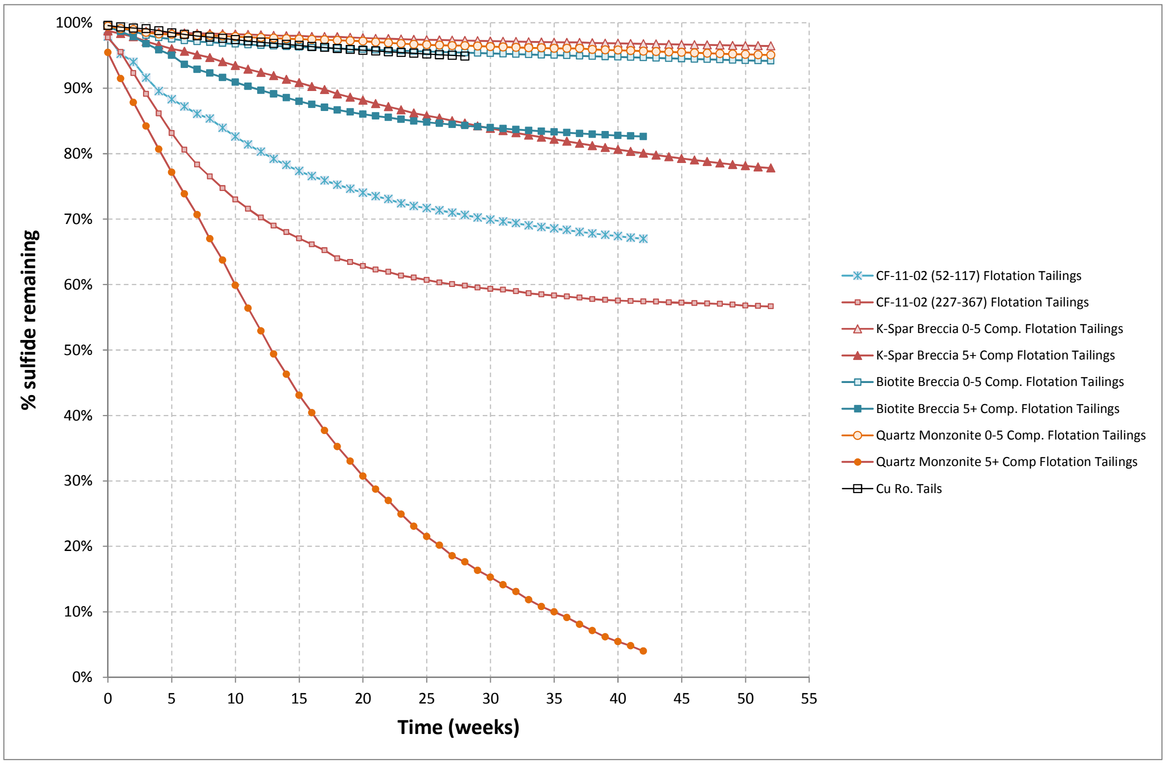

Figure 3-27: Tailings HCT Sulfide Remaining

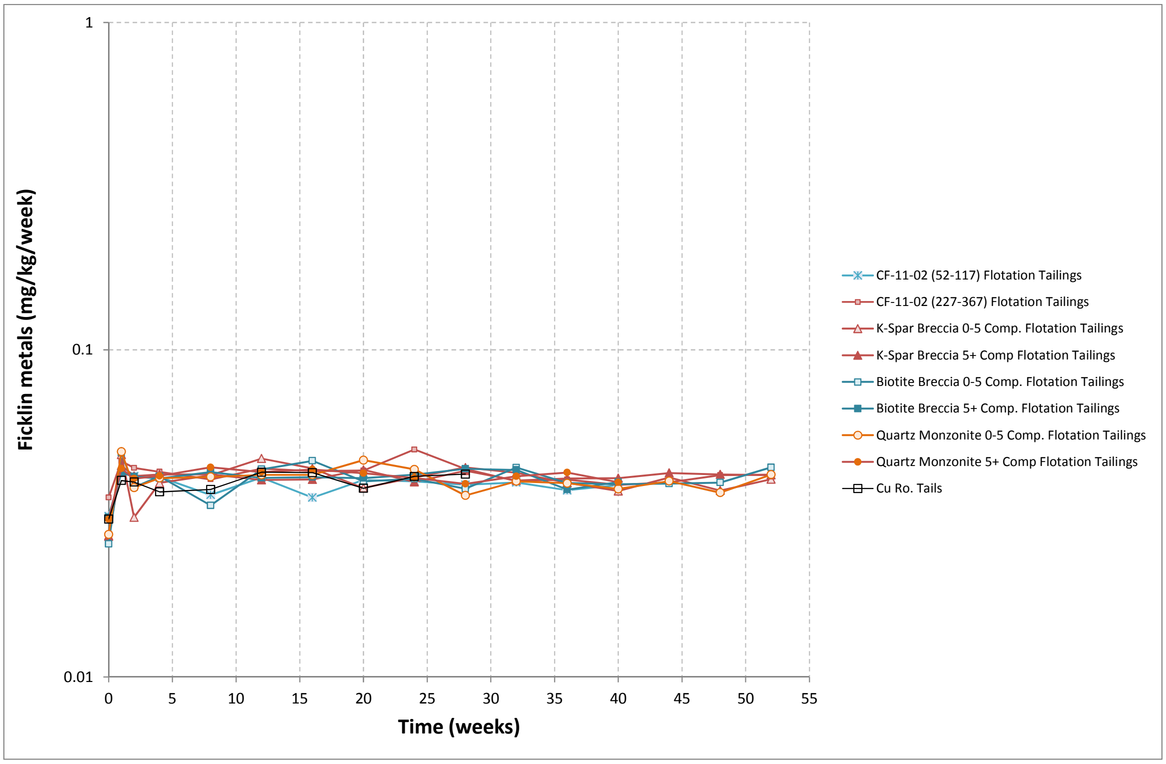

Figure 3-28: Tailings HCT Effluent Ficklin Metals

3.2 Comparison of Static and Kinetic Testwork Results

A comparison of the static test results with the corresponding HCT results provides an indication of the effectiveness of the static tests in predicting longer term behavior (Table 3-1, Figure 3-29 and Figure 3-30). As shown in Table 3-1, the results of the HCT tests for the waste rock samples are not consistent with the prediction of acid generation based on ABA results. However, the correlation between the HCT results and the acid generation prediction from the NAG results shows a slightly better correlation and suggests the NAG test is more effective in predicting the acid generating potential of the Copper Flat material types. However, despite the better correlation there are still a few samples that are predicted to be acid generating from the NAG test that did not develop acidic conditions in the HCT, despite the testwork continuing for up to 122 weeks in some cases. Therefore, the ABA and NAG test over-predict the acid generating potential of the Copper Flat materials in some cases.

The discrepancy between ABA, NAG and HCT results for the waste rock samples suggests that there may be some silicate buffering capacity in the Copper Flat material types and/or encapsulation of sulfide minerals in non-reactive minerals such as quartz and thus limiting reactivity. Although silicate buffering potential is unlikely to be of high magnitude, it may modify/buffer pH if present (Nesbit and Jambor, 2008) especially if the rate of acid generation is slow. The presence of chlorite-clinochlore, amphiboles and Ca-rich feldspars would likely be the source of this buffering as indicated by the relative reaction of these minerals. The poor correlation between the sulfide sulfur content of the Copper Flat materials and the final HCT pH (Figure 3-29) confirms the generally low reactivity of the waste rock and ore material, with high sulfide samples showing near-neutral pH after prolonged testing.The tailings samples show a good correlation between the acid generation predictions based on ABA and HCT results, with all tailings showing non-acid forming characteristics.

Table 3-1: Comparison of HCT results with static testwork results

Material type	Primary lithology	Cell ID	Acid Generation Prediction*			Post-HCT mineralogy
			ABA	NAG	HCT	
Andesite	Andesite	SRK 0864	NAF	NAF	NAF	
	Andesite	SRK 0866	NAF	PAF	NAF	
Sulfide waste	Coarse Crystalline Porphyry	CF-11-02 (367-408)	PAF	PAF	NAF	
	Quartz Monzonite	604673	PAF	PAF	PAF	x
	Quartz Monzonite	605153	NAF	NAF	NAF	
Sulfide ore	Biotite Breccia	604811	PAF	NAF	NAF	
	Biotite Breccia	604862	NAF	NAF	NAF	
	Biotite Breccia	604867	PAF	NAF	NAF	
	Biotite Breccia	604854	PAF	NAF	NAF	
	Quartz Feldspar Breccia	604767	PAF	PAF	NAF	x
	Quartz Feldspar Breccia	604787	PAF	NAF	NAF	
	Quartz Monzonite	604562	PAF	NAF	NAF	
	Quartz Monzonite	604606	NAF	NAF	NAF	
	Quartz Monzonite	604669	PAF	NAF	NAF	
	Quartz Monzonite	604653	NAF	NAF	NAF	
	Quartz Monzonite	604656	NAF	NAF	NAF	
	Biotite Breccia	605033	NAF	NAF	NAF	
Transitional waste	Biotite Breccia	SRK 0872	PAF	PAF	NAF	x
	Quartz Monzonite	604569	PAF	NAF	NAF	
	Quartz Monzonite	SRK 0858	PAF	PAF	PAF	x
	Coarse Crystalline Porphyry	CF-11-02 (0-27)	PAF	PAF	NAF	x
Transitional ore	Biotite Breccia	SRK 0854	PAF	PAF	PAF	x
	Quartz Monzonite	SRK 0867	PAF	NAF	NAF	x
Tailings	CF-11-02 (52-117) flotation tailings		NAF	-	NAF	
	CF-11-02 (227-367) flotation tailings		NAF	-	NAF	
	K-spar Breccia 0-5 comp. flotation tailings		NAF	-	NAF	
	K-spar Breccia 5+ comp. flotation tailings		NAF	-	NAF	
	Biotite Breccia 0-5 comp. flotation tailings		NAF	-	NAF	
	Biotite Breccia 5+ comp. flotation tailings		NAF	-	NAF	
	Quartz Monzonite 0-5 comp. flotation tailings		NAF	-	NAF	
	Quartz Monzonite 5+ comp. flotation tailings		NAF	-	NAF	
	Cu Ro. tailings		NAF	-	NAF	

* **PAF** = Potentially Acid Forming; **NAF** = Non-Acid Forming

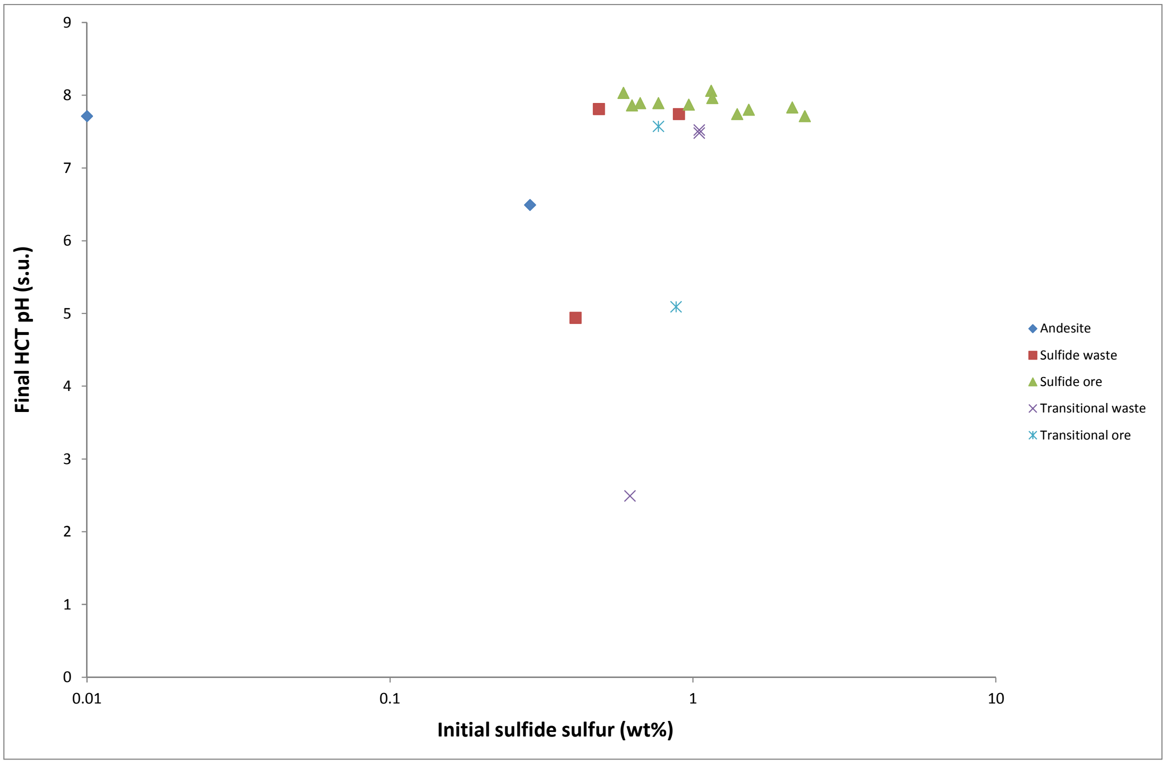

Figure 3-29: Sulfide sulfur vs. Final HCT pH

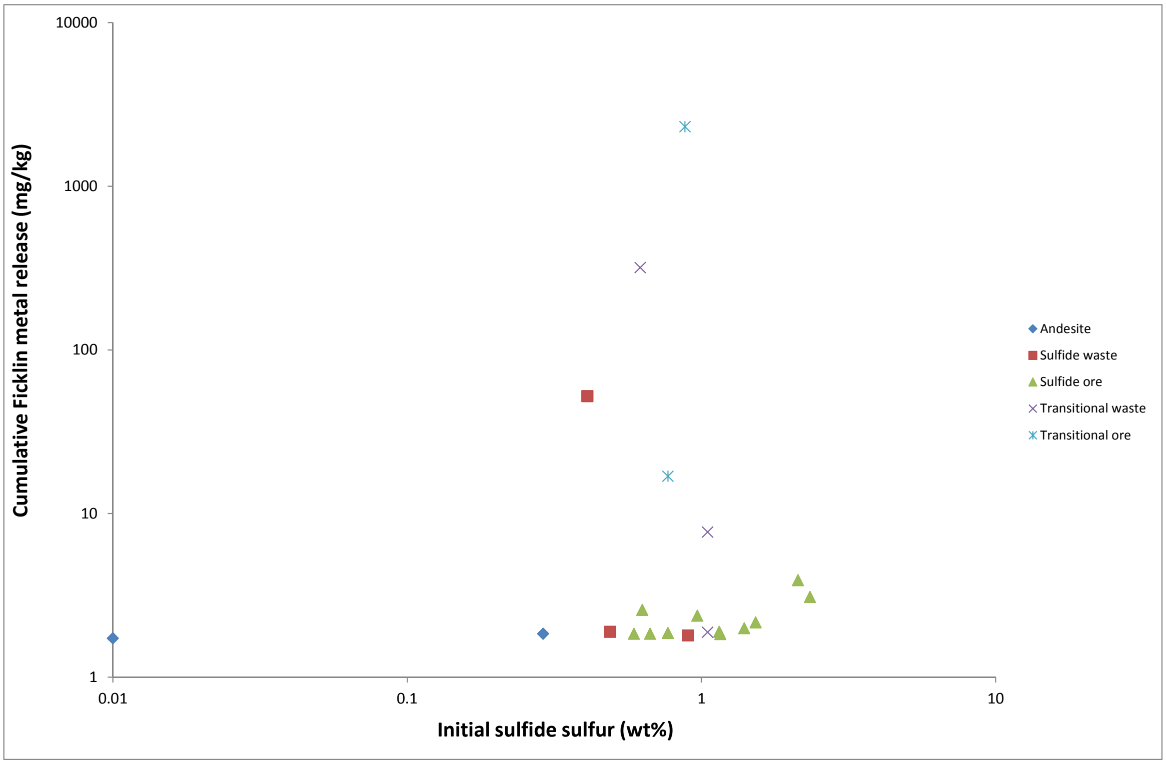

Figure 3-30: Sulfide sulfur vs. HCT Cumulative Ficklin Metal Release

4 Termination Testwork Results

The samples underwent geochemical characterization both before and after the humidity cell testwork. This included ABA and NAG testing and multi-element assay on both the initial (i.e., pre-leach) sample and the residual (i.e., post-leach) HCT material to allow the geochemical properties of the samples to be determined and interpreted along with the evolution of the leachate during the HCT.

Mineralogical analysis was also undertaken on seven of the post-HCT leached materials to assist in interpretation of the HCT results, in particular to assess why several of the samples that were predicted to be PAF by the static testwork results did not achieve acidic conditions in the HCT. Post-HCT mineralogical analysis included optical microscopy, SEM and XRD analysis.

The results of the termination testwork are detailed in the following sections.

4.1 Mineralogy

Mineralogical analysis was carried out on seven of the HCT residues and on one sample of pre-leach material to determine the mineralogical controls on acid generation and metal(loid) release, and in particular to understand why acid conditions did not develop in some of the cells despite elevated sulfide content and prolonged testing. The results are summarized in the following section and in Table 4-1. A full mineralogical report is provided in Appendix B, which includes detailed descriptions and photomicrographs of the samples.

The main sulfide minerals observed include pyrite (FeS_2) and chalcopyrite ($CuFeS_2$), which were present in all eight samples submitted for testing (Table 4-1). Galena (PbS) was also observed in two of the samples, and molybdenite was observed in three of the samples. Covellite (CuS) was observed in both the pre- and post-leach material for sample CF-11-02 (0-27ft).

There were two clear textural patterns for the occurrence of chalcopyrite and pyrite. Chalcopyrite tended to be fine-grained and encapsulated within quartz-feldspar composite particles (Figure 4-1). The only exceptions to this were samples SRK 0854 which produced acidic conditions during the HCT and the pre-leach sample for CF-11-02 (0-27ft). This indicates that the textural occurrence of chalcopyrite in cell SRK 0854 (i.e., liberated grains) likely contributed to its breakdown and subsequent acid generation in this cell. Pyrite within the samples was typically found to occur as either fine-grained crystals encapsulated in quartz-feldspar composite particles (Figure 4-2) or as medium- to coarse-grained euhedral crystals that are liberated (Figure 4-3). In general, all medium-/coarse-grained liberated examples of pyrite showed partial fracturing, occasionally to the point of disaggregation (i.e., fractures were connected and the grains were beginning to crumble). However, comparison with the pre-leach material demonstrates that the pyrite frequently exhibited this fractured texture *prior* to the humidity cell test, indicating that the fracturing and disaggregation observed in the post-HCT samples may not relate to breakdown of the sulfides during the test, but rather that this is a pre-existing texture. Furthermore, comparison with the humidity cell results demonstrates that this textural occurrence of pyrite only occasionally led to acid-generation (for example in cells SRK 0858 and SRK 0854), and that sulfate release from the humidity cells was typically slow, with low effluent concentrations. Sulfate rims around the pyrite grains (indicative of pyrite oxidation) were typically only observed in samples that developed acid conditions during the HCT (i.e., SRK 0854, SRK 0858 and 604673) as shown in Figure 4-4. Although, jarosite and schwertmannite were present in association with sulfide grains for a few samples (SRK 0867, SRK 0872 and CF-11-02 (0-27)) this association did not lead to acid generation in these cells.

Identifying potential mineralogical controls that could account for the lack of acid generation in several of the humidity cells is complex but can be related to three factors including:

1. The nature of the sulfides as medium- to coarse- or well-crystallized grains, meaning they are thermodynamically stable and difficult to weather;
2. The inclusion of many of the finer-grained sulfides (particularly chalcopyrite) in non-reactive silicate gangue;
3. The presence of acid buffering silicate minerals, especially chlorite group minerals and also to a limited extent, the small amounts of calcite concentrations present in the samples.

These factors are discussed in more detail below.

Sulfide Mineral Texture

Some of the pyrite in the post-HCT samples is present as medium-grained, well-crystallized and liberated crystals, which show evidence of fracturing and partial disaggregation. Although this textural occurrence suggests that the pyrite grains are available for weathering/oxidation reactions, acidic conditions were not realized in the majority of cells despite prolonged testing. It is possible that the medium- to coarse-grained and equigranular nature of the pyrite in the Copper Flat material means it is more likely to be thermodynamically stable and difficult to weather. Reasons for slow pyrite weathering have also been the topic of recent research and some have suggested that it may also relate to the trace element content of the pyrite, with the presence of cobalt and nickel slowing the rate of reaction (Lehner et al. 2007; Lehner and Savage, 2008; Parbhaker-Fox et al., 2013). Furthermore, there is little evidence of significant sulfide weathering in the majority of samples and products of sulfide oxidation such as jarosite and schwertmannite are generally absent. This demonstrates that the lack of acid generation may be explained by the stability of the sulfides rather than by significant neutralization in the cells.

Inclusion of Sulfides in Non-reactive Silicate Gangue

Encapsulation of chalcopyrite within a silicate gangue (quartz-feldspar) was common within the Copper Flat samples. Encapsulation of pyrite was also observed, however to a lesser extent than chalcopyrite. This textural occurrence limits the availability of these sulfide minerals for oxidation/weathering reactions, thus reducing the potential for acid generation. The only post-leach sample in which chalcopyrite occurred as medium-grained and liberated crystals was sample SRK 0854, which was one of the only cells to produce acidic conditions during the HCT. This supports the assumption that the textural occurrence of chalcopyrite in cell SRK 0854 likely contributed to its breakdown and subsequent acid generation in this cell.

Presence of Buffering Silicate Minerals

Although the occurrence of acid buffering carbonate minerals in the samples was found to be limited, the presence of silicate minerals such as phlogopite and clinochlore were more abundant and may offer some silicate buffering potential. Carbonate minerals in the form of calcite or ankerite were only observed in four of the eight cells at proportions of generally less than one percent (1%) by area (Table 4-1). In general the carbonates were very fine-grained and frequently encapsulated within quartz-feldspar composites (Figure 4-5), indicating they may not be available to contribute to acid buffering reactions, or at least slow to react and their proportions are too low to account for significant acid neutralization in the cells. The ABA testwork results (SRK, 2012) are consistent with these observations and demonstrate that carbonate proportions are considerably lower than the sulfide proportions. The encapsulation of carbonates may also account for the fact that generally greater than 70% of the original neutralization potential was remaining in the cells at the end of the humidity cell testwork period (Figure 3-13).

Despite the limited presence of carbonate minerals in the samples, the silicate minerals phlogopite and/or chlinochlore were observed in all eight samples submitted for testing. These minerals are known to offer some buffering capacity and may be one of the reasons why acidic conditions were not achieved in the majority of the Copper Flat humidity cells.

4.1.1 Additional Mineralogical Observations

For the three cells that showed evidence of acid generation during the HCT program (SRK 0854, SRK 0858 and 604673), there is a correlation between acid generation and copper release from these cells (Table 4-2). This may relate to the proportion of liberated chalcopyrite or copper sulfate minerals present in the initial (i.e., pre-leach) samples. Coarse liberated chalcopyrite grains were observed in cell SRK 0854 which presented the greatest copper release during the HCT. Similarly, the presence of copper sulfate minerals such as brochantite have been previously identified from grab sample assessment as being a likely component of the transitional samples. Although copper sulfate minerals were not identified in the current mineralogical assessment, this likely relates to the flushing of these minerals (i.e., consumption) during the HCT testwork. Therefore the breakdown of these copper sulfate minerals may be driving the observed acid generation in these cells and the apparent slow reactivity of the pyrite grains may lead to increased or eventual initiation of acid generation over much longer timescales.

Table 4-1: Summary of Post-HCT Mineralogy

		SRK Sample ID	SRK 0854	SRK 0858	SRK 0867	SRK 0872	604673	604767	CF-11-02 (0-27) (Post HCT)	CF-11-02 (0-27) (Pre HCT)
		HCT Behaviour	**PAF**	**PAF**	**NAF**	**NAF**	**PAF**	**NAF**	**NAF**	**NAF**
		Lithology → Ideal chemistry ↓	Transitional Ore	Transitional Waste	Transitional Ore	Transitional Waste	Sulfide Waste	Sulfide Ore	Transitional Waste	Transitional Waste
	Quartz	SiO_2	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	Thorite	$(Th,U)SiO_4$			X					
	Titanite	$CaTi(SiO_4)O$			X	X				
	Magnetite	Fe_3O_4	X			X				
	Fluorite	CaF_2						X		
	Zircon	$ZrSiO_4$							X	
	Rutile	TiO_2	X	X		X	X	X	X	X
Clay Minerals	Kaolinite	$AlSi_2O_5(OH)_4$		XX	XX	XX		XX		
	Illite	$K_{0.65}Al_2[(Si,Al)_4O_{10}](OH)_2$	XXX	XX	XXX	XXX	XX	XXX	XXX	XXX
	Clinochlore	$(Mg,Fe^{2+})_5Al(AlSi_3O_{10})(OH)_8$	XX			X	XX	X	XX	XX
	Phlogopite	$KMg_3(AlSi_3O_{10})(OH,F)_2$		X	X	X		X	X	X
Feldspars	Albite	$NaAlSi_3O_8$	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	Orthoclase	$(K,Na)AlSi_3O_8$	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Phosphates & Sulfates	Monazite	$(Ce,La,Nd,Th)(PO_4)$			X					
	Jarosite	$KFe^{3+}_3(SO_4)_2(OH)_6$		X	X					
	Schwertmannite	$Fe_8O_8(OH)_6(SO_4).nH_2O$	X	X		X	X		X	X
	Fluorapatite	$Ca_5(PO_4)_3F$	X	X		X		X	X	X
	Baryte	$BaSO_4$				X		X		
Carbonates	Ankerite	$Ca(Fe^{2+},Mg)(CO_3)_2$						X		X
	Calcite	$CaCO_3$			X				X	
Sulfides	Covellite	CuS							X	X
	Chalcopyrite	$CuFeS_2$	X	X	X	X	X	X	X	X
	Galena	PbS	X					X		
	Molybdenite	MoS	X				X	X		
	Pyrite	FeS_2	X	X	X	X	X	X	X	X
X	Trace Minerals (<1% by area)									
XX	Minor Minerals (1-10% by area)									
XXX	Major Minerals (> 10% by area)									

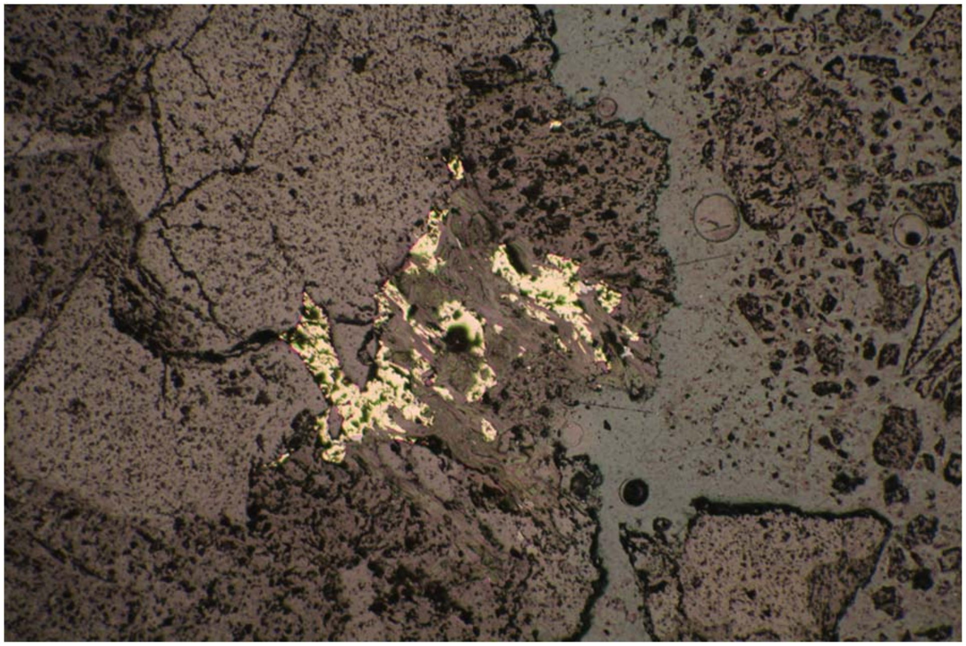

Figure 4-1: Fine-grained chalcopyrite included within quartz-feldspar grains in sample 604673

Reflected Light Image (x5 magnification). This is typical of much of the copper-sulfide mineralization within this sample.

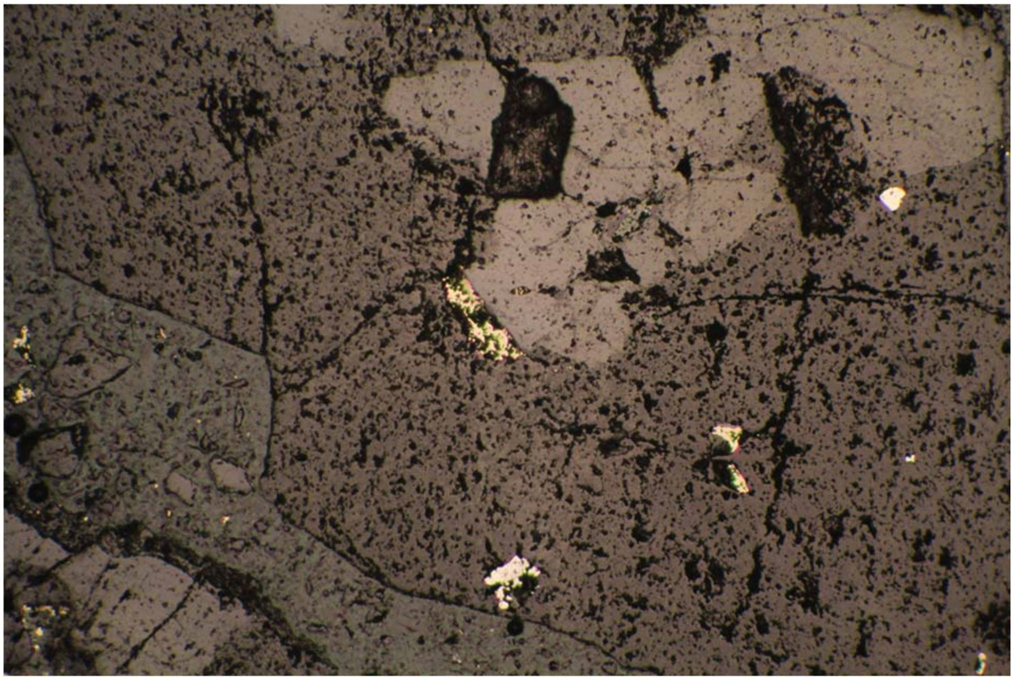

Figure 4-2: Inclusions of fine-grained sulfides with quartz-feldspar composite particles in sample 604767

Reflected Light Image (x5 magnification)

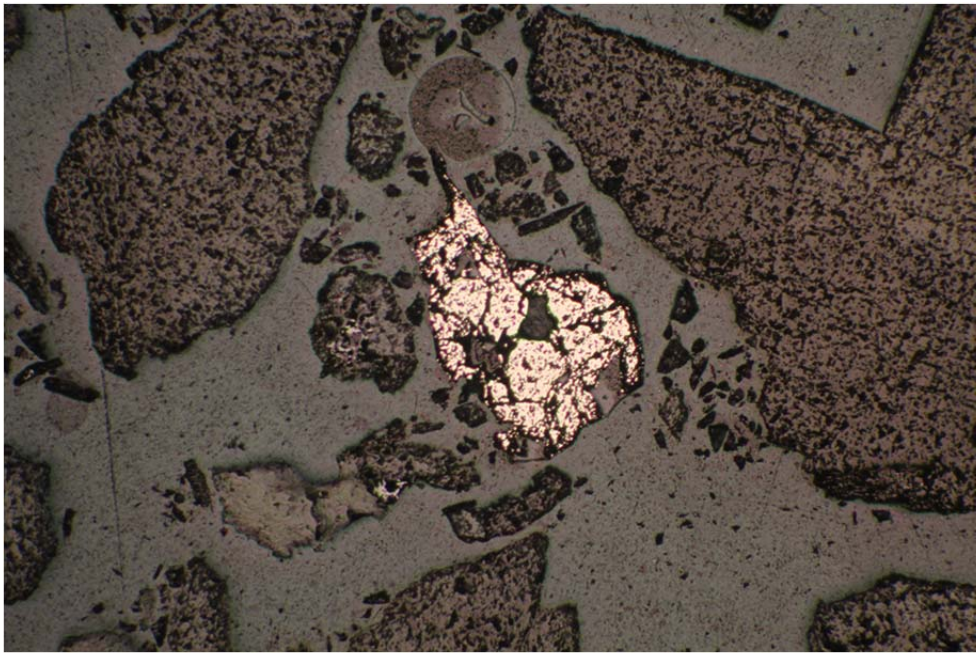

Figure 4-3: Coarse-grained liberated pyrite in sample SRK 0858

Reflected light image (x5 magnification). Coarse liberated pyrite grain showing a high degree of internal fracturing and granulation.

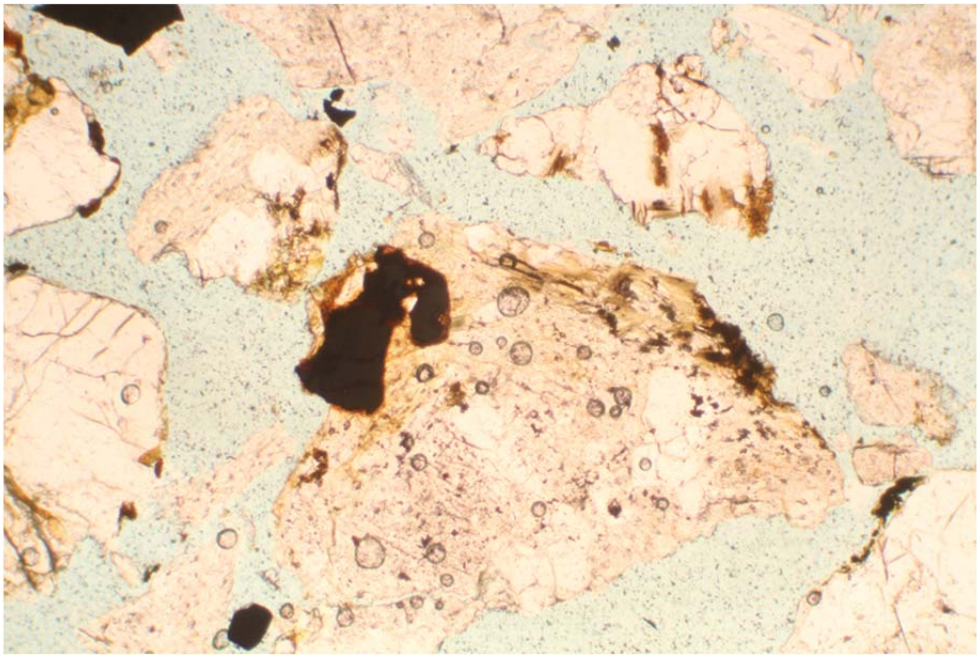

Figure 4-4: Sulfide weathering in sample SRK 0854

Plane Polarized Image (x5 magnification). Particles of quartz and feldspar with sulfide inclusions. Just to the left of the center of the field of view is an opaque pyrite grain showing brown sulfate weathering around the edges, indicating that sulfide breakdown was beginning to occur within the cell.

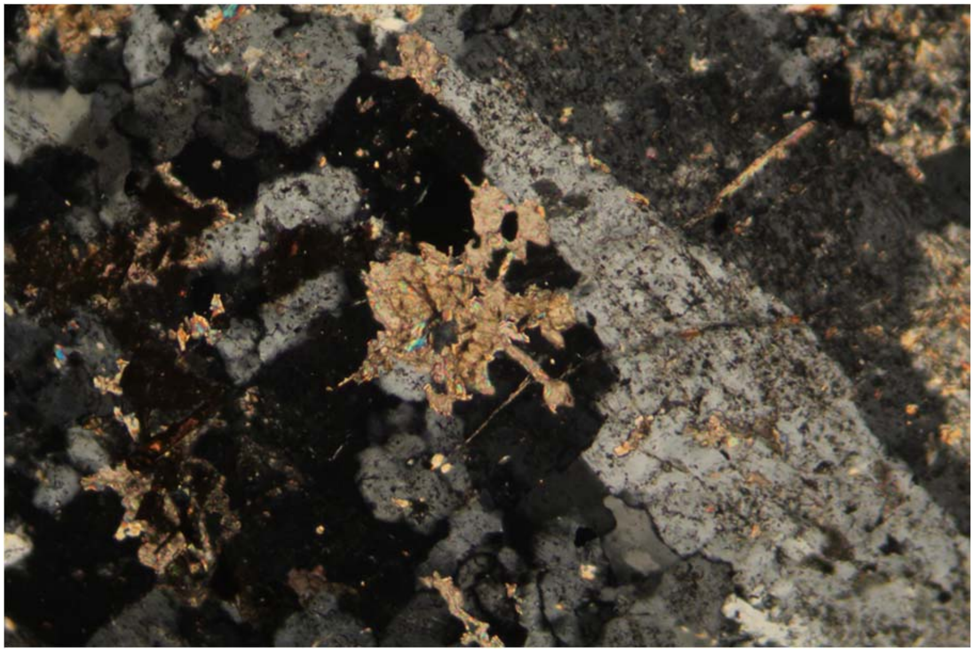

Figure 4-5: Fine-grained calcite included within a composite particle of quartz and feldspar in sample SRK 0867

Cross Polarized Image (x10 magnification)

Table 4-2: Mineralogy sample HCT copper release

Material type	Sample ID	Final HCT pH	Head Copper Assay (mg/kg)	Residue Copper Assay (mg/kg)	Cumulative Copper Release During HCT (mg/kg)	% of Copper Assay Mobilized During HCT
Sulfide Ore	604 767	7.83	5,972	5,970	2	0.04%
Sulfide Waste	604 673	4.94	1,198	1,150	48	4.04%
Transitional Ore	SRK 0854	5.12	9,780	7,490	2,290	23.4%
	SRK 0867	7.57	2,415	2,400	15	0.64%
Transitional Waste	SRK 0858	2.49	562	249	313	55.7%
	SRK 0872	7.28	875	870	5	0.61%
	CF-11-02 (0-27)	7.80	1,371	1,370	1	0.11%

🟥 Indicates acidic conditions achieved in HCT testwork

4.2 Acid Base Accounting

The pre-and post-leach ABA results for the waste rock, ore and tailings samples are summarized in Table 4-3. This shows that typically less than 10 percent of the original sulfur content was mobilized from the Copper Flat materials during the humidity cell testwork. The generally low sulfur mobilization reflects the slow weathering rates of the Copper Flat materials (consistent with Figure 3-14). The only exceptions include the samples of andesite and tailings material that were characterized by low initial sulfur contents as well as the samples that generated acidic conditions during the HCT. For example the sample that produced the most strongly acidic conditions (SRK 0858) showed the highest levels of sulfur mobilization during the humidity cell test, with 25% of the original sulfur content being released. Laboratory reports for the termination tests are provided in Appendix C.

The post-leach HCT results also demonstrate that there has been loss of inorganic carbon (i.e., neutralization potential) from the samples during the humidity cell test, due to consumption of neutralizing minerals through dissolution reactions. However, in most cases less than 30% of the initial NP was consumed during the test, indicating that acid neutralizing potential still exists in the samples. This is consistent with the calculated consumption of NP during the humidity cell test shown in Figure 3-13.

The paste pH for most samples did not change significantly between the initial and residual samples. The exceptions are cell 604673 (sulfide waste) and SRK 0858 (transitional waste), which produced considerably more acidic paste pH values in the post-leach material. The lower paste pH observed for these humidity cell residues relates to the development of acidic conditions in these cells.

Table 4-3: Pre- and Post-HCT ABA Results

Material type	Sample ID	Total sulfur (wt%)			Total inorganic carbon (wt%)			Paste pH (s.u.)	
		Head assay*	Residue assay	% mobilized during HCT	Head assay†	Residue assay	% consumed during HCT	Initial	Residue
Andesite	SRK 0864	0.03	0.01	61%	0.03	0.27	16%	7.59	8.19
	SRK 0866	0.25	0.23	7%	0.25	0.18	24%	7.70	8.04
Sulfide ore	604 562	1.77	1.69	4%	1.77	0.40	40%	7.97	7.84
	604 606	0.92	0.89	3%	0.92	0.24	32%	7.98	8.10
	604 653	1.00	0.96	4%	1.00	0.25	38%	8.09	8.01
	604 656	0.78	0.75	3%	0.78	0.62	15%	7.93	7.62
	604 669	0.88	0.82	6%	0.88	0.04	85%	8.07	7.51
	604 767	2.71	2.62	3%	2.71	0.19	63%	7.88	7.68
	604 787	1.37	1.33	3%	1.37	0.37	29%	8.02	7.75
	604 811	1.49	1.46	2%	1.49	0.35	24%	7.93	7.79
	604 854	1.80	1.74	3%	1.80	0.27	42%	8.15	8.03
	604 862	1.54	1.51	2%	1.54	0.44	23%	8.04	7.64
	604 867	2.88	2.74	5%	2.88	0.28	61%	8.03	7.66
	605 033	1.26	1.23	2%	1.26	0.30	26%	8.17	8.05
Sulfide waste	604 673	0.52	0.47	10%	0.52	0.01	93%	8.10	5.39
	605 153	0.61	0.59	3%	0.61	0.46	11%	8.60	8.11
	CF-11-02 (367-408)	1.11	1.10	1%	1.11	0.21	20%	8.49	8.34
Transitional ore	SRK 0854	1.17	0.95	19%	1.17	0.02	97%	4.80	5.45
	SRK 0867	1.04	0.96	8%	1.04	0.08	76%	6.46	7.57
Transitional waste	604 569	1.25	1.23	2%	1.25	0.20	28%	8.30	8.19
	SRK 0858	1.13	0.85	25%	1.13	0.00	100%	4.91	3.95
	SRK 0872	1.69	1.52	10%	1.69	0.02	97%	6.29	7.37
	CF-11-02 (0-27)	1.75	1.73	1%	1.75	0.26	23%	8.07	8.11
Tailings	CF-11-02 (227-367) Flotation Tailings	0.05	0.04	26%	0.05	0.26	19%	8.50	8.38
	CF-11-02 (52-117) Flotation Tailings	0.07	0.05	24%	0.07	0.29	16%	8.37	8.28
	K-Spar Breccia 5+ Comp. Flotation Tailings	0.40	0.36	10%	0.40	0.42	26%	8.28	8.09
	Biotite Breccia 5+ Comp. Flotation Tailings	0.26	0.24	8%	0.26	0.37	20%	8.49	8.39
	Quartz Monzonite 5+ Comp. Flotation Tailings	0.09	0.07	20%	0.09	0.32	19%	8.33	8.34
	Biotite Breccia 0-5 Comp. Flotation Tailings	1.09	1.07	2%	1.09	0.41	18%	8.00	8.14
	K-Spar Breccia 0-5 Comp. Flotation Tailings	1.02	1.00	2%	1.02	0.37	17%	8.07	8.11
	Quartz Monzonite 0-5 Comp. Flotation Tailings	0.78	0.76	2%	0.78	0.38	17%	7.89	8.00
	Cu Ro. Tail	0.80	0.77	4%	0.80	0.40	19%	8.12	8.09

* Reconstituted head assay for sulfur calculated from HCT residue sulfur plus cumulative sulfur release during HCT

† Reconstituted head assay for inorganic carbon calculated from residue carbon plus cumulative alkalinity release during HCT

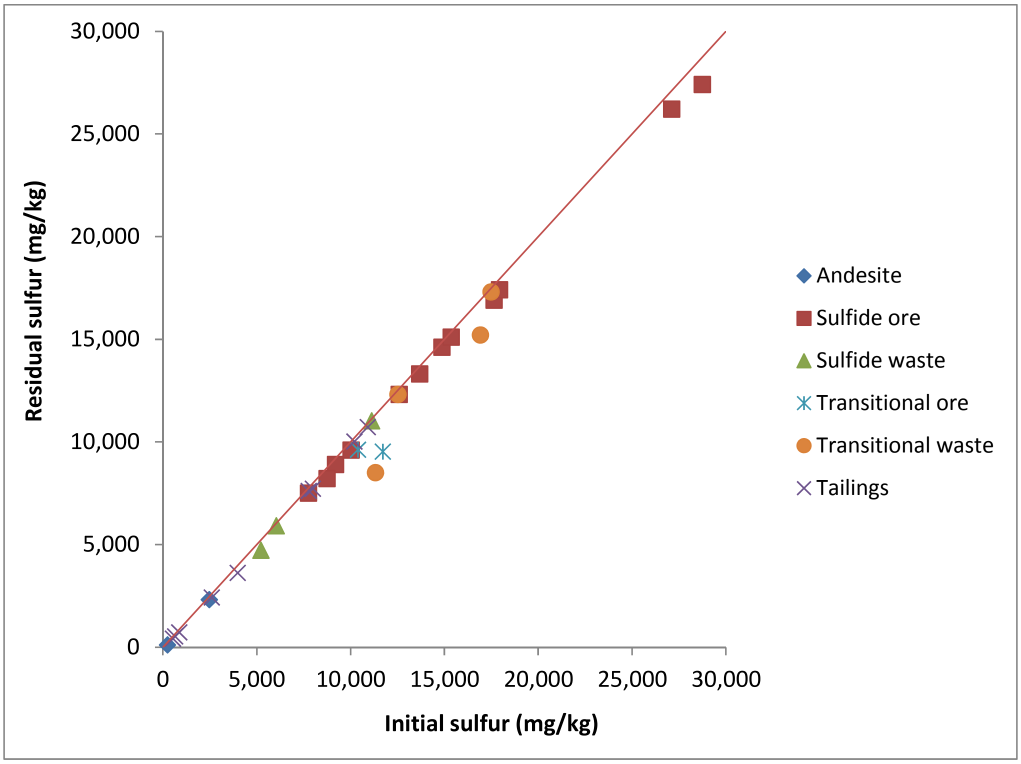

Figure 4-6: Scatter Plot of Initial vs. Residue Sulfur

4.3 Net Acid Generation

The pre- and post-leach NAG results for the waste rock, ore and tailings samples are summarized in Table 4-4. This demonstrates that there has been little change in NAG pH and NAG value between the pre- and post-HCT leached material. This supports the observation that the NAG test results are a better prediction of acid generation for the Copper Flat materials than the ABA testwork (see Section 3.2). Laboratory reports for the termination tests are provided in Appendix C.

Table 4-4: Pre- and Post-HCT NAG Results

Material type	Sample ID	NAG pH		NAG value (kg H_2SO_4 eq/t)	
		Initial	Residue	Initial	Residue
Andesite	SRK 0864	8.29	7.04	0	0
	SRK 0866	3.23	3.83	4.9	5.7
Sulfide ore	604 562	7.75	8.10	0	0
	604 606	9.60	8.13	0	0
	604 653	8.38	8.17	0	0
	604 656	8.20	7.97	0	0
	604 669	4.08	2.95	0	10.3
	604 767	3.21	2.63	17.3	17.5
	604 787	8.00	4.96	0	0
	604 811	8.42	7.94	0	0
	604 854	5.08	5.66	0	0
	604 862	8.28	7.78	0	0
	604 867	4.24	4.21	0	0
	605 033	8.30	8.04	0	0
Sulfide waste	604 673	3.66	2.78	5.29	9.7
	605 153	8.56	7.97	0	0
	CF-11-02 (367-408)	2.78	2.85	14.0	12.4
Transitional ore	SRK 0854	3.77	4.01	11.0	0
	SRK 0867	4.35	2.81	0	11.6
Transitional waste	604 569	8.33	8.01	0	0
	SRK 0858	3.15	2.59	9.22	16.3
	SRK 0872	3.14	2.82	8.82	25.4
	CF-11-02 (0-27)	3.28	2.69	9.24	17.1
Tailings	Cu Ro. Tail	9.23	9.88	0	0

🟥	Indicates PAF characteristics

4.4 Multi Element Analysis

The head and residue assays for the HCT samples are summarized in Table 4-5 to Table 4-8, which show the amount of leaching during the humidity cell test for key parameters relating to ARDML. Laboratory reports for the termination tests are provided in Appendix C.

The most significant metal(loid) release was generally observed from the sulfide ore and waste samples, which relates to both the higher initial trace elemental content of this material and also the marginally greater reactivity from these samples during the humidity cell test. In contrast, copper, molybdenum and manganese generally showed the highest mobilization from the transitional materials, which relates to the flushing of readily-soluble surficial salts from the surface of the transitional materials during the test. For example typically less than 1% of the initial copper inventory was leached from the sulfide samples during the humidity cell test compared to up to 56% from the transitional material.

There was generally minimal difference between the head and residue assays for the andesite material and tailings samples (Table 4-5 to Table 4-8), which relates to the generally low reactivity of these materials and also the low levels of metal(loid) release observed during the humidity cell test. The exceptions are molybdenum and sulfur, where a greater proportion of the initial inventory was leached but the initial (i.e., head assay) concentrations were much lower than the other material types.

Table 4-5: Pre- and Post-HCT Multi-Element Results (Arsenic, Cadmium and Chromium)

Material type	Sample ID	As				Cd				Cr			
		Head assay* (mg/kg)	Residue assay (mg/kg)	Cum. release during HCT (mg/kg)	% mobilized during HCT	Head assay* (mg/kg)	Residue assay (mg/kg)	Cum. release during HCT (mg/kg)	% mobilized during HCT	Head assay* (mg/kg)	Residue assay (mg/kg)	Cum. release during HCT (mg/kg)	% mobilized during HCT
Andesite	SRK 0864	0.9	0.8	0.10	11%	3.18	3.16	0.02	1%	47.1	47.0	0.10	0.2%
	SRK 0866	1.0	0.9	0.11	11%	0.07	0.05	0.02	30%	14.1	14.0	0.11	1%
Sulfide ore	604 562	1.0	0.9	0.11	11%	5.38	5.36	0.02	0.4%	7.11	7.00	0.11	2%
	604 606	0.6	0.5	0.11	18%	0.14	0.12	0.02	16%	6.11	6.00	0.11	2%
	604 653	0.6	0.5	0.11	18%	0.23	0.21	0.02	10%	7.11	7.00	0.11	2%
	604 656	0.5	0.4	0.11	22%	0.04	0.02	0.02	52%	6.11	6.00	0.11	2%
	604 669	2.0	1.9	0.15	7%	0.97	0.94	0.03	3%	2.15	2.00	0.15	7%
	604 767	15.5	15.3	0.23	1%	2.84	2.80	0.04	2%	2.22	2.00	0.22	10%
	604 787	9.0	8.9	0.14	2%	1.25	1.22	0.03	2%	1.14	1.00	0.14	12%
	604 811	8.5	8.4	0.12	1%	1.15	1.13	0.02	2%	7.11	7.00	0.11	2%
	604 854	18.0	17.9	0.11	0.6%	1.81	1.79	0.02	1%	4.11	4.00	0.11	3%
	604 862	11.1	11.0	0.11	1%	0.46	0.44	0.02	5%	3.11	3.00	0.11	4%
	604 867	1.7	1.6	0.11	7%	1.42	1.40	0.02	2%	6.11	6.00	0.11	2%
	605 033	4.9	4.8	0.11	2%	0.98	0.96	0.02	2%	7.11	7.00	0.11	2%
Sulfide waste	604 673	1.5	1.0	0.46	32%	0.20	0.11	0.09	44%	1.31	1.00	0.31	23%
	605 153	0.6	0.5	0.12	19%	1.12	1.10	0.02	2%	8.11	8.00	0.11	1%
	CF-11-02 (367-408)	2.0	1.8	0.15	8%	0.27	0.24	0.03	11%	1.14	1.00	0.14	13%
Transitional ore	SRK 0854	4.4	4.1	0.30	7%	0.73	0.50	0.23	32%	4.26	4.00	0.26	6%
	SRK 0867	5.2	5.1	0.12	2%	0.43	0.40	0.03	8%	6.12	6.00	0.12	2%
Transitional waste	604 569	0.9	0.8	0.12	13%	0.21	0.19	0.02	10%	6.11	6.00	0.11	2%
	SRK 0858	1.3	1.2	0.15	11%	0.17	0.04	0.13	77%	2.46	2.00	0.46	19%
	SRK 0872	2.7	2.4	0.29	11%	0.31	0.24	0.07	22%	4.25	4.00	0.25	6%
	CF-11-02 (0-27)	3.8	3.6	0.17	4%	0.35	0.31	0.04	11%	1.15	1.00	0.15	13%
Tailings	CF-11-02 (227-367) Flot. Tails	1.6	1.4	0.16	10%	0.19	0.16	0.03	14%	8.13	8.00	0.13	2%
	CF-11-02 (52-117) Flot. Tails	0.6	0.5	0.10	17%	0.15	0.13	0.02	13%	9.09	9.00	0.09	1%
	K-Spar Breccia 5+ Comp. Flot. Tails	2.3	2.2	0.14	6%	0.58	0.55	0.03	5%	15.1	15.0	0.13	1%
	Biotite Breccia 5+ Comp. Flot. Tails	1.3	1.2	0.10	8%	0.33	0.31	0.02	6%	7.10	7.00	0.10	1%
	Quartz Monzonite 5+ Comp. Flot. Tails	0.3	0.2	0.10	34%	0.14	0.12	0.02	14%	10.1	10.0	0.10	1%
	Biotite Breccia 0-5 Comp. Flot. Tailings	8.0	7.9	0.14	2%	0.78	0.75	0.03	3%	280	280	0.13	0.05%
	K-Spar Breccia 0-5 Comp. Flot. Tails	6.8	6.7	0.13	2%	0.60	0.57	0.03	4%	284	284	0.13	0.04%
	Quartz Monzonite 0-5 Comp. Flot. Tails	3.3	3.2	0.14	4%	0.80	0.77	0.03	3%	269	269	0.13	0.05%
	Cu Ro. Tail	5.3	5.2	0.07	1%	0.80	0.79	0.01	2%	17.1	17.0	0.07	0.40%

* Reconstituted head calculated from residue assay plus cumulative metal release during HCT

Table 4-6: Pre- and Post-HCT Multi-Element Results (Copper, Iron and Manganese)

Material type	Sample ID	Cu				Fe				Mn			
		Head assay* (mg/kg)	Residue assay (mg/kg)	Cum. release during HCT (mg/kg)	% mobilized during HCT	Head assay* (mg/kg)	Residue assay (mg/kg)	Cum. release during HCT (mg/kg)	% mobilized during HCT	Head assay* (mg/kg)	Residue assay (mg/kg)	Cum. release during HCT (mg/kg)	% mobilized during HCT
Andesite	SRK 0864	541	540	1.03	0.2%	61,000	61,000	0.29	0.0005%	1150	1150	0.2	0.02%
	SRK 0866	177	176	1.09	0.6%	58,200	58,200	0.25	0.0004%	776	776	0.3	0.03%
Sulfide ore	604 562	5,371	5,370	1.11	0.02%	30,100	30,100	0.28	0.0009%	658	650	7.8	1%
	604 606	1,606	1,605	1.10	0.1%	19,400	19,400	0.23	0.001%	178	177	1.0	0.5%
	604 653	2,091	2,090	1.11	0.1%	32,700	32,700	0.25	0.0008%	537	532	4.7	0.9%
	604 656	2,261	2,260	1.11	0.05%	23,500	23,500	0.22	0.0009%	656	654	1.8	0.3%
	604 669	3,261	3,260	1.49	0.05%	16,601	16,600	0.52	0.003%	337	319	17.9	5.3%
	604 767	5,972	5,970	2.19	0.04%	36,201	36,200	0.52	0.001%	320	306	13.6	4.3%
	604 787	5,961	5,960	1.42	0.02%	31,000	31,000	0.36	0.001%	271	269	2.2	0.8%
	604 811	2,581	2,580	1.13	0.04%	27,000	27,000	0.23	0.0008%	257	256	0.9	0.4%
	604 854	4,491	4,490	1.21	0.03%	27,700	27,700	0.27	0.001%	231	228	2.9	1%
	604 862	5,141	5,140	1.10	0.02%	125,500	125,500	0.28	0.0002%	748	747	1.1	0.1%
	604 867	14,302	14,300	2.30	0.02%	109,500	109,500	0.22	0.0002%	551	548	3.5	0.6%
	605 033	2,081	2,080	1.08	0.1%	48,300	48,300	0.22	0.0004%	471	470	1.3	0.3%
Sulfide waste	604 673	1,198	1,150	48.4	4.0%	8,201	8,200	1.09	0.01%	33	31	2.4	7%
	605 153	614	613	1.13	0.2%	23,700	23,700	0.27	0.001%	895	894	0.7	0.08%
	CF-11-02 (367-408)	1,472	1,470	1.50	0.1%	31,500	31,500	0.43	0.001%	370	369	0.6	0.2%
Transitional ore	SRK 0854	9,780	7,490	2,290	23%	20,121	20,100	21.1	0.10%	79	62	17.3	22%
	SRK 0867	2,415	2,400	15.5	0.6%	21,202	21,200	1.89	0.009%	177	166	11.2	6%
Transitional waste	604 569	1,481	1,480	1.11	0.1%	29,000	29,000	0.30	0.001%	368	366	1.6	0.4%
	SRK 0858	562	249	313	56%	23,286	22,500	786	3%	88	79	9.2	10%
	SRK 0872	875	870	5.35	0.6%	22,704	22,700	3.84	0.02%	120	112	8.4	7%
	CF-11-02 (0-27)	1,371	1,370	1.47	0.1%	33,801	33,800	0.55	0.002%	287	286	1.0	0.4%
Tailings	CF-11-02 (227-367) Flot. Tails	274	273	1.32	0.5%	26,001	26,000	0.84	0.003%	360	359	0.7	0.2%
	CF-11-02 (52-117) Flot. Tails	270	269	0.95	0.4%	26,600	26,600	0.31	0.001%	355	355	0.4	0.1%
	K-Spar Breccia 5+ Comp. Flot. Tails	882	881	1.30	0.1%	13,900	13,900	0.26	0.002%	215	214	1.2	0.6%
	Biotite Breccia 5+ Comp. Flot. Tails	748	747	1.00	0.1%	20,500	20,500	0.40	0.002%	399	398	0.8	0.2%
	Quartz Monzonite 5+ Comp. Flot. Tails	397	396	1.01	0.3%	15,100	15,100	0.26	0.002%	231	231	0.4	0.2%
	Biotite Breccia 0-5 Comp. Flot. Tails	181	180	1.27	0.7%	31,900	31,900	0.42	0.001%	392	391	0.5	0.1%
	K-Spar Breccia 0-5 Comp. Flot. Tails	217	216	1.29	0.6%	24,600	24,600	0.44	0.002%	282	281	0.6	0.2%
	Quartz Monzonite 0-5 Comp. Flot. Tails	193	192	1.27	0.7%	21,400	21,400	0.44	0.002%	299	299	0.5	0.2%
	Cu Ro. Tail	741	740	0.69	0.1%	25,200	25,200	0.14	0.0005%	455	454	0.7	0.1%

* Reconstituted head calculated from residue assay plus cumulative metal release during HCT

Table 4-7: Pre- and Post-HCT Multi-Element Results (Molybdenum, Nickel and Lead)

Material type	Sample ID	Mo				Ni				Pb			
		Head assay* (mg/kg)	Residue assay (mg/kg)	Cum. release during HCT (mg/kg)	% mobilized during HCT	Head assay* (mg/kg)	Residue assay (mg/kg)	Cum. release during HCT (mg/kg)	% mobilized during HCT	Head assay* (mg/kg)	Residue assay (mg/kg)	Cum. release during HCT (mg/kg)	% mobilized during HCT
Andesite	SRK 0864	2.2	1.8	0.43	20%	25.8	25.6	0.21	1%	10.3	10.2	0.05	0.5%
	SRK 0866	3.0	2.7	0.30	10%	7.52	7.3	0.22	3%	6.95	6.90	0.05	0.8%
Sulfide ore	604 562	18.7	18.5	0.22	1%	2.12	1.9	0.22	10%	416	416	0.07	0.02%
	604 606	11.4	11.1	0.34	3%	1.72	1.5	0.22	13%	17.1	17.0	0.06	0.3%
	604 653	51.9	51.4	0.53	1%	2.12	1.9	0.22	10%	21.5	21.4	0.06	0.3%
	604 656	445	444	1.01	0.2%	1.72	1.5	0.22	13%	14.6	14.5	0.06	0.4%
	604 669	88.1	87.6	0.54	1%	1.50	1.2	0.30	20%	112	112	0.07	0.1%
	604 767	26.6	26.1	0.47	2%	4.34	3.9	0.44	10%	101	101	0.11	0.1%
	604 787	136	135	0.85	1%	2.68	2.4	0.28	11%	67.6	67.5	0.07	0.1%
	604 811	97.4	97.0	0.35	0.4%	4.03	3.8	0.23	6%	51.0	50.9	0.06	0.1%
	604 854	474	473	0.78	0.2%	4.02	3.8	0.22	6%	32.9	32.8	0.06	0.2%
	604 862	558	558	0.35	0.1%	9.72	9.5	0.22	2%	9.85	9.80	0.05	0.6%
	604 867	496	496	0.38	0.1%	12.4	12.2	0.22	2%	10.2	10.1	0.06	0.5%
	605 033	59.1	58.6	0.46	1%	4.72	4.5	0.22	5%	39.8	39.7	0.05	0.1%
Sulfide waste	604 673	156	155	1.07	1%	1.61	1.0	0.61	38%	21.6	21.3	0.29	1%
	605 153	21.9	21.7	0.24	1%	3.43	3.2	0.23	7%	28.3	28.2	0.06	0.2%
	CF-11-02 (367-408)	5.0	4.8	0.30	6%	3.79	3.5	0.29	8%	18.3	18.2	0.07	0.4%
Transitional ore	SRK 0854	622	621	0.51	0.1%	3.99	3.3	0.69	17%	72.1	71.8	0.34	0.5%
	SRK 0867	66.5	66.1	0.44	1%	6.80	6.4	0.40	6%	29.9	29.8	0.06	0.2%
Transitional waste	604 569	4.7	4.5	0.27	6%	1.92	1.7	0.22	12%	21.5	21.4	0.06	0.3%
	SRK 0858	6.3	5.9	0.37	6%	1.38	1.0	0.38	28%	15.6	15.4	0.15	1%
	SRK 0872	19.2	12.3	6.88	36%	2.30	1.8	0.50	22%	35.2	35.1	0.12	0.4%
	CF-11-02 (0-27)	3.0	2.6	0.35	12%	2.59	2.3	0.29	11%	21.5	21.4	0.07	0.3%
Tailings	CF-11-02 (227-367) Flot. Tails	3.2	2.9	0.26	8%	3.86	3.6	0.26	7%	24.2	24.1	0.07	0.3%
	CF-11-02 (52-117) Flot. Tails	3.1	2.9	0.19	6%	3.89	3.7	0.19	5%	16.7	16.7	0.05	0.3%
	K-Spar Breccia 5+ Comp. Flot. Tails	51.1	49.8	1.35	3%	6.06	5.8	0.26	4%	62.3	62.2	0.06	0.1%
	Biotite Breccia 5+ Comp. Flot. Tails	14.4	14.2	0.24	2%	5.60	5.4	0.20	4%	15.2	15.1	0.05	0.3%
	Quartz Monzonite 5+ Comp. Flot. Tails	36.4	35.1	1.34	4%	5.90	5.7	0.20	3%	12.7	12.6	0.05	0.4%
	Biotite Breccia 0-5 Comp. Flot. Tails	38.1	37.3	0.80	2%	182	182	0.25	0.1%	34.6	34.5	0.06	0.2%
	K-Spar Breccia 0-5 Comp. Flot. Tails	33.1	32.1	0.97	3%	197	197	0.25	0.1%	29.1	29.0	0.06	0.2%
	Quartz Monzonite 0-5 Comp. Flot. Tails	28.3	27.9	0.43	2%	175	175	0.25	0.1%	33.2	33.1	0.06	0.2%
	Cu Ro. Tail	17.6	17.3	0.34	2%	13.14	13.0	0.14	1%	57.5	57.5	0.03	0.1%

* Reconstituted head calculated from residue assay plus cumulative metal release during HCT

Table 4-8: Pre- and Post-HCT Multi-Element Results (Sulfur, Uranium and Zinc)

Material type	Sample ID	S				U				Zn			
		Head assay* (mg/kg)	Residue assay (mg/kg)	Cum. release during HCT (mg/kg)	% mobilized during HCT	Head assay* (mg/kg)	Residue assay (mg/kg)	Cum. release during HCT (mg/kg)	% mobilized during HCT	Head assay* (mg/kg)	Residue assay (mg/kg)	Cum. release during HCT (mg/kg)	% mobilized during HCT
Andesite	SRK 0864	255	100	155	61%	2.39	2.20	0.19	8%	131	131	0.21	0.2%
	SRK 0866	2,479	2,300	179	7%	1.62	1.40	0.22	13%	47.2	47.0	0.24	1%
Sulfide ore	604 562	17,662	16,900	762	4%	4.43	4.20	0.23	5%	687	686	0.52	0.1%
	604 606	9,205	8,900	305	3%	8.81	8.20	0.61	7%	25.2	25.0	0.22	1%
	604 653	10,041	9,600	441	4%	5.04	4.70	0.34	7%	56.2	56.0	0.23	0.4%
	604 656	7,762	7,500	262	3%	5.13	4.60	0.53	10%	49.2	49.0	0.22	0.4%
	604 669	8,752	8,200	552	6%	7.69	7.10	0.59	8%	112	112	0.38	0.3%
	604 767	27,128	26,200	928	3%	15.0	13.80	1.16	8%	310	309	0.69	0.2%
	604 787	13,690	13,300	390	3%	10.3	9.10	1.21	12%	155	155	0.29	0.2%
	604 811	14,877	14,600	277	2%	5.50	4.90	0.60	11%	159	159	0.23	0.1%
	604 854	17,953	17,400	553	3%	3.97	3.70	0.27	7%	234	234	0.25	0.1%
	604 862	15,366	15,100	266	2%	5.65	5.40	0.25	4%	123	123	0.22	0.2%
	604 867	28,750	27,400	1,350	5%	3.88	3.70	0.18	5%	202	202	0.27	0.1%
	605 033	12,604	12,300	304	2%	6.18	5.80	0.38	6%	135	135	0.22	0.2%
Sulfide waste	604 673	5,229	4,700	529	10%	8.68	7.70	0.98	11%	14.0	12.0	2.03	14%
	605 153	6,055	5,900	155	3%	3.48	3.20	0.28	8%	192	192	0.23	0.1%
	CF-11-02 (367-408)	11,139	11,000	139	1%	5.85	5.70	0.15	3%	42.3	42.0	0.29	1%
Transitional ore	SRK 0854	11,729	9,500	2,229	19%	4.17	3.70	0.47	11%	70.9	55.0	15.88	22%
	SRK 0867	10,404	9,600	804	8%	5.55	5.30	0.25	5%	73.6	73.0	0.60	1%
Transitional waste	604 569	12,529	12,300	229	2%	6.87	6.50	0.37	5%	36.2	36.0	0.25	1%
	SRK 0858	11,334	8,500	2,834	25%	5.00	4.30	0.70	14%	20.1	18.0	2.13	11%
	SRK 0872	16,927	15,200	1,727	10%	4.43	4.00	0.43	10%	33.1	32.0	1.11	3%
	CF-11-02 (0-27)	17,499	17,300	199	1%	5.10	4.90	0.20	4%	46.3	46.0	0.29	1%
Tailings	CF-11-02 (227-367) Flot. Tails	540	400	140	26%	4.94	4.70	0.24	5%	41.3	41.0	0.28	1%
	CF-11-02 (52-117) Flot. Tails	655	500	155	24%	5.11	4.80	0.31	6%	35.2	35.0	0.19	1%
	K-Spar Breccia 5+ Comp. Flot. Tails	3,994	3,600	394	10%	7.24	6.10	1.14	16%	77.3	77.0	0.26	0.3%
	Biotite Breccia 5+ Comp. Flot. Tails	2,617	2,400	217	8%	5.48	5.20	0.28	5%	54.2	54.0	0.20	0.4%
	Quartz Monzonite 5+ Comp. Flot. Tails	880	700	180	20%	5.96	5.40	0.56	9%	30.2	30.0	0.20	1%
	Biotite Breccia 0-5 Comp. Flot. Tails	10,928	10,700	228	2%	6.30	5.50	0.80	13%	103	103	0.25	0.2%
	K-Spar Breccia 0-5 Comp. Flot. Tails	10,214	10,000	214	2%	5.82	5.00	0.82	14%	78.3	78.0	0.25	0.3%
	Quartz Monzonite 0-5 Comp. Flot. Tails	7,782	7,600	182	2%	5.96	5.30	0.66	11%	97.3	97.0	0.25	0.3%
	Cu Ro. Tail	7,998	7,700	298	4%	6.35	6.00	0.35	6%	117	117	0.14	0.1%

* Reconstituted head calculated from residue assay plus cumulative metal release during HCT

5 Conclusions

A kinetic testwork program has been undertaken as part of ARDML assessment for Copper Flat project, New Mexico, and has included the testing of 23 samples of waste rock/ore and nine samples of tailings material to determine the long-term leaching behavior of these materials. The cells were operated between 28 and 122 weeks and have now been terminated.

The majority of waste rock and ore cells produced circum-neutral to moderately alkaline pH leachates (pH 7 to 9) throughout the course of the humidity cell testwork and effluent pH was generally stable, indicating no onset of sulfide oxidation. Only two out of 23 waste rock cells produced acidic leachates (pH 2.5 to 5) from week zero onwards. These were samples of transitional (i.e., mixed sulfide/oxide) material that had secondary copper sulfate salts on the material surface. One sample of sulfide waste also showed declining pH and increasing effluent metal concentrations from week 45 onwards. These results are broadly consistent with previous geochemical studies at Copper Flat (Raugust, 2003).

The tailings cells produced circum-neutral leachates throughout the course of the testwork and showed generally showed low levels of metal(loid) release. The tailings cells all had greater than 70% of the initial neutralization potential remaining after 52 weeks of testing and the rate of sulfide consumption was greater than that of NP depletion, indicating that acidic conditions are unlikely to develop in the tailings impoundment.

Metal release from the samples was generally low and the consumption of NP was slow in the majority of cells, with samples still having over 70% of the initial NP remaining at termination. This indicates that significant buffering was still available when the cells were terminated and/or that acid generation is limited or occurs at a slow rate. Importantly, some of the HCTs for this project have been run appreciably longer than the typical regulatory requirement of 20 to 40 weeks in order to confirm long-term geochemical behavior of the material. Even with this continued testing, acidic conditions were not realized in the cells despite sulfide sulfur contents up to 2.34 wt% and predicted potentially acid forming (PAF) characteristics based on the ABA and NAG testwork results. The consumption of sulfide is also low and shows the sulfides are stable under the aggressive weathering conditions likely due to the coarse crystalline nature of the sulfides and and partial encapsulation of sulfides in non-reactive silicates. This confirms the generally low reactivity of the Copper Flat materials.

Mineralogical analysis was undertaken on seven of the humidity cell residues to assess speciation and textures of the sulfide minerals, and in particular to determine what influence these textures may have on the development of acid generation during the HCT program. The results indicate that the lack of acid generation in some of the cells may relate to a combination of factors, including: (i) the occurrence of sulfides as medium to coarse or well-crystallized grains, meaning they are thermodynamically stable and difficult to weather; (ii) the encapsulation of the finer-grained sulfides (particularly chalcopyrite) in non-reactive silicate gangue; and (iii) the presence of acid buffering silicate minerals such as chlorite group minerals. The final results of the humidity cell testing presented herein do not change the conclusions provided in the geochemical characterization report (SRK, 2013a) and an update to the geochemical models is not necessary to include the additional HCT data collected since the characterization and modeling reports were finalized.

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Appendix A – Humidity Cell Test Results

McClelland Reports

Table 7 . - Humidity Cell Analytical Results, 604 673 (1.5000 Kg)

					Total Fe					SO$_4$=			Acidity, CaCO$_3$ Equivalents			Alkalinity, CaCO$_3$ Equivalents		
Week	Vol. L	Effluent pH	Redox, mV (vs Ag/AgCI)	Conductivity µS/cm$^{1)}$	mg/l	mg/kg	Cum. mg/kg	Fe^{2}+ mg/l	Fe^{3}+ mg/l	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg
0	0.756	9.02	248	540	0.03	0.015	0.015	0.00	0.03	140.0	70.56	70.56	0	0.00	0.00	90	45.36	45.36
1	0.740	8.24	171	300	0.00	0.000	0.015	0.00	0.00	66.0	32.56	103.12	0	0.00	0.00	78	38.48	83.84
2	0.769	8.30	201	230	0.02	0.010	0.025	0.00	0.02	42.0	21.53	124.65	0	0.00	0.00	72	36.86	120.70
3	0.732	8.30	131	230	0.00	0.000	0.025	0.00	0.00	39.0	19.03	143.68	0	0.00	0.00	58	28.30	149.00
4	0.739	8.05	143	210	0.00	0.000	0.025	0.00	0.00	35.0	17.24	160.92	0	0.00	0.00	58	28.57	177.57
5	0.754	8.17	169	190	0.00	0.000	0.025	0.00	0.00	26.0	13.07	173.99	0	0.00	0.00	50	25.13	202.70
6	0.768	8.05	105	180	0.00	0.000	0.025	0.00	0.00	27.0	13.82	187.81	0	0.00	0.00	42	21.50	224.20
7	0.746	7.98	143	180	0.00	0.000	0.025	0.00	0.00	31.0	15.42	203.23	0	0.00	0.00	36	17.90	242.10
8	0.735	7.83	243	180	0.00	0.000	0.025	0.00	0.00	33.0	16.17	219.40	0	0.00	0.00	32	15.68	257.78
9	0.772	7.85	146	170	0.00	0.000	0.025	0.00	0.00	30.0	15.44	234.84	0	0.00	0.00	24	12.35	270.13
10	0.738	7.59	200	170	0.00	0.000	0.025	0.00	0.00	32.0	15.74	250.58	1	0.49	0.49	16	7.87	278.00
11	0.772	7.89	135	180	0.00	0.000	0.025	0.00	0.00	37.0	19.04	269.62	5	2.57	3.07	17	8.75	286.75
12	0.742	7.28	243	170	0.00	0.000	0.025	0.00	0.00	32.0	15.83	285.45	3	1.48	4.55	11	5.44	292.19
13	0.732	6.97	161	160	0.00	0.000	0.025	0.00	0.00	30.0	14.64	300.09	5	2.44	6.99	9	4.39	296.58
14	0.727	6.99	212	160	0.02	0.010	0.035	0.00	0.02	28.0	13.57	313.66	8	3.88	10.87	9	4.36	300.94
15	0.754	7.17	256	160	0.00	0.000	0.035	0.00	0.00	25.0	12.57	326.23	7	3.52	14.39	9	4.52	305.46
16	0.740	7.44	280	160	0.00	0.000	0.035	0.00	0.00	26.0	12.83	339.06	1	0.49	14.88	8	3.95	309.41
17	0.744	7.58	295	160	0.01	0.005	0.040	0.00	0.01	27.0	13.39	352.45	2	0.99	15.87	7	3.47	312.88
18	0.736	7.81	309	150	0.00	0.000	0.040	0.00	0.00	25.0	12.27	364.72	3	1.47	17.34	7	3.43	316.31
19	0.742	7.04	294	150	0.02	0.010	0.050	0.01	0.01	23.0	11.38	376.10	4	1.98	19.32	7	3.46	319.77
20	0.751	7.55	222	150	0.00	0.000	0.050	0.00	0.00	20.0	10.01	386.11	2	1.00	20.32	7	3.50	323.27
21	0.774	7.23	229	150	0.01	0.005	0.055	0.01	0.00	21.0	10.84	396.95	3	1.55	21.87	7	3.61	326.88
22	0.761	6.92	241	160	0.01	0.005	0.060	0.00	0.01	29.0	14.71	411.66	6	3.04	24.91	5	2.54	329.42
23	0.726	7.24	219	170	0.00	0.000	0.060	0.00	0.00	31.0	15.00	426.66	5	2.42	27.33	5	2.42	331.84
24	0.726	7.59	243	160	0.02	0.010	0.070	0.01	0.01	27.0	13.07	439.73	35	16.94	44.27	5	2.42	334.26
25	0.775	6.88	188	150	0.01	0.005	0.075	0.00	0.01	19.0	9.82	449.55	13	6.72	50.99	5	2.58	336.84
26	0.716	6.77	267	160	0.01	0.005	0.080	0.00	0.01	28.0	13.37	462.92	4	1.91	52.90	4	1.91	338.75
27	0.797	6.87	236	150	0.00	0.000	0.080	0.00	0.00	20.0	10.63	473.55	2	1.06	53.96	5	2.66	341.41
28	0.711	6.48	261	160	0.02	0.009	0.089	0.00	0.02	30.0	14.22	487.77	2	0.95	54.91	4	1.90	343.31
29	0.761	7.24	197	160	0.02	0.010	0.099	0.00	0.02	26.0	13.19	500.96	4	2.03	56.94	5	2.54	345.85
30	0.765	7.12	240	160	0.03	0.015	0.114	0.01	0.02	26.0	13.26	514.22	2	1.02	57.96	5	2.55	348.40
31	0.738	6.94	223	160	0.01	0.005	0.119	0.00	0.01	24.0	11.81	526.03	4	1.97	59.93	4	1.97	350.37
32	0.733	6.73	245	160	0.00	0.000	0.119	0.00	0.00	22.0	10.75	536.78	3	1.47	61.39	4	1.95	352.32
33	0.690	7.03	232	160	0.00	0.000	0.119	0.00	0.00	22.0	10.12	546.90	1	0.46	61.85	4	1.84	354.16
34	0.757	7.28	243	150	0.00	0.000	0.119	0.00	0.00	18.0	9.08	555.98	3	1.51	63.37	5	2.52	356.68
35	0.769	6.59	287	130	0.02	0.010	0.129	0.00	0.02	18.0	9.23	565.21	3	1.54	64.91	5	2.56	359.24
36	0.740	6.50	279	140	0.03	0.015	0.144	0.00	0.03	21.0	10.36	575.57	2	0.99	65.89	4	1.97	361.21
37	0.716	6.58	297	130	0.03	0.014	0.158	0.00	0.03	17.0	8.11	583.68	2	0.96	66.85	4	1.91	363.12
38	0.766	6.56	303	130	0.01	0.005	0.163	0.00	0.01	16.0	8.17	591.85	0	0.00	66.85	4	2.04	365.16
39	0.751	6.56	310	130	0.06	0.030	0.193	0.00	0.06	18.0	9.01	600.86	2	1.00	67.85	4	2.00	367.16
40	0.768	6.49	275	130	0.02	0.010	0.203	0.01	0.01	16.0	8.19	609.05	2	1.02	68.87	4	2.05	369.21
41	0.777	6.40	301	130	0.02	0.010	0.213	0.01	0.01	14.0	7.25	616.30	1	0.52	69.39	4	2.07	371.28
42	0.725	6.40	308	130	0.05	0.024	0.237	0.02	0.03	15.0	7.25	623.55	0	0.00	69.39	3	1.45	372.73
43	0.700	6.44	301	130	0.02	0.009	0.246	0.02	0.00	18.0	8.40	631.95	3	1.40	70.79	3	1.40	374.13
44	0.798	6.31	257	110	0.04	0.021	0.267	0.01	0.03	17.0	9.04	640.99	0	0.00	70.79	3	1.60	375.73
45	0.730	6.27	319	50.0	0.04	0.019	0.286	0.01	0.03	17.0	8.27	649.26	2	0.97	71.76	3	1.46	377.19
46	0.757	6.32	267	50.0	0.04	0.020	0.306	0.01	0.03	18.0	9.08	658.34	2	1.01	72.77	3	1.51	378.70
47	0.719	6.24	313	60.0	0.02	0.010	0.316	0.01	0.01	17.0	8.15	666.49	3	1.44	74.21	3	1.44	380.14
48	0.760	6.27	306	50.0	0.07	0.035	0.351	0.02	0.05	17.0	8.61	675.10	4	2.03	76.24	3	1.52	381.66
49	0.707	6.20	267	60.0	0.05	0.024	0.375	0.01	0.04	20.0	9.43	684.53	3	1.41	77.65	3	1.41	383.07
50	0.758	6.64	306	50.0	0.05	0.025	0.400	0.01	0.04	18.0	9.10	693.63	4	2.02	79.67	3	1.52	384.59
51	0.733	6.08	303	60.0	0.06	0.029	0.429	0.02	0.04	18.0	8.80	702.43	2	0.98	80.65	2	0.98	385.57
52	0.775	6.17	321	60.0	0.04	0.021	0.450	0.01	0.03	12.0	6.20	708.63	5	2.58	83.23	3	1.55	387.12
53	0.734	6.24	291	70.0	0.05	0.024	0.474	0.01	0.04	17.0	8.32	716.95	4	1.96	85.19	3	1.47	388.59
54	0.758	6.17	342	70.0	0.10	0.051	0.525	0.02	0.08	13.0	6.57	723.52	3	1.52	86.71	4	2.02	390.61
55	0.704	6.12	356	60.0	0.08	0.038	0.563	0.01	0.07	21.0	9.86	733.38	2	0.94	87.65	4	1.88	392.49
56	0.751	6.14	360	60.0	0.12	0.060	0.623	0.01	0.11	19.0	9.51	742.89	1	0.50	88.15	4	2.00	394.49
57	0.748	6.28	315	60.0	0.09	0.045	0.668	0.02	0.07	16.0	7.98	750.87	4	2.00	90.14	4	1.99	396.48
58	0.757	6.23	350	60.0	0.12	0.061	0.729	0.01	0.11	23.0	11.61	762.48	3	1.51	91.66	4	2.02	398.50
59	0.736	6.56	303	60.0	0.04	0.020	0.749	0.01	0.03	22.0	10.79	773.27	3	1.47	93.13	4	1.96	400.46
60	0.750	7.06	284	50.0	0.05	0.025	0.774	0.02	0.03	19.0	9.50	782.77	2	1.00	94.13	5	2.50	402.96
61	0.752	6.43	309	60.0	0.01	0.005	0.779	0.00	0.01	16.0	8.02	790.79	2	1.00	95.13	4	2.01	404.97
62	0.739	6.29	307	60.0	0.02	0.010	0.789	0.01	0.01	21.0	10.35	801.14	4	1.97	97.10	4	1.97	406.94
63	0.752	6.96	297	50.0	0.03	0.015	0.804	0.03	0.00	22.0	11.03	812.17	3	1.50	98.61	4	2.01	408.95
64	0.750	6.40	321	50.0	0.01	0.005	0.809	0.01	0.00	21.0	10.50	822.67	3	1.50	100.11	4	2.00	410.95
65	0.744	6.24	347	60.0	0.00	0.000	0.809	0.00	0.00	24.0	11.90	834.57	5	2.48	102.59	4	1.98	412.93
66	0.759	6.13	373	60.0	0.01	0.005	0.814	0.00	0.01	16.0	8.10	842.67	3	1.52	104.10	4	2.02	414.95
67	0.752	6.09	351	60.0	0.00	0.000	0.814	0.00	0.00	20.0	10.03	852.70	3	1.50	105.61	4	2.01	416.96
68	0.782	6.03	382	70.0	0.01	0.005	0.819	0.00	0.01	26.0	13.55	866.25	4	2.09	107.69	4	2.09	419.05
69	0.711	6.23	220	90.0	0.01	0.005	0.824	0.00	0.01	32.0	15.17	881.42	5	2.37	110.06	4	1.90	420.95
70	0.765	6.01	297	80.0	0.03	0.015	0.839	0.00	0.03	30.0	15.30	896.72	6	3.06	113.12	4	2.04	422.99

Mr Steve Raugust / **New Mexico Copper Corp.**
MLI Job No. 3438

Table 7 . - Humidity Cell Analytical Results, 604 673 (1.5000 Kg)

Week	Vol. L	Effluent pH	Redox, mV (vs Ag/AgCI)	Conductivity µS/cm[1]	Total Fe			Fe^{2}+	Fe^{3}+	SO$_4$=			Acidity, CaCO$_3$ Equivalents			Alkalinity, CaCO$_3$ Equivalents		
					mg/l	mg/kg	Cum. mg/kg	mg/l	mg/l	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg
71	0.700	5.85	323	90.0	0.07	0.033	0.872	0.01	0.06	28.0	13.07	909.79	5	2.33	115.46	2	0.93	423.92
72	0.769	6.07	344	60.0	0.03	0.015	0.887	0.00	0.03	19.0	9.74	919.53	5	2.56	118.02	3	1.54	425.46
73	0.715	6.02	371	70.0	0.03	0.014	0.901	0.00	0.03	31.0	14.78	934.31	5	2.38	120.40	4	1.91	427.37
74	0.800	6.22	343	60.0	0.03	0.016	0.917	0.00	0.03	21.0	11.20	945.51	5	2.67	123.07	4	2.13	429.50
75	0.708	6.14	272	80.0	0.03	0.014	0.931	0.03	0.00	24.0	11.33	956.84	12	5.66	128.73	6	2.83	432.33
76	0.771	5.99	278	70.0	0.04	0.021	0.952	0.02	0.02	25.0	12.85	969.69	7	3.60	132.33	4	2.06	434.39
77	0.728	5.68	328	80.0	0.12	0.058	1.010	0.04	0.08	27.0	13.10	982.79	6	2.91	135.24	2	0.97	435.36
78	0.739	5.58	288	70.0	0.03	0.015	1.025	0.00	0.03	23.0	11.33	994.12	7	3.45	138.69	2	0.99	436.35
79	0.765	5.51	307	70.0	0.03	0.015	1.040	0.01	0.02	21.0	10.71	1004.83	4	2.04	140.73	2	1.02	437.37
80	0.750	5.50	341	60.0	0.01	0.005	1.045	0.01	0.00	21.0	10.50	1015.33	7	3.50	144.23	2	1.00	438.37
81	0.757	5.31	324	70.0	0.03	0.015	1.060	0.00	0.03	21.0	10.60	1025.93	5	2.52	146.75	2	1.01	439.38
82	0.739	5.51	309	80.0	0.03	0.015	1.075	0.00	0.03	24.0	11.82	1037.75	8	3.94	150.70	2	0.99	440.37
83	0.753	5.29	324	80.0	0.02	0.010	1.085	0.00	0.02	27.0	13.55	1051.30	5	2.51	153.21	2	1.00	441.37
84	0.740	5.49	317	80.0	0.02	0.010	1.095	0.00	0.02	29.0	14.31	1065.61	8	3.95	157.15	2	0.99	442.36
85	0.759	5.47	312	80.0	0.02	0.010	1.105	0.00	0.02	25.0	12.65	1078.26	5	2.53	159.68	2	1.01	443.37
86	0.778	5.50	301	80.0	0.02	0.010	1.115	0.00	0.02	30.0	15.56	1093.82	5	2.59	162.28	2	1.04	444.41
87	0.729	5.35	286	80.0	0.11	0.053	1.168	0.00	0.11	31.0	15.07	1108.89	6	2.92	165.19	2	0.97	445.38
88	0.712	5.30	286	80.0	0.00	0.000	1.168	0.00	0.00	35.0	16.61	1125.50	7	3.32	168.51	2	0.95	446.33
89	0.783	5.58	300	70.0	0.03	0.016	1.184	0.00	0.03	26.0	13.57	1139.07	5	2.61	171.12	2	1.04	447.37
90	0.694	5.44	280	80.0	0.04	0.019	1.203	0.00	0.04	29.0	13.42	1152.49	6	2.78	173.90	2	0.93	448.30
91	0.732	5.29	292	70.0	0.02	0.010	1.213	0.00	0.02	27.0	13.18	1165.67	8	3.90	177.80	2	0.98	449.28
92	0.772	5.53	294	70.0	0.03	0.015	1.228	0.00	0.03	23.0	11.84	1177.51	5	2.57	180.38	2	1.03	450.31
93	0.734	5.52	293	90.0	0.04	0.020	1.248	0.00	0.04	30.0	14.68	1192.19	5	2.45	182.82	3	1.47	451.78
94	0.737	5.45	300	80.0	0.06	0.029	1.277	0.00	0.06	29.0	14.25	1206.44	5	2.46	185.28	2	0.98	452.76
95	0.747	5.38	307	60.0	0.03	0.015	1.292	0.00	0.03	24.0	11.95	1218.39	6	2.99	188.27	2	1.00	453.76
96	0.743	5.38	307	80.0	0.04	0.020	1.312	0.00	0.04	29.0	14.36	1232.75	6	2.97	191.24	2	0.99	454.75
97	0.748	5.50	283	70.0	0.01	0.005	1.317	0.00	0.01	26.0	12.97	1245.72	5	2.49	193.73	2	1.00	455.75
98	0.735	5.40	289	70.0	0.02	0.010	1.327	0.00	0.02	21.0	10.29	1256.01	5	2.45	196.18	2	0.98	456.73
99	0.738	5.27	354	80.0	0.02	0.010	1.337	0.00	0.02	21.0	10.33	1266.34	7	3.44	199.63	2	0.98	457.71
100	0.744	5.31	320	70.0	0.02	0.010	1.347	0.00	0.02	23.0	11.41	1277.75	5	2.48	202.11	2	0.99	458.70
101	0.747	5.27	323	70.0	0.06	0.030	1.377	0.02	0.04	25.0	12.45	1290.20	5	2.49	204.60	2	1.00	459.70
102	0.751	5.32	295	80.0	0.12	0.060	1.437	0.00	0.12	27.0	13.52	1303.72	6	3.00	207.60	2	1.00	460.70
103	0.735	5.22	303	80.0	0.02	0.010	1.447	0.00	0.02	26.0	12.74	1316.46	8	3.92	211.52	2	0.98	461.68
104	0.709	5.22	334	70.0	0.03	0.014	1.461	0.00	0.03	27.0	12.76	1329.22	6	2.84	214.36	2	0.95	462.63
105	0.728	5.17	326	80.0	0.08	0.039	1.500	0.00	0.08	29.0	14.07	1343.29	7	3.40	217.76	2	0.97	463.60
106	0.728	5.21	338	80.0	0.16	0.078	1.578	0.00	0.16	29.0	14.07	1357.36	6	2.91	220.67	2	0.97	464.57
107	0.727	5.17	320	80.0	0.07	0.034	1.612	0.00	0.07	28.0	13.57	1370.93	9	4.36	225.03	2	0.97	465.54
108	0.773	5.28	329	70.0	0.03	0.015	1.627	0.00	0.03	21.0	10.82	1381.75	7	3.61	228.64	2	1.03	466.57
109	0.732	5.00	299	80.0	0.06	0.029	1.656	0.00	0.06	28.0	13.66	1395.41	10	4.88	233.52	1	0.49	467.06
110	0.722	5.00	339	80.0	0.07	0.034	1.690	0.00	0.07	31.0	14.92	1410.33	7	3.37	236.89	1	0.48	467.54
111	0.746	4.96	324	80.0	0.07	0.035	1.725	0.00	0.07	27.0	13.43	1423.76	9	4.48	241.36	1	0.50	468.04
112	0.736	5.11	306	80.0	0.18	0.088	1.813	0.00	0.18	30.0	14.72	1438.48	8	3.93	245.29	2	0.98	469.02
113	0.740	5.12	309	80.0	0.31	0.153	1.966	0.00	0.31	25.0	12.33	1450.81	9	4.44	249.73	2	0.99	470.01
114	0.761	5.02	314	83.0	0.44	0.223	2.189	0.00	0.44	33.0	16.74	1467.55	9	4.57	254.29	2	1.01	471.02
115	0.681	5.13	290	85.5	0.21	0.095	2.284	0.00	0.21	31.0	14.07	1481.62	8	3.63	257.92	2	0.91	471.93
116	0.739	5.08	294	75.1	0.09	0.044	2.328	0.00	0.09	34.0	16.75	1498.37	7	3.45	261.37	2	0.99	472.92
117	0.750	5.07	294	70.4	0.20	0.100	2.428	0.00	0.20	29.0	14.50	1512.87	7	3.50	264.87	1	0.50	473.42
118	0.770	4.97	313	70.6	0.27	0.139	2.567	0.00	0.27	26.0	13.35	1526.22	7	3.59	268.47	1	0.51	473.93
119	0.710	5.02	307	86.2	0.08	0.038	2.605	0.00	0.08	33.0	15.62	1541.84	6	2.84	271.31	2	0.95	474.88
120	0.738	4.93	323	78.9	0.11	0.054	2.659	0.00	0.11	33.0	16.24	1558.08	9	4.43	275.73	1	0.49	475.37
121	0.727	4.81	313	89.8	0.11	0.053	2.712	0.00	0.11	34.0	16.48	1574.56	8	3.88	279.61	1	0.48	475.85
122	0.735	4.94	299	85.4	0.10	0.049	2.761	0.01	0.09	34.0	16.66	1591.22	10	4.90	284.51	1	0.49	476.34

[1] Conductivity originally reported in mS/cm. Reported in µS/cm after week 113.

Figure 7a.- Weekly Humidity Cell Analytical Results

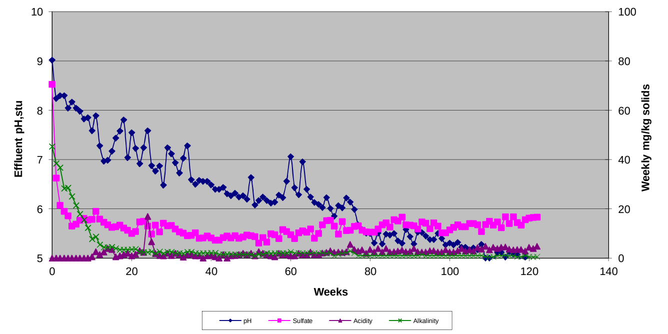


Figure 7b.- Cumulative Humidity Cell Analytical Results

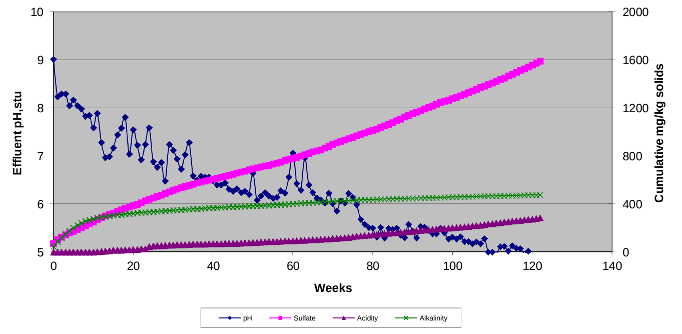


Table 22 . - Humidity Cell Analytical Results, CF-11-02 (0-27) (1.5315 Kg)

					Total Fe					SO$_4$=			Acidity, CaCO$_3$ Equivalents			Alkalinity, CaCO$_3$ Equivalents		
Week	Vol. L	Effluent pH	Redox, mV (vs Ag/AgCI)	Conductivity µS/cm1)	mg/l	mg/kg	Cum. mg/kg	Fe^{2}+ mg/l	Fe^{3}+ mg/l	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg
0	0.715	8.01	207	560	0.00	0.000	0.000	0.00	0.00	90.0	42.02	42.02	0	0.00	0.00	105	49.02	49.02
1	0.786	7.89	230	350	0.01	0.005	0.005	0.00	0.01	40.0	20.53	62.55	0	0.00	0.00	85	43.62	92.64
2	0.700	8.02	209	270	0.01	0.005	0.010	0.00	0.01	10.0	4.57	67.12	0	0.00	0.00	77	35.19	127.83
3	0.743	7.93	206	210	0.01	0.005	0.015	0.00	0.01	16.0	7.76	74.88	0	0.00	0.00	65	31.53	159.36
4	0.730	7.98	156	190	0.01	0.005	0.020	0.00	0.01	24.0	11.44	86.32	0	0.00	0.00	58	27.65	187.01
5	0.704	8.00	197	190	0.01	0.005	0.025	0.00	0.01	24.0	11.03	97.35	0	0.00	0.00	58	26.66	213.67
6	0.789	8.02	204	160	0.01	0.005	0.030	0.00	0.01	28.0	14.43	111.78	0	0.00	0.00	52	26.79	240.46
7	0.749	7.89	233	180	0.00	0.000	0.030	0.00	0.00	34.0	16.63	128.41	0	0.00	0.00	42	20.54	261.00
8	0.662	7.67	193	250	0.00	0.000	0.030	0.00	0.00	41.0	17.72	146.13	0	0.00	0.00	70	30.26	291.26
9	0.799	7.96	218	200	0.00	0.000	0.030	0.00	0.00	27.0	14.09	160.22	0	0.00	0.00	54	28.17	319.43
10	0.676	8.03	199	170	0.00	0.000	0.030	0.00	0.00	32.0	14.12	174.34	0	0.00	0.00	38	16.77	336.20
11	0.736	8.08	215	160	0.01	0.005	0.035	0.00	0.01	27.0	12.98	187.32	0	0.00	0.00	46	22.11	358.31
12	0.756	7.98	210	170	0.01	0.005	0.040	0.00	0.01	26.0	12.83	200.15	0	0.00	0.00	42	20.73	379.04
13	0.754	7.94	241	150	0.01	0.005	0.045	0.00	0.01	27.0	13.29	213.44	0	0.00	0.00	41	20.19	399.23
14	0.669	8.01	230	150	0.02	0.009	0.054	0.00	0.02	27.0	11.79	225.23	0	0.00	0.00	40	17.47	416.70
15	0.728	8.03	220	150	0.02	0.010	0.064	0.00	0.02	19.0	9.03	234.26	0	0.00	0.00	46	21.87	438.57
16	0.744	7.98	239	140	0.01	0.005	0.069	0.00	0.01	20.0	9.72	243.98	0	0.00	0.00	44	21.38	459.95
17	0.760	8.03	232	130	0.01	0.005	0.074	0.00	0.01	17.0	8.44	252.42	0	0.00	0.00	44	21.83	481.78
18	0.733	7.96	219	150	0.01	0.005	0.079	0.00	0.01	22.0	10.53	262.95	0	0.00	0.00	44	21.06	502.84
19	0.775	8.01	230	150	0.01	0.005	0.084	0.00	0.01	21.0	10.63	273.58	0	0.00	0.00	47	23.78	526.62
20	0.725	7.93	206	140	0.00	0.000	0.084	0.00	0.00	22.0	10.41	283.99	0	0.00	0.00	40	18.94	545.56
21	0.747	7.83	249	130	0.00	0.000	0.084	0.00	0.00	23.0	11.22	295.21	0	0.00	0.00	41	20.00	565.56
22	0.729	7.87	238	140	0.02	0.010	0.094	0.00	0.02	24.0	11.42	306.63	0	0.00	0.00	39	18.56	584.12
23	0.674	7.93	224	130	0.01	0.004	0.098	0.00	0.01	24.0	10.56	317.19	0	0.00	0.00	39	17.16	601.28
24	0.794	8.02	247	140	0.01	0.005	0.103	0.00	0.01	20.0	10.37	327.56	0	0.00	0.00	43	22.29	623.57
25	0.705	8.01	244	140	0.02	0.009	0.112	0.00	0.02	24.0	11.05	338.61	0	0.00	0.00	39	17.95	641.52
26	0.709	7.99	331	140	0.02	0.009	0.121	0.00	0.02	25.0	11.57	350.18	0	0.00	0.00	41	18.98	660.50
27	0.717	8.06	224	140	0.03	0.014	0.135	0.00	0.03	23.0	10.77	360.95	0	0.00	0.00	43	20.13	680.63
28	0.740	7.95	258	130	0.02	0.010	0.145	0.00	0.02	17.0	8.21	369.16	0	0.00	0.00	42	20.29	700.92
29	0.734	8.09	215	150	0.02	0.010	0.155	0.00	0.02	24.0	11.50	380.66	0	0.00	0.00	45	21.57	722.49
30	0.704	7.98	237	130	0.00	0.000	0.155	0.00	0.00	22.0	10.11	390.77	0	0.00	0.00	41	18.85	741.34
31	0.781	8.00	219	140	0.01	0.005	0.160	0.00	0.01	15.0	7.65	398.42	0	0.00	0.00	45	22.95	764.29
32	0.728	7.83	281	120	0.01	0.005	0.165	0.00	0.01	17.0	8.08	406.50	0	0.00	0.00	39	18.54	782.83
33	0.728	7.83	265	130	0.01	0.005	0.170	0.00	0.01	20.0	9.51	416.01	0	0.00	0.00	40	19.01	801.84
34	0.714	7.91	213	130	0.02	0.009	0.179	0.02	0.00	19.0	8.86	424.87	0	0.00	0.00	42	19.58	821.42
35	0.752	7.89	205	140	0.01	0.005	0.184	0.00	0.01	18.0	8.84	433.71	0	0.00	0.00	45	22.10	843.52
36	0.767	7.82	218	130	0.01	0.005	0.189	0.00	0.01	15.0	7.51	441.22	0	0.00	0.00	42	21.03	864.55
37	0.718	7.90	200	120	0.01	0.005	0.194	0.00	0.01	16.0	7.50	448.72	0	0.00	0.00	40	18.75	883.30
38	0.719	7.91	220	120	0.01	0.005	0.199	0.00	0.01	17.0	7.98	456.70	0	0.00	0.00	41	19.25	902.55
39	0.714	8.04	228	130	0.02	0.009	0.208	0.00	0.02	18.0	8.39	465.09	0	0.00	0.00	44	20.51	923.06
40	0.776	7.81	225	120	0.02	0.010	0.218	0.00	0.02	14.0	7.09	472.18	0	0.00	0.00	42	21.28	944.34
41	0.763	7.93	220	130	0.02	0.010	0.228	0.00	0.02	13.0	6.48	478.66	0	0.00	0.00	42	20.92	965.26
42	0.691	7.83	204	120	0.01	0.005	0.233	0.00	0.01	17.0	7.67	486.33	0	0.00	0.00	39	17.60	982.86
43	0.797	7.88	233	120	0.02	0.010	0.243	0.00	0.02	16.0	8.33	494.66	0	0.00	0.00	42	21.86	1004.72
44	0.666	7.88	212	120	0.00	0.000	0.243	0.00	0.00	16.0	6.96	501.62	0	0.00	0.00	39	16.96	1021.68
45	0.760	8.08	181	120	0.01	0.005	0.248	0.00	0.01	15.0	7.44	509.06	0	0.00	0.00	42	20.84	1042.52
46	0.754	7.91	193	130	0.01	0.005	0.253	0.00	0.01	14.0	6.89	515.95	0	0.00	0.00	41	20.19	1062.71
47	0.772	7.93	195	124	0.01	0.005	0.258	0.00	0.01	15.0	7.56	523.51	0	0.00	0.00	41	20.67	1083.38
48	0.698	8.00	171	122	0.01	0.005	0.263	0.00	0.01	15.0	6.84	530.35	0	0.00	0.00	38	17.32	1100.70
49	0.782	7.88	179	105	0.01	0.005	0.268	0.00	0.01	14.0	7.15	537.50	0	0.00	0.00	39	19.91	1120.61
50	0.667	7.97	170	116	0.01	0.004	0.272	0.00	0.01	16.0	6.97	544.47	0	0.00	0.00	37	16.11	1136.72
51	0.772	7.79	211	119	0.01	0.005	0.277	0.00	0.01	13.0	6.55	551.02	0	0.00	0.00	40	20.16	1156.88
52	0.755	7.87	186	108	0.01	0.005	0.282	0.00	0.01	13.0	6.41	557.43	0	0.00	0.00	38	18.73	1175.61
53	0.703	7.75	209	107	0.01	0.005	0.287	0.00	0.01	13.0	5.97	563.40	0	0.00	0.00	38	17.44	1193.05
54	0.738	7.74	196	122	0.01	0.005	0.292	0.00	0.01	14.0	6.75	570.15	0	0.00	0.00	38	18.31	1211.36
55	0.753	7.81	186	122	0.02	0.010	0.302	0.00	0.02	17.0	8.36	578.51	0	0.00	0.00	39	19.18	1230.54
56	0.714	7.82	205	131	0.01	0.005	0.307	0.00	0.01	14.0	6.53	585.04	0	0.00	0.00	38	17.72	1248.26
57	0.708	7.75	211	123	0.00	0.000	0.307	0.00	0.00	14.0	6.47	591.51	0	0.00	0.00	38	17.57	1265.83
58	0.736	8.41	127	129	0.02	0.010	0.317	0.00	0.02	12.0	5.77	597.28	0	0.00	0.00	41	19.70	1285.53
59	0.806	7.83	196	119	0.01	0.005	0.322	0.01	0.00	12.0	6.32	603.60	0	0.00	0.00	38	20.00	1305.53
60	0.752	7.80	211	118	<0.10	0.000	0.322	<0.10	<0.10	15.0	7.37	610.97	0	0.00	0.00	36	17.68	1323.21

Testing terminated at week 60

1) Conductivity originally reported in mS/cm. Reported in µS/cm after week 46.

Table 22 . - Humidity Cell Analytical Results, CF-11-02 (0-27) (1.5315 Kg)

					Total Fe					SO_4=			Acidity, $CaCO_3$ Equivalents			Alkalinity, $CaCO_3$ Equivalents		
Week	Vol. L	Effluent pH	Redox, mV (vs Ag/AgCI)	Conductivity µS/cm[1)]	mg/l	mg/kg	Cum. mg/kg	Fe^{2}+ mg/l	Fe^{3}+ mg/l	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg

Figure 22a.- Weekly Humidity Cell Analytical Results

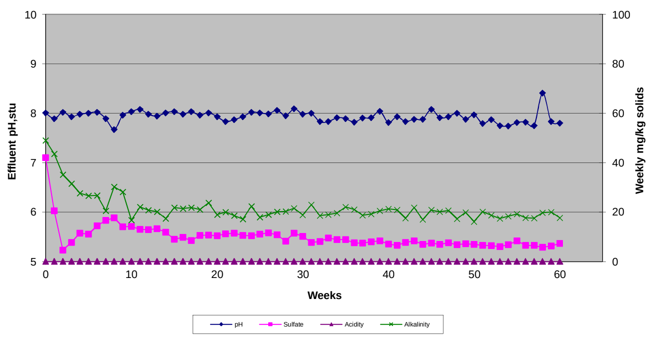
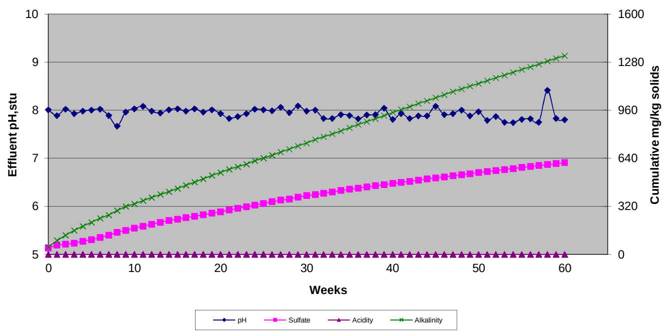


Figure 22b.- Cumulative Humidity Cell Analytical Results



Certifications: NV009332012A

Table 23 . - Humidity Cell Analytical Results, CF-11-02 (367-408) (1.5063 Kg)

Week	Vol. L	Effluent pH	Redox, mV (vs Ag/AgCl)	Conductivity µS/cm[1]	Total Fe			Fe^{2}+	Fe^{3}+	SO$_4$=			Acidity, CaCO$_3$ Equivalents			Alkalinity, CaCO$_3$ Equivalents		
					mg/l	mg/kg	Cum. mg/kg	mg/l	mg/l	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg
0	0.739	8.78	127	340	0.01	0.005	0.005	0.00	0.01	25.0	12.27	12.27	0	0.00	0.00	55	26.98	26.98
1	0.697	8.22	180	220	0.01	0.005	0.010	0.00	0.01	20.0	9.25	21.52	0	0.00	0.00	43	19.90	46.88
2	0.740	8.01	173	150	0.01	0.005	0.015	0.00	0.01	18.0	8.84	30.36	0	0.00	0.00	42	20.63	67.51
3	0.742	7.98	175	130	0.01	0.005	0.020	0.00	0.01	5.0	2.46	32.82	0	0.00	0.00	38	18.72	86.23
4	0.733	7.88	147	140	0.01	0.005	0.025	0.00	0.01	24.0	11.68	44.50	0	0.00	0.00	38	18.49	104.72
5	0.716	7.97	178	140	0.01	0.005	0.030	0.00	0.01	22.0	10.46	54.96	0	0.00	0.00	39	18.54	123.26
6	0.761	8.05	141	120	0.00	0.000	0.030	0.00	0.00	28.0	14.15	69.11	0	0.00	0.00	37	18.69	141.95
7	0.769	7.90	206	140	0.00	0.000	0.030	0.00	0.00	26.0	13.27	82.38	0	0.00	0.00	34	17.36	159.31
8	0.675	7.74	178	220	0.01	0.004	0.034	0.00	0.01	24.0	10.75	93.13	0	0.00	0.00	76	34.06	193.37
9	0.708	7.93	210	140	0.00	0.000	0.034	0.00	0.00	16.0	7.52	100.65	0	0.00	0.00	40	18.80	212.17
10	0.758	8.05	182	130	0.00	0.000	0.034	0.00	0.00	14.0	7.05	107.70	0	0.00	0.00	35	17.61	229.78
11	0.749	7.92	199	120	0.02	0.010	0.044	0.00	0.02	14.0	6.96	114.66	0	0.00	0.00	34	16.91	246.69
12	0.721	7.81	193	120	0.00	0.000	0.044	0.00	0.00	14.0	6.70	121.36	0	0.00	0.00	31	14.84	261.53
13	0.775	7.83	216	120	0.00	0.000	0.044	0.00	0.00	16.0	8.23	129.59	0	0.00	0.00	31	15.95	277.48
14	0.667	7.80	214	110	0.02	0.009	0.053	0.00	0.02	18.0	7.97	137.56	0	0.00	0.00	28	12.40	289.88
15	0.780	7.81	204	120	0.02	0.010	0.063	0.00	0.02	17.0	8.80	146.36	0	0.00	0.00	30	15.53	305.41
16	0.575	7.88	219	220	0.01	0.004	0.067	0.00	0.01	25.0	9.54	155.90	0	0.00	0.00	44	16.80	322.21
17	0.740	7.83	219	120	0.00	0.000	0.067	0.00	0.00	18.0	8.84	164.74	0	0.00	0.00	35	17.19	339.40
18	0.769	7.80	212	110	0.01	0.005	0.072	0.00	0.01	17.0	8.68	173.42	0	0.00	0.00	33	16.85	356.25
19	0.736	7.81	220	120	0.01	0.005	0.077	0.00	0.01	19.0	9.28	182.70	0	0.00	0.00	33	16.12	372.37
20	0.745	7.79	188	110	0.00	0.000	0.077	0.00	0.00	15.0	7.42	190.12	0	0.00	0.00	31	15.33	387.70
21	0.740	7.63	224	100	0.00	0.000	0.077	0.00	0.00	18.0	8.84	198.96	0	0.00	0.00	30	14.74	402.44
22	0.747	7.71	225	110	0.01	0.005	0.082	0.00	0.01	17.0	8.43	207.39	0	0.00	0.00	28	13.89	416.33
23	0.666	7.67	224	100	0.01	0.004	0.086	0.00	0.01	18.0	7.96	215.35	0	0.00	0.00	26	11.50	427.83
24	0.719	7.72	238	110	0.01	0.005	0.091	0.00	0.01	18.0	8.59	223.94	0	0.00	0.00	29	13.84	441.67
25	0.738	7.82	231	100	0.02	0.010	0.101	0.00	0.02	16.0	7.84	231.78	0	0.00	0.00	30	14.70	456.37
26	0.659	7.80	293	100	0.01	0.004	0.105	0.00	0.01	15.0	6.56	238.34	0	0.00	0.00	29	12.69	469.06
27	0.632	7.80	233	90.0	0.03	0.013	0.118	0.00	0.03	12.0	5.03	243.37	0	0.00	0.00	27	11.33	480.39
28	0.754	7.80	285	100	0.02	0.010	0.128	0.00	0.02	17.0	8.51	251.88	0	0.00	0.00	30	15.02	495.41
29	0.625	7.77	224	100	0.01	0.004	0.132	0.00	0.01	19.0	7.88	259.76	0	0.00	0.00	28	11.62	507.03
30	0.704	7.80	239	100	0.00	0.000	0.132	0.00	0.00	16.0	7.48	267.24	0	0.00	0.00	31	14.49	521.52
31	0.759	7.76	234	90.0	0.01	0.005	0.137	0.00	0.01	10.0	5.04	272.28	0	0.00	0.00	31	15.62	537.14
32	0.781	7.63	297	80.0	0.00	0.000	0.137	0.00	0.00	8.0	4.15	276.43	0	0.00	0.00	29	15.04	552.18
33	0.722	7.62	280	80.0	0.01	0.005	0.142	0.00	0.01	8.0	3.83	280.26	0	0.00	0.00	26	12.46	564.64
34	0.714	7.70	218	80.0	0.02	0.009	0.151	0.02	0.00	9.0	4.27	284.53	0	0.00	0.00	28	13.27	577.91
35	0.725	7.70	221	90.0	0.05	0.024	0.175	0.00	0.05	10.0	4.81	289.34	0	0.00	0.00	30	14.44	592.35
36	0.753	7.67	229	80.0	0.00	0.000	0.175	0.00	0.00	7.0	3.50	292.84	0	0.00	0.00	30	15.00	607.35
37	0.792	7.71	205	80.0	0.01	0.005	0.180	0.00	0.01	7.0	3.68	296.52	0	0.00	0.00	28	14.72	622.07
38	0.644	7.66	209	80.0	0.00	0.000	0.180	0.00	0.00	9.0	3.85	300.37	0	0.00	0.00	25	10.69	632.76
39	0.798	7.81	212	80.0	0.01	0.005	0.185	0.00	0.01	8.0	4.24	304.61	0	0.00	0.00	28	14.83	647.59
40	0.734	7.57	238	70.0	0.01	0.005	0.190	0.00	0.01	7.0	3.41	308.02	0	0.00	0.00	24	11.69	659.28
41	0.676	7.67	211	80.0	0.01	0.004	0.194	0.00	0.01	8.0	3.59	311.61	0	0.00	0.00	25	11.22	670.50
42	0.757	7.65	217	80.0	0.01	0.005	0.199	0.00	0.01	7.0	3.52	315.13	0	0.00	0.00	28	14.07	684.57
43	0.716	7.66	227	70.0	0.01	0.005	0.204	0.00	0.01	9.0	4.28	319.41	0	0.00	0.00	26	12.36	696.93
44	0.799	7.69	205	70.0	0.00	0.000	0.204	0.00	0.00	4.0	2.12	321.53	0	0.00	0.00	26	13.79	710.72
45	0.681	7.74	192	70.0	0.02	0.009	0.213	0.00	0.02	8.0	3.62	325.15	0	0.00	0.00	24	10.85	721.57
46	0.744	7.71	200	80.0	0.02	0.010	0.223	0.00	0.02	6.0	2.96	328.11	0	0.00	0.00	28	13.83	735.40
47	0.773	7.74	198	79.9	0.00	0.000	0.223	0.00	0.00	8.0	4.11	332.22	0	0.00	0.00	27	13.86	749.26
48	0.702	7.76	175	76.5[1]	0.01	0.005	0.228	0.00	0.01	6.0	2.80	335.02	0	0.00	0.00	25	11.65	760.91
49	0.759	7.68	193	66.8	0.01	0.005	0.233	0.00	0.01	2.0	1.01	336.03	0	0.00	0.00	25	12.60	773.51
50	0.750	7.84	171	72.7	0.01	0.005	0.238	0.00	0.01	1.0	0.50	336.53	0	0.00	0.00	25	12.45	785.96
51	0.768	7.54	211	70.8	0.01	0.005	0.243	0.00	0.01	1.0	0.51	337.04	0	0.00	0.00	24	12.24	798.20
52	0.689	7.64	187	66.9	0.02	0.009	0.252	0.00	0.02	1.0	0.46	337.50	0	0.00	0.00	22	10.06	808.26
53	0.711	7.55	208	67.7	0.03	0.014	0.266	0.00	0.03	1.0	0.47	337.97	0	0.00	0.00	24	11.33	819.59
54	0.731	7.54	203	76.1	0.01	0.005	0.271	0.00	0.01	7.0	3.40	341.37	0	0.00	0.00	24	11.65	831.24
55	0.774	7.59	190	72.0	0.02	0.010	0.281	0.00	0.02	7.0	3.60	344.97	0	0.00	0.00	24	12.33	843.57
56	0.698	7.57	203	75.0	0.00	0.000	0.281	0.00	0.00	9.0	4.17	349.14	0	0.00	0.00	23	10.66	854.23
57	0.701	7.55	204	73.1	0.00	0.000	0.281	0.00	0.00	8.0	3.72	352.86	0	0.00	0.00	23	10.70	864.93
58	0.789	7.69	161	71.1	0.03	0.016	0.297	0.00	0.03	5.0	2.62	355.48	0	0.00	0.00	23	12.05	876.98
59	0.768	7.72	183	65.0	0.01	0.005	0.302	0.00	0.01	5.0	2.55	358.03	0	0.00	0.00	21	10.71	887.69
60	0.720	7.56	179	64.2	<0.10	0.000	0.302	<0.10	<0.10	6.0	2.87	360.90	0	0.00	0.00	20	9.56	897.25

Testing terminated at week 60

[1] Conductivity originally reported in mS/cm. Reported in µS/cm after week 46.

Table 23 . - Humidity Cell Analytical Results, CF-11-02 (367-408) (1.5063 Kg)

					Total Fe					SO_4=			Acidity, $CaCO_3$ Equivalents			Alkalinity, $CaCO_3$ Equivalents		
	Vol.	Effluent	Redox, mV	Conductivity			Cum.	Fe^{2}+	Fe^{3}+			Cum.			Cum.			Cum.
Week	L	pH	(vs Ag/AgCI)	µS/cm[1)]	mg/l	mg/kg	mg/kg	mg/l	mg/l	mg/l	mg/kg	mg/kg	mg/l	mg/kg	mg/kg	mg/l	mg/kg	mg/kg

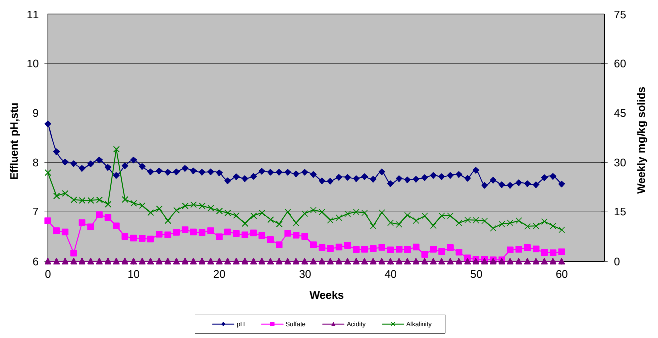


Figure 23a.- Weekly Humidity Cell Analytical Results

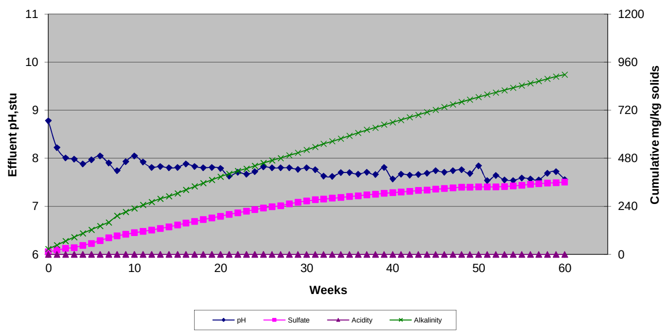


Figure 23b.- Cumulative Humidity Cell Analytical Results

Table 25 . - Humidity Cell Analytical Results, CF-11-02 (52-117) Flotation Tailings (1.5346 Kg)

					Total Fe					SO_4=			Acidity, $CaCO_3$ Equivalents			Alkalinity, $CaCO_3$ Equivalents		
Week	Vol. L	Effluent pH	Redox, mV (vs Ag/AgCI)	Conductivity µS/cm[1)]	mg/l	mg/kg	Cum. mg/kg	Fe^2+ mg/l	Fe^3+ mg/l	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg
0	0.563	7.90	208	470	0.01	0.004	0.004	0.00	0.01	69.0	25.31	25.31	0	0.00	0.00	102	37.42	37.42
1	0.773	8.10	200	360	0.00	0.000	0.004	0.00	0.00	63.0	31.73	57.04	0	0.00	0.00	89	44.83	82.25
2	0.755	7.77	228	350	0.00	0.000	0.004	0.00	0.00	30.0	14.76	71.80	0	0.00	0.00	77	37.88	120.13
3	0.682	7.98	207	310	0.00	0.000	0.004	0.00	0.00	65.0	28.89	100.69	0	0.00	0.00	53	23.55	143.68
4	0.751	8.16	181	300	0.00	0.000	0.004	0.00	0.00	50.0	24.47	125.16	0	0.00	0.00	63	30.83	174.51
5	0.758	8.12	185	250	0.01	0.005	0.009	0.00	0.01	30.0	14.82	139.98	0	0.00	0.00	61	30.13	204.64
6	0.683	7.99	177	240	0.01	0.004	0.013	0.00	0.01	30.0	13.35	153.33	0	0.00	0.00	52	23.14	227.78
7	0.831	8.12	225	230	0.01	0.005	0.018	0.00	0.01	25.0	13.54	166.87	0	0.00	0.00	63	34.12	261.90
8	0.662	8.03	185	190	0.02	0.009	0.027	0.00	0.02	20.0	8.63	175.50	0	0.00	0.00	47	20.27	282.17
9	0.744	8.10	176	220	0.02	0.010	0.037	0.00	0.02	35.0	16.97	192.47	0	0.00	0.00	59	28.60	310.77
10	0.761	8.06	193	190	0.01	0.005	0.042	0.00	0.01	32.0	15.87	208.34	0	0.00	0.00	56	27.77	338.54
11	0.725	8.08	219	190	0.00	0.000	0.042	0.00	0.00	31.0	14.65	222.99	0	0.00	0.00	56	26.46	365.00
12	0.748	8.01	201	170	0.00	0.000	0.042	0.00	0.00	27.0	13.16	236.15	0	0.00	0.00	53	25.83	390.83
13	0.714	8.04	234	170	0.01	0.005	0.047	0.00	0.01	28.0	13.03	249.18	0	0.00	0.00	53	24.66	415.49
14	0.746	8.02	201	170	0.00	0.000	0.047	0.00	0.00	23.0	11.18	260.36	0	0.00	0.00	56	27.22	442.71
15	0.775	7.90	230	160	0.00	0.000	0.047	0.00	0.00	22.0	11.11	271.47	0	0.00	0.00	53	26.77	469.48
16	0.650	7.92	233	160	0.01	0.004	0.051	0.00	0.01	22.0	9.32	280.79	0	0.00	0.00	49	20.75	490.23
17	0.815	7.99	225	150	0.02	0.011	0.062	0.00	0.02	15.0	7.97	288.76	0	0.00	0.00	51	27.09	517.32
18	0.746	8.01	239	150	0.02	0.010	0.072	0.00	0.02	16.0	7.78	296.54	0	0.00	0.00	51	24.79	542.11
19	0.753	8.13	219	150	0.02	0.010	0.082	0.00	0.02	15.0	7.36	303.90	0	0.00	0.00	50	24.53	566.64
20	0.735	8.05	293	140	0.01	0.005	0.087	0.00	0.01	15.0	7.18	311.08	0	0.00	0.00	50	23.95	590.59
21	0.707	8.05	196	150	0.02	0.009	0.096	0.00	0.02	14.0	6.45	317.53	0	0.00	0.00	52	23.96	614.55
22	0.734	8.02	263	130	0.02	0.010	0.106	0.00	0.02	11.0	5.26	322.79	0	0.00	0.00	52	24.87	639.42
23	0.751	8.10	203	170	0.01	0.005	0.111	0.00	0.01	16.0	7.83	330.62	0	0.00	0.00	57	27.89	667.31
24	0.729	8.01	237	140	0.00	0.000	0.111	0.00	0.00	10.0	4.75	335.37	0	0.00	0.00	55	26.13	693.44
25	0.749	7.97	236	140	0.01	0.005	0.116	0.00	0.01	8.0	3.90	339.27	0	0.00	0.00	51	24.89	718.33
26	0.784	7.80	289	130	0.01	0.005	0.121	0.00	0.01	8.0	4.09	343.36	0	0.00	0.00	49	25.03	743.36
27	0.717	7.86	273	130	0.02	0.009	0.130	0.00	0.02	9.0	4.21	347.57	0	0.00	0.00	46	21.49	764.85
28	0.711	7.89	207	140	0.02	0.009	0.139	0.02	0.00	9.0	4.17	351.74	0	0.00	0.00	50	23.17	788.02
29	0.743	7.91	216	150	0.01	0.005	0.144	0.01	0.00	10.0	4.84	356.58	0	0.00	0.00	52	25.18	813.20
30	0.746	7.85	225	130	0.01	0.005	0.149	0.00	0.01	8.0	3.89	360.47	0	0.00	0.00	47	22.85	836.05
31	0.764	7.93	190	130	0.01	0.005	0.154	0.00	0.01	7.0	3.48	363.95	0	0.00	0.00	52	25.89	861.94
32	0.723	7.90	184	120	0.00	0.000	0.154	0.00	0.00	6.0	2.83	366.78	0	0.00	0.00	47	22.14	884.08
33	0.775	8.01	190	130	0.01	0.005	0.159	0.00	0.01	8.0	4.04	370.82	0	0.00	0.00	50	25.25	909.33
34	0.665	7.89	221	120	0.02	0.009	0.168	0.00	0.02	7.0	3.03	373.85	0	0.00	0.00	48	20.80	930.13
35	0.802	7.96	193	110	0.02	0.010	0.178	0.00	0.02	5.0	2.61	376.46	0	0.00	0.00	43	22.47	952.60
36	0.684	7.83	218	110	0.01	0.004	0.182	0.00	0.01	6.0	2.67	379.13	0	0.00	0.00	45	20.06	972.66
37	0.808	7.94	200	110	0.01	0.005	0.187	0.00	0.01	7.0	3.69	382.82	0	0.00	0.00	47	24.75	997.41
38	0.735	7.92	180	110	0.01	0.005	0.192	0.00	0.01	6.0	2.87	385.69	0	0.00	0.00	46	22.03	1019.44
39	0.743	8.04	166	110	0.02	0.010	0.202	0.01	0.01	5.0	2.42	388.11	0	0.00	0.00	45	21.79	1041.23
40	0.709	7.94	184	120	0.02	0.009	0.211	0.00	0.02	5.0	2.31	390.42	0	0.00	0.00	46	21.25	1062.48
41	0.753	7.96	177	114	0.01	0.005	0.216	0.00	0.01	6.0	2.94	393.36	0	0.00	0.00	43	21.10	1083.58
42	0.716	7.96	161	102	0.01	0.005	0.221	0.00	0.01	4.0	1.87	395.23	0	0.00	0.00	39	18.20	1101.78

[1)] Conductivity originally reported in mS/cm. Reported in µS/cm after week 41.

Testing terminated after week 42

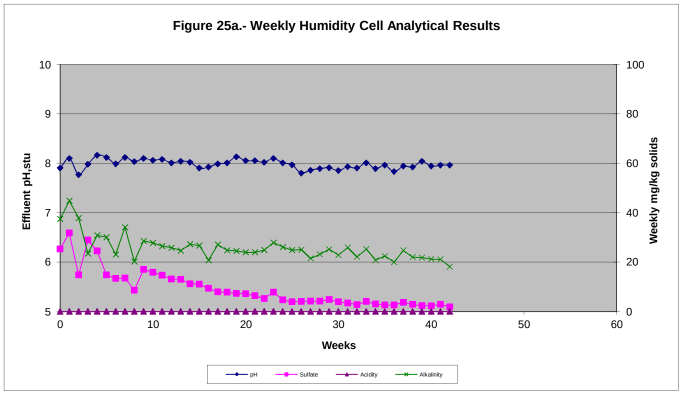


Figure 25a.- Weekly Humidity Cell Analytical Results

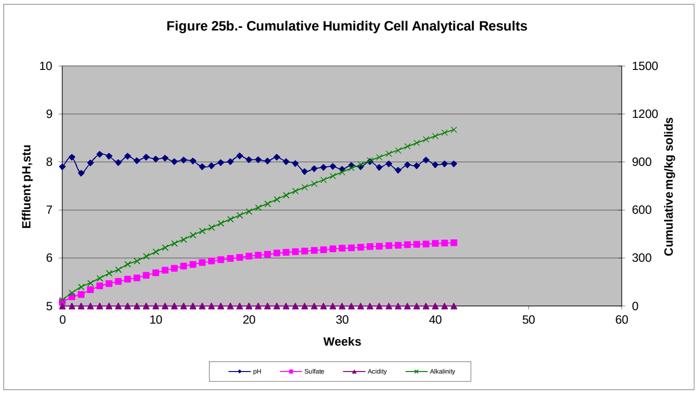


Figure 25b.- Cumulative Humidity Cell Analytical Results

Table 26 . - Humidity Cell Analytical Results, K-Spar Breccia 5+ Comp Flotation Tailings (1.4954 Kg)

					Total Fe					SO_4=			Acidity, $CaCO_3$ Equivalents			Alkalinity, $CaCO_3$ Equivalents		
Week	Vol. L	Effluent pH	Redox, mV (vs Ag/AgCI)	Conductivity μS/cm[1]	mg/l	mg/kg	Cum. mg/kg	Fe^2+ mg/l	Fe^3+ mg/l	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg
0	0.482	8.01	169	770	0.02	0.006	0.006	0.00	0.02	220.0	70.91	70.91	0	0.00	0.00	115	37.07	37.07
1	0.793	8.20	210	380	0.00	0.000	0.006	0.00	0.00	45.0	23.86	94.77	0	0.00	0.00	105	55.68	92.75
2	0.737	7.90	221	360	0.00	0.000	0.006	0.00	0.00	55.0	27.11	121.88	0	0.00	0.00	106	52.24	144.99
3	0.725	8.12	206	460	0.00	0.000	0.006	0.00	0.00	85.0	41.21	163.09	0	0.00	0.00	104	50.42	195.41
4	0.745	8.24	186	390	0.00	0.000	0.006	0.00	0.00	65.0	32.38	195.47	0	0.00	0.00	91	45.34	240.75
5	0.706	8.19	182	360	0.00	0.000	0.006	0.00	0.00	65.0	30.69	226.16	0	0.00	0.00	87	41.07	281.82
6	0.763	8.15	173	330	0.00	0.000	0.006	0.00	0.00	45.0	22.96	249.12	0	0.00	0.00	80	40.82	322.64
7	0.726	8.07	214	320	0.00	0.000	0.006	0.00	0.00	60.0	29.13	278.25	0	0.00	0.00	72	34.96	357.60
8	0.746	8.18	184	320	0.02	0.010	0.016	0.00	0.02	50.0	24.94	303.19	0	0.00	0.00	77	38.41	396.01
9	0.703	8.19	175	350	0.02	0.009	0.025	0.00	0.02	78.0	36.67	339.86	0	0.00	0.00	78	36.67	432.68
10	0.746	8.12	192	280	0.00	0.000	0.025	0.00	0.00	66.0	32.92	372.78	0	0.00	0.00	73	36.42	469.10
11	0.738	8.14	218	270	0.00	0.000	0.025	0.00	0.00	64.0	31.58	404.36	0	0.00	0.00	71	35.04	504.14
12	0.717	8.10	210	270	0.01	0.005	0.030	0.00	0.01	58.0	27.81	432.17	0	0.00	0.00	69	33.08	537.22
13	0.758	8.12	242	250	0.01	0.005	0.035	0.00	0.01	55.0	27.88	460.05	0	0.00	0.00	67	33.96	571.18
14	0.714	8.09	216	280	0.00	0.000	0.035	0.00	0.00	69.0	32.95	493.00	0	0.00	0.00	69	32.95	604.13
15	0.767	7.99	230	240	0.00	0.000	0.035	0.00	0.00	55.0	28.21	521.21	0	0.00	0.00	67	34.36	638.49
16	0.719	8.06	243	280	0.01	0.005	0.040	0.00	0.01	69.0	33.18	554.39	0	0.00	0.00	67	32.21	670.70
17	0.782	8.08	239	230	0.02	0.010	0.050	0.00	0.02	51.0	26.67	581.06	0	0.00	0.00	67	35.04	705.74
18	0.719	8.01	248	290	0.01	0.005	0.055	0.00	0.01	79.0	37.98	619.04	0	0.00	0.00	61	29.33	735.07
19	0.730	8.15	232	250	0.01	0.005	0.060	0.00	0.01	59.0	28.80	647.84	0	0.00	0.00	63	30.75	765.82
20	0.770	8.11	286	230	0.01	0.005	0.065	0.00	0.01	49.0	25.23	673.07	0	0.00	0.00	64	32.95	798.77
21	0.723	8.11	215	260	0.02	0.010	0.075	0.00	0.02	64.0	30.94	704.01	0	0.00	0.00	60	29.01	827.78
22	0.718	8.09	270	230	0.01	0.005	0.080	0.00	0.01	54.0	25.93	729.94	0	0.00	0.00	62	29.77	857.55
23	0.764	8.04	215	230	0.01	0.005	0.085	0.00	0.01	53.0	27.08	757.02	0	0.00	0.00	64	32.70	890.25
24	0.707	8.08	242	260	0.00	0.000	0.085	0.00	0.00	61.0	28.84	785.86	0	0.00	0.00	64	30.26	920.51
25	0.758	8.05	244	230	0.01	0.005	0.090	0.00	0.01	44.0	22.30	808.16	0	0.00	0.00	62	31.43	951.94
26	0.748	7.87	289	210	0.00	0.000	0.090	0.00	0.00	39.0	19.51	827.67	0	0.00	0.00	59	29.51	981.45
27	0.716	7.91	277	230	0.01	0.005	0.095	0.00	0.01	50.0	23.94	851.61	0	0.00	0.00	59	28.25	1009.70
28	0.765	7.97	208	210	0.02	0.010	0.105	0.02	0.00	40.0	20.46	872.07	0	0.00	0.00	59	30.18	1039.88
29	0.730	7.94	219	230	0.01	0.005	0.110	0.00	0.01	52.0	25.38	897.45	0	0.00	0.00	60	29.29	1069.17
30	0.756	7.95	227	210	0.00	0.000	0.110	0.00	0.00	41.0	20.73	918.18	0	0.00	0.00	61	30.84	1100.01
31	0.753	8.03	192	210	0.01	0.005	0.115	0.00	0.01	41.0	20.65	938.83	0	0.00	0.00	61	30.72	1130.73
32	0.714	7.90	189	180	0.00	0.000	0.115	0.00	0.00	36.0	17.19	956.02	0	0.00	0.00	50	23.87	1154.60
33	0.762	8.12	193	190	0.01	0.005	0.120	0.00	0.01	42.0	21.40	977.42	0	0.00	0.00	55	28.03	1182.63
34	0.675	7.93	224	190	0.04	0.018	0.138	0.00	0.04	41.0	18.51	995.93	0	0.00	0.00	53	23.92	1206.55
35	0.775	8.03	195	190	0.01	0.005	0.143	0.00	0.01	34.0	17.62	1013.55	0	0.00	0.00	56	29.02	1235.57
36	0.724	7.95	222	200	0.01	0.005	0.148	0.00	0.01	37.0	17.91	1031.46	0	0.00	0.00	56	27.11	1262.68
37	0.753	7.99	202	180	0.01	0.005	0.153	0.00	0.01	36.0	18.13	1049.59	0	0.00	0.00	56	28.20	1290.88
38	0.716	7.99	183	200	0.00	0.000	0.153	0.00	0.00	38.0	18.19	1067.78	0	0.00	0.00	57	27.29	1318.17
39	0.777	8.13	175	190	0.01	0.005	0.158	0.00	0.01	33.0	17.15	1084.93	0	0.00	0.00	57	29.62	1347.79
40	0.726	8.02	187	210	0.01	0.005	0.163	0.00	0.01	34.0	16.51	1101.44	0	0.00	0.00	57	27.67	1375.46
41	0.723	8.04	180	203	0.00	0.000	0.163	0.00	0.00	37.0	17.89	1119.33	0	0.00	0.00	57	27.56	1403.02
42	0.763	8.09	164	189	0.01	0.005	0.168	0.00	0.01	29.0	14.80	1134.13	0	0.00	0.00	55	28.06	1431.08
43	0.727	8.03	192	166	0.01	0.005	0.173	0.00	0.01	33.0	16.04	1150.17	0	0.00	0.00	53	25.77	1456.85
44	0.753	8.14	152	174	0.01	0.005	0.178	0.00	0.01	31.0	15.61	1165.78	0	0.00	0.00	54	27.19	1484.04
45	0.718	7.92	190	183	0.01	0.005	0.183	0.00	0.01	31.0	14.88	1180.66	0	0.00	0.00	53	25.45	1509.49
46	0.752	7.99	164	172	0.02	0.010	0.193	0.00	0.02	27.0	13.58	1194.24	0	0.00	0.00	54	27.16	1536.65
47	0.729	7.96	174	162	0.01	0.005	0.198	0.00	0.01	25.0	12.19	1206.43	0	0.00	0.00	54	26.32	1562.97
48	0.745	7.85	184	182	0.01	0.005	0.203	0.00	0.01	26.0	12.95	1219.38	0	0.00	0.00	53	26.40	1589.37
49	0.757	7.91	163	173	0.02	0.010	0.213	0.00	0.02	27.0	13.67	1233.05	0	0.00	0.00	52	26.32	1615.69
50	0.713	7.92	181	172	0.01	0.005	0.218	0.00	0.01	22.0	10.49	1243.54	0	0.00	0.00	51	24.32	1640.01
51	0.739	7.88	172	167	0.00	0.000	0.218	0.00	0.00	23.0	11.37	1254.91	0	0.00	0.00	51	25.20	1665.21
52	0.742	8.02	174	160	0.02	0.010	0.228	0.00	0.02	17.0	8.44	1263.35	0	0.00	0.00	49	24.31	1689.52

[1] Conductivity originally reported in mS/cm. Reported in μS/cm after week 40.

Figure 26a.- Weekly Humidity Cell Analytical Results

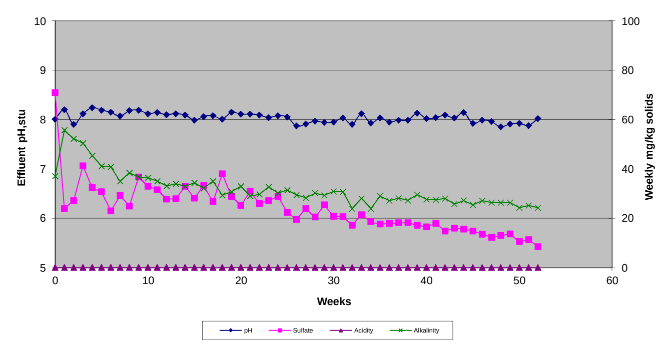


Figure 26b.- Cumulative Humidity Cell Analytical Results

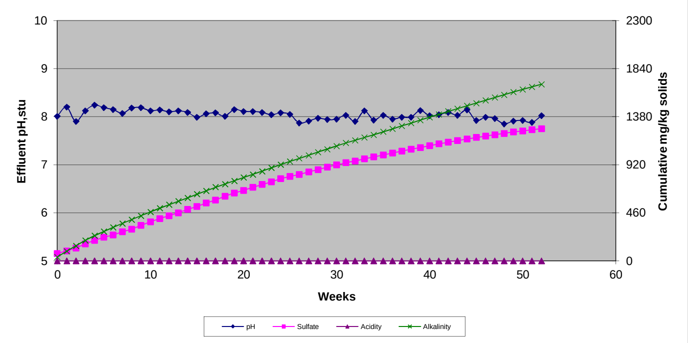


Table 27 . - Humidity Cell Analytical Results, Biotite Breccia 5+ Comp. Flotation Tailings (1.4964 Kg)

					Total Fe					SO_4=			Acidity, $CaCO_3$ Equivalents			Alkalinity, $CaCO_3$ Equivalents		
Week	Vol. L	Effluent pH	Redox, mV (vs Ag/AgCI)	Conductivity µS/cm[1]	mg/l	mg/kg	Cum. mg/kg	Fe^2+ mg/l	Fe^3+ mg/l	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg
0	0.552	8.10	173	390	0.01	0.004	0.004	0.00	0.01	68.0	25.08	25.08	0	0.00	0.00	71	26.19	26.19
1	0.754	8.25	220	470	0.00	0.000	0.004	0.00	0.00	62.0	31.24	56.32	0	0.00	0.00	135	68.02	94.21
2	0.734	7.94	221	450	0.00	0.000	0.004	0.00	0.00	69.0	33.85	90.17	0	0.00	0.00	136	66.71	160.92
3	0.755	8.15	204	450	0.01	0.005	0.009	0.00	0.01	88.0	44.40	134.57	0	0.00	0.00	116	58.53	219.45
4	0.725	8.31	190	380	0.00	0.000	0.009	0.00	0.00	80.0	38.76	173.33	0	0.00	0.00	81	39.24	258.69
5	0.718	8.29	182	350	0.00	0.000	0.009	0.00	0.00	74.0	35.51	208.84	0	0.00	0.00	97	46.54	305.23
6	0.764	8.22	171	340	0.01	0.005	0.014	0.00	0.01	114.0	58.20	267.04	0	0.00	0.00	88	44.93	350.16
7	0.751	8.17	210	290	0.01	0.005	0.019	0.00	0.01	62.0	31.12	298.16	0	0.00	0.00	69	34.63	384.79
8	0.758	8.14	192	260	0.02	0.010	0.029	0.00	0.02	50.0	25.33	323.49	0	0.00	0.00	62	31.41	416.20
9	0.646	8.10	181	280	0.02	0.009	0.038	0.00	0.02	63.0	27.20	350.69	0	0.00	0.00	60	25.90	442.10
10	0.752	8.23	189	290	0.01	0.005	0.043	0.00	0.01	60.0	30.15	380.84	0	0.00	0.00	78	39.20	481.30
11	0.762	8.27	215	270	0.00	0.000	0.043	0.00	0.00	54.0	27.50	408.34	0	0.00	0.00	82	41.76	523.06
12	0.728	8.15	213	240	0.00	0.000	0.043	0.00	0.00	52.0	25.30	433.64	0	0.00	0.00	65	31.62	554.68
13	0.730	8.18	241	260	0.01	0.005	0.048	0.00	0.01	46.0	22.44	456.08	0	0.00	0.00	72	35.12	589.80
14	0.723	8.12	218	240	0.00	0.000	0.048	0.00	0.00	50.0	24.16	480.24	0	0.00	0.00	67	32.37	622.17
15	0.743	8.05	223	230	0.01	0.005	0.053	0.01	0.00	46.0	22.84	503.08	0	0.00	0.00	72	35.75	657.92
16	0.732	8.06	241	230	0.01	0.005	0.058	0.00	0.01	42.0	20.55	523.63	0	0.00	0.00	67	32.77	690.69
17	0.743	8.11	240	210	0.02	0.010	0.068	0.00	0.02	37.0	18.37	542.00	0	0.00	0.00	66	32.77	723.46
18	0.725	8.09	242	210	0.02	0.010	0.078	0.00	0.02	35.0	16.96	558.96	0	0.00	0.00	66	31.98	755.44
19	0.730	8.24	235	210	0.02	0.010	0.088	0.00	0.02	27.0	13.17	572.13	0	0.00	0.00	68	33.17	788.61
20	0.727	8.18	278	200	0.01	0.005	0.093	0.00	0.01	28.0	13.60	585.73	0	0.00	0.00	68	33.04	821.65
21	0.763	8.21	220	200	0.02	0.010	0.103	0.00	0.02	23.0	11.73	597.46	0	0.00	0.00	72	36.71	858.36
22	0.697	8.10	272	180	0.02	0.009	0.112	0.00	0.02	20.0	9.32	606.78	0	0.00	0.00	66	30.74	889.10
23	0.743	8.22	212	200	0.01	0.005	0.117	0.00	0.01	25.0	12.41	619.19	0	0.00	0.00	73	36.25	925.35
24	0.744	8.18	235	190	0.00	0.000	0.117	0.00	0.00	20.0	9.94	629.13	0	0.00	0.00	71	35.30	960.65
25	0.751	8.14	243	190	0.01	0.005	0.122	0.00	0.01	16.0	8.03	637.16	0	0.00	0.00	70	35.13	995.78
26	0.716	7.95	282	170	0.01	0.005	0.127	0.00	0.01	14.0	6.70	643.86	0	0.00	0.00	64	30.62	1026.40
27	0.737	8.06	267	180	0.01	0.005	0.132	0.00	0.01	16.0	7.88	651.74	0	0.00	0.00	65	32.01	1058.41
28	0.776	8.07	205	170	0.02	0.010	0.142	0.02	0.00	14.0	7.26	659.00	0	0.00	0.00	67	34.74	1093.15
29	0.678	8.01	218	180	0.05	0.023	0.165	0.00	0.05	16.0	7.25	666.25	0	0.00	0.00	65	29.45	1122.60
30	0.743	8.00	227	170	0.00	0.000	0.165	0.00	0.00	13.0	6.45	672.70	0	0.00	0.00	63	31.28	1153.88
31	0.756	8.07	189	150	0.01	0.005	0.170	0.00	0.01	11.0	5.56	678.26	0	0.00	0.00	61	30.82	1184.70
32	0.770	8.06	185	160	0.00	0.000	0.170	0.00	0.00	11.0	5.66	683.92	0	0.00	0.00	62	31.90	1216.60
33	0.679	8.14	196	180	0.02	0.009	0.179	0.00	0.02	14.0	6.35	690.27	0	0.00	0.00	64	29.04	1245.64
34	0.751	8.10	218	160	0.02	0.010	0.189	0.00	0.02	10.0	5.02	695.29	0	0.00	0.00	61	30.61	1276.25
35	0.805	8.09	193	160	0.02	0.011	0.200	0.00	0.02	8.0	4.30	699.59	0	0.00	0.00	56	30.13	1306.38
36	0.670	8.00	216	160	0.01	0.004	0.204	0.00	0.01	10.0	4.48	704.07	0	0.00	0.00	62	27.76	1334.14
37	0.764	8.04	199	150	0.02	0.010	0.214	0.00	0.02	10.0	5.11	709.18	0	0.00	0.00	59	30.12	1364.26
38	0.744	8.02	181	160	0.00	0.000	0.214	0.00	0.00	10.0	4.97	714.15	0	0.00	0.00	57	28.34	1392.60
39	0.761	8.18	173	160	0.02	0.010	0.224	0.00	0.02	9.0	4.58	718.73	0	0.00	0.00	56	28.48	1421.08
40	0.707	8.06	185	160	0.01	0.005	0.229	0.00	0.01	7.0	3.31	722.04	0	0.00	0.00	62	29.29	1450.37
41	0.753	8.09	176	148	0.00	0.000	0.229	0.00	0.00	7.0	3.52	725.56	0	0.00	0.00	56	28.18	1478.55
42	0.734	8.09	165	140	0.02	0.010	0.239	0.00	0.02	7.0	3.43	728.99	0	0.00	0.00	53	26.00	1504.55

[1] Conductivity originally reported in mS/cm. Reported in µS/cm after week 41.

Testing terminated after week 42.

Figure 27a.- Weekly Humidity Cell Analytical Results

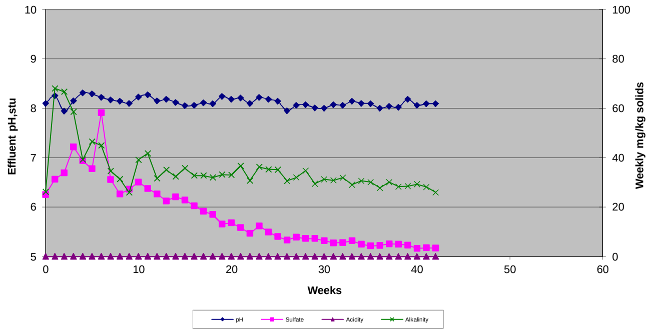


Figure 27b.- Cumulative Humidity Cell Analytical Results

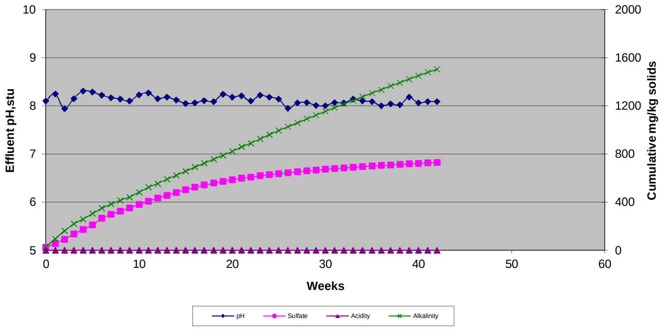


Table 28 . - Humidity Cell Analytical Results, Quartz Monzonite 5+ Comp Flotation Tailings (1.5106 Kg)

Week	Vol. L	Effluent pH	Redox, mV (vs Ag/AgCI)	Conductivity µS/cm[1)]	Total Fe mg/l	Total Fe mg/kg	Total Fe Cum. mg/kg	Fe^{2}+ mg/l	Fe^{3}+ mg/l	SO_4= mg/l	SO_4= mg/kg	SO_4= Cum. mg/kg	Acidity, $CaCO_3$ Equivalents mg/l	Acidity mg/kg	Acidity Cum. mg/kg	Alkalinity, $CaCO_3$ Equivalents mg/l	Alkalinity mg/kg	Alkalinity Cum. mg/kg
0	0.549	8.19	140	580	0.01	0.004	0.004	0.00	0.01	75.0	27.26	27.26	0	0.00	0.00	124	45.07	45.07
1	0.785	8.30	210	390	0.00	0.000	0.004	0.00	0.00	46.0	23.90	51.16	0	0.00	0.00	120	62.36	107.43
2	0.731	7.92	220	320	0.01	0.005	0.009	0.00	0.01	45.0	21.78	72.94	0	0.00	0.00	96	46.46	153.89
3	0.761	8.18	201	330	0.00	0.000	0.009	0.00	0.00	43.0	21.66	94.60	0	0.00	0.00	97	48.87	202.76
4	0.745	8.31	198	280	0.00	0.000	0.009	0.00	0.00	43.0	21.21	115.81	0	0.00	0.00	71	35.02	237.78
5	0.756	8.24	193	250	0.00	0.000	0.009	0.00	0.00	42.0	21.02	136.83	0	0.00	0.00	72	36.03	273.81
6	0.749	8.12	179	250	0.01	0.005	0.014	0.00	0.01	40.0	19.83	156.66	0	0.00	0.00	64	31.73	305.54
7	0.702	8.09	220	220	0.01	0.005	0.019	0.00	0.01	41.0	19.05	175.71	0	0.00	0.00	59	27.42	332.96
8	0.791	8.21	201	260	0.02	0.010	0.029	0.00	0.02	42.0	21.99	197.70	0	0.00	0.00	81	42.41	375.37
9	0.704	8.17	177	240	0.02	0.009	0.038	0.00	0.02	42.0	19.57	217.27	0	0.00	0.00	65	30.29	405.66
10	0.789	8.19	192	250	0.01	0.005	0.043	0.00	0.01	44.0	22.98	240.25	0	0.00	0.00	79	41.26	446.92
11	0.704	8.10	222	220	0.00	0.000	0.043	0.00	0.00	45.0	20.97	261.22	0	0.00	0.00	62	28.89	475.81
12	0.766	8.15	208	230	0.01	0.005	0.048	0.00	0.01	41.0	20.79	282.01	0	0.00	0.00	71	36.00	511.81
13	0.782	8.17	234	240	0.00	0.000	0.048	0.00	0.00	41.0	21.22	303.23	0	0.00	0.00	73	37.79	549.60
14	0.680	8.02	221	200	0.01	0.005	0.053	0.00	0.01	41.0	18.46	321.69	0	0.00	0.00	57	25.66	575.26
15	0.726	7.98	223	210	0.00	0.000	0.053	0.00	0.00	40.0	19.22	340.91	0	0.00	0.00	66	31.72	606.98
16	0.779	8.08	236	210	0.02	0.010	0.063	0.00	0.02	31.0	15.99	356.90	0	0.00	0.00	70	36.10	643.08
17	0.770	8.07	232	190	0.02	0.010	0.073	0.00	0.02	32.0	16.31	373.21	0	0.00	0.00	62	31.60	674.68
18	0.760	8.06	237	190	0.02	0.010	0.083	0.00	0.02	29.0	14.59	387.80	0	0.00	0.00	59	29.68	704.36
19	0.702	8.13	238	180	0.02	0.009	0.092	0.00	0.02	29.0	13.48	401.28	0	0.00	0.00	57	26.49	730.85
20	0.759	8.12	281	180	0.02	0.010	0.102	0.00	0.02	27.0	13.57	414.85	0	0.00	0.00	61	30.65	761.50
21	0.722	8.11	230	190	0.02	0.010	0.112	0.00	0.02	25.0	11.95	426.80	0	0.00	0.00	64	30.59	792.09
22	0.752	8.16	269	180	0.02	0.010	0.122	0.00	0.02	21.0	10.45	437.25	0	0.00	0.00	67	33.35	825.44
23	0.750	8.17	215	190	0.02	0.010	0.132	0.00	0.02	25.0	12.41	449.66	0	0.00	0.00	68	33.76	859.20
24	0.735	8.07	239	170	0.00	0.000	0.132	0.00	0.00	23.0	11.19	460.85	0	0.00	0.00	60	29.19	888.39
25	0.773	8.08	245	170	0.02	0.010	0.142	0.00	0.02	18.0	9.21	470.06	0	0.00	0.00	63	32.24	920.63
26	0.764	7.97	281	170	0.01	0.005	0.147	0.00	0.01	16.0	8.09	478.15	0	0.00	0.00	60	30.35	950.98
27	0.726	7.93	265	150	0.02	0.010	0.157	0.00	0.02	20.0	9.61	487.76	0	0.00	0.00	56	26.91	977.89
28	0.704	8.00	208	160	0.02	0.009	0.166	0.02	0.00	12.0	5.59	493.35	0	0.00	0.00	60	27.96	1005.85
29	0.775	7.97	223	160	0.05	0.026	0.192	0.00	0.05	15.0	7.70	501.05	0	0.00	0.00	57	29.24	1035.09
30	0.727	7.95	232	160	0.00	0.000	0.192	0.00	0.00	13.0	6.26	507.31	0	0.00	0.00	59	28.39	1063.48
31	0.746	8.00	195	150	0.01	0.005	0.197	0.00	0.01	14.0	6.91	514.22	0	0.00	0.00	55	27.16	1090.64
32	0.743	8.02	189	150	0.00	0.000	0.197	0.00	0.00	13.0	6.39	520.61	0	0.00	0.00	54	26.56	1117.20
33	0.735	8.08	197	150	0.02	0.010	0.207	0.00	0.02	15.0	7.30	527.91	0	0.00	0.00	55	26.76	1143.96
34	0.732	7.91	224	150	0.02	0.010	0.217	0.00	0.02	13.0	6.30	534.21	0	0.00	0.00	55	26.65	1170.61
35	0.742	8.02	191	140	0.02	0.010	0.227	0.00	0.02	10.0	4.91	539.12	0	0.00	0.00	52	25.54	1196.15
36	0.763	7.94	214	120	0.02	0.010	0.237	0.00	0.02	10.0	5.05	544.17	0	0.00	0.00	47	23.74	1219.89
37	0.729	7.98	201	130	0.01	0.005	0.242	0.00	0.01	13.0	6.27	550.44	0	0.00	0.00	51	24.61	1244.50
38	0.721	7.96	183	140	0.00	0.000	0.242	0.00	0.00	12.0	5.73	556.17	0	0.00	0.00	51	24.34	1268.84
39	0.792	8.06	181	130	0.05	0.026	0.268	0.03	0.02	11.0	5.77	561.94	0	0.00	0.00	50	26.21	1295.05
40	0.712	8.07	187	150	0.02	0.009	0.277	0.00	0.02	9.0	4.24	566.18	0	0.00	0.00	58	27.34	1322.39
41	0.734	8.06	177	147	0.00	0.000	0.277	0.00	0.00	8.0	3.89	570.07	0	0.00	0.00	54	26.24	1348.63
42	0.732	8.07	171	144	0.01	0.005	0.282	0.00	0.01	10.0	4.85	574.92	0	0.00	0.00	53	25.68	1374.31

[1)] Conductivity originally reported in mS/cm. Reported in µS/cm after week 41.

Testing terminated after week 42.

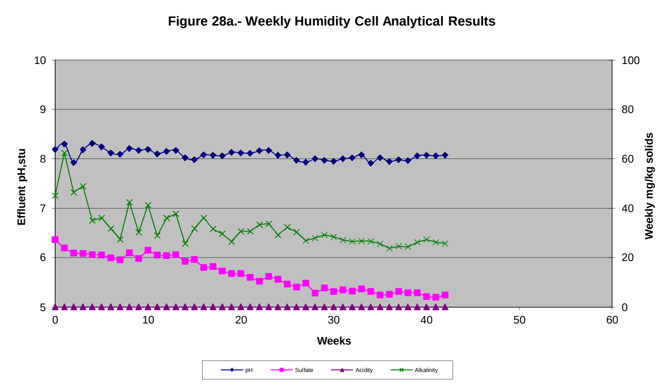


Figure 28a.- Weekly Humidity Cell Analytical Results

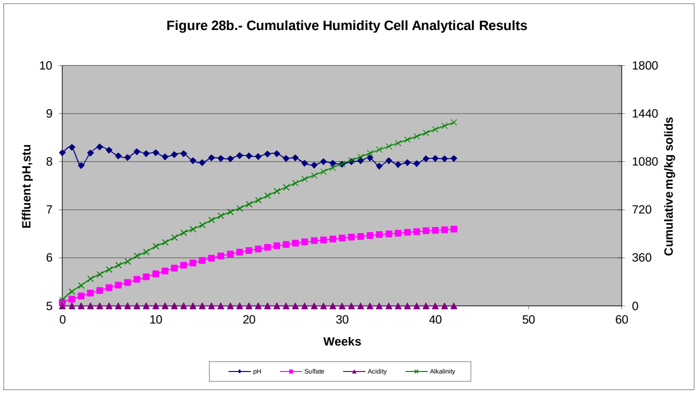


Figure 28b.- Cumulative Humidity Cell Analytical Results

Table 29 . - Humidity Cell Analytical Results, Biotite Breccia 0-5 Comp. Flotation Tailings (1.5047 Kg)

					Total Fe					SO$_4$=			Acidity, CaCO$_3$ Equivalents			Alkalinity, CaCO$_3$ Equivalents		
Week	Vol. L	Effluent pH	Redox, mV (vs Ag/AgCI)	Conductivity μS/cm[1]	mg/l	mg/kg	Cum. mg/kg	Fe^{2}+ mg/l	Fe^{3}+ mg/l	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg
0	0.460	7.93	164	900	0.04	0.012	0.012	0.00	0.04	200.0	61.14	61.14	0	0.00	0.00	86	26.29	26.29
1	0.873	8.11	207	420	0.00	0.000	0.012	0.00	0.00	65.0	37.71	98.85	0	0.00	0.00	82	47.57	73.86
2	0.685	7.76	223	440	0.01	0.005	0.017	0.00	0.01	115.0	52.35	151.20	0	0.00	0.00	77	35.05	108.91
3	0.776	7.96	210	450	0.00	0.000	0.017	0.00	0.00	140.0	72.20	223.40	0	0.00	0.00	54	27.85	136.76
4	0.740	8.06	203	340	0.00	0.000	0.017	0.00	0.00	85.0	41.80	265.20	0	0.00	0.00	45	22.13	158.89
5	0.666	7.96	202	280	0.00	0.000	0.017	0.00	0.00	60.0	26.56	291.76	0	0.00	0.00	47	20.80	179.69
6	0.797	8.01	180	270	0.00	0.000	0.017	0.00	0.00	50.0	26.48	318.24	0	0.00	0.00	52	27.54	207.23
7	0.773	7.97	228	200	0.01	0.005	0.022	0.00	0.01	35.0	17.98	336.22	0	0.00	0.00	47	24.15	231.38
8	0.603	7.98	202	180	0.02	0.008	0.030	0.00	0.02	30.0	12.02	348.24	0	0.00	0.00	44	17.63	249.01
9	0.724	8.07	181	200	0.02	0.010	0.040	0.00	0.02	34.0	16.36	364.60	0	0.00	0.00	52	25.02	274.03
10	0.807	8.06	197	190	0.01	0.005	0.045	0.00	0.01	30.0	16.09	380.69	0	0.00	0.00	58	31.11	305.14
11	0.713	7.96	229	160	0.00	0.000	0.045	0.00	0.00	24.0	11.37	392.06	0	0.00	0.00	50	23.69	328.83
12	0.777	8.01	211	150	0.01	0.005	0.050	0.00	0.01	20.0	10.33	402.39	0	0.00	0.00	49	25.30	354.13
13	0.649	7.98	245	170	0.01	0.004	0.054	0.00	0.01	23.0	9.92	412.31	0	0.00	0.00	52	22.43	376.56
14	0.752	8.04	224	160	0.00	0.000	0.054	0.00	0.00	22.0	10.99	423.30	0	0.00	0.00	55	27.49	404.05
15	0.683	7.89	235	160	0.00	0.000	0.054	0.00	0.00	21.0	9.53	432.83	0	0.00	0.00	55	24.97	429.02
16	0.825	7.94	245	160	0.01	0.005	0.059	0.00	0.01	18.0	9.87	442.70	0	0.00	0.00	55	30.16	459.18
17	0.692	7.95	234	140	0.02	0.009	0.068	0.00	0.02	17.0	7.82	450.52	0	0.00	0.00	49	22.53	481.71
18	0.752	7.90	245	160	0.01	0.005	0.073	0.00	0.01	17.0	8.50	459.02	0	0.00	0.00	52	25.99	507.70
19	0.677	8.02	243	150	0.02	0.009	0.082	0.00	0.02	18.0	8.10	467.12	0	0.00	0.00	52	23.40	531.10
20	0.714	8.03	285	160	0.01	0.005	0.087	0.00	0.01	18.0	8.54	475.66	0	0.00	0.00	56	26.57	557.67
21	0.835	8.01	233	160	0.02	0.011	0.098	0.00	0.02	16.0	8.88	484.54	0	0.00	0.00	57	31.63	589.30
22	0.713	7.98	272	140	0.01	0.005	0.103	0.00	0.01	13.0	6.16	490.70	0	0.00	0.00	50	23.69	612.99
23	0.692	8.00	219	150	0.01	0.005	0.108	0.00	0.01	19.0	8.74	499.44	0	0.00	0.00	53	24.37	637.36
24	0.727	8.02	241	140	0.00	0.000	0.108	0.00	0.00	17.0	8.21	507.65	0	0.00	0.00	53	25.61	662.97
25	0.724	7.97	249	160	0.01	0.005	0.113	0.00	0.01	14.0	6.74	514.39	0	0.00	0.00	57	27.43	690.40
26	0.710	7.90	283	150	0.00	0.000	0.113	0.00	0.00	13.0	6.13	520.52	0	0.00	0.00	55	25.95	716.35
27	0.811	7.90	268	150	0.01	0.005	0.118	0.00	0.01	14.0	7.55	528.07	0	0.00	0.00	56	30.18	746.53
28	0.678	7.89	214	140	0.02	0.009	0.127	0.02	0.00	14.0	6.31	534.38	0	0.00	0.00	52	23.43	769.96
29	0.792	7.92	226	160	0.01	0.005	0.132	0.00	0.01	14.0	7.37	541.75	0	0.00	0.00	57	30.00	799.96
30	0.698	7.87	236	150	0.00	0.000	0.132	0.00	0.00	13.0	6.03	547.78	0	0.00	0.00	53	24.59	824.55
31	0.720	7.94	198	150	0.01	0.005	0.137	0.00	0.01	13.0	6.22	554.00	0	0.00	0.00	57	27.27	851.82
32	0.787	7.93	189	140	0.00	0.000	0.137	0.00	0.00	13.0	6.80	560.80	0	0.00	0.00	56	29.29	881.11
33	0.640	7.98	200	160	0.01	0.004	0.141	0.00	0.01	16.0	6.81	567.61	0	0.00	0.00	58	24.67	905.78
34	0.793	7.92	224	150	0.02	0.011	0.152	0.00	0.02	13.0	6.85	574.46	0	0.00	0.00	56	29.51	935.29
35	0.780	7.99	186	150	0.01	0.005	0.157	0.00	0.01	11.0	5.70	580.16	0	0.00	0.00	56	29.03	964.32
36	0.706	7.92	215	150	0.01	0.005	0.162	0.00	0.01	13.0	6.10	586.26	0	0.00	0.00	56	26.28	990.60
37	0.734	7.96	202	150	0.01	0.005	0.167	0.00	0.01	15.0	7.32	593.58	0	0.00	0.00	57	27.80	1018.40
38	0.778	7.96	182	150	0.00	0.000	0.167	0.00	0.00	12.0	6.20	599.78	0	0.00	0.00	55	28.44	1046.84
39	0.784	8.05	180	140	0.03	0.016	0.183	0.00	0.03	11.0	5.73	605.51	0	0.00	0.00	54	28.14	1074.98
40	0.700	7.95	190	150	0.01	0.005	0.188	0.00	0.01	10.0	4.65	610.16	0	0.00	0.00	53	24.66	1099.64
41	0.765	7.98	184	152	0.00	0.000	0.188	0.00	0.00	13.0	6.61	616.77	0	0.00	0.00	55	27.96	1127.60
42	0.660	8.02	174	156	0.00	0.000	0.188	0.00	0.00	13.0	5.70	622.47	0	0.00	0.00	55	24.12	1151.72
43	0.772	7.98	184	132	0.01	0.005	0.193	0.00	0.01	13.0	6.67	629.14	0	0.00	0.00	53	27.19	1178.91
44	0.703	8.08	155	146	0.01	0.005	0.198	0.00	0.01	14.0	6.54	635.68	0	0.00	0.00	54	25.23	1204.14
45	0.800	7.90	193	146	0.00	0.000	0.198	0.00	0.00	13.0	6.91	642.59	0	0.00	0.00	53	28.18	1232.32
46	0.684	7.94	165	139	0.03	0.014	0.212	0.00	0.03	14.0	6.36	648.95	0	0.00	0.00	51	23.18	1255.50
47	0.759	7.86	169	138	0.01	0.005	0.217	0.00	0.01	11.0	5.55	654.50	0	0.00	0.00	54	27.24	1282.74
48	0.708	7.87	187	154	0.01	0.005	0.222	0.00	0.01	12.0	5.65	660.15	0	0.00	0.00	53	24.94	1307.68
49	0.769	7.93	165	149	0.02	0.010	0.232	0.00	0.02	12.0	6.13	666.28	0	0.00	0.00	54	27.60	1335.28
50	0.761	7.92	181	147	0.01	0.005	0.237	0.00	0.01	11.0	5.56	671.84	0	0.00	0.00	51	25.79	1361.07
51	0.667	7.86	172	143	0.00	0.000	0.237	0.00	0.00	12.0	5.32	677.16	0	0.00	0.00	49	21.72	1382.79
52	0.788	7.93	173	142	0.02	0.010	0.247	0.00	0.02	7.0	3.67	680.83	0	0.00	0.00	52	27.23	1410.02

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[1] Conductivity originally reported in mS/cm. Reported in μS/cm after week 40.

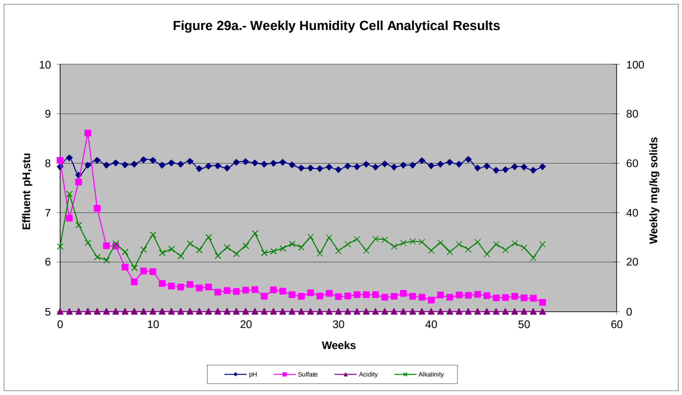
Figure 29a.- Weekly Humidity Cell Analytical Results

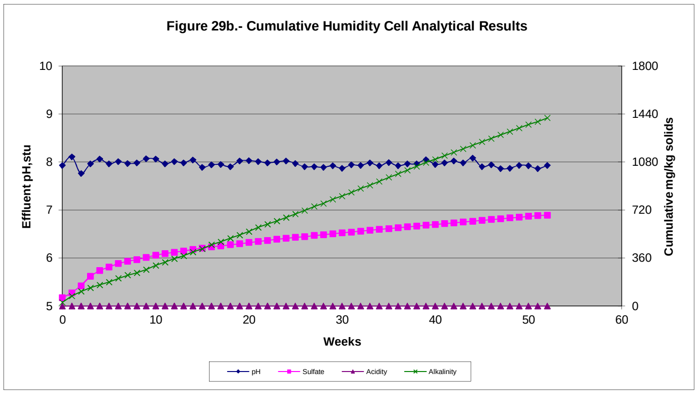
Figure 29b.- Cumulative Humidity Cell Analytical Results

Certifications: NV009332012A

Table 30 . - Humidity Cell Analytical Results, K-Spar Breccia 0-5 Comp. Flotation Tailings (1.4926 Kg)

					Total Fe					SO_4=			Acidity, $CaCO_3$ Equivalents			Alkalinity, $CaCO_3$ Equivalents		
	Vol.	Effluent	Redox, mV	Conductivity			Cum.	Fe^{2}+	Fe^{3}+			Cum.			Cum.			Cum.
Week	L	pH	(vs Ag/AgCl)	µS/cm[1]	mg/l	mg/kg	mg/kg	mg/l	mg/l	mg/l	mg/kg	mg/kg	mg/l	mg/kg	mg/kg	mg/l	mg/kg	mg/kg
0	0.483	7.86	196	870	0.01	0.003	0.003	0.00	0.01	215.0	69.57	69.57	0	0.00	0.00	63	20.39	20.39
1	0.854	8.10	194	510	0.00	0.000	0.003	0.00	0.00	130.0	74.38	143.95	0	0.00	0.00	80	45.77	66.16
2	0.550	7.83	205	370	0.01	0.004	0.007	0.00	0.01	59.0	21.74	165.69	0	0.00	0.00	105	38.69	104.85
3	0.610	8.01	207	520	0.00	0.000	0.007	0.00	0.00	105.0	42.91	208.60	0	0.00	0.00	62	25.34	130.19
4	0.701	8.13	205	330	0.00	0.000	0.007	0.00	0.00	55.0	25.83	234.43	0	0.00	0.00	85	39.92	170.11
5	0.744	8.20	180	250	0.00	0.000	0.007	0.00	0.00	15.0	7.48	241.91	0	0.00	0.00	83	41.37	211.48
6	0.737	8.10	181	240	0.00	0.000	0.007	0.00	0.00	15.0	7.41	249.32	0	0.00	0.00	77	38.02	249.50
7	0.739	8.12	235	220	0.00	0.000	0.007	0.00	0.00	15.0	7.43	256.75	0	0.00	0.00	74	36.64	286.14
8	0.739	8.12	206	200	0.02	0.010	0.017	0.00	0.02	10.0	4.95	261.70	0	0.00	0.00	72	35.65	321.79
9	0.738	8.13	181	200	0.01	0.005	0.022	0.00	0.01	17.0	8.41	270.11	0	0.00	0.00	70	34.61	356.40
10	0.737	8.07	204	190	0.01	0.005	0.027	0.00	0.01	16.0	7.90	278.01	0	0.00	0.00	68	33.58	389.98
11	0.755	8.12	229	180	0.01	0.005	0.032	0.00	0.01	16.0	8.09	286.10	0	0.00	0.00	68	34.40	424.38
12	0.832	8.24	199	160	0.01	0.006	0.038	0.00	0.01	14.0	7.80	293.90	0	0.00	0.00	64	35.67	460.05
13	0.726	8.11	245	200	0.00	0.000	0.038	0.00	0.00	34.0	16.54	310.44	0	0.00	0.00	61	29.67	489.72
14	0.616	8.30	178	100	0.01	0.004	0.042	0.00	0.01	15.0	6.19	316.63	0	0.00	0.00	30	12.38	502.10
15	0.619	7.57	219	40.0	0.00	0.000	0.042	0.00	0.00	1.0	0.41	317.04	0	0.00	0.00	16	6.64	508.74
16	0.597	7.91	225	210	0.02	0.008	0.050	0.00	0.02	49.0	19.60	336.64	0	0.00	0.00	43	17.20	525.94
17	0.583	7.78	212	40.0	0.02	0.008	0.058	0.00	0.02	4.0	1.56	338.20	0	0.00	0.00	19	7.42	533.36
18	0.628	8.63	185	50.0	0.04	0.017	0.075	0.01	0.03	3.0	1.26	339.46	0	0.00	0.00	22	9.26	542.62
19	0.540	8.11	175	210	0.02	0.007	0.082	0.00	0.02	49.0	17.73	357.19	0	0.00	0.00	45	16.28	558.90
20	0.676	8.13	247	180	0.02	0.009	0.091	0.00	0.02	31.0	14.04	371.23	0	0.00	0.00	55	24.91	583.81
21	0.752	8.16	223	160	0.02	0.010	0.101	0.00	0.02	21.0	10.58	381.81	0	0.00	0.00	54	27.21	611.02
22	0.615	8.13	237	130	0.02	0.008	0.109	0.00	0.02	12.0	4.94	386.75	0	0.00	0.00	45	18.54	629.56
23	0.666	8.14	205	180	0.01	0.004	0.113	0.00	0.01	23.0	10.26	397.01	0	0.00	0.00	59	26.33	655.89
24	0.729	8.17	209	160	0.00	0.000	0.113	0.00	0.00	19.0	9.28	406.29	0	0.00	0.00	57	27.84	683.73
25	0.738	8.04	247	170	0.01	0.005	0.118	0.00	0.01	15.0	7.42	413.71	0	0.00	0.00	61	30.16	713.89
26	0.719	8.29	245	90.0	0.01	0.005	0.123	0.00	0.01	9.0	4.34	418.05	0	0.00	0.00	37	17.82	731.71
27	0.774	8.00	258	180	0.01	0.005	0.128	0.00	0.01	15.0	7.78	425.83	0	0.00	0.00	66	34.22	765.93
28	0.781	8.01	211	150	0.02	0.010	0.138	0.02	0.00	14.0	7.33	433.16	0	0.00	0.00	60	31.39	797.32
29	0.712	7.98	223	160	0.01	0.005	0.143	0.00	0.01	14.0	6.68	439.84	0	0.00	0.00	57	27.19	824.51
30	0.751	7.97	232	160	0.00	0.000	0.143	0.00	0.00	12.0	6.04	445.88	0	0.00	0.00	59	29.69	854.20
31	0.714	7.99	196	140	0.01	0.005	0.148	0.00	0.01	11.0	5.26	451.14	0	0.00	0.00	56	26.79	880.99
32	0.752	8.01	187	150	0.00	0.000	0.148	0.00	0.00	12.0	6.05	457.19	0	0.00	0.00	56	28.21	909.20
33	0.754	8.04	196	160	0.01	0.005	0.153	0.00	0.01	13.0	6.57	463.76	0	0.00	0.00	59	29.80	939.00
34	0.742	7.97	199	130	0.03	0.015	0.168	0.00	0.03	9.0	4.47	468.23	0	0.00	0.00	50	24.86	963.86
35	0.713	8.01	190	130	0.01	0.005	0.173	0.00	0.01	9.0	4.30	472.53	0	0.00	0.00	51	24.36	988.22
36	0.701	7.93	211	120	0.02	0.009	0.182	0.00	0.02	11.0	5.17	477.70	0	0.00	0.00	46	21.60	1009.82
37	0.680	7.90	173	30.0	0.01	0.005	0.187	0.00	0.01	1.0	0.46	478.16	0	0.00	0.00	13	5.92	1015.74
38	0.750	8.02	178	170	0.00	0.000	0.187	0.00	0.00	21.0	10.55	488.71	0	0.00	0.00	56	28.14	1043.88
39	0.770	8.00	175	130	0.02	0.010	0.197	0.00	0.02	13.0	6.71	495.42	0	0.00	0.00	46	23.73	1067.61
40	0.662	7.97	191	130	0.01	0.004	0.201	0.00	0.01	10.0	4.44	499.86	0	0.00	0.00	48	21.29	1088.90
41	0.768	8.00	187	146	0.00	0.000	0.201	0.00	0.00	13.0	6.69	506.55	0	0.00	0.00	53	27.27	1116.17
42	0.734	8.07	172	137	0.01	0.005	0.206	0.00	0.01	11.0	5.41	511.96	0	0.00	0.00	50	24.59	1140.76
43	0.714	7.93	187	120	0.01	0.005	0.211	0.00	0.01	12.0	5.74	517.70	0	0.00	0.00	48	22.96	1163.72
44	0.728	8.08	154	134	0.01	0.005	0.216	0.00	0.01	12.0	5.85	523.55	0	0.00	0.00	51	24.87	1188.59
45	0.757	7.84	194	138	0.00	0.000	0.216	0.00	0.00	12.0	6.09	529.64	0	0.00	0.00	50	25.36	1213.95
46	0.712	7.90	167	131	0.02	0.010	0.226	0.00	0.02	9.0	4.29	533.93	0	0.00	0.00	49	23.37	1237.32
47	0.736	7.91	164	105	0.01	0.005	0.231	0.00	0.01	9.0	4.44	538.37	0	0.00	0.00	42	20.71	1258.03
48	0.664	7.88	174	147	0.01	0.004	0.235	0.00	0.01	14.0	6.23	544.60	0	0.00	0.00	50	22.24	1280.27
49	0.728	7.86	167	132	0.02	0.010	0.245	0.00	0.02	12.0	5.85	550.45	0	0.00	0.00	47	22.92	1303.19
50	0.752	7.92	182	136	0.00	0.000	0.245	0.00	0.00	9.0	4.53	554.98	0	0.00	0.00	48	24.18	1327.37
51	0.712	7.87	170	129	0.00	0.000	0.245	0.00	0.00	9.0	4.29	559.27	0	0.00	0.00	46	21.94	1349.31
52	0.719	7.93	174	133	0.03	0.014	0.259	0.00	0.03	7.0	3.37	562.64	0	0.00	0.00	49	23.60	1372.91

[1] Conductivity originally reported in mS/cm. Reported in µS/cm after week 40.

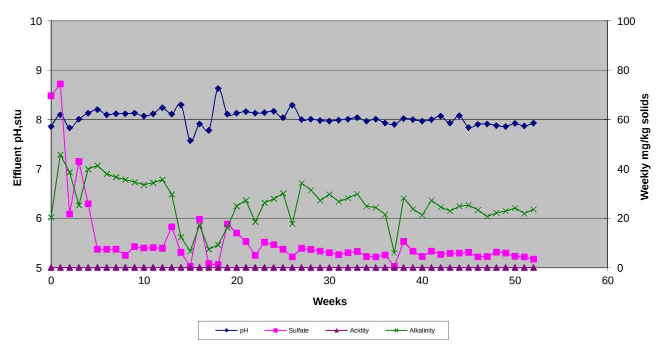

Figure 30a.- Weekly Humidity Cell Analytical Results

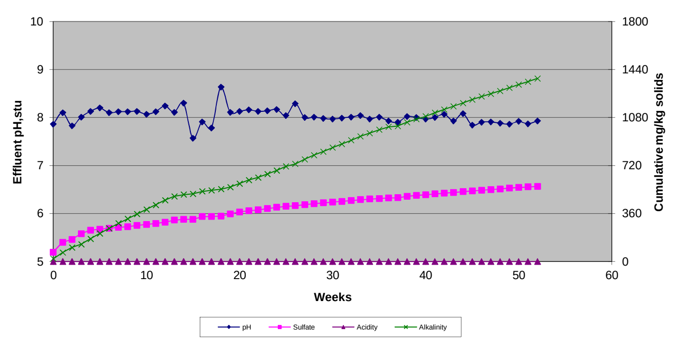

Figure 30b.- Cumulative Humidity Cell Analytical Results

Table 31 . - Humidity Cell Analytical Results, Quartz Monzonite 0-5 Comp. Flotation Tailings (1.4823 Kg)

					Total Fe					SO_4=			Acidity, $CaCO_3$ Equivalents			Alkalinity, $CaCO_3$ Equivalents		
Week	Vol. L	Effluent pH	Redox, mV (vs Ag/AgCl)	Conductivity µS/cm[1]	mg/l	mg/kg	Cum. mg/kg	Fe^{2}+ mg/l	Fe^{3}+ mg/l	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg
0	0.484	7.93	201	860	0.01	0.003	0.003	0.00	0.01	200.0	65.30	65.30	0	0.00	0.00	74	24.16	24.16
1	0.867	8.16	200	420	0.00	0.000	0.003	0.00	0.00	80.0	46.79	112.09	0	0.00	0.00	79	46.21	70.37
2	0.673	7.83	187	200	0.01	0.005	0.008	0.00	0.01	34.0	15.44	127.53	0	0.00	0.00	67	30.42	100.79
3	0.549	8.04	202	500	0.00	0.000	0.008	0.00	0.00	150.0	55.56	183.09	0	0.00	0.00	58	21.48	122.27
4	0.720	8.10	210	390	0.00	0.000	0.008	0.00	0.00	60.0	29.14	212.23	0	0.00	0.00	92	44.69	166.96
5	0.735	8.16	199	260	0.00	0.000	0.008	0.00	0.00	15.0	7.44	219.67	0	0.00	0.00	82	40.66	207.62
6	0.730	8.11	189	240	0.00	0.000	0.008	0.00	0.00	15.0	7.39	227.06	0	0.00	0.00	75	36.94	244.56
7	0.736	8.10	238	210	0.00	0.000	0.008	0.00	0.00	15.0	7.45	234.51	0	0.00	0.00	71	35.25	279.81
8	0.726	8.15	213	200	0.01	0.005	0.013	0.00	0.01	10.0	4.90	239.41	0	0.00	0.00	68	33.30	313.11
9	0.734	8.15	184	210	0.01	0.005	0.018	0.00	0.01	24.0	11.88	251.29	0	0.00	0.00	70	34.66	347.77
10	0.732	8.11	215	200	0.01	0.005	0.023	0.00	0.01	21.0	10.37	261.66	0	0.00	0.00	69	34.07	381.84
11	0.734	8.11	230	190	0.00	0.000	0.023	0.00	0.00	21.0	10.40	272.06	0	0.00	0.00	66	32.68	414.52
12	0.736	8.03	195	180	0.00	0.000	0.023	0.00	0.00	15.0	7.45	279.51	0	0.00	0.00	65	32.27	446.79
13	0.725	8.09	242	180	0.00	0.000	0.023	0.00	0.00	21.0	10.27	289.78	0	0.00	0.00	64	31.30	478.09
14	0.737	8.11	156	180	0.00	0.000	0.023	0.00	0.00	18.0	8.95	298.73	0	0.00	0.00	65	32.32	510.41
15	0.734	8.01	199	170	0.00	0.000	0.023	0.00	0.00	17.0	8.42	307.15	0	0.00	0.00	65	32.19	542.60
16	0.736	8.02	219	180	0.01	0.005	0.028	0.00	0.01	15.0	7.45	314.60	0	0.00	0.00	63	31.28	573.88
17	0.735	8.10	190	160	0.02	0.010	0.038	0.00	0.02	15.0	7.44	322.04	0	0.00	0.00	62	30.74	604.62
18	0.739	8.09	173	170	0.01	0.005	0.043	0.00	0.01	16.0	7.98	330.02	0	0.00	0.00	62	30.91	635.53
19	0.741	8.18	161	160	0.01	0.005	0.048	0.00	0.01	15.0	7.50	337.52	0	0.00	0.00	60	29.99	665.52
20	0.817	8.23	234	140	0.02	0.011	0.059	0.00	0.02	12.0	6.61	344.13	0	0.00	0.00	60	33.07	698.59
21	0.730	8.07	202	200	0.02	0.010	0.069	0.00	0.02	37.0	18.22	362.35	0	0.00	0.00	66	32.50	731.09
22	0.714	8.08	209	190	0.01	0.005	0.074	0.00	0.01	29.0	13.97	376.32	0	0.00	0.00	64	30.83	761.92
23	0.728	8.08	206	200	0.01	0.005	0.079	0.00	0.01	32.0	15.72	392.04	0	0.00	0.00	69	33.89	795.81
24	0.765	8.12	207	180	0.00	0.000	0.079	0.00	0.00	25.0	12.90	404.94	0	0.00	0.00	68	35.09	830.90
25	0.724	8.04	240	180	0.01	0.005	0.084	0.00	0.01	18.0	8.79	413.73	0	0.00	0.00	63	30.77	861.67
26	0.761	7.99	221	150	0.01	0.005	0.089	0.00	0.01	14.0	7.19	420.92	0	0.00	0.00	57	29.26	890.93
27	0.761	7.92	253	170	0.01	0.005	0.094	0.00	0.01	18.0	9.24	430.16	0	0.00	0.00	59	30.29	921.22
28	0.637	8.61	164	50.0	0.02	0.009	0.103	0.02	0.00	1.0	0.43	430.59	0	0.00	0.00	24	10.31	931.53
29	0.775	7.86	212	110	0.04	0.021	0.124	0.00	0.04	15.0	7.84	438.43	0	0.00	0.00	37	19.34	950.87
30	0.800	7.97	226	170	0.00	0.000	0.124	0.00	0.00	17.0	9.17	447.60	0	0.00	0.00	61	32.92	983.79
31	0.686	8.01	188	160	0.01	0.005	0.129	0.00	0.01	17.0	7.87	455.47	0	0.00	0.00	56	25.92	1009.71
32	0.704	7.99	188	150	0.00	0.000	0.129	0.00	0.00	17.0	8.07	463.54	0	0.00	0.00	56	26.60	1036.31
33	0.736	8.04	196	160	0.01	0.005	0.134	0.00	0.01	15.0	7.45	470.99	0	0.00	0.00	58	28.80	1065.11
34	0.699	8.07	170	40.0	0.02	0.009	0.143	0.00	0.02	1.0	0.47	471.46	0	0.00	0.00	21	9.90	1075.01
35	0.628	8.02	190	170	0.01	0.004	0.147	0.00	0.01	23.0	9.74	481.20	0	0.00	0.00	54	22.88	1097.89
36	0.694	7.68	200	30.0	0.02	0.009	0.156	0.00	0.02	1.0	0.47	481.67	0	0.00	0.00	16	7.49	1105.38
37	0.668	8.70	151	30.0	0.02	0.009	0.165	0.00	0.02	1.0	0.45	482.12	0	0.00	0.00	14	6.31	1111.69
38	0.793	8.02	179	210	0.00	0.000	0.165	0.00	0.00	35.0	18.72	500.84	0	0.00	0.00	63	33.70	1145.39
39	0.719	8.04	171	140	0.01	0.005	0.170	0.00	0.01	18.0	8.73	509.57	0	0.00	0.00	47	22.80	1168.19
40	0.667	7.86	188	80.0	0.02	0.009	0.179	0.00	0.02	8.0	3.60	513.17	0	0.00	0.00	29	13.05	1181.24
41	0.760	8.03	189	174	0.00	0.000	0.179	0.00	0.00	23.0	11.79	524.96	0	0.00	0.00	58	29.74	1210.98
42	0.731	8.09	174	163	0.01	0.005	0.184	0.00	0.01	16.0	7.89	532.85	0	0.00	0.00	57	28.11	1239.09
43	0.758	8.03	189	136	0.01	0.005	0.189	0.00	0.01	16.0	8.18	541.03	0	0.00	0.00	53	27.10	1266.19
44	0.705	8.14	153	146	0.02	0.010	0.199	0.00	0.02	16.0	7.61	548.64	0	0.00	0.00	52	24.73	1290.92
45	0.734	7.59	196	73.3	0.03	0.015	0.214	0.00	0.03	12.0	5.94	554.58	0	0.00	0.00	24	11.88	1302.80
46	0.724	7.98	163	164	0.02	0.010	0.224	0.00	0.02	23.0	11.23	565.81	0	0.00	0.00	56	27.35	1330.15
47	0.807	7.91	171	138	0.01	0.005	0.229	0.00	0.01	13.0	7.08	572.89	0	0.00	0.00	53	28.85	1359.00
48	0.650	7.88	168	150	0.01	0.004	0.233	0.00	0.01	16.0	7.02	579.91	0	0.00	0.00	50	21.93	1380.93
49	0.745	7.98	163	151	0.02	0.010	0.243	0.00	0.02	16.0	8.04	587.95	0	0.00	0.00	54	27.14	1408.07
50	0.716	7.96	166	145	0.00	0.000	0.243	0.00	0.00	12.0	5.80	593.75	0	0.00	0.00	49	23.67	1431.74
51	0.732	7.89	186	142	0.00	0.000	0.243	0.00	0.00	13.0	6.42	600.17	0	0.00	0.00	46	22.72	1454.46
52	0.738	8.06	182	145	0.04	0.020	0.263	0.00	0.04	11.0	5.48	605.65	0	0.00	0.00	51	25.39	1479.85

[1] Conductivity originally reported in mS/cm. Reported in µS/cm after week 40.

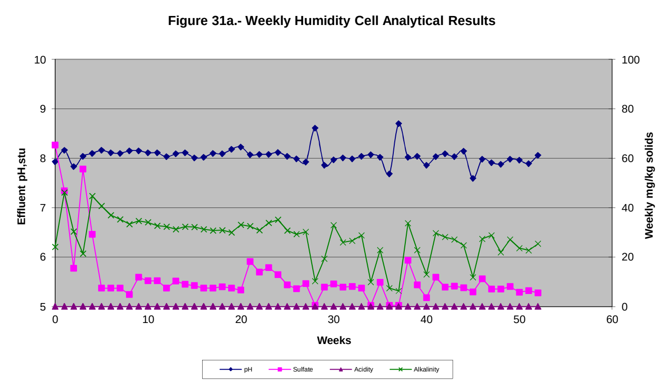
Figure 31a.- Weekly Humidity Cell Analytical Results

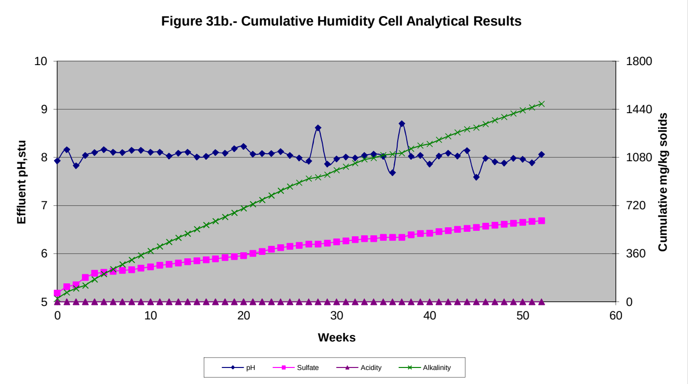
Figure 31b.- Cumulative Humidity Cell Analytical Results

Table . - Profile II Analytical Results, HC Extracts,
Copper Flat Project, Sample 604 673

	Extract Week							
Analysis, mg/L	Week 0	Week 1	Week 2	Week 4	Week 8	Week 12	Week 16	Week 20
Alkalinity, $CaCO_3$	76	70	67	52	31	8.0	6.1	4.7
CO_3, $CaCO_3$	5.9	2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	81	82	82	64	38	9.8	7.4	5.7
Aluminum	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium	<0.010	0.019	0.029	0.049	0.059	0.038	0.034	0.035
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	0.11	0.13	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	52	25	20	21	18	12	9.3	7.0
Chloride	17	1.5	<1.0	<1.0	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	3.2	2.0	1.6	1.1	0.54	0.34	0.32	0.33
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	7.6	4.0	3.2	3.3	2.4	1.5	1.2	0.95
Manganese	<0.0050	0.010	0.014	0.020	0.016	0.017	0.033	0.019
Mercury	0.00032	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	0.26	0.094	0.057	0.051	0.042	0.024	0.018	0.014
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	0.20	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	8.50	8.33	7.98	7.85	6.52	6.82	6.96	6.98
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	19	16	12	12	6.4	3.2	2.4	2.1
Scandium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium	0.010	0.0062	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	29	21	12	4.7	1.5	0.84	0.71	0.66
Strontium	0.38	0.23	0.19	0.19	0.16	0.10	<0.10	<0.10
Sulfate	140	60	38	32	31	31	26	20
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	350	190	140	150	110	56	48	62
Uranium	0.057	0.057	0.055	0.034	0.015	<0.010	<0.010	<0.010
Vanadium	0.017	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	4.97	2.90	2.09	1.83	1.33	0.84	0.66	0.51
Anions, meq/L	5.09	2.81	2.22	1.77	1.30	0.82	0.68	0.53
Balance, %	1.2	1.6	3.0	1.6	1.1	1.0	1.7	1.6
WET Lab Report #	1101435	1102063	1102168	1102331	1103402	1104345	1105313	1106342

Table . - Profile II Analytical Results, HC Extracts,
Copper Flat Project, Sample 604 673

	Extract Week							
Analysis, mg/L	Week 24	Week 28	Week 32	Week 36	Week 40	Week 44	Week 48	Week 52
Alkalinity, $CaCO_3$	2.0	1.5	<1.0	1.0	1.1	1.4	<1.0	<1.0
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	2.4	1.8	<1.0	1.3	1.3	1.7	<1.0	<1.0
Aluminum	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium	0.048	0.041	0.048	0.050	0.047	0.048	0.047	0.044
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0050	<0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	8.3	8.8	7.4	6.7	6.6	5.3	5.6	5.5
Chloride	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.13	0.097
Fluoride	0.43	0.55	0.55	0.51	0.49	0.40	0.40	0.41
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	1.1	1.2	1.0	0.98	0.89	0.74	0.78	0.79
Manganese	0.024	0.061	0.044	0.037	0.050	0.024	0.028	0.025
Mercury	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	0.018	0.015	0.015	0.016	0.015	0.012	<0.010	<0.010
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	6.35	6.22	6.14	6.06	6.29	6.33	5.89	5.92
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	2.2	1.9	1.8	1.5	1.5	1.2	1.4	1.2
Scandium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	0.73	0.74	0.55	<0.50	0.59	0.52	0.51	<0.50
Strontium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sulfate	28	29	23	22	19	14	16	15
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	29	51	47	38	40	28	62	32
Uranium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	0.010	<0.010	0.017	0.013	0.021	0.014	0.017	0.016
Cations, meq/L	0.59	0.62	0.52	0.46	0.47	0.38	0.41	0.37
Anions, meq/L	0.64	0.66	0.51	0.51	0.44	0.34	0.35	0.33
Balance, %	4.1	3.2	1.5	5.3	2.9	5.5	7.0	5.7
WET Lab Report #	1107281	1108216	1109159	1110123	1111082	1112047	1112489	1201427

Table . - Profile II Analytical Results, HC Extracts, Copper Flat Project, Sample 604 673

	Extract Week							
Analysis, mg/L	Week 56	Week 60	Week 64	Week 68	Week 72	Week 76	Week 80	Week 84
Alkalinity, CaCO$_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
CO$_3$, CaCO$_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO$_3$	1.2	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Aluminum	<0.045	<0.045	0.053	0.079	0.13	0.15	0.14	0.16
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.040	<0.0050
Barium	0.054	0.054	0.054	0.077	0.068	0.068	0.059	0.070
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012
Calcium	6.1	5.7	5.6	7.6	7.4	7.3	6.3	7.3
Chloride	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	0.20	0.24	0.36	0.55	0.77	0.87	0.93	1.2
Fluoride	0.32	0.37	0.31	0.31	0.39	0.52	0.54	0.40
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	<0.010	<0.010	<0.010	<0.010	<0.010	<0.050	0.018	0.017
Lead	<0.0025	<0.0025	<0.0025	<0.0025	0.0034	<0.0025	<0.0025	0.0027
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	0.92	0.83	0.81	1.1	1.0	1.0	0.90	1.0
Manganese	0.042	0.050	0.031	0.042	0.041	0.044	0.037	0.048
Mercury	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	<0.025	<0.025	<0.030	<0.030	<0.030	<0.025	<0.025	<0.025
pH, stu	5.46	5.96	5.70	5.44	5.42	5.41	4.92	5.17
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	1.2	0.92	0.90	1.1	<2.5	0.93	0.86	0.68
Scandium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.040	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.53	<0.50
Strontium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sulfate	18	18	22[1)]	25	23	27	28	28
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	35	43	18	55	35	52	58	51
Uranium	<0.010	<0.010	<0.0050	<0.0050	0.0078	0.0072	0.0096	0.014
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	0.028	0.031	0.030	0.046	0.044	0.048	0.040	0.050
Cations, meq/L	0.42	0.39	0.39	0.53	0.49	0.52	0.48	0.52
Anions, meq/L	0.41	0.41	0.41	0.54	0.50	0.59	0.61	0.60
Balance, %	<1.0	3.0	2.9	<1.0	<1.0	6.5	12	7.1
WET Lab Report #	1202374	1203479	1204385	1205361	1206343	1207261	1208181	1209076

1) Sulfate calculated from total sulfur result. The original sulfate analysis was higher than TDS result.

Table . - Profile II Analytical Results, HC Extracts,
Copper Flat Project, Sample 604 673

	Extract Week							
Analysis, mg/L	Week 88	Week 92	Week 96	Week 100	Week 104	Week 108	Week 112	Week 116
Alkalinity, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Aluminum	0.16	0.18	0.20	0.17	0.19	0.16	0.19	0.19
Antimony	<0.0025	<0.010	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.015
Barium	0.12	0.068	0.080	0.065	0.075	0.063	0.068	0.065
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.10	<0.10	<0.10	<0.100	<0.100	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	<0.0010	<0.0050	<0.0010
Calcium	8.4	6.7	7.7	6.0	7.2	6.2	7.2	7.0
Chloride	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	1.3	1.4	1.8	1.6	2.1	1.8	2.5	2.8
Fluoride	0.36	0.48	0.27	0.24	0.17	0.22	0.24	0.18
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	0.020	0.020	0.017	0.027	<0.010	<0.010	0.042	0.064
Lead	0.0026	0.0054	0.013	0.0091	0.011	0.0074	0.015	0.011
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	1.1	0.92	1.0	0.81	0.94	0.83	0.97	0.96
Manganese	0.051	0.048	0.051	0.041	0.050	0.041	0.052	0.053
Mercury	<0.00010	<0.0005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	5.31	5.49	5.29	5.11	5.64	4.83	4.95	4.71
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	1.0	0.84	0.88	0.82	0.82	0.72	0.72	0.71
Scandium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.100	<0.100	<0.100
Selenium	<0.0050	<0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.025
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	<0.50	<0.50	0.99	<0.50	<0.50	0.94	0.52	0.58
Strontium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sulfate	31	26	27	21	25	23	30	28
Thallium	<0.0010	<0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	63	34	65	74	48	32	60	59
Uranium	0.014	0.016	0.025	0.024	0.028	0.018	0.032	0.026
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	0.052	0.058	0.060	0.047	0.063	0.054	0.064	0.058
Cations, meq/L	0.60	0.50	0.62	0.46	0.55	0.51	0.59	0.59
Anions, meq/L	0.66	0.57	0.58	0.45	0.53	0.49	0.64	0.59
Balance, %	5.2	6.2	3.3	1.2	1.8	2.4	4.2	<1.0
WET Lab Report #	1210131	1211013	1211513	1212496	1301374	1302356	1303419	1304347

Table . - Profile II Analytical Results, HC Extracts,
Copper Flat Project, Sample 604 673

	Extract Week
Analysis, mg/L	Week 120
Alkalinity, $CaCO_3$	<1.0
CO_3, $CaCO_3$	<1.0
HCO_3	<1.0
Aluminum	0.20
Antimony	<0.010
Arsenic	<0.010
Barium	0.071
Beryllium	0.0010
Bismuth	<0.10
Boron	<0.10
Cadmium	0.0014
Calcium	7.7
Chloride	<1.00
Chromium	<0.0050
Cobalt	<0.010
Copper	3.3
Fluoride	0.18
Gallium	<0.10
Iron	0.065
Lead	0.017
Lithium	<0.10
Magnesium	1.0
Manganese	0.059
Mercury	<0.0002
Molybdenum	<0.010
Nickel	<0.010
Nitrate as N	<0.10
Nitrite as N	<0.025
pH, stu	4.79
Phosphorus	<0.50
Potassium	1.0
Scandium	<0.100
Selenium	<0.010
Silver	<0.0050
Sodium	<0.50
Strontium	<0.10
Sulfate	29
Thallium	<0.0020
Tin	<0.10
Titanium	<0.10
Total Dissolved Solids	66
Uranium	0.036
Vanadium	<0.010
Zinc	0.076
Cations, meq/L	0.63
Anions, meq/L	0.61
Balance, %	1.0
WET Lab Report #	1305351

Table . - Profile II Analytical Results, HC Extracts, Copper Flat Project, Sample CF-11-02 (0-27)

	Extract Week							
Analysis, mg/L	Week 0	Week 1	Week 2	Week 4	Week 8	Week 12	Week 16	Week 20
Alkalinity, $CaCO_3$	110	92	76	64	78	43	44	39
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	140	110	92	78	96	52	53	47
Aluminum	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	0.048	0.049
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.010
Barium	<0.010	<0.010	0.010	0.012	0.010	<0.010	<0.010	<0.010
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.10	<0.10	<0.10	0.20	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010
Calcium	40	32	25	24	32	20	16	19
Chloride	20	1.7	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	8.6	4.4	2.5	1.8	0.86	0.93	1.2	1.2
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	<0.010	<0.010	<0.010	<0.010	<0.050	<0.050	<0.050	<0.010
Lead	<0.0025	0.0028	0.0036	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	7.1	6.7	5.2	4.6	5.9	3.7	2.9	3.2
Manganese	0.031	0.12	0.064	0.043	0.061	0.035	0.028	0.028
Mercury	0.00037	0.00036	0.00032	0.00017	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	0.053	0.059	0.023	<0.010	<0.010	<0.010	0.011	<0.010
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	0.059	<0.030	<0.030	<0.030	<0.025	<0.025	<0.025	<0.025
pH, stu	8.16	7.45	7.93	7.97	7.35	7.79	7.67	7.55
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	18	15	11	8.9	7.0	3.5	2.4	2.2
Scandium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium	0.0099	0.011	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.010
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	48	18	7.4	2.8	1.6	0.72	0.62	0.53
Strontium	0.38	0.33	0.26	0.20	0.30	0.18	0.14	0.16
Sulfate	98	54	28	20	37	24	21	23
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	350	210	170	130	180	120	91	80
Uranium	0.014	0.027	0.020	0.014	0.0082	0.0067	<0.0050	<0.0050
Vanadium	<0.010	<0.010	<0.010	<0.010	0.011	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	5.13	3.32	2.28	1.93	2.33	1.42	1.13	1.30
Anions, meq/L	5.35	3.21	2.22	1.79	2.39	1.40	1.37	1.31
Balance, %	2.1	1.7	1.3	3.7	1.2	<1.0	9.5	<1.0
WET Lab Report #	1205220	1205362	1205478	1206157	1207066	1208040	1208599	1209549

Table . - Profile II Analytical Results, HC Extracts,
Copper Flat Project, Sample CF-11-02 (0-27)

	Extract Week							
Analysis, mg/L	Week 24	Week 28	Week 32	Week 36	Week 40	Week 44	Week 48	Week 52
Alkalinity, $CaCO_3$	44	38	44	43	61	40	38	39
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	15	<1.0	<1.0	<1.0
HCO_3	53	46	54	52	44	49	46	47
Aluminum	0.050	0.052	0.058	<0.045	0.048	0.052	0.060	0.054
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.10	<0.100	<0.100	<0.100	<0.100	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	18	16	17	18	17	17	16	16
Chloride	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	1.0	0.91	0.97	0.86	0.98	0.91	0.94	0.85
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	<0.010	<0.010	0.013	0.015	0.010	<0.010	0.013	0.014
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	3.2	2.9	3.0	3.0	2.8	2.6	2.6	2.6
Manganese	0.023	0.017	0.026	0.032	0.037	0.041	0.032	0.035
Mercury	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010
Molybdenum	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10
Nitrite as N	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.50	7.77	7.89	7.70	8.93	7.65	7.52	7.44
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	2.0	2.2	1.6	1.3	1.2	1.3	1.4	1.3
Scandium	<0.10	<0.1000	<0.10	<0.10	<0.10	<0.10	<0.100	<0.100
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	0.70	1.8	<0.50	<0.50	0.69	0.55	<0.50	0.60
Strontium	0.15	0.14	0.14	0.14	0.13	0.12	0.13	0.13
Sulfate	19	17	18	15	13	15	14	12
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	83	84	58	84	75	82	60	64
Uranium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	1.25	1.18	1.14	1.18	1.15	1.13	1.06	1.08
Anions, meq/L	1.32	1.16	1.31	1.21	1.54	1.16	1.09	1.06
Balance, %	2.6	<1.0	6.8	1.2	15	1.6	1.8	<1.0
WET Lab Report #	1210537	1211395	1212419	1301263	1302236	1303281	1304219	1305198

Table . - Profile II Analytical Results, HC Extracts,
Copper Flat Project, Sample CF-11-02 (0-27)

	Extract Week	
Analysis, mg/L	Week 56	Week 60
Alkalinity, $CaCO_3$	21	36
CO_3, $CaCO_3$	<1.0	<1.0
HCO_3	25	44
Aluminum	0.13	0.060
Antimony	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050
Barium	<0.010	<0.010
Beryllium	<0.0010	<0.0010
Bismuth	<0.10	<0.10
Boron	<0.10	<0.10
Cadmium	<0.0010	<0.0010
Calcium	13	16
Chloride	<1.00	<1.00
Chromium	<0.0050	<0.0050
Cobalt	<0.010	<0.010
Copper	<0.050	<0.050
Fluoride	0.79	0.87
Gallium	<0.10	<0.10
Iron	<0.010	0.012
Lead	<0.0025	<0.0025
Lithium	<0.10	<0.10
Magnesium	<0.50	2.4
Manganese	0.028	0.029
Mercury	<0.00010	<0.00010
Molybdenum	<0.010	<0.010
Nickel	<0.010	<0.010
Nitrate as N	<0.10	<0.10
Nitrite as N	<0.025	<0.025
pH, stu	6.99	7.47
Phosphorus	<0.50	<0.50
Potassium	0.50	0.87
Scandium	<0.100	<0.100
Selenium	<0.0050	<0.0050
Silver	<0.0050	<0.0050
Sodium	<0.50	<0.50
Strontium	<0.10	0.12
Sulfate	9.0	14
Thallium	<0.0010	<0.0010
Tin	<0.10	<0.10
Titanium	<0.10	<0.10
Total Dissolved Solids	42	70
Uranium	<0.0050	<0.0050
Vanadium	<0.010	<0.010
Zinc	<0.010	<0.010
Cations, meq/L	0.68	1.03
Anions, meq/L	0.64	1.06
Balance, %	2.9	1.5
WET Lab Report #	1306122	1307113

*Test Terminated after week 60.

Table . - Profile II Analytical Results, HC Extracts, Copper Flat Project, Sample CF-11-02 (367-408)

	Extract Week							
Analysis, mg/L	Week 0	Week 1	Week 2	Week 4	Week 8	Week 12	Week 16	Week 20
Alkalinity, $CaCO_3$	59	46	42	40	84	33	36	30
CO_3, $CaCO_3$	2.9	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	66	56	51	49	100	40	44	36
Aluminum	0.078	0.090	0.088	0.099	0.13	0.089	0.074	0.11
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010
Barium	<0.010	0.011	0.012	0.014	0.017	<0.010	0.015	<0.010
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.10	<0.10	<0.10	0.22	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	18	16	14	18	29	15	20	16
Chloride	32	3.4	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.079	<0.050
Fluoride	3.3	1.7	1.2	1.2	0.75	0.87	1.9	1.1
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	<0.010	<0.010	<0.010	<0.010	<0.010	<0.050	<0.010	<0.010
Lead	<0.0025	0.0027	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	2.1	1.9	1.5	1.9	2.7	1.3	1.5	0.94
Manganese	<0.0050	<0.0050	0.0071	0.0086	0.020	0.019	0.023	0.020
Mercury	0.00041	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	0.020	0.016	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	0.044	<0.030	<0.030	<0.030	<0.025	<0.025	0.11	<0.025
pH, stu	8.53	7.25	7.83	7.60	7.45	7.36	7.40	7.50
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	12	10	8.0	8.1	6.1	2.9	2.8	1.7
Scandium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium	<0.0050	0.0054	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	38	18	7.8	3.3	1.7	0.78	0.83	<0.50
Strontium	0.29	0.24	0.20	0.23	0.38	0.18	0.23	0.17
Sulfate	40	32	18	20	22	18	24	17
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	210	150	96	96	180	80	90	62
Uranium	<0.0050	0.0062	0.0075	0.0069	0.0058	<0.0050	<0.0050	<0.0050
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	3.04	2	1.38	1.42	1.91	0.97	1.24	0.93
Anions, meq/L	3.09	1.77	1.27	1.28	2.14	1.08	1.32	1.00
Balance, %	<1.0	6.2	3.9	5.0	5.5	5.0	3.1	3.6
WET Lab Report #	1205220	1205362	1205478	1206157	1207066	1208040	1208599	1209549

Table . - Profile II Analytical Results, HC Extracts, Copper Flat Project, Sample CF-11-02 (367-408)

	Extract Week							
Analysis, mg/L	Week 24	Week 28	Week 32	Week 36	Week 40	Week 44	Week 48	Week 52
Alkalinity, $CaCO_3$	29	23	30	28	25	25	23	20
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	36	28	37	34	31	31	28	25
Aluminum	0.10	0.14	0.12	0.084	0.12	0.15	0.14	0.12
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium	0.049	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.10	<0.100	<0.100	<0.100	<0.100	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	16	15	13	14	12	12	13	11
Chloride	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	0.056	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	1.0	1.0	0.97	0.91	0.91	0.89	0.86	0.71
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	<0.010	0.033	0.010	<0.010	<0.010	0.015	<0.010	0.016
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	0.83	0.69	0.53	<0.50	<0.50	<0.50	<0.50	<0.50
Manganese	0.022	0.022	0.022	0.021	0.023	0.029	0.024	0.028
Mercury	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10
Nitrite as N	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.69	7.54	7.40	7.41	7.61	7.52	7.28	7.16
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	1.4	1.8	1.1	0.85	<2.5	0.85	0.83	<2.5
Scandium	<0.10	<0.1000	<0.10	<0.10	<0.10	<0.10	<0.100	<0.100
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	0.58	1.4	<0.50	<0.50	0.51	<0.50	<0.50	<0.50
Strontium	0.15	0.15	0.12	0.12	<0.10	<0.10	<0.10	<0.10
Sulfate	17	16	8.7	7.8	8.1	6.8	7.5	7.5
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	63	89	45	48	45	54	51	45
Uranium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	0.94	0.93	0.74	0.73	0.64	0.64	0.69	0.56
Anions, meq/L	1.00	0.84	0.84	0.77	0.72	0.70	0.66	0.60
Balance, %	2.9	4.9	6.6	2.5	6.6	4.3	1.9	3.4
WET Lab Report #	1210537	1211395	1212419	1301263	1302236	1303281	1304219	1305198

Table . - Profile II Analytical Results, HC Extracts,
Copper Flat Project, Sample CF-11-02 (367-408)

	Extract Week	
Analysis, mg/L	Week 56	Week 60
Alkalinity, $CaCO_3$	39	18
CO_3, $CaCO_3$	<1.0	<1.0
HCO_3	47	22
Aluminum	<0.045	0.13
Antimony	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050
Barium	<0.010	<0.010
Beryllium	<0.0010	<0.0010
Bismuth	<0.10	<0.10
Boron	<0.10	<0.10
Cadmium	<0.0010	<0.0010
Calcium	20	9.6
Chloride	<1.00	<1.00
Chromium	<0.0050	<0.0050
Cobalt	<0.010	<0.010
Copper	<0.050	<0.050
Fluoride	0.94	0.71
Gallium	<0.10	<0.10
Iron	<0.010	<0.010
Lead	<0.0025	<0.0025
Lithium	<0.10	<0.10
Magnesium	3.1	<0.50
Manganese	0.035	0.023
Mercury	<0.00010	<0.00010
Molybdenum	<0.010	<0.010
Nickel	<0.010	<0.010
Nitrate as N	<0.10	<0.10
Nitrite as N	<0.025	<0.025
pH, stu	7.64	7.25
Phosphorus	<0.50	<0.50
Potassium	0.91	<0.50
Scandium	<0.100	<0.100
Selenium	<0.0050	<0.0050
Silver	<0.0050	<0.0050
Sodium	<0.50	<0.50
Strontium	0.16	<0.10
Sulfate	17	6.8
Thallium	<0.0010	<0.0010
Tin	<0.10	<0.10
Titanium	<0.10	<0.10
Total Dissolved Solids	64	48
Uranium	<0.0050	<0.0050
Vanadium	<0.010	<0.010
Zinc	<0.010	<0.010
Cations, meq/L	1.28	0.49
Anions, meq/L	1.17	0.54
Balance, %	4.2	4.4
WET Lab Report #	1306122	1307113

*Test Terminated after week 60.

Table . - Profile II Analytical Results, HC Extracts, Copper Flat Project Flotation Tailings, Sample CF-11-02 (227-367)

	Extract Week							
Analysis, mg/L	Week 0	Week 1	Week 2	Week 4	Week 8	Week 12	Week 16	Week 20
Alkalinity, $CaCO_3$	100	110	94	71	54	62	59	57
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	120	130	110	87	66	76	72	69
Aluminum	<0.22	0.069	<0.045	0.064	0.073	0.055	0.076	0.070
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0050	<0.0025
Arsenic	<0.0050	<0.0050	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.0050
Barium	0.022	0.049	0.068	0.083	0.049	0.055	0.044	0.044
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.10	0.14	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	22	23	30	30	22	23	20	19
Chloride	5.3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	3.5	1.8	1.5	1.6	1.6	1.6	1.5	1.5
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	<0.010	0.027	<0.010	<0.010	<0.050	<0.050	0.021	0.017
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	4.4	5.3	6.8	7.2	5.0	4.9	3.9	3.7
Manganese	<0.0050	0.030	<0.025	0.015	0.024	0.025	0.027	0.023
Mercury	0.0003	<0.00010	<0.00010	0.00016	<0.00010	<0.00010	0.0012	<0.00010
Molybdenum	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	0.069	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.78	7.78	7.60	7.61	7.66	7.75	7.81	7.75
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	22	17	16	12	7.5	6.0	4.8	4.3
Scandium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium	<0.0050	<0.0050	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	28	15	7.9	3.9	2.0	1.5	1.2	1.0
Strontium	0.22	0.24	0.30	0.29	0.22	0.21	0.20	0.18
Sulfate	46	33	51	49	35	24	17	12
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	250	180	190	160	110	120	100	92
Uranium	0.0091	0.017	0.025	0.030	0.016	0.012	0.0082	0.0068
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	3.24	2.68	2.81	2.57	1.80	1.78	1.50	1.42
Anions, meq/L	3.26	2.91	2.94	2.53	1.89	1.83	1.61	1.46
Balance, %	<1.0	4.1	2.3	<1.0	2.6	1.5	3.5	1.5
WET Lab Report #	1206505	1206646	1207080	1207417	1208332	1209232	1210284	1211156

Table . - Profile II Analytical Results, HC Extracts, Copper Flat Project Flotation Tailings, Sample CF-11-02 (227-367)

	Extract Week							
Analysis, mg/L	Week 24	Week 28	Week 32	Week 36	Week 40	Week 44	Week 48	Week 52
Alkalinity, $CaCO_3$	58	58	53	54	56	43	47	43
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	71	71	64	65	69	52	58	52
Aluminum	0.070	0.062	0.062	0.066	0.075	0.091	0.16	0.15
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0079
Barium	0.049	0.047	0.042	0.043	0.044	0.031	0.033	0.032
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.100	<0.100	<0.100	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	18	18	18	18	18	15	16	16
Chloride	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	1.1	1.1	1.1	1.0	1.1	0.94	0.96	0.85
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	0.054	<0.010	0.013	<0.010	0.018	<0.050	0.092	0.028
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	3.4	3.1	2.9	2.6	2.7	2.0	2.1	1.9
Manganese	0.038	0.027	0.025	0.029	0.029	0.019	0.022	0.030
Mercury	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	<0.10
Nitrite as N	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.85	7.84	7.75	7.80	7.77	7.70	7.86	7.78
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	3.8	3.3	2.9	2.7	2.7	2.2	2.1	2.1
Scandium	<0.10	<0.10	<0.10	<0.10	<0.100	<0.100	<0.100	<0.100
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	0.94	1.2	0.74	<0.50	1.6	<0.50	0.58	0.61
Strontium	0.19	0.17	0.16	0.16	0.16	0.12	0.14	0.13
Sulfate	8.4	6.9	5.9	5.4	4.3	3.7	3.5	3.1
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	86	77	80	67	76	57	69	63
Uranium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	0.019	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	1.33	1.30	1.25	1.19	1.27	0.98	1.07	1.05
Anions, meq/L	1.40	1.37	1.23	1.23	1.28	0.98	1.07	0.96
Balance, %	2.5	2.5	<1.0	1.7	<1.0	<1.0	<1.0	4.6
WET Lab Report #	1212123	1301048	1301483	1302487	1303567	1304490	1305511	1306471

Table . - Profile II Analytical Results, HC Extracts,
Copper Flat Project Flotation Tailings, Sample CF-11-02 (52-117)

	Extract Week							
Analysis, mg/L	Week 0	Week 1	Week 2	Week 4	Week 8	Week 12	Week 16	Week 20
Alkalinity, $CaCO_3$	110	98	83	65	48	53	49	48
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	130	120	100	79	58	64	59	58
Aluminum	0.055	0.083	<0.045	0.067	<0.20	0.045	0.055	0.054
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	0.0056	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium	<0.010	0.013	0.017	0.015	0.010	0.019	<0.010	<0.010
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.10	0.13	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	24	26	32	31	22	23	20	19
Chloride	9.5	1.4	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	0.051	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	3.9	1.9	1.6	1.6	1.3	1.3	1.3	1.2
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	<0.010	0.042	<0.010	0.013	<0.050	<0.010	0.018	0.014
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	4.0	4.8	5.8	5.6	3.5	3.4	2.8	2.5
Manganese	<0.0050	0.0093	0.013	0.019	0.022	0.022	0.027	0.026
Mercury	0.00027	0.00021	0.00017	<0.0002	<0.00010	<0.00010	0.00026	<0.00010
Molybdenum	0.013	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	0.064	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.84	7.79	7.54	7.43	7.67	7.71	7.78	7.69
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	29	24	21	15	8.1	6.0	4.9	4.2
Scandium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	36	21	9.6	4.3	1.8	1.4	1.2	0.94
Strontium	0.24	0.24	0.29	0.27	0.18	0.17	0.16	0.14
Sulfate	67	58	72	59	36	25	22	16
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	300	200	210	170	120	89	92	89
Uranium	0.015	0.025	0.027	0.032	0.021	0.021	0.017	0.014
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	3.84	3.23	3.03	2.59	1.67	1.65	1.41	1.31
Anions, meq/L	4.00	3.31	3.22	2.61	1.77	1.64	1.49	1.35
Balance, %	2.0	1.3	3.1	<1.0	2.8	<1.0	2.7	1.4
WET Lab Report #	1206505	1206646	1207080	1207417	1208332	1209232	1210284	1211156

Table . - Profile II Analytical Results, HC Extracts,
Copper Flat Project Flotation Tailings, Sample CF-11-02 (52-117)

	Extract Week				
Analysis, mg/L	Week 24	Week 28	Week 32	Week 36	Week 40*
Alkalinity, $CaCO_3$	55	50	48	45	46
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	67	61	59	55	57
Aluminum	0.054	0.048	0.050	0.054	0.056
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium	0.011	<0.010	<0.010	<0.010	<0.010
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.100	<0.100	<0.100	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	20	18	18	17	18
Chloride	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	1.0	0.92	0.95	0.82	0.85
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	0.012	<0.010	0.012	<0.010	0.013
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	2.4	2.0	1.8	1.5	1.5
Manganese	0.032	0.028	0.025	0.024	0.024
Mercury	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.74	7.77	7.74	7.75	7.66
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	3.8	3.0	2.9	2.6	2.4
Scandium	<0.10	<0.10	<0.10	<0.10	<0.100
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	1.0	0.98	0.76	<0.50	1.4
Strontium	0.16	0.13	0.12	0.12	0.12
Sulfate	12	10	7.4	7.6	6.6
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	100	86	68	59	68
Uranium	0.013	0.013	0.0098	0.0077	0.0065
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	1.34	1.19	1.16	1.05	1.15
Anions, meq/L	1.40	1.26	1.17	1.10	1.12
Balance, %	2.1	2.8	<1.0	2.7	1.6
WET Lab Report #	1212123	1301048	1301483	1302487	1303567

*Testing terminated after week 40

Table . - Profile II Analytical Results, HC Extracts, Copper Flat Project Flotation Tailings, Sample K-Spar Breccia 5+ Comp

	Extract Week							
Analysis, mg/L	Week 0	Week 1	Week 2	Week 4	Week 8	Week 12	Week 16	Week 20
Alkalinity, $CaCO_3$	120	120	120	96	79	70	68	63
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	150	140	140	120	96	85	83	76
Aluminum	<0.045	<0.045	<0.045	0.050	<0.045	<0.045	<0.045	<0.045
Antimony	0.0033	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.010	<0.0050	<0.0050
Barium	0.013	0.082	0.10	0.083	0.061	0.076	0.080	0.078
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.10	0.11	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	56	27	31	41	39	38	38	33
Chloride	11	1.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	3.3	2.2	1.6	1.5	1.4	1.3	1.3	1.3
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.011
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	15	7.7	8.6	11	8.0	6.5	5.5	4.3
Manganese	<0.0050	0.011	0.032	0.034	0.044	0.047	0.055	0.051
Mercury	<0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0005	<0.00010
Molybdenum	0.24	0.13	0.054	0.059	0.050	0.042	0.044	0.042
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	<0.25	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.94	8.03	7.89	7.78	7.88	7.84	7.95	7.80
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	36	23	22	16	7.4	4.8	4.2	3.6
Scandium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium	0.0091	<0.0050	<0.010	<0.0050	<0.0050	<0.010	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	42	20	8.4	2.5	1.4	1.2	2.2	0.98
Strontium	2.2	1.0	1.2	1.5	1.2	1.0	1.0	0.74
Sulfate	210	52	52	72	70	56	58	45
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	520	210	200	220	200	170	160	140
Uranium	0.13	0.11	0.12	0.13	0.087	0.059	0.049	0.035
Vanadium	0.026	<0.050	0.011	0.014	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	6.78	3.44	3.18	3.48	2.86	2.61	2.55	2.14
Anions, meq/L	7.31	3.52	3.46	3.54	3.10	2.63	2.64	2.25
Balance, %	3.8	1.2	4.2	<1.0	4.2	<1.0	1.6	2.6
WET Lab Report #	1206505	1206646	1207080	1207417	1208332	1209232	1210284	1211156

Table . - Profile II Analytical Results, HC Extracts,
Copper Flat Project Flotation Tailings, Sample K-Spar Breccia 5+ Comp

	Extract Week							
Analysis, mg/L	Week 24	Week 28	Week 32	Week 36	Week 40	Week 44	Week 48	Week 52
Alkalinity, $CaCO_3$	65	60	50	57	58	55	56	51
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	79	73	61	70	70	67	68	62
Aluminum	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0054
Barium	0.091	0.090	0.078	0.11	0.12	0.14	0.16	0.16
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.100	<0.100	<0.100	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	36	31	28	32	31	29	28	26
Chloride	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	1.2	1.1	1.1	1.1	1.2	1.3	1.3	1.4
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	4.3	3.2	2.6	2.7	2.5	2.1	1.9	1.7
Manganese	0.065	0.052	0.038	0.051	0.049	0.045	0.042	0.044
Mercury	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	0.051	0.043	0.044	0.049	0.046	0.052	0.050	0.053
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	<0.10
Nitrite as N	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.84	7.86	7.75	7.85	7.79	7.90	7.87	7.98
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	3.4	2.7	2.4	2.6	2.5	2.3	2.3	2.3
Scandium	<0.10	<0.10	<0.10	<0.10	<0.100	<0.100	<0.100	<0.100
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	1.0	1.1	0.84	<0.50	1.6	0.78	0.82	0.72
Strontium	0.90	0.66	0.55	0.62	0.57	0.50	0.49	0.45
Sulfate	55	37	30	34	33	24	22	19
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	170	140	86	100	120	110	110	98
Uranium	0.030	0.023	0.013	0.019	0.017	0.015	0.015	0.012
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	2.28	1.93	1.71	1.89	1.89	1.71	1.65	1.53
Anions, meq/L	2.50	2.02	1.68	1.91	1.90	1.67	1.64	1.49
Balance, %	4.6	2.4	<1.0	<1.0	<1.0	1.4	<1.0	1.4
WET Lab Report #	1212123	1301048	1301483	1302487	1303567	1304490	1305511	1306471

Table . - Profile II Analytical Results, HC Extracts, Copper Flat Project Flotation Tailings, Sample Biotite Breccia 5+ Comp

	Extract Week							
Analysis, mg/L	Week 0	Week 1	Week 2	Week 4	Week 8	Week 12	Week 16	Week 20
Alkalinity, $CaCO_3$	72	150	150	86	63	64	66	67
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	87	180	180	100	77	78	81	82
Aluminum	0.098	<0.045	<0.045	0.065	0.057	<0.045	0.050	0.047
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium	0.038	0.032	0.076	0.067	0.066	0.069	0.078	0.082
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.10	0.11	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	21	25	36	35	27	29	27	26
Chloride	12	2.4	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	2.6	3.2	2.2	2.3	1.9	1.8	1.8	1.9
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	0.036	<0.010	<0.010	<0.010	<0.050	<0.010	0.014	<0.010
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	4.6	8.2	12	11	7.8	7.8	6.3	5.8
Manganese	0.012	0.028	0.024	0.022	0.027	0.034	0.039	0.041
Mercury	<0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00012	<0.00010
Molybdenum	0.020	0.019	<0.010	0.015	0.016	0.011	0.010	0.011
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	0.071	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.74	8.05	7.97	7.78	7.87	7.83	7.96	7.89
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	32	42	36	20	8.4	6.0	4.8	4.2
Scandium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	24	24	9.9	3.1	1.5	1.1	1.7	0.87
Strontium	0.42	0.61	0.89	0.73	0.52	0.51	0.46	0.38
Sulfate	62	55	65	72	53	47	35	27
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	240	250	260	190	150	120	130	120
Uranium	0.013	0.028	0.038	0.039	0.019	0.013	0.011	0.0097
Vanadium	<0.010	0.012	0.013	0.016	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	3.30	4.04	4.14	3.31	2.28	2.29	2.07	1.93
Anions, meq/L	3.19	4.33	4.42	3.26	2.47	2.35	2.15	2.01
Balance, %	1.7	3.5	3.3	<1.0	4.0	1.3	1.9	2.0
WET Lab Report #	1206505	1206646	1207080	1207417	1208332	1209232	1210284	1211156

Table . - Profile II Analytical Results, HC Extracts, Copper Flat Project Flotation Tailings, Sample Biotite Breccia 5+ Comp

	Extract Week				
Analysis, mg/L	Week 24	Week 28	Week 32	Week 36	Week 40*
Alkalinity, $CaCO_3$	70	69	62	62	63
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	86	84	76	76	77
Aluminum	0.049	0.048	<0.045	<0.045	<0.045
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium	0.080	0.068	0.073	0.073	0.072
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.100	<0.100	<0.100	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	24	23	23	22	22
Chloride	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	1.5	1.5	1.5	1.4	1.5
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	0.012	0.016	<0.050	<0.010	<0.010
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	5.1	4.5	4.1	3.6	3.6
Manganese	0.046	0.046	0.045	0.052	0.054
Mercury	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	0.012	<0.010	<0.010	<0.010	<0.010
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.92	7.93	7.89	7.90	7.86
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	3.7	2.9	2.7	2.5	2.3
Scandium	<0.10	<0.10	<0.10	<0.10	<0.100
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	0.84	0.85	0.61	<0.50	1.3
Strontium	0.41	0.31	0.28	0.26	0.24
Sulfate	18	13	11	10	8.6
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	110	100	98	90	96
Uranium	0.0075	0.0065	0.0064	0.0070	0.0063
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	1.76	1.64	1.58	1.46	1.51
Anions, meq/L	1.86	1.73	1.55	1.53	1.52
Balance, %	3.0	2.7	<1.0	2.3	<1.0
WET Lab Report #	1212123	1301048	1301483	1302487	1303567

*Testing terminated after week 40

Table . - Profile II Analytical Results, HC Extracts,
Copper Flat Project Flotation Tailings, Sample Quartz Monzonite 5+ Comp

	Extract Week							
Analysis, mg/L	Week 0	Week 1	Week 2	Week 4	Week 8	Week 12	Week 16	Week 20
Alkalinity, $CaCO_3$	130	130	100	76	82	71	70	60
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	160	160	130	92	100	86	85	73
Aluminum	0.057	<0.045	<0.045	0.073	<0.045	<0.045	<0.045	<0.045
Antimony	0.0037	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium	<0.010	0.062	0.087	0.10	0.11	0.12	0.11	0.099
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	32	20	21	23	27	28	26	23
Chloride	11	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	5.0	2.5	2.1	2.0	1.7	1.5	1.6	1.6
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	<0.010	<0.050	<0.010	<0.010	<0.010	<0.010	<0.010	0.011
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	7.8	5.2	5.5	6.2	6.7	7.1	6.1	5.3
Manganese	<0.0050	<0.0050	0.013	0.0071	0.014	0.020	0.021	0.020
Mercury	0.00014	0.00016	0.00033	0.00045	<0.00010	<0.00010	0.00015	<0.00010
Molybdenum	0.21	0.099	0.057	0.056	0.064	0.069	0.066	0.079
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	0.066	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	8.00	8.11	7.78	7.74	7.96	7.89	8.00	7.82
Phosphorus	0.54	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	39	27	25	20	11	7.0	5.3	4.1
Scandium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	55	30	16	4.8	2.3	1.7	2.0	1.2
Strontium	1.1	0.71	0.78	0.82	0.91	0.91	0.83	0.64
Sulfate	92	40	41	40	39	36	27	26
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	370	200	180	150	160	120	120	120
Uranium	0.031	0.041	0.040	0.049	0.052	0.041	0.030	0.022
Vanadium	0.012	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	5.64	3.42	2.84	2.39	2.28	2.24	2.02	1.74
Anions, meq/L	5.11	3.59	3.09	2.45	2.54	2.24	2.04	1.82
Balance, %	4.9	2.4	4.4	1.2	5.4	<1.0	<1.0	2.2
WET Lab Report #	1206505	1206646	1207080	1207417	1208332	1209232	1210284	1211156

Table . - Profile II Analytical Results, HC Extracts, Copper Flat Project Flotation Tailings, Sample Quartz Monzonite 5+ Comp

	Extract Week				
Analysis, mg/L	Week 24	Week 28	Week 32	Week 36	Week 40*
Alkalinity, $CaCO_3$	60	62	55	47	59
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	73	75	67	58	72
Aluminum	<0.045	<0.045	<0.045	<0.045	<0.045
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium	0.11	0.11	0.11	0.10	0.13
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.100	<0.100	<0.100	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	21	21	20	17	21
Chloride	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	1.2	1.1	1.2	0.87	1.2
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	<0.010	<0.010	<0.010	<0.010	<0.050
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	4.7	4.4	4.0	3.0	3.6
Manganese	0.023	0.025	0.020	0.023	0.023
Mercury	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	0.069	0.055	0.059	0.052	0.052
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.83	7.89	7.84	7.80	7.90
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	3.4	2.8	2.5	2.2	2.3
Scandium	<0.10	<0.10	<0.10	<0.10	<0.100
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	1.1	1.2	0.91	<0.50	1.4
Strontium	0.70	0.57	0.52	0.43	0.48
Sulfate	20	15	13	11	10
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	110	94	86	77	90
Uranium	0.017	0.015	0.013	0.0092	0.010
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	1.57	1.53	1.43	1.15	1.46
Anions, meq/L	1.68	1.60	1.43	1.23	1.45
Balance, %	3.3	2.1	<1.0	3.1	<1.0
WET Lab Report #	1212123	1301048	1301483	1302487	1303567

*Testing terminated after week 40

Table . - Profile II Analytical Results, HC Extracts, Copper Flat Project Flotation Tailings, Sample Biotite Breccia (0-5) Comp

	Extract Week							
Analysis, mg/L	Week 0	Week 1	Week 2	Week 4	Week 8	Week 12	Week 16	Week 20
Alkalinity, $CaCO_3$	91	90	85	46	45	49	55	55
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	110	110	100	56	54	59	67	67
Aluminum	0.048	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium	0.018	0.016	0.038	0.032	0.030	0.047	0.063	0.079
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.10	0.13	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	72	31	47	37	22	20	20	21
Chloride	45	6.4	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	2.5	1.9	1.4	1.4	1.7	1.7	1.7	1.8
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	0.013	0.014	<0.010	<0.010	<0.050	<0.010	<0.010	0.019
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	7.9	4.7	7.5	6.3	4.0	4.2	4.1	4.3
Manganese	0.0085	0.031	0.025	0.017	0.015	0.015	0.014	0.018
Mercury	0.00011	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	0.18	0.14	0.072	0.042	0.034	0.023	0.020	0.022
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	1.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	0.30	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.75	7.76	7.64	7.27	7.61	7.70	7.87	7.78
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	29	17	18	9.6	5.0	3.6	3.1	2.6
Scandium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	72	29	12	3.5	1.6	1.0	1.2	0.71
Strontium	1.3	0.51	0.83	0.61	0.36	0.34	0.34	0.31
Sulfate	200	72	110	86	36	20	18	18
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	610	220	300	160	110	75	83	98
Uranium	0.030	0.039	0.032	0.037	0.032	0.036	0.040	0.041
Vanadium	0.013	<0.010	<0.010	<0.050	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	8.12	3.63	3.95	2.76	1.62	1.48	1.47	1.50
Anions, meq/L	7.45	3.58	4.00	2.78	1.72	1.47	1.56	1.57
Balance, %	4.3	<1.0	<1.0	<1.0	3.0	<1.0	3.1	2.2
WET Lab Report #	1206505	1206646	1207080	1207417	1208332	1209232	1210284	1211156

Table . - Profile II Analytical Results, HC Extracts,
Copper Flat Project Flotation Tailings, Sample Biotite Breccia (0-5) Comp

	Extract Week							
Analysis, mg/L	Week 24	Week 28	Week 32	Week 36	Week 40	Week 44	Week 48	Week 52
Alkalinity, $CaCO_3$	53	54	56	57	54	54	56	54
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	65	65	69	69	65	66	68	66
Aluminum	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050
Barium	0.071	0.076	0.092	0.097	0.099	0.10	0.11	0.12
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.100	<0.100	<0.100	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	19	19	21	20	20	20	21	22
Chloride	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	1.5	1.4	1.6	1.4	1.4	1.2	1.4	1.5
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	0.011	0.010	<0.010	<0.010	<0.010	<0.050	<0.010	0.018
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	4.0	4.0	4.3	3.8	3.8	3.9	4.0	4.1
Manganese	0.020	0.023	0.022	0.024	0.021	0.021	0.021	0.031
Mercury	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	0.021	0.015	0.015	0.014	0.012	<0.050	<0.050	0.016
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	<0.10
Nitrite as N	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.81	7.81	7.83	7.85	7.76	7.88	7.86	8.01
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	2.3	1.8	1.8	1.7	1.5	1.5	1.4	1.5
Scandium	<0.10	<0.10	<0.10	<0.10	<0.100	<0.100	<0.100	<0.100
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	0.67	0.72	0.52	<0.50	<2.5	<0.50	<0.50	0.68
Strontium	0.29	0.27	0.30	0.29	0.26	0.27	0.26	0.27
Sulfate	15	13	13	13	12	11	12	10
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	84	88	98	90	80	77	78	76
Uranium	0.034	0.034	0.031	0.028	0.023	0.023	0.022	0.019
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	1.37	1.36	1.47	1.36	1.35	1.36	1.41	1.51
Anions, meq/L	1.46	1.41	1.49	1.48	1.39	1.37	1.44	1.37
Balance, %	3.2	1.9	<1.0	4.2	1.4	<1.0	<1.0	4.7
WET Lab Report #	1212123	1301048	1301483	1302487	1303567	1304490	1305511	1306471

Table . - Profile II Analytical Results, HC Extracts, Copper Flat Project Flotation Tailings, Sample K-spar Breccia (0-5) Comp

	Extract Week							
Analysis, mg/L	Week 0	Week 1	Week 2	Week 4	Week 8	Week 12	Week 16	Week 20
Alkalinity, $CaCO_3$	66	88	110	94	73	60	42	53
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	80	110	140	110	89	73	51	65
Aluminum	<0.045	<0.045	<0.045	<0.045	<0.045	0.10	<0.045	<0.045
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium	0.012	0.091	0.097	0.045	0.089	0.21	0.096	0.073
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.10	0.20	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	68	44	37	40	24	21	25	24
Chloride	34	8.5	1.2	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.075	<0.050
Fluoride	1.8	1.7	1.1	2.0	2.0	1.6	1.6	1.6
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	<0.010	<0.010	0.012	<0.010	0.011	0.020	0.010	0.017
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	8.7	6.6	6.0	7.2	4.2	3.8	4.6	4.6
Manganese	0.024	0.040	0.060	0.040	0.024	0.017	0.015	0.020
Mercury	<0.00010	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	0.17	0.098	0.049	0.049	0.027	<0.050	0.054	0.033
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	<0.25	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.58	7.75	7.82	7.75	7.84	7.95	7.79	7.79
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	24	16	14	12	5.6	3.4	3.2	3.2
Scandium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium	0.0054	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	68	33	15	6.8	2.0	2.2	2.7	1.2
Strontium	1.5	0.92	0.80	0.88	0.51	0.45	0.51	0.43
Sulfate	220	110	60	61	21	15	44	30
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	580	310	280	170	110	100	130	130
Uranium	0.020	0.046	0.021	0.074	0.036	0.026	0.034	0.050
Vanadium	0.015	<0.010	<0.010	0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	7.68	4.58	3.35	3.19	1.77	1.56	1.83	1.71
Anions, meq/L	6.95	4.42	3.64	3.18	2.00	1.59	1.84	1.77
Balance, %	5.0	1.8	4.0	<1.0	6.0	1.2	<1.0	1.8
WET Lab Report #	1206505	1206646	1207080	1207417	1208332	1209232	1210284	1211156

Table . - Profile II Analytical Results, HC Extracts, Copper Flat Project Flotation Tailings, Sample K-spar Breccia (0-5) Comp

	Extract Week							
Analysis, mg/L	Week 24	Week 28	Week 32	Week 36	Week 40	Week 44	Week 48	Week 52
Alkalinity, $CaCO_3$	56	61	57	46	49	51	52	51
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	68	75	70	56	60	62	63	63
Aluminum	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050
Barium	0.083	0.10	0.13	0.12	0.10	0.12	0.13	0.14
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.100	<0.100	<0.100	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	20	20	20	17	18	18	19	20
Chloride	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	1.4	1.3	1.4	1.0	1.2	1.6	1.4	1.2
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	0.012	<0.010	<0.010	<0.010	<0.050	<0.050	<0.010	<0.010
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	4.3	4.2	4.2	2.9	3.6	3.6	3.9	4.0
Manganese	0.017	0.018	0.017	0.026	0.018	0.016	0.013	0.022
Mercury	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	0.026	0.017	0.017	0.014	<0.050	<0.050	0.016	0.017
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	<0.10
Nitrite as N	0.13	0.092	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.78	7.90	7.87	7.82	7.75	7.83	7.84	7.99
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	3.0	2.3	2.1	1.4	1.6	1.5	1.4	1.5
Scandium	<0.10	<0.10	<0.10	<0.10	<0.100	<0.100	<0.100	<0.100
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	0.95	0.80	0.63	<0.50	1.1	<0.50	0.51	<0.50
Strontium	0.41	0.44	0.39	0.29	0.32	0.33	0.33	0.34
Sulfate	17	13	12	11	11	12	12	9.7
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	94	98	96	71	78	61	85	77
Uranium	0.038	0.040	0.030	0.022	0.021	0.020	0.020	0.016
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	1.47	1.44	1.43	1.12	1.28	1.23	1.33	1.37
Anions, meq/L	1.54	1.57	1.47	1.20	1.28	1.35	1.36	1.30
Balance, %	2.4	4.3	1.6	3.3	<1.0	4.5	1.1	2.6
WET Lab Report #	1212123	1301048	1301483	1302487	1303567	1304490	1305511	1306471

Table . - Profile II Analytical Results, HC Extracts, Copper Flat Project Flotation Tailings, Sample Quartz Monzonite (0-5) Comp

	Extract Week							
Analysis, mg/L	Week 0	Week 1	Week 2	Week 4	Week 8	Week 12	Week 16	Week 20
Alkalinity, $CaCO_3$	77	84	71	96	69	66	63	53
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HCO_3	94	100	87	120	84	80	77	65
Aluminum	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium	0.012	0.022	0.031	0.040	0.091	0.12	0.12	0.11
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.10	0.21	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	70	32	27	43	25	24	23	20
Chloride	39	7.2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	1.9	1.5	0.45	1.9	1.8	1.8	1.7	1.6
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	<0.010	<0.050	0.020	<0.010	<0.050	<0.010	<0.010	0.016
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	7.2	4.3	2.6	6.9	4.0	4.1	4.0	3.6
Manganese	0.018	0.025	0.029	0.048	0.023	0.020	0.013	0.0089
Mercury	0.00012	<0.00010	<0.00010	0.00021	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	0.17	0.11	0.020	0.032	0.018	<0.010	<0.010	<0.010
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrite as N	<0.25	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.71	7.76	7.69	7.73	7.88	7.83	7.94	7.71
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	26	15	4.3	13	6.3	4.3	3.4	2.8
Scandium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	73	30	4.9	8.1	2.0	1.4	1.4	0.91
Strontium	1.1	0.55	0.35	0.74	0.42	0.42	0.40	0.30
Sulfate	220	83	29	68	23	18	16	13
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	600	260	190	220	120	120	100	110
Uranium	0.027	0.039	0.013	0.078	0.038	0.033	0.032	0.025
Vanadium	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	7.93	3.64	1.89	3.40	1.83	1.71	1.63	1.41
Anions, meq/L	7.32	3.65	2.05	3.48	1.95	1.78	1.68	1.42
Balance, %	4.0	<1.0	4.2	1.2	3.3	2.1	1.8	<1.0
WET Lab Report #	1206505	1206646	1207080	1207417	1208332	1209232	1210284	1211156

Table . - Profile II Analytical Results, HC Extracts,
Copper Flat Project Flotation Tailings, Sample Quartz Monzonite (0-5) Comp

	Extract Week							
Analysis, mg/L	Week 24	Week 28	Week 32	Week 36	Week 40	Week 44	Week 48	Week 52
Alkalinity, $CaCO_3$	68	18	55	13	29	52	57	52
CO_3, $CaCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	6.7	<1.0
HCO_3	83	22	67	16	35	64	56	64
Aluminum	<0.045	0.11	<0.045	0.051	<0.045	<0.045	<0.045	<0.045
Antimony	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic	<0.0050	0.0060	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium	0.16	0.056	0.088	0.016	0.14	0.098	0.094	0.11
Beryllium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Boron	<0.10	<0.100	<0.100	<0.100	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Calcium	26	6.5	22	4.7	11	20	20	22
Chloride	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chromium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	1.3	0.22	1.4	<0.10	0.55	1.2	1.2	1.1
Gallium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron	0.010	0.018	0.022	0.011	0.023	<0.010	<0.010	<0.010
Lead	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	4.7	0.86	4.3	<0.50	1.8	4.2	4.2	4.7
Manganese	0.025	<0.0050	0.014	<0.0050	0.018	0.018	0.014	0.021
Mercury	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Molybdenum	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.050	0.012
Nickel	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate as N	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	<0.10
Nitrite as N	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
pH, stu	7.88	7.48	7.84	7.49	7.56	7.87	8.73	8.02
Phosphorus	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Potassium	2.5	<0.50	2.0	<0.50	<0.50	1.5	1.4	1.3
Scandium	<0.10	<0.10	<0.10	<0.10	<0.100	<0.100	<0.100	<0.100
Selenium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium	0.87	1.7	0.74	<0.50	2.2	0.53	0.61	0.52
Strontium	0.38	<0.10	0.32	<0.10	0.12	0.28	0.26	0.28
Sulfate	21	4.2	15	<1.0	9.9	14	14	13
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Dissolved Solids	100	45	96	26	56	73	81	81
Uranium	0.034	<0.0050	0.024	<0.0050	0.011	0.021	0.019	0.016
Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cations, meq/L	1.79	0.48	1.54	0.24	0.79	1.41	1.41	1.54
Anions, meq/L	1.87	0.46	1.48	0.26	0.81	1.40	1.50	1.38
Balance, %	2.2	2.4	1.7	4.3	<1.0	<1.0	3.1	5.6
WET Lab Report #	1212123	1301048	1301483	1302487	1303567	1304490	1305511	1306471

WetLab Reports

WETLAB
WESTERN ENVIRONMENTAL
TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

12/10/2012

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1211513*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 11/29/2012. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

for Andy Smith
Laboratory Manager

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1211513

General Comments

None

Specific Comments

The matrix spike/matrix spike duplicate (MS/MSD) values for the analysis of Fluoride on sample 1211513-001 were outside laboratory acceptance criteria; however, the relative percent difference (RPD) value was acceptable, indicating probable matrix interference. The reported result should be considered an estimate.

Data Qualifier Legend

B	-- Blank contamination; Analyte detected above the method reporting limit in an associated blank
HT	-- Sample held beyond the accepted holding time
J	-- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	-- Reported value is estimated; The sample matrix interfered with the analysis
N	-- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	-- Not calculated due to matrix interference
Q	-- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
S	-- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.
SC	-- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438 Wk:96*

Date Printed: 12/10/2012
OrderID: *1211513*

Customer Sample ID: 604 673 WK:96
WETLAB Sample ID: 1211513-001

Collect Date/Time: 11/29/2012 09:00
Receive Date: 11/29/2012 16:10

PROFILE II

Parameter	Method	Results		Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	5.29		pH Units		11/29/2012
Trace Metals Digestion	EPA 200.2	Complete				12/3/2012
Bicarbonate (HCO3)	SM 2320B	<1.0		mg/L	1.0	11/29/2012
Carbonate (CO3)	SM 2320B	<1.0		mg/L	1.0	11/29/2012
Hydroxide (OH)	SM 2320B	<1.0		mg/L	1.0	11/29/2012
Total Alkalinity	SM 2320B	<1.0		mg/L as CaCO3	1.0	11/29/2012
Chloride	EPA 300.0	<1.00		mg/L	1.00	11/30/2012
Fluoride	EPA 300.0	0.27	M	mg/L	0.10	11/30/2012
Sulfate	EPA 300.0	27		mg/L	1.0	11/30/2012
Nitrate Nitrogen	EPA 300.0	<1.0		mg/L	1.0	11/30/2012
Nitrite Nitrogen	EPA 300.0	<0.025		mg/L	0.025	11/30/2012
Total Dissolved Solids (TDS)	SM 2540C	65		mg/L	10	12/4/2012
Aluminum	EPA 200.7	0.20		mg/L	0.045	12/5/2012
Barium	EPA 200.7	0.080		mg/L	0.010	12/5/2012
Beryllium	EPA 200.7	<0.0010		mg/L	0.0010	12/5/2012
Bismuth	EPA 200.7	<0.10		mg/L	0.10	12/5/2012
Boron	EPA 200.7	<0.10		mg/L	0.10	12/5/2012
Cadmium	EPA 200.7	<0.0010		mg/L	0.0010	12/5/2012
Calcium	EPA 200.7	7.7		mg/L	0.50	12/5/2012
Chromium	EPA 200.7	<0.0050		mg/L	0.0050	12/5/2012
Cobalt	EPA 200.7	<0.010		mg/L	0.010	12/5/2012
Copper	EPA 200.7	1.8		mg/L	0.050	12/5/2012
Gallium	EPA 200.7	<0.10		mg/L	0.10	12/5/2012
Iron	EPA 200.7	0.017		mg/L	0.010	12/5/2012
Lithium	EPA 200.7	<0.10		mg/L	0.10	12/5/2012
Magnesium	EPA 200.7	1.0		mg/L	0.50	12/5/2012
Manganese	EPA 200.7	0.051		mg/L	0.0050	12/5/2012
Molybdenum	EPA 200.7	<0.010		mg/L	0.010	12/5/2012

Customer Sample ID: 604 673 WK:96
WETLAB Sample ID: 1211513-001

Collect Date/Time: 11/29/2012 09:00
Receive Date: 11/29/2012 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Nickel	EPA 200.7	<0.010	mg/L	0.010	12/5/2012
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	12/5/2012
Potassium	EPA 200.7	0.88	mg/L	0.50	12/5/2012
Scandium	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Silver	EPA 200.7	<0.0050	mg/L	0.0050	12/5/2012
Sodium	EPA 200.7	0.99	mg/L	0.50	12/5/2012
Strontium	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Tin	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Titanium	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Vanadium	EPA 200.7	<0.010	mg/L	0.010	12/5/2012
Zinc	EPA 200.7	0.060	mg/L	0.010	12/5/2012
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	12/5/2012
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	12/5/2012
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	12/5/2012
Lead	EPA 200.8	0.013	mg/L	0.0025	12/5/2012
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	12/5/2012
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	12/5/2012
Uranium	EPA 200.8	0.025	mg/L	0.0050	12/5/2012
Anions	Calculation	0.58	meq/L	0.10	
Cations	Calculation	0.62	meq/L	0.10	
Error	Calculation	3.3	%	1.0	

Customer Sample ID: SRK 0854 WK:96
WETLAB Sample ID: 1211513-002

Collect Date/Time: 11/29/2012 09:00
Receive Date: 11/29/2012 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	4.86	pH Units		11/29/2012
Trace Metals Digestion	EPA 200.2	Complete			12/3/2012
Bicarbonate (HCO3)	SM 2320B	<1.0	mg/L	1.0	11/29/2012
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	11/29/2012
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	11/29/2012
Total Alkalinity	SM 2320B	<1.0	mg/L as CaCO3	1.0	11/29/2012
Chloride	EPA 300.0	<1.00	mg/L	1.00	11/30/2012
Fluoride	EPA 300.0	0.21	mg/L	0.10	11/30/2012
Sulfate	EPA 300.0	84	mg/L	1.0	11/30/2012
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	11/30/2012
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	11/30/2012
Total Dissolved Solids (TDS)	SM 2540C	130	mg/L	10	12/4/2012

Customer Sample ID: SRK 0854 WK:96

WETLAB Sample ID: 1211513-002

Collect Date/Time: 11/29/2012 09:00

Receive Date: 11/29/2012 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Aluminum	EPA 200.7	0.073	mg/L	0.045	12/5/2012
Barium	EPA 200.7	0.027	mg/L	0.010	12/5/2012
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	12/5/2012
Bismuth	EPA 200.7	0.11	mg/L	0.10	12/5/2012
Boron	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Cadmium	EPA 200.7	0.0012	mg/L	0.0010	12/5/2012
Calcium	EPA 200.7	3.6	mg/L	0.50	12/5/2012
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	12/5/2012
Cobalt	EPA 200.7	<0.010	mg/L	0.010	12/5/2012
Copper	EPA 200.7	41	mg/L	0.050	12/5/2012
Gallium	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Iron	EPA 200.7	<0.010	mg/L	0.010	12/5/2012
Lithium	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Magnesium	EPA 200.7	<0.50	mg/L	0.50	12/5/2012
Manganese	EPA 200.7	0.072	mg/L	0.0050	12/5/2012
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	12/5/2012
Nickel	EPA 200.7	<0.010	mg/L	0.010	12/5/2012
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	12/5/2012
Potassium	EPA 200.7	1.2	mg/L	0.50	12/5/2012
Scandium	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Silver	EPA 200.7	<0.0050	mg/L	0.0050	12/5/2012
Sodium	EPA 200.7	0.84	mg/L	0.50	12/5/2012
Strontium	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Tin	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Titanium	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Vanadium	EPA 200.7	<0.010	mg/L	0.010	12/5/2012
Zinc	EPA 200.7	0.17	mg/L	0.010	12/5/2012
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	12/5/2012
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	12/5/2012
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	12/5/2012
Lead	EPA 200.8	0.0097	mg/L	0.0025	12/5/2012
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	12/5/2012
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	12/5/2012
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	12/5/2012
Anions	Calculation	1.76	meq/L	0.10	
Cations	Calculation	1.55	meq/L	0.10	
Error	Calculation	6.2	%	1.0	

Customer Sample ID: SRK 0872 WK:96
WETLAB Sample ID: 1211513-003

Collect Date/Time: 11/29/2012 09:00
Receive Date: 11/29/2012 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	6.74	pH Units		11/29/2012
Trace Metals Digestion	EPA 200.2	Complete			12/3/2012
Bicarbonate (HCO3)	SM 2320B	7.2	mg/L	1.0	11/29/2012
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	11/29/2012
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	11/29/2012
Total Alkalinity	SM 2320B	5.9	mg/L as CaCO3	1.0	11/29/2012
Chloride	EPA 300.0	<1.00	mg/L	1.00	11/30/2012
Fluoride	EPA 300.0	0.62	mg/L	0.10	11/30/2012
Sulfate	EPA 300.0	23	mg/L	1.0	11/30/2012
Nitrate Nitrogen	EPA 300.0	1.1	mg/L	1.0	11/30/2012
Nitrite Nitrogen	EPA 300.0	0.080	mg/L	0.025	11/30/2012
Total Dissolved Solids (TDS)	SM 2540C	74	mg/L	10	12/4/2012
Aluminum	EPA 200.7	<0.045	mg/L	0.045	12/5/2012
Barium	EPA 200.7	0.042	mg/L	0.010	12/5/2012
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	12/5/2012
Bismuth	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Boron	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	12/5/2012
Calcium	EPA 200.7	10	mg/L	0.50	12/5/2012
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	12/5/2012
Cobalt	EPA 200.7	<0.010	mg/L	0.010	12/5/2012
Copper	EPA 200.7	<0.050	mg/L	0.050	12/5/2012
Gallium	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Iron	EPA 200.7	0.032	mg/L	0.010	12/5/2012
Lithium	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Magnesium	EPA 200.7	0.82	mg/L	0.50	12/5/2012
Manganese	EPA 200.7	0.012	mg/L	0.0050	12/5/2012
Molybdenum	EPA 200.7	0.045	mg/L	0.010	12/5/2012
Nickel	EPA 200.7	<0.010	mg/L	0.010	12/5/2012
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	12/5/2012
Potassium	EPA 200.7	<0.50	mg/L	0.50	12/5/2012
Scandium	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Silver	EPA 200.7	<0.0050	mg/L	0.0050	12/5/2012
Sodium	EPA 200.7	<0.50	mg/L	0.50	12/5/2012
Strontium	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Tin	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Titanium	EPA 200.7	<0.10	mg/L	0.10	12/5/2012
Vanadium	EPA 200.7	<0.010	mg/L	0.010	12/5/2012
Zinc	EPA 200.7	<0.010	mg/L	0.010	12/5/2012

Customer Sample ID: SRK 0872 WK:96
WETLAB Sample ID: 1211513-003

Collect Date/Time: 11/29/2012 09:00
Receive Date: 11/29/2012 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	12/5/2012
Antimony	EPA 200.8	0.0029	mg/L	0.0025	12/5/2012
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	12/5/2012
Lead	EPA 200.8	<0.0025	mg/L	0.0025	12/5/2012
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	12/5/2012
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	12/5/2012
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	12/5/2012
Anions	Calculation	0.71	meq/L	0.10	
Cations	Calculation	0.57	meq/L	0.10	
Error	Calculation	11	%	1.0	

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC12110975	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC12110975	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC12110976	Blank 1	Chloride	EPA 300.0	<1.0	mg/L
QC12110976	Blank 2	Chloride	EPA 300.0	<1.0	mg/L
QC12110977	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC12110977	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC12120040	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC12120040	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC12120041	Blank 1	Chloride	EPA 300.0	<1.0	mg/L
QC12120041	Blank 2	Chloride	EPA 300.0	<1.0	mg/L
QC12120043	Blank 1	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC12120043	Blank 2	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC12120043	Blank 3	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC12120044	Blank 1	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC12120044	Blank 2	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC12120044	Blank 3	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC12120045	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC12120045	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC12120110	Blank 1	Mercury	EPA 200.8	<0.00010	mg/L
		Antimony	EPA 200.8	<0.0025	mg/L
		Arsenic	EPA 200.8	<0.0050	mg/L
		Lead	EPA 200.8	<0.0025	mg/L
		Selenium	EPA 200.8	<0.0050	mg/L
		Thallium	EPA 200.8	<0.0010	mg/L
		Uranium	EPA 200.8	<0.0050	mg/L
QC12120111	Blank 1	Mercury	EPA 200.8	<0.00010	mg/L
		Antimony	EPA 200.8	<0.0025	mg/L
		Arsenic	EPA 200.8	<0.0050	mg/L
		Lead	EPA 200.8	<0.0025	mg/L
		Selenium	EPA 200.8	<0.0050	mg/L
		Thallium	EPA 200.8	<0.0010	mg/L
		Uranium	EPA 200.8	<0.0050	mg/L
QC12120177	Blank 1	Aluminum	EPA 200.7	<0.045	mg/L
		Barium	EPA 200.7	<0.010	mg/L
		Beryllium	EPA 200.7	<0.0010	mg/L
		Bismuth	EPA 200.7	<0.10	mg/L
		Boron	EPA 200.7	<0.10	mg/L
		Cadmium	EPA 200.7	<0.0010	mg/L
		Calcium	EPA 200.7	<0.50	mg/L
		Chromium	EPA 200.7	<0.0050	mg/L
		Cobalt	EPA 200.7	<0.010	mg/L
		Copper	EPA 200.7	<0.050	mg/L
		Gallium	EPA 200.7	<0.10	mg/L
		Iron	EPA 200.7	<0.010	mg/L
		Lithium	EPA 200.7	<0.10	mg/L
		Magnesium	EPA 200.7	<0.50	mg/L
		Manganese	EPA 200.7	<0.0050	mg/L

QCBatchID	QCType	Parameter	Method	Result	Units
		Molybdenum	EPA 200.7	<0.010	mg/L
		Nickel	EPA 200.7	<0.010	mg/L
		Phosphorus	EPA 200.7	<0.50	mg/L
		Potassium	EPA 200.7	<0.50	mg/L
		Scandium	EPA 200.7	<0.10	mg/L
		Silver	EPA 200.7	<0.0050	mg/L
		Sodium	EPA 200.7	<0.50	mg/L
		Strontium	EPA 200.7	<0.10	mg/L
		Tin	EPA 200.7	<0.10	mg/L
		Titanium	EPA 200.7	<0.10	mg/L
		Vanadium	EPA 200.7	<0.010	mg/L
		Zinc	EPA 200.7	<0.010	mg/L
QC12120178	Blank 1	Aluminum	EPA 200.7	<0.045	mg/L
		Barium	EPA 200.7	<0.010	mg/L
		Beryllium	EPA 200.7	<0.0010	mg/L
		Bismuth	EPA 200.7	<0.10	mg/L
		Boron	EPA 200.7	<0.100	mg/L
		Cadmium	EPA 200.7	<0.0010	mg/L
		Calcium	EPA 200.7	<0.50	mg/L
		Chromium	EPA 200.7	<0.0050	mg/L
		Cobalt	EPA 200.7	<0.010	mg/L
		Copper	EPA 200.7	<0.050	mg/L
		Gallium	EPA 200.7	<0.10	mg/L
		Iron	EPA 200.7	<0.010	mg/L
		Lithium	EPA 200.7	<0.10	mg/L
		Magnesium	EPA 200.7	<0.50	mg/L
		Manganese	EPA 200.7	<0.0050	mg/L
		Molybdenum	EPA 200.7	<0.010	mg/L
		Nickel	EPA 200.7	<0.010	mg/L
		Phosphorus	EPA 200.7	<0.50	mg/L
		Potassium	EPA 200.7	<0.50	mg/L
		Scandium	EPA 200.7	<0.10	mg/L
		Silver	EPA 200.7	<0.0050	mg/L
		Sodium	EPA 200.7	<0.50	mg/L
		Strontium	EPA 200.7	<0.10	mg/L
		Tin	EPA 200.7	<0.10	mg/L
		Titanium	EPA 200.7	<0.10	mg/L
		Vanadium	EPA 200.7	<0.010	mg/L
		Zinc	EPA 200.7	<0.010	mg/L
QC12120191	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC12120191	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC12110944	LCS 1	pH	SM 4500-H+ B	6.99	7.00	100	pH Units
QC12110944	LCS 2	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC12110944	LCS 3	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC12110945	LCS 1	Total Alkalinity	SM 2320B	99.1	100	99	mg/L
QC12110945	LCS 2	Total Alkalinity	SM 2320B	99.4	100	99	mg/L
QC12110945	LCS 3	Total Alkalinity	SM 2320B	99.4	100	99	mg/L
QC12110945	LCS 4	Total Alkalinity	SM 2320B	99.2	100	99	mg/L
QC12110975	LCS 1	Fluoride	EPA 300.0	1.88	2.00	94	mg/L
QC12110976	LCS 1	Chloride	EPA 300.0	10.9	10.0	109	mg/L
QC12110977	LCS 1	Sulfate	EPA 300.0	23.9	25.0	96	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC12120040	LCS 1	Fluoride	EPA 300.0	1.88	2.00	94	mg/L
QC12120041	LCS 1	Chloride	EPA 300.0	10.9	10.0	109	mg/L
QC12120043	LCS 1	Nitrite Nitrogen	EPA 300.0	0.540	0.500	108	mg/L
QC12120044	LCS 1	Nitrate Nitrogen	EPA 300.0	1.94	2.00	97	mg/L
QC12120045	LCS 1	Sulfate	EPA 300.0	23.9	25.0	96	mg/L
QC12120110	LCS 1	Mercury	EPA 200.8	0.000928	0.001	93	mg/L
		Antimony	EPA 200.8	0.0093	0.010	93	mg/L
		Arsenic	EPA 200.8	0.0490	0.050	98	mg/L
		Lead	EPA 200.8	0.0100	0.010	100	mg/L
		Selenium	EPA 200.8	0.0437	0.050	87	mg/L
		Thallium	EPA 200.8	0.0098	0.010	98	mg/L
		Uranium	EPA 200.8	0.0098	0.010	98	mg/L
QC12120111	LCS 1	Mercury	EPA 200.8	0.000965	0.001	96	mg/L
		Antimony	EPA 200.8	0.0098	0.010	98	mg/L
		Arsenic	EPA 200.8	0.0499	0.050	100	mg/L
		Lead	EPA 200.8	0.0097	0.010	97	mg/L
		Selenium	EPA 200.8	0.0471	0.050	94	mg/L
		Thallium	EPA 200.8	0.0096	0.010	96	mg/L
		Uranium	EPA 200.8	0.0095	0.010	95	mg/L
QC12120177	LCS 1	Aluminum	EPA 200.7	0.943	1.00	94	mg/L
		Barium	EPA 200.7	0.946	1.00	95	mg/L
		Beryllium	EPA 200.7	0.961	1.00	96	mg/L
		Bismuth	EPA 200.7	0.980	1.00	98	mg/L
		Boron	EPA 200.7	0.909	1.00	91	mg/L
		Cadmium	EPA 200.7	0.958	1.00	96	mg/L
		Calcium	EPA 200.7	9.57	10.0	96	mg/L
		Chromium	EPA 200.7	0.934	1.00	93	mg/L
		Cobalt	EPA 200.7	0.940	1.00	94	mg/L
		Copper	EPA 200.7	4.57	5.00	91	mg/L
		Gallium	EPA 200.7	0.946	1.00	95	mg/L
		Iron	EPA 200.7	0.940	1.00	94	mg/L
		Lithium	EPA 200.7	0.948	1.00	95	mg/L
		Magnesium	EPA 200.7	9.30	10.0	93	mg/L
		Manganese	EPA 200.7	0.937	1.00	94	mg/L
		Molybdenum	EPA 200.7	0.945	1.00	94	mg/L
		Nickel	EPA 200.7	4.70	5.00	94	mg/L
		Phosphorus	EPA 200.7	4.78	5.00	96	mg/L
		Potassium	EPA 200.7	9.51	10.0	95	mg/L
		Scandium	EPA 200.7	0.942	1.00	94	mg/L
		Silver	EPA 200.7	0.084	0.090	94	mg/L
		Sodium	EPA 200.7	9.64	10.0	96	mg/L
		Strontium	EPA 200.7	0.962	1.00	96	mg/L
		Tin	EPA 200.7	0.941	1.00	94	mg/L
		Titanium	EPA 200.7	0.953	1.00	95	mg/L
		Vanadium	EPA 200.7	0.931	1.00	93	mg/L
		Zinc	EPA 200.7	0.958	1.00	96	mg/L
QC12120178	LCS 1	Aluminum	EPA 200.7	0.940	1.00	94	mg/L
		Barium	EPA 200.7	0.944	1.00	94	mg/L
		Beryllium	EPA 200.7	0.954	1.00	95	mg/L
		Bismuth	EPA 200.7	0.980	1.00	98	mg/L
		Boron	EPA 200.7	0.920	1.00	92	mg/L
		Cadmium	EPA 200.7	0.951	1.00	95	mg/L
		Calcium	EPA 200.7	9.55	10.0	96	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
		Chromium	EPA 200.7	0.934	1.00	93	mg/L
		Cobalt	EPA 200.7	0.944	1.00	94	mg/L
		Copper	EPA 200.7	4.54	5.00	91	mg/L
		Gallium	EPA 200.7	0.950	1.00	95	mg/L
		Iron	EPA 200.7	0.933	1.00	93	mg/L
		Lithium	EPA 200.7	0.959	1.00	96	mg/L
		Magnesium	EPA 200.7	9.21	10.0	92	mg/L
		Manganese	EPA 200.7	0.931	1.00	93	mg/L
		Molybdenum	EPA 200.7	0.953	1.00	95	mg/L
		Nickel	EPA 200.7	4.72	5.00	94	mg/L
		Phosphorus	EPA 200.7	4.82	5.00	96	mg/L
		Potassium	EPA 200.7	9.53	10.0	95	mg/L
		Scandium	EPA 200.7	0.943	1.00	94	mg/L
		Silver	EPA 200.7	0.085	0.090	95	mg/L
		Sodium	EPA 200.7	9.66	10.0	97	mg/L
		Strontium	EPA 200.7	1.01	1.00	101	mg/L
		Tin	EPA 200.7	0.940	1.00	94	mg/L
		Titanium	EPA 200.7	0.951	1.00	95	mg/L
		Vanadium	EPA 200.7	0.935	1.00	94	mg/L
		Zinc	EPA 200.7	0.958	1.00	96	mg/L
QC12120191	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	151	150	100	mg/L
QC12120191	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	151	150	100	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC12110944	Duplicate	pH	SM 4500-H+ B	1211498-001	6.86	6.86	pH Units	<1%
QC12110944	Duplicate	pH	SM 4500-H+ B	1211498-008	7.89	7.88	pH Units	<1%
QC12110944	Duplicate	pH	SM 4500-H+ B	1211503-009	7.34	7.34	pH Units	<1%
QC12110944	Duplicate	pH	SM 4500-H+ B	1211512-002	7.55	7.62	pH Units	1 %
QC12110944	Duplicate	pH	SM 4500-H+ B	1211514-001	5.82	5.77	pH Units	1 %
QC12110945	Duplicate	Bicarbonate (HCO3)	SM 2320B	1211498-001	436	456	mg/L	4 %
		Carbonate (CO3)	SM 2320B	1211498-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1211498-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1211498-001	358	374	mg/L as CaCO3	4 %
QC12110945	Duplicate	Bicarbonate (HCO3)	SM 2320B	1211498-008	263	262	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1211498-008	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1211498-008	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1211498-008	216	215	mg/L as CaCO3	<1%
QC12110945	Duplicate	Bicarbonate (HCO3)	SM 2320B	1211503-009	150	152	mg/L	1 %
		Carbonate (CO3)	SM 2320B	1211503-009	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1211503-009	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1211503-009	123	124	mg/L as CaCO3	1 %
QC12110945	Duplicate	Bicarbonate (HCO3)	SM 2320B	1211512-002	64.8	62.8	mg/L	3 %
		Carbonate (CO3)	SM 2320B	1211512-002	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1211512-002	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1211512-002	53.1	51.5	mg/L as CaCO3	3 %
QC12110945	Duplicate	Bicarbonate (HCO3)	SM 2320B	1211514-001	<1.000	<1.000	mg/L	17 %
		Carbonate (CO3)	SM 2320B	1211514-001	<1.000	<1.000	mg/L	<1%

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
		Hydroxide (OH)	SM 2320B	1211514-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1211514-001	<1.000	<1.000	mg/L as CaCO3	17 %
QC12120191	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1211512-001	2638	2618	mg/L	1 %
QC12120191	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1212008-002	39.0	32.0	mg/L	20 %
QC12120191	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1212009-002	40.0	32.0	mg/L	22 %
QC12120191	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1211530-001	213	203	mg/L	5 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC12110975	MS 1	Fluoride	EPA 300.0	1211513-001	0.266	M	2.68	2.81	2.00	mg/L	NC	NC	NC
QC12110976	MS 1	Chloride	EPA 300.0	1211513-001	<1.000		5.27	5.50	5.00	mg/L	104	109	4 %
QC12110977	MS 1	Sulfate	EPA 300.0	1211513-001	27.0		37.8	39.3	10.0	mg/L	108	124	4 %
QC12120040	MS 1	Fluoride	EPA 300.0	1211515-001	<0.100		1.76	1.88	2.00	mg/L	87	93	7 %
QC12120041	MS 1	Chloride	EPA 300.0	1211515-001	<1.000		4.99	5.15	5.00	mg/L	99	102	3 %
QC12120043	MS 1	Nitrite Nitrogen	EPA 300.0	1211513-001	<0.025		0.513	0.524	0.500	mg/L	103	105	2 %
QC12120043	MS 2	Nitrite Nitrogen	EPA 300.0	1211515-001	<0.025		0.476	0.497	0.500	mg/L	95	99	4 %
QC12120044	MS 1	Nitrate Nitrogen	EPA 300.0	1211513-001	<1.000		1.86	1.93	2.00	mg/L	93	96	4 %
QC12120044	MS 2	Nitrate Nitrogen	EPA 300.0	1211515-001	<1.000		1.93	2.01	2.00	mg/L	95	99	4 %
QC12120045	MS 1	Sulfate	EPA 300.0	1211515-001	2.05		11.6	12.0	10.0	mg/L	95	100	3 %
QC12120110	MS 1	Mercury	EPA 200.8	1211512-001	<0.00010		0.000903	0.000902	0.001	mg/L	82	81	<1%
		Antimony	EPA 200.8	1211512-001	0.0053		0.0147	0.0147	0.010	mg/L	94	94	<1%
		Arsenic	EPA 200.8	1211512-001	0.0178		0.0763	0.0757	0.050	mg/L	117	116	1 %
		Lead	EPA 200.8	1211512-001	0.0053		0.0137	0.0140	0.010	mg/L	84	87	2 %
		Selenium	EPA 200.8	1211512-001	0.1580		0.2185	0.2157	0.050	mg/L	121	115	1 %
		Thallium	EPA 200.8	1211512-001	<0.0010		0.0083	0.0084	0.010	mg/L	83	83	1 %
		Uranium	EPA 200.8	1211512-001	0.0104		0.0194	0.0195	0.010	mg/L	90	91	1 %
QC12120111	MS 1	Mercury	EPA 200.8	1211521-001	<0.00010		0.000906	0.000949	0.001	mg/L	89	93	5 %
		Antimony	EPA 200.8	1211521-001	<0.0025		0.0094	0.0094	0.010	mg/L	94	95	<1%
		Arsenic	EPA 200.8	1211521-001	<0.0050		0.0532	0.0535	0.050	mg/L	105	106	1 %
		Lead	EPA 200.8	1211521-001	<0.0025		0.0097	0.0097	0.010	mg/L	96	95	<1%
		Selenium	EPA 200.8	1211521-001	<0.0050		0.0468	0.0463	0.050	mg/L	93	92	1 %
		Thallium	EPA 200.8	1211521-001	<0.0010		0.0094	0.0094	0.010	mg/L	94	95	<1%
		Uranium	EPA 200.8	1211521-001	<0.0050		0.0108	0.0107	0.010	mg/L	98	96	1 %
QC12120177	MS 1	Aluminum	EPA 200.7	1211512-001	62.4	SC	63.9	64.0	1.00	mg/L	NC	NC	NC
		Barium	EPA 200.7	1211512-001	0.011		0.870	0.858	1.00	mg/L	86	85	1 %
		Beryllium	EPA 200.7	1211512-001	0.003		0.892	0.896	1.00	mg/L	89	89	<1%
		Bismuth	EPA 200.7	1211512-001	<0.100		0.945	0.946	1.00	mg/L	94	95	<1%
		Boron	EPA 200.7	1211512-001	0.163		1.07	1.05	1.00	mg/L	91	89	2 %
		Cadmium	EPA 200.7	1211512-001	0.057		0.938	0.928	1.00	mg/L	88	87	1 %
		Calcium	EPA 200.7	1211512-001	483		496	493	10.0	mg/L	130	100	1 %
		Chromium	EPA 200.7	1211512-001	0.007		0.863	0.856	1.00	mg/L	86	85	1 %
		Cobalt	EPA 200.7	1211512-001	0.405		1.26	1.25	1.00	mg/L	86	84	1 %
		Copper	EPA 200.7	1211512-001	11.8		17.1	17.1	5.00	mg/L	106	106	<1%
		Gallium	EPA 200.7	1211512-001	<0.100		0.966	0.956	1.00	mg/L	96	95	1 %
		Iron	EPA 200.7	1211512-001	2.67		3.65	3.65	1.00	mg/L	98	98	<1%
		Lithium	EPA 200.7	1211512-001	<0.100		1.05	1.05	1.00	mg/L	99	99	<1%
		Magnesium	EPA 200.7	1211512-001	17.8		27.0	27.0	10.0	mg/L	92	92	<1%
		Manganese	EPA 200.7	1211512-001	2.61		3.50	3.52	1.00	mg/L	89	91	1 %
		Molybdenum	EPA 200.7	1211512-001	<0.010		0.868	0.877	1.00	mg/L	88	89	1 %
		Nickel	EPA 200.7	1211512-001	0.291		4.60	4.55	5.00	mg/L	86	85	1 %
		Phosphorus	EPA 200.7	1211512-001	<0.500		4.84	4.88	5.00	mg/L	95	96	1 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Potassium	EPA 200.7	1211512-001	2.58	12.6	12.7	10.0	mg/L	100	101	1 %
		Scandium	EPA 200.7	1211512-001	<0.100	0.898	0.903	1.00	mg/L	90	90	1 %
		Silver	EPA 200.7	1211512-001	<0.005	0.082	0.083	0.090	mg/L	92	93	1 %
		Sodium	EPA 200.7	1211512-001	27.4	37.0	37.3	10.0	mg/L	96	99	1 %
		Strontium	EPA 200.7	1211512-001	0.913	1.85	1.87	1.00	mg/L	94	96	1 %
		Tin	EPA 200.7	1211512-001	<0.100	0.828	0.836	1.00	mg/L	88	89	1 %
		Titanium	EPA 200.7	1211512-001	<0.100	0.921	0.924	1.00	mg/L	92	93	<1%
		Vanadium	EPA 200.7	1211512-001	0.013	0.908	0.898	1.00	mg/L	90	89	1 %
		Zinc	EPA 200.7	1211512-001	10.6	11.3	11.1	1.00	mg/L	70	50	2 %
QC12120178	MS 1	Aluminum	EPA 200.7	1211521-001	0.067	1.03	1.04	1.00	mg/L	96	97	1 %
		Barium	EPA 200.7	1211521-001	0.028	0.962	0.964	1.00	mg/L	93	94	<1%
		Beryllium	EPA 200.7	1211521-001	<0.001	0.953	0.954	1.00	mg/L	95	95	<1%
		Bismuth	EPA 200.7	1211521-001	<0.100	0.957	0.964	1.00	mg/L	95	96	1 %
		Boron	EPA 200.7	1211521-001	<0.100	0.948	0.955	1.00	mg/L	92	93	1 %
		Cadmium	EPA 200.7	1211521-001	<0.001	0.939	0.940	1.00	mg/L	94	94	<1%
		Calcium	EPA 200.7	1211521-001	13.5	23.6	23.4	10.0	mg/L	101	99	1 %
		Chromium	EPA 200.7	1211521-001	<0.005	0.922	0.926	1.00	mg/L	92	93	<1%
		Cobalt	EPA 200.7	1211521-001	<0.010	0.923	0.926	1.00	mg/L	92	93	<1%
		Copper	EPA 200.7	1211521-001	<0.050	4.51	4.50	5.00	mg/L	90	90	<1%
		Gallium	EPA 200.7	1211521-001	<0.100	0.962	0.968	1.00	mg/L	96	97	1 %
		Iron	EPA 200.7	1211521-001	0.505	1.46	1.46	1.00	mg/L	96	96	<1%
		Lithium	EPA 200.7	1211521-001	<0.100	0.931	0.930	1.00	mg/L	93	93	<1%
		Magnesium	EPA 200.7	1211521-001	3.21	12.2	12.3	10.0	mg/L	90	91	1 %
		Manganese	EPA 200.7	1211521-001	0.070	0.982	0.983	1.00	mg/L	91	91	<1%
		Molybdenum	EPA 200.7	1211521-001	<0.010	0.951	0.957	1.00	mg/L	94	95	1 %
		Nickel	EPA 200.7	1211521-001	<0.010	4.60	4.61	5.00	mg/L	92	92	<1%
		Phosphorus	EPA 200.7	1211521-001	<0.500	4.89	4.89	5.00	mg/L	96	96	<1%
		Potassium	EPA 200.7	1211521-001	2.03	11.7	11.6	10.0	mg/L	97	96	1 %
		Scandium	EPA 200.7	1211521-001	<0.100	0.940	0.942	1.00	mg/L	94	94	<1%
		Silver	EPA 200.7	1211521-001	<0.005	0.084	0.084	0.090	mg/L	93	93	<1%
		Sodium	EPA 200.7	1211521-001	17.1	26.5	26.1	10.0	mg/L	94	90	2 %
		Strontium	EPA 200.7	1211521-001	0.145	1.15	1.16	1.00	mg/L	100	101	1 %
		Tin	EPA 200.7	1211521-001	<0.100	0.920	0.930	1.00	mg/L	93	94	1 %
		Titanium	EPA 200.7	1211521-001	<0.100	0.964	0.974	1.00	mg/L	96	97	1 %
		Vanadium	EPA 200.7	1211521-001	<0.010	0.938	0.943	1.00	mg/L	93	94	1 %
		Zinc	EPA 200.7	1211521-001	0.011	0.960	0.961	1.00	mg/L	95	95	<1%

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Lab Number 1211513
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Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company ______
Address ______
City, State & Zip ______
Contact ______
Phone ______
Fax ______
Email ______

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium	Spl. No.
604 673	Wk:96	11/29/12	9:00	WW	2	X	X	1
SRK 0854	↓	↓	↓	↓	↓	↓	↓	2
SRK 0872	↓	↓	↓	↓	↓	↓	↓	3

Instructions/Comments/Special Requirements:

1211 5
513 3

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 18.4°C	11/28/12	4:10p		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 6				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1211513
Report Due Date: 12/13/12
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company ______
Address ______
City, State & Zip ______
Contact ______
Phone ______
Fax ______
Email ______

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium	Spl. No.
604 673	Wk:96	11/29/12	9:00	WW	2	X	X	1
SRK 0854	↓	↓	↓	↓	↓	↓	↓	2
SRK 0872	↓	↓	↓	↓	↓	↓	↓	3

Instructions/Comments/Special Requirements:

1211 5
513 3

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 18.4°C	11/28/12	9:10		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 6				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

WETLAB
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TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

12/28/2012

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1212123*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 12/6/2012. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Andy Smith
QA Manager

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1212123

General Comments

None

Specific Comments

Due to a laboratory oversight the analysis for Total Dissolved Solids (TDS) on samples 1212123-006 and 007 was performed past the EPA recommended holding time. We apologize for any inconvenience this may have caused.

Data Qualifier Legend

B	-- Blank contamination; Analyte detected above the method reporting limit in an associated blank
HT	-- Sample held beyond the accepted holding time
J	-- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	-- Reported value is estimated; The sample matrix interfered with the analysis
N	-- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	-- Not calculated due to matrix interference
Q	-- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
S	-- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.
SC	-- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438 Wk: 24*

Date Printed: 12/28/2012
OrderID: *1212123*

Customer Sample ID: CF-11-02 (227-367) WK:24
WETLAB Sample ID: 1212123-001

Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.85	pH Units		12/6/2012
Trace Metals Digestion	EPA 200.2	Complete			12/11/2012
Bicarbonate (HCO3)	SM 2320B	71	mg/L	1.0	12/6/2012
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	12/6/2012
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	12/6/2012
Total Alkalinity	SM 2320B	58	mg/L as CaCO3	1.0	12/6/2012
Chloride	EPA 300.0	<1.00	mg/L	1.00	12/7/2012
Fluoride	EPA 300.0	1.1	mg/L	0.10	12/7/2012
Sulfate	EPA 300.0	8.4	mg/L	1.0	12/7/2012
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	12/7/2012
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	12/7/2012
Total Dissolved Solids (TDS)	SM 2540C	86	mg/L	10	12/11/2012
Aluminum	EPA 200.7	0.070	mg/L	0.045	12/11/2012
Barium	EPA 200.7	0.049	mg/L	0.010	12/11/2012
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	12/11/2012
Bismuth	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Boron	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	12/11/2012
Calcium	EPA 200.7	18	mg/L	0.50	12/11/2012
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	12/11/2012
Cobalt	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Copper	EPA 200.7	<0.050	mg/L	0.050	12/11/2012
Gallium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Iron	EPA 200.7	0.054	mg/L	0.010	12/11/2012
Lithium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Magnesium	EPA 200.7	3.4	mg/L	0.50	12/11/2012
Manganese	EPA 200.7	0.038	mg/L	0.0050	12/11/2012

Customer Sample ID: CF-11-02 (227-367) WK:24
WETLAB Sample ID: 1212123-001

Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Nickel	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	12/11/2012
Potassium	EPA 200.7	3.8	mg/L	0.50	12/11/2012
Scandium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Silver	EPA 200.7	<0.005	mg/L	0.005	12/11/2012
Sodium	EPA 200.7	0.94	mg/L	0.50	12/11/2012
Strontium	EPA 200.7	0.19	mg/L	0.10	12/11/2012
Tin	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Titanium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Vanadium	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Zinc	EPA 200.7	0.019	mg/L	0.010	12/11/2012
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	12/12/2012
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Lead	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	12/12/2012
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Anions	Calculation	1.40	meq/L	0.10	
Cations	Calculation	1.33	meq/L	0.10	
Error	Calculation	2.5	%	1.0	

Customer Sample ID: CF-11-02 (52-117) WK:24
WETLAB Sample ID: 1212123-002

Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.74	pH Units		12/6/2012
Trace Metals Digestion	EPA 200.2	Complete			12/11/2012
Bicarbonate (HCO3)	SM 2320B	67	mg/L	1.0	12/6/2012
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	12/6/2012
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	12/6/2012
Total Alkalinity	SM 2320B	55	mg/L as CaCO3	1.0	12/6/2012
Chloride	EPA 300.0	<1.00	mg/L	1.00	12/7/2012
Fluoride	EPA 300.0	1.0	mg/L	0.10	12/7/2012
Sulfate	EPA 300.0	12	mg/L	1.0	12/7/2012
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	12/7/2012
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	12/7/2012

Customer Sample ID: CF-11-02 (52-117) WK:24
WETLAB Sample ID: 1212123-002

Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Total Dissolved Solids (TDS)	SM 2540C	100	mg/L	10	12/11/2012
Aluminum	EPA 200.7	0.054	mg/L	0.045	12/11/2012
Barium	EPA 200.7	0.011	mg/L	0.010	12/11/2012
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	12/11/2012
Bismuth	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Boron	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	12/11/2012
Calcium	EPA 200.7	20	mg/L	0.50	12/11/2012
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	12/11/2012
Cobalt	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Copper	EPA 200.7	<0.050	mg/L	0.050	12/11/2012
Gallium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Iron	EPA 200.7	0.012	mg/L	0.010	12/11/2012
Lithium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Magnesium	EPA 200.7	2.4	mg/L	0.50	12/11/2012
Manganese	EPA 200.7	0.032	mg/L	0.0050	12/11/2012
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Nickel	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	12/11/2012
Potassium	EPA 200.7	3.8	mg/L	0.50	12/11/2012
Scandium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Silver	EPA 200.7	<0.005	mg/L	0.005	12/11/2012
Sodium	EPA 200.7	1.0	mg/L	0.50	12/11/2012
Strontium	EPA 200.7	0.16	mg/L	0.10	12/11/2012
Tin	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Titanium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Vanadium	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Zinc	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	12/12/2012
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Lead	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	12/12/2012
Uranium	EPA 200.8	0.013	mg/L	0.0050	12/12/2012
Anions	Calculation	1.40	meq/L	0.10	
Cations	Calculation	1.34	meq/L	0.10	
Error	Calculation	2.1	%	1.0	

Customer Sample ID: K-Spar Breccia 5+ Comp WK:24
WETLAB Sample ID: 1212123-003

Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.84	pH Units		12/6/2012
Trace Metals Digestion	EPA 200.2	Complete			12/11/2012
Bicarbonate (HCO3)	SM 2320B	79	mg/L	1.0	12/6/2012
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	12/6/2012
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	12/6/2012
Total Alkalinity	SM 2320B	65	mg/L as CaCO3	1.0	12/6/2012
Chloride	EPA 300.0	<1.00	mg/L	1.00	12/7/2012
Fluoride	EPA 300.0	1.2	mg/L	0.10	12/7/2012
Sulfate	EPA 300.0	55	mg/L	1.0	12/7/2012
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	12/7/2012
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	12/7/2012
Total Dissolved Solids (TDS)	SM 2540C	170	mg/L	10	12/11/2012
Aluminum	EPA 200.7	<0.045	mg/L	0.045	12/11/2012
Barium	EPA 200.7	0.091	mg/L	0.010	12/11/2012
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	12/11/2012
Bismuth	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Boron	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	12/11/2012
Calcium	EPA 200.7	36	mg/L	0.50	12/11/2012
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	12/11/2012
Cobalt	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Copper	EPA 200.7	<0.050	mg/L	0.050	12/11/2012
Gallium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Iron	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Lithium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Magnesium	EPA 200.7	4.3	mg/L	0.50	12/11/2012
Manganese	EPA 200.7	0.065	mg/L	0.0050	12/11/2012
Molybdenum	EPA 200.7	0.051	mg/L	0.010	12/11/2012
Nickel	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	12/11/2012
Potassium	EPA 200.7	3.4	mg/L	0.50	12/11/2012
Scandium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Silver	EPA 200.7	<0.005	mg/L	0.005	12/11/2012
Sodium	EPA 200.7	1.0	mg/L	0.50	12/11/2012
Strontium	EPA 200.7	0.90	mg/L	0.10	12/11/2012
Tin	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Titanium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Vanadium	EPA 200.7	<0.010	mg/L	0.010	12/11/2012

Customer Sample ID: K-Spar Breccia 5+ Comp WK:24
WETLAB Sample ID: 1212123-003

Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Zinc	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	12/12/2012
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Lead	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	12/12/2012
Uranium	EPA 200.8	0.030	mg/L	0.0050	12/12/2012
Anions	Calculation	2.50	meq/L	0.10	
Cations	Calculation	2.28	meq/L	0.10	
Error	Calculation	4.6	%	1.0	

Customer Sample ID: Biotite Breccia 5+ Comp WK:24
WETLAB Sample ID: 1212123-004

Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.92	pH Units		12/6/2012
Trace Metals Digestion	EPA 200.2	Complete			12/11/2012
Bicarbonate (HCO3)	SM 2320B	86	mg/L	1.0	12/6/2012
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	12/6/2012
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	12/6/2012
Total Alkalinity	SM 2320B	70	mg/L as CaCO3	1.0	12/6/2012
Chloride	EPA 300.0	<1.00	mg/L	1.00	12/7/2012
Fluoride	EPA 300.0	1.5	mg/L	0.10	12/7/2012
Sulfate	EPA 300.0	18	mg/L	1.0	12/7/2012
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	12/7/2012
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	12/7/2012
Total Dissolved Solids (TDS)	SM 2540C	110	mg/L	10	12/11/2012
Aluminum	EPA 200.7	0.049	mg/L	0.045	12/11/2012
Barium	EPA 200.7	0.080	mg/L	0.010	12/11/2012
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	12/11/2012
Bismuth	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Boron	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	12/11/2012
Calcium	EPA 200.7	24	mg/L	0.50	12/11/2012
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	12/11/2012
Cobalt	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Copper	EPA 200.7	<0.050	mg/L	0.050	12/11/2012

Customer Sample ID: Biotite Breccia 5+ Comp WK:24
WETLAB Sample ID: 1212123-004

Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Gallium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Iron	EPA 200.7	0.012	mg/L	0.010	12/11/2012
Lithium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Magnesium	EPA 200.7	5.1	mg/L	0.50	12/11/2012
Manganese	EPA 200.7	0.046	mg/L	0.0050	12/11/2012
Molybdenum	EPA 200.7	0.012	mg/L	0.010	12/11/2012
Nickel	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	12/11/2012
Potassium	EPA 200.7	3.7	mg/L	0.50	12/11/2012
Scandium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Silver	EPA 200.7	<0.005	mg/L	0.005	12/11/2012
Sodium	EPA 200.7	0.84	mg/L	0.50	12/11/2012
Strontium	EPA 200.7	0.41	mg/L	0.10	12/11/2012
Tin	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Titanium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Vanadium	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Zinc	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	12/12/2012
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Lead	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	12/12/2012
Uranium	EPA 200.8	0.0075	mg/L	0.0050	12/12/2012
Anions	Calculation	1.86	meq/L	0.10	
Cations	Calculation	1.76	meq/L	0.10	
Error	Calculation	3.0	%	1.0	

Customer Sample ID: Quartz Monzonite 5+ Comp WK:24
WETLAB Sample ID: 1212123-005

Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.83	pH Units		12/6/2012
Trace Metals Digestion	EPA 200.2	Complete			12/11/2012
Bicarbonate (HCO3)	SM 2320B	73	mg/L	1.0	12/6/2012
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	12/6/2012
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	12/6/2012
Total Alkalinity	SM 2320B	60	mg/L as CaCO3	1.0	12/6/2012

Customer Sample ID: Quartz Monzonite 5+ Comp WK:24
WETLAB Sample ID: 1212123-005

Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Chloride	EPA 300.0	<1.00	mg/L	1.00	12/7/2012
Fluoride	EPA 300.0	1.2	mg/L	0.10	12/7/2012
Sulfate	EPA 300.0	20	mg/L	1.0	12/7/2012
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	12/7/2012
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	12/7/2012
Total Dissolved Solids (TDS)	SM 2540C	110	mg/L	10	12/11/2012
Aluminum	EPA 200.7	<0.045	mg/L	0.045	12/11/2012
Barium	EPA 200.7	0.11	mg/L	0.010	12/11/2012
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	12/11/2012
Bismuth	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Boron	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	12/11/2012
Calcium	EPA 200.7	21	mg/L	0.50	12/11/2012
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	12/11/2012
Cobalt	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Copper	EPA 200.7	<0.050	mg/L	0.050	12/11/2012
Gallium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Iron	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Lithium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Magnesium	EPA 200.7	4.7	mg/L	0.50	12/11/2012
Manganese	EPA 200.7	0.023	mg/L	0.0050	12/11/2012
Molybdenum	EPA 200.7	0.069	mg/L	0.010	12/11/2012
Nickel	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	12/11/2012
Potassium	EPA 200.7	3.4	mg/L	0.50	12/11/2012
Scandium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Silver	EPA 200.7	<0.005	mg/L	0.005	12/11/2012
Sodium	EPA 200.7	1.1	mg/L	0.50	12/11/2012
Strontium	EPA 200.7	0.70	mg/L	0.10	12/11/2012
Tin	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Titanium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Vanadium	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Zinc	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	12/12/2012
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Lead	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012

Customer Sample ID: Quartz Monzonite 5+ Comp WK:24
WETLAB Sample ID: 1212123-005

Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	12/12/2012
Uranium	EPA 200.8	0.017	mg/L	0.0050	12/12/2012
Anions	Calculation	1.68	meq/L	0.10	
Cations	Calculation	1.57	meq/L	0.10	
Error	Calculation	3.3	%	1.0	

Customer Sample ID: Biotite Breccia 0-5 Comp WK:24
WETLAB Sample ID: 1212123-006

Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results		Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.81		pH Units		12/6/2012
Trace Metals Digestion	EPA 200.2	Complete				12/11/2012
Bicarbonate (HCO3)	SM 2320B	65		mg/L	1.0	12/6/2012
Carbonate (CO3)	SM 2320B	<1.0		mg/L	1.0	12/6/2012
Hydroxide (OH)	SM 2320B	<1.0		mg/L	1.0	12/6/2012
Total Alkalinity	SM 2320B	53		mg/L as CaCO3	1.0	12/6/2012
Chloride	EPA 300.0	<1.00		mg/L	1.00	12/7/2012
Fluoride	EPA 300.0	1.5		mg/L	0.10	12/7/2012
Sulfate	EPA 300.0	15		mg/L	1.0	12/7/2012
Nitrate Nitrogen	EPA 300.0	<1.0		mg/L	1.0	12/7/2012
Nitrite Nitrogen	EPA 300.0	<0.025		mg/L	0.025	12/7/2012
Total Dissolved Solids (TDS)	SM 2540C	84	HT	mg/L	10	12/26/2012
Aluminum	EPA 200.7	<0.045		mg/L	0.045	12/11/2012
Barium	EPA 200.7	0.071		mg/L	0.010	12/11/2012
Beryllium	EPA 200.7	<0.0010		mg/L	0.0010	12/11/2012
Bismuth	EPA 200.7	<0.10		mg/L	0.10	12/11/2012
Boron	EPA 200.7	<0.10		mg/L	0.10	12/11/2012
Cadmium	EPA 200.7	<0.0010		mg/L	0.0010	12/11/2012
Calcium	EPA 200.7	19		mg/L	0.50	12/11/2012
Chromium	EPA 200.7	<0.0050		mg/L	0.0050	12/11/2012
Cobalt	EPA 200.7	<0.010		mg/L	0.010	12/11/2012
Copper	EPA 200.7	<0.050		mg/L	0.050	12/11/2012
Gallium	EPA 200.7	<0.10		mg/L	0.10	12/11/2012
Iron	EPA 200.7	0.011		mg/L	0.010	12/11/2012
Lithium	EPA 200.7	<0.10		mg/L	0.10	12/11/2012
Magnesium	EPA 200.7	4.0		mg/L	0.50	12/11/2012
Manganese	EPA 200.7	0.020		mg/L	0.0050	12/11/2012
Molybdenum	EPA 200.7	0.021		mg/L	0.010	12/11/2012

Customer Sample ID: Biotite Breccia 0-5 Comp WK:24
WETLAB Sample ID: 1212123-006
Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Nickel	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	12/11/2012
Potassium	EPA 200.7	2.3	mg/L	0.50	12/11/2012
Scandium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Silver	EPA 200.7	<0.005	mg/L	0.005	12/11/2012
Sodium	EPA 200.7	0.67	mg/L	0.50	12/11/2012
Strontium	EPA 200.7	0.29	mg/L	0.10	12/12/2012
Tin	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Titanium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Vanadium	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Zinc	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	12/12/2012
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Lead	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	12/12/2012
Uranium	EPA 200.8	0.034	mg/L	0.0050	12/12/2012
Anions	Calculation	1.46	meq/L	0.10	
Cations	Calculation	1.37	meq/L	0.10	
Error	Calculation	3.2	%	1.0	

Customer Sample ID: K-Spar Breccia 0-5 Comp WK:24
WETLAB Sample ID: 1212123-007
Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results		Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.78		pH Units		12/6/2012
Trace Metals Digestion	EPA 200.2	Complete				12/11/2012
Bicarbonate (HCO3)	SM 2320B	68		mg/L	1.0	12/6/2012
Carbonate (CO3)	SM 2320B	<1.0		mg/L	1.0	12/6/2012
Hydroxide (OH)	SM 2320B	<1.0		mg/L	1.0	12/6/2012
Total Alkalinity	SM 2320B	56		mg/L as CaCO3	1.0	12/6/2012
Chloride	EPA 300.0	<1.00		mg/L	1.00	12/7/2012
Fluoride	EPA 300.0	1.4		mg/L	0.10	12/7/2012
Sulfate	EPA 300.0	17		mg/L	1.0	12/7/2012
Nitrate Nitrogen	EPA 300.0	<1.0		mg/L	1.0	12/7/2012
Nitrite Nitrogen	EPA 300.0	0.13		mg/L	0.025	12/7/2012
Total Dissolved Solids (TDS)	SM 2540C	94	HT	mg/L	10	12/26/2012

Customer Sample ID: K-Spar Breccia 0-5 Comp WK:24
WETLAB Sample ID: 1212123-007

Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Aluminum	EPA 200.7	<0.045	mg/L	0.045	12/11/2012
Barium	EPA 200.7	0.083	mg/L	0.010	12/11/2012
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	12/11/2012
Bismuth	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Boron	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	12/11/2012
Calcium	EPA 200.7	20	mg/L	0.50	12/11/2012
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	12/11/2012
Cobalt	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Copper	EPA 200.7	<0.050	mg/L	0.050	12/11/2012
Gallium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Iron	EPA 200.7	0.012	mg/L	0.010	12/11/2012
Lithium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Magnesium	EPA 200.7	4.3	mg/L	0.50	12/11/2012
Manganese	EPA 200.7	0.017	mg/L	0.0050	12/11/2012
Molybdenum	EPA 200.7	0.026	mg/L	0.010	12/11/2012
Nickel	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	12/11/2012
Potassium	EPA 200.7	3.0	mg/L	0.50	12/11/2012
Scandium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Silver	EPA 200.7	<0.005	mg/L	0.005	12/11/2012
Sodium	EPA 200.7	0.95	mg/L	0.50	12/11/2012
Strontium	EPA 200.7	0.41	mg/L	0.10	12/12/2012
Tin	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Titanium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Vanadium	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Zinc	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	12/12/2012
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Lead	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	12/12/2012
Uranium	EPA 200.8	0.038	mg/L	0.0050	12/12/2012
Anions	Calculation	1.54	meq/L	0.10	
Cations	Calculation	1.47	meq/L	0.10	
Error	Calculation	2.4	%	1.0	

Customer Sample ID: Quartz Monzonite 0-5 Comp WK:24
WETLAB Sample ID: 1212123-008

Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.88	pH Units		12/6/2012
Trace Metals Digestion	EPA 200.2	Complete			12/11/2012
Bicarbonate (HCO3)	SM 2320B	83	mg/L	1.0	12/6/2012
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	12/6/2012
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	12/6/2012
Total Alkalinity	SM 2320B	68	mg/L as CaCO3	1.0	12/6/2012
Chloride	EPA 300.0	<1.00	mg/L	1.00	12/7/2012
Fluoride	EPA 300.0	1.3	mg/L	0.10	12/7/2012
Sulfate	EPA 300.0	21	mg/L	1.0	12/7/2012
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	12/7/2012
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	12/7/2012
Total Dissolved Solids (TDS)	SM 2540C	100	mg/L	10	12/20/2012
Aluminum	EPA 200.7	<0.045	mg/L	0.045	12/11/2012
Barium	EPA 200.7	0.16	mg/L	0.010	12/11/2012
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	12/11/2012
Bismuth	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Boron	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	12/11/2012
Calcium	EPA 200.7	26	mg/L	0.50	12/11/2012
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	12/11/2012
Cobalt	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Copper	EPA 200.7	<0.050	mg/L	0.050	12/11/2012
Gallium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Iron	EPA 200.7	0.010	mg/L	0.010	12/11/2012
Lithium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Magnesium	EPA 200.7	4.7	mg/L	0.50	12/11/2012
Manganese	EPA 200.7	0.025	mg/L	0.0050	12/11/2012
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	12/12/2012
Nickel	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	12/11/2012
Potassium	EPA 200.7	2.5	mg/L	0.50	12/11/2012
Scandium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Silver	EPA 200.7	<0.005	mg/L	0.005	12/11/2012
Sodium	EPA 200.7	0.87	mg/L	0.50	12/11/2012
Strontium	EPA 200.7	0.38	mg/L	0.10	12/12/2012
Tin	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Titanium	EPA 200.7	<0.10	mg/L	0.10	12/11/2012
Vanadium	EPA 200.7	<0.010	mg/L	0.010	12/11/2012

Customer Sample ID: Quartz Monzonite 0-5 Comp WK:24
WETLAB Sample ID: 1212123-008

Collect Date/Time: 12/6/2012 09:00
Receive Date: 12/6/2012 15:05

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Zinc	EPA 200.7	<0.010	mg/L	0.010	12/11/2012
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	12/12/2012
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Lead	EPA 200.8	<0.0025	mg/L	0.0025	12/12/2012
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	12/12/2012
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	12/12/2012
Uranium	EPA 200.8	0.034	mg/L	0.0050	12/12/2012
Anions	Calculation	1.87	meq/L	0.10	
Cations	Calculation	1.79	meq/L	0.10	
Error	Calculation	2.2	%	1.0	

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC12120272	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC12120272	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC12120272	Blank 3	Fluoride	EPA 300.0	<0.10	mg/L
QC12120279	Blank 1	Chloride	EPA 300.0	<1.0	mg/L
QC12120279	Blank 2	Chloride	EPA 300.0	<1.0	mg/L
QC12120279	Blank 3	Chloride	EPA 300.0	<1.0	mg/L
QC12120284	Blank 1	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC12120284	Blank 2	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC12120284	Blank 3	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC12120289	Blank 1	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC12120289	Blank 2	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC12120289	Blank 3	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC12120294	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC12120294	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC12120294	Blank 3	Sulfate	EPA 300.0	<1.0	mg/L
QC12120379	Blank 1	Aluminum	EPA 200.7	<0.045	mg/L
		Barium	EPA 200.7	<0.010	mg/L
		Beryllium	EPA 200.7	<0.0010	mg/L
		Bismuth	EPA 200.7	<0.10	mg/L
		Boron	EPA 200.7	<0.10	mg/L
		Cadmium	EPA 200.7	<0.0010	mg/L
		Calcium	EPA 200.7	<0.50	mg/L
		Chromium	EPA 200.7	<0.0050	mg/L
		Cobalt	EPA 200.7	<0.010	mg/L
		Copper	EPA 200.7	<0.050	mg/L
		Gallium	EPA 200.7	<0.10	mg/L
		Iron	EPA 200.7	<0.010	mg/L
		Lithium	EPA 200.7	<0.10	mg/L
		Magnesium	EPA 200.7	<0.50	mg/L
		Manganese	EPA 200.7	<0.0050	mg/L
		Molybdenum	EPA 200.7	<0.010	mg/L
		Nickel	EPA 200.7	<0.010	mg/L
		Phosphorus	EPA 200.7	<0.50	mg/L
		Potassium	EPA 200.7	<0.50	mg/L
		Scandium	EPA 200.7	<0.10	mg/L
		Silver	EPA 200.7	<0.0050	mg/L
		Sodium	EPA 200.7	<0.50	mg/L
		Strontium	EPA 200.7	<0.10	mg/L
		Tin	EPA 200.7	<0.10	mg/L
		Titanium	EPA 200.7	<0.10	mg/L
		Vanadium	EPA 200.7	<0.010	mg/L
		Zinc	EPA 200.7	<0.010	mg/L
QC12120381	Blank 1	Aluminum, Dissolved	EPA 200.7	<0.045	mg/L
		Barium, Dissolved	EPA 200.7	<0.010	mg/L
		Beryllium, Dissolved	EPA 200.7	<0.0010	mg/L
		Bismuth, Dissolved	EPA 200.7	<0.10	mg/L
		Boron, Dissolved	EPA 200.7	<0.10	mg/L

QCBatchID	QCType	Parameter	Method	Result	Units
		Cadmium, Dissolved	EPA 200.7	<0.0010	mg/L
		Calcium, Dissolved	EPA 200.7	<0.50	mg/L
		Chromium, Dissolved	EPA 200.7	<0.0050	mg/L
		Cobalt, Dissolved	EPA 200.7	<0.010	mg/L
		Copper, Dissolved	EPA 200.7	<0.050	mg/L
		Gallium, Dissolved	EPA 200.7	<0.10	mg/L
		Iron, Dissolved	EPA 200.7	<0.010	mg/L
		Lithium, Dissolved	EPA 200.7	<0.10	mg/L
		Magnesium, Dissolved	EPA 200.7	<0.50	mg/L
		Manganese, Dissolved	EPA 200.7	<0.0050	mg/L
		Molybdenum, Dissolved	EPA 200.7	<0.010	mg/L
		Nickel, Dissolved	EPA 200.7	<0.010	mg/L
		Phosphorus, Dissolved	EPA 200.7	<0.50	mg/L
		Potassium, Dissolved	EPA 200.7	<0.50	mg/L
		Scandium, Dissolved	EPA 200.7	<0.10	mg/L
		Silver, Dissolved	EPA 200.7	<0.0050	mg/L
		Sodium, Dissolved	EPA 200.7	<0.50	mg/L
		Strontium, Dissolved	EPA 200.7	<0.10	mg/L
		Tin, Dissolved	EPA 200.7	<0.10	mg/L
		Titanium, Dissolved	EPA 200.7	<0.10	mg/L
		Vanadium, Dissolved	EPA 200.7	<0.010	mg/L
		Zinc, Dissolved	EPA 200.7	<0.010	mg/L
QC12120428	Blank 1	Mercury	EPA 200.8	<0.00010	mg/L
		Antimony	EPA 200.8	<0.0025	mg/L
		Arsenic	EPA 200.8	<0.0050	mg/L
		Lead	EPA 200.8	<0.0025	mg/L
		Selenium	EPA 200.8	<0.0050	mg/L
		Thallium	EPA 200.8	<0.0010	mg/L
		Uranium	EPA 200.8	<0.0050	mg/L
QC12120429	Blank 1	Uranium, Dissolved	EPA 200.8	<0.0050	mg/L
		Mercury, Dissolved	EPA 200.8	<0.00010	mg/L
		Antimony, Dissolved	EPA 200.8	<0.0025	mg/L
		Arsenic, Dissolved	EPA 200.8	<0.0050	mg/L
		Lead, Dissolved	EPA 200.8	<0.0025	mg/L
		Selenium, Dissolved	EPA 200.8	<0.0050	mg/L
		Thallium, Dissolved	EPA 200.8	<0.0010	mg/L
QC12120479	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC12120479	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC12120749	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC12120231	LCS 1	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC12120231	LCS 2	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC12120231	LCS 3	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC12120231	LCS 4	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC12120237	LCS 1	Total Alkalinity	SM 2320B	100.0	100	100	mg/L
QC12120237	LCS 2	Total Alkalinity	SM 2320B	99.8	100	100	mg/L
QC12120237	LCS 3	Total Alkalinity	SM 2320B	99.6	100	100	mg/L
QC12120237	LCS 4	Total Alkalinity	SM 2320B	99.7	100	100	mg/L
QC12120237	LCS 5	Total Alkalinity	SM 2320B	100	100	100	mg/L
QC12120272	LCS 1	Fluoride	EPA 300.0	1.85	2.00	93	mg/L
QC12120279	LCS 1	Chloride	EPA 300.0	10.2	10.0	102	mg/L
QC12120284	LCS 1	Nitrite Nitrogen	EPA 300.0	0.542	0.500	108	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC12120289	LCS 1	Nitrate Nitrogen	EPA 300.0	1.97	2.00	98	mg/L
QC12120289	LCS 2	Nitrate Nitrogen	EPA 300.0		2.00		mg/L
QC12120294	LCS 1	Sulfate	EPA 300.0	24.0	25.0	96	mg/L
QC12120379	LCS 1	Aluminum	EPA 200.7	0.977	1.00	98	mg/L
		Barium	EPA 200.7	0.965	1.00	96	mg/L
		Beryllium	EPA 200.7	0.967	1.00	97	mg/L
		Bismuth	EPA 200.7	1.00	1.00	100	mg/L
		Boron	EPA 200.7	0.936	1.00	94	mg/L
		Cadmium	EPA 200.7	0.967	1.00	97	mg/L
		Calcium	EPA 200.7	9.64	10.0	96	mg/L
		Chromium	EPA 200.7	0.957	1.00	96	mg/L
		Cobalt	EPA 200.7	0.964	1.00	96	mg/L
		Copper	EPA 200.7	4.76	5.00	95	mg/L
		Gallium	EPA 200.7	0.969	1.00	97	mg/L
		Iron	EPA 200.7	0.971	1.00	97	mg/L
		Lithium	EPA 200.7	0.977	1.00	98	mg/L
		Magnesium	EPA 200.7	9.54	10.0	95	mg/L
		Manganese	EPA 200.7	0.961	1.00	96	mg/L
		Molybdenum	EPA 200.7	0.966	1.00	97	mg/L
		Nickel	EPA 200.7	4.82	5.00	96	mg/L
		Phosphorus	EPA 200.7	4.79	5.00	96	mg/L
		Potassium	EPA 200.7	9.69	10.0	97	mg/L
		Scandium	EPA 200.7	0.969	1.00	97	mg/L
		Silver	EPA 200.7	0.088	0.090	98	mg/L
		Sodium	EPA 200.7	9.47	10.0	95	mg/L
		Strontium	EPA 200.7	1.03	1.00	103	mg/L
		Tin	EPA 200.7	0.945	1.00	94	mg/L
		Titanium	EPA 200.7	0.986	1.00	99	mg/L
		Vanadium	EPA 200.7	0.964	1.00	96	mg/L
		Zinc	EPA 200.7	0.957	1.00	96	mg/L
QC12120381	LCS 1	Aluminum, Dissolved	EPA 200.7	0.992	1.00	99	mg/L
		Barium, Dissolved	EPA 200.7	0.971	1.00	97	mg/L
		Beryllium, Dissolved	EPA 200.7	0.961	1.00	96	mg/L
		Bismuth, Dissolved	EPA 200.7	0.992	1.00	99	mg/L
		Boron, Dissolved	EPA 200.7	0.937	1.00	94	mg/L
		Cadmium, Dissolved	EPA 200.7	0.962	1.00	96	mg/L
		Calcium, Dissolved	EPA 200.7	9.54	10.0	95	mg/L
		Chromium, Dissolved	EPA 200.7	0.962	1.00	96	mg/L
		Cobalt, Dissolved	EPA 200.7	0.959	1.00	96	mg/L
		Copper, Dissolved	EPA 200.7	4.75	5.00	95	mg/L
		Gallium, Dissolved	EPA 200.7	0.974	1.00	97	mg/L
		Iron, Dissolved	EPA 200.7	0.973	1.00	97	mg/L
		Lithium, Dissolved	EPA 200.7	0.980	1.00	98	mg/L
		Magnesium, Dissolved	EPA 200.7	9.64	10.0	96	mg/L
		Manganese, Dissolved	EPA 200.7	0.954	1.00	95	mg/L
		Molybdenum, Dissolved	EPA 200.7	0.981	1.00	98	mg/L
		Nickel, Dissolved	EPA 200.7	4.83	5.00	97	mg/L
		Phosphorus, Dissolved	EPA 200.7	4.73	5.00	95	mg/L
		Potassium, Dissolved	EPA 200.7	9.83	10.0	98	mg/L
		Scandium, Dissolved	EPA 200.7	0.978	1.00	98	mg/L
		Silver, Dissolved	EPA 200.7	0.088	0.090	98	mg/L
		Sodium, Dissolved	EPA 200.7	9.09	10.0	91	mg/L
		Strontium, Dissolved	EPA 200.7	1.06	1.00	106	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
		Tin, Dissolved	EPA 200.7	0.951	1.00	95	mg/L
		Titanium, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
		Vanadium, Dissolved	EPA 200.7	0.974	1.00	97	mg/L
		Zinc, Dissolved	EPA 200.7	0.945	1.00	94	mg/L
QC12120428	LCS 1	Mercury	EPA 200.8	0.000900	0.001	90	mg/L
		Antimony	EPA 200.8	0.0093	0.010	92	mg/L
		Arsenic	EPA 200.8	0.0492	0.050	98	mg/L
		Lead	EPA 200.8	0.0091	0.010	91	mg/L
		Selenium	EPA 200.8	0.0460	0.050	92	mg/L
		Thallium	EPA 200.8	0.0091	0.010	91	mg/L
		Uranium	EPA 200.8	0.0088	0.010	88	mg/L
QC12120429	LCS 1	Uranium, Dissolved	EPA 200.8	0.0094	0.010	94	mg/L
		Mercury, Dissolved	EPA 200.8	0.000957	0.001	96	mg/L
		Antimony, Dissolved	EPA 200.8	0.0094	0.010	94	mg/L
		Arsenic, Dissolved	EPA 200.8	0.0474	0.050	95	mg/L
		Lead, Dissolved	EPA 200.8	0.0094	0.010	94	mg/L
		Selenium, Dissolved	EPA 200.8	0.0442	0.050	88	mg/L
		Thallium, Dissolved	EPA 200.8	0.0093	0.010	93	mg/L
QC12120479	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	143	150	95	mg/L
QC12120479	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	143	150	95	mg/L
QC12120749	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	148	150	99	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC12120231	Duplicate	pH	SM 4500-H+ B	1212098-001	5.77	5.75	pH Units	<1%
QC12120231	Duplicate	pH	SM 4500-H+ B	1212101-001	7.68	7.66	pH Units	<1%
QC12120231	Duplicate	pH	SM 4500-H+ B	1212110-003	11.3	11.3	pH Units	1 %
QC12120231	Duplicate	pH	SM 4500-H+ B	1212122-001	7.66	7.64	pH Units	<1%
QC12120231	Duplicate	pH	SM 4500-H+ B	1212123-007	7.78	7.83	pH Units	1 %
QC12120231	Duplicate	pH	SM 4500-H+ B	1212130-001	7.65	7.66	pH Units	<1%
QC12120231	Duplicate	pH	SM 4500-H+ B	1212130-007	8.12	8.14	pH Units	<1%
QC12120237	Duplicate	Bicarbonate (HCO3)	SM 2320B	1212098-001	5.49	5.28	mg/L	4 %
		Carbonate (CO3)	SM 2320B	1212098-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1212098-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1212098-001	4.50	4.33	mg/L as CaCO3	4 %
QC12120237	Duplicate	Bicarbonate (HCO3)	SM 2320B	1212101-001	208	207	mg/L	1 %
		Carbonate (CO3)	SM 2320B	1212101-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1212101-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1212101-001	171	169	mg/L as CaCO3	1 %
QC12120237	Duplicate	Bicarbonate (HCO3)	SM 2320B	1212110-003	<1.000	<1.000	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1212110-003	60.1	62.1	mg/L	3 %
		Hydroxide (OH)	SM 2320B	1212110-003	57.3	60.4	mg/L	5 %
		Total Alkalinity	SM 2320B	1212110-003	268	281	mg/L as CaCO3	5 %
QC12120237	Duplicate	Bicarbonate (HCO3)	SM 2320B	1212122-001	50.3	48.2	mg/L	4 %
		Carbonate (CO3)	SM 2320B	1212122-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1212122-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1212122-001	41.3	39.6	mg/L as CaCO3	4 %

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC12120237	Duplicate	Bicarbonate (HCO3)	SM 2320B	1212123-007	68.2	68.3	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1212123-007	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1212123-007	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1212123-007	55.9	56.0	mg/L as CaCO3	<1%
QC12120237	Duplicate	Bicarbonate (HCO3)	SM 2320B	1212130-001	126	125	mg/L	1 %
		Carbonate (CO3)	SM 2320B	1212130-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1212130-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1212130-001	103	103	mg/L as CaCO3	1 %
QC12120237	Duplicate	Bicarbonate (HCO3)	SM 2320B	1212130-007	133	133	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1212130-007	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1212130-007	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1212130-007	109	109	mg/L as CaCO3	<1%
QC12120479	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1212022-001	1940	1990	mg/L	3 %
QC12120479	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1212109-003	402	407	mg/L	1 %
QC12120479	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1212145-003	781	845 Q	mg/L	8 %
QC12120479	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1212152-005	300	286	mg/L	5 %
QC12120749	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1212319-001	1408	1442	mg/L	2 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC12120272	MS 1	Fluoride	EPA 300.0	1212122-001	<0.100	1.78	1.81	2.00	mg/L	88	89	2 %
QC12120272	MS 2	Fluoride	EPA 300.0	1212137-001	0.916 M	2.44	2.49	2.00	mg/L	NC	NC	NC
QC12120279	MS 1	Chloride	EPA 300.0	1212122-001	<1.000	5.14	5.29	5.00	mg/L	102	105	3 %
QC12120279	MS 2	Chloride	EPA 300.0	1212137-001	2.57	7.29	7.42	5.00	mg/L	94	97	2 %
QC12120284	MS 1	Nitrite Nitrogen	EPA 300.0	1212122-001	<0.025	0.540	0.557	0.500	mg/L	108	111	3 %
QC12120284	MS 2	Nitrite Nitrogen	EPA 300.0	1212137-001	0.064	0.526	0.540	0.500	mg/L	92	95	3 %
QC12120289	MS 1	Nitrate Nitrogen	EPA 300.0	1212122-001	<1.000	1.88	1.94	2.00	mg/L	93	96	3 %
QC12120289	MS 2	Nitrate Nitrogen	EPA 300.0	1212137-001	<1.000	1.82	1.88	2.00	mg/L	89	91	3 %
QC12120294	MS 1	Sulfate	EPA 300.0	1212122-001	4.62	14.4	14.6	10.0	mg/L	97	100	1 %
QC12120294	MS 2	Sulfate	EPA 300.0	1212137-001	1.09	10.6	10.8	10.0	mg/L	95	98	2 %
QC12120379	MS 1	Aluminum	EPA 200.7	1212110-003	1.47 M	3.24	3.25	1.00	mg/L	NC	NC	NC
		Barium	EPA 200.7	1212110-003	0.190	1.14	0.981	1.00	mg/L	95	79	15 %
		Beryllium	EPA 200.7	1212110-003	<0.001	0.970	0.975	1.00	mg/L	97	97	1 %
		Bismuth	EPA 200.7	1212110-003	<0.100	0.963	0.975	1.00	mg/L	97	98	1 %
		Boron	EPA 200.7	1212110-003	0.123	1.12	1.13	1.00	mg/L	100	101	1 %
		Cadmium	EPA 200.7	1212110-003	<0.001	0.939	0.949	1.00	mg/L	94	95	1 %
		Calcium	EPA 200.7	1212110-003	66.1	74.8	76.5	10.0	mg/L	87	104	2 %
		Chromium	EPA 200.7	1212110-003	<0.005	0.934	0.943	1.00	mg/L	93	94	1 %
		Cobalt	EPA 200.7	1212110-003	<0.010	0.942	0.954	1.00	mg/L	94	95	1 %
		Copper	EPA 200.7	1212110-003	<0.050	5.04	5.11	5.00	mg/L	100	102	1 %
		Gallium	EPA 200.7	1212110-003	<0.100	0.957	0.967	1.00	mg/L	95	96	1 %
		Iron	EPA 200.7	1212110-003	1.44	2.65	2.66	1.00	mg/L	121	122	<1%
		Lithium	EPA 200.7	1212110-003	<0.100	1.00	1.01	1.00	mg/L	93	94	1 %
		Magnesium	EPA 200.7	1212110-003	0.628	10.2	10.2	10.0	mg/L	96	96	<1%
		Manganese	EPA 200.7	1212110-003	0.024	0.951	0.963	1.00	mg/L	93	94	1 %
		Molybdenum	EPA 200.7	1212110-003	0.074	1.05	1.07	1.00	mg/L	98	100	2 %
		Nickel	EPA 200.7	1212110-003	<0.010	4.70	4.74	5.00	mg/L	94	95	1 %
		Phosphorus	EPA 200.7	1212110-003	<0.500	5.13	5.15	5.00	mg/L	99	99	<1%

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Potassium	EPA 200.7	1212110-003	12.9	22.6	23.0	10.0	mg/L	97	101	2 %
		Scandium	EPA 200.7	1212110-003	<0.100	0.983	0.993	1.00	mg/L	98	99	1 %
		Silver	EPA 200.7	1212110-003	<0.005	0.089	0.088	0.090	mg/L	99	98	1 %
		Sodium	EPA 200.7	1212110-003	125	133	135	10.0	mg/L	80	100	1 %
		Strontium	EPA 200.7	1212110-003	2.76	3.76	3.87	1.00	mg/L	100	111	3 %
		Tin	EPA 200.7	1212110-003	<0.100	0.916	0.935	1.00	mg/L	95	97	2 %
		Titanium	EPA 200.7	1212110-003	<0.100	1.02	1.04	1.00	mg/L	101	103	2 %
		Vanadium	EPA 200.7	1212110-003	0.029	1.02	0.976	1.00	mg/L	99	95	4 %
		Zinc	EPA 200.7	1212110-003	<0.010	0.970	0.976	1.00	mg/L	97	97	1 %
QC12120381	MS 1	Aluminum, Dissolved	EPA 200.7	1212133-001	<0.045	1.02	1.02	1.00	mg/L	102	102	<1%
		Barium, Dissolved	EPA 200.7	1212133-001	0.089	1.05	1.04	1.00	mg/L	96	95	1 %
		Beryllium, Dissolved	EPA 200.7	1212133-001	<0.001	0.963	0.960	1.00	mg/L	96	96	<1%
		Bismuth, Dissolved	EPA 200.7	1212133-001	<0.100	0.975	0.975	1.00	mg/L	98	98	<1%
		Boron, Dissolved	EPA 200.7	1212133-001	0.231	1.21	1.20	1.00	mg/L	98	97	1 %
		Cadmium, Dissolved	EPA 200.7	1212133-001	<0.001	0.945	0.942	1.00	mg/L	95	94	<1%
		Calcium, Dissolved	EPA 200.7	1212133-001	35.9	46.0	45.0	10.0	mg/L	101	91	2 %
		Chromium, Dissolved	EPA 200.7	1212133-001	<0.005	0.936	0.935	1.00	mg/L	94	93	<1%
		Cobalt, Dissolved	EPA 200.7	1212133-001	<0.010	0.945	0.940	1.00	mg/L	94	94	1 %
		Copper, Dissolved	EPA 200.7	1212133-001	<0.050	5.00	4.99	5.00	mg/L	100	100	<1%
		Gallium, Dissolved	EPA 200.7	1212133-001	<0.100	0.970	0.968	1.00	mg/L	97	96	<1%
		Iron, Dissolved	EPA 200.7	1212133-001	<0.010	0.972	0.961	1.00	mg/L	97	96	1 %
		Lithium, Dissolved	EPA 200.7	1212133-001	<0.100	0.953	0.956	1.00	mg/L	94	94	<1%
		Magnesium, Dissolved	EPA 200.7	1212133-001	9.63	19.1	18.8	10.0	mg/L	95	92	2 %
		Manganese, Dissolved	EPA 200.7	1212133-001	<0.005	0.930	0.926	1.00	mg/L	94	93	<1%
		Molybdenum, Dissolved	EPA 200.7	1212133-001	<0.010	0.971	0.974	1.00	mg/L	97	97	<1%
		Nickel, Dissolved	EPA 200.7	1212133-001	<0.010	4.69	4.68	5.00	mg/L	94	94	<1%
		Phosphorus, Dissolved	EPA 200.7	1212133-001	<0.500	4.97	4.96	5.00	mg/L	98	98	<1%
		Potassium, Dissolved	EPA 200.7	1212133-001	4.23	13.9	13.8	10.0	mg/L	97	96	1 %
		Scandium, Dissolved	EPA 200.7	1212133-001	<0.100	0.981	0.980	1.00	mg/L	NC	NC	NC
		Silver, Dissolved	EPA 200.7	1212133-001	<0.005	0.089	0.089	0.090	mg/L	98	98	<1%
		Sodium, Dissolved	EPA 200.7	1212133-001	80.7	89.8	87.7	10.0	mg/L	91	70	2 %
		Strontium, Dissolved	EPA 200.7	1212133-001	0.323	1.40	1.40	1.00	mg/L	108	108	<1%
		Tin, Dissolved	EPA 200.7	1212133-001	<0.100	0.910	0.915	1.00	mg/L	94	94	1 %
		Titanium, Dissolved	EPA 200.7	1212133-001	<0.100	0.989	0.990	1.00	mg/L	99	99	<1%
		Vanadium, Dissolved	EPA 200.7	1212133-001	<0.010	0.998	0.997	1.00	mg/L	99	99	<1%
		Zinc, Dissolved	EPA 200.7	1212133-001	<0.010	0.951	0.948	1.00	mg/L	95	95	<1%
QC12120428	MS 1	Mercury	EPA 200.8	1212110-003	<0.00010	0.000909	0.000862	0.001	mg/L	84	80	5 %
		Antimony	EPA 200.8	1212110-003	<0.0025	0.0102	0.0103	0.010	mg/L	89	90	1 %
		Arsenic	EPA 200.8	1212110-003	0.0143	0.0633	0.0642	0.050	mg/L	98	100	1 %
		Lead	EPA 200.8	1212110-003	0.0037	0.0122	0.0123	0.010	mg/L	85	85	1 %
		Selenium	EPA 200.8	1212110-003	<0.0050	0.0425	0.0430	0.050	mg/L	82	83	1 %
		Thallium	EPA 200.8	1212110-003	<0.0010	0.0083	0.0083	0.010	mg/L	82	83	<1%
		Uranium	EPA 200.8	1212110-003	<0.0050	0.0091	0.0091	0.010	mg/L	91	91	<1%
QC12120429	MS 1	Uranium, Dissolved	EPA 200.8	1212133-001	<0.0050	0.0099	0.0098	0.010	mg/L	97	96	1 %
		Mercury, Dissolved	EPA 200.8	1212133-001	<0.00010	0.000882	0.000893	0.001	mg/L	87	88	1 %
		Antimony, Dissolved	EPA 200.8	1212133-001	<0.0025	0.0098	0.0098	0.010	mg/L	95	95	<1%
		Arsenic, Dissolved	EPA 200.8	1212133-001	<0.0050	0.0493	0.0494	0.050	mg/L	98	98	<1%
		Lead, Dissolved	EPA 200.8	1212133-001	<0.0025	0.0092	0.0091	0.010	mg/L	92	91	1 %
		Selenium, Dissolved	EPA 200.8	1212133-001	<0.0050	0.0441	0.0450	0.050	mg/L	85	87	2 %
		Thallium, Dissolved	EPA 200.8	1212133-001	<0.0010	0.0088	0.0087	0.010	mg/L	87	87	1 %

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1212123
Report Due Date: 12/20/12
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company ______
Address ______
City, State & Zip ______
Contact ______
Phone ______
Fax ______
Email ______

Additional Information
Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes
DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

Analyses Requested

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
CF-11-02 (227-367)	Wk:24	12/06/12	9:00	ww	2	X	X									1
CF-11-02 (52-117)	↓	↓	↓	↓	↓	↓	↓									2
K-Spar Breccia 5+ Comp	↓	↓	↓	↓	↓	↓	↓									3
Biotite Breccia 5+ Comp	↓	↓	↓	↓	↓	↓	↓									4
Quartz Monzonite 5+ Comp	↓	↓	↓	↓	↓	↓	↓									5
Biotite Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓									6
K-Spar Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓									7
Quartz Monzonite 0-5 Comp	↓	↓	↓	↓	↓	↓	↓									5 8

1212 \
123 8

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 19.8°C	12/6/12	3:05p		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 16				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

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475 E. Greg Street #119 | Sparks, Nevada 89431
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Lab Number 1212123
Report Due Date: 12/20/12
Page 1 of 1

Client McClelland Laboratories, Inc.	
Address 1016 Greg Street	
City, State & Zip Sparks, NV 89431	
Contact Mike Medina	
Phone 775-356-1300	Collector's Name Robert
Fax 775-356-8917	Project Name
P.O. Number	Project Number 3438
Email mli@mettest.com	

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company ______
Address ______
City, State & Zip ______
Contact ______
Phone ______
Fax ______
Email ______

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
CF-11-02 (227-367)	Wk:24	12/06/12	9:00	WW	2	X	X									1
CF-11-02 (52-117)	↓	↓	↓	↓	↓	↓	↓									2
K-Spar Breccia 5+ Comp	↓	↓	↓	↓	↓	↓	↓									3
Biotite Breccia 5+ Comp	↓	↓	↓	↓	↓	↓	↓									4
Quartz Monzonite 5+ Comp	↓	↓	↓	↓	↓	↓	↓									5
Biotite Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓									6
K-Spar Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓									7
Quartz Monzonite 0-5 Comp	↓	↓	↓	↓	↓	↓	↓									8

1212 \ 5 8
123 8

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 19.8°C	12/6/12	3:05p	Dee	
Custody Seals Intact? Y N [✓ None]				
Number of Containers 16				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

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Specializing in Soil, Hazardous Waste and Water Analysis.

1/15/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1212419*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 12/20/2012. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Andy Smith
QA Manager

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1212419

General Comments

None

Specific Comments

The matrix spike/matrix spike duplicate (MS/MSD) values for the analysis of Fluoride on sample 1212419-002 were outside laboratory acceptance criteria; however, the relative percent difference (RPD) value was acceptable, indicating probable matrix interference. The reported result should be considered an estimate.

Data Qualifier Legend

B -- Blank contamination; Analyte detected above the method reporting limit in an associated blank

HT -- Sample held beyond the accepted holding time

J -- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit

M -- Reported value is estimated; The sample matrix interfered with the analysis

N -- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.

NC -- Not calculated due to matrix interference

Q -- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy

S -- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.

SC -- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438 Wk: 32*

Date Printed: 1/15/2013
OrderID: *1212419*

Customer Sample ID: CF-11-02 (0-27) Wk:32
WETLAB Sample ID: 1212419-001

Collect Date/Time: 12/20/2012 09:00
Receive Date: 12/20/2012 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.89	pH Units		12/20/2012
Trace Metals Digestion	EPA 200.2	Complete			12/27/2012
Bicarbonate (HCO3)	SM 2320B	54	mg/L	1.0	12/20/2012
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	12/20/2012
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	12/20/2012
Total Alkalinity	SM 2320B	44	mg/L as CaCO3	1.0	12/20/2012
Chloride	EPA 300.0	<1.00	mg/L	1.00	12/21/2012
Fluoride	EPA 300.0	0.97	mg/L	0.10	12/21/2012
Sulfate	EPA 300.0	18	mg/L	1.0	12/21/2012
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	12/21/2012
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	12/21/2012
Total Dissolved Solids (TDS)	SM 2540C	58	mg/L	10	12/26/2012
Aluminum	EPA 200.7	0.058	mg/L	0.045	1/4/2013
Barium	EPA 200.7	<0.010	mg/L	0.010	1/4/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	1/4/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	1/4/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	1/4/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	1/4/2013
Calcium	EPA 200.7	17	mg/L	0.50	1/4/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	1/4/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	1/4/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	1/4/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	1/4/2013
Iron	EPA 200.7	0.013	mg/L	0.010	1/4/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	1/4/2013
Magnesium	EPA 200.7	3.0	mg/L	0.50	1/4/2013
Manganese	EPA 200.7	0.026	mg/L	0.0050	1/4/2013

Customer Sample ID: CF-11-02 (0-27) Wk:32 **Collect Date/Time:** 12/20/2012 09:00
WETLAB Sample ID: 1212419-001 **Receive Date:** 12/20/2012 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	1/4/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/4/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/4/2013
Potassium	EPA 200.7	1.6	mg/L	0.50	1/4/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/4/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/4/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	1/4/2013
Strontium	EPA 200.7	0.14	mg/L	0.10	1/4/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/4/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/4/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/4/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	1/4/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	12/28/2012
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	12/28/2012
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	12/28/2012
Lead	EPA 200.8	<0.0025	mg/L	0.0025	12/28/2012
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	12/28/2012
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	12/28/2012
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	12/28/2012
Anions	Calculation	1.31	meq/L	0.10	
Cations	Calculation	1.14	meq/L	0.10	
Error	Calculation	6.8	%	1.0	

Customer Sample ID: CF-11-02 (367-408) Wk: 32 **Collect Date/Time:** 12/20/2012 09:00
WETLAB Sample ID: 1212419-002 **Receive Date:** 12/20/2012 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.40	pH Units		12/20/2012
Trace Metals Digestion	EPA 200.2	Complete			12/27/2012
Bicarbonate (HCO3)	SM 2320B	37	mg/L	1.0	12/20/2012
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	12/20/2012
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	12/20/2012
Total Alkalinity	SM 2320B	30	mg/L as CaCO3	1.0	12/20/2012
Chloride	EPA 300.0	<1.00	mg/L	1.00	12/21/2012
Fluoride	EPA 300.0	0.97 M	mg/L	0.10	12/21/2012
Sulfate	EPA 300.0	8.7	mg/L	1.0	12/21/2012
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	12/21/2012
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	12/21/2012

Customer Sample ID: CF-11-02 (367-408) Wk: 32
WETLAB Sample ID: 1212419-002

Collect Date/Time: 12/20/2012 09:00
Receive Date: 12/20/2012 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Total Dissolved Solids (TDS)	SM 2540C	45	mg/L	10	12/26/2012
Aluminum	EPA 200.7	0.12	mg/L	0.045	1/4/2013
Barium	EPA 200.7	<0.010	mg/L	0.010	1/4/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	1/4/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	1/4/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	1/4/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	1/4/2013
Calcium	EPA 200.7	13	mg/L	0.50	1/4/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	1/4/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	1/4/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	1/4/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	1/4/2013
Iron	EPA 200.7	0.010	mg/L	0.010	1/4/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	1/4/2013
Magnesium	EPA 200.7	0.53	mg/L	0.50	1/4/2013
Manganese	EPA 200.7	0.022	mg/L	0.0050	1/4/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	1/4/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/4/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/4/2013
Potassium	EPA 200.7	1.1	mg/L	0.50	1/4/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/4/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/4/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	1/4/2013
Strontium	EPA 200.7	0.12	mg/L	0.10	1/4/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/4/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/4/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/4/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	1/4/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	12/28/2012
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	12/28/2012
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	12/28/2012
Lead	EPA 200.8	<0.0025	mg/L	0.0025	12/28/2012
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	12/28/2012
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	12/28/2012
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	12/28/2012
Anions	Calculation	0.84	meq/L	0.10	
Cations	Calculation	0.74	meq/L	0.10	
Error	Calculation	6.6	%	1.0	

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC12120770	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC12120770	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC12120770	Blank 3	Fluoride	EPA 300.0	<0.10	mg/L
QC12120772	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC12120772	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC12120772	Blank 3	Fluoride	EPA 300.0	<0.10	mg/L
QC12120776	Blank 1	Chloride	EPA 300.0	<1.0	mg/L
QC12120776	Blank 2	Chloride	EPA 300.0	<1.0	mg/L
QC12120776	Blank 3	Chloride	EPA 300.0	<1.0	mg/L
QC12120779	Blank 1	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC12120779	Blank 2	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC12120779	Blank 3	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC12120780	Blank 1	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC12120780	Blank 2	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC12120780	Blank 3	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC12120784	Blank 1	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC12120784	Blank 2	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC12120784	Blank 3	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC12120786	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC12120786	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC12120786	Blank 3	Sulfate	EPA 300.0	<1.0	mg/L
QC12120787	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC12120787	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC12120787	Blank 3	Sulfate	EPA 300.0	<1.0	mg/L
QC12120885	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC12120885	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13010002	Blank 1	Mercury	EPA 200.8	<0.00010	mg/L
		Antimony	EPA 200.8	<0.0025	mg/L
		Arsenic	EPA 200.8	<0.0050	mg/L
		Lead	EPA 200.8	<0.0025	mg/L
		Selenium	EPA 200.8	<0.0050	mg/L
		Thallium	EPA 200.8	<0.0010	mg/L
		Uranium	EPA 200.8	<0.0050	mg/L
QC13010090	Blank 1	Aluminum	EPA 200.7	<0.045	mg/L
		Barium	EPA 200.7	<0.010	mg/L
		Beryllium	EPA 200.7	<0.0010	mg/L
		Bismuth	EPA 200.7	<0.10	mg/L
		Boron	EPA 200.7	<0.10	mg/L
		Cadmium	EPA 200.7	<0.0010	mg/L
		Calcium	EPA 200.7	<0.50	mg/L
		Chromium	EPA 200.7	<0.0050	mg/L
		Cobalt	EPA 200.7	<0.010	mg/L
		Copper	EPA 200.7	<0.050	mg/L
		Gallium	EPA 200.7	<0.10	mg/L
		Iron	EPA 200.7	<0.010	mg/L
		Lithium	EPA 200.7	<0.10	mg/L
		Magnesium	EPA 200.7	<0.50	mg/L

QCBatchID	QCType	Parameter	Method	Result	Units
		Manganese	EPA 200.7	<0.0050	mg/L
		Molybdenum	EPA 200.7	<0.010	mg/L
		Nickel	EPA 200.7	<0.010	mg/L
		Phosphorus	EPA 200.7	<0.50	mg/L
		Potassium	EPA 200.7	<0.50	mg/L
		Scandium	EPA 200.7	<0.10	mg/L
		Silver	EPA 200.7	<0.0050	mg/L
		Sodium	EPA 200.7	<0.50	mg/L
		Strontium	EPA 200.7	<0.10	mg/L
		Tin	EPA 200.7	<0.10	mg/L
		Titanium	EPA 200.7	<0.10	mg/L
		Vanadium	EPA 200.7	<0.010	mg/L
		Zinc	EPA 200.7	<0.010	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC12120743	LCS 1	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC12120743	LCS 2	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC12120743	LCS 3	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC12120746	LCS 1	Total Alkalinity	SM 2320B	99.4	100	99	mg/L
QC12120746	LCS 2	Total Alkalinity	SM 2320B	99.1	100	99	mg/L
QC12120746	LCS 3	Total Alkalinity	SM 2320B	99.4	100	99	mg/L
QC12120746	LCS 4	Total Alkalinity	SM 2320B	99.7	100	100	mg/L
QC12120770	LCS 1	Fluoride	EPA 300.0	1.83	2.00	91	mg/L
QC12120772	LCS 1	Fluoride	EPA 300.0	1.83	2.00	91	mg/L
QC12120776	LCS 1	Chloride	EPA 300.0	10.2	10.0	102	mg/L
QC12120779	LCS 1	Nitrite Nitrogen	EPA 300.0	0.536	0.500	107	mg/L
QC12120780	LCS 1	Nitrite Nitrogen	EPA 300.0	0.536	0.500	107	mg/L
QC12120784	LCS 1	Nitrate Nitrogen	EPA 300.0	1.97	2.00	98	mg/L
QC12120786	LCS 1	Sulfate	EPA 300.0	24.0	25.0	96	mg/L
QC12120787	LCS 1	Sulfate	EPA 300.0	24.0	25.0	96	mg/L
QC12120885	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	139	150	92	mg/L
QC12120885	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	140	150	93	mg/L
QC13010002	LCS 1	Mercury	EPA 200.8	0.000920	0.001	92	mg/L
		Antimony	EPA 200.8	0.0092	0.010	92	mg/L
		Arsenic	EPA 200.8	0.0483	0.050	96	mg/L
		Lead	EPA 200.8	0.0097	0.010	97	mg/L
		Selenium	EPA 200.8	0.0446	0.050	89	mg/L
		Thallium	EPA 200.8	0.0093	0.010	93	mg/L
		Uranium	EPA 200.8	0.0093	0.010	93	mg/L
QC13010090	LCS 1	Aluminum	EPA 200.7	0.915	1.00	92	mg/L
		Barium	EPA 200.7	0.926	1.00	93	mg/L
		Beryllium	EPA 200.7	0.973	1.00	97	mg/L
		Bismuth	EPA 200.7	0.974	1.00	97	mg/L
		Boron	EPA 200.7	0.881	1.00	88	mg/L
		Cadmium	EPA 200.7	0.936	1.00	94	mg/L
		Calcium	EPA 200.7	9.62	10.0	96	mg/L
		Chromium	EPA 200.7	0.920	1.00	92	mg/L
		Cobalt	EPA 200.7	0.937	1.00	94	mg/L
		Copper	EPA 200.7	4.62	5.00	92	mg/L
		Gallium	EPA 200.7	0.943	1.00	94	mg/L
		Iron	EPA 200.7	0.941	1.00	94	mg/L
		Lithium	EPA 200.7	0.943	1.00	94	mg/L
		Magnesium	EPA 200.7	9.11	10.0	91	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
		Manganese	EPA 200.7	0.942	1.00	94	mg/L
		Molybdenum	EPA 200.7	0.916	1.00	92	mg/L
		Nickel	EPA 200.7	4.61	5.00	92	mg/L
		Phosphorus	EPA 200.7	4.61	5.00	92	mg/L
		Potassium	EPA 200.7	9.60	10.0	96	mg/L
		Scandium	EPA 200.7	0.941	1.00	94	mg/L
		Silver	EPA 200.7	0.083	0.090	92	mg/L
		Sodium	EPA 200.7	10.1	10.0	101	mg/L
		Strontium	EPA 200.7	0.986	1.00	99	mg/L
		Tin	EPA 200.7	0.909	1.00	91	mg/L
		Titanium	EPA 200.7	0.963	1.00	96	mg/L
		Vanadium	EPA 200.7	0.919	1.00	92	mg/L
		Zinc	EPA 200.7	0.929	1.00	93	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC12120743	Duplicate	pH	SM 4500-H+ B	1212414-001	6.83	6.90	pH Units	1 %
QC12120743	Duplicate	pH	SM 4500-H+ B	1212415-002	7.43	7.41	pH Units	<1%
QC12120743	Duplicate	pH	SM 4500-H+ B	1212414-004	7.47	7.52	pH Units	1 %
QC12120743	Duplicate	pH	SM 4500-H+ B	1212419-002	7.40	7.36	pH Units	1 %
QC12120743	Duplicate	pH	SM 4500-H+ B	1212401-003	7.04	7.04	pH Units	<1%
QC12120746	Duplicate	Bicarbonate (HCO3)	SM 2320B	1212414-001	20.1	18.8	mg/L	7 %
		Carbonate (CO3)	SM 2320B	1212414-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1212414-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1212414-001	16.4	15.4	mg/L as CaCO3	7 %
QC12120746	Duplicate	Bicarbonate (HCO3)	SM 2320B	1212415-002	38.9	37.8	mg/L	3 %
		Carbonate (CO3)	SM 2320B	1212415-002	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1212415-002	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1212415-002	31.9	31.0	mg/L as CaCO3	3 %
QC12120746	Duplicate	Bicarbonate (HCO3)	SM 2320B	1212414-004	43.1	43.4	mg/L	1 %
		Carbonate (CO3)	SM 2320B	1212414-004	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1212414-004	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1212414-004	35.4	35.6	mg/L as CaCO3	1 %
QC12120746	Duplicate	Bicarbonate (HCO3)	SM 2320B	1212419-002	37.0	35.2	mg/L	5 %
		Carbonate (CO3)	SM 2320B	1212419-002	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1212419-002	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1212419-002	30.3	28.8	mg/L as CaCO3	5 %
QC12120746	Duplicate	Bicarbonate (HCO3)	SM 2320B	1212401-003	488	488	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1212401-003	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1212401-003	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1212401-003	400	400	mg/L as CaCO3	<1%
QC12120885	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1212415-001	10.0	10.0	mg/L	<1%
QC12120885	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1212444-001	21.0	21.0	mg/L	<1%
QC12120885	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1212446-009	595	594	mg/L	<1%
QC12120885	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1212450-002	678	670	mg/L	1 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC12120770	MS 1	Fluoride	EPA 300.0	1212414-001	0.208		1.80	1.87	2.00	mg/L	87	91	4 %
QC12120770	MS 2	Fluoride	EPA 300.0	1212414-010	<0.100		1.84	1.90	2.00	mg/L	89	92	3 %
QC12120772	MS 1	Fluoride	EPA 300.0	1212419-002	0.969	M	2.56	2.62	2.00	mg/L	NC	NC	NC
QC12120772	MS 2	Fluoride	EPA 300.0	1212446-001	10.1	M	17.5	17.7	2.00	mg/L	NC	NC	NC
QC12120776	MS 1	Chloride	EPA 300.0	1212419-001	<1.000		5.33	5.54	5.00	mg/L	105	109	4 %
QC12120776	MS 2	Chloride	EPA 300.0	1212446-001	17.1		43.1	43.1	5.00	mg/L	104	104	<1%
QC12120779	MS 1	Nitrite Nitrogen	EPA 300.0	1212414-004	<0.025		0.551	0.577	0.500	mg/L	107	112	5 %
QC12120779	MS 2	Nitrite Nitrogen	EPA 300.0	1212414-010	<0.025		0.566	0.588	0.500	mg/L	110	114	4 %
QC12120780	MS 1	Nitrite Nitrogen	EPA 300.0	1212419-002	<0.025		0.539	0.568	0.500	mg/L	105	110	5 %
QC12120780	MS 2	Nitrite Nitrogen	EPA 300.0	1212446-001	<0.125		2.79	2.80	0.500	mg/L	112	112	<1%
QC12120784	MS 1	Nitrate Nitrogen	EPA 300.0	1212419-002	<1.000		2.06	2.15	2.00	mg/L	102	106	4 %
QC12120784	MS 2	Nitrate Nitrogen	EPA 300.0	1212446-001	<1.000		10.3	10.4	2.00	mg/L	103	104	1 %
QC12120786	MS 1	Sulfate	EPA 300.0	1212414-004	14.0		23.8	24.3	10.0	mg/L	98	102	2 %
QC12120786	MS 2	Sulfate	EPA 300.0	1212414-010	18.2		27.9	28.2	10.0	mg/L	97	100	1 %
QC12120787	MS 1	Sulfate	EPA 300.0	1212419-002	8.73		18.7	19.1	10.0	mg/L	100	103	2 %
QC12120787	MS 2	Sulfate	EPA 300.0	1212446-001	41.6		92.2	92.2	10.0	mg/L	101	101	<1%
QC13010002	MS 1	Mercury	EPA 200.8	1212438-002	<0.00010		0.000870	0.000879	0.001	mg/L	87	88	1 %
		Antimony	EPA 200.8	1212438-002	<0.0025		0.0093	0.0091	0.010	mg/L	93	90	2 %
		Arsenic	EPA 200.8	1212438-002	<0.0030		0.0542	0.0530	0.050	mg/L	105	103	2 %
		Lead	EPA 200.8	1212438-002	<0.0025		0.0091	0.0089	0.010	mg/L	91	89	2 %
		Selenium	EPA 200.8	1212438-002	<0.0050		0.0510	0.0505	0.050	mg/L	95	94	1 %
		Thallium	EPA 200.8	1212438-002	<0.0010		0.0087	0.0086	0.010	mg/L	87	86	1 %
		Uranium	EPA 200.8	1212438-002	0.0163		0.0259	0.0254	0.010	mg/L	96	90	2 %
QC13010090	MS 1	Aluminum	EPA 200.7	1212438-002	<0.045		0.920	0.902	1.00	mg/L	91	89	2 %
		Barium	EPA 200.7	1212438-002	0.046		0.931	0.909	1.00	mg/L	88	86	2 %
		Beryllium	EPA 200.7	1212438-002	<0.001		0.958	0.918	1.00	mg/L	96	92	4 %
		Bismuth	EPA 200.7	1212438-002	<0.100		0.910	0.889	1.00	mg/L	92	90	2 %
		Boron	EPA 200.7	1212438-002	<0.100		0.942	0.922	1.00	mg/L	92	90	2 %
		Cadmium	EPA 200.7	1212438-002	<0.001		0.879	0.858	1.00	mg/L	88	86	2 %
		Calcium	EPA 200.7	1212438-002	58.8		67.2	67.8	10.0	mg/L	84	90	1 %
		Chromium	EPA 200.7	1212438-002	<0.005		0.890	0.870	1.00	mg/L	89	87	2 %
		Cobalt	EPA 200.7	1212438-002	<0.010		0.838	0.818	1.00	mg/L	84	82	2 %
		Copper	EPA 200.7	1212438-002	<0.050		4.49	4.39	5.00	mg/L	90	88	2 %
		Gallium	EPA 200.7	1212438-002	<0.100		0.965	0.943	1.00	mg/L	96	94	2 %
		Iron	EPA 200.7	1212438-002	<0.010		0.930	0.925	1.00	mg/L	93	92	1 %
		Lithium	EPA 200.7	1212438-002	<0.100		0.935	0.941	1.00	mg/L	93	94	1 %
		Magnesium	EPA 200.7	1212438-002	27.9		35.1	35.5	10.0	mg/L	72	76	1 %
		Manganese	EPA 200.7	1212438-002	<0.005		0.876	0.854	1.00	mg/L	89	87	3 %
		Molybdenum	EPA 200.7	1212438-002	<0.010		0.910	0.883	1.00	mg/L	91	88	3 %
		Nickel	EPA 200.7	1212438-002	<0.010		4.10	4.00	5.00	mg/L	82	80	2 %
		Phosphorus	EPA 200.7	1212438-002	<0.500		4.66	4.51	5.00	mg/L	92	89	3 %
		Potassium	EPA 200.7	1212438-002	4.14		13.9	13.9	10.0	mg/L	98	98	<1%
		Scandium	EPA 200.7	1212438-002	<0.100		0.935	0.899	1.00	mg/L	93	90	4 %
		Silver	EPA 200.7	1212438-002	<0.005		0.083	0.080	0.090	mg/L	93	90	4 %
		Sodium	EPA 200.7	1212438-002	21.3		31.2	31.6	10.0	mg/L	99	103	1 %
		Strontium	EPA 200.7	1212438-002	0.545		1.53	1.54	1.00	mg/L	98	100	1 %
		Tin	EPA 200.7	1212438-002	<0.100		0.881	0.854	1.00	mg/L	91	89	3 %
		Titanium	EPA 200.7	1212438-002	<0.100		0.975	0.974	1.00	mg/L	98	97	<1%
		Vanadium	EPA 200.7	1212438-002	0.037		0.948	0.925	1.00	mg/L	91	89	2 %
		Zinc	EPA 200.7	1212438-002	<0.010		0.853	0.826	1.00	mg/L	85	82	3 %

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1212419
Report Due Date: 1/9/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard 5 Day Other

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information
Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes
DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER:

Analyses Requested

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium	Spl. No.
CF-11-02 (0-27)	Wk:32	12/20/12	9:00	WW	2	X	X	1
CF-11-02 (367-408)	↓	↓	↓	↓	↓	↓	↓	2

1212 5
419 2

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 20.2 °C	12-20-12	14:20		
Custody Seals Intact? Y N None				
Number of Containers 4				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

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Lab Number 1212419
Report Due Date: 1/9/13
Page 1 of 1

Client	McClelland Laboratories, Inc.
Address	1016 Greg Street
City, State & Zip	Sparks, NV 89431
Contact	Mike Medina
Phone 775-356-1300	Collector's Name Robert
Fax 775-356-8917	Project Name
P.O. Number	Project Number 3438
Email mli@mettest.com	

Turnaround Time
Standard ____ 5 Day ____ Other ____

Billing Address (if different than Client Address):
Company ____
Address ____
City, State & Zip ____
Contact ____
Phone ____
Fax ____
Email ____

Additional Information

Fax Results	Y	N	To: Client	Billing
Email Results	Y	N	To: Client	Billing
Compliance Monitoring	Y	N		
Fax Results to State EPA	Y	N		

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ____

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium	Spl. No.
CF-11-02 (0-27)	Wk:32	12/20/12	9:00	WW	2	X	X	1
CF-11-02 (367-408)	↓	↓	↓	↓	↓	↓	↓	2

1212 5
419 2

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 202 °C	12-20-12	14:20		
Custody Seals Intact? Y N None				
Number of Containers 4				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

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Specializing in Soil, Hazardous Waste and Water Analysis.

1/9/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1212496*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 12/27/2012. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Andy Smith
QA Manager

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817

ELKO
1084 Lamoille Hwy.
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933

LAS VEGAS
3230 Polaris Ave., Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 776-6152

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1212496

General Comments

None

Specific Comments

The matrix spike/matrix spike duplicate (MS/MSD) values for the analysis of Sulfate on sample 1212496-003 were outside laboratory acceptance criteria; however, the relative percent difference (RPD) value was acceptable, indicating probable matrix interference. The reported result should be considered an estimate.

Data Qualifier Legend

B	-- Blank contamination; Analyte detected above the method reporting limit in an associated blank
HT	-- Sample held beyond the accepted holding time
J	-- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	-- Reported value is estimated; The sample matrix interfered with the analysis
N	-- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	-- Not calculated due to matrix interference
Q	-- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
S	-- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.
SC	-- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438 WK:100*

Date Printed: 1/9/2013
OrderID: *1212496*

Customer Sample ID: 604 673 Wk: 100
WETLAB Sample ID: 1212496-001

Collect Date/Time: 12/27/2012 09:00
Receive Date: 12/27/2012 15:25

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	5.11	pH Units		12/27/2012
Trace Metals Digestion	EPA 200.2	Complete			1/2/2013
Bicarbonate (HCO3)	SM 2320B	<1.0	mg/L	1.0	12/27/2012
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	12/27/2012
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	12/27/2012
Total Alkalinity	SM 2320B	<1.0	mg/L as CaCO3	1.0	12/27/2012
Chloride	EPA 300.0	<1.00	mg/L	1.00	12/28/2012
Fluoride	EPA 300.0	0.24	mg/L	0.10	12/28/2012
Sulfate	EPA 300.0	21	mg/L	1.0	12/28/2012
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	12/28/2012
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	12/28/2012
Total Dissolved Solids (TDS)	SM 2540C	74	mg/L	10	1/2/2013
Aluminum	EPA 200.7	0.17	mg/L	0.045	1/7/2013
Barium	EPA 200.7	0.065	mg/L	0.010	1/7/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	1/7/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Boron	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	1/7/2013
Calcium	EPA 200.7	6.0	mg/L	0.50	1/7/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	1/7/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	1/7/2013
Copper	EPA 200.7	1.6	mg/L	0.050	1/7/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Iron	EPA 200.7	0.027	mg/L	0.010	1/7/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Magnesium	EPA 200.7	0.81	mg/L	0.50	1/7/2013
Manganese	EPA 200.7	0.041	mg/L	0.0050	1/7/2013

Customer Sample ID: 604 673 Wk: 100
WETLAB Sample ID: 1212496-001

Collect Date/Time: 12/27/2012 09:00
Receive Date: 12/27/2012 15:25

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	1/7/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/7/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/7/2013
Potassium	EPA 200.7	0.82	mg/L	0.50	1/7/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/7/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	1/7/2013
Strontium	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/7/2013
Zinc	EPA 200.7	0.047	mg/L	0.010	1/7/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	1/2/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/2/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	1/2/2013
Lead	EPA 200.8	0.0091	mg/L	0.0025	1/2/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/2/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/2/2013
Uranium	EPA 200.8	0.024	mg/L	0.0050	1/2/2013
Anions	Calculation	0.45	meq/L	0.10	
Cations	Calculation	0.46	meq/L	0.10	
Error	Calculation	1.2	%	1.0	

Customer Sample ID: SRK 0854 Wk: 100
WETLAB Sample ID: 1212496-002

Collect Date/Time: 12/27/2012 09:00
Receive Date: 12/27/2012 15:25

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	4.93	pH Units		12/27/2012
Trace Metals Digestion	EPA 200.2	Complete			1/2/2013
Bicarbonate (HCO3)	SM 2320B	<1.0	mg/L	1.0	12/27/2012
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	12/27/2012
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	12/27/2012
Total Alkalinity	SM 2320B	<1.0	mg/L as CaCO3	1.0	12/27/2012
Chloride	EPA 300.0	<1.00	mg/L	1.00	12/28/2012
Fluoride	EPA 300.0	0.14	mg/L	0.10	12/28/2012
Sulfate	EPA 300.0	59	mg/L	1.0	12/28/2012
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	12/28/2012
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	12/28/2012

Customer Sample ID: SRK 0854 Wk: 100
WETLAB Sample ID: 1212496-002

Collect Date/Time: 12/27/2012 09:00
Receive Date: 12/27/2012 15:25

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Total Dissolved Solids (TDS)	SM 2540C	130	mg/L	10	1/2/2013
Aluminum	EPA 200.7	0.045	mg/L	0.045	1/7/2013
Barium	EPA 200.7	0.032	mg/L	0.010	1/7/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	1/7/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Boron	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	1/7/2013
Calcium	EPA 200.7	2.5	mg/L	0.50	1/7/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	1/7/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	1/7/2013
Copper	EPA 200.7	33	mg/L	0.050	1/7/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	1/7/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Magnesium	EPA 200.7	<0.50	mg/L	0.50	1/7/2013
Manganese	EPA 200.7	0.053	mg/L	0.0050	1/7/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	1/7/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/7/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/7/2013
Potassium	EPA 200.7	0.70	mg/L	0.50	1/7/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/7/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	1/7/2013
Strontium	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/7/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/7/2013
Zinc	EPA 200.7	0.12	mg/L	0.010	1/7/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	1/2/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/2/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	1/2/2013
Lead	EPA 200.8	0.0073	mg/L	0.0025	1/2/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/2/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/2/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	1/2/2013
Anions	Calculation	1.24	meq/L	0.10	
Cations	Calculation	1.19	meq/L	0.10	
Error	Calculation	1.8	%	1.0	

Customer Sample ID: SRK 0872 Wk: 100
WETLAB Sample ID: 1212496-003

Collect Date/Time: 12/27/2012 09:00
Receive Date: 12/27/2012 15:25

PROFILE II

Parameter	Method	Results		Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.03		pH Units		12/27/2012
Trace Metals Digestion	EPA 200.2	Complete				1/2/2013
Bicarbonate (HCO3)	SM 2320B	11		mg/L	1.0	12/27/2012
Carbonate (CO3)	SM 2320B	<1.0		mg/L	1.0	12/27/2012
Hydroxide (OH)	SM 2320B	<1.0		mg/L	1.0	12/27/2012
Total Alkalinity	SM 2320B	8.8		mg/L as CaCO3	1.0	12/27/2012
Chloride	EPA 300.0	<1.00		mg/L	1.00	12/28/2012
Fluoride	EPA 300.0	0.51		mg/L	0.10	12/28/2012
Sulfate	EPA 300.0	21	M	mg/L	1.0	12/28/2012
Nitrate Nitrogen	EPA 300.0	1.0		mg/L	1.0	12/28/2012
Nitrite Nitrogen	EPA 300.0	0.051		mg/L	0.025	12/28/2012
Total Dissolved Solids (TDS)	SM 2540C	78		mg/L	10	1/2/2013
Aluminum	EPA 200.7	<0.045		mg/L	0.045	1/7/2013
Barium	EPA 200.7	0.024		mg/L	0.010	1/7/2013
Beryllium	EPA 200.7	<0.0010		mg/L	0.0010	1/7/2013
Bismuth	EPA 200.7	<0.10		mg/L	0.10	1/7/2013
Boron	EPA 200.7	<0.10		mg/L	0.10	1/7/2013
Cadmium	EPA 200.7	<0.0010		mg/L	0.0010	1/7/2013
Calcium	EPA 200.7	11		mg/L	0.50	1/7/2013
Chromium	EPA 200.7	<0.0050		mg/L	0.0050	1/7/2013
Cobalt	EPA 200.7	<0.010		mg/L	0.010	1/7/2013
Copper	EPA 200.7	<0.050		mg/L	0.050	1/7/2013
Gallium	EPA 200.7	<0.10		mg/L	0.10	1/7/2013
Iron	EPA 200.7	0.030		mg/L	0.010	1/7/2013
Lithium	EPA 200.7	<0.10		mg/L	0.10	1/7/2013
Magnesium	EPA 200.7	0.89		mg/L	0.50	1/7/2013
Manganese	EPA 200.7	0.0091		mg/L	0.0050	1/7/2013
Molybdenum	EPA 200.7	0.037		mg/L	0.010	1/7/2013
Nickel	EPA 200.7	<0.010		mg/L	0.010	1/7/2013
Phosphorus	EPA 200.7	<0.50		mg/L	0.50	1/7/2013
Potassium	EPA 200.7	<0.50		mg/L	0.50	1/7/2013
Scandium	EPA 200.7	<0.10		mg/L	0.10	1/7/2013
Silver	EPA 200.7	<0.0050		mg/L	0.0050	1/7/2013
Sodium	EPA 200.7	<0.50		mg/L	0.50	1/7/2013
Strontium	EPA 200.7	<0.10		mg/L	0.10	1/7/2013
Tin	EPA 200.7	<0.10		mg/L	0.10	1/7/2013
Titanium	EPA 200.7	<0.10		mg/L	0.10	1/7/2013
Vanadium	EPA 200.7	<0.010		mg/L	0.010	1/7/2013

Customer Sample ID: SRK 0872 Wk: 100
WETLAB Sample ID: 1212496-003

Collect Date/Time: 12/27/2012 09:00
Receive Date: 12/27/2012 15:25

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Zinc	EPA 200.7	<0.010	mg/L	0.010	1/7/2013
Mercury	EPA 200.8	0.00016	mg/L	0.00010	1/2/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/2/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	1/2/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	1/2/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/2/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/2/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	1/2/2013
Anions	Calculation	0.72	meq/L	0.10	
Cations	Calculation	0.62	meq/L	0.10	
Error	Calculation	6.8	%	1.0	

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13010012	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC13010012	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC13010012	Blank 3	Fluoride	EPA 300.0	<0.10	mg/L
QC13010014	Blank 1	Chloride	EPA 300.0	<1.0	mg/L
QC13010014	Blank 2	Chloride	EPA 300.0	<1.0	mg/L
QC13010014	Blank 3	Chloride	EPA 300.0	<1.0	mg/L
QC13010016	Blank 1	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13010016	Blank 2	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13010016	Blank 3	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13010017	Blank 1	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13010017	Blank 2	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13010017	Blank 3	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13010018	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC13010018	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC13010018	Blank 3	Sulfate	EPA 300.0	<1.0	mg/L
QC13010052	Blank 1	Uranium, Dissolved	EPA 200.8	<0.0050	mg/L
		Mercury, Dissolved	EPA 200.8	<0.00010	mg/L
		Antimony, Dissolved	EPA 200.8	<0.0025	mg/L
		Arsenic, Dissolved	EPA 200.8	<0.0050	mg/L
		Lead, Dissolved	EPA 200.8	<0.0025	mg/L
		Selenium, Dissolved	EPA 200.8	<0.0050	mg/L
		Thallium, Dissolved	EPA 200.8	<0.0010	mg/L
QC13010119	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13010119	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13010186	Blank 1	Aluminum, Dissolved	EPA 200.7	<0.045	mg/L
		Barium, Dissolved	EPA 200.7	<0.010	mg/L
		Beryllium, Dissolved	EPA 200.7	<0.0010	mg/L
		Bismuth, Dissolved	EPA 200.7	<0.10	mg/L
		Boron, Dissolved	EPA 200.7	<0.10	mg/L
		Cadmium, Dissolved	EPA 200.7	<0.0010	mg/L
		Calcium, Dissolved	EPA 200.7	<0.50	mg/L
		Chromium, Dissolved	EPA 200.7	<0.0050	mg/L
		Cobalt, Dissolved	EPA 200.7	<0.010	mg/L
		Copper, Dissolved	EPA 200.7	<0.050	mg/L
		Gallium, Dissolved	EPA 200.7	<0.10	mg/L
		Iron, Dissolved	EPA 200.7	<0.010	mg/L
		Lithium, Dissolved	EPA 200.7	<0.10	mg/L
		Magnesium, Dissolved	EPA 200.7	<0.50	mg/L
		Manganese, Dissolved	EPA 200.7	<0.0050	mg/L
		Molybdenum, Dissolved	EPA 200.7	<0.010	mg/L
		Nickel, Dissolved	EPA 200.7	<0.010	mg/L
		Phosphorus, Dissolved	EPA 200.7	<0.50	mg/L
		Potassium, Dissolved	EPA 200.7	<0.50	mg/L
		Scandium, Dissolved	EPA 200.7	<0.10	mg/L
		Silver, Dissolved	EPA 200.7	<0.0050	mg/L
		Sodium, Dissolved	EPA 200.7	<0.50	mg/L
		Strontium, Dissolved	EPA 200.7	<0.10	mg/L

QCBatchID	QCType	Parameter	Method	Result	Units
		Tin, Dissolved	EPA 200.7	<0.10	mg/L
		Titanium, Dissolved	EPA 200.7	<0.10	mg/L
		Vanadium, Dissolved	EPA 200.7	<0.010	mg/L
		Zinc, Dissolved	EPA 200.7	<0.010	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC12120862	LCS 1	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC12120872	LCS 1	Total Alkalinity	SM 2320B	99.6	100	100	mg/L
QC12120872	LCS 2	Total Alkalinity	SM 2320B	99.0	100	99	mg/L
QC13010012	LCS 1	Fluoride	EPA 300.0	1.93	2.00	96	mg/L
QC13010014	LCS 1	Chloride	EPA 300.0	10.2	10.0	102	mg/L
QC13010016	LCS 1	Nitrite Nitrogen	EPA 300.0	0.550	0.500	110	mg/L
QC13010017	LCS 1	Nitrate Nitrogen	EPA 300.0	1.97	2.00	98	mg/L
QC13010018	LCS 1	Sulfate	EPA 300.0	24.0	25.0	96	mg/L
QC13010052	LCS 1	Uranium, Dissolved	EPA 200.8	0.0099	0.010	99	mg/L
		Mercury, Dissolved	EPA 200.8	0.000982	0.001	98	mg/L
		Antimony, Dissolved	EPA 200.8	0.0094	0.010	94	mg/L
		Arsenic, Dissolved	EPA 200.8	0.0497	0.050	99	mg/L
		Lead, Dissolved	EPA 200.8	0.0100	0.010	100	mg/L
		Selenium, Dissolved	EPA 200.8	0.0460	0.050	92	mg/L
		Thallium, Dissolved	EPA 200.8	0.0100	0.010	100	mg/L
QC13010119	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	161	150	108	mg/L
QC13010119	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	163	150	108	mg/L
QC13010186	LCS 1	Aluminum, Dissolved	EPA 200.7	1.13	1.00	113	mg/L
		Barium, Dissolved	EPA 200.7	1.08	1.00	108	mg/L
		Beryllium, Dissolved	EPA 200.7	0.993	1.00	99	mg/L
		Bismuth, Dissolved	EPA 200.7	1.04	1.00	104	mg/L
		Boron, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Cadmium, Dissolved	EPA 200.7	1.15	1.00	115	mg/L
		Calcium, Dissolved	EPA 200.7	9.98	10.0	100	mg/L
		Chromium, Dissolved	EPA 200.7	1.05	1.00	105	mg/L
		Cobalt, Dissolved	EPA 200.7	1.10	1.00	110	mg/L
		Copper, Dissolved	EPA 200.7	4.73	5.00	95	mg/L
		Gallium, Dissolved	EPA 200.7	1.09	1.00	109	mg/L
		Iron, Dissolved	EPA 200.7	0.985	1.00	98	mg/L
		Lithium, Dissolved	EPA 200.7	0.851	1.00	85	mg/L
		Magnesium, Dissolved	EPA 200.7	10.1	10.0	101	mg/L
		Manganese, Dissolved	EPA 200.7	1.05	1.00	105	mg/L
		Molybdenum, Dissolved	EPA 200.7	1.04	1.00	104	mg/L
		Nickel, Dissolved	EPA 200.7	5.50	5.00	110	mg/L
		Phosphorus, Dissolved	EPA 200.7	4.81	5.00	96	mg/L
		Potassium, Dissolved	EPA 200.7	9.98	10.0	100	mg/L
		Scandium, Dissolved	EPA 200.7	0.959	1.00	96	mg/L
		Silver, Dissolved	EPA 200.7	0.090	0.090	100	mg/L
		Sodium, Dissolved	EPA 200.7	9.18	10.0	92	mg/L
		Strontium, Dissolved	EPA 200.7	0.892	1.00	89	mg/L
		Tin, Dissolved	EPA 200.7	1.14	1.00	114	mg/L
		Titanium, Dissolved	EPA 200.7	0.937	1.00	94	mg/L
		Vanadium, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
		Zinc, Dissolved	EPA 200.7	0.954	1.00	95	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC12120862	Duplicate	pH	SM 4500-H+ B	1212494-001	5.09	5.09	pH Units	<1%
QC12120872	Duplicate	Bicarbonate (HCO3)	SM 2320B	1212494-001	<1.000	<1.000	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1212494-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1212494-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1212494-001	<1.000	<1.000	mg/L as CaCO3	<1%
QC13010119	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1212487-002	888	856	mg/L	4 %
QC13010119	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1212521-001	679	671	mg/L	1 %
QC13010119	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1212526-004	611	603	mg/L	1 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13010012	MS 1	Fluoride	EPA 300.0	1212496-003	0.510	2.21	2.16	2.00	mg/L	85	82	2 %
QC13010012	MS 2	Fluoride	EPA 300.0	1212518-003	2.03	45.3	45.6	2.00	mg/L	87	87	1 %
QC13010014	MS 1	Chloride	EPA 300.0	1212496-003	<1.000	5.17	5.33	5.00	mg/L	103	106	3 %
QC13010014	MS 2	Chloride	EPA 300.0	1212521-001	<10.00	61.8	62.9	5.00	mg/L	107	109	2 %
QC13010016	MS 1	Nitrite Nitrogen	EPA 300.0	1212496-003	0.051	0.604	0.615	0.500	mg/L	111	113	2 %
QC13010016	MS 2	Nitrite Nitrogen	EPA 300.0	1212521-001	<0.250	5.69	5.91	0.500	mg/L	110	115	4 %
QC13010017	MS 1	Nitrate Nitrogen	EPA 300.0	1212496-003	1.00	3.03	3.03	2.00	mg/L	102	102	<1%
QC13010017	MS 2	Nitrate Nitrogen	EPA 300.0	1212521-001	<1.000	20.7	21.2	2.00	mg/L	102	104	2 %
QC13010018	MS 1	Sulfate	EPA 300.0	1212496-003	20.5 M	27.7	27.8	10.0	mg/L	NC	NC	NC
QC13010018	MS 2	Sulfate	EPA 300.0	1212521-001	430	534	539	10.0	mg/L	104	109	1 %
QC13010052	MS 1	Uranium, Dissolved	EPA 200.8	1212514-001	<0.0050	0.0112	0.0111	0.010	mg/L	100	99	1 %
		Mercury, Dissolved	EPA 200.8	1212514-001	<0.00010	0.001039	0.001027	0.001	mg/L	101	100	1 %
		Antimony, Dissolved	EPA 200.8	1212514-001	<0.0025	0.0096	0.0096	0.010	mg/L	90	91	<1%
		Arsenic, Dissolved	EPA 200.8	1212514-001	<0.0050	0.0530	0.0534	0.050	mg/L	101	102	1 %
		Lead, Dissolved	EPA 200.8	1212514-001	<0.0025	0.0100	0.0098	0.010	mg/L	100	98	2 %
		Selenium, Dissolved	EPA 200.8	1212514-001	<0.0050	0.0465	0.0473	0.050	mg/L	93	95	2 %
		Thallium, Dissolved	EPA 200.8	1212514-001	<0.0010	0.0099	0.0099	0.010	mg/L	97	97	<1%
QC13010186	MS 1	Aluminum, Dissolved	EPA 200.7	1212514-001	<0.045	0.956	0.993	1.00	mg/L	95	99	4 %
		Barium, Dissolved	EPA 200.7	1212514-001	0.066	0.974	0.986	1.00	mg/L	91	92	1 %
		Beryllium, Dissolved	EPA 200.7	1212514-001	<0.001	0.940	0.936	1.00	mg/L	94	94	<1%
		Bismuth, Dissolved	EPA 200.7	1212514-001	<0.100	0.922	0.935	1.00	mg/L	94	95	1 %
		Boron, Dissolved	EPA 200.7	1212514-001	<0.100	0.988	1.00	1.00	mg/L	94	95	1 %
		Cadmium, Dissolved	EPA 200.7	1212514-001	<0.001	0.890	0.898	1.00	mg/L	89	90	1 %
		Calcium, Dissolved	EPA 200.7	1212514-001	40.1	47.9	47.3	10.0	mg/L	78	72	1 %
		Chromium, Dissolved	EPA 200.7	1212514-001	<0.005	0.926	0.939	1.00	mg/L	93	94	1 %
		Cobalt, Dissolved	EPA 200.7	1212514-001	<0.010	0.867	0.873	1.00	mg/L	87	87	1 %
		Copper, Dissolved	EPA 200.7	1212514-001	<0.050	4.61	4.68	5.00	mg/L	92	94	2 %
		Gallium, Dissolved	EPA 200.7	1212514-001	<0.100	1.01	1.02	1.00	mg/L	101	102	1 %
		Iron, Dissolved	EPA 200.7	1212514-001	0.012	0.937	0.939	1.00	mg/L	93	93	<1%
		Lithium, Dissolved	EPA 200.7	1212514-001	<0.100	1.01	1.01	1.00	mg/L	100	100	<1%
		Magnesium, Dissolved	EPA 200.7	1212514-001	14.1	21.9	21.8	10.0	mg/L	78	77	<1%
		Manganese, Dissolved	EPA 200.7	1212514-001	<0.005	0.909	0.923	1.00	mg/L	92	93	2 %
		Molybdenum, Dissolved	EPA 200.7	1212514-001	<0.010	0.929	0.943	1.00	mg/L	93	94	1 %
		Nickel, Dissolved	EPA 200.7	1212514-001	<0.010	4.36	4.40	5.00	mg/L	87	88	1 %
		Phosphorus, Dissolved	EPA 200.7	1212514-001	<0.500	4.74	4.78	5.00	mg/L	94	95	1 %
		Potassium, Dissolved	EPA 200.7	1212514-001	1.70	11.8	11.9	10.0	mg/L	101	102	1 %
		Scandium, Dissolved	EPA 200.7	1212514-001	<0.100	0.952	0.953	1.00	mg/L	95	95	<1%
		Silver, Dissolved	EPA 200.7	1212514-001	<0.005	0.089	0.090	0.090	mg/L	100	101	1 %
		Sodium, Dissolved	EPA 200.7	1212514-001	8.50	17.6	17.6	10.0	mg/L	91	91	<1%

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Strontium, Dissolved	EPA 200.7	1212514-001	0.148	1.06	1.07	1.00	mg/L	91	92	1 %
		Tin, Dissolved	EPA 200.7	1212514-001	<0.100	0.889	0.905	1.00	mg/L	91	93	2 %
		Titanium, Dissolved	EPA 200.7	1212514-001	<0.100	0.965	0.970	1.00	mg/L	97	97	1 %
		Vanadium, Dissolved	EPA 200.7	1212514-001	0.023	0.961	0.971	1.00	mg/L	94	95	1 %
		Zinc, Dissolved	EPA 200.7	1212514-001	<0.010	0.863	0.870	1.00	mg/L	86	87	1 %

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1212496
Report Due Date: 1/14/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ____ 5 Day ____ Other ____

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ____

Analyses Requested

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
604 673	Wk:100	12/27/12	9:00	WW	2	X	X									1
SRK 0854	↓	↓	↓	↓	↓	↓	↓									2
SRK 0872	↓	↓	↓	↓	↓	↓	↓									3

1212 5
496 3

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 18.5 °C	12/27/12	3:25p		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 6				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

WETLAB
WESTERN ENVIRONMENTAL
TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

1/18/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1301048*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 1/3/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

ASmith

Andy Smith
QA Manager

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1301048

General Comments

None

Specific Comments

The matrix spike/matrix spike duplicate (MS/MSD) values for the analysis of Fluoride on sample 1301048-001 were outside laboratory acceptance criteria; however, the relative percent difference (RPD) value was acceptable, indicating probable matrix interference. The reported result should be considered an estimate.

Due to a laboratory reanalysis requirement the analysis for Total Dissolved Solids (TDS) on sample 1301048-001 was performed past the EPA recommended holding time. We apologize for any inconvenience this may have caused.

Data Qualifier Legend

B -- Blank contamination; Analyte detected above the method reporting limit in an associated blank
HT -- Sample held beyond the accepted holding time
J -- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M -- Reported value is estimated; The sample matrix interfered with the analysis
N -- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC -- Not calculated due to matrix interference
Q -- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
S -- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.
SC -- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438 WK:28*

Date Printed: 1/18/2013
OrderID: *1301048*

Customer Sample ID: CF-11-02 (227-367) Wk:28
WETLAB Sample ID: 1301048-001

Collect Date/Time: 1/3/2013 09:00
Receive Date: 1/3/2013 16:10

PROFILE II

Parameter	Method	Results		Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.84		pH Units		1/3/2013
Trace Metals Digestion	EPA 200.2	Complete				1/4/2013
Bicarbonate (HCO3)	SM 2320B	71		mg/L	1.0	1/3/2013
Carbonate (CO3)	SM 2320B	<1.0		mg/L	1.0	1/3/2013
Hydroxide (OH)	SM 2320B	<1.0		mg/L	1.0	1/3/2013
Total Alkalinity	SM 2320B	58		mg/L as CaCO3	1.0	1/3/2013
Chloride	EPA 300.0	<1.00		mg/L	1.00	1/4/2013
Fluoride	EPA 300.0	1.1	M	mg/L	0.10	1/4/2013
Sulfate	EPA 300.0	6.9		mg/L	1.0	1/4/2013
Nitrate Nitrogen	EPA 300.0	<1.0		mg/L	1.0	1/4/2013
Nitrite Nitrogen	EPA 300.0	<0.025		mg/L	0.025	1/4/2013
Total Dissolved Solids (TDS)	SM 2540C	77	HT	mg/L	10	1/16/2013
Aluminum	EPA 200.7	0.062		mg/L	0.045	1/8/2013
Barium	EPA 200.7	0.047		mg/L	0.010	1/8/2013
Beryllium	EPA 200.7	<0.0010		mg/L	0.0010	1/8/2013
Bismuth	EPA 200.7	<0.10		mg/L	0.10	1/8/2013
Boron	EPA 200.7	<0.100		mg/L	0.100	1/8/2013
Cadmium	EPA 200.7	<0.0010		mg/L	0.0010	1/8/2013
Calcium	EPA 200.7	18		mg/L	0.50	1/8/2013
Chromium	EPA 200.7	<0.0050		mg/L	0.0050	1/8/2013
Cobalt	EPA 200.7	<0.010		mg/L	0.010	1/8/2013
Copper	EPA 200.7	<0.050		mg/L	0.050	1/8/2013
Gallium	EPA 200.7	<0.10		mg/L	0.10	1/8/2013
Iron	EPA 200.7	<0.010		mg/L	0.010	1/8/2013
Lithium	EPA 200.7	<0.10		mg/L	0.10	1/8/2013
Magnesium	EPA 200.7	3.1		mg/L	0.50	1/8/2013
Manganese	EPA 200.7	0.027		mg/L	0.0050	1/8/2013

Customer Sample ID: CF-11-02 (227-367) Wk:28 **Collect Date/Time:** 1/3/2013 09:00
WETLAB Sample ID: 1301048-001 **Receive Date:** 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/8/2013
Potassium	EPA 200.7	3.3	mg/L	0.50	1/8/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Sodium	EPA 200.7	1.2	mg/L	0.50	1/8/2013
Strontium	EPA 200.7	0.17	mg/L	0.10	1/8/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	1/8/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/8/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Anions	Calculation	1.37	meq/L	0.10	
Cations	Calculation	1.30	meq/L	0.10	
Error	Calculation	2.5	%	1.0	

Customer Sample ID: CF-11-02 (52-117) Wk:28 **Collect Date/Time:** 1/3/2013 09:00
WETLAB Sample ID: 1301048-002 **Receive Date:** 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.77	pH Units		1/3/2013
Trace Metals Digestion	EPA 200.2	Complete			1/4/2013
Bicarbonate (HCO3)	SM 2320B	61	mg/L	1.0	1/3/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/3/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/3/2013
Total Alkalinity	SM 2320B	50	mg/L as CaCO3	1.0	1/3/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	1/4/2013
Fluoride	EPA 300.0	0.92	mg/L	0.10	1/4/2013
Sulfate	EPA 300.0	10	mg/L	1.0	1/4/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	1/4/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	1/4/2013

Customer Sample ID: CF-11-02 (52-117) Wk:28
WETLAB Sample ID: 1301048-002

Collect Date/Time: 1/3/2013 09:00
Receive Date: 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Total Dissolved Solids (TDS)	SM 2540C	86	mg/L	10	1/8/2013
Aluminum	EPA 200.7	0.048	mg/L	0.045	1/8/2013
Barium	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	1/8/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	1/8/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	1/8/2013
Calcium	EPA 200.7	18	mg/L	0.50	1/8/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	1/8/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Magnesium	EPA 200.7	2.0	mg/L	0.50	1/8/2013
Manganese	EPA 200.7	0.028	mg/L	0.0050	1/8/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/8/2013
Potassium	EPA 200.7	3.0	mg/L	0.50	1/8/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Sodium	EPA 200.7	0.98	mg/L	0.50	1/8/2013
Strontium	EPA 200.7	0.13	mg/L	0.10	1/8/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	1/8/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/8/2013
Uranium	EPA 200.8	0.013	mg/L	0.0050	1/8/2013
Anions	Calculation	1.26	meq/L	0.10	
Cations	Calculation	1.19	meq/L	0.10	
Error	Calculation	2.8	%	1.0	

Customer Sample ID: K-Spar Breccia 5+ Comp Wk:28
WETLAB Sample ID: 1301048-003

Collect Date/Time: 1/3/2013 09:00
Receive Date: 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.86	pH Units		1/3/2013
Trace Metals Digestion	EPA 200.2	Complete			1/4/2013
Bicarbonate (HCO3)	SM 2320B	73	mg/L	1.0	1/3/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/3/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/3/2013
Total Alkalinity	SM 2320B	60	mg/L as CaCO3	1.0	1/3/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	1/4/2013
Fluoride	EPA 300.0	1.1	mg/L	0.10	1/4/2013
Sulfate	EPA 300.0	37	mg/L	1.0	1/4/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	1/4/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	1/4/2013
Total Dissolved Solids (TDS)	SM 2540C	140	mg/L	10	1/8/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	1/8/2013
Barium	EPA 200.7	0.090	mg/L	0.010	1/8/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	1/8/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	1/8/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	1/8/2013
Calcium	EPA 200.7	31	mg/L	0.50	1/8/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	1/8/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Magnesium	EPA 200.7	3.2	mg/L	0.50	1/8/2013
Manganese	EPA 200.7	0.052	mg/L	0.0050	1/8/2013
Molybdenum	EPA 200.7	0.043	mg/L	0.010	1/8/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/8/2013
Potassium	EPA 200.7	2.7	mg/L	0.50	1/8/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Sodium	EPA 200.7	1.1	mg/L	0.50	1/8/2013
Strontium	EPA 200.7	0.66	mg/L	0.10	1/8/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/8/2013

Customer Sample ID: K-Spar Breccia 5+ Comp Wk:28 **Collect Date/Time:** 1/3/2013 09:00
WETLAB Sample ID: 1301048-003 **Receive Date:** 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Zinc	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	1/8/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/8/2013
Uranium	EPA 200.8	0.023	mg/L	0.0050	1/8/2013
Anions	Calculation	2.02	meq/L	0.10	
Cations	Calculation	1.93	meq/L	0.10	
Error	Calculation	2.4	%	1.0	

Customer Sample ID: Biotite Breccia 5+ Comp Wk:28 **Collect Date/Time:** 1/3/2013 09:00
WETLAB Sample ID: 1301048-004 **Receive Date:** 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.93	pH Units		1/3/2013
Trace Metals Digestion	EPA 200.2	Complete			1/4/2013
Bicarbonate (HCO3)	SM 2320B	84	mg/L	1.0	1/3/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/3/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/3/2013
Total Alkalinity	SM 2320B	69	mg/L as CaCO3	1.0	1/3/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	1/4/2013
Fluoride	EPA 300.0	1.5	mg/L	0.10	1/4/2013
Sulfate	EPA 300.0	13	mg/L	1.0	1/4/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	1/4/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	1/4/2013
Total Dissolved Solids (TDS)	SM 2540C	100	mg/L	10	1/8/2013
Aluminum	EPA 200.7	0.048	mg/L	0.045	1/8/2013
Barium	EPA 200.7	0.068	mg/L	0.010	1/8/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	1/8/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	1/8/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	1/8/2013
Calcium	EPA 200.7	23	mg/L	0.50	1/8/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	1/8/2013

Customer Sample ID: Biotite Breccia 5+ Comp Wk:28
WETLAB Sample ID: 1301048-004

Collect Date/Time: 1/3/2013 09:00
Receive Date: 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Gallium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Iron	EPA 200.7	0.016	mg/L	0.010	1/8/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Magnesium	EPA 200.7	4.5	mg/L	0.50	1/8/2013
Manganese	EPA 200.7	0.046	mg/L	0.0050	1/8/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/8/2013
Potassium	EPA 200.7	2.9	mg/L	0.50	1/8/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Sodium	EPA 200.7	0.85	mg/L	0.50	1/8/2013
Strontium	EPA 200.7	0.31	mg/L	0.10	1/8/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	1/8/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/8/2013
Uranium	EPA 200.8	0.0065	mg/L	0.0050	1/8/2013
Anions	Calculation	1.73	meq/L	0.10	
Cations	Calculation	1.64	meq/L	0.10	
Error	Calculation	2.7	%	1.0	

Customer Sample ID: Quartz Monzonite 5+ Comp Wk:28
WETLAB Sample ID: 1301048-005

Collect Date/Time: 1/3/2013 09:00
Receive Date: 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.89	pH Units		1/3/2013
Trace Metals Digestion	EPA 200.2	Complete			1/4/2013
Bicarbonate (HCO3)	SM 2320B	75	mg/L	1.0	1/3/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/3/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/3/2013
Total Alkalinity	SM 2320B	62	mg/L as CaCO3	1.0	1/3/2013

Customer Sample ID: Quartz Monzonite 5+ Comp Wk:28
WETLAB Sample ID: 1301048-005

Collect Date/Time: 1/3/2013 09:00
Receive Date: 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Chloride	EPA 300.0	<1.00	mg/L	1.00	1/4/2013
Fluoride	EPA 300.0	1.1	mg/L	0.10	1/4/2013
Sulfate	EPA 300.0	15	mg/L	1.0	1/4/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	1/4/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	1/4/2013
Total Dissolved Solids (TDS)	SM 2540C	94	mg/L	10	1/8/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	1/8/2013
Barium	EPA 200.7	0.11	mg/L	0.010	1/8/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	1/8/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	1/8/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	1/8/2013
Calcium	EPA 200.7	21	mg/L	0.50	1/8/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	1/8/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Magnesium	EPA 200.7	4.4	mg/L	0.50	1/8/2013
Manganese	EPA 200.7	0.025	mg/L	0.0050	1/8/2013
Molybdenum	EPA 200.7	0.055	mg/L	0.010	1/8/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/8/2013
Potassium	EPA 200.7	2.8	mg/L	0.50	1/8/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Sodium	EPA 200.7	1.2	mg/L	0.50	1/8/2013
Strontium	EPA 200.7	0.57	mg/L	0.10	1/8/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	1/8/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013

Customer Sample ID: Quartz Monzonite 5+ Comp Wk:28 **Collect Date/Time:** 1/3/2013 09:00
WETLAB Sample ID: 1301048-005 **Receive Date:** 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/8/2013
Uranium	EPA 200.8	0.015	mg/L	0.0050	1/8/2013
Anions	Calculation	1.60	meq/L	0.10	
Cations	Calculation	1.53	meq/L	0.10	
Error	Calculation	2.1	%	1.0	

Customer Sample ID: Biotite Breccia 0-5 Comp Wk:28 **Collect Date/Time:** 1/3/2013 09:00
WETLAB Sample ID: 1301048-006 **Receive Date:** 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.81	pH Units		1/3/2013
Trace Metals Digestion	EPA 200.2	Complete			1/4/2013
Bicarbonate (HCO3)	SM 2320B	65	mg/L	1.0	1/3/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/3/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/3/2013
Total Alkalinity	SM 2320B	54	mg/L as CaCO3	1.0	1/3/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	1/4/2013
Fluoride	EPA 300.0	1.4	mg/L	0.10	1/4/2013
Sulfate	EPA 300.0	13	mg/L	1.0	1/4/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	1/4/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	1/4/2013
Total Dissolved Solids (TDS)	SM 2540C	88	mg/L	10	1/8/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	1/8/2013
Barium	EPA 200.7	0.076	mg/L	0.010	1/8/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	1/8/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	1/8/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	1/8/2013
Calcium	EPA 200.7	19	mg/L	0.50	1/8/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	1/8/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Iron	EPA 200.7	0.010	mg/L	0.010	1/8/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Magnesium	EPA 200.7	4.0	mg/L	0.50	1/8/2013
Manganese	EPA 200.7	0.023	mg/L	0.0050	1/8/2013
Molybdenum	EPA 200.7	0.015	mg/L	0.010	1/8/2013

Customer Sample ID: Biotite Breccia 0-5 Comp Wk:28
Collect Date/Time: 1/3/2013 09:00
WETLAB Sample ID: 1301048-006
Receive Date: 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/8/2013
Potassium	EPA 200.7	1.8	mg/L	0.50	1/8/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Sodium	EPA 200.7	0.72	mg/L	0.50	1/8/2013
Strontium	EPA 200.7	0.27	mg/L	0.10	1/8/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	1/8/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/8/2013
Uranium	EPA 200.8	0.034	mg/L	0.0050	1/8/2013
Anions	Calculation	1.41	meq/L	0.10	
Cations	Calculation	1.36	meq/L	0.10	
Error	Calculation	1.9	%	1.0	

Customer Sample ID: K-Spar Breccia 0-5 Comp Wk:28
Collect Date/Time: 1/3/2013 09:00
WETLAB Sample ID: 1301048-007
Receive Date: 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.90	pH Units		1/3/2013
Trace Metals Digestion	EPA 200.2	Complete			1/4/2013
Bicarbonate (HCO3)	SM 2320B	75	mg/L	1.0	1/3/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/3/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/3/2013
Total Alkalinity	SM 2320B	61	mg/L as CaCO3	1.0	1/3/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	1/4/2013
Fluoride	EPA 300.0	1.3	mg/L	0.10	1/4/2013
Sulfate	EPA 300.0	13	mg/L	1.0	1/4/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	1/4/2013
Nitrite Nitrogen	EPA 300.0	0.092	mg/L	0.025	1/4/2013
Total Dissolved Solids (TDS)	SM 2540C	98	mg/L	10	1/8/2013

Customer Sample ID: K-Spar Breccia 0-5 Comp Wk:28 **Collect Date/Time:** 1/3/2013 09:00
WETLAB Sample ID: 1301048-007 **Receive Date:** 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Aluminum	EPA 200.7	<0.045	mg/L	0.045	1/8/2013
Barium	EPA 200.7	0.10	mg/L	0.010	1/8/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	1/8/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	1/8/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	1/8/2013
Calcium	EPA 200.7	20	mg/L	0.50	1/8/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	1/8/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Magnesium	EPA 200.7	4.2	mg/L	0.50	1/8/2013
Manganese	EPA 200.7	0.018	mg/L	0.0050	1/8/2013
Molybdenum	EPA 200.7	0.017	mg/L	0.010	1/8/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/8/2013
Potassium	EPA 200.7	2.3	mg/L	0.50	1/8/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Sodium	EPA 200.7	0.80	mg/L	0.50	1/8/2013
Strontium	EPA 200.7	0.44	mg/L	0.10	1/8/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	1/8/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/8/2013
Uranium	EPA 200.8	0.040	mg/L	0.0050	1/8/2013
Anions	Calculation	1.57	meq/L	0.10	
Cations	Calculation	1.44	meq/L	0.10	
Error	Calculation	4.3	%	1.0	

Customer Sample ID: Quartz Monzonite 0-5 Comp Wk:28
WETLAB Sample ID: 1301048-008

Collect Date/Time: 1/3/2013 09:00
Receive Date: 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.48	pH Units		1/3/2013
Trace Metals Digestion	EPA 200.2	Complete			1/4/2013
Bicarbonate (HCO3)	SM 2320B	22	mg/L	1.0	1/3/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/3/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/3/2013
Total Alkalinity	SM 2320B	18	mg/L as CaCO3	1.0	1/3/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	1/4/2013
Fluoride	EPA 300.0	0.22	mg/L	0.10	1/4/2013
Sulfate	EPA 300.0	4.2	mg/L	1.0	1/4/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	1/4/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	1/4/2013
Total Dissolved Solids (TDS)	SM 2540C	45	mg/L	10	1/8/2013
Aluminum	EPA 200.7	0.11	mg/L	0.045	1/8/2013
Barium	EPA 200.7	0.056	mg/L	0.010	1/8/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	1/8/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	1/8/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	1/8/2013
Calcium	EPA 200.7	6.5	mg/L	0.50	1/8/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	1/8/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Iron	EPA 200.7	0.018	mg/L	0.010	1/8/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Magnesium	EPA 200.7	0.86	mg/L	0.50	1/8/2013
Manganese	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/8/2013
Potassium	EPA 200.7	<0.50	mg/L	0.50	1/8/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/8/2013
Sodium	EPA 200.7	1.7	mg/L	0.50	1/8/2013
Strontium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/8/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/8/2013

Customer Sample ID: Quartz Monzonite 0-5 Comp Wk:28
WETLAB Sample ID: 1301048-008

Collect Date/Time: 1/3/2013 09:00
Receive Date: 1/3/2013 16:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Zinc	EPA 200.7	<0.010	mg/L	0.010	1/8/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	1/8/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Arsenic	EPA 200.8	0.0060	mg/L	0.0050	1/8/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	1/8/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/8/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	1/8/2013
Anions	Calculation	0.46	meq/L	0.10	
Cations	Calculation	0.48	meq/L	0.10	
Error	Calculation	2.4	%	1.0	

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13010154	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC13010154	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC13010154	Blank 3	Fluoride	EPA 300.0	<0.10	mg/L
QC13010158	Blank 1	Chloride	EPA 300.0	<1.0	mg/L
QC13010158	Blank 2	Chloride	EPA 300.0	<1.0	mg/L
QC13010158	Blank 3	Chloride	EPA 300.0	<1.0	mg/L
QC13010162	Blank 1	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13010162	Blank 2	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13010162	Blank 3	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13010167	Blank 1	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13010167	Blank 2	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13010167	Blank 3	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13010171	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC13010171	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC13010171	Blank 3	Sulfate	EPA 300.0	<1.0	mg/L
QC13010195	Blank 1	Mercury	EPA 200.8	<0.00010	mg/L
		Antimony	EPA 200.8	<0.0025	mg/L
		Arsenic	EPA 200.8	<0.0050	mg/L
		Lead	EPA 200.8	<0.0025	mg/L
		Selenium	EPA 200.8	<0.0050	mg/L
		Thallium	EPA 200.8	<0.0010	mg/L
		Uranium	EPA 200.8	<0.0050	mg/L
QC13010196	Blank 1	Mercury	EPA 200.8	<0.00010	mg/L
		Antimony	EPA 200.8	<0.0025	mg/L
		Arsenic	EPA 200.8	<0.0050	mg/L
		Lead	EPA 200.8	<0.0025	mg/L
		Selenium	EPA 200.8	<0.0050	mg/L
		Thallium	EPA 200.8	<0.0010	mg/L
		Uranium	EPA 200.8	<0.0050	mg/L
QC13010216	Blank 1	Aluminum	EPA 200.7	<0.045	mg/L
		Barium	EPA 200.7	<0.010	mg/L
		Beryllium	EPA 200.7	<0.0010	mg/L
		Bismuth	EPA 200.7	<0.10	mg/L
		Boron	EPA 200.7	<0.100	mg/L
		Cadmium	EPA 200.7	<0.0010	mg/L
		Calcium	EPA 200.7	<0.50	mg/L
		Chromium	EPA 200.7	<0.0050	mg/L
		Cobalt	EPA 200.7	<0.010	mg/L
		Copper	EPA 200.7	<0.050	mg/L
		Gallium	EPA 200.7	<0.10	mg/L
		Iron	EPA 200.7	<0.010	mg/L
		Lithium	EPA 200.7	<0.10	mg/L
		Magnesium	EPA 200.7	<0.50	mg/L
		Manganese	EPA 200.7	<0.0050	mg/L
		Molybdenum	EPA 200.7	<0.010	mg/L
		Nickel	EPA 200.7	<0.010	mg/L
		Phosphorus	EPA 200.7	<0.50	mg/L

QCBatchID	QCType	Parameter	Method	Result	Units
		Potassium	EPA 200.7	<0.50	mg/L
		Scandium	EPA 200.7	<0.10	mg/L
		Silver	EPA 200.7	<0.0050	mg/L
		Sodium	EPA 200.7	<0.50	mg/L
		Strontium	EPA 200.7	<0.10	mg/L
		Tin	EPA 200.7	<0.10	mg/L
		Titanium	EPA 200.7	<0.10	mg/L
		Vanadium	EPA 200.7	<0.010	mg/L
		Zinc	EPA 200.7	<0.010	mg/L
QC13010218	Blank 1	Aluminum	EPA 200.7	<0.045	mg/L
		Barium	EPA 200.7	<0.010	mg/L
		Beryllium	EPA 200.7	<0.0010	mg/L
		Bismuth	EPA 200.7	<0.10	mg/L
		Boron	EPA 200.7	<0.10	mg/L
		Cadmium	EPA 200.7	<0.0010	mg/L
		Calcium	EPA 200.7	<0.50	mg/L
		Chromium	EPA 200.7	<0.0050	mg/L
		Cobalt	EPA 200.7	<0.010	mg/L
		Copper	EPA 200.7	<0.050	mg/L
		Gallium	EPA 200.7	<0.10	mg/L
		Iron	EPA 200.7	<0.010	mg/L
		Lithium	EPA 200.7	<0.10	mg/L
		Magnesium	EPA 200.7	<0.50	mg/L
		Manganese	EPA 200.7	<0.0050	mg/L
		Molybdenum	EPA 200.7	<0.010	mg/L
		Nickel	EPA 200.7	<0.010	mg/L
		Phosphorus	EPA 200.7	<0.50	mg/L
		Potassium	EPA 200.7	<0.50	mg/L
		Scandium	EPA 200.7	<0.10	mg/L
		Silver	EPA 200.7	<0.0050	mg/L
		Sodium	EPA 200.7	<0.50	mg/L
		Strontium	EPA 200.7	<0.10	mg/L
		Tin	EPA 200.7	<0.10	mg/L
		Titanium	EPA 200.7	<0.10	mg/L
		Vanadium	EPA 200.7	<0.010	mg/L
		Zinc	EPA 200.7	<0.010	mg/L
QC13010309	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13010309	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13010309	Blank 3	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13010390	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13010390	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13010108	LCS 1	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC13010108	LCS 2	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC13010108	LCS 3	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC13010108	LCS 4	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC13010110	LCS 1	Total Alkalinity	SM 2320B	99.4	100	99	mg/L
QC13010110	LCS 2	Total Alkalinity	SM 2320B	99.6	100	100	mg/L
QC13010110	LCS 3	Total Alkalinity	SM 2320B	99.6	100	100	mg/L
QC13010110	LCS 4	Total Alkalinity	SM 2320B	99.8	100	100	mg/L
QC13010110	LCS 5	Total Alkalinity	SM 2320B	101	100	101	mg/L
QC13010154	LCS 1	Fluoride	EPA 300.0	1.95	2.00	98	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13010158	LCS 1	Chloride	EPA 300.0	9.81	10.0	98	mg/L
QC13010162	LCS 1	Nitrite Nitrogen	EPA 300.0	0.545	0.500	109	mg/L
QC13010167	LCS 1	Nitrate Nitrogen	EPA 300.0	1.89	2.00	95	mg/L
QC13010171	LCS 1	Sulfate	EPA 300.0	23.6	25.0	94	mg/L
QC13010195	LCS 1	Mercury	EPA 200.8	0.000978	0.001	98	mg/L
		Antimony	EPA 200.8	0.0095	0.010	95	mg/L
		Arsenic	EPA 200.8	0.0487	0.050	97	mg/L
		Lead	EPA 200.8	0.0093	0.010	93	mg/L
		Selenium	EPA 200.8	0.0444	0.050	89	mg/L
		Thallium	EPA 200.8	0.0093	0.010	93	mg/L
		Uranium	EPA 200.8	0.0091	0.010	91	mg/L
QC13010196	LCS 1	Mercury	EPA 200.8	0.000972	0.001	97	mg/L
		Antimony	EPA 200.8	0.0092	0.010	92	mg/L
		Arsenic	EPA 200.8	0.0495	0.050	99	mg/L
		Lead	EPA 200.8	0.0098	0.010	98	mg/L
		Selenium	EPA 200.8	0.0451	0.050	90	mg/L
		Thallium	EPA 200.8	0.0097	0.010	96	mg/L
		Uranium	EPA 200.8	0.0097	0.010	97	mg/L
QC13010216	LCS 1	Aluminum	EPA 200.7	0.954	1.00	95	mg/L
		Barium	EPA 200.7	0.973	1.00	97	mg/L
		Beryllium	EPA 200.7	0.975	1.00	98	mg/L
		Bismuth	EPA 200.7	0.995	1.00	100	mg/L
		Boron	EPA 200.7	0.940	1.00	94	mg/L
		Cadmium	EPA 200.7	0.985	1.00	98	mg/L
		Calcium	EPA 200.7	9.78	10.0	98	mg/L
		Chromium	EPA 200.7	0.964	1.00	96	mg/L
		Cobalt	EPA 200.7	0.979	1.00	98	mg/L
		Copper	EPA 200.7	4.69	5.00	94	mg/L
		Gallium	EPA 200.7	0.970	1.00	97	mg/L
		Iron	EPA 200.7	0.955	1.00	96	mg/L
		Lithium	EPA 200.7	0.945	1.00	94	mg/L
		Magnesium	EPA 200.7	9.33	10.0	93	mg/L
		Manganese	EPA 200.7	0.976	1.00	98	mg/L
		Molybdenum	EPA 200.7	0.955	1.00	96	mg/L
		Nickel	EPA 200.7	4.87	5.00	97	mg/L
		Phosphorus	EPA 200.7	4.89	5.00	98	mg/L
		Potassium	EPA 200.7	9.54	10.0	95	mg/L
		Scandium	EPA 200.7	0.957	1.00	96	mg/L
		Silver	EPA 200.7	0.087	0.090	97	mg/L
		Sodium	EPA 200.7	9.96	10.0	100	mg/L
		Strontium	EPA 200.7	1.00	1.00	100	mg/L
		Tin	EPA 200.7	0.929	1.00	93	mg/L
		Titanium	EPA 200.7	0.954	1.00	95	mg/L
		Vanadium	EPA 200.7	0.970	1.00	97	mg/L
		Zinc	EPA 200.7	0.980	1.00	98	mg/L
QC13010218	LCS 1	Aluminum	EPA 200.7	0.953	1.00	95	mg/L
		Barium	EPA 200.7	0.978	1.00	98	mg/L
		Beryllium	EPA 200.7	0.988	1.00	99	mg/L
		Bismuth	EPA 200.7	0.995	1.00	100	mg/L
		Boron	EPA 200.7	0.943	1.00	94	mg/L
		Cadmium	EPA 200.7	1.00	1.00	100	mg/L
		Calcium	EPA 200.7	9.90	10.0	99	mg/L
		Chromium	EPA 200.7	0.971	1.00	97	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
		Cobalt	EPA 200.7	0.984	1.00	98	mg/L
		Copper	EPA 200.7	4.66	5.00	93	mg/L
		Gallium	EPA 200.7	0.967	1.00	97	mg/L
		Iron	EPA 200.7	0.962	1.00	96	mg/L
		Lithium	EPA 200.7	0.949	1.00	95	mg/L
		Magnesium	EPA 200.7	9.55	10.0	96	mg/L
		Manganese	EPA 200.7	0.990	1.00	99	mg/L
		Molybdenum	EPA 200.7	0.956	1.00	96	mg/L
		Nickel	EPA 200.7	4.91	5.00	98	mg/L
		Phosphorus	EPA 200.7	4.99	5.00	100	mg/L
		Potassium	EPA 200.7	9.56	10.0	96	mg/L
		Scandium	EPA 200.7	0.958	1.00	96	mg/L
		Silver	EPA 200.7	0.087	0.090	97	mg/L
		Sodium	EPA 200.7	9.35	10.0	94	mg/L
		Strontium	EPA 200.7	0.933	1.00	93	mg/L
		Tin	EPA 200.7	0.965	1.00	96	mg/L
		Titanium	EPA 200.7	0.972	1.00	97	mg/L
		Vanadium	EPA 200.7	0.970	1.00	97	mg/L
		Zinc	EPA 200.7	1.00	1.00	100	mg/L
QC13010309	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	157	150	105	mg/L
QC13010309	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	157	150	105	mg/L
QC13010309	LCS 3	Total Dissolved Solids (TDS)	SM 2540C	149	150	100	mg/L
QC13010390	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	159	150	106	mg/L
QC13010390	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	157	150	105	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC13010108	Duplicate	pH	SM 4500-H+ B	1301018-001	8.10	8.13	pH Units	<1%
QC13010108	Duplicate	pH	SM 4500-H+ B	1301018-002	7.83	7.86	pH Units	<1%
QC13010108	Duplicate	pH	SM 4500-H+ B	1301018-003	8.00	8.01	pH Units	<1%
QC13010108	Duplicate	pH	SM 4500-H+ B	1301044-001	6.44	6.40	pH Units	1 %
QC13010108	Duplicate	pH	SM 4500-H+ B	1301044-008	6.16	6.15	pH Units	<1%
QC13010108	Duplicate	pH	SM 4500-H+ B	1301047-001	7.62	7.64	pH Units	<1%
QC13010108	Duplicate	pH	SM 4500-H+ B	1301052-001	7.85	7.86	pH Units	<1%
QC13010110	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301018-001	234	235	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1301018-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1301018-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1301018-001	192	192	mg/L as CaCO3	<1%
QC13010110	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301018-002	153	152	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1301018-002	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1301018-002	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1301018-002	125	125	mg/L as CaCO3	<1%
QC13010110	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301018-003	185	186	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1301018-003	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1301018-003	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1301018-003	152	152	mg/L as CaCO3	<1%
QC13010110	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301044-001	21.4	20.3	mg/L	5 %
		Carbonate (CO3)	SM 2320B	1301044-001	<1.000	<1.000	mg/L	<1%

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result		Units	RPD
		Hydroxide (OH)	SM 2320B	1301044-001	<1.000	<1.000		mg/L	<1%
		Total Alkalinity	SM 2320B	1301044-001	17.5	16.6		mg/L as CaCO3	5 %
QC13010110	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301044-008	23.7	23.6		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1301044-008	<1.000	<1.000		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1301044-008	<1.000	<1.000		mg/L	<1%
		Total Alkalinity	SM 2320B	1301044-008	19.4	19.4		mg/L as CaCO3	<1%
QC13010110	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301047-001	40.6	38.9		mg/L	4 %
		Carbonate (CO3)	SM 2320B	1301047-001	<1.000	<1.000		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1301047-001	<1.000	<1.000		mg/L	<1%
		Total Alkalinity	SM 2320B	1301047-001	33.2	31.9		mg/L as CaCO3	4 %
QC13010110	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301052-001	118	118		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1301052-001	<1.000	<1.000		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1301052-001	<1.000	<1.000		mg/L	<1%
		Total Alkalinity	SM 2320B	1301052-001	96.9	96.9		mg/L as CaCO3	<1%
QC13010309	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301047-001	54.0	58.0		mg/L	7 %
QC13010309	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301078-003	802	808		mg/L	1 %
QC13010309	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301090-001	33.0	32.0		mg/L	3 %
QC13010309	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301090-011	47.0	37.0		mg/L	24 %
QC13010309	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1212510-001		2220		mg/L	<1%
QC13010390	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301093-001	630	628		mg/L	<1%
QC13010390	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301121-003	267	552		mg/L	%
QC13010390	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301048-001	77.0	56.0	HT	mg/L	<1%

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13010154	MS 1	Fluoride	EPA 300.0	1301048-001	1.09	M	2.52	2.55	2.00	mg/L	NC	NC	NC
QC13010154	MS 2	Fluoride	EPA 300.0	1301047-001	<0.100		1.68	1.70	2.00	mg/L	82	83	1 %
QC13010158	MS 1	Chloride	EPA 300.0	1301044-001	1.22		6.61	6.84	5.00	mg/L	108	112	3 %
QC13010158	MS 2	Chloride	EPA 300.0	1301048-001	<1.000		5.18	5.30	5.00	mg/L	103	106	2 %
QC13010162	MS 1	Nitrite Nitrogen	EPA 300.0	1301044-001	<0.025		0.594	0.618	0.500	mg/L	119	124	4 %
QC13010162	MS 2	Nitrite Nitrogen	EPA 300.0	1301048-001	<0.025		0.569	0.580	0.500	mg/L	110	112	2 %
QC13010167	MS 1	Nitrate Nitrogen	EPA 300.0	1301044-001	<1.000		2.29	2.38	2.00	mg/L	107	112	4 %
QC13010167	MS 2	Nitrate Nitrogen	EPA 300.0	1301048-001	<1.000		2.01	2.07	2.00	mg/L	99	102	3 %
QC13010171	MS 1	Sulfate	EPA 300.0	1301044-001	1.23		11.8	12.2	10.0	mg/L	106	110	3 %
QC13010171	MS 2	Sulfate	EPA 300.0	1301048-001	6.88		16.8	17.1	10.0	mg/L	100	102	2 %
QC13010195	MS 1	Mercury	EPA 200.8	1301046-003	<0.00100		0.001920	0.001880	0.001	mg/L	97	93	2 %
		Antimony	EPA 200.8	1301046-003	1.3582	SC	1.3182	1.3619	0.010	mg/L	NC	NC	NC
		Arsenic	EPA 200.8	1301046-003	3.7847	SC	3.7367	3.8235	0.050	mg/L	NC	NC	NC
		Lead	EPA 200.8	1301046-003	<0.0100		0.0125	0.0127	0.010	mg/L	99	101	2 %
		Selenium	EPA 200.8	1301046-003	0.3284	SC	0.3997	0.3995	0.050	mg/L	NC	NC	NC
		Thallium	EPA 200.8	1301046-003	<0.0100		0.0101	0.0102	0.010	mg/L	103	104	1 %
		Uranium	EPA 200.8	1301046-003	<0.0100		<0.0100	<0.0100	0.010	mg/L	104	105	#Erro
QC13010196	MS 1	Mercury	EPA 200.8	1301044-011	<0.00010		0.000959	0.000990	0.001	mg/L	95	98	3 %
		Antimony	EPA 200.8	1301044-011	<0.0025		0.0091	0.0092	0.010	mg/L	91	91	1 %
		Arsenic	EPA 200.8	1301044-011	<0.0050		0.0500	0.0504	0.050	mg/L	100	101	1 %
		Lead	EPA 200.8	1301044-011	<0.0025		0.0099	0.0101	0.010	mg/L	98	101	2 %
		Selenium	EPA 200.8	1301044-011	<0.0050		0.0452	0.0453	0.050	mg/L	90	91	<1%

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Thallium	EPA 200.8	1301044-011	<0.0010	0.0096	0.0098	0.010	mg/L	96	98	2 %
		Uranium	EPA 200.8	1301044-011	<0.0050	0.0098	0.0100	0.010	mg/L	98	100	2 %
QC13010216	MS 1	Aluminum	EPA 200.7	1301046-003	1.04	2.27	2.24	1.00	mg/L	123	120	1 %
		Barium	EPA 200.7	1301046-003	0.018	0.982	0.977	1.00	mg/L	96	96	1 %
		Beryllium	EPA 200.7	1301046-003	<0.001	0.975	0.974	1.00	mg/L	97	97	<1%
		Bismuth	EPA 200.7	1301046-003	<0.100	0.996	1.01	1.00	mg/L	99	101	1 %
		Boron	EPA 200.7	1301046-003	<0.100	1.05	1.06	1.00	mg/L	98	99	1 %
		Cadmium	EPA 200.7	1301046-003	<0.001	0.940	0.935	1.00	mg/L	94	93	1 %
		Calcium	EPA 200.7	1301046-003	9.17	18.7	18.9	10.0	mg/L	95	97	1 %
		Chromium	EPA 200.7	1301046-003	<0.005	0.953	0.948	1.00	mg/L	95	95	1 %
		Cobalt	EPA 200.7	1301046-003	0.014	0.965	0.961	1.00	mg/L	95	95	<1%
		Copper	EPA 200.7	1301046-003	0.079	5.26	5.27	5.00	mg/L	104	104	<1%
		Gallium	EPA 200.7	1301046-003	<0.100	1.02	1.02	1.00	mg/L	102	102	<1%
		Iron	EPA 200.7	1301046-003	0.326	1.32	1.31	1.00	mg/L	99	98	1 %
		Lithium	EPA 200.7	1301046-003	<0.100	0.968	0.969	1.00	mg/L	97	97	<1%
		Magnesium	EPA 200.7	1301046-003	<0.500	9.53	9.51	10.0	mg/L	94	94	<1%
		Manganese	EPA 200.7	1301046-003	0.018	0.986	0.983	1.00	mg/L	97	97	<1%
		Molybdenum	EPA 200.7	1301046-003	0.155	1.09	1.10	1.00	mg/L	94	94	1 %
		Nickel	EPA 200.7	1301046-003	0.015	4.76	4.73	5.00	mg/L	95	94	1 %
		Phosphorus	EPA 200.7	1301046-003	<0.500	5.04	5.08	5.00	mg/L	98	99	1 %
		Potassium	EPA 200.7	1301046-003	2.67	12.5	12.3	10.0	mg/L	98	96	2 %
		Scandium	EPA 200.7	1301046-003	<0.100	0.957	0.955	1.00	mg/L	96	96	<1%
		Silver	EPA 200.7	1301046-003	<0.005	0.090	0.092	0.090	mg/L	100	101	2 %
		Sodium	EPA 200.7	1301046-003	134	145	145	10.0	mg/L	110	110	<1%
		Strontium	EPA 200.7	1301046-003	<0.100	1.00	1.01	1.00	mg/L	98	99	1 %
		Tin	EPA 200.7	1301046-003	<0.100	0.934	0.941	1.00	mg/L	95	95	1 %
		Titanium	EPA 200.7	1301046-003	<0.100	0.979	0.982	1.00	mg/L	98	98	<1%
		Vanadium	EPA 200.7	1301046-003	0.048	1.02	1.02	1.00	mg/L	97	97	<1%
		Zinc	EPA 200.7	1301046-003	0.040	1.02	1.03	1.00	mg/L	98	99	1 %
QC13010218	MS 1	Aluminum	EPA 200.7	1301044-012	<0.045	0.985	0.988	1.00	mg/L	98	98	<1%
		Barium	EPA 200.7	1301044-012	0.026	0.988	0.993	1.00	mg/L	96	97	1 %
		Beryllium	EPA 200.7	1301044-012	<0.001	0.968	0.975	1.00	mg/L	97	97	1 %
		Bismuth	EPA 200.7	1301044-012	<0.100	0.975	0.982	1.00	mg/L	98	98	1 %
		Boron	EPA 200.7	1301044-012	<0.100	0.983	1.00	1.00	mg/L	96	98	2 %
		Cadmium	EPA 200.7	1301044-012	<0.001	0.952	0.960	1.00	mg/L	95	96	1 %
		Calcium	EPA 200.7	1301044-012	13.3	22.9	23.3	10.0	mg/L	96	100	2 %
		Chromium	EPA 200.7	1301044-012	<0.005	0.952	0.957	1.00	mg/L	95	96	1 %
		Cobalt	EPA 200.7	1301044-012	<0.010	0.941	0.951	1.00	mg/L	94	95	1 %
		Copper	EPA 200.7	1301044-012	<0.050	4.79	4.80	5.00	mg/L	96	96	<1%
		Gallium	EPA 200.7	1301044-012	<0.100	0.988	0.991	1.00	mg/L	99	99	<1%
		Iron	EPA 200.7	1301044-012	0.011	0.970	0.969	1.00	mg/L	96	96	<1%
		Lithium	EPA 200.7	1301044-012	<0.100	0.953	0.963	1.00	mg/L	95	96	1 %
		Magnesium	EPA 200.7	1301044-012	7.25	16.5	16.5	10.0	mg/L	92	92	<1%
		Manganese	EPA 200.7	1301044-012	0.005	0.966	0.973	1.00	mg/L	96	97	1 %
		Molybdenum	EPA 200.7	1301044-012	<0.010	0.938	0.943	1.00	mg/L	94	94	1 %
		Nickel	EPA 200.7	1301044-012	<0.010	4.71	4.73	5.00	mg/L	94	95	<1%
		Phosphorus	EPA 200.7	1301044-012	<0.500	4.83	4.88	5.00	mg/L	95	96	1 %
		Potassium	EPA 200.7	1301044-012	6.15	15.7	15.8	10.0	mg/L	95	96	1 %
		Scandium	EPA 200.7	1301044-012	<0.100	0.965	0.967	1.00	mg/L	96	97	<1%
		Silver	EPA 200.7	1301044-012	<0.005	0.088	0.088	0.090	mg/L	98	98	<1%
		Sodium	EPA 200.7	1301044-012	17.2	26.9	27.4	10.0	mg/L	97	102	2 %
		Strontium	EPA 200.7	1301044-012	0.113	1.11	1.13	1.00	mg/L	100	102	2 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Tin	EPA 200.7	1301044-012	<0.100	0.903	0.906	1.00	mg/L	92	92	<1%
		Titanium	EPA 200.7	1301044-012	<0.100	0.974	0.972	1.00	mg/L	97	97	<1%
		Vanadium	EPA 200.7	1301044-012	<0.010	0.974	0.978	1.00	mg/L	97	97	<1%
		Zinc	EPA 200.7	1301044-012	<0.010	0.949	0.951	1.00	mg/L	95	95	<1%

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1301048
Report Due Date: 1/17/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ____ 5-Day ____ Other ____

Billing Address (If different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ____

Analyses Requested

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium								Spl. No.
CF-11-02 (227-367)	Wk:28	01/03/13	9:00	WW	2	X	X								1
CF-11-02 (52-117)	↓	↓	↓	↓	↓	↓	↓								2
K-Spar Breccia 5+ Comp	↓	↓	↓	↓	↓	↓	↓								3
Biotite Breccia 5+ Comp	↓	↓	↓	↓	↓	↓	↓								4
Quartz Monzonite 5+ Comp	↓	↓	↓	↓	↓	↓	↓								5
Biotite Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓								6
K-Spar Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓								7
Quartz Monzonite 0-5 Comp	↓	↓	↓	↓	↓	↓	↓								8

Instructions/Comments/Special Requirements:

1301 \ 1
048 1

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 18.3 °C	1-3-13	1610		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 16				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

WETLAB
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Lab Number 1301048
Report Due Date: 1/17/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard 5-Day Other

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information
Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes
DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium								Spl. No.
CF-11-02 (227-367)	Wk:28	01/03/13	9:00	WW	2	X	X								1
CF-11-02 (52-117)	↓	↓	↓	↓	↓	↓	↓								2
K-Spar Breccia 5+ Comp	↓	↓	↓	↓	↓	↓	↓								3
Biotite Breccia 5+ Comp	↓	↓	↓	↓	↓	↓	↓								4
Quartz Monzonite 5+ Comp	↓	↓	↓	↓	↓	↓	↓								5
Biotite Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓								6
K-Spar Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓								7
Quartz Monzonite 0-5 Comp	↓	↓	↓	↓	↓	↓	↓								8

Instructions/Comments/Special Requirements:

1301 1
048 1

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 18.3 °C	1-3-13	1610		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 16				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

WETLAB
WESTERN ENVIRONMENTAL
TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

1/29/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1301263*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 1/17/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Andy Smith
QA Manager

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817

ELKO
1084 Lamoille Hwy.
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933

LAS VEGAS
3230 Polaris Ave., Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 776-6152

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1301263

General Comments

None

Specific Comments

None

Data Qualifier Legend

B	-- Blank contamination; Analyte detected above the method reporting limit in an associated blank
HT	-- Sample held beyond the accepted holding time
J	-- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	-- Reported value is estimated; The sample matrix interfered with the analysis
N	-- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	-- Not calculated due to matrix interference
Q	-- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
S	-- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.
SC	-- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438 Wk:36*

Date Printed: 1/29/2013
OrderID: *1301263*

Customer Sample ID: CF-11-02 (0-27) WK:36
WETLAB Sample ID: 1301263-001

Collect Date/Time: 1/17/2013 09:00
Receive Date: 1/17/2013 14:40

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.70	pH Units		1/17/2013
Trace Metals Digestion	EPA 200.2	Complete			1/21/2013
Bicarbonate (HCO3)	SM 2320B	52	mg/L	1.0	1/17/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/17/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/17/2013
Total Alkalinity	SM 2320B	43	mg/L as CaCO3	1.0	1/17/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	1/18/2013
Fluoride	EPA 300.0	0.86	mg/L	0.10	1/18/2013
Sulfate	EPA 300.0	15	mg/L	1.0	1/18/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	1/18/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	1/18/2013
Total Dissolved Solids (TDS)	SM 2540C	84	mg/L	10	1/21/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	1/22/2013
Barium	EPA 200.7	<0.010	mg/L	0.010	1/22/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	1/22/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	1/22/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	1/22/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	1/22/2013
Calcium	EPA 200.7	18	mg/L	0.50	1/22/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	1/22/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	1/22/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	1/22/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	1/22/2013
Iron	EPA 200.7	0.015	mg/L	0.010	1/22/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	1/22/2013
Magnesium	EPA 200.7	3.0	mg/L	0.50	1/22/2013
Manganese	EPA 200.7	0.032	mg/L	0.0050	1/22/2013

Customer Sample ID: CF-11-02 (0-27) WK:36
WETLAB Sample ID: 1301263-001

Collect Date/Time: 1/17/2013 09:00
Receive Date: 1/17/2013 14:40

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	1/22/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/22/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/22/2013
Potassium	EPA 200.7	1.3	mg/L	0.50	1/22/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/22/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/22/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	1/22/2013
Strontium	EPA 200.7	0.14	mg/L	0.10	1/22/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/22/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/22/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/22/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	1/22/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	1/22/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/22/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	1/22/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	1/22/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/22/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/22/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	1/22/2013
Anions	Calculation	1.21	meq/L	0.10	
Cations	Calculation	1.18	meq/L	0.10	
Error	Calculation	1.2	%	1.0	

Customer Sample ID: CF-11-02 (367-408) WK:36
WETLAB Sample ID: 1301263-002

Collect Date/Time: 1/17/2013 09:00
Receive Date: 1/17/2013 14:40

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.41	pH Units		1/17/2013
Trace Metals Digestion	EPA 200.2	Complete			1/21/2013
Bicarbonate (HCO3)	SM 2320B	34	mg/L	1.0	1/17/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/17/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/17/2013
Total Alkalinity	SM 2320B	28	mg/L as CaCO3	1.0	1/17/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	1/18/2013
Fluoride	EPA 300.0	0.91	mg/L	0.10	1/18/2013
Sulfate	EPA 300.0	7.8	mg/L	1.0	1/18/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	1/18/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	1/18/2013

Customer Sample ID: CF-11-02 (367-408) WK:36
WETLAB Sample ID: 1301263-002

Collect Date/Time: 1/17/2013 09:00
Receive Date: 1/17/2013 14:40

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Total Dissolved Solids (TDS)	SM 2540C	48	mg/L	10	1/21/2013
Aluminum	EPA 200.7	0.084	mg/L	0.045	1/22/2013
Barium	EPA 200.7	<0.010	mg/L	0.010	1/22/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	1/22/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	1/22/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	1/22/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	1/22/2013
Calcium	EPA 200.7	14	mg/L	0.50	1/22/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	1/22/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	1/22/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	1/22/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	1/22/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	1/22/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	1/22/2013
Magnesium	EPA 200.7	<0.50	mg/L	0.50	1/22/2013
Manganese	EPA 200.7	0.021	mg/L	0.0050	1/22/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	1/22/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/22/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/22/2013
Potassium	EPA 200.7	0.85	mg/L	0.50	1/22/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/22/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/22/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	1/22/2013
Strontium	EPA 200.7	0.12	mg/L	0.10	1/22/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/22/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/22/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/22/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	1/22/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	1/22/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/22/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	1/22/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	1/22/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/22/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/22/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	1/22/2013
Anions	Calculation	0.77	meq/L	0.10	
Cations	Calculation	0.73	meq/L	0.10	
Error	Calculation	2.5	%	1.0	

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13010575	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC13010575	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC13010575	Blank 3	Fluoride	EPA 300.0	<0.10	mg/L
QC13010579	Blank 1	Chloride	EPA 300.0	<1.0	mg/L
QC13010579	Blank 2	Chloride	EPA 300.0	<1.0	mg/L
QC13010579	Blank 3	Chloride	EPA 300.0	<1.0	mg/L
QC13010583	Blank 1	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13010583	Blank 2	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13010583	Blank 3	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13010589	Blank 1	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13010589	Blank 2	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13010589	Blank 3	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13010592	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC13010592	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC13010592	Blank 3	Sulfate	EPA 300.0	<1.0	mg/L
QC13010661	Blank 1	Uranium, Dissolved	EPA 200.8	<0.0050	mg/L
		Mercury, Dissolved	EPA 200.8	<0.00010	mg/L
		Antimony, Dissolved	EPA 200.8	<0.0025	mg/L
		Arsenic, Dissolved	EPA 200.8	<0.0050	mg/L
		Lead, Dissolved	EPA 200.8	<0.0025	mg/L
		Selenium, Dissolved	EPA 200.8	<0.0050	mg/L
		Thallium, Dissolved	EPA 200.8	<0.0010	mg/L
QC13010677	Blank 1	Aluminum, Dissolved	EPA 200.7	<0.045	mg/L
		Barium, Dissolved	EPA 200.7	<0.010	mg/L
		Beryllium, Dissolved	EPA 200.7	<0.0010	mg/L
		Bismuth, Dissolved	EPA 200.7	<0.10	mg/L
		Boron, Dissolved	EPA 200.7	<0.10	mg/L
		Cadmium, Dissolved	EPA 200.7	<0.0010	mg/L
		Calcium, Dissolved	EPA 200.7	<0.50	mg/L
		Chromium, Dissolved	EPA 200.7	<0.0050	mg/L
		Cobalt, Dissolved	EPA 200.7	<0.010	mg/L
		Copper, Dissolved	EPA 200.7	<0.050	mg/L
		Gallium, Dissolved	EPA 200.7	<0.10	mg/L
		Iron, Dissolved	EPA 200.7	<0.010	mg/L
		Lithium, Dissolved	EPA 200.7	<0.10	mg/L
		Magnesium, Dissolved	EPA 200.7	<0.50	mg/L
		Manganese, Dissolved	EPA 200.7	<0.0050	mg/L
		Molybdenum, Dissolved	EPA 200.7	<0.010	mg/L
		Nickel, Dissolved	EPA 200.7	<0.010	mg/L
		Phosphorus, Dissolved	EPA 200.7	<0.50	mg/L
		Potassium, Dissolved	EPA 200.7	<0.50	mg/L
		Scandium, Dissolved	EPA 200.7	<0.10	mg/L
		Silver, Dissolved	EPA 200.7	<0.0050	mg/L
		Sodium, Dissolved	EPA 200.7	<0.50	mg/L
		Strontium, Dissolved	EPA 200.7	<0.10	mg/L
		Tin, Dissolved	EPA 200.7	<0.10	mg/L
		Titanium, Dissolved	EPA 200.7	<0.10	mg/L

QCBatchID	QCType	Parameter	Method	Result	Units
		Vanadium, Dissolved	EPA 200.7	<0.010	mg/L
		Zinc, Dissolved	EPA 200.7	<0.010	mg/L
QC13010685	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13010685	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13010543	LCS 1	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC13010543	LCS 2	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC13010544	LCS 1	Total Alkalinity	SM 2320B	96.9	100	97	mg/L
QC13010544	LCS 2	Total Alkalinity	SM 2320B	99.5	100	100	mg/L
QC13010544	LCS 3	Total Alkalinity	SM 2320B	100	100	100	mg/L
QC13010575	LCS 1	Fluoride	EPA 300.0	1.97	2.00	98	mg/L
QC13010579	LCS 1	Chloride	EPA 300.0	10.2	10.0	102	mg/L
QC13010583	LCS 1	Nitrite Nitrogen	EPA 300.0	0.542	0.500	108	mg/L
QC13010589	LCS 1	Nitrate Nitrogen	EPA 300.0	1.97	2.00	99	mg/L
QC13010592	LCS 1	Sulfate	EPA 300.0	24.3	25.0	97	mg/L
QC13010661	LCS 1	Uranium, Dissolved	EPA 200.8	0.0099	0.010	99	mg/L
		Mercury, Dissolved	EPA 200.8	0.001001	0.001	100	mg/L
		Antimony, Dissolved	EPA 200.8	0.0093	0.010	93	mg/L
		Arsenic, Dissolved	EPA 200.8	0.0483	0.050	96	mg/L
		Lead, Dissolved	EPA 200.8	0.0099	0.010	99	mg/L
		Selenium, Dissolved	EPA 200.8	0.0466	0.050	93	mg/L
		Thallium, Dissolved	EPA 200.8	0.0099	0.010	99	mg/L
QC13010677	LCS 1	Aluminum, Dissolved	EPA 200.7	0.981	1.00	98	mg/L
		Barium, Dissolved	EPA 200.7	0.998	1.00	100	mg/L
		Beryllium, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
		Bismuth, Dissolved	EPA 200.7	1.04	1.00	104	mg/L
		Boron, Dissolved	EPA 200.7	0.962	1.00	96	mg/L
		Cadmium, Dissolved	EPA 200.7	1.02	1.00	102	mg/L
		Calcium, Dissolved	EPA 200.7	10.1	10.0	101	mg/L
		Chromium, Dissolved	EPA 200.7	0.989	1.00	99	mg/L
		Cobalt, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Copper, Dissolved	EPA 200.7	4.78	5.00	96	mg/L
		Gallium, Dissolved	EPA 200.7	0.991	1.00	99	mg/L
		Iron, Dissolved	EPA 200.7	0.992	1.00	99	mg/L
		Lithium, Dissolved	EPA 200.7	0.970	1.00	97	mg/L
		Magnesium, Dissolved	EPA 200.7	10.1	10.0	101	mg/L
		Manganese, Dissolved	EPA 200.7	0.997	1.00	100	mg/L
		Molybdenum, Dissolved	EPA 200.7	0.992	1.00	99	mg/L
		Nickel, Dissolved	EPA 200.7	5.00	5.00	100	mg/L
		Phosphorus, Dissolved	EPA 200.7	5.20	5.00	104	mg/L
		Potassium, Dissolved	EPA 200.7	9.80	10.0	98	mg/L
		Scandium, Dissolved	EPA 200.7	0.981	1.00	98	mg/L
		Silver, Dissolved	EPA 200.7	0.089	0.090	99	mg/L
		Sodium, Dissolved	EPA 200.7	9.69	10.0	97	mg/L
		Strontium, Dissolved	EPA 200.7	0.971	1.00	97	mg/L
		Tin, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Titanium, Dissolved	EPA 200.7	0.996	1.00	100	mg/L
		Vanadium, Dissolved	EPA 200.7	0.983	1.00	98	mg/L
		Zinc, Dissolved	EPA 200.7	1.03	1.00	103	mg/L
QC13010685	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	144	150	96	mg/L
QC13010685	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	149	150	100	mg/L

				Duplicate	Sample	Duplicate	

QCBatchID	QCType			Sample	Result	Result		
QC13010543	Duplicate	pH	SM 4500-H+ B	1301254-001	8.55	8.64	pH Units	1 %
QC13010543	Duplicate	pH	SM 4500-H+ B	1301254-011	7.50	7.48	pH Units	<1%
QC13010543	Duplicate	pH	SM 4500-H+ B	1301264-001	4.22	4.20	pH Units	<1%
QC13010544	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301254-001	28.8	27.7	mg/L	4 %
		Carbonate (CO3)	SM 2320B	1301254-001	2.49	2.88	mg/L	15 %
		Hydroxide (OH)	SM 2320B	1301254-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1301254-001	27.8	27.5	mg/L as CaCO3	1 %
QC13010544	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301254-011	20.2	18.9	mg/L	7 %
		Carbonate (CO3)	SM 2320B	1301254-011	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1301254-011	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1301254-011	16.6	15.5	mg/L as CaCO3	7 %
QC13010544	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301270-001	116	116	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1301270-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1301270-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1301270-001	95.5	95.1	mg/L as CaCO3	<1%
QC13010685	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301240-002	58.0	48.0	mg/L	19 %
QC13010685	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301240-012	79.0	79.0	mg/L	<1%
QC13010685	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301288-003	2088	2096	mg/L	<1%
QC13010685	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301235-001		1160	mg/L	<1%

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13010575	MS 1	Fluoride	EPA 300.0	1301274-001	1.32	18.1	17.7	2.00	mg/L	84	82	2 %
QC13010575	MS 2	Fluoride	EPA 300.0	1301289-001	<0.500	8.70	8.69	2.00	mg/L	82	82	<1%
QC13010579	MS 1	Chloride	EPA 300.0	1301263-001	<1.000	5.32	5.49	5.00	mg/L	105	109	3 %
QC13010579	MS 2	Chloride	EPA 300.0	1301274-001	92.0	148	144	5.00	mg/L	111	104	3 %
QC13010583	MS 1	Nitrite Nitrogen	EPA 300.0	1301263-002	<0.025	0.585	0.600	0.500	mg/L	114	117	3 %
QC13010583	MS 2	Nitrite Nitrogen	EPA 300.0	1301283-001	<0.125	2.94	2.90	0.500	mg/L	118	116	1 %
QC13010589	MS 1	Nitrate Nitrogen	EPA 300.0	1301263-002	<1.000	2.37	2.47	2.00	mg/L	98	103	4 %
QC13010589	MS 2	Nitrate Nitrogen	EPA 300.0	1301283-001	<1.000	10.8	10.6	2.00	mg/L	104	103	2 %
QC13010592	MS 1	Sulfate	EPA 300.0	1301263-002	7.81	17.7	18.1	10.0	mg/L	99	102	2 %
QC13010592	MS 2	Sulfate	EPA 300.0	1301274-001	482	587	572	10.0	mg/L	105	90	3 %
QC13010661	MS 1	Uranium, Dissolved	EPA 200.8	1301266-001	<0.0050	0.0098	0.0099	0.010	mg/L	98	99	1 %
		Mercury, Dissolved	EPA 200.8	1301266-001	<0.00010	0.000838	0.000847	0.001	mg/L	84	85	1 %
		Antimony, Dissolved	EPA 200.8	1301266-001	<0.0025	0.0088	0.0089	0.010	mg/L	88	89	1 %
		Arsenic, Dissolved	EPA 200.8	1301266-001	0.0054	0.0552	0.0542	0.050	mg/L	100	98	2 %
		Lead, Dissolved	EPA 200.8	1301266-001	<0.0025	0.0095	0.0095	0.010	mg/L	95	95	<1%
		Selenium, Dissolved	EPA 200.8	1301266-001	<0.0050	0.0441	0.0429	0.050	mg/L	88	86	3 %
		Thallium, Dissolved	EPA 200.8	1301266-001	<0.0010	0.0100	0.0100	0.010	mg/L	92	92	<1%
QC13010677	MS 1	Aluminum, Dissolved	EPA 200.7	1301266-001	<0.045	1.02	0.975	1.00	mg/L	101	96	5 %
		Barium, Dissolved	EPA 200.7	1301266-001	0.042	1.03	1.01	1.00	mg/L	99	97	2 %
		Beryllium, Dissolved	EPA 200.7	1301266-001	<0.001	0.995	0.988	1.00	mg/L	100	99	1 %
		Bismuth, Dissolved	EPA 200.7	1301266-001	<0.100	0.982	0.980	1.00	mg/L	99	99	<1%
		Boron, Dissolved	EPA 200.7	1301266-001	0.140	1.14	1.13	1.00	mg/L	100	99	1 %
		Cadmium, Dissolved	EPA 200.7	1301266-001	<0.001	1.00	0.978	1.00	mg/L	100	98	2 %
		Calcium, Dissolved	EPA 200.7	1301266-001	48.4	57.1	58.3	10.0	mg/L	87	99	2 %
		Chromium, Dissolved	EPA 200.7	1301266-001	<0.005	0.971	0.955	1.00	mg/L	97	95	2 %
		Cobalt, Dissolved	EPA 200.7	1301266-001	<0.010	0.962	0.950	1.00	mg/L	96	95	1 %
		Copper, Dissolved	EPA 200.7	1301266-001	<0.050	4.70	4.61	5.00	mg/L	94	92	2 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Gallium, Dissolved	EPA 200.7	1301266-001	<0.100	1.00	0.992	1.00	mg/L	100	99	1 %
		Iron, Dissolved	EPA 200.7	1301266-001	2.47	3.53	3.56	1.00	mg/L	106	109	1 %
		Lithium, Dissolved	EPA 200.7	1301266-001	<0.100	0.933	0.930	1.00	mg/L	93	92	<1%
		Magnesium, Dissolved	EPA 200.7	1301266-001	18.1	26.9	27.0	10.0	mg/L	88	89	<1%
		Manganese, Dissolved	EPA 200.7	1301266-001	0.185	1.16	1.14	1.00	mg/L	97	95	2 %
		Molybdenum, Dissolved	EPA 200.7	1301266-001	<0.010	0.996	0.993	1.00	mg/L	99	99	<1%
		Nickel, Dissolved	EPA 200.7	1301266-001	<0.010	4.81	4.72	5.00	mg/L	96	94	2 %
		Phosphorus, Dissolved	EPA 200.7	1301266-001	<0.500	5.37	5.37	5.00	mg/L	105	105	<1%
		Potassium, Dissolved	EPA 200.7	1301266-001	9.02	18.8	18.9	10.0	mg/L	98	99	1 %
		Scandium, Dissolved	EPA 200.7	1301266-001	<0.100	0.981	0.976	1.00	mg/L	98	98	1 %
		Silver, Dissolved	EPA 200.7	1301266-001	<0.005	0.088	0.088	0.090	mg/L	98	98	<1%
		Sodium, Dissolved	EPA 200.7	1301266-001	34.5	43.3	43.8	10.0	mg/L	88	93	1 %
		Strontium, Dissolved	EPA 200.7	1301266-001	0.258	1.22	1.22	1.00	mg/L	96	96	<1%
		Tin, Dissolved	EPA 200.7	1301266-001	<0.100	0.977	0.978	1.00	mg/L	100	100	<1%
		Titanium, Dissolved	EPA 200.7	1301266-001	<0.100	0.993	0.991	1.00	mg/L	99	99	<1%
		Vanadium, Dissolved	EPA 200.7	1301266-001	0.017	1.02	1.01	1.00	mg/L	100	99	1 %
		Zinc, Dissolved	EPA 200.7	1301266-001	0.066	1.08	1.06	1.00	mg/L	101	99	2 %

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #118 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1301263
Report Due Date: 1/31/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard [illegible] Day [illegible] Other

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results	Y	N	To: Client	Billing
Email Results	Y	N	To: Client	Billing
Compliance Monitoring	Y	N		
Fax Results to State EPA	Y	N		

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER:

Analyses Requested

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
CF-11-02 (0-27)	Wk:36	01/17/13	9:00	WW	2	X	X									1
CF-11-02 (367-408)	↓	↓	↓	↓	↓	↓	↓									2

1301 1
263 2

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 18.9 °C	1/17/13	1440		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 4				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

WETLAB
WESTERN ENVIRONMENTAL
TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

2/7/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1301374*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 1/24/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Andy Smith
QA Manager

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1301374

General Comments

None

Specific Comments

Due to a laboratory reanalysis requirement the analysis for Total Dissolved Solids (TDS) on sample 1301374-001 was performed past the EPA recommended holding time. We apologize for any inconvenience this may have caused.

Data Qualifier Legend

B	-- Blank contamination; Analyte detected above the method reporting limit in an associated blank
HT	-- Sample held beyond the accepted holding time
J	-- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	-- Reported value is estimated; The sample matrix interfered with the analysis
N	-- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	-- Not calculated due to matrix interference
Q	-- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
S	-- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.
SC	-- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438 Wk:104*

Date Printed: 2/7/2013
OrderID: *1301374*

Customer Sample ID: 604 673 Wk: 104
WETLAB Sample ID: 1301374-001

Collect Date/Time: 1/24/2013 09:00
Receive Date: 1/24/2013 14:35

PROFILE II

Parameter	Method	Results		Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	5.64		pH Units		1/24/2013
Trace Metals Digestion	EPA 200.2	Complete				1/28/2013
Bicarbonate (HCO3)	SM 2320B	<1.0		mg/L	1.0	1/24/2013
Carbonate (CO3)	SM 2320B	<1.0		mg/L	1.0	1/24/2013
Hydroxide (OH)	SM 2320B	<1.0		mg/L	1.0	1/24/2013
Total Alkalinity	SM 2320B	<1.0		mg/L as CaCO3	1.0	1/24/2013
Chloride	EPA 300.0	<1.00		mg/L	1.00	1/25/2013
Fluoride	EPA 300.0	0.17		mg/L	0.10	1/25/2013
Sulfate	EPA 300.0	25		mg/L	1.0	1/25/2013
Nitrate Nitrogen	EPA 300.0	<1.0		mg/L	1.0	1/25/2013
Nitrite Nitrogen	EPA 300.0	<0.025		mg/L	0.025	1/25/2013
Total Dissolved Solids (TDS)	SM 2540C	48	HT	mg/L	10	2/5/2013
Aluminum	EPA 200.7	0.19		mg/L	0.045	1/29/2013
Barium	EPA 200.7	0.075		mg/L	0.010	1/29/2013
Beryllium	EPA 200.7	0.0010		mg/L	0.0010	1/29/2013
Bismuth	EPA 200.7	<0.10		mg/L	0.10	1/29/2013
Boron	EPA 200.7	<0.100		mg/L	0.100	1/29/2013
Cadmium	EPA 200.7	0.0014		mg/L	0.0010	1/29/2013
Calcium	EPA 200.7	7.2		mg/L	0.50	1/29/2013
Chromium	EPA 200.7	<0.0050		mg/L	0.0050	1/29/2013
Cobalt	EPA 200.7	<0.010		mg/L	0.010	1/29/2013
Copper	EPA 200.7	2.1		mg/L	0.050	1/29/2013
Gallium	EPA 200.7	<0.10		mg/L	0.10	1/29/2013
Iron	EPA 200.7	<0.010		mg/L	0.010	1/29/2013
Lithium	EPA 200.7	<0.10		mg/L	0.10	1/29/2013
Magnesium	EPA 200.7	0.94		mg/L	0.50	1/29/2013
Manganese	EPA 200.7	0.050		mg/L	0.0050	1/29/2013

Customer Sample ID: 604 673 Wk: 104 **Collect Date/Time:** 1/24/2013 09:00
WETLAB Sample ID: 1301374-001 **Receive Date:** 1/24/2013 14:35

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	1/29/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/29/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/29/2013
Potassium	EPA 200.7	0.82	mg/L	0.50	1/29/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/29/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	1/30/2013
Strontium	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/29/2013
Zinc	EPA 200.7	0.063	mg/L	0.010	1/29/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	1/28/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/28/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	1/28/2013
Lead	EPA 200.8	0.011	mg/L	0.0025	1/29/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/28/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/29/2013
Uranium	EPA 200.8	0.028	mg/L	0.0050	1/29/2013
Anions	Calculation	0.53	meq/L	0.10	
Cations	Calculation	0.55	meq/L	0.10	
Error	Calculation	1.8	%	1.0	

Customer Sample ID: SRK 0854 Wk: 104 **Collect Date/Time:** 1/24/2013 09:00
WETLAB Sample ID: 1301374-002 **Receive Date:** 1/24/2013 14:35

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	5.08	pH Units		1/24/2013
Trace Metals Digestion	EPA 200.2	Complete			1/28/2013
Bicarbonate (HCO3)	SM 2320B	<1.0	mg/L	1.0	1/24/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/24/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/24/2013
Total Alkalinity	SM 2320B	<1.0	mg/L as CaCO3	1.0	1/24/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	1/25/2013
Fluoride	EPA 300.0	0.10	mg/L	0.10	1/25/2013
Sulfate	EPA 300.0	69	mg/L	1.0	1/25/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	1/25/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	1/25/2013

Customer Sample ID: SRK 0854 Wk: 104
WETLAB Sample ID: 1301374-002

Collect Date/Time: 1/24/2013 09:00
Receive Date: 1/24/2013 14:35

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Total Dissolved Solids (TDS)	SM 2540C	140	mg/L	10	1/29/2013
Aluminum	EPA 200.7	0.053	mg/L	0.045	1/29/2013
Barium	EPA 200.7	0.033	mg/L	0.010	1/29/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	1/29/2013
Bismuth	EPA 200.7	0.12	mg/L	0.10	1/29/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	1/29/2013
Cadmium	EPA 200.7	0.0012	mg/L	0.0010	1/30/2013
Calcium	EPA 200.7	2.9	mg/L	0.50	1/29/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	1/29/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	1/29/2013
Copper	EPA 200.7	42	mg/L	0.050	1/29/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	1/29/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Magnesium	EPA 200.7	<0.50	mg/L	0.50	1/29/2013
Manganese	EPA 200.7	0.062	mg/L	0.0050	1/29/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	1/29/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/29/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/29/2013
Potassium	EPA 200.7	0.65	mg/L	0.50	1/29/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/29/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	1/30/2013
Strontium	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/29/2013
Zinc	EPA 200.7	0.15	mg/L	0.010	1/29/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	1/28/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/28/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	1/28/2013
Lead	EPA 200.8	0.012	mg/L	0.0025	1/30/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/28/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/30/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	1/30/2013
Anions	Calculation	1.44	meq/L	0.10	
Cations	Calculation	1.50	meq/L	0.10	
Error	Calculation	1.8	%	1.0	

Customer Sample ID: SRK 0872 Wk: 104
WETLAB Sample ID: 1301374-003

Collect Date/Time: 1/24/2013 09:00
Receive Date: 1/24/2013 14:35

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	6.87	pH Units		1/24/2013
Trace Metals Digestion	EPA 200.2	Complete			1/28/2013
Bicarbonate (HCO3)	SM 2320B	6.8	mg/L	1.0	1/24/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/24/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/24/2013
Total Alkalinity	SM 2320B	5.6	mg/L as CaCO3	1.0	1/24/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	1/25/2013
Fluoride	EPA 300.0	0.40	mg/L	0.10	1/25/2013
Sulfate	EPA 300.0	18	mg/L	1.0	1/25/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	1/25/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	1/25/2013
Total Dissolved Solids (TDS)	SM 2540C	73	mg/L	10	1/29/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	1/29/2013
Barium	EPA 200.7	0.020	mg/L	0.010	1/29/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	1/29/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	1/29/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	1/29/2013
Calcium	EPA 200.7	9.1	mg/L	0.50	1/29/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	1/29/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	1/29/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	1/29/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Iron	EPA 200.7	0.025	mg/L	0.010	1/29/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Magnesium	EPA 200.7	0.74	mg/L	0.50	1/29/2013
Manganese	EPA 200.7	<0.0050	mg/L	0.0050	1/29/2013
Molybdenum	EPA 200.7	0.052	mg/L	0.010	1/29/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	1/29/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	1/29/2013
Potassium	EPA 200.7	<0.50	mg/L	0.50	1/29/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	1/29/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	1/29/2013
Strontium	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	1/29/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	1/29/2013

Customer Sample ID: SRK 0872 Wk: 104
WETLAB Sample ID: 1301374-003

Collect Date/Time: 1/24/2013 09:00
Receive Date: 1/24/2013 14:35

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Zinc	EPA 200.7	<0.010	mg/L	0.010	1/29/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	1/28/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	1/28/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	1/28/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	1/29/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	1/28/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	1/29/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	1/29/2013
Anions	Calculation	0.51	meq/L	0.10	
Cations	Calculation	0.52	meq/L	0.10	
Error	Calculation	<1.0	%	1.0	

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13010811	Blank 1	Uranium, Dissolved	EPA 200.8	<0.0050	mg/L
		Mercury, Dissolved	EPA 200.8	<0.00010	mg/L
		Antimony, Dissolved	EPA 200.8	<0.0025	mg/L
		Arsenic, Dissolved	EPA 200.8	<0.0050	mg/L
		Lead, Dissolved	EPA 200.8	<0.0025	mg/L
		Selenium, Dissolved	EPA 200.8	<0.0050	mg/L
		Thallium, Dissolved	EPA 200.8	<0.0010	mg/L
QC13010817	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC13010817	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC13010817	Blank 3	Fluoride	EPA 300.0	<0.10	mg/L
QC13010818	Blank 1	Chloride	EPA 300.0	<1.0	mg/L
QC13010818	Blank 2	Chloride	EPA 300.0	<1.0	mg/L
QC13010818	Blank 3	Chloride	EPA 300.0	<1.0	mg/L
QC13010819	Blank 1	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13010819	Blank 2	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13010819	Blank 3	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13010820	Blank 1	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13010820	Blank 2	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13010820	Blank 3	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13010821	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC13010821	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC13010821	Blank 3	Sulfate	EPA 300.0	<1.0	mg/L
QC13010864	Blank 1	Aluminum, Dissolved	EPA 200.7	<0.045	mg/L
		Barium, Dissolved	EPA 200.7	<0.010	mg/L
		Beryllium, Dissolved	EPA 200.7	<0.0010	mg/L
		Bismuth, Dissolved	EPA 200.7	<0.10	mg/L
		Boron, Dissolved	EPA 200.7	<0.10	mg/L
		Cadmium, Dissolved	EPA 200.7	<0.0010	mg/L
		Calcium, Dissolved	EPA 200.7	<0.50	mg/L
		Chromium, Dissolved	EPA 200.7	<0.0050	mg/L
		Cobalt, Dissolved	EPA 200.7	<0.010	mg/L
		Copper, Dissolved	EPA 200.7	<0.050	mg/L
		Gallium, Dissolved	EPA 200.7	<0.10	mg/L
		Iron, Dissolved	EPA 200.7	<0.010	mg/L
		Lithium, Dissolved	EPA 200.7	<0.10	mg/L
		Magnesium, Dissolved	EPA 200.7	<0.50	mg/L
		Manganese, Dissolved	EPA 200.7	<0.0050	mg/L
		Molybdenum, Dissolved	EPA 200.7	<0.010	mg/L
		Nickel, Dissolved	EPA 200.7	<0.010	mg/L
		Phosphorus, Dissolved	EPA 200.7	<0.50	mg/L
		Potassium, Dissolved	EPA 200.7	<0.50	mg/L
		Scandium, Dissolved	EPA 200.7	<0.10	mg/L
		Silver, Dissolved	EPA 200.7	<0.0050	mg/L
		Sodium, Dissolved	EPA 200.7	<0.50	mg/L
		Strontium, Dissolved	EPA 200.7	<0.10	mg/L
		Tin, Dissolved	EPA 200.7	<0.10	mg/L
		Titanium, Dissolved	EPA 200.7	<0.10	mg/L

QCBatchID	QCType	Parameter	Method	Result	Units
		Vanadium, Dissolved	EPA 200.7	<0.010	mg/L
		Zinc, Dissolved	EPA 200.7	<0.010	mg/L
QC13010922	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13010754	LCS 1	pH	SM 4500-H+ B	6.99	7.00	100	pH Units
QC13010754	LCS 2	pH	SM 4500-H+ B	6.99	7.00	100	pH Units
QC13010756	LCS 1	Total Alkalinity	SM 2320B	98.0	100	98	mg/L
QC13010756	LCS 2	Total Alkalinity	SM 2320B	99.3	100	99	mg/L
QC13010756	LCS 3	Total Alkalinity	SM 2320B	99.7	100	100	mg/L
QC13010811	LCS 1	Uranium, Dissolved	EPA 200.8	0.0095	0.010	95	mg/L
		Mercury, Dissolved	EPA 200.8	0.000953	0.001	95	mg/L
		Antimony, Dissolved	EPA 200.8	0.0090	0.010	90	mg/L
		Arsenic, Dissolved	EPA 200.8	0.0501	0.050	100	mg/L
		Lead, Dissolved	EPA 200.8	0.0097	0.010	97	mg/L
		Selenium, Dissolved	EPA 200.8	0.0465	0.050	93	mg/L
		Thallium, Dissolved	EPA 200.8	0.0096	0.010	96	mg/L
QC13010817	LCS 1	Fluoride	EPA 300.0	1.99	2.00	99	mg/L
QC13010818	LCS 1	Chloride	EPA 300.0	9.56	10.0	96	mg/L
QC13010819	LCS 1	Nitrite Nitrogen	EPA 300.0	0.518	0.500	104	mg/L
QC13010820	LCS 1	Nitrate Nitrogen	EPA 300.0	1.83	2.00	92	mg/L
QC13010821	LCS 1	Sulfate	EPA 300.0	23.0	25.0	92	mg/L
QC13010864	LCS 1	Aluminum, Dissolved	EPA 200.7	0.999	1.00	100	mg/L
		Barium, Dissolved	EPA 200.7	0.981	1.00	98	mg/L
		Beryllium, Dissolved	EPA 200.7	1.02	1.00	102	mg/L
		Bismuth, Dissolved	EPA 200.7	1.03	1.00	103	mg/L
		Boron, Dissolved	EPA 200.7	0.951	1.00	95	mg/L
		Cadmium, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
		Calcium, Dissolved	EPA 200.7	9.97	10.0	100	mg/L
		Chromium, Dissolved	EPA 200.7	0.975	1.00	98	mg/L
		Cobalt, Dissolved	EPA 200.7	0.985	1.00	98	mg/L
		Copper, Dissolved	EPA 200.7	4.83	5.00	97	mg/L
		Gallium, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Iron, Dissolved	EPA 200.7	0.963	1.00	96	mg/L
		Lithium, Dissolved	EPA 200.7	0.980	1.00	98	mg/L
		Magnesium, Dissolved	EPA 200.7	9.45	10.0	94	mg/L
		Manganese, Dissolved	EPA 200.7	1.02	1.00	102	mg/L
		Molybdenum, Dissolved	EPA 200.7	0.927	1.00	93	mg/L
		Nickel, Dissolved	EPA 200.7	4.88	5.00	98	mg/L
		Phosphorus, Dissolved	EPA 200.7	4.80	5.00	96	mg/L
		Potassium, Dissolved	EPA 200.7	10.0	10.0	100	mg/L
		Scandium, Dissolved	EPA 200.7	0.958	1.00	96	mg/L
		Silver, Dissolved	EPA 200.7	0.089	0.090	98	mg/L
		Sodium, Dissolved	EPA 200.7	9.35	10.0	94	mg/L
		Strontium, Dissolved	EPA 200.7	0.988	1.00	99	mg/L
		Tin, Dissolved	EPA 200.7	0.963	1.00	96	mg/L
		Titanium, Dissolved	EPA 200.7	0.990	1.00	99	mg/L
		Vanadium, Dissolved	EPA 200.7	0.970	1.00	97	mg/L
		Zinc, Dissolved	EPA 200.7	0.964	1.00	96	mg/L
QC13010922	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	157	150	105	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result		Units	RPD
QC13010754	Duplicate	pH	SM 4500-H+ B	1301365-002	8.47	8.40		pH Units	1 %
QC13010754	Duplicate	pH	SM 4500-H+ B	1301360-001	7.96	7.92		pH Units	1 %
QC13010754	Duplicate	pH	SM 4500-H+ B	1301381-001	8.40	8.42		pH Units	<1%
QC13010756	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301365-002	33.0	33.0	Q	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1301365-002	3.49	1.99	Q	mg/L	55 %
		Hydroxide (OH)	SM 2320B	1301365-002	<1.000	<1.000		mg/L	<1%
		Total Alkalinity	SM 2320B	1301365-002	31.7	30.4		mg/L as CaCO3	4 %
QC13010756	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301360-001	346	392		mg/L	12 %
		Carbonate (CO3)	SM 2320B	1301360-001	<1.000	<1.000		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1301360-001	<1.000	<1.000		mg/L	<1%
		Total Alkalinity	SM 2320B	1301360-001	284	321		mg/L as CaCO3	12 %
QC13010756	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301381-001	195	194		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1301381-001	2.53	3.19		mg/L	23 %
		Hydroxide (OH)	SM 2320B	1301381-001	<1.000	<1.000		mg/L	<1%
		Total Alkalinity	SM 2320B	1301381-001	164	165		mg/L as CaCO3	<1%
QC13010922	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301372-001	10.0	23.0	HT	mg/L	4 %
QC13010922	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301411-001	208	208		mg/L	<1%

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13010811	MS 1	Uranium, Dissolved	EPA 200.8	1301381-001	<0.0050		0.0129	0.0130	0.010	mg/L	98	99	1 %
		Mercury, Dissolved	EPA 200.8	1301381-001	<0.00010		0.000937	0.000967	0.001	mg/L	87	90	3 %
		Antimony, Dissolved	EPA 200.8	1301381-001	0.0066		0.0155	0.0154	0.010	mg/L	89	88	1 %
		Arsenic, Dissolved	EPA 200.8	1301381-001	0.0264		0.0632	0.0629	0.050	mg/L	74	73	<1%
		Lead, Dissolved	EPA 200.8	1301381-001	<0.0025		0.0095	0.0095	0.010	mg/L	95	95	<1%
		Selenium, Dissolved	EPA 200.8	1301381-001	<0.0050	M	0.0339	0.0341	0.050	mg/L	NC	NC	NC
		Thallium, Dissolved	EPA 200.8	1301381-001	<0.0010		0.0090	0.0092	0.010	mg/L	90	92	2 %
QC13010817	MS 1	Fluoride	EPA 300.0	1301372-001	<0.100		1.95	2.06	2.00	mg/L	100	106	5 %
QC13010817	MS 2	Fluoride	EPA 300.0	1301398-006	0.477		2.26	2.28	2.00	mg/L	89	90	1 %
QC13010818	MS 1	Chloride	EPA 300.0	1301372-001	<1.000		5.05	5.24	5.00	mg/L	100	104	4 %
QC13010818	MS 2	Chloride	EPA 300.0	1301398-006	<1.000		4.97	5.03	5.00	mg/L	98	99	1 %
QC13010819	MS 1	Nitrite Nitrogen	EPA 300.0	1301372-001	<0.025		0.534	0.551	0.500	mg/L	107	110	3 %
QC13010819	MS 2	Nitrite Nitrogen	EPA 300.0	1301398-006	<0.025		0.495	0.505	0.500	mg/L	98	100	2 %
QC13010820	MS 1	Nitrate Nitrogen	EPA 300.0	1301372-001	<1.000		2.02	2.08	2.00	mg/L	97	100	3 %
QC13010820	MS 2	Nitrate Nitrogen	EPA 300.0	1301398-006	<1.000		2.06	2.08	2.00	mg/L	101	102	1 %
QC13010821	MS 1	Sulfate	EPA 300.0	1301372-001	1.98		11.8	12.2	10.0	mg/L	98	103	3 %
QC13010821	MS 2	Sulfate	EPA 300.0	1301398-006	9.34		18.7	18.9	10.0	mg/L	94	95	1 %
QC13010864	MS 1	Aluminum, Dissolved	EPA 200.7	1301381-001	<0.045		1.05	1.02	1.00	mg/L	104	101	3 %
		Barium, Dissolved	EPA 200.7	1301381-001	<0.010		0.972	0.972	1.00	mg/L	97	97	<1%
		Beryllium, Dissolved	EPA 200.7	1301381-001	<0.001		1.02	1.02	1.00	mg/L	102	102	<1%
		Bismuth, Dissolved	EPA 200.7	1301381-001	<0.100		1.02	1.03	1.00	mg/L	101	102	1 %
		Boron, Dissolved	EPA 200.7	1301381-001	0.315		1.32	1.32	1.00	mg/L	101	101	<1%
		Cadmium, Dissolved	EPA 200.7	1301381-001	<0.001		0.978	0.980	1.00	mg/L	98	98	<1%
		Calcium, Dissolved	EPA 200.7	1301381-001	4.88		14.5	14.7	10.0	mg/L	96	98	1 %
		Chromium, Dissolved	EPA 200.7	1301381-001	<0.005		0.939	0.942	1.00	mg/L	94	94	<1%
		Cobalt, Dissolved	EPA 200.7	1301381-001	<0.010		0.959	0.966	1.00	mg/L	96	97	1 %
		Copper, Dissolved	EPA 200.7	1301381-001	<0.050		5.12	5.12	5.00	mg/L	102	102	<1%
		Gallium, Dissolved	EPA 200.7	1301381-001	<0.100		0.988	0.991	1.00	mg/L	99	99	<1%

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Iron, Dissolved	EPA 200.7	1301381-001	<0.010		0.959	0.960	1.00	mg/L	95	95	<1%
		Lithium, Dissolved	EPA 200.7	1301381-001	0.464		1.39	1.40	1.00	mg/L	93	94	1 %
		Magnesium, Dissolved	EPA 200.7	1301381-001	<0.500		9.49	9.58	10.0	mg/L	94	95	1 %
		Manganese, Dissolved	EPA 200.7	1301381-001	<0.005		1.01	1.01	1.00	mg/L	101	101	<1%
		Molybdenum, Dissolved	EPA 200.7	1301381-001	<0.010		0.921	0.925	1.00	mg/L	91	92	<1%
		Nickel, Dissolved	EPA 200.7	1301381-001	<0.010		4.71	4.74	5.00	mg/L	94	95	1 %
		Phosphorus, Dissolved	EPA 200.7	1301381-001	<0.500		4.78	4.83	5.00	mg/L	95	96	1 %
		Potassium, Dissolved	EPA 200.7	1301381-001	2.25		11.9	11.9	10.0	mg/L	96	96	<1%
		Scandium, Dissolved	EPA 200.7	1301381-001	<0.100		0.950	0.955	1.00	mg/L	95	95	1 %
		Silver, Dissolved	EPA 200.7	1301381-001	<0.005		0.088	0.088	0.090	mg/L	97	98	<1%
		Sodium, Dissolved	EPA 200.7	1301381-001	116	SC	119	121	10.0	mg/L	NC	NC	NC
		Strontium, Dissolved	EPA 200.7	1301381-001	<0.100		1.00	1.00	1.00	mg/L	97	97	<1%
		Tin, Dissolved	EPA 200.7	1301381-001	<0.100		0.958	0.961	1.00	mg/L	96	97	<1%
		Titanium, Dissolved	EPA 200.7	1301381-001	<0.100		0.990	0.994	1.00	mg/L	99	99	<1%
		Vanadium, Dissolved	EPA 200.7	1301381-001	<0.010		0.959	0.963	1.00	mg/L	96	96	<1%
		Zinc, Dissolved	EPA 200.7	1301381-001	<0.010		0.980	0.992	1.00	mg/L	98	99	1 %

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1301374
Report Due Date: 2/7/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard [illegible] 5 Day [illegible] Other

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER:

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium	Spl. No.
604 673	Wk:104	01/24/13	9:00	WW	2	X	X	1
SRK 0854	↓	↓	↓	↓	↓	↓	↓	2
SRK 0872	↓	↓	↓	↓	↓	↓	↓	3

1301 5
374 3

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 20 °C	1/24/13	2:35p		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 6				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

WETLAB
WESTERN ENVIRONMENTAL
TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

2/19/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1301483*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 1/31/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Andy Smith
QA Manager

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1301483

General Comments

None

Specific Comments

Due to the sample matrix it was necessary to analyze the following at a dilution:
1301483-004 Iron
The reporting limits have been adjusted accordingly.

Due to a laboratory reanalysis requirements the analysis for Total Dissolved Solids (TDS) on samples 1301483-001 and 007 was performed past the EPA recommended holding time. We apologize for any inconvenience this may have caused.

Data Qualifier Legend

B	-- Blank contamination; Analyte detected above the method reporting limit in an associated blank
D	-- Reporting limit is elevated due to required sample dilution
HT	-- Sample analyzed beyond the accepted holding time
J	-- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	-- Reported value is estimated; The sample matrix interfered with the analysis
N	-- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	-- Not calculated due to matrix interference
Q	-- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
S	-- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.
SC	-- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438 Wk: 32*

Date Printed: 2/19/2013
OrderID: *1301483*

Customer Sample ID: CF-11-02 (227-367) Wk: 32
WETLAB Sample ID: 1301483-001

Collect Date/Time: 1/31/2013 09:00
Receive Date: 1/31/2013 14:20

PROFILE II

Parameter	Method	Results		Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.75		pH Units		1/31/2013
Trace Metals Digestion	EPA 200.2	Complete				2/5/2013
Bicarbonate (HCO3)	SM 2320B	64		mg/L	1.0	1/31/2013
Carbonate (CO3)	SM 2320B	<1.0		mg/L	1.0	1/31/2013
Hydroxide (OH)	SM 2320B	<1.0		mg/L	1.0	1/31/2013
Total Alkalinity	SM 2320B	53		mg/L as CaCO3	1.0	1/31/2013
Chloride	EPA 300.0	<1.00		mg/L	1.00	2/1/2013
Fluoride	EPA 300.0	1.1		mg/L	0.10	2/1/2013
Sulfate	EPA 300.0	5.9		mg/L	1.0	2/1/2013
Nitrate Nitrogen	EPA 300.0	<1.0		mg/L	1.0	2/1/2013
Nitrite Nitrogen	EPA 300.0	<0.025		mg/L	0.025	2/1/2013
Total Dissolved Solids (TDS)	SM 2540C	80	HT	mg/L	10	2/14/2013
Aluminum	EPA 200.7	0.062		mg/L	0.045	2/6/2013
Barium	EPA 200.7	0.042		mg/L	0.010	2/6/2013
Beryllium	EPA 200.7	<0.0010		mg/L	0.0010	2/6/2013
Bismuth	EPA 200.7	<0.10		mg/L	0.10	2/6/2013
Boron	EPA 200.7	<0.100		mg/L	0.100	2/6/2013
Cadmium	EPA 200.7	<0.0010		mg/L	0.0010	2/6/2013
Calcium	EPA 200.7	18		mg/L	0.50	2/6/2013
Chromium	EPA 200.7	<0.0050		mg/L	0.0050	2/6/2013
Cobalt	EPA 200.7	<0.010		mg/L	0.010	2/6/2013
Copper	EPA 200.7	<0.050		mg/L	0.050	2/6/2013
Gallium	EPA 200.7	<0.10		mg/L	0.10	2/6/2013
Iron	EPA 200.7	0.013		mg/L	0.010	2/6/2013
Lithium	EPA 200.7	<0.10		mg/L	0.10	2/6/2013
Magnesium	EPA 200.7	2.9		mg/L	0.50	2/6/2013
Manganese	EPA 200.7	0.025		mg/L	0.0050	2/6/2013

Customer Sample ID: CF-11-02 (227-367) Wk: 32
WETLAB Sample ID: 1301483-001

Collect Date/Time: 1/31/2013 09:00
Receive Date: 1/31/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	2/6/2013
Potassium	EPA 200.7	2.9	mg/L	0.50	2/6/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	2/6/2013
Sodium	EPA 200.7	0.74	mg/L	0.50	2/6/2013
Strontium	EPA 200.7	0.16	mg/L	0.10	2/6/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	2/6/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	2/6/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	2/6/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	2/6/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	2/6/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	2/6/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	2/6/2013
Anions	Calculation	1.23	meq/L	0.10	
Cations	Calculation	1.25	meq/L	0.10	
Error	Calculation	<1.0	%	1.0	

Customer Sample ID: CF-11-02 (52-117) Wk: 32
WETLAB Sample ID: 1301483-002

Collect Date/Time: 1/31/2013 09:00
Receive Date: 1/31/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.74	pH Units		1/31/2013
Trace Metals Digestion	EPA 200.2	Complete			2/5/2013
Bicarbonate (HCO3)	SM 2320B	59	mg/L	1.0	1/31/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/31/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/31/2013
Total Alkalinity	SM 2320B	48	mg/L as CaCO3	1.0	1/31/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	2/1/2013
Fluoride	EPA 300.0	0.95	mg/L	0.10	2/1/2013
Sulfate	EPA 300.0	7.4	mg/L	1.0	2/1/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	2/1/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	2/1/2013

Customer Sample ID: CF-11-02 (52-117) Wk: 32
WETLAB Sample ID: 1301483-002

Collect Date/Time: 1/31/2013 09:00
Receive Date: 1/31/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Total Dissolved Solids (TDS)	SM 2540C	68	mg/L	10	2/5/2013
Aluminum	EPA 200.7	0.050	mg/L	0.045	2/6/2013
Barium	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	2/6/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	2/6/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	2/6/2013
Calcium	EPA 200.7	18	mg/L	0.50	2/6/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	2/6/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	2/6/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Iron	EPA 200.7	0.012	mg/L	0.010	2/6/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Magnesium	EPA 200.7	1.8	mg/L	0.50	2/6/2013
Manganese	EPA 200.7	0.025	mg/L	0.0050	2/6/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	2/6/2013
Potassium	EPA 200.7	2.9	mg/L	0.50	2/6/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	2/6/2013
Sodium	EPA 200.7	0.76	mg/L	0.50	2/6/2013
Strontium	EPA 200.7	0.12	mg/L	0.10	2/6/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	2/6/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	2/6/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	2/6/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	2/6/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	2/6/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	2/6/2013
Uranium	EPA 200.8	0.0098	mg/L	0.0050	2/6/2013
Anions	Calculation	1.17	meq/L	0.10	
Cations	Calculation	1.16	meq/L	0.10	
Error	Calculation	<1.0	%	1.0	

Customer Sample ID: K-Spar Breccia 5+ Comp Wk: 32
WETLAB Sample ID: 1301483-003

Collect Date/Time: 1/31/2013 09:00
Receive Date: 1/31/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.75	pH Units		1/31/2013
Trace Metals Digestion	EPA 200.2	Complete			2/5/2013
Bicarbonate (HCO3)	SM 2320B	61	mg/L	1.0	1/31/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/31/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/31/2013
Total Alkalinity	SM 2320B	50	mg/L as CaCO3	1.0	1/31/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	2/1/2013
Fluoride	EPA 300.0	1.1	mg/L	0.10	2/1/2013
Sulfate	EPA 300.0	30	mg/L	1.0	2/1/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	2/1/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	2/1/2013
Total Dissolved Solids (TDS)	SM 2540C	86	mg/L	10	2/5/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	2/6/2013
Barium	EPA 200.7	0.078	mg/L	0.010	2/6/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	2/6/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	2/6/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	2/6/2013
Calcium	EPA 200.7	28	mg/L	0.50	2/6/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	2/6/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	2/6/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Magnesium	EPA 200.7	2.6	mg/L	0.50	2/6/2013
Manganese	EPA 200.7	0.038	mg/L	0.0050	2/6/2013
Molybdenum	EPA 200.7	0.044	mg/L	0.010	2/6/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	2/6/2013
Potassium	EPA 200.7	2.4	mg/L	0.50	2/6/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	2/6/2013
Sodium	EPA 200.7	0.84	mg/L	0.50	2/6/2013
Strontium	EPA 200.7	0.55	mg/L	0.10	2/6/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	2/6/2013

Customer Sample ID:	K-Spar Breccia 5+ Comp Wk: 32	**Collect Date/Time:**	1/31/2013 09:00
WETLAB Sample ID:	1301483-003	**Receive Date:**	1/31/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Zinc	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	2/6/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	2/6/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	2/6/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	2/6/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	2/6/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	2/6/2013
Uranium	EPA 200.8	0.013	mg/L	0.0050	2/6/2013
Anions	Calculation	1.68	meq/L	0.10	
Cations	Calculation	1.71	meq/L	0.10	
Error	Calculation	<1.0	%	1.0	

Customer Sample ID:	Biotite Breccia 5+ Comp Wk: 32	**Collect Date/Time:**	1/31/2013 09:00
WETLAB Sample ID:	1301483-004	**Receive Date:**	1/31/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.89	pH Units		1/31/2013
Trace Metals Digestion	EPA 200.2	Complete			2/5/2013
Bicarbonate (HCO3)	SM 2320B	76	mg/L	1.0	1/31/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/31/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/31/2013
Total Alkalinity	SM 2320B	62	mg/L as CaCO3	1.0	1/31/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	2/1/2013
Fluoride	EPA 300.0	1.5	mg/L	0.10	2/1/2013
Sulfate	EPA 300.0	11	mg/L	1.0	2/1/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	2/1/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	2/1/2013
Total Dissolved Solids (TDS)	SM 2540C	98	mg/L	10	2/5/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	2/6/2013
Barium	EPA 200.7	0.073	mg/L	0.010	2/6/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	2/6/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	2/6/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	2/6/2013
Calcium	EPA 200.7	23	mg/L	0.50	2/6/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	2/6/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	2/6/2013

Customer Sample ID: Biotite Breccia 5+ Comp Wk: 32 **Collect Date/Time:** 1/31/2013 09:00
WETLAB Sample ID: 1301483-004 **Receive Date:** 1/31/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Gallium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Iron	EPA 200.7	<0.050	mg/L	0.050	2/6/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Magnesium	EPA 200.7	4.1	mg/L	0.50	2/6/2013
Manganese	EPA 200.7	0.045	mg/L	0.0050	2/6/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	2/6/2013
Potassium	EPA 200.7	2.7	mg/L	0.50	2/6/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	2/6/2013
Sodium	EPA 200.7	0.61	mg/L	0.50	2/6/2013
Strontium	EPA 200.7	0.28	mg/L	0.10	2/6/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	2/6/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	2/6/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	2/6/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	2/6/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	2/6/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	2/6/2013
Uranium	EPA 200.8	0.0064	mg/L	0.0050	2/6/2013
Anions	Calculation	1.55	meq/L	0.10	
Cations	Calculation	1.58	meq/L	0.10	
Error	Calculation	<1.0	%	1.0	

Customer Sample ID: Quartz Monozonite 5+ Comp Wk: 32 **Collect Date/Time:** 1/31/2013 09:00
WETLAB Sample ID: 1301483-005 **Receive Date:** 1/31/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.84	pH Units		1/31/2013
Trace Metals Digestion	EPA 200.2	Complete			2/5/2013
Bicarbonate (HCO3)	SM 2320B	67	mg/L	1.0	1/31/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/31/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/31/2013
Total Alkalinity	SM 2320B	55	mg/L as CaCO3	1.0	1/31/2013

Customer Sample ID: Quartz Monozonite 5+ Comp Wk: 32
Collect Date/Time: 1/31/2013 09:00
WETLAB Sample ID: 1301483-005
Receive Date: 1/31/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Chloride	EPA 300.0	<1.00	mg/L	1.00	2/1/2013
Fluoride	EPA 300.0	1.2	mg/L	0.10	2/1/2013
Sulfate	EPA 300.0	13	mg/L	1.0	2/1/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	2/1/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	2/1/2013
Total Dissolved Solids (TDS)	SM 2540C	86	mg/L	10	2/5/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	2/6/2013
Barium	EPA 200.7	0.11	mg/L	0.010	2/6/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	2/6/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	2/6/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	2/6/2013
Calcium	EPA 200.7	20	mg/L	0.50	2/6/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	2/6/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	2/6/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Magnesium	EPA 200.7	4.0	mg/L	0.50	2/6/2013
Manganese	EPA 200.7	0.020	mg/L	0.0050	2/6/2013
Molybdenum	EPA 200.7	0.059	mg/L	0.010	2/6/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	2/6/2013
Potassium	EPA 200.7	2.5	mg/L	0.50	2/6/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	2/6/2013
Sodium	EPA 200.7	0.91	mg/L	0.50	2/6/2013
Strontium	EPA 200.7	0.52	mg/L	0.10	2/6/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	2/6/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	2/6/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	2/6/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	2/6/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	2/6/2013

Customer Sample ID: Quartz Monozonite 5+ Comp Wk: 32
WETLAB Sample ID: 1301483-005
Collect Date/Time: 1/31/2013 09:00
Receive Date: 1/31/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	2/6/2013
Uranium	EPA 200.8	0.013	mg/L	0.0050	2/6/2013
Anions	Calculation	1.43	meq/L	0.10	
Cations	Calculation	1.43	meq/L	0.10	
Error	Calculation	<1.0	%	1.0	

Customer Sample ID: Biotite Breccia 0-5 Comp Wk: 32
WETLAB Sample ID: 1301483-006
Collect Date/Time: 1/31/2013 09:00
Receive Date: 1/31/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.83	pH Units		1/31/2013
Trace Metals Digestion	EPA 200.2	Complete			2/5/2013
Bicarbonate (HCO3)	SM 2320B	69	mg/L	1.0	1/31/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/31/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/31/2013
Total Alkalinity	SM 2320B	56	mg/L as CaCO3	1.0	1/31/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	2/1/2013
Fluoride	EPA 300.0	1.6	mg/L	0.10	2/1/2013
Sulfate	EPA 300.0	13	mg/L	1.0	2/1/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	2/1/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	2/1/2013
Total Dissolved Solids (TDS)	SM 2540C	98	mg/L	10	2/5/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	2/6/2013
Barium	EPA 200.7	0.092	mg/L	0.010	2/6/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	2/6/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	2/6/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	2/6/2013
Calcium	EPA 200.7	21	mg/L	0.50	2/6/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	2/6/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	2/6/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Magnesium	EPA 200.7	4.3	mg/L	0.50	2/6/2013
Manganese	EPA 200.7	0.022	mg/L	0.0050	2/6/2013
Molybdenum	EPA 200.7	0.015	mg/L	0.010	2/6/2013

Customer Sample ID: Biotite Breccia 0-5 Comp Wk: 32 **Collect Date/Time:** 1/31/2013 09:00
WETLAB Sample ID: 1301483-006 **Receive Date:** 1/31/2013 14:20

PROFILE II

Parameter	Method	Results		Units	Reporting Limit	Date Analyzed
Nickel	EPA 200.7	<0.010		mg/L	0.010	2/6/2013
Phosphorus	EPA 200.7	<0.50		mg/L	0.50	2/6/2013
Potassium	EPA 200.7	1.8		mg/L	0.50	2/6/2013
Scandium	EPA 200.7	<0.10		mg/L	0.10	2/6/2013
Silver	EPA 200.7	<0.0050		mg/L	0.0050	2/6/2013
Sodium	EPA 200.7	0.52		mg/L	0.50	2/6/2013
Strontium	EPA 200.7	0.30		mg/L	0.10	2/6/2013
Tin	EPA 200.7	<0.10		mg/L	0.10	2/6/2013
Titanium	EPA 200.7	<0.10		mg/L	0.10	2/6/2013
Vanadium	EPA 200.7	<0.010		mg/L	0.010	2/6/2013
Zinc	EPA 200.7	<0.010		mg/L	0.010	2/6/2013
Mercury	EPA 200.8	<0.00010		mg/L	0.00010	2/6/2013
Antimony	EPA 200.8	<0.0025		mg/L	0.0025	2/6/2013
Arsenic	EPA 200.8	<0.0050		mg/L	0.0050	2/6/2013
Lead	EPA 200.8	<0.0025		mg/L	0.0025	2/6/2013
Selenium	EPA 200.8	<0.0050		mg/L	0.0050	2/6/2013
Thallium	EPA 200.8	<0.0010		mg/L	0.0010	2/6/2013
Uranium	EPA 200.8	0.031		mg/L	0.0050	2/6/2013
Anions	Calculation	1.49		meq/L	0.10	
Cations	Calculation	1.47		meq/L	0.10	
Error	Calculation	<1.0		%	1.0	

Customer Sample ID: K-Spar Breccia 0-5 Comp Wk: 32 **Collect Date/Time:** 1/31/2013 09:00
WETLAB Sample ID: 1301483-007 **Receive Date:** 1/31/2013 14:20

PROFILE II

Parameter	Method	Results		Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.87		pH Units		1/31/2013
Trace Metals Digestion	EPA 200.2	Complete				2/5/2013
Bicarbonate (HCO3)	SM 2320B	70		mg/L	1.0	1/31/2013
Carbonate (CO3)	SM 2320B	<1.0		mg/L	1.0	1/31/2013
Hydroxide (OH)	SM 2320B	<1.0		mg/L	1.0	1/31/2013
Total Alkalinity	SM 2320B	57		mg/L as CaCO3	1.0	1/31/2013
Chloride	EPA 300.0	<1.00		mg/L	1.00	2/1/2013
Fluoride	EPA 300.0	1.4		mg/L	0.10	2/1/2013
Sulfate	EPA 300.0	12		mg/L	1.0	2/1/2013
Nitrate Nitrogen	EPA 300.0	<1.0		mg/L	1.0	2/1/2013
Nitrite Nitrogen	EPA 300.0	<0.025		mg/L	0.025	2/1/2013
Total Dissolved Solids (TDS)	SM 2540C	96	HT	mg/L	10	2/14/2013

Customer Sample ID: K-Spar Breccia 0-5 Comp Wk: 32
WETLAB Sample ID: 1301483-007

Collect Date/Time: 1/31/2013 09:00
Receive Date: 1/31/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Aluminum	EPA 200.7	<0.045	mg/L	0.045	2/6/2013
Barium	EPA 200.7	0.13	mg/L	0.010	2/6/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	2/6/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	2/6/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	2/6/2013
Calcium	EPA 200.7	20	mg/L	0.50	2/6/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	2/6/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	2/6/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Magnesium	EPA 200.7	4.2	mg/L	0.50	2/6/2013
Manganese	EPA 200.7	0.017	mg/L	0.0050	2/6/2013
Molybdenum	EPA 200.7	0.017	mg/L	0.010	2/6/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	2/6/2013
Potassium	EPA 200.7	2.1	mg/L	0.50	2/6/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	2/6/2013
Sodium	EPA 200.7	0.63	mg/L	0.50	2/6/2013
Strontium	EPA 200.7	0.39	mg/L	0.10	2/6/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	2/6/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	2/6/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	2/6/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	2/6/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	2/6/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	2/6/2013
Uranium	EPA 200.8	0.030	mg/L	0.0050	2/6/2013
Anions	Calculation	1.47	meq/L	0.10	
Cations	Calculation	1.43	meq/L	0.10	
Error	Calculation	1.6	%	1.0	

Customer Sample ID: Quartz Monzonite 0-5 Comp Wk: 32
Collect Date/Time: 1/31/2013 09:00
WETLAB Sample ID: 1301483-008
Receive Date: 1/31/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.84	pH Units		1/31/2013
Trace Metals Digestion	EPA 200.2	Complete			2/5/2013
Bicarbonate (HCO3)	SM 2320B	67	mg/L	1.0	1/31/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	1/31/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	1/31/2013
Total Alkalinity	SM 2320B	55	mg/L as CaCO3	1.0	1/31/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	2/1/2013
Fluoride	EPA 300.0	1.4	mg/L	0.10	2/1/2013
Sulfate	EPA 300.0	15	mg/L	1.0	2/1/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	2/1/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	2/1/2013
Total Dissolved Solids (TDS)	SM 2540C	96	mg/L	10	2/5/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	2/6/2013
Barium	EPA 200.7	0.088	mg/L	0.010	2/6/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	2/6/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	2/6/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	2/6/2013
Calcium	EPA 200.7	22	mg/L	0.50	2/6/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	2/6/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	2/6/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Iron	EPA 200.7	0.022	mg/L	0.010	2/6/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Magnesium	EPA 200.7	4.3	mg/L	0.50	2/6/2013
Manganese	EPA 200.7	0.014	mg/L	0.0050	2/6/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	2/6/2013
Potassium	EPA 200.7	2.0	mg/L	0.50	2/6/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	2/6/2013
Sodium	EPA 200.7	0.74	mg/L	0.50	2/6/2013
Strontium	EPA 200.7	0.32	mg/L	0.10	2/6/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	2/6/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	2/6/2013

Customer Sample ID: Quartz Monzonite 0-5 Comp Wk: 32
WETLAB Sample ID: 1301483-008

Collect Date/Time: 1/31/2013 09:00
Receive Date: 1/31/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Zinc	EPA 200.7	<0.010	mg/L	0.010	2/6/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	2/6/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	2/6/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	2/6/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	2/6/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	2/6/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	2/6/2013
Uranium	EPA 200.8	0.024	mg/L	0.0050	2/6/2013
Anions	Calculation	1.48	meq/L	0.10	
Cations	Calculation	1.54	meq/L	0.10	
Error	Calculation	1.7	%	1.0	

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13020049	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC13020049	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC13020050	Blank 1	Chloride	EPA 300.0	<1.0	mg/L
QC13020050	Blank 2	Chloride	EPA 300.0	<1.0	mg/L
QC13020051	Blank 1	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13020051	Blank 2	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13020053	Blank 1	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13020053	Blank 2	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13020055	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC13020055	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC13020123	Blank 1	Aluminum, Dissolved	EPA 200.7	<0.045	mg/L
		Barium, Dissolved	EPA 200.7	<0.010	mg/L
		Beryllium, Dissolved	EPA 200.7	<0.0010	mg/L
		Bismuth, Dissolved	EPA 200.7	<0.10	mg/L
		Boron, Dissolved	EPA 200.7	<0.10	mg/L
		Cadmium, Dissolved	EPA 200.7	<0.0010	mg/L
		Calcium, Dissolved	EPA 200.7	<0.50	mg/L
		Chromium, Dissolved	EPA 200.7	<0.0050	mg/L
		Cobalt, Dissolved	EPA 200.7	<0.010	mg/L
		Copper, Dissolved	EPA 200.7	<0.050	mg/L
		Gallium, Dissolved	EPA 200.7	<0.10	mg/L
		Iron, Dissolved	EPA 200.7	<0.010	mg/L
		Lithium, Dissolved	EPA 200.7	<0.10	mg/L
		Magnesium, Dissolved	EPA 200.7	<0.50	mg/L
		Manganese, Dissolved	EPA 200.7	<0.0050	mg/L
		Molybdenum, Dissolved	EPA 200.7	<0.010	mg/L
		Nickel, Dissolved	EPA 200.7	<0.010	mg/L
		Phosphorus, Dissolved	EPA 200.7	<0.50	mg/L
		Potassium, Dissolved	EPA 200.7	<0.50	mg/L
		Scandium, Dissolved	EPA 200.7	<0.10	mg/L
		Silver, Dissolved	EPA 200.7	<0.0050	mg/L
		Sodium, Dissolved	EPA 200.7	<0.50	mg/L
		Strontium, Dissolved	EPA 200.7	<0.10	mg/L
		Tin, Dissolved	EPA 200.7	<0.10	mg/L
		Titanium, Dissolved	EPA 200.7	<0.10	mg/L
		Vanadium, Dissolved	EPA 200.7	<0.010	mg/L
		Zinc, Dissolved	EPA 200.7	<0.010	mg/L
QC13020129	Blank 1	Aluminum, Dissolved	EPA 200.7	<0.045	mg/L
		Barium, Dissolved	EPA 200.7	<0.010	mg/L
		Beryllium, Dissolved	EPA 200.7	<0.0010	mg/L
		Bismuth, Dissolved	EPA 200.7	<0.10	mg/L
		Boron, Dissolved	EPA 200.7	<0.10	mg/L
		Cadmium, Dissolved	EPA 200.7	<0.0010	mg/L
		Calcium, Dissolved	EPA 200.7	<0.50	mg/L
		Chromium, Dissolved	EPA 200.7	<0.0050	mg/L
		Cobalt, Dissolved	EPA 200.7	<0.010	mg/L
		Copper, Dissolved	EPA 200.7	<0.050	mg/L

QCBatchID	QCType	Parameter	Method	Result	Units
		Gallium, Dissolved	EPA 200.7	<0.10	mg/L
		Iron, Dissolved	EPA 200.7	<0.010	mg/L
		Lithium, Dissolved	EPA 200.7	<0.10	mg/L
		Magnesium, Dissolved	EPA 200.7	<0.50	mg/L
		Manganese, Dissolved	EPA 200.7	<0.0050	mg/L
		Molybdenum, Dissolved	EPA 200.7	<0.010	mg/L
		Nickel, Dissolved	EPA 200.7	<0.010	mg/L
		Phosphorus, Dissolved	EPA 200.7	<0.50	mg/L
		Potassium, Dissolved	EPA 200.7	<0.50	mg/L
		Scandium, Dissolved	EPA 200.7	<0.10	mg/L
		Silver, Dissolved	EPA 200.7	<0.0050	mg/L
		Sodium, Dissolved	EPA 200.7	<0.50	mg/L
		Strontium, Dissolved	EPA 200.7	<0.10	mg/L
		Tin, Dissolved	EPA 200.7	<0.10	mg/L
		Titanium, Dissolved	EPA 200.7	<0.10	mg/L
		Vanadium, Dissolved	EPA 200.7	<0.010	mg/L
		Zinc, Dissolved	EPA 200.7	<0.010	mg/L
QC13020140	Blank 1	Uranium, Dissolved	EPA 200.8	<0.0050	mg/L
		Mercury, Dissolved	EPA 200.8	<0.00010	mg/L
		Antimony, Dissolved	EPA 200.8	<0.0025	mg/L
		Arsenic, Dissolved	EPA 200.8	<0.0050	mg/L
		Lead, Dissolved	EPA 200.8	<0.0025	mg/L
		Selenium, Dissolved	EPA 200.8	<0.0050	mg/L
		Thallium, Dissolved	EPA 200.8	<0.0010	mg/L
QC13020141	Blank 1	Uranium, Dissolved	EPA 200.8	<0.0050	mg/L
		Mercury, Dissolved	EPA 200.8	<0.00010	mg/L
		Antimony, Dissolved	EPA 200.8	<0.0025	mg/L
		Arsenic, Dissolved	EPA 200.8	<0.0050	mg/L
		Lead, Dissolved	EPA 200.8	<0.0025	mg/L
		Selenium, Dissolved	EPA 200.8	<0.0050	mg/L
		Thallium, Dissolved	EPA 200.8	<0.0010	mg/L
QC13020181	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13020181	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13020181	Blank 3	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13020181	Blank 4	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13020016	LCS 1	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13020016	LCS 2	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13020016	LCS 3	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13020020	LCS 1	Total Alkalinity	SM 2320B	96.5	100	96	mg/L
QC13020020	LCS 2	Total Alkalinity	SM 2320B	99.0	100	99	mg/L
QC13020020	LCS 3	Total Alkalinity	SM 2320B	98.7	100	99	mg/L
QC13020020	LCS 4	Total Alkalinity	SM 2320B	99.0	100	99	mg/L
QC13020049	LCS 1	Fluoride	EPA 300.0	2.00	2.00	100	mg/L
QC13020050	LCS 1	Chloride	EPA 300.0	9.73	10.0	97	mg/L
QC13020051	LCS 1	Nitrite Nitrogen	EPA 300.0	0.524	0.500	105	mg/L
QC13020053	LCS 1	Nitrate Nitrogen	EPA 300.0	1.97	2.00	98	mg/L
QC13020055	LCS 1	Sulfate	EPA 300.0	23.9	25.0	95	mg/L
QC13020123	LCS 1	Aluminum, Dissolved	EPA 200.7	0.930	1.00	93	mg/L
		Barium, Dissolved	EPA 200.7	0.999	1.00	100	mg/L
		Beryllium, Dissolved	EPA 200.7	0.998	1.00	100	mg/L
		Bismuth, Dissolved	EPA 200.7	1.07	1.00	107	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
		Boron, Dissolved	EPA 200.7	0.945	1.00	94	mg/L
		Cadmium, Dissolved	EPA 200.7	1.02	1.00	102	mg/L
		Calcium, Dissolved	EPA 200.7	10.0	10.0	100	mg/L
		Chromium, Dissolved	EPA 200.7	0.983	1.00	98	mg/L
		Cobalt, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
		Copper, Dissolved	EPA 200.7	4.86	5.00	97	mg/L
		Gallium, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Iron, Dissolved	EPA 200.7	0.983	1.00	98	mg/L
		Lithium, Dissolved	EPA 200.7	0.962	1.00	96	mg/L
		Magnesium, Dissolved	EPA 200.7	9.89	10.0	99	mg/L
		Manganese, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Molybdenum, Dissolved	EPA 200.7	1.02	1.00	102	mg/L
		Nickel, Dissolved	EPA 200.7	5.01	5.00	100	mg/L
		Phosphorus, Dissolved	EPA 200.7	5.11	5.00	102	mg/L
		Potassium, Dissolved	EPA 200.7	9.89	10.0	99	mg/L
		Scandium, Dissolved	EPA 200.7	0.978	1.00	98	mg/L
		Silver, Dissolved	EPA 200.7	0.088	0.090	98	mg/L
		Sodium, Dissolved	EPA 200.7	9.96	10.0	100	mg/L
		Strontium, Dissolved	EPA 200.7	0.963	1.00	96	mg/L
		Tin, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
		Titanium, Dissolved	EPA 200.7	0.986	1.00	99	mg/L
		Vanadium, Dissolved	EPA 200.7	0.983	1.00	98	mg/L
		Zinc, Dissolved	EPA 200.7	1.04	1.00	104	mg/L
QC13020129	LCS 1	Aluminum, Dissolved	EPA 200.7	0.972	1.00	97	mg/L
		Barium, Dissolved	EPA 200.7	1.02	1.00	102	mg/L
		Beryllium, Dissolved	EPA 200.7	0.991	1.00	99	mg/L
		Bismuth, Dissolved	EPA 200.7	1.05	1.00	105	mg/L
		Boron, Dissolved	EPA 200.7	0.937	1.00	94	mg/L
		Cadmium, Dissolved	EPA 200.7	1.02	1.00	102	mg/L
		Calcium, Dissolved	EPA 200.7	10.1	10.0	101	mg/L
		Chromium, Dissolved	EPA 200.7	0.995	1.00	100	mg/L
		Cobalt, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Copper, Dissolved	EPA 200.7	4.87	5.00	97	mg/L
		Gallium, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
		Iron, Dissolved	EPA 200.7	0.999	1.00	100	mg/L
		Lithium, Dissolved	EPA 200.7	0.991	1.00	99	mg/L
		Magnesium, Dissolved	EPA 200.7	10.0	10.0	100	mg/L
		Manganese, Dissolved	EPA 200.7	0.998	1.00	100	mg/L
		Molybdenum, Dissolved	EPA 200.7	0.995	1.00	100	mg/L
		Nickel, Dissolved	EPA 200.7	5.09	5.00	102	mg/L
		Phosphorus, Dissolved	EPA 200.7	5.03	5.00	101	mg/L
		Potassium, Dissolved	EPA 200.7	10.1	10.0	101	mg/L
		Scandium, Dissolved	EPA 200.7	0.994	1.00	99	mg/L
		Silver, Dissolved	EPA 200.7	0.090	0.090	100	mg/L
		Sodium, Dissolved	EPA 200.7	10.1	10.0	101	mg/L
		Strontium, Dissolved	EPA 200.7	0.982	1.00	98	mg/L
		Tin, Dissolved	EPA 200.7	0.968	1.00	97	mg/L
		Titanium, Dissolved	EPA 200.7	0.968	1.00	97	mg/L
		Vanadium, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Zinc, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
QC13020140	LCS 1	Uranium, Dissolved	EPA 200.8	0.0096	0.010	96	mg/L
		Mercury, Dissolved	EPA 200.8	0.000971	0.001	97	mg/L
		Antimony, Dissolved	EPA 200.8	0.0095	0.010	95	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13020141	LCS 1	Arsenic, Dissolved	EPA 200.8	0.0501	0.050	100	mg/L
		Lead, Dissolved	EPA 200.8	0.0096	0.010	96	mg/L
		Selenium, Dissolved	EPA 200.8	0.0468	0.050	94	mg/L
		Thallium, Dissolved	EPA 200.8	0.0097	0.010	97	mg/L
		Uranium, Dissolved	EPA 200.8	0.0096	0.010	96	mg/L
		Mercury, Dissolved	EPA 200.8	0.000939	0.001	94	mg/L
		Antimony, Dissolved	EPA 200.8	0.0094	0.010	94	mg/L
		Arsenic, Dissolved	EPA 200.8	0.0492	0.050	98	mg/L
		Lead, Dissolved	EPA 200.8	0.0097	0.010	97	mg/L
		Selenium, Dissolved	EPA 200.8	0.0465	0.050	93	mg/L
		Thallium, Dissolved	EPA 200.8	0.0094	0.010	94	mg/L
QC13020181	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	159	150	106	mg/L
QC13020181	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	140	150	93	mg/L
QC13020181	LCS 3	Total Dissolved Solids (TDS)	SM 2540C	141	150	94	mg/L
QC13020181	LCS 4	Total Dissolved Solids (TDS)	SM 2540C	151	150	100	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC13020016	Duplicate	pH	SM 4500-H+ B	1301468-001	4.59	4.61	pH Units	<1%
QC13020016	Duplicate	pH	SM 4500-H+ B	1301473-003	7.41	7.41	pH Units	<1%
QC13020016	Duplicate	pH	SM 4500-H+ B	1301477-001	7.58	7.61	pH Units	<1%
QC13020016	Duplicate	pH	SM 4500-H+ B	1301487-001	7.78	7.82	pH Units	1 %
QC13020016	Duplicate	pH	SM 4500-H+ B	1301487-005	7.74	7.73	pH Units	<1%
QC13020020	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301468-001	<1.000	<1.000	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1301468-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1301468-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1301468-001	<1.000	<1.000	mg/L as CaCO3	<1%
QC13020020	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301473-003	174	176	mg/L	1 %
		Carbonate (CO3)	SM 2320B	1301473-003	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1301473-003	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1301473-003	143	144	mg/L as CaCO3	1 %
QC13020020	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301477-001	218	218	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1301477-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1301477-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1301477-001	178	179	mg/L as CaCO3	<1%
QC13020020	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301487-001	136	135	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1301487-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1301487-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1301487-001	111	111	mg/L as CaCO3	<1%
QC13020020	Duplicate	Bicarbonate (HCO3)	SM 2320B	1301487-005	182	183	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1301487-005	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1301487-005	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1301487-005	150	150	mg/L as CaCO3	<1%
QC13020181	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301437-001	21.0	23.0	mg/L	9 %
QC13020181	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301438-006	45.0	45.0	mg/L	<1%
QC13020181	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301452-008	54.0	57.0	mg/L	5 %

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result		Units	RPD
QC13020181	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1301483-007	96.0	68.0	HT	mg/L	12 %
QC13020181	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1302008-004	884	896		mg/L	1 %
QC13020181	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1302031-004	28.0	20.0		mg/L	33 %
QC13020181	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1302031-014	31.0	34.0		mg/L	9 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13020049	MS 1	Fluoride	EPA 300.0	1301481-001	<0.100	1.84	1.87	2.00	mg/L	94	96	2 %
QC13020050	MS 1	Chloride	EPA 300.0	1301481-001	<1.000	4.99	5.10	5.00	mg/L	99	101	2 %
QC13020051	MS 1	Nitrite Nitrogen	EPA 300.0	1301481-001	<0.025	0.524	0.532	0.500	mg/L	105	106	2 %
QC13020053	MS 1	Nitrate Nitrogen	EPA 300.0	1301481-001	<1.000	2.00	2.03	2.00	mg/L	98	100	1 %
QC13020055	MS 1	Sulfate	EPA 300.0	1301481-001	4.91	14.5	14.7	10.0	mg/L	96	98	1 %
QC13020123	MS 1	Aluminum, Dissolved	EPA 200.7	1301473-002	<0.045	0.972	0.969	1.00	mg/L	96	96	<1%
		Barium, Dissolved	EPA 200.7	1301473-002	0.040	1.06	1.06	1.00	mg/L	102	102	<1%
		Beryllium, Dissolved	EPA 200.7	1301473-002	<0.001	0.999	1.00	1.00	mg/L	100	100	<1%
		Bismuth, Dissolved	EPA 200.7	1301473-002	<0.100	1.05	1.05	1.00	mg/L	106	106	<1%
		Boron, Dissolved	EPA 200.7	1301473-002	0.110	1.13	1.13	1.00	mg/L	102	102	<1%
		Cadmium, Dissolved	EPA 200.7	1301473-002	<0.001	1.03	1.03	1.00	mg/L	103	103	<1%
		Calcium, Dissolved	EPA 200.7	1301473-002	51.6	60.3	59.7	10.0	mg/L	87	81	1 %
		Chromium, Dissolved	EPA 200.7	1301473-002	<0.005	0.987	0.991	1.00	mg/L	99	99	<1%
		Cobalt, Dissolved	EPA 200.7	1301473-002	0.010	0.985	0.986	1.00	mg/L	97	98	<1%
		Copper, Dissolved	EPA 200.7	1301473-002	<0.050	4.84	4.84	5.00	mg/L	97	97	<1%
		Gallium, Dissolved	EPA 200.7	1301473-002	<0.100	1.02	1.02	1.00	mg/L	102	102	<1%
		Iron, Dissolved	EPA 200.7	1301473-002	<0.010	1.01	1.00	1.00	mg/L	101	100	1 %
		Lithium, Dissolved	EPA 200.7	1301473-002	<0.100	0.952	0.950	1.00	mg/L	93	93	<1%
		Magnesium, Dissolved	EPA 200.7	1301473-002	24.1	32.2	32.1	10.0	mg/L	81	80	<1%
		Manganese, Dissolved	EPA 200.7	1301473-002	<0.005	0.980	0.983	1.00	mg/L	100	100	<1%
		Molybdenum, Dissolved	EPA 200.7	1301473-002	<0.010	1.06	1.05	1.00	mg/L	106	105	1 %
		Nickel, Dissolved	EPA 200.7	1301473-002	<0.010	4.87	4.89	5.00	mg/L	97	98	<1%
		Phosphorus, Dissolved	EPA 200.7	1301473-002	<0.500	5.45	5.46	5.00	mg/L	107	107	<1%
		Potassium, Dissolved	EPA 200.7	1301473-002	5.67	15.4	15.3	10.0	mg/L	97	96	1 %
		Scandium, Dissolved	EPA 200.7	1301473-002	<0.100	0.990	0.993	1.00	mg/L	99	99	<1%
		Silver, Dissolved	EPA 200.7	1301473-002	<0.005	0.090	0.092	0.090	mg/L	100	103	2 %
		Sodium, Dissolved	EPA 200.7	1301473-002	29.8	39.1	38.9	10.0	mg/L	93	91	1 %
		Strontium, Dissolved	EPA 200.7	1301473-002	0.213	1.16	1.16	1.00	mg/L	95	95	<1%
		Tin, Dissolved	EPA 200.7	1301473-002	<0.100	1.00	0.991	1.00	mg/L	103	102	1 %
		Titanium, Dissolved	EPA 200.7	1301473-002	<0.100	0.984	0.983	1.00	mg/L	98	98	<1%
		Vanadium, Dissolved	EPA 200.7	1301473-002	0.039	1.05	1.05	1.00	mg/L	101	101	<1%
		Zinc, Dissolved	EPA 200.7	1301473-002	<0.010	0.973	0.976	1.00	mg/L	97	97	<1%
QC13020129	MS 1	Aluminum, Dissolved	EPA 200.7	1301487-001	<0.045	0.970	0.967	1.00	mg/L	96	96	<1%
		Barium, Dissolved	EPA 200.7	1301487-001	<0.010	1.01	1.02	1.00	mg/L	100	101	1 %
		Beryllium, Dissolved	EPA 200.7	1301487-001	<0.001	0.989	0.991	1.00	mg/L	99	99	<1%
		Bismuth, Dissolved	EPA 200.7	1301487-001	<0.100	1.02	1.03	1.00	mg/L	103	104	1 %
		Boron, Dissolved	EPA 200.7	1301487-001	<0.100	1.08	1.08	1.00	mg/L	98	98	<1%
		Cadmium, Dissolved	EPA 200.7	1301487-001	<0.001	1.00	1.01	1.00	mg/L	100	101	1 %
		Calcium, Dissolved	EPA 200.7	1301487-001	46.0	54.7	55.2	10.0	mg/L	87	92	1 %
		Chromium, Dissolved	EPA 200.7	1301487-001	0.009	0.989	0.990	1.00	mg/L	98	98	<1%
		Cobalt, Dissolved	EPA 200.7	1301487-001	<0.010	0.977	0.979	1.00	mg/L	98	98	<1%
		Copper, Dissolved	EPA 200.7	1301487-001	<0.050	4.95	4.96	5.00	mg/L	99	99	<1%
		Gallium, Dissolved	EPA 200.7	1301487-001	<0.100	1.02	1.02	1.00	mg/L	102	102	<1%
		Iron, Dissolved	EPA 200.7	1301487-001	0.016	1.01	1.01	1.00	mg/L	99	99	<1%

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Lithium, Dissolved	EPA 200.7	1301487-001	<0.100	0.969	0.965	1.00	mg/L	95	95	<1%
		Magnesium, Dissolved	EPA 200.7	1301487-001	6.47	15.7	15.8	10.0	mg/L	92	93	1 %
		Manganese, Dissolved	EPA 200.7	1301487-001	<0.005	0.973	0.974	1.00	mg/L	98	99	<1%
		Molybdenum, Dissolved	EPA 200.7	1301487-001	<0.010	1.00	1.00	1.00	mg/L	100	100	<1%
		Nickel, Dissolved	EPA 200.7	1301487-001	<0.010	4.93	4.95	5.00	mg/L	99	99	<1%
		Phosphorus, Dissolved	EPA 200.7	1301487-001	<0.500	5.12	5.15	5.00	mg/L	101	102	1 %
		Potassium, Dissolved	EPA 200.7	1301487-001	3.70	13.6	13.6	10.0	mg/L	99	99	<1%
		Scandium, Dissolved	EPA 200.7	1301487-001	<0.100	0.993	0.991	1.00	mg/L	99	99	<1%
		Silver, Dissolved	EPA 200.7	1301487-001	<0.005	0.090	0.089	0.090	mg/L	100	99	1 %
		Sodium, Dissolved	EPA 200.7	1301487-001	13.9	23.3	23.3	10.0	mg/L	94	94	<1%
		Strontium, Dissolved	EPA 200.7	1301487-001	0.138	1.10	1.10	1.00	mg/L	96	96	<1%
		Tin, Dissolved	EPA 200.7	1301487-001	<0.100	0.955	0.953	1.00	mg/L	98	98	<1%
		Titanium, Dissolved	EPA 200.7	1301487-001	<0.100	0.970	0.966	1.00	mg/L	97	97	<1%
		Vanadium, Dissolved	EPA 200.7	1301487-001	0.012	1.02	1.02	1.00	mg/L	101	101	<1%
		Zinc, Dissolved	EPA 200.7	1301487-001	<0.010	0.993	1.00	1.00	mg/L	99	100	1 %
QC13020140	MS 1	Uranium, Dissolved	EPA 200.8	1301473-002	<0.0050	0.0128	0.0128	0.010	mg/L	100	100	<1%
		Mercury, Dissolved	EPA 200.8	1301473-002	<0.00010	0.000960	0.000959	0.001	mg/L	94	94	<1%
		Antimony, Dissolved	EPA 200.8	1301473-002	<0.0025	0.0091	0.0093	0.010	mg/L	90	92	2 %
		Arsenic, Dissolved	EPA 200.8	1301473-002	0.0080	0.0576	0.0573	0.050	mg/L	99	99	1 %
		Lead, Dissolved	EPA 200.8	1301473-002	<0.0025	0.0096	0.0097	0.010	mg/L	96	97	1 %
		Selenium, Dissolved	EPA 200.8	1301473-002	<0.0050	0.0474	0.0472	0.050	mg/L	90	89	<1%
		Thallium, Dissolved	EPA 200.8	1301473-002	<0.0010	0.0094	0.0095	0.010	mg/L	94	94	1 %
QC13020141	MS 1	Uranium, Dissolved	EPA 200.8	1301487-001	0.0075	0.0168	0.0169	0.010	mg/L	93	94	1 %
		Mercury, Dissolved	EPA 200.8	1301487-001	<0.00100	0.001003	<0.00100	0.001	mg/L	97	94	#Erro
		Antimony, Dissolved	EPA 200.8	1301487-001	<0.0025	0.0091	0.0093	0.010	mg/L	88	89	2 %
		Arsenic, Dissolved	EPA 200.8	1301487-001	<0.0050	0.0517	0.0505	0.050	mg/L	98	96	2 %
		Lead, Dissolved	EPA 200.8	1301487-001	<0.0025	0.0096	0.0096	0.010	mg/L	95	95	<1%
		Selenium, Dissolved	EPA 200.8	1301487-001	<0.0050	0.0461	0.0451	0.050	mg/L	88	86	2 %
		Thallium, Dissolved	EPA 200.8	1301487-001	<0.0010	0.0093	0.0093	0.010	mg/L	93	93	<1%

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 13014823
Report Due Date: 02-14-13
Page 1 of 1

Client McClelland Laboratories, Inc.	
Address 1016 Greg Street	
City, State & Zip Sparks, NV 89431	
Contact Mike Medina	
Phone 775-356-1300	Collector's Name Robert
Fax 775-356-8917	Project Name
P.O. Number	Project Number 3438
Email mli@mettest.com	

Turnaround Time
Standard 5 Day Other

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results	Y	N	To: Client	Billing
Email Results	Y	N	To: Client	Billing
Compliance Monitoring	Y	N		
Fax Results to State EPA	Y	N		

Sample Type Codes

DW = Drinking Water	SD = Solid
WW = Wastewater	SO = Soil
SW = Surface Water	HW = Hazardous Waste
MW = Monitoring Well	OTHER:

Analyses Requested

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
CF-11-02 (227-367)	Wk:32	01/31/13	9:00	WW	2	X	X									1
CF-11-02 (52-117)																2
K-Spar Breccia 5+ Comp																3
Biotite Breccia 5+ Comp																4
Quartz Monzonite 5+ Comp																5
Biotite Breccia 0-5 Comp																6
K-Spar Breccia 0-5 Comp																7
Quartz Monzonite 0-5 Comp	↓	↓	↓	↓	↓	↓	↓									8

1301 - 5
483 8

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 17.8 °C	1/31/13	14:20		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 16				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

WETLAB
WESTERN ENVIRONMENTAL
TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

2/27/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1302236*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 2/14/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

ASmith

Andy Smith
QA Manager

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1302236

General Comments

None

Specific Comments

Due to the sample matrix it was necessary to analyze the following at a dilution:
1302236-002 Potassium
The reporting limits have been adjusted accordingly.

Data Qualifier Legend

B	-- Blank contamination; Analyte detected above the method reporting limit in an associated blank
D	-- Reporting limit is elevated due to required sample dilution
HT	-- Sample analyzed beyond the accepted holding time
J	-- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	-- Reported value is estimated; The sample matrix interfered with the analysis
N	-- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	-- Not calculated due to matrix interference
Q	-- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
S	-- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.
SC	-- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438 Wk:40*

Date Printed: 2/27/2013
OrderID: *1302236*

Customer Sample ID: CF-11-02 (0-27) Wk:40
WETLAB Sample ID: 1302236-001

Collect Date/Time: 2/14/2013 09:00
Receive Date: 2/14/2013 14:50

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	8.93	pH Units		2/14/2013
Trace Metals Digestion	EPA 200.2	Complete			2/19/2013
Bicarbonate (HCO3)	SM 2320B	44	mg/L	1.0	2/14/2013
Carbonate (CO3)	SM 2320B	15	mg/L	1.0	2/14/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	2/14/2013
Total Alkalinity	SM 2320B	61	mg/L as CaCO3	1.0	2/14/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	2/15/2013
Fluoride	EPA 300.0	0.98	mg/L	0.10	2/15/2013
Sulfate	EPA 300.0	13	mg/L	1.0	2/15/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	2/15/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	2/15/2013
Total Dissolved Solids (TDS)	SM 2540C	75	mg/L	10	2/20/2013
Aluminum	EPA 200.7	0.048	mg/L	0.045	2/20/2013
Barium	EPA 200.7	<0.010	mg/L	0.010	2/20/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	2/20/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	2/20/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	2/20/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	2/20/2013
Calcium	EPA 200.7	17	mg/L	0.50	2/20/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	2/20/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	2/20/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	2/20/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	2/20/2013
Iron	EPA 200.7	0.010	mg/L	0.010	2/20/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	2/20/2013
Magnesium	EPA 200.7	2.8	mg/L	0.50	2/20/2013
Manganese	EPA 200.7	0.037	mg/L	0.0050	2/20/2013

Customer Sample ID: CF-11-02 (0-27) Wk:40
WETLAB Sample ID: 1302236-001

Collect Date/Time: 2/14/2013 09:00
Receive Date: 2/14/2013 14:50

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	2/20/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	2/20/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	2/20/2013
Potassium	EPA 200.7	1.2	mg/L	0.50	2/20/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	2/20/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	2/20/2013
Sodium	EPA 200.7	0.69	mg/L	0.50	2/20/2013
Strontium	EPA 200.7	0.13	mg/L	0.10	2/20/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	2/20/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	2/20/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	2/20/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	2/20/2013
Mercury	EPA 200.8	0.00011	mg/L	0.00010	2/20/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	2/20/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	2/20/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	2/20/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	2/20/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	2/20/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	2/20/2013
Anions	Calculation	1.54	meq/L	0.10	
Cations	Calculation	1.15	meq/L	0.10	
Error	Calculation	15	%	1.0	

Customer Sample ID: CF-11-02 (367-408) Wk:40
WETLAB Sample ID: 1302236-002

Collect Date/Time: 2/14/2013 09:00
Receive Date: 2/14/2013 14:50

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.61	pH Units		2/14/2013
Trace Metals Digestion	EPA 200.2	Complete			2/19/2013
Bicarbonate (HCO3)	SM 2320B	31	mg/L	1.0	2/14/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	2/14/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	2/14/2013
Total Alkalinity	SM 2320B	25	mg/L as CaCO3	1.0	2/14/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	2/15/2013
Fluoride	EPA 300.0	0.91	mg/L	0.10	2/15/2013
Sulfate	EPA 300.0	8.1	mg/L	1.0	2/15/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	2/15/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	2/15/2013

Customer Sample ID: CF-11-02 (367-408) Wk:40
WETLAB Sample ID: 1302236-002

Collect Date/Time: 2/14/2013 09:00
Receive Date: 2/14/2013 14:50

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Total Dissolved Solids (TDS)	SM 2540C	45	mg/L	10	2/20/2013
Aluminum	EPA 200.7	0.12	mg/L	0.045	2/20/2013
Barium	EPA 200.7	<0.010	mg/L	0.010	2/20/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	2/20/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	2/20/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	2/20/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	2/20/2013
Calcium	EPA 200.7	12	mg/L	0.50	2/20/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	2/20/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	2/20/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	2/20/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	2/20/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	2/20/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	2/20/2013
Magnesium	EPA 200.7	<0.50	mg/L	0.50	2/20/2013
Manganese	EPA 200.7	0.023	mg/L	0.0050	2/20/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	2/20/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	2/20/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	2/20/2013
Potassium	EPA 200.7	<2.5	mg/L	2.5	2/20/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	2/20/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	2/20/2013
Sodium	EPA 200.7	0.51	mg/L	0.50	2/20/2013
Strontium	EPA 200.7	<0.10	mg/L	0.10	2/20/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	2/20/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	2/20/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	2/20/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	2/20/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	2/20/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	2/20/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	2/20/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	2/20/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	2/20/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	2/20/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	2/20/2013
Anions	Calculation	0.72	meq/L	0.10	
Cations	Calculation	0.64	meq/L	0.10	
Error	Calculation	6.6	%	1.0	

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13020467	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC13020467	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC13020467	Blank 3	Fluoride	EPA 300.0	<0.10	mg/L
QC13020469	Blank 1	Chloride	EPA 300.0	<1.0	mg/L
QC13020469	Blank 2	Chloride	EPA 300.0	<1.0	mg/L
QC13020469	Blank 3	Chloride	EPA 300.0	<1.0	mg/L
QC13020473	Blank 1	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13020473	Blank 2	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13020473	Blank 3	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13020477	Blank 1	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13020477	Blank 2	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13020477	Blank 3	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13020479	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC13020479	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC13020479	Blank 3	Sulfate	EPA 300.0	<1.0	mg/L
QC13020526	Blank 1	Aluminum	EPA 200.7	<0.045	mg/L
		Barium	EPA 200.7	<0.010	mg/L
		Beryllium	EPA 200.7	<0.0010	mg/L
		Bismuth	EPA 200.7	<0.10	mg/L
		Boron	EPA 200.7	<0.100	mg/L
		Cadmium	EPA 200.7	<0.0010	mg/L
		Calcium	EPA 200.7	<0.50	mg/L
		Chromium	EPA 200.7	<0.0050	mg/L
		Cobalt	EPA 200.7	<0.010	mg/L
		Copper	EPA 200.7	<0.050	mg/L
		Gallium	EPA 200.7	<0.10	mg/L
		Iron	EPA 200.7	<0.010	mg/L
		Lithium	EPA 200.7	<0.10	mg/L
		Magnesium	EPA 200.7	<0.50	mg/L
		Manganese	EPA 200.7	<0.0050	mg/L
		Molybdenum	EPA 200.7	<0.010	mg/L
		Nickel	EPA 200.7	<0.010	mg/L
		Phosphorus	EPA 200.7	<0.50	mg/L
		Potassium	EPA 200.7	<0.50	mg/L
		Scandium	EPA 200.7	<0.10	mg/L
		Silver	EPA 200.7	<0.0050	mg/L
		Sodium	EPA 200.7	<0.50	mg/L
		Strontium	EPA 200.7	<0.10	mg/L
		Tin	EPA 200.7	<0.10	mg/L
		Titanium	EPA 200.7	<0.10	mg/L
		Vanadium	EPA 200.7	<0.010	mg/L
		Zinc	EPA 200.7	<0.010	mg/L
QC13020535	Blank 1	Mercury	EPA 200.8	<0.00010	mg/L
		Antimony	EPA 200.8	<0.0025	mg/L
		Arsenic	EPA 200.8	<0.0050	mg/L
		Lead	EPA 200.8	<0.0025	mg/L
		Selenium	EPA 200.8	<0.0050	mg/L

QCBatchID	QCType	Parameter	Method	Result	Units
		Thallium	EPA 200.8	<0.0010	mg/L
		Uranium	EPA 200.8	<0.0050	mg/L
QC13020628	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13020422	LCS 1	pH	SM 4500-H+ B	6.99	7.00	100	pH Units
QC13020422	LCS 2	pH	SM 4500-H+ B	6.99	7.00	100	pH Units
QC13020422	LCS 3	pH	SM 4500-H+ B	6.99	7.00	100	pH Units
QC13020425	LCS 1	Total Alkalinity	SM 2320B	98.2	100	98	mg/L
QC13020425	LCS 2	Total Alkalinity	SM 2320B	98.6	100	99	mg/L
QC13020425	LCS 3	Total Alkalinity	SM 2320B	98.8	100	99	mg/L
QC13020425	LCS 4	Total Alkalinity	SM 2320B	99.4	100	99	mg/L
QC13020467	LCS 1	Fluoride	EPA 300.0	2.01	2.00	100	mg/L
QC13020469	LCS 1	Chloride	EPA 300.0	9.71	10.0	97	mg/L
QC13020473	LCS 1	Nitrite Nitrogen	EPA 300.0	0.524	0.500	105	mg/L
QC13020477	LCS 1	Nitrate Nitrogen	EPA 300.0	1.97	2.00	98	mg/L
QC13020479	LCS 1	Sulfate	EPA 300.0	23.7	25.0	95	mg/L
QC13020526	LCS 1	Aluminum	EPA 200.7	0.955	1.00	96	mg/L
		Barium	EPA 200.7	0.978	1.00	98	mg/L
		Beryllium	EPA 200.7	0.988	1.00	99	mg/L
		Bismuth	EPA 200.7	1.02	1.00	102	mg/L
		Boron	EPA 200.7	0.940	1.00	94	mg/L
		Cadmium	EPA 200.7	1.01	1.00	101	mg/L
		Calcium	EPA 200.7	9.84	10.0	98	mg/L
		Chromium	EPA 200.7	0.971	1.00	97	mg/L
		Cobalt	EPA 200.7	0.988	1.00	99	mg/L
		Copper	EPA 200.7	4.67	5.00	93	mg/L
		Gallium	EPA 200.7	0.974	1.00	97	mg/L
		Iron	EPA 200.7	0.955	1.00	96	mg/L
		Lithium	EPA 200.7	0.946	1.00	95	mg/L
		Magnesium	EPA 200.7	9.35	10.0	94	mg/L
		Manganese	EPA 200.7	0.991	1.00	99	mg/L
		Molybdenum	EPA 200.7	0.963	1.00	96	mg/L
		Nickel	EPA 200.7	4.90	5.00	98	mg/L
		Phosphorus	EPA 200.7	5.03	5.00	101	mg/L
		Potassium	EPA 200.7	9.55	10.0	96	mg/L
		Scandium	EPA 200.7	0.950	1.00	95	mg/L
		Silver	EPA 200.7	0.085	0.090	94	mg/L
		Sodium	EPA 200.7	9.31	10.0	93	mg/L
		Strontium	EPA 200.7	0.935	1.00	94	mg/L
		Tin	EPA 200.7	0.972	1.00	97	mg/L
		Titanium	EPA 200.7	0.953	1.00	95	mg/L
		Vanadium	EPA 200.7	0.963	1.00	96	mg/L
		Zinc	EPA 200.7	1.03	1.00	103	mg/L
QC13020535	LCS 1	Mercury	EPA 200.8	0.001014	0.001	101	mg/L
		Antimony	EPA 200.8	0.0094	0.010	94	mg/L
		Arsenic	EPA 200.8	0.0487	0.050	97	mg/L
		Lead	EPA 200.8	0.0098	0.010	98	mg/L
		Selenium	EPA 200.8	0.0464	0.050	93	mg/L
		Thallium	EPA 200.8	0.0098	0.010	98	mg/L
		Uranium	EPA 200.8	0.0097	0.010	97	mg/L
QC13020628	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	157	150	105	mg/L

				Duplicate	Sample	Duplicate	

QCBatchID	QCType			Sample	Result	Result			
QC13020422	Duplicate	pH	SM 4500-H+ B	1302226-001	7.69	7.70		pH Units	<1%
QC13020422	Duplicate	pH	SM 4500-H+ B	1302231-001	7.54	7.56		pH Units	<1%
QC13020422	Duplicate	pH	SM 4500-H+ B	1302238-001	7.37	7.40		pH Units	<1%
QC13020422	Duplicate	pH	SM 4500-H+ B	1302239-007	10.0	10.1		pH Units	1 %
QC13020422	Duplicate	pH	SM 4500-H+ B	1302249-009	7.38	7.40		pH Units	<1%
QC13020425	Duplicate	Bicarbonate (HCO3)	SM 2320B	1302226-001	113	112		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1302226-001	<1.000	<1.000		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1302226-001	<1.000	<1.000		mg/L	<1%
		Total Alkalinity	SM 2320B	1302226-001	92.6	92.2		mg/L as CaCO3	<1%
QC13020425	Duplicate	Bicarbonate (HCO3)	SM 2320B	1302231-001	260	260		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1302231-001	<1.000	<1.000		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1302231-001	<1.000	<1.000		mg/L	<1%
		Total Alkalinity	SM 2320B	1302231-001	213	214		mg/L as CaCO3	<1%
QC13020425	Duplicate	Bicarbonate (HCO3)	SM 2320B	1302238-001	118	119		mg/L	1 %
		Carbonate (CO3)	SM 2320B	1302238-001	<1.000	<1.000		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1302238-001	<1.000	<1.000		mg/L	<1%
		Total Alkalinity	SM 2320B	1302238-001	96.8	97.6		mg/L as CaCO3	1 %
QC13020425	Duplicate	Bicarbonate (HCO3)	SM 2320B	1302239-007	<1.000	<1.000		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1302239-007	78.9	60.6	Q	mg/L	26 %
		Hydroxide (OH)	SM 2320B	1302239-007	100	109		mg/L	9 %
		Total Alkalinity	SM 2320B	1302239-007	425	422		mg/L as CaCO3	1 %
QC13020425	Duplicate	Bicarbonate (HCO3)	SM 2320B	1302249-009	111	111		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1302249-009	<1.000	<1.000		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1302249-009	<1.000	<1.000		mg/L	<1%
		Total Alkalinity	SM 2320B	1302249-009	90.9	91.1		mg/L as CaCO3	<1%
QC13020628	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1302236-001	75.0	73.0		mg/L	3 %
QC13020628	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1302268-001	35.0	26.0		mg/L	30 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13020467	MS 1	Fluoride	EPA 300.0	1302236-002	0.907		2.66	2.73	2.00	mg/L	88	91	3 %
QC13020467	MS 2	Fluoride	EPA 300.0	1302265-001	1.05		3.11	3.05	2.00	mg/L	103	100	2 %
QC13020469	MS 1	Chloride	EPA 300.0	1302236-002	<1.000		4.79	4.91	5.00	mg/L	95	97	2 %
QC13020469	MS 2	Chloride	EPA 300.0	1302265-001	5.30		10.3	10.1	5.00	mg/L	99	97	2 %
QC13020473	MS 1	Nitrite Nitrogen	EPA 300.0	1302236-002	<0.025		0.511	0.524	0.500	mg/L	101	103	3 %
QC13020473	MS 2	Nitrite Nitrogen	EPA 300.0	1302265-001	0.107		0.588	0.568	0.500	mg/L	96	92	3 %
QC13020477	MS 1	Nitrate Nitrogen	EPA 300.0	1302236-002	<1.000		1.90	1.96	2.00	mg/L	93	96	3 %
QC13020477	MS 2	Nitrate Nitrogen	EPA 300.0	1302265-001	<1.000		2.28	2.21	2.00	mg/L	104	100	3 %
QC13020479	MS 1	Sulfate	EPA 300.0	1302236-002	8.14		17.3	17.5	10.0	mg/L	91	94	1 %
QC13020479	MS 2	Sulfate	EPA 300.0	1302226-003	<1.000		10.00	10.1	10.0	mg/L	96	97	1 %
QC13020526	MS 1	Aluminum	EPA 200.7	1302271-001	16.0	SC	16.6	16.7	1.00	mg/L	NC	NC	NC
		Barium	EPA 200.7	1302271-001	0.015		0.787	0.789	1.00	mg/L	77	77	<1%
		Beryllium	EPA 200.7	1302271-001	0.013		0.804	0.802	1.00	mg/L	79	79	<1%
		Bismuth	EPA 200.7	1302271-001	<0.100		0.835	0.830	1.00	mg/L	85	85	1 %
		Boron	EPA 200.7	1302271-001	0.236		1.09	1.09	1.00	mg/L	85	85	<1%
		Cadmium	EPA 200.7	1302271-001	0.283		1.06	1.06	1.00	mg/L	78	78	<1%
		Calcium	EPA 200.7	1302271-001	420	SC	343	342	10.0	mg/L	NC	NC	NC

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Chromium	EPA 200.7	1302271-001	<0.005		0.781	0.778	1.00	mg/L	78	77	<1%
		Cobalt	EPA 200.7	1302271-001	1.66		2.37	2.37	1.00	mg/L	71	71	<1%
		Copper	EPA 200.7	1302271-001	0.413		4.52	4.53	5.00	mg/L	82	82	<1%
		Gallium	EPA 200.7	1302271-001	<0.100		0.812	0.811	1.00	mg/L	81	81	<1%
		Iron	EPA 200.7	1302271-001	0.135		0.929	0.933	1.00	mg/L	79	80	<1%
		Lithium	EPA 200.7	1302271-001	0.256		1.07	1.07	1.00	mg/L	81	81	<1%
		Magnesium	EPA 200.7	1302271-001	184		195	196	10.0	mg/L	110	120	1 %
		Manganese	EPA 200.7	1302271-001	18.5	SC	19.0	19.1	1.00	mg/L	NC	NC	NC
		Molybdenum	EPA 200.7	1302271-001	<0.010		0.802	0.799	1.00	mg/L	81	81	<1%
		Nickel	EPA 200.7	1302271-001	4.14		7.70	7.70	5.00	mg/L	71	71	<1%
		Phosphorus	EPA 200.7	1302271-001	<0.500		4.46	4.41	5.00	mg/L	90	89	1 %
		Potassium	EPA 200.7	1302271-001	15.3		23.9	24.1	10.0	mg/L	86	88	1 %
		Scandium	EPA 200.7	1302271-001	<0.100		0.809	0.807	1.00	mg/L	81	80	<1%
		Silver	EPA 200.7	1302271-001	<0.005		0.076	0.076	0.090	mg/L	85	85	<1%
		Sodium	EPA 200.7	1302271-001	750	SC	671	688	10.0	mg/L	NC	NC	NC
		Strontium	EPA 200.7	1302271-001	0.827		1.62	1.63	1.00	mg/L	79	80	1 %
		Tin	EPA 200.7	1302271-001	<0.100		0.760	0.755	1.00	mg/L	82	81	1 %
		Titanium	EPA 200.7	1302271-001	<0.100		0.829	0.829	1.00	mg/L	83	83	<1%
		Vanadium	EPA 200.7	1302271-001	0.058		0.877	0.874	1.00	mg/L	82	82	<1%
		Zinc	EPA 200.7	1302271-001	13.0	SC	13.3	13.3	1.00	mg/L	NC	NC	NC
QC13020535	MS 1	Mercury	EPA 200.8	1302271-001	0.007220	SC	0.007841	0.008242	0.001	mg/L	NC	NC	NC
		Antimony	EPA 200.8	1302271-001	0.0250		0.0354	0.0355	0.010	mg/L	104	105	<1%
		Arsenic	EPA 200.8	1302271-001	0.0665		0.1109	0.1113	0.050	mg/L	89	89	<1%
		Lead	EPA 200.8	1302271-001	<0.0050	M	0.0069	0.0068	0.010	mg/L	NC	NC	NC
		Selenium	EPA 200.8	1302271-001	0.6842		0.7442	0.7667	0.050	mg/L	120	165	3 %
		Thallium	EPA 200.8	1302271-001	0.0054	M	0.0118	0.0119	0.010	mg/L	NC	NC	NC
		Uranium	EPA 200.8	1302271-001	0.1497		0.1620	0.1624	0.010	mg/L	123	127	<1%

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1302236
Report Due Date: 3/1/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company ______
Address ______
City, State & Zip ______
Contact ______
Phone ______
Fax ______
Email ______

Additional Information

Fax Results	Y	N	To: Client	Billing
Email Results	Y	N	To: Client	Billing
Compliance Monitoring	Y	N		
Fax Results to State EPA	Y	N		

Sample Type Codes

DW = Drinking Water	SD = Solid
WW = Wastewater	SO = Soil
SW = Surface Water	HW = Hazardous Waste
MW = Monitoring Well	OTHER: ______

Analyses Requested

SAMPLE ID/LOCATION	DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
CF-11-02 (0-27) Wk:40	02/14/13	9:00	WW	2	X	X									1
CF-11-02 (367-408) ↓	↓	↓	↓	↓	↓	↓									2

1302 5
236 2

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 20.3 °C	2/14/13	1450		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 4				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

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Lab Number 1302236
Report Due Date: 3/1/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard 5-Day Other

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER:

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium	Spl. No.
CF-11-02 (0-27)	Wk:40	02/14/13	9:00	WW	2	X	X	1
CF-11-02 (367-408)	↓	↓	↓	↓	↓	↓	↓	2

Analyses Requested

1302 5
236 2

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 20.8 °C	2/14/13	1450		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 4				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

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TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

3/6/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1302356*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 2/21/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Andy Smith
QA Manager

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1302356

General Comments

None

Specific Comments

None

Data Qualifier Legend

B	-- Blank contamination; Analyte detected above the method reporting limit in an associated blank
D	-- Reporting limit is elevated due to required sample dilution
HT	-- Sample analyzed beyond the accepted holding time
J	-- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	-- Reported value is estimated; The sample matrix interfered with the analysis
N	-- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	-- Not calculated due to matrix interference
Q	-- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
S	-- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.
SC	-- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438 Wk:108*

Date Printed: 3/6/2013
OrderID: *1302356*

Customer Sample ID: 604 673 Wk:108
WETLAB Sample ID: 1302356-001

Collect Date/Time: 2/21/2013 09:00
Receive Date: 2/21/2013 15:25

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	4.83	pH Units		2/21/2013
Trace Metals Digestion	EPA 200.2	Complete			2/26/2013
Bicarbonate (HCO3)	SM 2320B	<1.0	mg/L	1.0	2/22/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	2/22/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	2/22/2013
Total Alkalinity	SM 2320B	<1.0	mg/L as CaCO3	1.0	2/22/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	2/22/2013
Fluoride	EPA 300.0	0.22	mg/L	0.10	2/22/2013
Sulfate	EPA 300.0	23	mg/L	1.0	2/22/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	2/22/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	2/22/2013
Total Dissolved Solids (TDS)	SM 2540C	32	mg/L	10	2/26/2013
Aluminum	EPA 200.7	0.16	mg/L	0.045	2/27/2013
Barium	EPA 200.7	0.063	mg/L	0.010	2/27/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	2/27/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	2/27/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	2/27/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	2/27/2013
Calcium	EPA 200.7	6.2	mg/L	0.50	2/27/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	2/27/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	2/27/2013
Copper	EPA 200.7	1.8	mg/L	0.050	2/27/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	2/27/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	2/27/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	2/27/2013
Magnesium	EPA 200.7	0.83	mg/L	0.50	2/27/2013
Manganese	EPA 200.7	0.041	mg/L	0.0050	2/27/2013

Customer Sample ID: 604 673 Wk:108
WETLAB Sample ID: 1302356-001

Collect Date/Time: 2/21/2013 09:00
Receive Date: 2/21/2013 15:25

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	2/27/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	2/27/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	2/27/2013
Potassium	EPA 200.7	0.72	mg/L	0.50	2/27/2013
Scandium	EPA 200.7	<0.100	mg/L	0.100	2/27/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	2/27/2013
Sodium	EPA 200.7	0.94	mg/L	0.50	2/27/2013
Strontium	EPA 200.7	<0.10	mg/L	0.10	2/27/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	2/27/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	2/27/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	2/27/2013
Zinc	EPA 200.7	0.054	mg/L	0.010	2/27/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	2/27/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	2/27/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	2/27/2013
Lead	EPA 200.8	0.0074	mg/L	0.0025	2/27/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	2/27/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	2/27/2013
Uranium	EPA 200.8	0.018	mg/L	0.0050	2/27/2013
Anions	Calculation	0.49	meq/L	0.10	
Cations	Calculation	0.51	meq/L	0.10	
Error	Calculation	2.4	%	1.0	

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13020646	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC13020646	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC13020646	Blank 3	Fluoride	EPA 300.0	<0.10	mg/L
QC13020650	Blank 1	Chloride	EPA 300.0	<1.0	mg/L
QC13020650	Blank 2	Chloride	EPA 300.0	<1.0	mg/L
QC13020650	Blank 3	Chloride	EPA 300.0	<1.0	mg/L
QC13020654	Blank 1	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13020654	Blank 2	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13020654	Blank 3	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13020656	Blank 1	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13020656	Blank 2	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13020656	Blank 3	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13020658	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC13020658	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC13020658	Blank 3	Sulfate	EPA 300.0	<1.0	mg/L
QC13020745	Blank 1	Aluminum, Dissolved	EPA 200.7	<0.045	mg/L
		Barium, Dissolved	EPA 200.7	<0.010	mg/L
		Beryllium, Dissolved	EPA 200.7	<0.0010	mg/L
		Bismuth, Dissolved	EPA 200.7	<0.10	mg/L
		Boron, Dissolved	EPA 200.7	<0.10	mg/L
		Cadmium, Dissolved	EPA 200.7	<0.0010	mg/L
		Calcium, Dissolved	EPA 200.7	<0.50	mg/L
		Chromium, Dissolved	EPA 200.7	<0.0050	mg/L
		Cobalt, Dissolved	EPA 200.7	<0.010	mg/L
		Copper, Dissolved	EPA 200.7	<0.050	mg/L
		Gallium, Dissolved	EPA 200.7	<0.10	mg/L
		Iron, Dissolved	EPA 200.7	<0.010	mg/L
		Lithium, Dissolved	EPA 200.7	<0.10	mg/L
		Magnesium, Dissolved	EPA 200.7	<0.50	mg/L
		Manganese, Dissolved	EPA 200.7	<0.0050	mg/L
		Molybdenum, Dissolved	EPA 200.7	<0.010	mg/L
		Nickel, Dissolved	EPA 200.7	<0.010	mg/L
		Phosphorus, Dissolved	EPA 200.7	<0.50	mg/L
		Potassium, Dissolved	EPA 200.7	<0.50	mg/L
		Scandium, Dissolved	EPA 200.7	<0.10	mg/L
		Silver, Dissolved	EPA 200.7	<0.0050	mg/L
		Sodium, Dissolved	EPA 200.7	<0.50	mg/L
		Strontium, Dissolved	EPA 200.7	<0.10	mg/L
		Tin, Dissolved	EPA 200.7	<0.10	mg/L
		Titanium, Dissolved	EPA 200.7	<0.10	mg/L
		Vanadium, Dissolved	EPA 200.7	<0.010	mg/L
		Zinc, Dissolved	EPA 200.7	<0.010	mg/L
QC13020779	Blank 1	Uranium, Dissolved	EPA 200.8	<0.0050	mg/L
		Mercury, Dissolved	EPA 200.8	<0.00010	mg/L
		Antimony, Dissolved	EPA 200.8	<0.0025	mg/L
		Arsenic, Dissolved	EPA 200.8	<0.0050	mg/L
		Lead, Dissolved	EPA 200.8	<0.0025	mg/L

QCBatchID	QCType	Parameter	Method	Result	Units
		Selenium, Dissolved	EPA 200.8	<0.0050	mg/L
		Thallium, Dissolved	EPA 200.8	<0.0010	mg/L
QC13020800	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13020599	LCS 1	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13020599	LCS 2	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13020600	LCS 1	Total Alkalinity	SM 2320B	98.4	100	98	mg/L
QC13020600	LCS 2	Total Alkalinity	SM 2320B	93.3	100	93	mg/L
QC13020600	LCS 3	Total Alkalinity	SM 2320B	99.6	100	100	mg/L
QC13020600	LCS 4	Total Alkalinity	SM 2320B	97.4	100	97	mg/L
QC13020646	LCS 1	Fluoride	EPA 300.0	1.81	2.00	91	mg/L
QC13020650	LCS 1	Chloride	EPA 300.0	10.1	10.0	101	mg/L
QC13020654	LCS 1	Nitrite Nitrogen	EPA 300.0	0.457	0.500	91	mg/L
QC13020656	LCS 1	Nitrate Nitrogen	EPA 300.0	2.02	2.00	101	mg/L
QC13020658	LCS 1	Sulfate	EPA 300.0	23.6	25.0	94	mg/L
QC13020745	LCS 1	Aluminum, Dissolved	EPA 200.7	0.965	1.00	96	mg/L
		Barium, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
		Beryllium, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Bismuth, Dissolved	EPA 200.7	1.03	1.00	103	mg/L
		Boron, Dissolved	EPA 200.7	0.984	1.00	98	mg/L
		Cadmium, Dissolved	EPA 200.7	1.04	1.00	104	mg/L
		Calcium, Dissolved	EPA 200.7	10.3	10.0	103	mg/L
		Chromium, Dissolved	EPA 200.7	0.994	1.00	99	mg/L
		Cobalt, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
		Copper, Dissolved	EPA 200.7	4.83	5.00	97	mg/L
		Gallium, Dissolved	EPA 200.7	0.981	1.00	98	mg/L
		Iron, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
		Lithium, Dissolved	EPA 200.7	0.984	1.00	98	mg/L
		Magnesium, Dissolved	EPA 200.7	10.2	10.0	102	mg/L
		Manganese, Dissolved	EPA 200.7	0.977	1.00	98	mg/L
		Molybdenum, Dissolved	EPA 200.7	1.03	1.00	103	mg/L
		Nickel, Dissolved	EPA 200.7	5.12	5.00	102	mg/L
		Phosphorus, Dissolved	EPA 200.7	5.40	5.00	108	mg/L
		Potassium, Dissolved	EPA 200.7	9.92	10.0	99	mg/L
		Scandium, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Silver, Dissolved	EPA 200.7	0.090	0.090	99	mg/L
		Sodium, Dissolved	EPA 200.7	10.0	10.0	100	mg/L
		Strontium, Dissolved	EPA 200.7	0.974	1.00	97	mg/L
		Tin, Dissolved	EPA 200.7	1.02	1.00	102	mg/L
		Titanium, Dissolved	EPA 200.7	0.989	1.00	99	mg/L
		Vanadium, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Zinc, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
QC13020779	LCS 1	Uranium, Dissolved	EPA 200.8	0.0092	0.010	92	mg/L
		Mercury, Dissolved	EPA 200.8	0.000864	0.001	86	mg/L
		Antimony, Dissolved	EPA 200.8	0.0095	0.010	95	mg/L
		Arsenic, Dissolved	EPA 200.8	0.0498	0.050	100	mg/L
		Lead, Dissolved	EPA 200.8	0.0094	0.010	94	mg/L
		Selenium, Dissolved	EPA 200.8	0.0468	0.050	94	mg/L
		Thallium, Dissolved	EPA 200.8	0.0094	0.010	94	mg/L
QC13020800	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	159	150	106	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD

QC13020599	Duplicate	pH	SM 4500-H+ B	1302342-003	6.79	6.81	pH Units	<1%
QC13020599	Duplicate	pH	SM 4500-H+ B	1302342-004	6.83	6.84	pH Units	<1%
QC13020599	Duplicate	pH	SM 4500-H+ B	1302355-001	5.80	5.86	pH Units	1 %
QC13020599	Duplicate	pH	SM 4500-H+ B	1302356-001	4.83	4.86	pH Units	1 %
QC13020600	Duplicate	Bicarbonate (HCO3)	SM 2320B	1302342-003	232	233	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1302342-003	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1302342-003	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1302342-003	190	191	mg/L as CaCO3	<1%
QC13020600	Duplicate	Bicarbonate (HCO3)	SM 2320B	1302342-004	154	154	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1302342-004	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1302342-004	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1302342-004	126	126	mg/L as CaCO3	<1%
QC13020600	Duplicate	Bicarbonate (HCO3)	SM 2320B	1302355-001	<1.000	<1.000	mg/L	7 %
		Carbonate (CO3)	SM 2320B	1302355-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1302355-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1302355-001	<1.000	<1.000	mg/L as CaCO3	7 %
QC13020600	Duplicate	Bicarbonate (HCO3)	SM 2320B	1302356-001	<1.000	<1.000	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1302356-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1302356-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1302356-001	<1.000	<1.000	mg/L as CaCO3	<1%
QC13020800	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1302356-001	32.0	30.0	mg/L	6 %
QC13020800	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1302397-004	1002	1002	mg/L	<1%

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13020646	MS 1	Fluoride	EPA 300.0	1302356-001	0.219	2.26	2.30	2.00	mg/L	102	104	2 %
QC13020646	MS 2	Fluoride	EPA 300.0	1302350-001	<1.000	18.8	18.7	2.00	mg/L	94	93	1 %
QC13020650	MS 1	Chloride	EPA 300.0	1302356-001	<1.000	5.15	5.26	5.00	mg/L	103	105	2 %
QC13020650	MS 2	Chloride	EPA 300.0	1302350-001	141	195	193	5.00	mg/L	108	106	1 %
QC13020654	MS 1	Nitrite Nitrogen	EPA 300.0	1302356-001	<0.025	0.468	0.478	0.500	mg/L	94	96	2 %
QC13020654	MS 2	Nitrite Nitrogen	EPA 300.0	1302372-001	<0.025	0.549	0.556	0.500	mg/L	105	107	1 %
QC13020656	MS 1	Nitrate Nitrogen	EPA 300.0	1302356-001	<1.000	2.17	2.22	2.00	mg/L	106	108	2 %
QC13020656	MS 2	Nitrate Nitrogen	EPA 300.0	1302372-001	<1.000	2.22	2.26	2.00	mg/L	109	110	2 %
QC13020658	MS 1	Sulfate	EPA 300.0	1302356-001	23.5	33.1	33.3	10.0	mg/L	96	99	1 %
QC13020658	MS 2	Sulfate	EPA 300.0	1302350-001	95.6	200	198	10.0	mg/L	105	102	1 %
QC13020745	MS 1	Aluminum, Dissolved	EPA 200.7	1302378-001	<0.045	1.06	1.06	1.00	mg/L	105	105	<1%
		Barium, Dissolved	EPA 200.7	1302378-001	0.163	1.16	1.16	1.00	mg/L	100	100	<1%
		Beryllium, Dissolved	EPA 200.7	1302378-001	<0.001	1.00	0.999	1.00	mg/L	100	100	<1%
		Bismuth, Dissolved	EPA 200.7	1302378-001	<0.100	0.981	0.987	1.00	mg/L	100	101	1 %
		Boron, Dissolved	EPA 200.7	1302378-001	0.230	1.29	1.28	1.00	mg/L	106	105	1 %
		Cadmium, Dissolved	EPA 200.7	1302378-001	<0.001	1.01	1.00	1.00	mg/L	101	100	1 %
		Calcium, Dissolved	EPA 200.7	1302378-001	91.5	100	101	10.0	mg/L	85	95	1 %
		Chromium, Dissolved	EPA 200.7	1302378-001	<0.005	0.998	0.997	1.00	mg/L	100	100	<1%
		Cobalt, Dissolved	EPA 200.7	1302378-001	<0.010	0.981	0.974	1.00	mg/L	97	96	1 %
		Copper, Dissolved	EPA 200.7	1302378-001	<0.050	4.96	4.94	5.00	mg/L	99	99	<1%
		Gallium, Dissolved	EPA 200.7	1302378-001	<0.100	1.00	1.00	1.00	mg/L	100	100	<1%
		Iron, Dissolved	EPA 200.7	1302378-001	<0.010	1.00	1.00	1.00	mg/L	100	100	<1%
		Lithium, Dissolved	EPA 200.7	1302378-001	<0.100	0.955	0.951	1.00	mg/L	93	93	<1%
		Magnesium, Dissolved	EPA 200.7	1302378-001	23.9	33.2	33.3	10.0	mg/L	93	94	<1%

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Manganese, Dissolved	EPA 200.7	1302378-001	<0.005	0.935	0.932	1.00	mg/L	96	96	<1%
		Molybdenum, Dissolved	EPA 200.7	1302378-001	<0.010	1.05	1.06	1.00	mg/L	105	106	1 %
		Nickel, Dissolved	EPA 200.7	1302378-001	<0.010	4.90	4.89	5.00	mg/L	98	98	<1%
		Phosphorus, Dissolved	EPA 200.7	1302378-001	<0.500	5.93	5.93	5.00	mg/L	113	113	<1%
		Potassium, Dissolved	EPA 200.7	1302378-001	2.30	12.1	12.1	10.0	mg/L	98	98	<1%
		Scandium, Dissolved	EPA 200.7	1302378-001	<0.100	1.00	1.00	1.00	mg/L	100	100	<1%
		Silver, Dissolved	EPA 200.7	1302378-001	<0.005	0.092	0.093	0.090	mg/L	102	102	1 %
		Sodium, Dissolved	EPA 200.7	1302378-001	184 SC	189	191	10.0	mg/L	NC	NC	NC
		Strontium, Dissolved	EPA 200.7	1302378-001	0.944	1.89	1.90	1.00	mg/L	95	96	1 %
		Tin, Dissolved	EPA 200.7	1302378-001	<0.100	1.00	1.00	1.00	mg/L	104	104	<1%
		Titanium, Dissolved	EPA 200.7	1302378-001	<0.100	0.999	0.996	1.00	mg/L	100	100	<1%
		Vanadium, Dissolved	EPA 200.7	1302378-001	0.028	1.06	1.06	1.00	mg/L	103	103	<1%
		Zinc, Dissolved	EPA 200.7	1302378-001	<0.010	0.974	0.981	1.00	mg/L	97	98	1 %
QC13020779	MS 1	Uranium, Dissolved	EPA 200.8	1302378-001	<0.0050	0.0145	0.0144	0.010	mg/L	95	95	1 %
		Mercury, Dissolved	EPA 200.8	1302378-001	0.000554	0.001305	0.001312	0.001	mg/L	75	76	1 %
		Antimony, Dissolved	EPA 200.8	1302378-001	<0.0025	0.0098	0.0098	0.010	mg/L	96	96	<1%
		Arsenic, Dissolved	EPA 200.8	1302378-001	0.0197	0.0740	0.0726	0.050	mg/L	109	106	2 %
		Lead, Dissolved	EPA 200.8	1302378-001	<0.0025	0.0088	0.0087	0.010	mg/L	88	87	1 %
		Selenium, Dissolved	EPA 200.8	1302378-001	0.0054	0.0520	0.0531	0.050	mg/L	93	95	2 %
		Thallium, Dissolved	EPA 200.8	1302378-001	<0.0010	0.0087	0.0087	0.010	mg/L	87	87	<1%

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1302356
Report Due Date: 3/7/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company ______
Address ______
City, State & Zip ______
Contact ______
Phone ______
Fax ______
Email ______

Additional Information

Fax Results	Y	N	To: Client Billing
Email Results	Y	N	To: Client Billing
Compliance Monitoring	Y	N	
Fax Results to State EPA	Y	N	

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

Analyses Requested

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium	Spl. No.
604 673	Wk:108	02/21/13	9:00	WW	2	X	X	1

1302 5
356 1

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 19.5 °C	2/21/13	3:25p		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 6				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

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Lab Number 1302356
Report Due Date: 3/7/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

SAMPLE ID/LOCATION	DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
604 673 Wk:108	02/21/13	9:00	WW	2	X	X									1

1302 5
356 1

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 19.5 °C	2/21/13	3:25p		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 6				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

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Specializing in Soil, Hazardous Waste and Water Analysis.

3/18/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1302487*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 2/28/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Jennifer Delaney
QA Specialist

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1302487

General Comments

None

Specific Comments

The following is a synopsis of the reanalysis of Total Dissolved Solids

- Sample 1302487-005 reanalysis results for Total Dissolved Solids have been reported.

This reanalysis was performed past the EPA recommended holding time due to an unacceptable cation/anion balance using data obtained within the holding time. We apologize for any inconvenience this may cause.

Data Qualifier Legend

B -- Blank contamination; Analyte detected above the method reporting limit in an associated blank

D -- Reporting limit is elevated due to required sample dilution

HT -- Sample analyzed beyond the accepted holding time

J -- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit

M -- Reported value is estimated; The sample matrix interfered with the analysis

N -- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.

NC -- Not calculated due to matrix interference

Q -- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy

S -- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.

SC -- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438 Wk: 36*

Date Printed: 3/18/2013
OrderID: *1302487*

Customer Sample ID: CF-11-02 (227-367) Wk:36
WETLAB Sample ID: 1302487-001

Collect Date/Time: 2/28/2013 09:00
Receive Date: 2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.80	pH Units		2/28/2013
Trace Metals Digestion	EPA 200.2	Complete			3/7/2013
Bicarbonate (HCO3)	SM 2320B	65	mg/L	1.0	2/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Total Alkalinity	SM 2320B	54	mg/L as CaCO3	1.0	2/28/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/2/2013
Fluoride	EPA 300.0	1.0	mg/L	0.10	3/2/2013
Sulfate	EPA 300.0	5.4	mg/L	1.0	3/2/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/2/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/2/2013
Total Dissolved Solids (TDS)	SM 2540C	67	mg/L	10	3/6/2013
Aluminum	EPA 200.7	0.066	mg/L	0.045	3/8/2013
Barium	EPA 200.7	0.043	mg/L	0.010	3/8/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	3/8/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	3/8/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	3/8/2013
Calcium	EPA 200.7	18	mg/L	0.50	3/8/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	3/8/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	3/8/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Magnesium	EPA 200.7	2.6	mg/L	0.50	3/8/2013
Manganese	EPA 200.7	0.029	mg/L	0.0050	3/8/2013

Customer Sample ID: CF-11-02 (227-367) Wk:36
WETLAB Sample ID: 1302487-001
Collect Date/Time: 2/28/2013 09:00
Receive Date: 2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Potassium	EPA 200.7	2.7	mg/L	0.50	3/8/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	3/8/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Strontium	EPA 200.7	0.16	mg/L	0.10	3/8/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	3/11/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	3/12/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	3/11/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	3/11/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	3/11/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	3/11/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	3/11/2013
Anions	Calculation	1.23	meq/L	0.10	
Cations	Calculation	1.19	meq/L	0.10	
Error	Calculation	1.7	%	1.0	

Customer Sample ID: CF-11-02 (52-117) Wk:36
WETLAB Sample ID: 1302487-002
Collect Date/Time: 2/28/2013 09:00
Receive Date: 2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.75	pH Units		2/28/2013
Trace Metals Digestion	EPA 200.2	Complete			3/7/2013
Bicarbonate (HCO3)	SM 2320B	55	mg/L	1.0	2/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Total Alkalinity	SM 2320B	45	mg/L as CaCO3	1.0	2/28/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/2/2013
Fluoride	EPA 300.0	0.82	mg/L	0.10	3/2/2013
Sulfate	EPA 300.0	7.6	mg/L	1.0	3/2/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/2/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/2/2013

Customer Sample ID: CF-11-02 (52-117) Wk:36
WETLAB Sample ID: 1302487-002

Collect Date/Time: 2/28/2013 09:00
Receive Date: 2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Total Dissolved Solids (TDS)	SM 2540C	59	mg/L	10	3/6/2013
Aluminum	EPA 200.7	0.054	mg/L	0.045	3/8/2013
Barium	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	3/8/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	3/8/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	3/8/2013
Calcium	EPA 200.7	17	mg/L	0.50	3/8/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	3/8/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	3/8/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Magnesium	EPA 200.7	1.5	mg/L	0.50	3/8/2013
Manganese	EPA 200.7	0.024	mg/L	0.0050	3/8/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Potassium	EPA 200.7	2.6	mg/L	0.50	3/8/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	3/8/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Strontium	EPA 200.7	0.12	mg/L	0.10	3/8/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	3/12/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	3/12/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	3/12/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	3/12/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	3/12/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	3/12/2013
Uranium	EPA 200.8	0.0077	mg/L	0.0050	3/12/2013
Anions	Calculation	1.10	meq/L	0.10	
Cations	Calculation	1.05	meq/L	0.10	
Error	Calculation	2.7	%	1.0	

Customer Sample ID: K-Spar Breccia 5+ Comp Wk:36
WETLAB Sample ID: 1302487-003

Collect Date/Time: 2/28/2013 09:00
Receive Date: 2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.85	pH Units		2/28/2013
Trace Metals Digestion	EPA 200.2	Complete			3/7/2013
Bicarbonate (HCO3)	SM 2320B	70	mg/L	1.0	2/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Total Alkalinity	SM 2320B	57	mg/L as CaCO3	1.0	2/28/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/2/2013
Fluoride	EPA 300.0	1.1	mg/L	0.10	3/2/2013
Sulfate	EPA 300.0	34	mg/L	1.0	3/2/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/2/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/2/2013
Total Dissolved Solids (TDS)	SM 2540C	100	mg/L	10	3/6/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	3/8/2013
Barium	EPA 200.7	0.11	mg/L	0.010	3/8/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	3/8/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	3/8/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	3/8/2013
Calcium	EPA 200.7	32	mg/L	0.50	3/8/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	3/8/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	3/8/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Magnesium	EPA 200.7	2.7	mg/L	0.50	3/8/2013
Manganese	EPA 200.7	0.051	mg/L	0.0050	3/8/2013
Molybdenum	EPA 200.7	0.049	mg/L	0.010	3/8/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Potassium	EPA 200.7	2.6	mg/L	0.50	3/8/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	3/8/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Strontium	EPA 200.7	0.62	mg/L	0.10	3/8/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	3/8/2013

Customer Sample ID:	K-Spar Breccia 5+ Comp Wk:36	**Collect Date/Time:**	2/28/2013 09:00
WETLAB Sample ID:	1302487-003	**Receive Date:**	2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Zinc	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	3/12/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	3/12/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	3/12/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	3/12/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	3/12/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	3/12/2013
Uranium	EPA 200.8	0.019	mg/L	0.0050	3/12/2013
Anions	Calculation	1.91	meq/L	0.10	
Cations	Calculation	1.89	meq/L	0.10	
Error	Calculation	<1.0	%	1.0	

Customer Sample ID:	Biotite Breccia 5+ Comp Wk:36	**Collect Date/Time:**	2/28/2013 09:00
WETLAB Sample ID:	1302487-004	**Receive Date:**	2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.90	pH Units		2/28/2013
Trace Metals Digestion	EPA 200.2	Complete			3/8/2013
Bicarbonate (HCO3)	SM 2320B	76	mg/L	1.0	2/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Total Alkalinity	SM 2320B	62	mg/L as CaCO3	1.0	2/28/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/2/2013
Fluoride	EPA 300.0	1.4	mg/L	0.10	3/2/2013
Sulfate	EPA 300.0	10	mg/L	1.0	3/2/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/2/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/2/2013
Total Dissolved Solids (TDS)	SM 2540C	90	mg/L	10	3/6/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	3/8/2013
Barium	EPA 200.7	0.073	mg/L	0.010	3/8/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	3/8/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	3/8/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	3/8/2013
Calcium	EPA 200.7	22	mg/L	0.50	3/8/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	3/8/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	3/8/2013

Customer Sample ID: Biotite Breccia 5+ Comp Wk:36 **Collect Date/Time:** 2/28/2013 09:00
WETLAB Sample ID: 1302487-004 **Receive Date:** 2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Gallium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Magnesium	EPA 200.7	3.6	mg/L	0.50	3/8/2013
Manganese	EPA 200.7	0.052	mg/L	0.0050	3/8/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Potassium	EPA 200.7	2.5	mg/L	0.50	3/8/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	3/8/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Strontium	EPA 200.7	0.26	mg/L	0.10	3/8/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	3/12/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	3/12/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	3/12/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	3/12/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	3/12/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	3/12/2013
Uranium	EPA 200.8	0.0070	mg/L	0.0050	3/12/2013
Anions	Calculation	1.53	meq/L	0.10	
Cations	Calculation	1.46	meq/L	0.10	
Error	Calculation	2.3	%	1.0	

Customer Sample ID: Quartz Monzonite 5+ Comp Wk:36 **Collect Date/Time:** 2/28/2013 09:00
WETLAB Sample ID: 1302487-005 **Receive Date:** 2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.80	pH Units		2/28/2013
Trace Metals Digestion	EPA 200.2	Complete			3/8/2013
Bicarbonate (HCO3)	SM 2320B	58	mg/L	1.0	2/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Total Alkalinity	SM 2320B	47	mg/L as CaCO3	1.0	2/28/2013

Customer Sample ID: Quartz Monzonite 5+ Comp Wk:36
WETLAB Sample ID: 1302487-005

Collect Date/Time: 2/28/2013 09:00
Receive Date: 2/28/2013 14:10

PROFILE II

Parameter	Method	Results		Units	Reporting Limit	Date Analyzed
Chloride	EPA 300.0	<1.00		mg/L	1.00	3/2/2013
Fluoride	EPA 300.0	0.87		mg/L	0.10	3/2/2013
Sulfate	EPA 300.0	11		mg/L	1.0	3/2/2013
Nitrate Nitrogen	EPA 300.0	<1.0		mg/L	1.0	3/2/2013
Nitrite Nitrogen	EPA 300.0	<0.025		mg/L	0.025	3/2/2013
Total Dissolved Solids (TDS)	SM 2540C	77	HT	mg/L	10	3/12/2013
Aluminum	EPA 200.7	<0.045		mg/L	0.045	3/8/2013
Barium	EPA 200.7	0.10		mg/L	0.010	3/8/2013
Beryllium	EPA 200.7	<0.0010		mg/L	0.0010	3/8/2013
Bismuth	EPA 200.7	<0.10		mg/L	0.10	3/8/2013
Boron	EPA 200.7	<0.100		mg/L	0.100	3/8/2013
Cadmium	EPA 200.7	<0.0010		mg/L	0.0010	3/8/2013
Calcium	EPA 200.7	17		mg/L	0.50	3/8/2013
Chromium	EPA 200.7	<0.0050		mg/L	0.0050	3/8/2013
Cobalt	EPA 200.7	<0.010		mg/L	0.010	3/8/2013
Copper	EPA 200.7	<0.050		mg/L	0.050	3/8/2013
Gallium	EPA 200.7	<0.10		mg/L	0.10	3/8/2013
Iron	EPA 200.7	<0.010		mg/L	0.010	3/8/2013
Lithium	EPA 200.7	<0.10		mg/L	0.10	3/8/2013
Magnesium	EPA 200.7	3.0		mg/L	0.50	3/8/2013
Manganese	EPA 200.7	0.023		mg/L	0.0050	3/8/2013
Molybdenum	EPA 200.7	0.052		mg/L	0.010	3/8/2013
Nickel	EPA 200.7	<0.010		mg/L	0.010	3/8/2013
Phosphorus	EPA 200.7	<0.50		mg/L	0.50	3/8/2013
Potassium	EPA 200.7	2.2		mg/L	0.50	3/8/2013
Scandium	EPA 200.7	<0.10		mg/L	0.10	3/8/2013
Silver	EPA 200.7	<0.0050		mg/L	0.0050	3/8/2013
Sodium	EPA 200.7	<0.50		mg/L	0.50	3/8/2013
Strontium	EPA 200.7	0.43		mg/L	0.10	3/8/2013
Tin	EPA 200.7	<0.10		mg/L	0.10	3/8/2013
Titanium	EPA 200.7	<0.10		mg/L	0.10	3/8/2013
Vanadium	EPA 200.7	<0.010		mg/L	0.010	3/8/2013
Zinc	EPA 200.7	<0.010		mg/L	0.010	3/8/2013
Mercury	EPA 200.8	<0.00010		mg/L	0.00010	3/12/2013
Antimony	EPA 200.8	<0.0025		mg/L	0.0025	3/12/2013
Arsenic	EPA 200.8	<0.0050		mg/L	0.0050	3/12/2013
Lead	EPA 200.8	<0.0025		mg/L	0.0025	3/12/2013
Selenium	EPA 200.8	<0.0050		mg/L	0.0050	3/12/2013

Customer Sample ID: Quartz Monzonite 5+ Comp Wk:36 **Collect Date/Time:** 2/28/2013 09:00
WETLAB Sample ID: 1302487-005 **Receive Date:** 2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	3/12/2013
Uranium	EPA 200.8	0.0092	mg/L	0.0050	3/12/2013
Anions	Calculation	1.23	meq/L	0.10	
Cations	Calculation	1.15	meq/L	0.10	
Error	Calculation	3.1	%	1.0	

Customer Sample ID: Biotite Breccia 0-5 Comp Wk:36 **Collect Date/Time:** 2/28/2013 09:00
WETLAB Sample ID: 1302487-006 **Receive Date:** 2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.85	pH Units		2/28/2013
Trace Metals Digestion	EPA 200.2	Complete			3/8/2013
Bicarbonate (HCO3)	SM 2320B	69	mg/L	1.0	2/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Total Alkalinity	SM 2320B	57	mg/L as CaCO3	1.0	2/28/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/2/2013
Fluoride	EPA 300.0	1.4	mg/L	0.10	3/2/2013
Sulfate	EPA 300.0	13	mg/L	1.0	3/2/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/2/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/2/2013
Total Dissolved Solids (TDS)	SM 2540C	90	mg/L	10	3/6/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	3/8/2013
Barium	EPA 200.7	0.097	mg/L	0.010	3/8/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	3/8/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	3/8/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	3/8/2013
Calcium	EPA 200.7	20	mg/L	0.50	3/8/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	3/8/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	3/8/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Magnesium	EPA 200.7	3.8	mg/L	0.50	3/8/2013
Manganese	EPA 200.7	0.024	mg/L	0.0050	3/8/2013
Molybdenum	EPA 200.7	0.014	mg/L	0.010	3/8/2013

Customer Sample ID: Biotite Breccia 0-5 Comp Wk:36 **Collect Date/Time:** 2/28/2013 09:00
WETLAB Sample ID: 1302487-006 **Receive Date:** 2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Nickel	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Potassium	EPA 200.7	1.7	mg/L	0.50	3/8/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	3/8/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Strontium	EPA 200.7	0.29	mg/L	0.10	3/8/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	3/12/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	3/12/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	3/12/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	3/12/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	3/12/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	3/12/2013
Uranium	EPA 200.8	0.028	mg/L	0.0050	3/12/2013
Anions	Calculation	1.48	meq/L	0.10	
Cations	Calculation	1.36	meq/L	0.10	
Error	Calculation	4.2	%	1.0	

Customer Sample ID: K-Spar Breccia 0-5 Comp Wk:36 **Collect Date/Time:** 2/28/2013 09:00
WETLAB Sample ID: 1302487-007 **Receive Date:** 2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.82	pH Units		2/28/2013
Trace Metals Digestion	EPA 200.2	Complete			3/8/2013
Bicarbonate (HCO3)	SM 2320B	56	mg/L	1.0	2/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Total Alkalinity	SM 2320B	46	mg/L as CaCO3	1.0	2/28/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/2/2013
Fluoride	EPA 300.0	1.0	mg/L	0.10	3/2/2013
Sulfate	EPA 300.0	11	mg/L	1.0	3/2/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/2/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/2/2013
Total Dissolved Solids (TDS)	SM 2540C	71	mg/L	10	3/6/2013

Customer Sample ID: K-Spar Breccia 0-5 Comp Wk:36
WETLAB Sample ID: 1302487-007

Collect Date/Time: 2/28/2013 09:00
Receive Date: 2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Aluminum	EPA 200.7	<0.045	mg/L	0.045	3/8/2013
Barium	EPA 200.7	0.12	mg/L	0.010	3/8/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	3/8/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	3/8/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	3/8/2013
Calcium	EPA 200.7	17	mg/L	0.50	3/8/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	3/8/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	3/8/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Magnesium	EPA 200.7	2.9	mg/L	0.50	3/8/2013
Manganese	EPA 200.7	0.026	mg/L	0.0050	3/8/2013
Molybdenum	EPA 200.7	0.014	mg/L	0.010	3/8/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Potassium	EPA 200.7	1.4	mg/L	0.50	3/8/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	3/8/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Strontium	EPA 200.7	0.29	mg/L	0.10	3/8/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	3/12/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	3/12/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	3/12/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	3/12/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	3/12/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	3/12/2013
Uranium	EPA 200.8	0.022	mg/L	0.0050	3/12/2013
Anions	Calculation	1.20	meq/L	0.10	
Cations	Calculation	1.12	meq/L	0.10	
Error	Calculation	3.3	%	1.0	

Customer Sample ID: Quartz Monzonite 0-5 Comp Wk:36
WETLAB Sample ID: 1302487-008

Collect Date/Time: 2/28/2013 09:00
Receive Date: 2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.49	pH Units		2/28/2013
Trace Metals Digestion	EPA 200.2	Complete			3/8/2013
Bicarbonate (HCO3)	SM 2320B	16	mg/L	1.0	2/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	2/28/2013
Total Alkalinity	SM 2320B	13	mg/L as CaCO3	1.0	2/28/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/2/2013
Fluoride	EPA 300.0	<0.10	mg/L	0.10	3/2/2013
Sulfate	EPA 300.0	<1.0	mg/L	1.0	3/2/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/2/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/2/2013
Total Dissolved Solids (TDS)	SM 2540C	26	mg/L	10	3/6/2013
Aluminum	EPA 200.7	0.051	mg/L	0.045	3/8/2013
Barium	EPA 200.7	0.016	mg/L	0.010	3/8/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	3/8/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	3/8/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	3/8/2013
Calcium	EPA 200.7	4.7	mg/L	0.50	3/8/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	3/8/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	3/8/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Iron	EPA 200.7	0.011	mg/L	0.010	3/8/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Magnesium	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Manganese	EPA 200.7	<0.0050	mg/L	0.0050	3/8/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Potassium	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	3/8/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	3/8/2013
Strontium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	3/8/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	3/8/2013

Customer Sample ID:	Quartz Monzonite 0-5 Comp Wk:36	**Collect Date/Time:**	2/28/2013 09:00
WETLAB Sample ID:	1302487-008	**Receive Date:**	2/28/2013 14:10

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Zinc	EPA 200.7	<0.010	mg/L	0.010	3/8/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	3/12/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	3/12/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	3/12/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	3/12/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	3/12/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	3/12/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	3/12/2013
Anions	Calculation	0.26	meq/L	0.10	
Cations	Calculation	0.24	meq/L	0.10	
Error	Calculation	4.3	%	1.0	

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13030045	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC13030045	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC13030045	Blank 3	Fluoride	EPA 300.0	<0.10	mg/L
QC13030049	Blank 1	Chloride	EPA 300.0	<1.0	mg/L
QC13030049	Blank 2	Chloride	EPA 300.0	<1.0	mg/L
QC13030049	Blank 3	Chloride	EPA 300.0	<1.0	mg/L
QC13030057	Blank 1	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13030057	Blank 2	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13030057	Blank 3	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13030061	Blank 1	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13030061	Blank 2	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13030061	Blank 3	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13030065	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC13030065	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC13030065	Blank 3	Sulfate	EPA 300.0	<1.0	mg/L
QC13030280	Blank 1	Mercury	EPA 200.8	<0.00010	mg/L
		Antimony	EPA 200.8	<0.0025	mg/L
		Arsenic	EPA 200.8	<0.0050	mg/L
		Lead	EPA 200.8	<0.0025	mg/L
		Selenium	EPA 200.8	<0.0050	mg/L
		Thallium	EPA 200.8	<0.0010	mg/L
		Uranium	EPA 200.8	<0.0050	mg/L
QC13030290	Blank 1	Aluminum	EPA 200.7	<0.045	mg/L
		Barium	EPA 200.7	<0.010	mg/L
		Beryllium	EPA 200.7	<0.0010	mg/L
		Bismuth	EPA 200.7	<0.10	mg/L
		Boron	EPA 200.7	<0.100	mg/L
		Cadmium	EPA 200.7	<0.0010	mg/L
		Calcium	EPA 200.7	<0.50	mg/L
		Chromium	EPA 200.7	<0.0050	mg/L
		Cobalt	EPA 200.7	<0.010	mg/L
		Copper	EPA 200.7	<0.050	mg/L
		Gallium	EPA 200.7	<0.10	mg/L
		Iron	EPA 200.7	<0.010	mg/L
		Lithium	EPA 200.7	<0.10	mg/L
		Magnesium	EPA 200.7	<0.50	mg/L
		Manganese	EPA 200.7	<0.0050	mg/L
		Molybdenum	EPA 200.7	<0.010	mg/L
		Nickel	EPA 200.7	<0.010	mg/L
		Phosphorus	EPA 200.7	<0.50	mg/L
		Potassium	EPA 200.7	<0.50	mg/L
		Scandium	EPA 200.7	<0.10	mg/L
		Silver	EPA 200.7	<0.0050	mg/L
		Sodium	EPA 200.7	<0.50	mg/L
		Strontium	EPA 200.7	<0.10	mg/L
		Tin	EPA 200.7	<0.10	mg/L
		Titanium	EPA 200.7	<0.10	mg/L

QCBatchID	QCType	Parameter	Method	Result	Units
		Vanadium	EPA 200.7	<0.010	mg/L
		Zinc	EPA 200.7	<0.010	mg/L
QC13030293	Blank 1	Aluminum, Dissolved	EPA 200.7	<0.045	mg/L
		Barium, Dissolved	EPA 200.7	<0.010	mg/L
		Beryllium, Dissolved	EPA 200.7	<0.0010	mg/L
		Bismuth, Dissolved	EPA 200.7	<0.10	mg/L
		Boron, Dissolved	EPA 200.7	<0.10	mg/L
		Cadmium, Dissolved	EPA 200.7	<0.0010	mg/L
		Calcium, Dissolved	EPA 200.7	<0.50	mg/L
		Chromium, Dissolved	EPA 200.7	<0.0050	mg/L
		Cobalt, Dissolved	EPA 200.7	<0.010	mg/L
		Copper, Dissolved	EPA 200.7	<0.050	mg/L
		Gallium, Dissolved	EPA 200.7	<0.10	mg/L
		Iron, Dissolved	EPA 200.7	<0.010	mg/L
		Lithium, Dissolved	EPA 200.7	<0.10	mg/L
		Magnesium, Dissolved	EPA 200.7	<0.50	mg/L
		Manganese, Dissolved	EPA 200.7	<0.0050	mg/L
		Molybdenum, Dissolved	EPA 200.7	<0.010	mg/L
		Nickel, Dissolved	EPA 200.7	<0.010	mg/L
		Phosphorus, Dissolved	EPA 200.7	<0.50	mg/L
		Potassium, Dissolved	EPA 200.7	<0.50	mg/L
		Scandium, Dissolved	EPA 200.7	<0.10	mg/L
		Silver, Dissolved	EPA 200.7	<0.0050	mg/L
		Sodium, Dissolved	EPA 200.7	<0.50	mg/L
		Strontium, Dissolved	EPA 200.7	<0.10	mg/L
		Tin, Dissolved	EPA 200.7	<0.10	mg/L
		Titanium, Dissolved	EPA 200.7	<0.10	mg/L
		Vanadium, Dissolved	EPA 200.7	<0.010	mg/L
		Zinc, Dissolved	EPA 200.7	<0.010	mg/L
QC13030347	Blank 1	Uranium, Dissolved	EPA 200.8	<0.0050	mg/L
		Mercury, Dissolved	EPA 200.8	<0.00010	mg/L
		Antimony, Dissolved	EPA 200.8	<0.0025	mg/L
		Arsenic, Dissolved	EPA 200.8	<0.0050	mg/L
		Lead, Dissolved	EPA 200.8	<0.0025	mg/L
		Selenium, Dissolved	EPA 200.8	<0.0050	mg/L
		Thallium, Dissolved	EPA 200.8	<0.0010	mg/L
QC13030478	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13030478	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13030478	Blank 3	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13030010	LCS 1	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13030010	LCS 2	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13030010	LCS 3	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13030045	LCS 1	Fluoride	EPA 300.0	1.81	2.00	90	mg/L
QC13030049	LCS 1	Chloride	EPA 300.0	10.2	10.0	102	mg/L
QC13030057	LCS 1	Nitrite Nitrogen	EPA 300.0	0.507	0.500	101	mg/L
QC13030061	LCS 1	Nitrate Nitrogen	EPA 300.0	2.02	2.00	101	mg/L
QC13030065	LCS 1	Sulfate	EPA 300.0	24.0	25.0	96	mg/L
QC13030280	LCS 1	Mercury	EPA 200.8	0.000911	0.001	91	mg/L
		Antimony	EPA 200.8	0.0100	0.010	100	mg/L
		Arsenic	EPA 200.8	0.0519	0.050	104	mg/L
		Lead	EPA 200.8	0.0098	0.010	98	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
		Selenium	EPA 200.8	0.0503	0.050	101	mg/L
		Thallium	EPA 200.8	0.0098	0.010	98	mg/L
		Uranium	EPA 200.8	0.0098	0.010	98	mg/L
QC13030290	LCS 1	Aluminum	EPA 200.7	1.01	1.00	101	mg/L
		Barium	EPA 200.7	1.01	1.00	101	mg/L
		Beryllium	EPA 200.7	1.00	1.00	100	mg/L
		Bismuth	EPA 200.7	1.04	1.00	104	mg/L
		Boron	EPA 200.7	1.01	1.00	101	mg/L
		Cadmium	EPA 200.7	1.02	1.00	102	mg/L
		Calcium	EPA 200.7	10.1	10.0	101	mg/L
		Chromium	EPA 200.7	1.00	1.00	100	mg/L
		Cobalt	EPA 200.7	1.01	1.00	101	mg/L
		Copper	EPA 200.7	4.98	5.00	100	mg/L
		Gallium	EPA 200.7	1.01	1.00	101	mg/L
		Iron	EPA 200.7	0.997	1.00	100	mg/L
		Lithium	EPA 200.7	0.994	1.00	99	mg/L
		Magnesium	EPA 200.7	10.0	10.0	100	mg/L
		Manganese	EPA 200.7	0.998	1.00	100	mg/L
		Molybdenum	EPA 200.7	1.00	1.00	100	mg/L
		Nickel	EPA 200.7	5.09	5.00	102	mg/L
		Phosphorus	EPA 200.7	5.18	5.00	104	mg/L
		Potassium	EPA 200.7	10.2	10.0	102	mg/L
		Scandium	EPA 200.7	1.01	1.00	101	mg/L
		Silver	EPA 200.7	0.092	0.090	102	mg/L
		Sodium	EPA 200.7	9.86	10.0	99	mg/L
		Strontium	EPA 200.7	1.00	1.00	100	mg/L
		Tin	EPA 200.7	0.992	1.00	99	mg/L
		Titanium	EPA 200.7	1.00	1.00	100	mg/L
		Vanadium	EPA 200.7	1.01	1.00	101	mg/L
		Zinc	EPA 200.7	1.03	1.00	103	mg/L
QC13030293	LCS 1	Aluminum, Dissolved	EPA 200.7	0.991	1.00	99	mg/L
		Barium, Dissolved	EPA 200.7	0.980	1.00	98	mg/L
		Beryllium, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Bismuth, Dissolved	EPA 200.7	1.02	1.00	102	mg/L
		Boron, Dissolved	EPA 200.7	0.986	1.00	99	mg/L
		Cadmium, Dissolved	EPA 200.7	0.989	1.00	99	mg/L
		Calcium, Dissolved	EPA 200.7	9.88	10.0	99	mg/L
		Chromium, Dissolved	EPA 200.7	0.979	1.00	98	mg/L
		Cobalt, Dissolved	EPA 200.7	0.988	1.00	99	mg/L
		Copper, Dissolved	EPA 200.7	4.99	5.00	100	mg/L
		Gallium, Dissolved	EPA 200.7	0.992	1.00	99	mg/L
		Iron, Dissolved	EPA 200.7	0.956	1.00	96	mg/L
		Lithium, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Magnesium, Dissolved	EPA 200.7	9.51	10.0	95	mg/L
		Manganese, Dissolved	EPA 200.7	0.995	1.00	100	mg/L
		Molybdenum, Dissolved	EPA 200.7	0.951	1.00	95	mg/L
		Nickel, Dissolved	EPA 200.7	4.88	5.00	98	mg/L
		Phosphorus, Dissolved	EPA 200.7	4.87	5.00	97	mg/L
		Potassium, Dissolved	EPA 200.7	10.1	10.0	101	mg/L
		Scandium, Dissolved	EPA 200.7	0.986	1.00	99	mg/L
		Silver, Dissolved	EPA 200.7	0.090	0.090	99	mg/L
		Sodium, Dissolved	EPA 200.7	10.0	10.0	100	mg/L
		Strontium, Dissolved	EPA 200.7	1.01	1.00	101	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
		Tin, Dissolved	EPA 200.7	0.962	1.00	96	mg/L
		Titanium, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Vanadium, Dissolved	EPA 200.7	0.977	1.00	98	mg/L
		Zinc, Dissolved	EPA 200.7	0.979	1.00	98	mg/L
QC13030347	LCS 1	Uranium, Dissolved	EPA 200.8	0.0099	0.010	99	mg/L
		Mercury, Dissolved	EPA 200.8	0.000896	0.001	90	mg/L
		Antimony, Dissolved	EPA 200.8	0.0097	0.010	97	mg/L
		Arsenic, Dissolved	EPA 200.8	0.0510	0.050	102	mg/L
		Lead, Dissolved	EPA 200.8	0.0099	0.010	99	mg/L
		Selenium, Dissolved	EPA 200.8	0.0487	0.050	98	mg/L
		Thallium, Dissolved	EPA 200.8	0.0100	0.010	100	mg/L
QC13030408	LCS 1	Total Alkalinity	SM 2320B	98.9	100	99	mg/L
QC13030408	LCS 2	Total Alkalinity	SM 2320B	99.0	100	99	mg/L
QC13030478	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	144	150	96	mg/L
QC13030478	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	156	150	104	mg/L
QC13030478	LCS 3	Total Dissolved Solids (TDS)	SM 2540C	143	150	95	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC13030010	Duplicate	pH	SM 4500-H+ B	1302474-001	7.78	7.77	pH Units	<1%
QC13030010	Duplicate	pH	SM 4500-H+ B	1302484-001	10.2	10.2	pH Units	<1%
QC13030010	Duplicate	pH	SM 4500-H+ B	1302488-002	8.11	8.12	pH Units	<1%
QC13030010	Duplicate	pH	SM 4500-H+ B	1302484-002	10.1	10.1	pH Units	<1%
QC13030010	Duplicate	pH	SM 4500-H+ B	1302484-003	10.2	10.2	pH Units	<1%
QC13030010	Duplicate	pH	SM 4500-H+ B	1302497-003	7.79	7.84	pH Units	1 %
QC13030010	Duplicate	pH	SM 4500-H+ B	1302493-004	7.56	7.59	pH Units	<1%
QC13030408	Duplicate	Bicarbonate (HCO3)	SM 2320B	1302474-001	173	173	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1302474-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1302474-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1302474-001	142	142	mg/L as CaCO3	<1%
QC13030408	Duplicate	Bicarbonate (HCO3)	SM 2320B	1302484-001	67.3	65.3	mg/L	3 %
		Carbonate (CO3)	SM 2320B	1302484-001	218	220	mg/L	1 %
		Hydroxide (OH)	SM 2320B	1302484-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1302484-001	418	419	mg/L as CaCO3	<1%
QC13030408	Duplicate	Bicarbonate (HCO3)	SM 2320B	1302484-002	13.2	13.7	mg/L	4 %
		Carbonate (CO3)	SM 2320B	1302484-002	90.1	89.6	mg/L	1 %
		Hydroxide (OH)	SM 2320B	1302484-002	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1302484-002	160	160 Q	mg/L as CaCO3	<1%
QC13030408	Duplicate	Bicarbonate (HCO3)	SM 2320B	1302497-003	127	126	mg/L	1 %
		Carbonate (CO3)	SM 2320B	1302497-003	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1302497-003	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1302497-003	104	103	mg/L as CaCO3	1 %
QC13030478	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303097-001	575	582	mg/L	1 %
QC13030478	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303098-003	98.0	93.0	mg/L	5 %
QC13030478	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303134-002	604	604	mg/L	<1%
QC13030478	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303168-003	1410	1448	mg/L	3 %

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC13030478	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303185-003	1082	1086	mg/L	<1%

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13030045	MS 1	Fluoride	EPA 300.0	1302485-022	0.706	2.54	2.55	2.00	mg/L	92	92	<1%
QC13030045	MS 2	Fluoride	EPA 300.0	1302487-008	<0.100	1.92	1.95	2.00	mg/L	93	94	2 %
QC13030049	MS 1	Chloride	EPA 300.0	1302485-022	2.83	8.19	8.24	5.00	mg/L	107	108	1 %
QC13030049	MS 2	Chloride	EPA 300.0	1302487-008	<1.000	5.29	5.37	5.00	mg/L	106	108	2 %
QC13030057	MS 1	Nitrite Nitrogen	EPA 300.0	1302485-022	0.074	0.606	0.612	0.500	mg/L	106	108	1 %
QC13030057	MS 2	Nitrite Nitrogen	EPA 300.0	1302487-008	<0.025	0.531	0.538	0.500	mg/L	105	106	1 %
QC13030061	MS 1	Nitrate Nitrogen	EPA 300.0	1302485-022	<1.000	2.27	2.30	2.00	mg/L	108	109	1 %
QC13030061	MS 2	Nitrate Nitrogen	EPA 300.0	1302487-008	<1.000	2.21	2.24	2.00	mg/L	108	110	1 %
QC13030065	MS 1	Sulfate	EPA 300.0	1302485-022	12.0	22.1	22.2	10.0	mg/L	101	102	<1%
QC13030065	MS 2	Sulfate	EPA 300.0	1302487-008	<1.000	10.8	10.9	10.0	mg/L	102	103	1 %
QC13030280	MS 1	Mercury	EPA 200.8	1302438-002	<0.00010	0.000901	0.000904	0.001	mg/L	90	90	<1%
		Antimony	EPA 200.8	1302438-002	<0.0025	0.0099	0.0099	0.010	mg/L	99	99	<1%
		Arsenic	EPA 200.8	1302438-002	<0.0050	0.0501	0.0495	0.050	mg/L	100	99	1 %
		Lead	EPA 200.8	1302438-002	<0.0025	0.0098	0.0099	0.010	mg/L	98	99	1 %
		Selenium	EPA 200.8	1302438-002	<0.0050	0.0464	0.0462	0.050	mg/L	93	92	<1%
		Thallium	EPA 200.8	1302438-002	<0.0010	0.0097	0.0097	0.010	mg/L	97	98	<1%
		Uranium	EPA 200.8	1302438-002	<0.0050	0.0097	0.0098	0.010	mg/L	97	98	1 %
QC13030290	MS 1	Aluminum	EPA 200.7	1302438-002	<0.045	1.01	1.01	1.00	mg/L	101	101	<1%
		Barium	EPA 200.7	1302438-002	<0.010	1.02	1.01	1.00	mg/L	102	101	1 %
		Beryllium	EPA 200.7	1302438-002	<0.001	1.01	1.00	1.00	mg/L	101	100	1 %
		Bismuth	EPA 200.7	1302438-002	<0.100	1.04	1.04	1.00	mg/L	103	103	<1%
		Boron	EPA 200.7	1302438-002	<0.100	1.02	1.02	1.00	mg/L	102	102	<1%
		Cadmium	EPA 200.7	1302438-002	<0.001	1.02	1.02	1.00	mg/L	102	102	<1%
		Calcium	EPA 200.7	1302438-002	<0.500	10.2	10.1	10.0	mg/L	101	100	1 %
		Chromium	EPA 200.7	1302438-002	<0.005	1.01	1.01	1.00	mg/L	101	101	<1%
		Cobalt	EPA 200.7	1302438-002	<0.010	1.01	1.01	1.00	mg/L	101	101	<1%
		Copper	EPA 200.7	1302438-002	<0.050	4.96	4.97	5.00	mg/L	99	99	<1%
		Gallium	EPA 200.7	1302438-002	<0.100	1.01	1.01	1.00	mg/L	101	101	<1%
		Iron	EPA 200.7	1302438-002	<0.010	0.992	0.984	1.00	mg/L	99	98	1 %
		Lithium	EPA 200.7	1302438-002	<0.100	0.996	1.00	1.00	mg/L	100	100	<1%
		Magnesium	EPA 200.7	1302438-002	<0.500	9.84	9.82	10.0	mg/L	98	98	<1%
		Manganese	EPA 200.7	1302438-002	<0.005	1.01	1.01	1.00	mg/L	101	101	<1%
		Molybdenum	EPA 200.7	1302438-002	<0.010	0.988	0.987	1.00	mg/L	99	99	<1%
		Nickel	EPA 200.7	1302438-002	<0.010	5.07	5.07	5.00	mg/L	101	101	<1%
		Phosphorus	EPA 200.7	1302438-002	<0.500	5.10	5.08	5.00	mg/L	101	100	<1%
		Potassium	EPA 200.7	1302438-002	<0.500	10.2	10.2	10.0	mg/L	102	102	<1%
		Scandium	EPA 200.7	1302438-002	<0.100	1.00	0.996	1.00	mg/L	100	100	<1%
		Silver	EPA 200.7	1302438-002	<0.005	0.091	0.092	0.090	mg/L	101	102	1 %
		Sodium	EPA 200.7	1302438-002	<0.500	10.5	10.5	10.0	mg/L	102	102	<1%
		Strontium	EPA 200.7	1302438-002	<0.100	1.01	1.01	1.00	mg/L	101	101	<1%
		Tin	EPA 200.7	1302438-002	<0.100	0.988	0.986	1.00	mg/L	99	98	<1%
		Titanium	EPA 200.7	1302438-002	<0.100	1.00	1.00	1.00	mg/L	100	100	<1%
		Vanadium	EPA 200.7	1302438-002	<0.010	1.01	1.01	1.00	mg/L	101	101	<1%
		Zinc	EPA 200.7	1302438-002	<0.010	1.02	1.02	1.00	mg/L	102	102	<1%
QC13030293	MS 1	Aluminum, Dissolved	EPA 200.7	1303119-002	<0.045	1.04	1.03	1.00	mg/L	103	102	1 %
		Barium, Dissolved	EPA 200.7	1303119-002	0.092	1.06	1.07	1.00	mg/L	97	98	1 %
		Beryllium, Dissolved	EPA 200.7	1303119-002	<0.001	0.993	1.01	1.00	mg/L	99	101	2 %
		Bismuth, Dissolved	EPA 200.7	1303119-002	<0.100	0.978	0.977	1.00	mg/L	99	99	<1%

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Boron, Dissolved	EPA 200.7	1303119-002	0.344	1.38	1.40	1.00	mg/L	104	106	1 %
		Cadmium, Dissolved	EPA 200.7	1303119-002	<0.001	0.965	0.985	1.00	mg/L	97	99	2 %
		Calcium, Dissolved	EPA 200.7	1303119-002	62.0	72.2	73.4	10.0	mg/L	102	114	2 %
		Chromium, Dissolved	EPA 200.7	1303119-002	<0.005	0.975	0.987	1.00	mg/L	97	99	1 %
		Cobalt, Dissolved	EPA 200.7	1303119-002	<0.010	0.926	0.940	1.00	mg/L	92	94	2 %
		Copper, Dissolved	EPA 200.7	1303119-002	<0.050	4.85	4.86	5.00	mg/L	97	97	<1%
		Gallium, Dissolved	EPA 200.7	1303119-002	<0.100	1.01	1.00	1.00	mg/L	101	100	1 %
		Iron, Dissolved	EPA 200.7	1303119-002	<0.010	0.943	0.953	1.00	mg/L	94	95	1 %
		Lithium, Dissolved	EPA 200.7	1303119-002	0.138	1.09	1.08	1.00	mg/L	95	94	1 %
		Magnesium, Dissolved	EPA 200.7	1303119-002	21.9	29.9	30.7	10.0	mg/L	80	88	3 %
		Manganese, Dissolved	EPA 200.7	1303119-002	<0.005	0.978	0.992	1.00	mg/L	99	100	1 %
		Molybdenum, Dissolved	EPA 200.7	1303119-002	<0.010	0.969	0.971	1.00	mg/L	97	97	<1%
		Nickel, Dissolved	EPA 200.7	1303119-002	<0.010	4.58	4.64	5.00	mg/L	92	93	1 %
		Phosphorus, Dissolved	EPA 200.7	1303119-002	<0.500	5.09	5.16	5.00	mg/L	100	102	1 %
		Potassium, Dissolved	EPA 200.7	1303119-002	10.8	20.6	20.5	10.0	mg/L	98	97	<1%
		Scandium, Dissolved	EPA 200.7	1303119-002	<0.100	0.974	0.975	1.00	mg/L	97	97	<1%
		Silver, Dissolved	EPA 200.7	1303119-002	<0.005	0.090	0.090	0.090	mg/L	101	100	<1%
		Sodium, Dissolved	EPA 200.7	1303119-002	35.8	46.1	44.3	10.0	mg/L	103	85	4 %
		Strontium, Dissolved	EPA 200.7	1303119-002	0.386	1.39	1.33	1.00	mg/L	100	94	4 %
		Tin, Dissolved	EPA 200.7	1303119-002	<0.100	0.949	0.967	1.00	mg/L	98	100	2 %
		Titanium, Dissolved	EPA 200.7	1303119-002	<0.100	1.00	1.00	1.00	mg/L	100	100	<1%
		Vanadium, Dissolved	EPA 200.7	1303119-002	0.017	1.01	1.02	1.00	mg/L	99	100	1 %
		Zinc, Dissolved	EPA 200.7	1303119-002	0.015	0.950	0.967	1.00	mg/L	94	95	2 %
QC13030347	MS 1	Uranium, Dissolved	EPA 200.8	1303119-002	<0.0050	0.0100	0.0100	0.010	mg/L	99	99	<1%
		Mercury, Dissolved	EPA 200.8	1303119-002	<0.00010	0.000878	0.000874	0.001	mg/L	84	84	<1%
		Antimony, Dissolved	EPA 200.8	1303119-002	0.0051	0.0148	0.0149	0.010	mg/L	97	99	1 %
		Arsenic, Dissolved	EPA 200.8	1303119-002	0.0071	0.0575	0.0572	0.050	mg/L	101	100	1 %
		Lead, Dissolved	EPA 200.8	1303119-002	<0.0025	0.0093	0.0093	0.010	mg/L	93	93	<1%
		Selenium, Dissolved	EPA 200.8	1303119-002	<0.0050	0.0448	0.0456	0.050	mg/L	90	91	2 %
		Thallium, Dissolved	EPA 200.8	1303119-002	<0.0010	0.0096	0.0096	0.010	mg/L	95	94	<1%

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #119 | Sparks, Nevada 89431
tel [775] 355-0202 | fax [775] 355-0817 | www.WETLaboratory.com

Lab Number 1302487
Report Due Date: 3/14/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ______ 5-Day ______ Other

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

Analyses Requested

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
CF-11-02 (227-367)	Wk:36	02/28/13	9:00	WW	2	X	X									1
CF-11-02 (52-117)	↓	↓	↓	↓	↓	↓	↓									2
K-Spar Breccia 5+ Comp	↓	↓	↓	↓	↓	↓	↓									3
Biotite Breccia 5+ Comp	↓	↓	↓	↓	↓	↓	↓									4
Quartz Monzonite 5+ Comp	↓	↓	↓	↓	↓	↓	↓									5
Biotite Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓									6
K-Spar Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓									7
Quartz Monzonite 0-5 Comp	↓	↓	↓	↓	↓	↓	↓									8

1302487 1-8

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 20.9 °C	2/28/13	1410		
Custody Seals Intact? Y N None				
Number of Containers 16				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

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Lab Number 1302487
Report Due Date: 3/14/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ____ 5-Day ____ Other ____

Billing Address (if different than Client Address):
Company ____
Address ____
City, State & Zip ____
Contact ____
Phone ____
Fax ____
Email ____

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ____

Analyses Requested

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium	Spl. No.
CF-11-02 (227-367)	Wk:36	02/28/13	9:00	WW	2	X	X	1
CF-11-02 (52-117)	↓	↓	↓	↓	↓	↓	↓	2
K-Spar Breccia 5+ Comp	↓	↓	↓	↓	↓	↓	↓	3
Biotite Breccia 5+ Comp	↓	↓	↓	↓	↓	↓	↓	4
Quartz Monzonite 5+ Comp	↓	↓	↓	↓	↓	↓	↓	5
Biotite Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓	6
K-Spar Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓	7
Quartz Monzonite 0-5 Comp	↓	↓	↓	↓	↓	↓	↓	8

1302 487 8

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 20.9 °C	2/28/13	1410		
Custody Seals Intact? Y N None				
Number of Containers 16				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

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TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

3/27/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1303281*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 3/14/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

ASmith

Andy Smith
QA Manager

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1303281

General Comments

None

Specific Comments

None

Data Qualifier Legend

B -- Blank contamination; Analyte detected above the method reporting limit in an associated blank
D -- Reporting limit is elevated due to required sample dilution
HT -- Sample analyzed beyond the accepted holding time
J -- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M -- Reported value is estimated; The sample matrix interfered with the analysis
N -- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC -- Not calculated due to matrix interference
Q -- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
S -- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.
SC -- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438 Wk:44*

Date Printed: 3/27/2013
OrderID: *1303281*

Customer Sample ID: CF-11-02 (0-27) Wk: 44
WETLAB Sample ID: 1303281-001

Collect Date/Time: 3/14/2013 09:00
Receive Date: 3/14/2013 14:50

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.65	pH Units		3/14/2013
Trace Metals Digestion	EPA 200.2	Complete			3/20/2013
Bicarbonate (HCO3)	SM 2320B	49	mg/L	1.0	3/14/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	3/14/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	3/14/2013
Total Alkalinity	SM 2320B	40	mg/L as CaCO3	1.0	3/14/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/15/2013
Fluoride	EPA 300.0	0.91	mg/L	0.10	3/15/2013
Sulfate	EPA 300.0	15	mg/L	1.0	3/15/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/15/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/15/2013
Total Dissolved Solids (TDS)	SM 2540C	82	mg/L	10	3/19/2013
Aluminum	EPA 200.7	0.052	mg/L	0.045	3/21/2013
Barium	EPA 200.7	<0.010	mg/L	0.010	3/21/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	3/21/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	3/21/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	3/21/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	3/21/2013
Calcium	EPA 200.7	17	mg/L	0.50	3/21/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	3/21/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	3/21/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	3/21/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	3/21/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	3/21/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	3/21/2013
Magnesium	EPA 200.7	2.6	mg/L	0.50	3/21/2013
Manganese	EPA 200.7	0.041	mg/L	0.0050	3/21/2013

Customer Sample ID: CF-11-02 (0-27) Wk: 44
WETLAB Sample ID: 1303281-001

Collect Date/Time: 3/14/2013 09:00
Receive Date: 3/14/2013 14:50

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	3/21/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	3/21/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	3/21/2013
Potassium	EPA 200.7	1.3	mg/L	0.50	3/21/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	3/21/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	3/21/2013
Sodium	EPA 200.7	0.55	mg/L	0.50	3/21/2013
Strontium	EPA 200.7	0.12	mg/L	0.10	3/22/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	3/21/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	3/21/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	3/21/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	3/21/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	3/25/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	3/25/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	3/25/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	3/25/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	3/25/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	3/25/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	3/25/2013
Anions	Calculation	1.16	meq/L	0.10	
Cations	Calculation	1.13	meq/L	0.10	
Error	Calculation	1.6	%	1.0	

Customer Sample ID: CF-11-02 (367-408) Wk: 44
WETLAB Sample ID: 1303281-002

Collect Date/Time: 3/14/2013 09:00
Receive Date: 3/14/2013 14:50

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.52	pH Units		3/14/2013
Trace Metals Digestion	EPA 200.2	Complete			3/20/2013
Bicarbonate (HCO3)	SM 2320B	31	mg/L	1.0	3/14/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	3/14/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	3/14/2013
Total Alkalinity	SM 2320B	25	mg/L as CaCO3	1.0	3/14/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/15/2013
Fluoride	EPA 300.0	0.89	mg/L	0.10	3/15/2013
Sulfate	EPA 300.0	6.8	mg/L	1.0	3/15/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/15/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/15/2013

Customer Sample ID: CF-11-02 (367-408) Wk: 44
WETLAB Sample ID: 1303281-002

Collect Date/Time: 3/14/2013 09:00
Receive Date: 3/14/2013 14:50

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Total Dissolved Solids (TDS)	SM 2540C	54	mg/L	10	3/19/2013
Aluminum	EPA 200.7	0.15	mg/L	0.045	3/21/2013
Barium	EPA 200.7	<0.010	mg/L	0.010	3/21/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	3/21/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	3/21/2013
Boron	EPA 200.7	<0.100	mg/L	0.100	3/21/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	3/21/2013
Calcium	EPA 200.7	12	mg/L	0.50	3/21/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	3/21/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	3/21/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	3/21/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	3/21/2013
Iron	EPA 200.7	0.015	mg/L	0.010	3/21/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	3/21/2013
Magnesium	EPA 200.7	<0.50	mg/L	0.50	3/21/2013
Manganese	EPA 200.7	0.029	mg/L	0.0050	3/21/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	3/21/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	3/21/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	3/21/2013
Potassium	EPA 200.7	0.85	mg/L	0.50	3/21/2013
Scandium	EPA 200.7	<0.10	mg/L	0.10	3/21/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	3/21/2013
Sodium	EPA 200.7	<0.50	mg/L	0.50	3/21/2013
Strontium	EPA 200.7	<0.10	mg/L	0.10	3/22/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	3/21/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	3/21/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	3/21/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	3/21/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	3/25/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	3/25/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	3/25/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	3/25/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	3/25/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	3/25/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	3/25/2013
Anions	Calculation	0.70	meq/L	0.10	
Cations	Calculation	0.64	meq/L	0.10	
Error	Calculation	4.3	%	1.0	

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13030551	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC13030551	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC13030551	Blank 3	Fluoride	EPA 300.0	<0.10	mg/L
QC13030554	Blank 1	Chloride	EPA 300.0	<1.0	mg/L
QC13030554	Blank 2	Chloride	EPA 300.0	<1.0	mg/L
QC13030554	Blank 3	Chloride	EPA 300.0	<1.0	mg/L
QC13030556	Blank 1	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13030556	Blank 2	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13030556	Blank 3	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13030557	Blank 1	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13030557	Blank 2	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13030557	Blank 3	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13030559	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC13030559	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC13030559	Blank 3	Sulfate	EPA 300.0	<1.0	mg/L
QC13030683	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13030683	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13030745	Blank 1	Aluminum	EPA 200.7	<0.045	mg/L
		Barium	EPA 200.7	<0.010	mg/L
		Beryllium	EPA 200.7	<0.0010	mg/L
		Bismuth	EPA 200.7	<0.10	mg/L
		Boron	EPA 200.7	<0.10	mg/L
		Cadmium	EPA 200.7	<0.0010	mg/L
		Calcium	EPA 200.7	<0.50	mg/L
		Chromium	EPA 200.7	<0.0050	mg/L
		Cobalt	EPA 200.7	<0.010	mg/L
		Copper	EPA 200.7	<0.050	mg/L
		Gallium	EPA 200.7	<0.10	mg/L
		Iron	EPA 200.7	<0.010	mg/L
		Lithium	EPA 200.7	<0.10	mg/L
		Magnesium	EPA 200.7	<0.50	mg/L
		Manganese	EPA 200.7	<0.0050	mg/L
		Molybdenum	EPA 200.7	<0.010	mg/L
		Nickel	EPA 200.7	<0.010	mg/L
		Phosphorus	EPA 200.7	<0.50	mg/L
		Potassium	EPA 200.7	<0.50	mg/L
		Scandium	EPA 200.7	<0.10	mg/L
		Silver	EPA 200.7	<0.0050	mg/L
		Sodium	EPA 200.7	<0.50	mg/L
		Strontium	EPA 200.7	<0.10	mg/L
		Tin	EPA 200.7	<0.10	mg/L
		Titanium	EPA 200.7	<0.10	mg/L
		Vanadium	EPA 200.7	<0.010	mg/L
		Zinc	EPA 200.7	<0.010	mg/L
QC13030763	Blank 1	Mercury	EPA 200.8	<0.00010	mg/L
		Antimony	EPA 200.8	<0.0025	mg/L
		Arsenic	EPA 200.8	<0.0050	mg/L

QCBatchID	QCType	Parameter	Method	Result	Units
		Lead	EPA 200.8	<0.0025	mg/L
		Selenium	EPA 200.8	<0.0050	mg/L
		Thallium	EPA 200.8	<0.0010	mg/L
		Uranium	EPA 200.8	<0.0050	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13030488	LCS 1	pH	SM 4500-H+ B	6.99	7.00	100	pH Units
QC13030490	LCS 1	Total Alkalinity	SM 2320B	98.8	100	99	mg/L
QC13030490	LCS 2	Total Alkalinity	SM 2320B	98.7	100	99	mg/L
QC13030490	LCS 3	Total Alkalinity	SM 2320B	99.2	100	99	mg/L
QC13030551	LCS 1	Fluoride	EPA 300.0	1.90	2.00	95	mg/L
QC13030554	LCS 1	Chloride	EPA 300.0	10.3	10.0	103	mg/L
QC13030556	LCS 1	Nitrite Nitrogen	EPA 300.0	0.494	0.500	99	mg/L
QC13030557	LCS 1	Nitrate Nitrogen	EPA 300.0	2.03	2.00	102	mg/L
QC13030559	LCS 1	Sulfate	EPA 300.0	24.7	25.0	99	mg/L
QC13030683	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	152	150	101	mg/L
QC13030683	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	152	150	101	mg/L
QC13030745	LCS 1	Aluminum	EPA 200.7	0.971	1.00	97	mg/L
		Barium	EPA 200.7	0.940	1.00	94	mg/L
		Beryllium	EPA 200.7	0.953	1.00	95	mg/L
		Bismuth	EPA 200.7	1.02	1.00	102	mg/L
		Boron	EPA 200.7	1.02	1.00	102	mg/L
		Cadmium	EPA 200.7	0.952	1.00	95	mg/L
		Calcium	EPA 200.7	9.57	10.0	96	mg/L
		Chromium	EPA 200.7	0.999	1.00	100	mg/L
		Cobalt	EPA 200.7	1.01	1.00	101	mg/L
		Copper	EPA 200.7	4.86	5.00	97	mg/L
		Gallium	EPA 200.7	1.01	1.00	101	mg/L
		Iron	EPA 200.7	0.923	1.00	92	mg/L
		Lithium	EPA 200.7	1.03	1.00	103	mg/L
		Magnesium	EPA 200.7	9.08	10.0	91	mg/L
		Manganese	EPA 200.7	0.963	1.00	96	mg/L
		Molybdenum	EPA 200.7	0.946	1.00	95	mg/L
		Nickel	EPA 200.7	4.60	5.00	92	mg/L
		Phosphorus	EPA 200.7	5.15	5.00	103	mg/L
		Potassium	EPA 200.7	9.96	10.0	100	mg/L
		Scandium	EPA 200.7	0.979	1.00	98	mg/L
		Silver	EPA 200.7	0.089	0.090	99	mg/L
		Sodium	EPA 200.7	10.5	10.0	105	mg/L
		Strontium	EPA 200.7	0.891	1.00	89	mg/L
		Tin	EPA 200.7	0.973	1.00	97	mg/L
		Titanium	EPA 200.7	0.974	1.00	97	mg/L
		Vanadium	EPA 200.7	0.925	1.00	92	mg/L
		Zinc	EPA 200.7	0.988	1.00	99	mg/L
QC13030763	LCS 1	Mercury	EPA 200.8	0.000991	0.001	99	mg/L
		Antimony	EPA 200.8	0.0095	0.010	95	mg/L
		Arsenic	EPA 200.8	0.0526	0.050	105	mg/L
		Lead	EPA 200.8	0.0100	0.010	100	mg/L
		Selenium	EPA 200.8	0.0478	0.050	96	mg/L
		Thallium	EPA 200.8	0.0099	0.010	99	mg/L
		Uranium	EPA 200.8	0.0099	0.010	99	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD

QC13030488	Duplicate	pH	SM 4500-H+ B	1303274-001	7.73	7.73	pH Units	<1%
QC13030488	Duplicate	pH	SM 4500-H+ B	1303282-001	7.97	7.99	pH Units	<1%
QC13030488	Duplicate	pH	SM 4500-H+ B	1303282-002	7.78	7.79	pH Units	<1%
QC13030490	Duplicate	Bicarbonate (HCO3)	SM 2320B	1303274-001	153	153	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1303274-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1303274-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1303274-001	126	126	mg/L as CaCO3	<1%
QC13030490	Duplicate	Bicarbonate (HCO3)	SM 2320B	1303282-001	139	138	mg/L	1 %
		Carbonate (CO3)	SM 2320B	1303282-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1303282-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1303282-001	114	113	mg/L as CaCO3	1 %
QC13030490	Duplicate	Bicarbonate (HCO3)	SM 2320B	1303282-002	139	139	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1303282-002	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1303282-002	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1303282-002	114	114	mg/L as CaCO3	<1%
QC13030683	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303281-001	82.0	77.0	mg/L	6 %
QC13030683	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303302-002	293	369	mg/L	23 %
QC13030683	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303320-004	1872	1872	mg/L	<1%
QC13030683	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303320-014	3930	3900	mg/L	1 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13030551	MS 1	Fluoride	EPA 300.0	1303281-002	0.886	2.79	2.80	2.00	mg/L	95	96	<1%
QC13030551	MS 2	Fluoride	EPA 300.0	1303317-001	0.159	1.98	2.02	2.00	mg/L	91	93	2 %
QC13030554	MS 1	Chloride	EPA 300.0	1303281-002	<1.000	5.30	5.36	5.00	mg/L	106	107	1 %
QC13030554	MS 2	Chloride	EPA 300.0	1303317-001	<1.000	5.12	5.17	5.00	mg/L	103	104	1 %
QC13030556	MS 1	Nitrite Nitrogen	EPA 300.0	1303281-002	<0.025	0.514	0.522	0.500	mg/L	101	103	2 %
QC13030556	MS 2	Nitrite Nitrogen	EPA 300.0	1303317-001	<0.025	0.493	0.500	0.500	mg/L	99	100	1 %
QC13030557	MS 1	Nitrate Nitrogen	EPA 300.0	1303281-002	<1.000	2.13	2.16	2.00	mg/L	106	107	1 %
QC13030557	MS 2	Nitrate Nitrogen	EPA 300.0	1303317-001	<1.000	2.05	2.07	2.00	mg/L	102	103	1 %
QC13030559	MS 1	Sulfate	EPA 300.0	1303281-002	6.75	16.8	16.9	10.0	mg/L	100	102	1 %
QC13030559	MS 2	Sulfate	EPA 300.0	1303317-001	31.7	40.9	41.0	10.0	mg/L	92	93	<1%
QC13030745	MS 1	Aluminum	EPA 200.7	1303282-002	0.051	1.05	1.05	1.00	mg/L	100	100	<1%
		Barium	EPA 200.7	1303282-002	<0.010	0.932	0.941	1.00	mg/L	93	94	1 %
		Beryllium	EPA 200.7	1303282-002	<0.001	0.967	0.944	1.00	mg/L	97	94	2 %
		Bismuth	EPA 200.7	1303282-002	<0.100	1.02	1.03	1.00	mg/L	103	104	1 %
		Boron	EPA 200.7	1303282-002	<0.100	1.09	1.10	1.00	mg/L	103	104	1 %
		Cadmium	EPA 200.7	1303282-002	<0.001	0.938	0.947	1.00	mg/L	94	95	1 %
		Calcium	EPA 200.7	1303282-002	29.7	38.6	39.1	10.0	mg/L	89	94	1 %
		Chromium	EPA 200.7	1303282-002	<0.005	0.985	0.990	1.00	mg/L	99	99	1 %
		Cobalt	EPA 200.7	1303282-002	<0.010	0.901	0.964	1.00	mg/L	90	96	7 %
		Copper	EPA 200.7	1303282-002	<0.050	4.76	4.75	5.00	mg/L	95	95	<1%
		Gallium	EPA 200.7	1303282-002	<0.100	1.02	1.03	1.00	mg/L	102	103	1 %
		Iron	EPA 200.7	1303282-002	0.038	0.960	0.959	1.00	mg/L	92	92	<1%
		Lithium	EPA 200.7	1303282-002	<0.100	1.02	1.03	1.00	mg/L	97	98	1 %
		Magnesium	EPA 200.7	1303282-002	11.1	19.8	19.9	10.0	mg/L	87	88	1 %
		Manganese	EPA 200.7	1303282-002	<0.005	0.941	0.950	1.00	mg/L	94	95	1 %
		Molybdenum	EPA 200.7	1303282-002	<0.010	0.954	0.951	1.00	mg/L	95	95	<1%
		Nickel	EPA 200.7	1303282-002	<0.010	4.39	4.45	5.00	mg/L	88	89	1 %
		Phosphorus	EPA 200.7	1303282-002	<0.500	5.25	5.33	5.00	mg/L	103	104	2 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13030763	MS 1	Potassium	EPA 200.7	1303282-002	1.57	11.2	11.2	10.0	mg/L	96	96	<1%
		Scandium	EPA 200.7	1303282-002	<0.100	0.970	0.973	1.00	mg/L	97	97	<1%
		Silver	EPA 200.7	1303282-002	<0.005	0.088	0.088	0.090	mg/L	98	98	<1%
		Sodium	EPA 200.7	1303282-002	18.9	27.5	27.9	10.0	mg/L	86	90	1 %
		Strontium	EPA 200.7	1303282-002	0.125	1.01	1.03	1.00	mg/L	88	90	2 %
		Tin	EPA 200.7	1303282-002	<0.100	0.979	0.975	1.00	mg/L	100	99	<1%
		Titanium	EPA 200.7	1303282-002	<0.100	0.981	0.978	1.00	mg/L	98	98	<1%
		Vanadium	EPA 200.7	1303282-002	0.022	0.943	0.950	1.00	mg/L	92	93	1 %
		Zinc	EPA 200.7	1303282-002	<0.010	0.974	0.983	1.00	mg/L	97	98	1 %
		Mercury	EPA 200.8	1303282-002	<0.00010	0.000880	0.000878	0.001	mg/L	86	86	<1%
		Antimony	EPA 200.8	1303282-002	<0.0025	0.0096	0.0095	0.010	mg/L	96	95	1 %
		Arsenic	EPA 200.8	1303282-002	0.0211	0.0739	0.0739	0.050	mg/L	106	106	<1%
		Lead	EPA 200.8	1303282-002	<0.0025	0.0094	0.0093	0.010	mg/L	94	93	1 %
		Selenium	EPA 200.8	1303282-002	<0.0050	0.0471	0.0467	0.050	mg/L	93	92	1 %
		Thallium	EPA 200.8	1303282-002	<0.0010	0.0094	0.0094	0.010	mg/L	94	94	<1%
		Uranium	EPA 200.8	1303282-002	<0.0050	0.0132	0.0131	0.010	mg/L	99	98	1 %

WETLAB
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475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1303281
Report Due Date: 3/28/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company ______
Address ______
City, State & Zip ______
Contact ______
Phone ______
Fax ______
Email ______

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

Analyses Requested

SAMPLE ID/LOCATION	DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
CF-11-02 (0-27) Wk:44	03/14/13	9:00	WW	2	X	X									1
CF-11-02 (367-408) ↓	↓	↓	↓	↓	↓	↓									2

Instructions/Comments/Special Requirements:

1303 \ 5
281 1

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 19.8 °C	3/14/13	1950		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 4				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

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tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1303281
Report Due Date: 3/28/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company ______
Address ______
City, State & Zip ______
Contact ______
Phone ______
Fax ______
Email ______

Additional Information
Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes
DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

Analyses Requested

SAMPLE ID/LOCATION	DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium	Spl. No.
CF-11-02 (0-27) Wk:44	03/14/13	9:00	WW	2	X	X	1
CF-11-02 (367-408) ↓	↓	↓	↓	↓	↓	↓	2

Instructions/Comments/Special Requirements:

1303 5
281 1

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 19.8 °C	3/14/13	1450		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 4				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

WETLAB
WESTERN ENVIRONMENTAL
TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

4/4/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1303419*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 3/21/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Andy Smith
QA Manager

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1303419

General Comments

None

Specific Comments

Due to the sample matrix it was necessary to analyze the following at a dilution:
1303419-001 Cadmium
The reporting limits have been adjusted accordingly.

Data Qualifier Legend

B -- Blank contamination; Analyte detected above the method reporting limit in an associated blank

D -- Reporting limit is elevated due to required sample dilution

HT -- Sample analyzed beyond the accepted holding time

J -- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit

M -- Reported value is estimated; The sample matrix interfered with the analysis

N -- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.

NC -- Not calculated due to matrix interference

Q -- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy

S -- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.

SC -- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438 WK:112*

Date Printed: 4/4/2013
OrderID: *1303419*

Customer Sample ID: 604 673 Wk:112
WETLAB Sample ID: 1303419-001

Collect Date/Time: 3/21/2013 09:00
Receive Date: 3/21/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	4.95	pH Units		3/21/2013
Trace Metals Digestion	EPA 200.2	Complete			3/27/2013
Bicarbonate (HCO3)	SM 2320B	<1.0	mg/L	1.0	3/21/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	3/21/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	3/21/2013
Total Alkalinity	SM 2320B	<1.0	mg/L as CaCO3	1.0	3/21/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/22/2013
Fluoride	EPA 300.0	0.24	mg/L	0.10	3/22/2013
Sulfate	EPA 300.0	30	mg/L	1.0	3/22/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/22/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/22/2013
Total Dissolved Solids (TDS)	SM 2540C	60	mg/L	10	3/26/2013
Aluminum	EPA 200.7	0.19	mg/L	0.045	3/27/2013
Barium	EPA 200.7	0.068	mg/L	0.010	3/27/2013
Beryllium	EPA 200.7	0.0010	mg/L	0.0010	3/27/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	3/27/2013
Boron	EPA 200.7	<0.10	mg/L	0.10	3/27/2013
Cadmium	EPA 200.7	<0.0050	mg/L	0.0050	3/28/2013
Calcium	EPA 200.7	7.2	mg/L	0.50	3/27/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	3/27/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	3/27/2013
Copper	EPA 200.7	2.5	mg/L	0.050	3/27/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	3/27/2013
Iron	EPA 200.7	0.042	mg/L	0.010	3/27/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	3/27/2013
Magnesium	EPA 200.7	0.97	mg/L	0.50	3/27/2013
Manganese	EPA 200.7	0.052	mg/L	0.0050	3/27/2013

Customer Sample ID: 604 673 Wk:112

WETLAB Sample ID: 1303419-001

Collect Date/Time: 3/21/2013 09:00

Receive Date: 3/21/2013 14:20

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	3/27/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	3/27/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	3/27/2013
Potassium	EPA 200.7	0.72	mg/L	0.50	3/27/2013
Scandium	EPA 200.7	<0.100	mg/L	0.100	3/27/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	3/27/2013
Sodium	EPA 200.7	0.52	mg/L	0.50	3/27/2013
Strontium	EPA 200.7	<0.10	mg/L	0.10	3/27/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	3/27/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	3/27/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	3/27/2013
Zinc	EPA 200.7	0.064	mg/L	0.010	3/27/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	3/29/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	3/29/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	3/29/2013
Lead	EPA 200.8	0.015	mg/L	0.0025	3/29/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	3/29/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	3/29/2013
Uranium	EPA 200.8	0.032	mg/L	0.0050	3/29/2013
Anions	Calculation	0.64	meq/L	0.10	
Cations	Calculation	0.59	meq/L	0.10	
Error	Calculation	4.2	%	1.0	

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13030770	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC13030770	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC13030770	Blank 3	Fluoride	EPA 300.0	<0.10	mg/L
QC13030771	Blank 1	Chloride	EPA 300.0	<1.0	mg/L
QC13030771	Blank 2	Chloride	EPA 300.0	<1.0	mg/L
QC13030771	Blank 3	Chloride	EPA 300.0	<1.0	mg/L
QC13030773	Blank 1	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13030773	Blank 2	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13030773	Blank 3	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13030774	Blank 1	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13030774	Blank 2	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13030774	Blank 3	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13030775	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC13030775	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC13030775	Blank 3	Sulfate	EPA 300.0	<1.0	mg/L
QC13030920	Blank 1	Aluminum, Dissolved	EPA 200.7	<0.045	mg/L
		Barium, Dissolved	EPA 200.7	<0.010	mg/L
		Beryllium, Dissolved	EPA 200.7	<0.0010	mg/L
		Bismuth, Dissolved	EPA 200.7	<0.10	mg/L
		Boron, Dissolved	EPA 200.7	<0.10	mg/L
		Cadmium, Dissolved	EPA 200.7	<0.0010	mg/L
		Calcium, Dissolved	EPA 200.7	<0.50	mg/L
		Chromium, Dissolved	EPA 200.7	<0.0050	mg/L
		Cobalt, Dissolved	EPA 200.7	<0.010	mg/L
		Copper, Dissolved	EPA 200.7	<0.050	mg/L
		Gallium, Dissolved	EPA 200.7	<0.10	mg/L
		Iron, Dissolved	EPA 200.7	<0.010	mg/L
		Lithium, Dissolved	EPA 200.7	<0.10	mg/L
		Magnesium, Dissolved	EPA 200.7	<0.50	mg/L
		Manganese, Dissolved	EPA 200.7	<0.0050	mg/L
		Molybdenum, Dissolved	EPA 200.7	<0.010	mg/L
		Nickel, Dissolved	EPA 200.7	<0.010	mg/L
		Phosphorus, Dissolved	EPA 200.7	<0.50	mg/L
		Potassium, Dissolved	EPA 200.7	<0.50	mg/L
		Scandium, Dissolved	EPA 200.7	<0.10	mg/L
		Silver, Dissolved	EPA 200.7	<0.0050	mg/L
		Sodium, Dissolved	EPA 200.7	<0.50	mg/L
		Strontium, Dissolved	EPA 200.7	<0.10	mg/L
		Tin, Dissolved	EPA 200.7	<0.10	mg/L
		Titanium, Dissolved	EPA 200.7	<0.10	mg/L
		Vanadium, Dissolved	EPA 200.7	<0.010	mg/L
		Zinc, Dissolved	EPA 200.7	<0.010	mg/L
QC13030962	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13030962	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13030972	Blank 1	Uranium, Dissolved	EPA 200.8	<0.0050	mg/L
		Mercury, Dissolved	EPA 200.8	<0.00010	mg/L
		Antimony, Dissolved	EPA 200.8	<0.0025	mg/L

QCBatchID	QCType	Parameter	Method	Result	Units
		Arsenic, Dissolved	EPA 200.8	<0.0050	mg/L
		Lead, Dissolved	EPA 200.8	<0.0025	mg/L
		Selenium, Dissolved	EPA 200.8	<0.0050	mg/L
		Thallium, Dissolved	EPA 200.8	<0.0010	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13030719	LCS 1	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC13030719	LCS 2	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC13030721	LCS 1	Total Alkalinity	SM 2320B	99.6	100	100	mg/L
QC13030721	LCS 2	Total Alkalinity	SM 2320B	99.0	100	99	mg/L
QC13030721	LCS 3	Total Alkalinity	SM 2320B	100.0	100	100	mg/L
QC13030770	LCS 1	Fluoride	EPA 300.0	1.83	2.00	91	mg/L
QC13030771	LCS 1	Chloride	EPA 300.0	9.74	10.0	97	mg/L
QC13030773	LCS 1	Nitrite Nitrogen	EPA 300.0	0.458	0.500	92	mg/L
QC13030774	LCS 1	Nitrate Nitrogen	EPA 300.0	1.90	2.00	95	mg/L
QC13030775	LCS 1	Sulfate	EPA 300.0	24.3	25.0	97	mg/L
QC13030920	LCS 1	Aluminum, Dissolved	EPA 200.7	0.938	1.00	94	mg/L
		Barium, Dissolved	EPA 200.7	0.944	1.00	94	mg/L
		Beryllium, Dissolved	EPA 200.7	0.967	1.00	97	mg/L
		Bismuth, Dissolved	EPA 200.7	0.982	1.00	98	mg/L
		Boron, Dissolved	EPA 200.7	0.922	1.00	92	mg/L
		Cadmium, Dissolved	EPA 200.7	0.974	1.00	97	mg/L
		Calcium, Dissolved	EPA 200.7	9.68	10.0	97	mg/L
		Chromium, Dissolved	EPA 200.7	0.935	1.00	94	mg/L
		Cobalt, Dissolved	EPA 200.7	0.956	1.00	96	mg/L
		Copper, Dissolved	EPA 200.7	4.59	5.00	92	mg/L
		Gallium, Dissolved	EPA 200.7	0.945	1.00	94	mg/L
		Iron, Dissolved	EPA 200.7	0.932	1.00	93	mg/L
		Lithium, Dissolved	EPA 200.7	0.883	1.00	88	mg/L
		Magnesium, Dissolved	EPA 200.7	9.36	10.0	94	mg/L
		Manganese, Dissolved	EPA 200.7	0.956	1.00	96	mg/L
		Molybdenum, Dissolved	EPA 200.7	0.935	1.00	94	mg/L
		Nickel, Dissolved	EPA 200.7	4.75	5.00	95	mg/L
		Phosphorus, Dissolved	EPA 200.7	4.89	5.00	98	mg/L
		Potassium, Dissolved	EPA 200.7	9.12	10.0	91	mg/L
		Scandium, Dissolved	EPA 200.7	0.931	1.00	93	mg/L
		Silver, Dissolved	EPA 200.7	0.083	0.090	92	mg/L
		Sodium, Dissolved	EPA 200.7	9.55	10.0	96	mg/L
		Strontium, Dissolved	EPA 200.7	0.912	1.00	91	mg/L
		Tin, Dissolved	EPA 200.7	0.987	1.00	99	mg/L
		Titanium, Dissolved	EPA 200.7	0.946	1.00	95	mg/L
		Vanadium, Dissolved	EPA 200.7	0.927	1.00	93	mg/L
		Zinc, Dissolved	EPA 200.7	0.992	1.00	99	mg/L
QC13030962	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	153	150	102	mg/L
QC13030962	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	159	150	106	mg/L
QC13030972	LCS 1	Uranium, Dissolved	EPA 200.8	0.0097	0.010	96	mg/L
		Mercury, Dissolved	EPA 200.8	0.000901	0.001	90	mg/L
		Antimony, Dissolved	EPA 200.8	0.0096	0.010	96	mg/L
		Arsenic, Dissolved	EPA 200.8	0.0495	0.050	99	mg/L
		Lead, Dissolved	EPA 200.8	0.0096	0.010	96	mg/L
		Selenium, Dissolved	EPA 200.8	0.0474	0.050	95	mg/L
		Thallium, Dissolved	EPA 200.8	0.0096	0.010	96	mg/L

				Duplicate	Sample	Duplicate	

QCBatchID	QCType			Sample	Result	Result		
QC13030719	Duplicate	pH	SM 4500-H+ B	1303404-001	7.29	7.38	pH Units	1 %
QC13030719	Duplicate	pH	SM 4500-H+ B	1303404-002	7.65	7.64	pH Units	<1%
QC13030719	Duplicate	pH	SM 4500-H+ B	1303404-003	7.63	7.64	pH Units	<1%
QC13030719	Duplicate	pH	SM 4500-H+ B	1303404-004	7.09	7.07	pH Units	<1%
QC13030721	Duplicate	Bicarbonate (HCO3)	SM 2320B	1303404-001	400	348	mg/L	14 %
		Carbonate (CO3)	SM 2320B	1303404-001	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1303404-001	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1303404-001	328	285	mg/L as CaCO3	14 %
QC13030721	Duplicate	Bicarbonate (HCO3)	SM 2320B	1303404-002	391	392	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1303404-002	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1303404-002	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1303404-002	321	321	mg/L as CaCO3	<1%
QC13030721	Duplicate	Bicarbonate (HCO3)	SM 2320B	1303404-003	385	385	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1303404-003	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1303404-003	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1303404-003	316	316	mg/L as CaCO3	<1%
QC13030721	Duplicate	Bicarbonate (HCO3)	SM 2320B	1303404-004	150	149	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1303404-004	<1.000	<1.000	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1303404-004	<1.000	<1.000	mg/L	<1%
		Total Alkalinity	SM 2320B	1303404-004	123	122	mg/L as CaCO3	<1%
QC13030962	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303419-001	60.0	57.0	mg/L	5 %
QC13030962	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303440-001	1018	1038	mg/L	2 %
QC13030962	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303462-004	811	819	mg/L	1 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13030770	MS 1	Fluoride	EPA 300.0	1303419-001	0.240	2.45	2.52	2.00	mg/L	111	114	3 %
QC13030770	MS 2	Fluoride	EPA 300.0	1303405-003	<0.100	1.91	1.97	2.00	mg/L	96	99	3 %
QC13030771	MS 1	Chloride	EPA 300.0	1303419-001	<1.000	5.22	5.32	5.00	mg/L	105	107	2 %
QC13030771	MS 2	Chloride	EPA 300.0	1303405-003	<1.000	5.37	5.42	5.00	mg/L	107	108	1 %
QC13030773	MS 1	Nitrite Nitrogen	EPA 300.0	1303419-001	<0.025	0.480	0.491	0.500	mg/L	96	98	2 %
QC13030773	MS 2	Nitrite Nitrogen	EPA 300.0	1303445-001	<0.250	4.90	5.00	0.500	mg/L	97	99	2 %
QC13030774	MS 1	Nitrate Nitrogen	EPA 300.0	1303419-001	<1.000	2.10	2.14	2.00	mg/L	104	106	2 %
QC13030774	MS 2	Nitrate Nitrogen	EPA 300.0	1303445-001	28.3	48.8	49.3	2.00	mg/L	102	105	1 %
QC13030775	MS 1	Sulfate	EPA 300.0	1303419-001	30.0	39.3	39.5	10.0	mg/L	93	95	1 %
QC13030775	MS 2	Sulfate	EPA 300.0	1303405-003	<1.000	9.91	10.1	10.0	mg/L	99	101	2 %
QC13030920	MS 1	Aluminum, Dissolved	EPA 200.7	1303410-002	<0.045	0.926	0.936	1.00	mg/L	92	93	1 %
		Barium, Dissolved	EPA 200.7	1303410-002	<0.010	0.927	0.922	1.00	mg/L	92	92	1 %
		Beryllium, Dissolved	EPA 200.7	1303410-002	<0.001	0.965	0.955	1.00	mg/L	97	96	1 %
		Bismuth, Dissolved	EPA 200.7	1303410-002	<0.100	0.910	0.898	1.00	mg/L	95	93	1 %
		Boron, Dissolved	EPA 200.7	1303410-002	0.157	1.17	1.16	1.00	mg/L	101	100	1 %
		Cadmium, Dissolved	EPA 200.7	1303410-002	<0.001	0.954	0.943	1.00	mg/L	96	94	1 %
		Calcium, Dissolved	EPA 200.7	1303410-002	140	148	143	10.0	mg/L	80	30	3 %
		Chromium, Dissolved	EPA 200.7	1303410-002	<0.005	0.943	0.934	1.00	mg/L	94	93	1 %
		Cobalt, Dissolved	EPA 200.7	1303410-002	<0.010	0.874	0.862	1.00	mg/L	87	86	1 %
		Copper, Dissolved	EPA 200.7	1303410-002	<0.050	4.39	4.40	5.00	mg/L	88	88	<1%
		Gallium, Dissolved	EPA 200.7	1303410-002	<0.100	0.940	0.942	1.00	mg/L	94	94	<1%
		Iron, Dissolved	EPA 200.7	1303410-002	0.254	1.19	1.19	1.00	mg/L	94	94	<1%

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13030972	MS 1	Lithium, Dissolved	EPA 200.7	1303410-002	<0.100	0.837	0.824	1.00	mg/L	81	80	2 %
		Magnesium, Dissolved	EPA 200.7	1303410-002	27.0	34.6	33.9	10.0	mg/L	76	69	2 %
		Manganese, Dissolved	EPA 200.7	1303410-002	0.010	0.949	0.947	1.00	mg/L	94	94	<1%
		Molybdenum, Dissolved	EPA 200.7	1303410-002	<0.050	0.977	0.961	1.00	mg/L	97	96	2 %
		Nickel, Dissolved	EPA 200.7	1303410-002	<0.010	4.38	4.34	5.00	mg/L	88	87	1 %
		Phosphorus, Dissolved	EPA 200.7	1303410-002	<0.500	5.24	5.19	5.00	mg/L	104	103	1 %
		Potassium, Dissolved	EPA 200.7	1303410-002	6.63	15.9	15.8	10.0	mg/L	93	92	1 %
		Scandium, Dissolved	EPA 200.7	1303410-002	<0.100	0.929	0.926	1.00	mg/L	93	93	<1%
		Silver, Dissolved	EPA 200.7	1303410-002	<0.005	0.082	0.082	0.090	mg/L	92	91	<1%
		Sodium, Dissolved	EPA 200.7	1303410-002	66.5 SC	73.0	73.2	10.0	mg/L	NC	NC	NC
		Strontium, Dissolved	EPA 200.7	1303410-002	0.878	1.77	1.74	1.00	mg/L	89	86	2 %
		Tin, Dissolved	EPA 200.7	1303410-002	<0.100	0.942	0.923	1.00	mg/L	101	99	2 %
		Titanium, Dissolved	EPA 200.7	1303410-002	<0.100	0.959	0.947	1.00	mg/L	96	95	1 %
		Vanadium, Dissolved	EPA 200.7	1303410-002	0.033	0.989	0.984	1.00	mg/L	96	95	1 %
		Zinc, Dissolved	EPA 200.7	1303410-002	<0.010	0.941	0.924	1.00	mg/L	94	92	2 %
		Uranium, Dissolved	EPA 200.8	1303410-002	<0.0050	0.0144	0.0143	0.010	mg/L	97	96	1 %
		Mercury, Dissolved	EPA 200.8	1303410-002	<0.00010	0.000791	0.000776	0.001	mg/L	78	77	2 %
		Antimony, Dissolved	EPA 200.8	1303410-002	<0.0025	0.0093	0.0095	0.010	mg/L	91	92	2 %
		Arsenic, Dissolved	EPA 200.8	1303410-002	<0.0050	0.0554	0.0549	0.050	mg/L	107	106	1 %
		Lead, Dissolved	EPA 200.8	1303410-002	<0.0025	0.0091	0.0090	0.010	mg/L	90	89	1 %
		Selenium, Dissolved	EPA 200.8	1303410-002	<0.0050	0.0489	0.0478	0.050	mg/L	94	91	2 %
		Thallium, Dissolved	EPA 200.8	1303410-002	<0.0010	0.0089	0.0089	0.010	mg/L	88	88	<1%

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1303419
Report Due Date: 4/4/13
Page 1 of 1

Client	McClelland Laboratories, Inc.
Address	1016 Greg Street
City, State & Zip	Sparks, NV 89431
Contact	Mike Medina
Phone 775-356-1300	Collector's Name Robert
Fax 775-356-8917	Project Name
P.O. Number	Project Number 3438
Email	mli@mettest.com

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company ______
Address ______
City, State & Zip ______
Contact ______
Phone ______
Fax ______
Email ______

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water	SD = Solid
WW = Wastewater	SO = Soil
SW = Surface Water	HW = Hazardous Waste
MW = Monitoring Well	OTHER: ______

Analyses Requested

SAMPLE ID/LOCATION	DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
604 673 Wk:112	03/21/13	9:00	WW	2	X	X									1

1303 419 1

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 20 °C	3/21/13	2:20p		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 6				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

WETLAB
WESTERN ENVIRONMENTAL
TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

4/11/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1303567*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 3/28/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

ASmith

Andy Smith
QA Manager

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817

ELKO
1084 Lamoille Hwy.
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933

LAS VEGAS
3230 Polaris Ave., Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 776-6152

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1303567

General Comments

None

Specific Comments

Due to the sample matrix it was necessary to analyze the following at a dilution:
1303567-005 Iron
1303567-006 Sodium
1303567-007 Iron, Molybdenum
The reporting limits have been adjusted accordingly.

Due to a laboratory reanalysis requirement the analysis for Total Dissolved Solids (TDS) on sample 1303567-004 was performed past the EPA recommended holding time. We apologize for any inconvenience this may have caused.

Data Qualifier Legend

B	-- Blank contamination; Analyte detected above the method reporting limit in an associated blank
D	-- Reporting limit is elevated due to required sample dilution
HT	-- Sample analyzed beyond the accepted holding time
J	-- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	-- Reported value is estimated; The sample matrix interfered with the analysis
N	-- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	-- Not calculated due to matrix interference
Q	-- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
S	-- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.
SC	-- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438*

Date Printed: 4/11/2013
OrderID: *1303567*

Customer Sample ID: CF-11-02 (227-367) Wk:40
WETLAB Sample ID: 1303567-001

Collect Date/Time: 3/28/2013 09:00
Receive Date: 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.77	pH Units		3/28/2013
Trace Metals Digestion	EPA 200.2	Complete			4/4/2013
Bicarbonate (HCO3)	SM 2320B	69	mg/L	1.0	3/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Total Alkalinity	SM 2320B	56	mg/L as CaCO3	1.0	3/28/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/29/2013
Fluoride	EPA 300.0	1.1	mg/L	0.10	3/29/2013
Sulfate	EPA 300.0	4.3	mg/L	1.0	3/29/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/29/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/29/2013
Total Dissolved Solids (TDS)	SM 2540C	76	mg/L	10	4/2/2013
Aluminum	EPA 200.7	0.075	mg/L	0.045	4/4/2013
Barium	EPA 200.7	0.044	mg/L	0.010	4/4/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Boron	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Calcium	EPA 200.7	18	mg/L	0.50	4/4/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	4/4/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Iron	EPA 200.7	0.018	mg/L	0.010	4/4/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Magnesium	EPA 200.7	2.7	mg/L	0.50	4/4/2013
Manganese	EPA 200.7	0.029	mg/L	0.0050	4/4/2013

Customer Sample ID: CF-11-02 (227-367) Wk:40
WETLAB Sample ID: 1303567-001

Collect Date/Time: 3/28/2013 09:00
Receive Date: 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	4/4/2013
Potassium	EPA 200.7	2.7	mg/L	0.50	4/4/2013
Scandium	EPA 200.7	<0.100	mg/L	0.100	4/4/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Sodium	EPA 200.7	1.6	mg/L	0.50	4/4/2013
Strontium	EPA 200.7	0.16	mg/L	0.10	4/4/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	4/5/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	4/5/2013
Uranium	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Anions	Calculation	1.28	meq/L	0.10	
Cations	Calculation	1.27	meq/L	0.10	
Error	Calculation	<1.0	%	1.0	

Customer Sample ID: CF-11-02 (52-117) Wk:40
WETLAB Sample ID: 1303567-002

Collect Date/Time: 3/28/2013 09:00
Receive Date: 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.66	pH Units		3/28/2013
Trace Metals Digestion	EPA 200.2	Complete			4/4/2013
Bicarbonate (HCO3)	SM 2320B	57	mg/L	1.0	3/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Total Alkalinity	SM 2320B	46	mg/L as CaCO3	1.0	3/28/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/29/2013
Fluoride	EPA 300.0	0.85	mg/L	0.10	3/29/2013
Sulfate	EPA 300.0	6.6	mg/L	1.0	3/29/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/29/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/29/2013

Customer Sample ID: CF-11-02 (52-117) Wk:40
WETLAB Sample ID: 1303567-002

Collect Date/Time: 3/28/2013 09:00
Receive Date: 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Total Dissolved Solids (TDS)	SM 2540C	68	mg/L	10	4/2/2013
Aluminum	EPA 200.7	0.056	mg/L	0.045	4/4/2013
Barium	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Boron	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Calcium	EPA 200.7	18	mg/L	0.50	4/4/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	4/4/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Iron	EPA 200.7	0.013	mg/L	0.010	4/4/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Magnesium	EPA 200.7	1.5	mg/L	0.50	4/4/2013
Manganese	EPA 200.7	0.024	mg/L	0.0050	4/4/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	4/4/2013
Potassium	EPA 200.7	2.4	mg/L	0.50	4/4/2013
Scandium	EPA 200.7	<0.100	mg/L	0.100	4/4/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Sodium	EPA 200.7	1.4	mg/L	0.50	4/4/2013
Strontium	EPA 200.7	0.12	mg/L	0.10	4/4/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	4/5/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	4/5/2013
Uranium	EPA 200.8	0.0065	mg/L	0.0050	4/5/2013
Anions	Calculation	1.12	meq/L	0.10	
Cations	Calculation	1.15	meq/L	0.10	
Error	Calculation	1.6	%	1.0	

Customer Sample ID: K-Spar Breccia 5+ Comp Wk:40
WETLAB Sample ID: 1303567-003

Collect Date/Time: 3/28/2013 09:00
Receive Date: 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.79	pH Units		3/28/2013
Trace Metals Digestion	EPA 200.2	Complete			4/4/2013
Bicarbonate (HCO3)	SM 2320B	70	mg/L	1.0	3/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Total Alkalinity	SM 2320B	58	mg/L as CaCO3	1.0	3/28/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/29/2013
Fluoride	EPA 300.0	1.2	mg/L	0.10	3/29/2013
Sulfate	EPA 300.0	33	mg/L	1.0	3/29/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/29/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/29/2013
Total Dissolved Solids (TDS)	SM 2540C	120	mg/L	10	4/2/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	4/4/2013
Barium	EPA 200.7	0.12	mg/L	0.010	4/4/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Boron	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Calcium	EPA 200.7	31	mg/L	0.50	4/4/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	4/4/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Magnesium	EPA 200.7	2.5	mg/L	0.50	4/4/2013
Manganese	EPA 200.7	0.049	mg/L	0.0050	4/4/2013
Molybdenum	EPA 200.7	0.046	mg/L	0.010	4/4/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	4/4/2013
Potassium	EPA 200.7	2.5	mg/L	0.50	4/4/2013
Scandium	EPA 200.7	<0.100	mg/L	0.100	4/4/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Sodium	EPA 200.7	1.6	mg/L	0.50	4/4/2013
Strontium	EPA 200.7	0.57	mg/L	0.10	4/4/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	4/4/2013

Customer Sample ID: K-Spar Breccia 5+ Comp Wk:40
Collect Date/Time: 3/28/2013 09:00
WETLAB Sample ID: 1303567-003
Receive Date: 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Zinc	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	4/5/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	4/5/2013
Uranium	EPA 200.8	0.017	mg/L	0.0050	4/5/2013
Anions	Calculation	1.90	meq/L	0.10	
Cations	Calculation	1.89	meq/L	0.10	
Error	Calculation	<1.0	%	1.0	

Customer Sample ID: Biotite Breccia 5+ Comp Wk:40
Collect Date/Time: 3/28/2013 09:00
WETLAB Sample ID: 1303567-004
Receive Date: 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.86	pH Units		3/28/2013
Trace Metals Digestion	EPA 200.2	Complete			4/4/2013
Bicarbonate (HCO3)	SM 2320B	77	mg/L	1.0	3/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Total Alkalinity	SM 2320B	63	mg/L as CaCO3	1.0	3/28/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/29/2013
Fluoride	EPA 300.0	1.5	mg/L	0.10	3/29/2013
Sulfate	EPA 300.0	8.6	mg/L	1.0	3/29/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/29/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/29/2013
Total Dissolved Solids (TDS)	SM 2540C	96 HT	mg/L	10	4/11/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	4/4/2013
Barium	EPA 200.7	0.072	mg/L	0.010	4/4/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Boron	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Calcium	EPA 200.7	22	mg/L	0.50	4/4/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	4/4/2013

Customer Sample ID: Biotite Breccia 5+ Comp Wk:40 **Collect Date/Time:** 3/28/2013 09:00
WETLAB Sample ID: 1303567-004 **Receive Date:** 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Gallium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Magnesium	EPA 200.7	3.6	mg/L	0.50	4/4/2013
Manganese	EPA 200.7	0.054	mg/L	0.0050	4/4/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	4/4/2013
Potassium	EPA 200.7	2.3	mg/L	0.50	4/4/2013
Scandium	EPA 200.7	<0.100	mg/L	0.100	4/4/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Sodium	EPA 200.7	1.3	mg/L	0.50	4/4/2013
Strontium	EPA 200.7	0.24	mg/L	0.10	4/4/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	4/5/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	4/5/2013
Uranium	EPA 200.8	0.0063	mg/L	0.0050	4/5/2013
Anions	Calculation	1.52	meq/L	0.10	
Cations	Calculation	1.51	meq/L	0.10	
Error	Calculation	<1.0	%	1.0	

Customer Sample ID: Quartz Monzonite 5+ Comp Wk:40 **Collect Date/Time:** 3/28/2013 09:00
WETLAB Sample ID: 1303567-005 **Receive Date:** 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.90	pH Units		3/28/2013
Trace Metals Digestion	EPA 200.2	Complete			4/4/2013
Bicarbonate (HCO3)	SM 2320B	72	mg/L	1.0	3/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Total Alkalinity	SM 2320B	59	mg/L as CaCO3	1.0	3/28/2013

Customer Sample ID: Quartz Monzonite 5+ Comp Wk:40
WETLAB Sample ID: 1303567-005

Collect Date/Time: 3/28/2013 09:00
Receive Date: 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/29/2013
Fluoride	EPA 300.0	1.2	mg/L	0.10	3/29/2013
Sulfate	EPA 300.0	10	mg/L	1.0	3/29/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/29/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/29/2013
Total Dissolved Solids (TDS)	SM 2540C	90	mg/L	10	4/2/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	4/4/2013
Barium	EPA 200.7	0.13	mg/L	0.010	4/4/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Boron	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Calcium	EPA 200.7	21	mg/L	0.50	4/4/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	4/4/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Iron	EPA 200.7	<0.050	mg/L	0.050	4/5/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Magnesium	EPA 200.7	3.6	mg/L	0.50	4/4/2013
Manganese	EPA 200.7	0.023	mg/L	0.0050	4/4/2013
Molybdenum	EPA 200.7	0.052	mg/L	0.010	4/4/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	4/4/2013
Potassium	EPA 200.7	2.3	mg/L	0.50	4/4/2013
Scandium	EPA 200.7	<0.100	mg/L	0.100	4/4/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Sodium	EPA 200.7	1.4	mg/L	0.50	4/4/2013
Strontium	EPA 200.7	0.48	mg/L	0.10	4/4/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	4/5/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013

Customer Sample ID: Quartz Monzonite 5+ Comp Wk:40
WETLAB Sample ID: 1303567-005

Collect Date/Time: 3/28/2013 09:00
Receive Date: 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	4/5/2013
Uranium	EPA 200.8	0.010	mg/L	0.0050	4/5/2013
Anions	Calculation	1.45	meq/L	0.10	
Cations	Calculation	1.46	meq/L	0.10	
Error	Calculation	<1.0	%	1.0	

Customer Sample ID: Biotite Breccia 0-5 Comp Wk:40
WETLAB Sample ID: 1303567-006

Collect Date/Time: 3/28/2013 09:00
Receive Date: 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.76	pH Units		3/28/2013
Trace Metals Digestion	EPA 200.2	Complete			4/4/2013
Bicarbonate (HCO3)	SM 2320B	65	mg/L	1.0	3/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Total Alkalinity	SM 2320B	54	mg/L as CaCO3	1.0	3/28/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/29/2013
Fluoride	EPA 300.0	1.4	mg/L	0.10	3/29/2013
Sulfate	EPA 300.0	12	mg/L	1.0	3/29/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/29/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/29/2013
Total Dissolved Solids (TDS)	SM 2540C	80	mg/L	10	4/2/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	4/4/2013
Barium	EPA 200.7	0.099	mg/L	0.010	4/4/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Boron	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Calcium	EPA 200.7	20	mg/L	0.50	4/4/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	4/4/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Iron	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Magnesium	EPA 200.7	3.8	mg/L	0.50	4/4/2013
Manganese	EPA 200.7	0.021	mg/L	0.0050	4/4/2013
Molybdenum	EPA 200.7	0.012	mg/L	0.010	4/4/2013

Customer Sample ID: Biotite Breccia 0-5 Comp Wk:40
WETLAB Sample ID: 1303567-006

Collect Date/Time: 3/28/2013 09:00
Receive Date: 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Nickel	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	4/4/2013
Potassium	EPA 200.7	1.5	mg/L	0.50	4/4/2013
Scandium	EPA 200.7	<0.100	mg/L	0.100	4/4/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Sodium	EPA 200.7	<2.5	mg/L	2.5	4/5/2013
Strontium	EPA 200.7	0.26	mg/L	0.10	4/4/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	4/5/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	4/5/2013
Uranium	EPA 200.8	0.023	mg/L	0.0050	4/5/2013
Anions	Calculation	1.39	meq/L	0.10	
Cations	Calculation	1.35	meq/L	0.10	
Error	Calculation	1.4	%	1.0	

Customer Sample ID: K-Spar Breccia 0-5 Comp Wk:40
WETLAB Sample ID: 1303567-007

Collect Date/Time: 3/28/2013 09:00
Receive Date: 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.75	pH Units		3/28/2013
Trace Metals Digestion	EPA 200.2	Complete			4/4/2013
Bicarbonate (HCO3)	SM 2320B	60	mg/L	1.0	3/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Total Alkalinity	SM 2320B	49	mg/L as CaCO3	1.0	3/28/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/29/2013
Fluoride	EPA 300.0	1.2	mg/L	0.10	3/29/2013
Sulfate	EPA 300.0	11	mg/L	1.0	3/29/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/29/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/29/2013
Total Dissolved Solids (TDS)	SM 2540C	78	mg/L	10	4/2/2013

Customer Sample ID: K-Spar Breccia 0-5 Comp Wk:40
WETLAB Sample ID: 1303567-007

Collect Date/Time: 3/28/2013 09:00
Receive Date: 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Aluminum	EPA 200.7	<0.045	mg/L	0.045	4/4/2013
Barium	EPA 200.7	0.10	mg/L	0.010	4/4/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Boron	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Calcium	EPA 200.7	18	mg/L	0.50	4/4/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	4/4/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Iron	EPA 200.7	<0.050	mg/L	0.050	4/5/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Magnesium	EPA 200.7	3.6	mg/L	0.50	4/4/2013
Manganese	EPA 200.7	0.018	mg/L	0.0050	4/4/2013
Molybdenum	EPA 200.7	<0.050	mg/L	0.050	4/5/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	4/4/2013
Potassium	EPA 200.7	1.6	mg/L	0.50	4/4/2013
Scandium	EPA 200.7	<0.100	mg/L	0.100	4/4/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Sodium	EPA 200.7	1.1	mg/L	0.50	4/4/2013
Strontium	EPA 200.7	0.32	mg/L	0.10	4/4/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Zinc	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	4/5/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	4/5/2013
Uranium	EPA 200.8	0.021	mg/L	0.0050	4/5/2013
Anions	Calculation	1.28	meq/L	0.10	
Cations	Calculation	1.28	meq/L	0.10	
Error	Calculation	<1.0	%	1.0	

Customer Sample ID: Quartz Monzonite 0-5 Comp Wk:40
WETLAB Sample ID: 1303567-008

Collect Date/Time: 3/28/2013 09:00
Receive Date: 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
pH	SM 4500-H+ B	7.56	pH Units		3/28/2013
Trace Metals Digestion	EPA 200.2	Complete			4/4/2013
Bicarbonate (HCO3)	SM 2320B	35	mg/L	1.0	3/28/2013
Carbonate (CO3)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Hydroxide (OH)	SM 2320B	<1.0	mg/L	1.0	3/28/2013
Total Alkalinity	SM 2320B	29	mg/L as CaCO3	1.0	3/28/2013
Chloride	EPA 300.0	<1.00	mg/L	1.00	3/29/2013
Fluoride	EPA 300.0	0.55	mg/L	0.10	3/29/2013
Sulfate	EPA 300.0	9.9	mg/L	1.0	3/29/2013
Nitrate Nitrogen	EPA 300.0	<1.0	mg/L	1.0	3/29/2013
Nitrite Nitrogen	EPA 300.0	<0.025	mg/L	0.025	3/29/2013
Total Dissolved Solids (TDS)	SM 2540C	56	mg/L	10	4/2/2013
Aluminum	EPA 200.7	<0.045	mg/L	0.045	4/4/2013
Barium	EPA 200.7	0.14	mg/L	0.010	4/4/2013
Beryllium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Bismuth	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Boron	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Cadmium	EPA 200.7	<0.0010	mg/L	0.0010	4/4/2013
Calcium	EPA 200.7	11	mg/L	0.50	4/4/2013
Chromium	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Cobalt	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Copper	EPA 200.7	<0.050	mg/L	0.050	4/4/2013
Gallium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Iron	EPA 200.7	0.023	mg/L	0.010	4/4/2013
Lithium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Magnesium	EPA 200.7	1.8	mg/L	0.50	4/4/2013
Manganese	EPA 200.7	0.018	mg/L	0.0050	4/4/2013
Molybdenum	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Nickel	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Phosphorus	EPA 200.7	<0.50	mg/L	0.50	4/4/2013
Potassium	EPA 200.7	<0.50	mg/L	0.50	4/4/2013
Scandium	EPA 200.7	<0.100	mg/L	0.100	4/4/2013
Silver	EPA 200.7	<0.0050	mg/L	0.0050	4/4/2013
Sodium	EPA 200.7	2.2	mg/L	0.50	4/4/2013
Strontium	EPA 200.7	0.12	mg/L	0.10	4/4/2013
Tin	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Titanium	EPA 200.7	<0.10	mg/L	0.10	4/4/2013
Vanadium	EPA 200.7	<0.010	mg/L	0.010	4/4/2013

Customer Sample ID: Quartz Monzonite 0-5 Comp Wk:40
WETLAB Sample ID: 1303567-008

Collect Date/Time: 3/28/2013 09:00
Receive Date: 3/28/2013 14:30

PROFILE II

Parameter	Method	Results	Units	Reporting Limit	Date Analyzed
Zinc	EPA 200.7	<0.010	mg/L	0.010	4/4/2013
Mercury	EPA 200.8	<0.00010	mg/L	0.00010	4/5/2013
Antimony	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Arsenic	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Lead	EPA 200.8	<0.0025	mg/L	0.0025	4/5/2013
Selenium	EPA 200.8	<0.0050	mg/L	0.0050	4/5/2013
Thallium	EPA 200.8	<0.0010	mg/L	0.0010	4/5/2013
Uranium	EPA 200.8	0.011	mg/L	0.0050	4/5/2013
Anions	Calculation	0.81	meq/L	0.10	
Cations	Calculation	0.79	meq/L	0.10	
Error	Calculation	<1.0	%	1.0	

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13040001	Blank 1	Fluoride	EPA 300.0	<0.10	mg/L
QC13040001	Blank 2	Fluoride	EPA 300.0	<0.10	mg/L
QC13040001	Blank 3	Fluoride	EPA 300.0	<0.10	mg/L
QC13040006	Blank 1	Chloride	EPA 300.0	<1.0	mg/L
QC13040006	Blank 2	Chloride	EPA 300.0	<1.0	mg/L
QC13040006	Blank 3	Chloride	EPA 300.0	<1.0	mg/L
QC13040013	Blank 1	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13040013	Blank 2	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13040013	Blank 3	Nitrite Nitrogen	EPA 300.0	<0.025	mg/L
QC13040018	Blank 1	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13040018	Blank 2	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13040018	Blank 3	Nitrate Nitrogen	EPA 300.0	<1.0	mg/L
QC13040023	Blank 1	Sulfate	EPA 300.0	<1.0	mg/L
QC13040023	Blank 2	Sulfate	EPA 300.0	<1.0	mg/L
QC13040023	Blank 3	Sulfate	EPA 300.0	<1.0	mg/L
QC13040178	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13040178	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13040178	Blank 3	Total Dissolved Solids (TDS)	SM 2540C	<10	mg/L
QC13040200	Blank 1	Aluminum	EPA 200.7	<0.045	mg/L
		Barium	EPA 200.7	<0.010	mg/L
		Beryllium	EPA 200.7	<0.0010	mg/L
		Bismuth	EPA 200.7	<0.10	mg/L
		Boron	EPA 200.7	<0.10	mg/L
		Cadmium	EPA 200.7	<0.0010	mg/L
		Calcium	EPA 200.7	<0.50	mg/L
		Chromium	EPA 200.7	<0.0050	mg/L
		Cobalt	EPA 200.7	<0.010	mg/L
		Copper	EPA 200.7	<0.050	mg/L
		Gallium	EPA 200.7	<0.10	mg/L
		Iron	EPA 200.7	<0.010	mg/L
		Lithium	EPA 200.7	<0.10	mg/L
		Magnesium	EPA 200.7	<0.50	mg/L
		Manganese	EPA 200.7	<0.0050	mg/L
		Molybdenum	EPA 200.7	<0.010	mg/L
		Nickel	EPA 200.7	<0.010	mg/L
		Phosphorus	EPA 200.7	<0.50	mg/L
		Potassium	EPA 200.7	<0.50	mg/L
		Scandium	EPA 200.7	<0.100	mg/L
		Silver	EPA 200.7	<0.0050	mg/L
		Sodium	EPA 200.7	<0.50	mg/L
		Strontium	EPA 200.7	<0.10	mg/L
		Tin	EPA 200.7	<0.10	mg/L
		Titanium	EPA 200.7	<0.10	mg/L
		Vanadium	EPA 200.7	<0.010	mg/L
		Zinc	EPA 200.7	<0.010	mg/L
QC13040227	Blank 1	Mercury	EPA 200.8	<0.00010	mg/L
		Antimony	EPA 200.8	<0.0025	mg/L

QCBatchID	QCType	Parameter	Method	Result	Units
		Arsenic	EPA 200.8	<0.0050	mg/L
		Lead	EPA 200.8	<0.0025	mg/L
		Selenium	EPA 200.8	<0.0050	mg/L
		Thallium	EPA 200.8	<0.0010	mg/L
		Uranium	EPA 200.8	<0.0050	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13030974	LCS 1	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13030974	LCS 2	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13030975	LCS 1	Total Alkalinity	SM 2320B	99.4	100	99	mg/L
QC13030975	LCS 2	Total Alkalinity	SM 2320B	99.0	100	99	mg/L
QC13030975	LCS 3	Total Alkalinity	SM 2320B	99.3	100	99	mg/L
QC13040001	LCS 1	Fluoride	EPA 300.0	1.83	2.00	92	mg/L
QC13040006	LCS 1	Chloride	EPA 300.0	10.2	10.0	102	mg/L
QC13040013	LCS 1	Nitrite Nitrogen	EPA 300.0	0.495	0.500	99	mg/L
QC13040018	LCS 1	Nitrate Nitrogen	EPA 300.0	2.01	2.00	100	mg/L
QC13040023	LCS 1	Sulfate	EPA 300.0	24.4	25.0	98	mg/L
QC13040178	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	147	150	98	mg/L
QC13040178	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	157	150	105	mg/L
QC13040178	LCS 3	Total Dissolved Solids (TDS)	SM 2540C	159	150	106	mg/L
QC13040200	LCS 1	Aluminum	EPA 200.7	0.981	1.00	98	mg/L
		Barium	EPA 200.7	0.979	1.00	98	mg/L
		Beryllium	EPA 200.7	0.975	1.00	98	mg/L
		Bismuth	EPA 200.7	0.983	1.00	98	mg/L
		Boron	EPA 200.7	0.976	1.00	98	mg/L
		Cadmium	EPA 200.7	0.986	1.00	99	mg/L
		Calcium	EPA 200.7	9.44	10.0	94	mg/L
		Chromium	EPA 200.7	0.973	1.00	97	mg/L
		Cobalt	EPA 200.7	0.983	1.00	98	mg/L
		Copper	EPA 200.7	4.82	5.00	96	mg/L
		Gallium	EPA 200.7	0.985	1.00	98	mg/L
		Iron	EPA 200.7	0.974	1.00	97	mg/L
		Lithium	EPA 200.7	0.944	1.00	94	mg/L
		Magnesium	EPA 200.7	9.51	10.0	95	mg/L
		Manganese	EPA 200.7	0.976	1.00	98	mg/L
		Molybdenum	EPA 200.7	0.978	1.00	98	mg/L
		Nickel	EPA 200.7	4.91	5.00	98	mg/L
		Phosphorus	EPA 200.7	4.92	5.00	98	mg/L
		Potassium	EPA 200.7	9.63	10.0	96	mg/L
		Scandium	EPA 200.7	0.973	1.00	97	mg/L
		Silver	EPA 200.7	0.089	0.090	99	mg/L
		Sodium	EPA 200.7	9.59	10.0	96	mg/L
		Strontium	EPA 200.7	0.999	1.00	100	mg/L
		Tin	EPA 200.7	0.985	1.00	98	mg/L
		Titanium	EPA 200.7	0.979	1.00	98	mg/L
		Vanadium	EPA 200.7	0.979	1.00	98	mg/L
		Zinc	EPA 200.7	0.996	1.00	100	mg/L
QC13040227	LCS 1	Mercury	EPA 200.8	0.000911	0.001	91	mg/L
		Antimony	EPA 200.8	0.0099	0.010	99	mg/L
		Arsenic	EPA 200.8	0.0528	0.050	106	mg/L
		Lead	EPA 200.8	0.0100	0.010	100	mg/L
		Selenium	EPA 200.8	0.0509	0.050	102	mg/L
		Thallium	EPA 200.8	0.0100	0.010	100	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
		Uranium	EPA 200.8	0.0099	0.010	98	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result		Units	RPD
QC13030974	Duplicate	pH	SM 4500-H+ B	1303558-001	7.39	7.40		pH Units	<1%
QC13030974	Duplicate	pH	SM 4500-H+ B	1303555-005	7.80	7.82		pH Units	<1%
QC13030974	Duplicate	pH	SM 4500-H+ B	1303568-001	7.46	7.45		pH Units	<1%
QC13030975	Duplicate	Bicarbonate (HCO3)	SM 2320B	1303558-001	215	216		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1303558-001	<1.000	<1.000		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1303558-001	<1.000	<1.000		mg/L	<1%
		Total Alkalinity	SM 2320B	1303558-001	177	177		mg/L as CaCO3	<1%
QC13030975	Duplicate	Bicarbonate (HCO3)	SM 2320B	1303555-005	171	170		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1303555-005	<1.000	<1.000		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1303555-005	<1.000	<1.000		mg/L	<1%
		Total Alkalinity	SM 2320B	1303555-005	140	140		mg/L as CaCO3	<1%
QC13030975	Duplicate	Bicarbonate (HCO3)	SM 2320B	1303568-001	39.8	39.6		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1303568-001	<1.000	<1.000		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1303568-001	<1.000	<1.000		mg/L	<1%
		Total Alkalinity	SM 2320B	1303568-001	32.6	32.5		mg/L as CaCO3	<1%
QC13040178	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303532-001	484	438	Q	mg/L	10 %
QC13040178	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303533-001	100	99.0		mg/L	1 %
QC13040178	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303567-006	80.0	84.0		mg/L	5 %
QC13040178	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1303594-008	343	346		mg/L	1 %
QC13040178	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1304005-002	210	212		mg/L	1 %
QC13040178	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1304010-002	297	305		mg/L	3 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13040001	MS 1	Fluoride	EPA 300.0	1303567-008	0.546		2.40	2.43	2.00	mg/L	93	94	1 %
QC13040001	MS 2	Fluoride	EPA 300.0	1303568-001	<0.100		1.90	1.94	2.00	mg/L	92	94	2 %
QC13040006	MS 1	Chloride	EPA 300.0	1303567-008	<1.000		5.37	5.42	5.00	mg/L	108	109	1 %
QC13040006	MS 2	Chloride	EPA 300.0	1303568-001	<1.000		5.39	5.46	5.00	mg/L	109	110	1 %
QC13040013	MS 1	Nitrite Nitrogen	EPA 300.0	1303567-008	<0.025		0.513	0.518	0.500	mg/L	101	102	1 %
QC13040013	MS 2	Nitrite Nitrogen	EPA 300.0	1303568-001	<0.025		0.509	0.518	0.500	mg/L	102	104	2 %
QC13040018	MS 1	Nitrate Nitrogen	EPA 300.0	1303567-008	<1.000		2.18	2.20	2.00	mg/L	107	108	1 %
QC13040018	MS 2	Nitrate Nitrogen	EPA 300.0	1303568-001	<1.000		2.14	2.17	2.00	mg/L	106	108	1 %
QC13040023	MS 1	Sulfate	EPA 300.0	1303567-008	9.89		20.0	20.1	10.0	mg/L	101	102	<1%
QC13040023	MS 2	Sulfate	EPA 300.0	1303568-001	5.42		15.5	15.6	10.0	mg/L	101	102	1 %
QC13040200	MS 1	Aluminum	EPA 200.7	1303566-001	<0.045		0.940	0.917	1.00	mg/L	91	89	2 %
		Barium	EPA 200.7	1303566-001	0.032		0.968	0.963	1.00	mg/L	94	93	1 %
		Beryllium	EPA 200.7	1303566-001	<0.001		0.976	0.983	1.00	mg/L	98	98	1 %
		Bismuth	EPA 200.7	1303566-001	<0.100		0.926	0.908	1.00	mg/L	98	96	2 %
		Boron	EPA 200.7	1303566-001	1.32		2.40	2.39	1.00	mg/L	108	107	<1%
		Cadmium	EPA 200.7	1303566-001	<0.001		0.921	0.928	1.00	mg/L	92	93	1 %
		Calcium	EPA 200.7	1303566-001	146	SC	160	161	10.0	mg/L	NC	NC	NC
		Chromium	EPA 200.7	1303566-001	<0.005		0.942	0.939	1.00	mg/L	94	94	<1%
		Cobalt	EPA 200.7	1303566-001	<0.010		0.932	0.933	1.00	mg/L	93	93	<1%
		Copper	EPA 200.7	1303566-001	<0.050		4.98	4.89	5.00	mg/L	99	98	2 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Gallium	EPA 200.7	1303566-001	<0.100	0.922	0.905	1.00	mg/L	92	90	2 %
		Iron	EPA 200.7	1303566-001	0.018	0.969	0.969	1.00	mg/L	95	95	<1%
		Lithium	EPA 200.7	1303566-001	<0.100	0.966	0.934	1.00	mg/L	89	86	3 %
		Magnesium	EPA 200.7	1303566-001	45.9	53.4	53.9	10.0	mg/L	75	80	1 %
		Manganese	EPA 200.7	1303566-001	0.733	1.72	1.71	1.00	mg/L	99	98	1 %
		Molybdenum	EPA 200.7	1303566-001	0.072	1.06	1.05	1.00	mg/L	99	98	1 %
		Nickel	EPA 200.7	1303566-001	<0.010	4.58	4.59	5.00	mg/L	91	92	<1%
		Phosphorus	EPA 200.7	1303566-001	<0.500	5.33	5.28	5.00	mg/L	105	104	1 %
		Potassium	EPA 200.7	1303566-001	4.14	14.1	13.9	10.0	mg/L	100	98	1 %
		Scandium	EPA 200.7	1303566-001	<0.100	0.971	0.968	1.00	mg/L	97	97	<1%
		Silver	EPA 200.7	1303566-001	<0.005	0.087	0.086	0.090	mg/L	97	96	1 %
		Sodium	EPA 200.7	1303566-001	379	390	391	10.0	mg/L	110	120	<1%
		Strontium	EPA 200.7	1303566-001	1.63	2.58	2.55	1.00	mg/L	95	92	1 %
		Tin	EPA 200.7	1303566-001	<0.100	0.914	0.909	1.00	mg/L	98	97	1 %
		Titanium	EPA 200.7	1303566-001	<0.100	0.981	0.985	1.00	mg/L	98	99	<1%
		Vanadium	EPA 200.7	1303566-001	0.135	1.14	1.13	1.00	mg/L	100	99	1 %
		Zinc	EPA 200.7	1303566-001	<0.010	0.983	0.994	1.00	mg/L	98	99	1 %
QC13040227	MS 1	Mercury	EPA 200.8	1303566-001	<0.00200	<0.00200	0.002000	0.001	mg/L	70	80	#Erro
		Antimony	EPA 200.8	1303566-001	<0.0025	0.0122	0.0122	0.010	mg/L	97	98	<1%
		Arsenic	EPA 200.8	1303566-001	0.1118	0.1666	0.1670	0.050	mg/L	110	110	<1%
		Lead	EPA 200.8	1303566-001	<0.0025	0.0089	0.0089	0.010	mg/L	87	86	<1%
		Selenium	EPA 200.8	1303566-001	0.0052	0.0523	0.0522	0.050	mg/L	94	94	<1%
		Thallium	EPA 200.8	1303566-001	<0.0010	0.0085	0.0086	0.010	mg/L	84	85	1 %
		Uranium	EPA 200.8	1303566-001	<0.0050	0.0143	0.0144	0.010	mg/L	98	99	1 %

1303567

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number ~~130366~~
Report Due Date: 4/11/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ____ 5-Day ____ Other ____

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER:

SAMPLE ID/LOCATION	DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
CF-11-02 (227-367) Wk:40	03/28/13	9:00	WW	2	X	X									1
CF-11-02 (52-117)															2
K-Spar Breccia 5+ Comp															3
Biotite Breccia 5+ Comp															4
Quartz Monzonite 5+ Comp															5
Biotite Breccia 0-5 Comp															6
K-Spar Breccia 0-5 Comp															7
Quartz Monzonite 0-5 Comp ↓	↓	↓	↓	↓	↓	↓									8

1303567 5 8

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 21 °C	~~3/27/13~~	14:30		
Custody Seals Intact? Y N [✓ None]	3/28/13			
Number of Containers 16				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

1303567

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tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number ~~130366~~
Report Due Date: 4/11/13
Page 1 of 1

Client	McClelland Laboratories, Inc.
Address	1016 Greg Street
City, State & Zip	Sparks, NV 89431
Contact	Mike Medina
Phone	775-356-1300
Collector's Name	Robert
Fax	775-356-8917
Project Name	
P.O. Number	
Project Number	3438
Email	mli@mettest.com

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company ______
Address ______
City, State & Zip ______
Contact ______
Phone ______
Fax ______
Email ______

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

SAMPLE ID/LOCATION	DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
CF-11-02 (227-367) Wk:40	03/28/13	9:00	WW	2	X	X									1
CF-11-02 (52-117)															2
K-Spar Breccia 5+ Comp															3
Biotite Breccia 5+ Comp															4
Quartz Monzonite 5+ Comp															5
Biotite Breccia 0-5 Comp															6
K-Spar Breccia 0-5 Comp															7
Quartz Monzonite 0-5 Comp ↓	↓	↓	↓	↓	↓	↓									8

1303567 5 8

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 21 °C	3/28/13	14:30		
Custody Seals Intact? Y N [✓ None]	3/28/13			
Number of Containers 16				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

WETLAB
WESTERN ENVIRONMENTAL
TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

4/24/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1304219*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 4/11/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Jennifer Delaney
QA Specialist

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817

ELKO
1084 Lamoille Hwy.
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933

LAS VEGAS
3230 Polaris Ave., Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 776-6152

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1304219

General Comments

None

Specific Comments

None

Data Qualifier Legend

B	-- Blank contamination; Analyte detected above the method reporting limit in an associated blank
D	-- Reporting limit is elevated due to required sample dilution
HT	-- Sample analyzed beyond the accepted holding time
J	-- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	-- Reported value is estimated; The sample matrix interfered with the analysis
N	-- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	-- Not calculated due to matrix interference
Q	-- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
S	-- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.
SC	-- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438*

Date Printed: 4/24/2013
OrderID: *1304219*

Customer Sample ID: CF-11-02 (0-27) Wk:48
WETLAB Sample ID: 1304219-001

Collect Date/Time: 4/11/2013 09:00
Receive Date: 4/11/2013 14:10

Analyte	Method	Results	Units	DF	RL	Analyzed
General Chemistry						
pH	SM 4500-H+ B	7.52	pH Units	1		4/11/2013
Bicarbonate (HCO3)	SM 2320B	46	mg/L	1	1.0	4/11/2013
Carbonate (CO3)	SM 2320B	ND	mg/L	1	1.0	4/11/2013
Hydroxide (OH)	SM 2320B	ND	mg/L	1	1.0	4/11/2013
Total Alkalinity	SM 2320B	38	mg/L as CaCO3	1	1.0	4/11/2013
Total Dissolved Solids (TDS)	SM 2540C	60	mg/L	1	10	4/16/2013
Anions by Ion Chromatography						
Chloride	EPA 300.0	ND	mg/L	1	1.00	4/12/2013
Fluoride	EPA 300.0	0.94	mg/L	1	0.10	4/12/2013
Sulfate	EPA 300.0	14	mg/L	1	1.0	4/12/2013
Nitrate Nitrogen	EPA 300.0	ND	mg/L	1	1.0	4/12/2013
Nitrite Nitrogen	EPA 300.0	ND	mg/L	1	0.025	4/12/2013
Trace Metals by ICP-OES						
Aluminum	EPA 200.7	0.060	mg/L	1	0.045	4/17/2013
Barium	EPA 200.7	ND	mg/L	1	0.010	4/17/2013
Beryllium	EPA 200.7	ND	mg/L	1	0.0010	4/17/2013
Bismuth	EPA 200.7	ND	mg/L	1	0.10	4/17/2013
Boron	EPA 200.7	ND	mg/L	1	0.10	4/18/2013
Cadmium	EPA 200.7	ND	mg/L	1	0.0010	4/17/2013
Calcium	EPA 200.7	16	mg/L	1	0.50	4/17/2013
Chromium	EPA 200.7	ND	mg/L	1	0.0050	4/17/2013
Cobalt	EPA 200.7	ND	mg/L	1	0.010	4/17/2013
Copper	EPA 200.7	ND	mg/L	1	0.050	4/17/2013
Gallium	EPA 200.7	ND	mg/L	1	0.10	4/17/2013
Iron	EPA 200.7	0.013	mg/L	1	0.010	4/17/2013
Lithium	EPA 200.7	ND	mg/L	1	0.10	4/17/2013
Magnesium	EPA 200.7	2.6	mg/L	1	0.50	4/17/2013
Manganese	EPA 200.7	0.032	mg/L	1	0.0050	4/17/2013
Molybdenum	EPA 200.7	ND	mg/L	1	0.010	4/17/2013
Nickel	EPA 200.7	ND	mg/L	1	0.010	4/17/2013
Phosphorus	EPA 200.7	ND	mg/L	1	0.50	4/17/2013
Potassium	EPA 200.7	1.4	mg/L	1	0.50	4/17/2013

Customer Sample ID: CF-11-02 (0-27) Wk:48
WETLAB Sample ID: 1304219-001
Collect Date/Time: 4/11/2013 09:00
Receive Date: 4/11/2013 14:10

Analyte	Method	Results	Units	DF	RL	Analyzed
Scandium	EPA 200.7	ND	mg/L	1	0.100	4/17/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	4/17/2013
Sodium	EPA 200.7	ND	mg/L	1	0.50	4/18/2013
Strontium	EPA 200.7	0.13	mg/L	1	0.10	4/17/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	4/17/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	4/17/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	4/17/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	4/17/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	4/19/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	4/23/2013
Arsenic	EPA 200.8	ND	mg/L	1	0.0050	4/19/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	4/19/2013
Selenium	EPA 200.8	ND	mg/L	1	0.0050	4/19/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	4/19/2013
Uranium	EPA 200.8	ND	mg/L	1	0.0050	4/19/2013
Ion Balance						
Anions	Calculation	1.09	meq/L	1	0.10	
Cations	Calculation	1.06	meq/L	1	0.10	
Error	Calculation	1.8	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		4/17/2013

Customer Sample ID: CF-11-02 (367-408) Wk:48
WETLAB Sample ID: 1304219-002
Collect Date/Time: 4/11/2013 09:00
Receive Date: 4/11/2013 14:10

Analyte	Method	Results	Units	DF	RL	Analyzed
General Chemistry						
pH	SM 4500-H+ B	7.28	pH Units	1		4/11/2013
Bicarbonate (HCO3)	SM 2320B	28	mg/L	1	1.0	4/11/2013
Carbonate (CO3)	SM 2320B	ND	mg/L	1	1.0	4/11/2013
Hydroxide (OH)	SM 2320B	ND	mg/L	1	1.0	4/11/2013
Total Alkalinity	SM 2320B	23	mg/L as CaCO3	1	1.0	4/11/2013
Total Dissolved Solids (TDS)	SM 2540C	51	mg/L	1	10	4/16/2013
Anions by Ion Chromatography						
Chloride	EPA 300.0	ND	mg/L	1	1.00	4/12/2013
Fluoride	EPA 300.0	0.86	mg/L	1	0.10	4/12/2013
Sulfate	EPA 300.0	7.5	mg/L	1	1.0	4/12/2013
Nitrate Nitrogen	EPA 300.0	ND	mg/L	1	1.0	4/12/2013
Nitrite Nitrogen	EPA 300.0	ND	mg/L	1	0.025	4/12/2013
Trace Metals by ICP-OES						
Aluminum	EPA 200.7	0.14	mg/L	1	0.045	4/17/2013
Barium	EPA 200.7	ND	mg/L	1	0.010	4/17/2013
Beryllium	EPA 200.7	ND	mg/L	1	0.0010	4/17/2013
Bismuth	EPA 200.7	ND	mg/L	1	0.10	4/17/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID: CF-11-02 (367-408) Wk:48 **Collect Date/Time:** 4/11/2013 09:00
WETLAB Sample ID: 1304219-002 **Receive Date:** 4/11/2013 14:10

Analyte	Method	Results	Units	DF	RL	Analyzed
Boron	EPA 200.7	ND	mg/L	1	0.10	4/18/2013
Cadmium	EPA 200.7	ND	mg/L	1	0.0010	4/17/2013
Calcium	EPA 200.7	13	mg/L	1	0.50	4/17/2013
Chromium	EPA 200.7	ND	mg/L	1	0.0050	4/17/2013
Cobalt	EPA 200.7	ND	mg/L	1	0.010	4/17/2013
Copper	EPA 200.7	ND	mg/L	1	0.050	4/17/2013
Gallium	EPA 200.7	ND	mg/L	1	0.10	4/17/2013
Iron	EPA 200.7	ND	mg/L	1	0.010	4/17/2013
Lithium	EPA 200.7	ND	mg/L	1	0.10	4/17/2013
Magnesium	EPA 200.7	ND	mg/L	1	0.50	4/17/2013
Manganese	EPA 200.7	0.024	mg/L	1	0.0050	4/17/2013
Molybdenum	EPA 200.7	ND	mg/L	1	0.010	4/17/2013
Nickel	EPA 200.7	ND	mg/L	1	0.010	4/17/2013
Phosphorus	EPA 200.7	ND	mg/L	1	0.50	4/17/2013
Potassium	EPA 200.7	0.83	mg/L	1	0.50	4/17/2013
Scandium	EPA 200.7	ND	mg/L	1	0.100	4/17/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	4/17/2013
Sodium	EPA 200.7	ND	mg/L	1	0.50	4/18/2013
Strontium	EPA 200.7	ND	mg/L	1	0.10	4/17/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	4/17/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	4/17/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	4/17/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	4/17/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	4/19/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	4/23/2013
Arsenic	EPA 200.8	ND	mg/L	1	0.0050	4/19/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	4/19/2013
Selenium	EPA 200.8	ND	mg/L	1	0.0050	4/19/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	4/19/2013
Uranium	EPA 200.8	ND	mg/L	1	0.0050	4/19/2013
Ion Balance						
Anions	Calculation	0.66	meq/L	1	0.10	
Cations	Calculation	0.69	meq/L	1	0.10	
Error	Calculation	1.9	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		4/17/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13040485	Blank 1	Fluoride	EPA 300.0	ND	mg/L
QC13040485	Blank 2	Fluoride	EPA 300.0	ND	mg/L
QC13040485	Blank 3	Fluoride	EPA 300.0	ND	mg/L
QC13040487	Blank 1	Chloride	EPA 300.0	ND	mg/L
QC13040487	Blank 2	Chloride	EPA 300.0	ND	mg/L
QC13040487	Blank 3	Chloride	EPA 300.0	ND	mg/L
QC13040489	Blank 1	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13040489	Blank 2	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13040489	Blank 3	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13040493	Blank 1	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13040493	Blank 2	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13040493	Blank 3	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13040496	Blank 1	Sulfate	EPA 300.0	ND	mg/L
QC13040496	Blank 2	Sulfate	EPA 300.0	ND	mg/L
QC13040496	Blank 3	Sulfate	EPA 300.0	ND	mg/L
QC13040618	Blank 1	Aluminum	EPA 200.7	ND	mg/L
		Barium	EPA 200.7	ND	mg/L
		Beryllium	EPA 200.7	ND	mg/L
		Bismuth	EPA 200.7	ND	mg/L
		Boron	EPA 200.7	ND	mg/L
		Cadmium	EPA 200.7	ND	mg/L
		Calcium	EPA 200.7	ND	mg/L
		Chromium	EPA 200.7	ND	mg/L
		Cobalt	EPA 200.7	ND	mg/L
		Copper	EPA 200.7	ND	mg/L
		Gallium	EPA 200.7	ND	mg/L
		Iron	EPA 200.7	ND	mg/L
		Lithium	EPA 200.7	ND	mg/L
		Magnesium	EPA 200.7	ND	mg/L
		Manganese	EPA 200.7	ND	mg/L
		Molybdenum	EPA 200.7	ND	mg/L
		Nickel	EPA 200.7	ND	mg/L
		Phosphorus	EPA 200.7	ND	mg/L
		Potassium	EPA 200.7	ND	mg/L
		Scandium	EPA 200.7	ND	mg/L
		Silver	EPA 200.7	ND	mg/L
		Sodium	EPA 200.7	ND	mg/L
		Strontium	EPA 200.7	ND	mg/L
		Tin	EPA 200.7	ND	mg/L
		Titanium	EPA 200.7	ND	mg/L
		Vanadium	EPA 200.7	ND	mg/L
		Zinc	EPA 200.7	ND	mg/L
QC13040630	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13040630	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13040687	Blank 1	Mercury	EPA 200.8	ND	mg/L
		Antimony	EPA 200.8	ND	mg/L

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

QCBatchID	QCType	Parameter	Method	Result	Units
		Arsenic	EPA 200.8	ND	mg/L
		Lead	EPA 200.8	ND	mg/L
		Selenium	EPA 200.8	ND	mg/L
		Thallium	EPA 200.8	ND	mg/L
		Uranium	EPA 200.8	ND	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13040432	LCS 1	pH	SM 4500-H+ B	6.99	7.00	100	pH Units
QC13040432	LCS 2	pH	SM 4500-H+ B	6.99	7.00	100	pH Units
QC13040432	LCS 3	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13040433	LCS 1	Total Alkalinity	SM 2320B	98.5	100	98	mg/L
QC13040433	LCS 2	Total Alkalinity	SM 2320B	98.4	100	98	mg/L
QC13040433	LCS 3	Total Alkalinity	SM 2320B	98.5	100	98	mg/L
QC13040433	LCS 4	Total Alkalinity	SM 2320B	98.8	100	99	mg/L
QC13040485	LCS 1	Fluoride	EPA 300.0	1.91	2.00	95	mg/L
QC13040487	LCS 1	Chloride	EPA 300.0	10.2	10.0	102	mg/L
QC13040489	LCS 1	Nitrite Nitrogen	EPA 300.0	0.454	0.500	91	mg/L
QC13040493	LCS 1	Nitrate Nitrogen	EPA 300.0	1.97	2.00	98	mg/L
QC13040496	LCS 1	Sulfate	EPA 300.0	24.3	25.0	97	mg/L
QC13040618	LCS 1	Aluminum	EPA 200.7	1.00	1.00	100	mg/L
		Barium	EPA 200.7	0.986	1.00	99	mg/L
		Beryllium	EPA 200.7	0.966	1.00	97	mg/L
		Bismuth	EPA 200.7	1.03	1.00	103	mg/L
		Boron	EPA 200.7	0.972	1.00	97	mg/L
		Cadmium	EPA 200.7	0.990	1.00	99	mg/L
		Calcium	EPA 200.7	9.82	10.0	98	mg/L
		Chromium	EPA 200.7	0.974	1.00	97	mg/L
		Cobalt	EPA 200.7	0.980	1.00	98	mg/L
		Copper	EPA 200.7	4.83	5.00	97	mg/L
		Gallium	EPA 200.7	0.986	1.00	99	mg/L
		Iron	EPA 200.7	0.971	1.00	97	mg/L
		Lithium	EPA 200.7	0.952	1.00	95	mg/L
		Magnesium	EPA 200.7	9.56	10.0	96	mg/L
		Manganese	EPA 200.7	0.971	1.00	97	mg/L
		Molybdenum	EPA 200.7	0.990	1.00	99	mg/L
		Nickel	EPA 200.7	4.89	5.00	98	mg/L
		Phosphorus	EPA 200.7	4.99	5.00	100	mg/L
		Potassium	EPA 200.7	9.77	10.0	98	mg/L
		Scandium	EPA 200.7	0.969	1.00	97	mg/L
		Silver	EPA 200.7	0.088	0.090	98	mg/L
		Sodium	EPA 200.7	9.84	10.0	98	mg/L
		Strontium	EPA 200.7	0.979	1.00	98	mg/L
		Tin	EPA 200.7	0.980	1.00	98	mg/L
		Titanium	EPA 200.7	0.970	1.00	97	mg/L
		Vanadium	EPA 200.7	0.976	1.00	98	mg/L
		Zinc	EPA 200.7	0.989	1.00	99	mg/L
QC13040630	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	144	150	96	mg/L
QC13040630	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	137	150	92	mg/L
QC13040687	LCS 1	Mercury	EPA 200.8	0.000934	0.001	93	mg/L
		Antimony	EPA 200.8	0.0088	0.010	88	mg/L
		Arsenic	EPA 200.8	0.0500	0.050	100	mg/L
		Lead	EPA 200.8	0.0099	0.010	99	mg/L
		Selenium	EPA 200.8	0.0497	0.050	99	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
		Thallium	EPA 200.8	0.0098	0.010	98	mg/L
		Uranium	EPA 200.8	0.0097	0.010	97	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC13040432	Duplicate	pH	SM 4500-H+ B	1304219-001	7.52	7.51	pH Units	<1%
QC13040432	Duplicate	pH	SM 4500-H+ B	1304234-001	8.79	8.80	pH Units	<1%
QC13040432	Duplicate	pH	SM 4500-H+ B	1304233-004	7.34	7.36	pH Units	<1%
QC13040432	Duplicate	pH	SM 4500-H+ B	1304234-006	7.80	7.81	pH Units	<1%
QC13040433	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304219-001	46.2	46.0	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1304219-001	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1304219-001	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1304219-001	37.9	37.8	mg/L as CaCO3	<1%
QC13040433	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304234-001	242	243	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1304234-001	21.4	21.1	mg/L	2 %
		Hydroxide (OH)	SM 2320B	1304234-001	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1304234-001	234	234	mg/L as CaCO3	<1%
QC13040433	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304233-004	152	152	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1304233-004	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1304233-004	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1304233-004	125	125	mg/L as CaCO3	<1%
QC13040433	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304234-006	172	171	mg/L	1 %
		Carbonate (CO3)	SM 2320B	1304234-006	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1304234-006	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1304234-006	141	140	mg/L as CaCO3	1 %
QC13040433	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304221-001	87.9	88.8	mg/L	1 %
		Carbonate (CO3)	SM 2320B	1304221-001	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1304221-001	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1304221-001	72.1	72.8	mg/L as CaCO3	1 %
QC13040630	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1304237-001	215	214	mg/L	<1%
QC13040630	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1304239-001	477	466	mg/L	2 %
QC13040630	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1304239-009	275	269	mg/L	2 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13040485	MS 1	Fluoride	EPA 300.0	1304219-002	0.857	2.78	2.88	2.00	mg/L	96	101	4 %
QC13040485	MS 2	Fluoride	EPA 300.0	1304249-013	0.396	2.41	2.40	2.00	mg/L	101	100	<1%
QC13040487	MS 1	Chloride	EPA 300.0	1304219-002	ND	5.24	5.31	5.00	mg/L	105	106	1 %
QC13040487	MS 2	Chloride	EPA 300.0	1304249-001	ND	5.81	5.86	5.00	mg/L	106	107	1 %
QC13040489	MS 1	Nitrite Nitrogen	EPA 300.0	1304219-002	ND	0.494	0.499	0.500	mg/L	99	100	1 %
QC13040489	MS 2	Nitrite Nitrogen	EPA 300.0	1304249-001	ND	0.492	0.498	0.500	mg/L	98	100	1 %
QC13040493	MS 1	Nitrate Nitrogen	EPA 300.0	1304219-002	ND	2.10	2.13	2.00	mg/L	104	105	1 %
QC13040493	MS 2	Nitrate Nitrogen	EPA 300.0	1304239-004	6.08	27.4	27.6	2.00	mg/L	107	108	1 %
QC13040496	MS 1	Sulfate	EPA 300.0	1304219-002	7.55	18.0	18.1	10.0	mg/L	104	106	1 %
QC13040496	MS 2	Sulfate	EPA 300.0	1304249-013	4.02	14.4	14.5	10.0	mg/L	104	105	1 %
QC13040618	MS 1	Aluminum	EPA 200.7	1304221-005	ND	0.850	0.850	1.00	mg/L	82	82	<1%

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Barium	EPA 200.7	1304221-005	0.170		1.13	1.13	1.00	mg/L	96	96	<1%
		Beryllium	EPA 200.7	1304221-005	ND		1.02	1.01	1.00	mg/L	102	101	1 %
		Bismuth	EPA 200.7	1304221-005	ND		0.962	0.966	1.00	mg/L	98	99	<1%
		Boron	EPA 200.7	1304221-005	17.5	SC	19.6	19.7	1.00	mg/L	NC	NC	NC
		Cadmium	EPA 200.7	1304221-005	ND		1.02	1.02	1.00	mg/L	102	102	<1%
		Calcium	EPA 200.7	1304221-005	67.4		77.8	77.1	10.0	mg/L	104	97	1 %
		Chromium	EPA 200.7	1304221-005	ND		0.954	0.952	1.00	mg/L	95	95	<1%
		Cobalt	EPA 200.7	1304221-005	ND		0.932	0.940	1.00	mg/L	93	94	1 %
		Copper	EPA 200.7	1304221-005	ND		5.21	5.18	5.00	mg/L	104	103	1 %
		Gallium	EPA 200.7	1304221-005	ND		0.849	0.848	1.00	mg/L	84	84	<1%
		Iron	EPA 200.7	1304221-005	0.065		1.02	1.05	1.00	mg/L	96	99	3 %
		Lithium	EPA 200.7	1304221-005	2.25		3.43	3.40	1.00	mg/L	118	115	1 %
		Magnesium	EPA 200.7	1304221-005	ND		9.51	9.54	10.0	mg/L	91	91	<1%
		Manganese	EPA 200.7	1304221-005	0.012		0.964	0.958	1.00	mg/L	95	95	1 %
		Molybdenum	EPA 200.7	1304221-005	ND		0.962	0.969	1.00	mg/L	98	99	1 %
		Nickel	EPA 200.7	1304221-005	ND		4.82	4.80	5.00	mg/L	96	96	<1%
		Phosphorus	EPA 200.7	1304221-005	ND		5.50	5.56	5.00	mg/L	107	109	1 %
		Potassium	EPA 200.7	1304221-005	111		124	124	10.0	mg/L	130	130	<1%
		Scandium	EPA 200.7	1304221-005	ND		0.976	0.974	1.00	mg/L	98	97	<1%
		Silver	EPA 200.7	1304221-005	ND		0.089	0.088	0.090	mg/L	100	99	1 %
		Sodium	EPA 200.7	1304221-005	1440	SC	1510	1520	10.0	mg/L	NC	NC	NC
		Strontium	EPA 200.7	1304221-005	2.46		3.46	3.41	1.00	mg/L	100	95	1 %
		Tin	EPA 200.7	1304221-005	ND		0.929	0.942	1.00	mg/L	97	98	1 %
		Titanium	EPA 200.7	1304221-005	ND		0.975	0.972	1.00	mg/L	98	97	<1%
		Vanadium	EPA 200.7	1304221-005	ND		0.998	0.995	1.00	mg/L	99	99	<1%
		Zinc	EPA 200.7	1304221-005	ND		1.05	1.06	1.00	mg/L	105	106	1 %
QC13040687	MS 1	Mercury	EPA 200.8	1304221-005	ND		0.001400	0.001300	0.001	mg/L	110	100	7 %
		Antimony	EPA 200.8	1304221-005	ND		<0.0125	<0.0125	0.010	mg/L	107	110	#Erro
		Arsenic	EPA 200.8	1304221-005	0.0129	M	0.0415	0.0421	0.050	mg/L	NC	NC	NC
		Lead	EPA 200.8	1304221-005	ND		0.0076	0.0079	0.010	mg/L	74	76	4 %
		Selenium	EPA 200.8	1304221-005	ND	M	0.0410	0.0403	0.050	mg/L	NC	NC	NC
		Thallium	EPA 200.8	1304221-005	ND		0.0074	0.0077	0.010	mg/L	74	76	4 %
		Uranium	EPA 200.8	1304221-005	ND		0.0080	0.0083	0.010	mg/L	80	83	4 %

WETLAB
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Lab Number 1304219
Report Due Date: 4/25/13
Page 1 of 1

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City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ______ 5 Day ______ Other ______

Billing Address (if different than Client Address):
Company ______
Address ______
City, State & Zip ______
Contact ______
Phone ______
Fax ______
Email ______

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

SAMPLE ID/LOCATION	DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
CF-11-02 (0-27) Wk:48	04/11/13	9:00	WW	2	X	X									1
CF-11-02 (367-408) ↓	↓	↓	↓	↓	↓	↓									2

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 19.5 °C	4/11/13	1410		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 4				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1304219
Report Due Date: 4/25/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ___ 5 Day ___ Other ___

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

Analyses Requested

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
CF-11-02 (0-27)	Wk:48	04/11/13	9:00	WW	2	X	X									1
CF-11-02 (367-408)	↓	↓	↓	↓	↓	↓	↓									2

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 19.5 °C	4/11/13	1410		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 4				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

WETLAB
WESTERN ENVIRONMENTAL
TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

4/30/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1304347*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 4/18/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

ASmith

Andy Smith
QA Manager

McClelland Laboratory - 1304347

General Comments

None

Specific Comments

Due to the sample matrix it was necessary to analyze the following at a dilution:
1304347-001 Arsenic, Selenium
The reporting limits have been adjusted accordingly.

Data Qualifier Legend

B	-- Blank contamination; Analyte detected above the method reporting limit in an associated blank
D	-- Reporting limit is elevated due to required sample dilution
DF	-- Dilution Factor
HT	-- Sample analyzed beyond the accepted holding time
J	-- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	-- Reported value is estimated; The sample matrix interfered with the analysis
MCL	-- State or EPA Maximum Contamination Level
N	-- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	-- Not calculated due to matrix interference
ND	-- Non-detect result; Indicates the result was below the reporting limit (RL)
Q	-- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
RL	-- Reporting Limit or Practical Quantitation Limit
S	-- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits
SC	-- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438*

Date Printed: 4/30/2013
OrderID: *1304347*

Customer Sample ID: 604 673
WETLAB Sample ID: 1304347-001

Collect Date/Time: 4/18/2013 09:00
Receive Date: 4/18/2013 14:05

Analyte	Method	Results		Units	DF	RL	Analyzed
General Chemistry							
pH	SM 4500-H+ B	4.71	Q	pH Units	1		4/18/2013
Bicarbonate (HCO3)	SM 2320B	ND		mg/L	1	1.0	4/18/2013
Carbonate (CO3)	SM 2320B	ND		mg/L	1	1.0	4/18/2013
Hydroxide (OH)	SM 2320B	ND		mg/L	1	1.0	4/18/2013
Total Alkalinity	SM 2320B	ND		mg/L as CaCO3	1	1.0	4/18/2013
Total Dissolved Solids (TDS)	SM 2540C	59		mg/L	1	10	4/23/2013
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND		mg/L	1	1.00	4/19/2013
Fluoride	EPA 300.0	0.18		mg/L	1	0.10	4/19/2013
Sulfate	EPA 300.0	28		mg/L	1	1.0	4/19/2013
Nitrate Nitrogen	EPA 300.0	ND		mg/L	1	1.0	4/19/2013
Nitrite Nitrogen	EPA 300.0	ND		mg/L	1	0.025	4/19/2013
Trace Metals by ICP-OES							
Aluminum	EPA 200.7	0.19		mg/L	1	0.045	4/23/2013
Barium	EPA 200.7	0.065		mg/L	1	0.010	4/23/2013
Beryllium	EPA 200.7	ND		mg/L	1	0.0010	4/23/2013
Bismuth	EPA 200.7	ND		mg/L	1	0.10	4/23/2013
Boron	EPA 200.7	ND		mg/L	1	0.10	4/23/2013
Cadmium	EPA 200.7	ND		mg/L	1	0.0010	4/23/2013
Calcium	EPA 200.7	7.0		mg/L	1	0.50	4/23/2013
Chromium	EPA 200.7	ND		mg/L	1	0.0050	4/23/2013
Cobalt	EPA 200.7	ND		mg/L	1	0.010	4/23/2013
Copper	EPA 200.7	2.8		mg/L	1	0.050	4/23/2013
Gallium	EPA 200.7	ND		mg/L	1	0.10	4/23/2013
Iron	EPA 200.7	0.064		mg/L	1	0.010	4/23/2013
Lithium	EPA 200.7	ND		mg/L	1	0.10	4/23/2013
Magnesium	EPA 200.7	0.96		mg/L	1	0.50	4/23/2013
Manganese	EPA 200.7	0.053		mg/L	1	0.0050	4/23/2013
Molybdenum	EPA 200.7	ND		mg/L	1	0.010	4/23/2013
Nickel	EPA 200.7	ND		mg/L	1	0.010	4/23/2013
Phosphorus	EPA 200.7	ND		mg/L	1	0.50	4/23/2013
Potassium	EPA 200.7	0.71		mg/L	1	0.50	4/23/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID: 604 673
WETLAB Sample ID: 1304347-001

Collect Date/Time: 4/18/2013 09:00
Receive Date: 4/18/2013 14:05

Analyte	Method	Results	Units	DF	RL	Analyzed
Scandium	EPA 200.7	ND	mg/L	1	0.100	4/23/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	4/23/2013
Sodium	EPA 200.7	0.58	mg/L	1	0.50	4/23/2013
Strontium	EPA 200.7	ND	mg/L	1	0.10	4/23/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	4/23/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	4/23/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	4/23/2013
Zinc	EPA 200.7	0.058	mg/L	1	0.010	4/23/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	4/23/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	4/23/2013
Arsenic	EPA 200.8	ND	mg/L	5	0.015	4/24/2013
Lead	EPA 200.8	0.011	mg/L	1	0.0025	4/23/2013
Selenium	EPA 200.8	ND	mg/L	5	0.025	4/24/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	4/23/2013
Uranium	EPA 200.8	0.026	mg/L	1	0.0050	4/23/2013
Ion Balance						
Anions	Calculation	0.59	meq/L	1	0.10	
Cations	Calculation	0.59	meq/L	1	0.10	
Error	Calculation	ND	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		4/22/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13040691	Blank 1	Fluoride	EPA 300.0	ND	mg/L
QC13040691	Blank 2	Fluoride	EPA 300.0	ND	mg/L
QC13040691	Blank 3	Fluoride	EPA 300.0	ND	mg/L
QC13040693	Blank 1	Chloride	EPA 300.0	ND	mg/L
QC13040693	Blank 2	Chloride	EPA 300.0	ND	mg/L
QC13040693	Blank 3	Chloride	EPA 300.0	ND	mg/L
QC13040695	Blank 1	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13040695	Blank 2	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13040695	Blank 3	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13040696	Blank 1	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13040696	Blank 2	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13040696	Blank 3	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13040697	Blank 1	Sulfate	EPA 300.0	ND	mg/L
QC13040697	Blank 2	Sulfate	EPA 300.0	ND	mg/L
QC13040697	Blank 3	Sulfate	EPA 300.0	ND	mg/L
QC13040772	Blank 1	Aluminum, Dissolved	EPA 200.7	ND	mg/L
		Barium, Dissolved	EPA 200.7	ND	mg/L
		Beryllium, Dissolved	EPA 200.7	ND	mg/L
		Bismuth, Dissolved	EPA 200.7	ND	mg/L
		Boron, Dissolved	EPA 200.7	ND	mg/L
		Cadmium, Dissolved	EPA 200.7	ND	mg/L
		Calcium, Dissolved	EPA 200.7	ND	mg/L
		Chromium, Dissolved	EPA 200.7	ND	mg/L
		Cobalt, Dissolved	EPA 200.7	ND	mg/L
		Copper, Dissolved	EPA 200.7	ND	mg/L
		Gallium, Dissolved	EPA 200.7	ND	mg/L
		Iron, Dissolved	EPA 200.7	ND	mg/L
		Lithium, Dissolved	EPA 200.7	ND	mg/L
		Magnesium, Dissolved	EPA 200.7	ND	mg/L
		Manganese, Dissolved	EPA 200.7	ND	mg/L
		Molybdenum, Dissolved	EPA 200.7	ND	mg/L
		Nickel, Dissolved	EPA 200.7	ND	mg/L
		Phosphorus, Dissolved	EPA 200.7	ND	mg/L
		Potassium, Dissolved	EPA 200.7	ND	mg/L
		Scandium, Dissolved	EPA 200.7	ND	mg/L
		Silver, Dissolved	EPA 200.7	ND	mg/L
		Sodium, Dissolved	EPA 200.7	ND	mg/L
		Strontium, Dissolved	EPA 200.7	ND	mg/L
		Tin, Dissolved	EPA 200.7	ND	mg/L
		Titanium, Dissolved	EPA 200.7	ND	mg/L
		Vanadium, Dissolved	EPA 200.7	ND	mg/L
		Zinc, Dissolved	EPA 200.7	ND	mg/L
QC13040791	Blank 1	Uranium, Dissolved	EPA 200.8	ND	mg/L
		Mercury, Dissolved	EPA 200.8	ND	mg/L
		Antimony, Dissolved	EPA 200.8	ND	mg/L
		Arsenic, Dissolved	EPA 200.8	ND	mg/L

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

QCBatchID	QCType	Parameter	Method	Result	Units
		Lead, Dissolved	EPA 200.8	ND	mg/L
		Selenium, Dissolved	EPA 200.8	ND	mg/L
		Thallium, Dissolved	EPA 200.8	ND	mg/L
QC13040886	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13040886	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13040660	LCS 1	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13040660	LCS 2	pH	SM 4500-H+ B	6.99	7.00	100	pH Units
QC13040660	LCS 3	pH	SM 4500-H+ B	6.98	7.00	100	pH Units
QC13040663	LCS 1	Total Alkalinity	SM 2320B	99.3	100	99	mg/L
QC13040663	LCS 2	Total Alkalinity	SM 2320B	99.1	100	99	mg/L
QC13040663	LCS 3	Total Alkalinity	SM 2320B	99.7	100	100	mg/L
QC13040663	LCS 4	Total Alkalinity	SM 2320B	100	100	100	mg/L
QC13040691	LCS 1	Fluoride	EPA 300.0	2.03	2.00	101	mg/L
QC13040693	LCS 1	Chloride	EPA 300.0	10.2	10.0	102	mg/L
QC13040695	LCS 1	Nitrite Nitrogen	EPA 300.0	0.474	0.500	95	mg/L
QC13040696	LCS 1	Nitrate Nitrogen	EPA 300.0	1.95	2.00	97	mg/L
QC13040697	LCS 1	Sulfate	EPA 300.0	24.5	25.0	98	mg/L
QC13040772	LCS 1	Aluminum, Dissolved	EPA 200.7	0.989	1.00	99	mg/L
		Barium, Dissolved	EPA 200.7	0.966	1.00	97	mg/L
		Beryllium, Dissolved	EPA 200.7	0.968	1.00	97	mg/L
		Bismuth, Dissolved	EPA 200.7	0.958	1.00	96	mg/L
		Boron, Dissolved	EPA 200.7	0.947	1.00	95	mg/L
		Cadmium, Dissolved	EPA 200.7	0.966	1.00	97	mg/L
		Calcium, Dissolved	EPA 200.7	9.65	10.0	96	mg/L
		Chromium, Dissolved	EPA 200.7	0.963	1.00	96	mg/L
		Cobalt, Dissolved	EPA 200.7	0.946	1.00	95	mg/L
		Copper, Dissolved	EPA 200.7	4.80	5.00	96	mg/L
		Gallium, Dissolved	EPA 200.7	0.977	1.00	98	mg/L
		Iron, Dissolved	EPA 200.7	0.954	1.00	95	mg/L
		Lithium, Dissolved	EPA 200.7	0.963	1.00	96	mg/L
		Magnesium, Dissolved	EPA 200.7	9.50	10.0	95	mg/L
		Manganese, Dissolved	EPA 200.7	0.958	1.00	96	mg/L
		Molybdenum, Dissolved	EPA 200.7	0.939	1.00	94	mg/L
		Nickel, Dissolved	EPA 200.7	4.82	5.00	96	mg/L
		Phosphorus, Dissolved	EPA 200.7	4.77	5.00	95	mg/L
		Potassium, Dissolved	EPA 200.7	9.81	10.0	98	mg/L
		Scandium, Dissolved	EPA 200.7	0.970	1.00	97	mg/L
		Silver, Dissolved	EPA 200.7	0.086	0.090	96	mg/L
		Sodium, Dissolved	EPA 200.7	10.0	10.0	100	mg/L
		Strontium, Dissolved	EPA 200.7	0.968	1.00	97	mg/L
		Tin, Dissolved	EPA 200.7	0.938	1.00	94	mg/L
		Titanium, Dissolved	EPA 200.7	0.953	1.00	95	mg/L
		Vanadium, Dissolved	EPA 200.7	0.954	1.00	95	mg/L
		Zinc, Dissolved	EPA 200.7	0.965	1.00	96	mg/L
QC13040791	LCS 1	Uranium, Dissolved	EPA 200.8	0.0093	0.010	93	mg/L
		Mercury, Dissolved	EPA 200.8	0.000952	0.001	95	mg/L
		Antimony, Dissolved	EPA 200.8	0.0096	0.010	96	mg/L
		Arsenic, Dissolved	EPA 200.8	0.0502	0.050	100	mg/L
		Lead, Dissolved	EPA 200.8	0.0095	0.010	95	mg/L
		Selenium, Dissolved	EPA 200.8	0.0440	0.050	88	mg/L
		Thallium, Dissolved	EPA 200.8	0.0096	0.010	96	mg/L

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13040886	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	163	150	108	mg/L
QC13040886	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	148	150	99	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result		Units	RPD
QC13040660	Duplicate	pH	SM 4500-H+ B	1304338-001	7.98	8.00		pH Units	<1%
QC13040660	Duplicate	pH	SM 4500-H+ B	1304347-001	4.71	4.94	Q	pH Units	5 %
QC13040660	Duplicate	pH	SM 4500-H+ B	1304349-001	5.81	5.71		pH Units	2 %
QC13040660	Duplicate	pH	SM 4500-H+ B	1304356-002	9.54	9.71	Q	pH Units	2 %
QC13040660	Duplicate	pH	SM 4500-H+ B	1304351-006	7.87	7.87		pH Units	<1%
QC13040660	Duplicate	pH	SM 4500-H+ B	1304352-004	7.63	7.51	Q	pH Units	2 %
QC13040663	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304338-001	179	179		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1304338-001	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1304338-001	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1304338-001	146	146		mg/L as CaCO3	<1%
QC13040663	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304347-001	ND	ND		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1304347-001	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1304347-001	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1304347-001	ND	ND		mg/L as CaCO3	<1%
QC13040663	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304349-001	ND	ND	Q	mg/L	23 %
		Carbonate (CO3)	SM 2320B	1304349-001	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1304349-001	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1304349-001	ND	ND	Q	mg/L as CaCO3	23 %
QC13040663	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304356-002	131	97.5	Q	mg/L	29 %
		Carbonate (CO3)	SM 2320B	1304356-002	199	219		mg/L	9 %
		Hydroxide (OH)	SM 2320B	1304356-002	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1304356-002	438	443		mg/L as CaCO3	1 %
QC13040663	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304351-006	183	183		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1304351-006	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1304351-006	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1304351-006	150	150		mg/L as CaCO3	<1%
QC13040663	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304352-004	176	175		mg/L	1 %
		Carbonate (CO3)	SM 2320B	1304352-004	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1304352-004	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1304352-004	145	144		mg/L as CaCO3	1 %
QC13040886	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1304347-001	59.0	55.0		mg/L	7 %
QC13040886	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1304353-009	223	224		mg/L	<1%
QC13040886	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1304374-006	180	181		mg/L	1 %
QC13040886	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1304375-006	237	243		mg/L	2 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13040691	MS 1	Fluoride	EPA 300.0	1304349-001	ND		2.28	2.31	2.00	mg/L	114	116	1 %
QC13040691	MS 2	Fluoride	EPA 300.0	1304379-001	0.259	M	5.59	5.89	2.00	mg/L	NC	NC	NC

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13040693	MS 1	Chloride	EPA 300.0	1304349-001	ND		5.18	5.37	5.00	mg/L	104	108	4 %
QC13040693	MS 2	Chloride	EPA 300.0	1304355-001	19.7		46.2	46.3	5.00	mg/L	106	106	<1%
QC13040695	MS 1	Nitrite Nitrogen	EPA 300.0	1304349-001	ND		0.430	0.405	0.500	mg/L	86	81	6 %
QC13040695	MS 2	Nitrite Nitrogen	EPA 300.0	1304381-009	ND		0.465	0.482	0.500	mg/L	91	95	4 %
QC13040696	MS 1	Nitrate Nitrogen	EPA 300.0	1304349-001	ND		2.10	2.17	2.00	mg/L	104	107	3 %
QC13040696	MS 2	Nitrate Nitrogen	EPA 300.0	1304381-009	ND		2.17	2.20	2.00	mg/L	105	106	1 %
QC13040697	MS 1	Sulfate	EPA 300.0	1304349-001	2.18		13.0	13.3	10.0	mg/L	108	112	2 %
QC13040697	MS 2	Sulfate	EPA 300.0	1304379-001	142	M	171	173	10.0	mg/L	NC	NC	NC
QC13040772	MS 1	Aluminum, Dissolved	EPA 200.7	1304351-001	1.37		2.40	2.39	1.00	mg/L	103	102	<1%
		Barium, Dissolved	EPA 200.7	1304351-001	0.076		1.04	1.03	1.00	mg/L	96	95	1 %
		Beryllium, Dissolved	EPA 200.7	1304351-001	ND		0.988	0.983	1.00	mg/L	99	98	1 %
		Bismuth, Dissolved	EPA 200.7	1304351-001	ND		0.968	0.970	1.00	mg/L	97	97	<1%
		Boron, Dissolved	EPA 200.7	1304351-001	ND		0.982	0.975	1.00	mg/L	97	97	1 %
		Cadmium, Dissolved	EPA 200.7	1304351-001	ND		0.982	0.976	1.00	mg/L	98	98	1 %
		Calcium, Dissolved	EPA 200.7	1304351-001	87.8	SC	106	105	10.0	mg/L	NC	NC	NC
		Chromium, Dissolved	EPA 200.7	1304351-001	ND		0.968	0.964	1.00	mg/L	96	96	<1%
		Cobalt, Dissolved	EPA 200.7	1304351-001	0.031		0.964	0.953	1.00	mg/L	93	92	1 %
		Copper, Dissolved	EPA 200.7	1304351-001	ND		4.78	4.78	5.00	mg/L	96	96	<1%
		Gallium, Dissolved	EPA 200.7	1304351-001	ND		0.994	0.991	1.00	mg/L	99	99	<1%
		Iron, Dissolved	EPA 200.7	1304351-001	0.012		0.975	0.968	1.00	mg/L	96	96	1 %
		Lithium, Dissolved	EPA 200.7	1304351-001	ND		0.950	0.960	1.00	mg/L	92	93	1 %
		Magnesium, Dissolved	EPA 200.7	1304351-001	18.0		29.0	28.5	10.0	mg/L	110	105	2 %
		Manganese, Dissolved	EPA 200.7	1304351-001	ND		0.962	0.957	1.00	mg/L	96	96	1 %
		Molybdenum, Dissolved	EPA 200.7	1304351-001	0.159		1.12	1.11	1.00	mg/L	96	95	1 %
		Nickel, Dissolved	EPA 200.7	1304351-001	ND		4.81	4.79	5.00	mg/L	96	96	<1%
		Phosphorus, Dissolved	EPA 200.7	1304351-001	ND		5.20	5.17	5.00	mg/L	102	101	1 %
		Potassium, Dissolved	EPA 200.7	1304351-001	28.6		40.9	41.2	10.0	mg/L	123	126	1 %
		Scandium, Dissolved	EPA 200.7	1304351-001	ND		0.966	0.964	1.00	mg/L	97	96	<1%
		Silver, Dissolved	EPA 200.7	1304351-001	ND		0.086	0.087	0.090	mg/L	94	95	1 %
		Sodium, Dissolved	EPA 200.7	1304351-001	50.2	SC	63.7	64.2	10.0	mg/L	NC	NC	NC
		Strontium, Dissolved	EPA 200.7	1304351-001	0.689		1.69	1.71	1.00	mg/L	100	102	1 %
		Tin, Dissolved	EPA 200.7	1304351-001	ND		0.962	0.949	1.00	mg/L	97	95	1 %
		Titanium, Dissolved	EPA 200.7	1304351-001	ND		0.961	0.957	1.00	mg/L	96	96	<1%
		Vanadium, Dissolved	EPA 200.7	1304351-001	0.063		1.04	1.03	1.00	mg/L	98	97	1 %
		Zinc, Dissolved	EPA 200.7	1304351-001	ND		0.960	0.970	1.00	mg/L	96	97	1 %
QC13040791	MS 1	Uranium, Dissolved	EPA 200.8	1304351-001	ND		0.0091	0.0090	0.010	mg/L	89	88	1 %
		Mercury, Dissolved	EPA 200.8	1304351-001	ND		0.000845	0.000832	0.001	mg/L	76	75	2 %
		Antimony, Dissolved	EPA 200.8	1304351-001	0.0302		0.0391	0.0389	0.010	mg/L	89	88	1 %
		Arsenic, Dissolved	EPA 200.8	1304351-001	0.1748		0.2297	0.2298	0.050	mg/L	110	110	<1%
		Lead, Dissolved	EPA 200.8	1304351-001	ND		0.0083	0.0082	0.010	mg/L	83	82	1 %
		Selenium, Dissolved	EPA 200.8	1304351-001	0.0140		0.0633	0.0629	0.050	mg/L	98	98	1 %
		Thallium, Dissolved	EPA 200.8	1304351-001	0.0115		0.0202	0.0198	0.010	mg/L	87	83	2 %

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1304347
Report Due Date: ~~4/~~DS 5/2/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company ______
Address ______
City, State & Zip ______
Contact ______
Phone ______
Fax ______
Email ______

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

SAMPLE ID/LOCATION	DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
604 673 Wk:116	04/18/13	9:00	WW	2	X	X									1

1304 5
347 1

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 21.5 °C	4/18/13	1405		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 6				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

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Lab Number 1304347
Report Due Date: ~~4/25~~ 5/2/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company ______
Address ______
City, State & Zip ______
Contact ______
Phone ______
Fax ______
Email ______

Additional Information
Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes
DW = Drinking Water SD = Solid
WW = Wastewater SO = Soil
SW = Surface Water HW = Hazardous Waste
MW = Monitoring Well OTHER: ______

Analyses Requested

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
604 673	Wk:116	04/18/13	9:00	WW	2	X	X									1

1304 5
347 1

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 21.5 °C	4/18/13	1405		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 6				

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301.2E

WETLAB
WESTERN ENVIRONMENTAL
TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

5/7/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1304490*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 4/25/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Jennifer Delaney

Jennifer Delaney
QA Specialist

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1304490

General Comments

None

Specific Comments

Due to the sample matrix it was necessary to analyze the following at a dilution:
1304490-001 Iron
1304490-003 Iron and Molybdenum
1304490-004 Iron and Molybedenum
The reporting limits have been adjusted accordingly.

Report Legend

B -- Blank contamination; Analyte detected above the method reporting limit in an associated blank

D -- Reporting limit is elevated due to required sample dilution

DF -- Dilution Factor

HT -- Sample analyzed beyond the accepted holding time

J -- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit

M -- Reported value is estimated; The sample matrix interfered with the analysis

MCL -- State or EPA Maximum Contamination Level

N -- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.

NC -- Not calculated due to matrix interference

ND -- Non-detect result; Indicates the result was below the reporting limit (RL)

Q -- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy

RL -- Reporting Limit or Practical Quantitation Limit

S -- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits

SC -- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438*

Date Printed: 5/7/2013
OrderID: *1304490*

Customer Sample ID: CF-11-02 (227-367) Wk:44
WETLAB Sample ID: 1304490-001

Collect Date/Time: 4/25/2013 09:00
Receive Date: 4/25/2013 14:40

Analyte	Method	Results	Units	DF	RL	Analyzed
General Chemistry						
pH	SM 4500-H+ B	7.70	pH Units	1		4/25/2013
Bicarbonate (HCO3)	SM 2320B	52	mg/L	1	1.0	4/25/2013
Carbonate (CO3)	SM 2320B	ND	mg/L	1	1.0	4/25/2013
Hydroxide (OH)	SM 2320B	ND	mg/L	1	1.0	4/25/2013
Total Alkalinity	SM 2320B	43	mg/L as CaCO3	1	1.0	4/25/2013
Total Dissolved Solids (TDS)	SM 2540C	57	mg/L	1	10	4/30/2013
Anions by Ion Chromatography						
Chloride	EPA 300.0	ND	mg/L	1	1.00	4/26/2013
Fluoride	EPA 300.0	0.94	mg/L	1	0.10	4/26/2013
Sulfate	EPA 300.0	3.7	mg/L	1	1.0	4/26/2013
Nitrate Nitrogen	EPA 300.0	ND	mg/L	1	1.0	4/26/2013
Nitrite Nitrogen	EPA 300.0	ND	mg/L	1	0.025	4/26/2013
Trace Metals by ICP-OES						
Aluminum	EPA 200.7	0.091	mg/L	1	0.045	5/2/2013
Barium	EPA 200.7	0.031	mg/L	1	0.010	5/2/2013
Beryllium	EPA 200.7	ND	mg/L	1	0.0010	5/2/2013
Bismuth	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Boron	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Cadmium	EPA 200.7	ND	mg/L	1	0.0010	5/2/2013
Calcium	EPA 200.7	15	mg/L	1	0.50	5/2/2013
Chromium	EPA 200.7	ND	mg/L	1	0.0050	5/2/2013
Cobalt	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Copper	EPA 200.7	ND	mg/L	1	0.050	5/2/2013
Gallium	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Iron	EPA 200.7	ND	mg/L	5	0.050	5/3/2013
Lithium	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Magnesium	EPA 200.7	2.0	mg/L	1	0.50	5/2/2013
Manganese	EPA 200.7	0.019	mg/L	1	0.0050	5/2/2013
Molybdenum	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Nickel	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Phosphorus	EPA 200.7	ND	mg/L	1	0.50	5/2/2013
Potassium	EPA 200.7	2.2	mg/L	1	0.50	5/2/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID: CF-11-02 (227-367) Wk:44 **Collect Date/Time:** 4/25/2013 09:00
WETLAB Sample ID: 1304490-001 **Receive Date:** 4/25/2013 14:40

Analyte	Method	Results	Units	DF	RL	Analyzed
Scandium	EPA 200.7	ND	mg/L	1	0.100	5/2/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	5/2/2013
Sodium	EPA 200.7	ND	mg/L	1	0.50	5/2/2013
Strontium	EPA 200.7	0.12	mg/L	1	0.10	5/2/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	4/30/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	4/30/2013
Arsenic	EPA 200.8	ND	mg/L	1	0.0050	4/30/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	4/30/2013
Selenium	EPA 200.8	ND	mg/L	1	0.0050	4/30/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	4/30/2013
Uranium	EPA 200.8	ND	mg/L	1	0.0050	4/30/2013
Ion Balance						
Anions	Calculation	0.98	meq/L	1	0.10	
Cations	Calculation	0.98	meq/L	1	0.10	
Error	Calculation	ND	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		4/30/2013

Customer Sample ID: K-Spar Breccia 5+ Comp Wk:44 **Collect Date/Time:** 4/25/2013 09:00
WETLAB Sample ID: 1304490-002 **Receive Date:** 4/25/2013 14:40

Analyte	Method	Results	Units	DF	RL	Analyzed
General Chemistry						
pH	SM 4500-H+ B	7.90	pH Units	1		4/25/2013
Bicarbonate (HCO3)	SM 2320B	67	mg/L	1	1.0	4/25/2013
Carbonate (CO3)	SM 2320B	ND	mg/L	1	1.0	4/25/2013
Hydroxide (OH)	SM 2320B	ND	mg/L	1	1.0	4/25/2013
Total Alkalinity	SM 2320B	55	mg/L as CaCO3	1	1.0	4/25/2013
Total Dissolved Solids (TDS)	SM 2540C	110	mg/L	1	10	4/30/2013
Anions by Ion Chromatography						
Chloride	EPA 300.0	ND	mg/L	1	1.00	4/26/2013
Fluoride	EPA 300.0	1.3	mg/L	1	0.10	4/26/2013
Sulfate	EPA 300.0	24	mg/L	1	1.0	4/26/2013
Nitrate Nitrogen	EPA 300.0	ND	mg/L	1	1.0	4/26/2013
Nitrite Nitrogen	EPA 300.0	ND	mg/L	1	0.025	4/26/2013
Trace Metals by ICP-OES						
Aluminum	EPA 200.7	ND	mg/L	1	0.045	5/2/2013
Barium	EPA 200.7	0.14	mg/L	1	0.010	5/2/2013
Beryllium	EPA 200.7	ND	mg/L	1	0.0010	5/2/2013
Bismuth	EPA 200.7	ND	mg/L	1	0.10	5/2/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID: K-Spar Breccia 5+ Comp Wk:44 **Collect Date/Time:** 4/25/2013 09:00

WETLAB Sample ID: 1304490-002 **Receive Date:** 4/25/2013 14:40

Analyte	Method	Results	Units	DF	RL	Analyzed
Boron	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Cadmium	EPA 200.7	ND	mg/L	1	0.0010	5/2/2013
Calcium	EPA 200.7	29	mg/L	1	0.50	5/2/2013
Chromium	EPA 200.7	ND	mg/L	1	0.0050	5/2/2013
Cobalt	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Copper	EPA 200.7	ND	mg/L	1	0.050	5/2/2013
Gallium	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Iron	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Lithium	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Magnesium	EPA 200.7	2.1	mg/L	1	0.50	5/2/2013
Manganese	EPA 200.7	0.045	mg/L	1	0.0050	5/2/2013
Molybdenum	EPA 200.7	0.052	mg/L	1	0.010	5/2/2013
Nickel	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Phosphorus	EPA 200.7	ND	mg/L	1	0.50	5/2/2013
Potassium	EPA 200.7	2.3	mg/L	1	0.50	5/2/2013
Scandium	EPA 200.7	ND	mg/L	1	0.100	5/2/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	5/2/2013
Sodium	EPA 200.7	0.78	mg/L	1	0.50	5/2/2013
Strontium	EPA 200.7	0.50	mg/L	1	0.10	5/2/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	4/30/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	4/30/2013
Arsenic	EPA 200.8	ND	mg/L	1	0.0050	4/30/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	4/30/2013
Selenium	EPA 200.8	ND	mg/L	1	0.0050	4/30/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	4/30/2013
Uranium	EPA 200.8	0.015	mg/L	1	0.0050	4/30/2013
Ion Balance						
Anions	Calculation	1.67	meq/L	1	0.10	
Cations	Calculation	1.71	meq/L	1	0.10	
Error	Calculation	1.4	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		4/30/2013

Customer Sample ID: Biotite Breccia 0-5 Comp Wk:44 **Collect Date/Time:** 4/25/2013 09:00

WETLAB Sample ID: 1304490-003 **Receive Date:** 4/25/2013 14:40

Analyte	Method	Results	Units	DF	RL	Analyzed
General Chemistry						
pH	SM 4500-H+ B	7.88	pH Units	1		4/25/2013
Bicarbonate (HCO3)	SM 2320B	66	mg/L	1	1.0	4/25/2013
Carbonate (CO3)	SM 2320B	ND	mg/L	1	1.0	4/25/2013

Customer Sample ID: Biotite Breccia 0-5 Comp Wk:44
WETLAB Sample ID: 1304490-003
Collect Date/Time: 4/25/2013 09:00
Receive Date: 4/25/2013 14:40

Analyte	Method	Results	Units	DF	RL	Analyzed
Hydroxide (OH)	SM 2320B	ND	mg/L	1	1.0	4/25/2013
Total Alkalinity	SM 2320B	54	mg/L as CaCO3	1	1.0	4/25/2013
Total Dissolved Solids (TDS)	SM 2540C	77	mg/L	1	10	4/30/2013
Anions by Ion Chromatography						
Chloride	EPA 300.0	ND	mg/L	1	1.00	4/26/2013
Fluoride	EPA 300.0	1.2	mg/L	1	0.10	4/26/2013
Sulfate	EPA 300.0	11	mg/L	1	1.0	4/26/2013
Nitrate Nitrogen	EPA 300.0	ND	mg/L	1	1.0	4/26/2013
Nitrite Nitrogen	EPA 300.0	ND	mg/L	1	0.025	4/26/2013
Trace Metals by ICP-OES						
Aluminum	EPA 200.7	ND	mg/L	1	0.045	5/2/2013
Barium	EPA 200.7	0.10	mg/L	1	0.010	5/2/2013
Beryllium	EPA 200.7	ND	mg/L	1	0.0010	5/2/2013
Bismuth	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Boron	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Cadmium	EPA 200.7	ND	mg/L	1	0.0010	5/2/2013
Calcium	EPA 200.7	20	mg/L	1	0.50	5/2/2013
Chromium	EPA 200.7	ND	mg/L	1	0.0050	5/2/2013
Cobalt	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Copper	EPA 200.7	ND	mg/L	1	0.050	5/2/2013
Gallium	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Iron	EPA 200.7	ND	mg/L	5	0.050	5/3/2013
Lithium	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Magnesium	EPA 200.7	3.9	mg/L	1	0.50	5/2/2013
Manganese	EPA 200.7	0.021	mg/L	1	0.0050	5/2/2013
Molybdenum	EPA 200.7	ND	mg/L	5	0.050	5/3/2013
Nickel	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Phosphorus	EPA 200.7	ND	mg/L	1	0.50	5/2/2013
Potassium	EPA 200.7	1.5	mg/L	1	0.50	5/2/2013
Scandium	EPA 200.7	ND	mg/L	1	0.100	5/2/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	5/2/2013
Sodium	EPA 200.7	ND	mg/L	1	0.50	5/2/2013
Strontium	EPA 200.7	0.27	mg/L	1	0.10	5/2/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	4/30/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	4/30/2013
Arsenic	EPA 200.8	ND	mg/L	1	0.0050	4/30/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	4/30/2013
Selenium	EPA 200.8	ND	mg/L	1	0.0050	4/30/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	4/30/2013
Uranium	EPA 200.8	0.023	mg/L	1	0.0050	4/30/2013
Ion Balance						
Anions	Calculation	1.37	meq/L	1	0.10	

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID: Biotite Breccia 0-5 Comp Wk:44
WETLAB Sample ID: 1304490-003
Collect Date/Time: 4/25/2013 09:00
Receive Date: 4/25/2013 14:40

Analyte	Method	Results	Units	DF	RL	Analyzed
Cations	Calculation	1.36	meq/L	1	0.10	
Error	Calculation	ND	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		4/30/2013

Customer Sample ID: K-Spar Breccia 0-5 Comp Wk:44
WETLAB Sample ID: 1304490-004
Collect Date/Time: 4/25/2013 09:00
Receive Date: 4/25/2013 14:40

Analyte	Method	Results	Units	DF	RL	Analyzed
General Chemistry						
pH	SM 4500-H+ B	7.83	pH Units	1		4/25/2013
Bicarbonate (HCO3)	SM 2320B	62	mg/L	1	1.0	4/25/2013
Carbonate (CO3)	SM 2320B	ND	mg/L	1	1.0	4/25/2013
Hydroxide (OH)	SM 2320B	ND	mg/L	1	1.0	4/25/2013
Total Alkalinity	SM 2320B	51	mg/L as CaCO3	1	1.0	4/25/2013
Total Dissolved Solids (TDS)	SM 2540C	61	mg/L	1	10	4/30/2013
Anions by Ion Chromatography						
Chloride	EPA 300.0	ND	mg/L	1	1.00	4/26/2013
Fluoride	EPA 300.0	1.6	mg/L	1	0.10	4/26/2013
Sulfate	EPA 300.0	12	mg/L	1	1.0	4/26/2013
Nitrate Nitrogen	EPA 300.0	ND	mg/L	1	1.0	4/26/2013
Nitrite Nitrogen	EPA 300.0	ND	mg/L	1	0.025	4/26/2013
Trace Metals by ICP-OES						
Aluminum	EPA 200.7	ND	mg/L	1	0.045	5/2/2013
Barium	EPA 200.7	0.12	mg/L	1	0.010	5/2/2013
Beryllium	EPA 200.7	ND	mg/L	1	0.0010	5/2/2013
Bismuth	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Boron	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Cadmium	EPA 200.7	ND	mg/L	1	0.0010	5/2/2013
Calcium	EPA 200.7	18	mg/L	1	0.50	5/2/2013
Chromium	EPA 200.7	ND	mg/L	1	0.0050	5/2/2013
Cobalt	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Copper	EPA 200.7	ND	mg/L	1	0.050	5/2/2013
Gallium	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Iron	EPA 200.7	ND	mg/L	5	0.050	5/3/2013
Lithium	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Magnesium	EPA 200.7	3.6	mg/L	1	0.50	5/2/2013
Manganese	EPA 200.7	0.016	mg/L	1	0.0050	5/2/2013
Molybdenum	EPA 200.7	ND	mg/L	5	0.050	5/3/2013
Nickel	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Phosphorus	EPA 200.7	ND	mg/L	1	0.50	5/2/2013
Potassium	EPA 200.7	1.5	mg/L	1	0.50	5/2/2013
Scandium	EPA 200.7	ND	mg/L	1	0.100	5/2/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	5/2/2013
Sodium	EPA 200.7	ND	mg/L	1	0.50	5/2/2013
Strontium	EPA 200.7	0.33	mg/L	1	0.10	5/2/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID: K-Spar Breccia 0-5 Comp Wk:44 **Collect Date/Time:** 4/25/2013 09:00
WETLAB Sample ID: 1304490-004 **Receive Date:** 4/25/2013 14:40

Analyte	Method	Results	Units	DF	RL	Analyzed
Tin	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	4/30/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	4/30/2013
Arsenic	EPA 200.8	ND	mg/L	1	0.0050	4/30/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	4/30/2013
Selenium	EPA 200.8	ND	mg/L	1	0.0050	4/30/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	4/30/2013
Uranium	EPA 200.8	0.020	mg/L	1	0.0050	4/30/2013
Ion Balance						
Anions	Calculation	1.35	meq/L	1	0.10	
Cations	Calculation	1.23	meq/L	1	0.10	
Error	Calculation	4.5	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		4/30/2013

Customer Sample ID: Quartz Monzonite 0-5 Comp Wk:44 **Collect Date/Time:** 4/25/2013 09:00
WETLAB Sample ID: 1304490-005 **Receive Date:** 4/25/2013 14:40

Analyte	Method	Results	Units	DF	RL	Analyzed
General Chemistry						
pH	SM 4500-H+ B	7.87	pH Units	1		4/25/2013
Bicarbonate (HCO3)	SM 2320B	64	mg/L	1	1.0	4/25/2013
Carbonate (CO3)	SM 2320B	ND	mg/L	1	1.0	4/25/2013
Hydroxide (OH)	SM 2320B	ND	mg/L	1	1.0	4/25/2013
Total Alkalinity	SM 2320B	52	mg/L as CaCO3	1	1.0	4/25/2013
Total Dissolved Solids (TDS)	SM 2540C	73	mg/L	1	10	4/30/2013
Anions by Ion Chromatography						
Chloride	EPA 300.0	ND	mg/L	1	1.00	4/26/2013
Fluoride	EPA 300.0	1.2	mg/L	1	0.10	4/26/2013
Sulfate	EPA 300.0	14	mg/L	1	1.0	4/26/2013
Nitrate Nitrogen	EPA 300.0	ND	mg/L	1	1.0	4/26/2013
Nitrite Nitrogen	EPA 300.0	ND	mg/L	1	0.025	4/26/2013
Trace Metals by ICP-OES						
Aluminum	EPA 200.7	ND	mg/L	1	0.045	5/2/2013
Barium	EPA 200.7	0.098	mg/L	1	0.010	5/2/2013
Beryllium	EPA 200.7	ND	mg/L	1	0.0010	5/2/2013
Bismuth	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Boron	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Cadmium	EPA 200.7	ND	mg/L	1	0.0010	5/2/2013
Calcium	EPA 200.7	20	mg/L	1	0.50	5/2/2013
Chromium	EPA 200.7	ND	mg/L	1	0.0050	5/2/2013

Customer Sample ID:	Quartz Monzonite 0-5 Comp Wk:44	**Collect Date/Time:**	4/25/2013 09:00
WETLAB Sample ID:	1304490-005	**Receive Date:**	4/25/2013 14:40

Analyte	Method	Results	Units	DF	RL	Analyzed
Cobalt	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Copper	EPA 200.7	ND	mg/L	1	0.050	5/2/2013
Gallium	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Iron	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Lithium	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Magnesium	EPA 200.7	4.2	mg/L	1	0.50	5/2/2013
Manganese	EPA 200.7	0.018	mg/L	1	0.0050	5/2/2013
Molybdenum	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Nickel	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Phosphorus	EPA 200.7	ND	mg/L	1	0.50	5/2/2013
Potassium	EPA 200.7	1.5	mg/L	1	0.50	5/2/2013
Scandium	EPA 200.7	ND	mg/L	1	0.100	5/2/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	5/2/2013
Sodium	EPA 200.7	0.53	mg/L	1	0.50	5/2/2013
Strontium	EPA 200.7	0.28	mg/L	1	0.10	5/2/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	5/2/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	5/2/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	4/30/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	4/30/2013
Arsenic	EPA 200.8	ND	mg/L	1	0.0050	4/30/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	4/30/2013
Selenium	EPA 200.8	ND	mg/L	1	0.0050	4/30/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	4/30/2013
Uranium	EPA 200.8	0.021	mg/L	1	0.0050	4/30/2013
Ion Balance						
Anions	Calculation	1.40	meq/L	1	0.10	
Cations	Calculation	1.41	meq/L	1	0.10	
Error	Calculation	ND	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		4/30/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13040964	Blank 1	Fluoride	EPA 300.0	ND	mg/L
QC13040964	Blank 2	Fluoride	EPA 300.0	ND	mg/L
QC13040964	Blank 3	Fluoride	EPA 300.0	ND	mg/L
QC13040969	Blank 1	Chloride	EPA 300.0	ND	mg/L
QC13040969	Blank 2	Chloride	EPA 300.0	ND	mg/L
QC13040969	Blank 3	Chloride	EPA 300.0	ND	mg/L
QC13040972	Blank 1	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13040972	Blank 2	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13040972	Blank 3	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13040975	Blank 1	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13040975	Blank 2	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13040975	Blank 3	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13040980	Blank 1	Sulfate	EPA 300.0	ND	mg/L
QC13040980	Blank 2	Sulfate	EPA 300.0	ND	mg/L
QC13040980	Blank 3	Sulfate	EPA 300.0	ND	mg/L
QC13050006	Blank 1	Uranium, Dissolved	EPA 200.8	ND	mg/L
		Mercury, Dissolved	EPA 200.8	ND	mg/L
		Antimony, Dissolved	EPA 200.8	ND	mg/L
		Arsenic, Dissolved	EPA 200.8	ND	mg/L
		Lead, Dissolved	EPA 200.8	ND	mg/L
		Selenium, Dissolved	EPA 200.8	ND	mg/L
		Thallium, Dissolved	EPA 200.8	ND	mg/L
QC13050007	Blank 1	Uranium, Dissolved	EPA 200.8	ND	mg/L
		Mercury, Dissolved	EPA 200.8	ND	mg/L
		Antimony, Dissolved	EPA 200.8	ND	mg/L
		Arsenic, Dissolved	EPA 200.8	ND	mg/L
		Lead, Dissolved	EPA 200.8	ND	mg/L
		Selenium, Dissolved	EPA 200.8	ND	mg/L
		Thallium, Dissolved	EPA 200.8	ND	mg/L
QC13050101	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13050101	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13050101	Blank 3	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13050117	Blank 1	Aluminum, Dissolved	EPA 200.7	ND	mg/L
		Barium, Dissolved	EPA 200.7	ND	mg/L
		Beryllium, Dissolved	EPA 200.7	ND	mg/L
		Bismuth, Dissolved	EPA 200.7	ND	mg/L
		Boron, Dissolved	EPA 200.7	ND	mg/L
		Cadmium, Dissolved	EPA 200.7	ND	mg/L
		Calcium, Dissolved	EPA 200.7	ND	mg/L
		Chromium, Dissolved	EPA 200.7	ND	mg/L
		Cobalt, Dissolved	EPA 200.7	ND	mg/L
		Copper, Dissolved	EPA 200.7	ND	mg/L
		Gallium, Dissolved	EPA 200.7	ND	mg/L
		Iron, Dissolved	EPA 200.7	ND	mg/L
		Lithium, Dissolved	EPA 200.7	ND	mg/L
		Magnesium, Dissolved	EPA 200.7	ND	mg/L

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

QCBatchID	QCType	Parameter	Method	Result	Units
		Manganese, Dissolved	EPA 200.7	ND	mg/L
		Molybdenum, Dissolved	EPA 200.7	ND	mg/L
		Nickel, Dissolved	EPA 200.7	ND	mg/L
		Phosphorus, Dissolved	EPA 200.7	ND	mg/L
		Potassium, Dissolved	EPA 200.7	ND	mg/L
		Scandium, Dissolved	EPA 200.7	ND	mg/L
		Silver, Dissolved	EPA 200.7	ND	mg/L
		Sodium, Dissolved	EPA 200.7	ND	mg/L
		Strontium, Dissolved	EPA 200.7	ND	mg/L
		Tin, Dissolved	EPA 200.7	ND	mg/L
		Titanium, Dissolved	EPA 200.7	ND	mg/L
		Vanadium, Dissolved	EPA 200.7	ND	mg/L
		Zinc, Dissolved	EPA 200.7	ND	mg/L
QC13050118	Blank 1	Aluminum, Dissolved	EPA 200.7	ND	mg/L
		Barium, Dissolved	EPA 200.7	ND	mg/L
		Beryllium, Dissolved	EPA 200.7	ND	mg/L
		Bismuth, Dissolved	EPA 200.7	ND	mg/L
		Boron, Dissolved	EPA 200.7	ND	mg/L
		Cadmium, Dissolved	EPA 200.7	ND	mg/L
		Calcium, Dissolved	EPA 200.7	ND	mg/L
		Chromium, Dissolved	EPA 200.7	ND	mg/L
		Cobalt, Dissolved	EPA 200.7	ND	mg/L
		Copper, Dissolved	EPA 200.7	ND	mg/L
		Gallium, Dissolved	EPA 200.7	ND	mg/L
		Iron, Dissolved	EPA 200.7	ND	mg/L
		Lithium, Dissolved	EPA 200.7	ND	mg/L
		Magnesium, Dissolved	EPA 200.7	ND	mg/L
		Manganese, Dissolved	EPA 200.7	ND	mg/L
		Molybdenum, Dissolved	EPA 200.7	ND	mg/L
		Nickel, Dissolved	EPA 200.7	ND	mg/L
		Phosphorus, Dissolved	EPA 200.7	ND	mg/L
		Potassium, Dissolved	EPA 200.7	ND	mg/L
		Scandium, Dissolved	EPA 200.7	ND	mg/L
		Silver, Dissolved	EPA 200.7	ND	mg/L
		Sodium, Dissolved	EPA 200.7	ND	mg/L
		Strontium, Dissolved	EPA 200.7	ND	mg/L
		Tin, Dissolved	EPA 200.7	ND	mg/L
		Titanium, Dissolved	EPA 200.7	ND	mg/L
		Vanadium, Dissolved	EPA 200.7	ND	mg/L
		Zinc, Dissolved	EPA 200.7	ND	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13040889	LCS 1	pH	SM 4500-H+ B	6.99	7.00	100	pH Units
QC13040889	LCS 2	pH	SM 4500-H+ B	6.99	7.00	100	pH Units
QC13040889	LCS 3	pH	SM 4500-H+ B	6.99	7.00	100	pH Units
QC13040890	LCS 1	Total Alkalinity	SM 2320B	99.6	100	100	mg/L
QC13040890	LCS 2	Total Alkalinity	SM 2320B	99.3	100	99	mg/L
QC13040890	LCS 3	Total Alkalinity	SM 2320B	99.4	100	99	mg/L
QC13040890	LCS 4	Total Alkalinity	SM 2320B	100.0	100	100	mg/L
QC13040964	LCS 1	Fluoride	EPA 300.0	1.96	2.00	98	mg/L
QC13040969	LCS 1	Chloride	EPA 300.0	10.2	10.0	102	mg/L
QC13040972	LCS 1	Nitrite Nitrogen	EPA 300.0	0.507	0.500	101	mg/L
QC13040975	LCS 1	Nitrate Nitrogen	EPA 300.0	1.98	2.00	99	mg/L

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13040980	LCS 1	Sulfate	EPA 300.0	24.0	25.0	96	mg/L
QC13050006	LCS 1	Uranium, Dissolved	EPA 200.8	0.0102	0.010	102	mg/L
		Mercury, Dissolved	EPA 200.8	0.001044	0.001	104	mg/L
		Antimony, Dissolved	EPA 200.8	0.0099	0.010	99	mg/L
		Arsenic, Dissolved	EPA 200.8	0.0498	0.050	100	mg/L
		Lead, Dissolved	EPA 200.8	0.0103	0.010	103	mg/L
		Selenium, Dissolved	EPA 200.8	0.0461	0.050	92	mg/L
		Thallium, Dissolved	EPA 200.8	0.0102	0.010	102	mg/L
QC13050007	LCS 1	Uranium, Dissolved	EPA 200.8	0.0102	0.010	102	mg/L
		Mercury, Dissolved	EPA 200.8	0.001044	0.001	104	mg/L
		Antimony, Dissolved	EPA 200.8	0.0099	0.010	99	mg/L
		Arsenic, Dissolved	EPA 200.8	0.0498	0.050	100	mg/L
		Lead, Dissolved	EPA 200.8	0.0103	0.010	103	mg/L
		Selenium, Dissolved	EPA 200.8	0.0461	0.050	92	mg/L
		Thallium, Dissolved	EPA 200.8	0.0102	0.010	102	mg/L
QC13050101	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	145	150	97	mg/L
QC13050101	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	139	150	92	mg/L
QC13050101	LCS 3	Total Dissolved Solids (TDS)	SM 2540C	139	150	92	mg/L
QC13050117	LCS 1	Aluminum, Dissolved	EPA 200.7	0.972	1.00	97	mg/L
		Barium, Dissolved	EPA 200.7	0.949	1.00	95	mg/L
		Beryllium, Dissolved	EPA 200.7	0.974	1.00	97	mg/L
		Bismuth, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Boron, Dissolved	EPA 200.7	0.895	1.00	90	mg/L
		Cadmium, Dissolved	EPA 200.7	0.943	1.00	94	mg/L
		Calcium, Dissolved	EPA 200.7	9.58	10.0	96	mg/L
		Chromium, Dissolved	EPA 200.7	0.946	1.00	95	mg/L
		Cobalt, Dissolved	EPA 200.7	0.952	1.00	95	mg/L
		Copper, Dissolved	EPA 200.7	4.77	5.00	95	mg/L
		Gallium, Dissolved	EPA 200.7	0.973	1.00	97	mg/L
		Iron, Dissolved	EPA 200.7	0.958	1.00	96	mg/L
		Lithium, Dissolved	EPA 200.7	0.957	1.00	96	mg/L
		Magnesium, Dissolved	EPA 200.7	9.53	10.0	95	mg/L
		Manganese, Dissolved	EPA 200.7	0.957	1.00	96	mg/L
		Molybdenum, Dissolved	EPA 200.7	0.952	1.00	95	mg/L
		Nickel, Dissolved	EPA 200.7	4.71	5.00	94	mg/L
		Phosphorus, Dissolved	EPA 200.7	4.79	5.00	96	mg/L
		Potassium, Dissolved	EPA 200.7	9.87	10.0	99	mg/L
		Scandium, Dissolved	EPA 200.7	0.968	1.00	97	mg/L
		Silver, Dissolved	EPA 200.7	0.087	0.090	96	mg/L
		Sodium, Dissolved	EPA 200.7	10.1	10.0	101	mg/L
		Strontium, Dissolved	EPA 200.7	0.950	1.00	95	mg/L
		Tin, Dissolved	EPA 200.7	0.965	1.00	96	mg/L
		Titanium, Dissolved	EPA 200.7	0.981	1.00	98	mg/L
		Vanadium, Dissolved	EPA 200.7	0.950	1.00	95	mg/L
		Zinc, Dissolved	EPA 200.7	0.946	1.00	95	mg/L
QC13050118	LCS 1	Aluminum, Dissolved	EPA 200.7	0.972	1.00	97	mg/L
		Barium, Dissolved	EPA 200.7	0.949	1.00	95	mg/L
		Beryllium, Dissolved	EPA 200.7	0.974	1.00	97	mg/L
		Bismuth, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Boron, Dissolved	EPA 200.7	0.895	1.00	90	mg/L
		Cadmium, Dissolved	EPA 200.7	0.943	1.00	94	mg/L
		Calcium, Dissolved	EPA 200.7	9.58	10.0	96	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
		Chromium, Dissolved	EPA 200.7	0.946	1.00	95	mg/L
		Cobalt, Dissolved	EPA 200.7	0.952	1.00	95	mg/L
		Copper, Dissolved	EPA 200.7	4.77	5.00	95	mg/L
		Gallium, Dissolved	EPA 200.7	0.973	1.00	97	mg/L
		Iron, Dissolved	EPA 200.7	0.958	1.00	96	mg/L
		Lithium, Dissolved	EPA 200.7	0.957	1.00	96	mg/L
		Magnesium, Dissolved	EPA 200.7	9.53	10.0	95	mg/L
		Manganese, Dissolved	EPA 200.7	0.957	1.00	96	mg/L
		Molybdenum, Dissolved	EPA 200.7	0.952	1.00	95	mg/L
		Nickel, Dissolved	EPA 200.7	4.71	5.00	94	mg/L
		Phosphorus, Dissolved	EPA 200.7	4.79	5.00	96	mg/L
		Potassium, Dissolved	EPA 200.7	9.87	10.0	99	mg/L
		Scandium, Dissolved	EPA 200.7	0.968	1.00	97	mg/L
		Silver, Dissolved	EPA 200.7	0.087	0.090	96	mg/L
		Sodium, Dissolved	EPA 200.7	10.1	10.0	101	mg/L
		Strontium, Dissolved	EPA 200.7	0.950	1.00	95	mg/L
		Tin, Dissolved	EPA 200.7	0.965	1.00	96	mg/L
		Titanium, Dissolved	EPA 200.7	0.981	1.00	98	mg/L
		Vanadium, Dissolved	EPA 200.7	0.950	1.00	95	mg/L
		Zinc, Dissolved	EPA 200.7	0.946	1.00	95	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC13040889	Duplicate	pH	SM 4500-H+ B	1304481-001	7.40	7.40	pH Units	<1%
QC13040889	Duplicate	pH	SM 4500-H+ B	1304481-002	7.75	7.72	pH Units	<1%
QC13040889	Duplicate	pH	SM 4500-H+ B	1304481-003	7.53	7.54	pH Units	<1%
QC13040889	Duplicate	pH	SM 4500-H+ B	1304481-004	7.52	7.51	pH Units	<1%
QC13040889	Duplicate	pH	SM 4500-H+ B	1304481-007	7.77	7.78	pH Units	<1%
QC13040890	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304481-001	189	189	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1304481-001	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1304481-001	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1304481-001	155	155	mg/L as CaCO3	<1%
QC13040890	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304481-002	148	148	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1304481-002	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1304481-002	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1304481-002	122	121	mg/L as CaCO3	<1%
QC13040890	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304481-003	179	179	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1304481-003	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1304481-003	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1304481-003	147	147	mg/L as CaCO3	<1%
QC13040890	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304481-004	184	183	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1304481-004	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1304481-004	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1304481-004	151	150	mg/L as CaCO3	<1%
QC13040890	Duplicate	Bicarbonate (HCO3)	SM 2320B	1304481-007	145	145	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1304481-007	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1304481-007	ND	ND	mg/L	<1%

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result		Units	RPD
		Total Alkalinity	SM 2320B	1304481-007	119	119		mg/L as CaCO3	<1%
QC13050101	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1304489-001	45.0	39.0		mg/L	14 %
QC13050101	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1304494-005	213	211		mg/L	1 %
QC13050101	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1304495-005	280	269		mg/L	4 %
QC13050101	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1304529-003	276	277		mg/L	<1%
QC13050101	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1304534-004	143	126	Q	mg/L	13 %
QC13050101	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1304501-005	149	140		mg/L	6 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13040964	MS 1	Fluoride	EPA 300.0	1304489-001	ND	1.93	1.95	2.00	mg/L	96	98	1 %
QC13040964	MS 2	Fluoride	EPA 300.0	1304525-005	ND	1.97	2.03	2.00	mg/L	95	98	3 %
QC13040969	MS 1	Chloride	EPA 300.0	1304501-009	4.34	9.62	9.98	5.00	mg/L	106	113	4 %
QC13040969	MS 2	Chloride	EPA 300.0	1304489-001	ND	5.24	5.33	5.00	mg/L	105	107	2 %
QC13040972	MS 1	Nitrite Nitrogen	EPA 300.0	1304501-009	ND	0.497	0.534	0.500	mg/L	98	105	7 %
QC13040972	MS 2	Nitrite Nitrogen	EPA 300.0	1304489-001	ND	0.502	0.512	0.500	mg/L	100	102	2 %
QC13040975	MS 1	Nitrate Nitrogen	EPA 300.0	1304501-009	ND	2.20	2.34	2.00	mg/L	104	111	6 %
QC13040975	MS 2	Nitrate Nitrogen	EPA 300.0	1304489-001	ND	2.10	2.12	2.00	mg/L	103	104	1 %
QC13040980	MS 1	Sulfate	EPA 300.0	1304501-009	5.58	15.9	16.7	10.0	mg/L	103	111	5 %
QC13040980	MS 2	Sulfate	EPA 300.0	1304489-001	6.07	15.9	16.1	10.0	mg/L	98	100	1 %
QC13050006	MS 1	Uranium, Dissolved	EPA 200.8	1304494-001	ND	0.0104	0.0104	0.010	mg/L	104	104	<1%
		Mercury, Dissolved	EPA 200.8	1304494-001	ND	0.000980	0.001018	0.001	mg/L	95	98	4 %
		Antimony, Dissolved	EPA 200.8	1304494-001	0.0076	0.0173	0.0172	0.010	mg/L	98	97	1 %
		Arsenic, Dissolved	EPA 200.8	1304494-001	0.0260	0.0793	0.0776	0.050	mg/L	107	103	2 %
		Lead, Dissolved	EPA 200.8	1304494-001	ND	0.0101	0.0101	0.010	mg/L	100	100	<1%
		Selenium, Dissolved	EPA 200.8	1304494-001	ND	0.0472	0.0468	0.050	mg/L	92	91	1 %
		Thallium, Dissolved	EPA 200.8	1304494-001	0.0024	0.0123	0.0123	0.010	mg/L	99	99	<1%
QC13050007	MS 1	Uranium, Dissolved	EPA 200.8	1304494-002	ND	0.0104	0.0102	0.010	mg/L	104	102	2 %
		Mercury, Dissolved	EPA 200.8	1304494-002	ND	0.000932	0.000913	0.001	mg/L	91	89	2 %
		Antimony, Dissolved	EPA 200.8	1304494-002	0.0042	0.0138	0.0141	0.010	mg/L	96	99	2 %
		Arsenic, Dissolved	EPA 200.8	1304494-002	0.0135	0.0645	0.0648	0.050	mg/L	102	103	<1%
		Lead, Dissolved	EPA 200.8	1304494-002	ND	0.0099	0.0099	0.010	mg/L	99	99	<1%
		Selenium, Dissolved	EPA 200.8	1304494-002	ND	0.0460	0.0459	0.050	mg/L	91	91	<1%
		Thallium, Dissolved	EPA 200.8	1304494-002	0.0017	0.0118	0.0117	0.010	mg/L	101	100	1 %
QC13050117	MS 1	Aluminum, Dissolved	EPA 200.7	1304494-001	0.073	0.981	0.990	1.00	mg/L	91	92	1 %
		Barium, Dissolved	EPA 200.7	1304494-001	0.050	0.976	0.998	1.00	mg/L	93	95	2 %
		Beryllium, Dissolved	EPA 200.7	1304494-001	ND	0.978	0.988	1.00	mg/L	98	99	1 %
		Bismuth, Dissolved	EPA 200.7	1304494-001	ND	0.937	0.951	1.00	mg/L	96	97	1 %
		Boron, Dissolved	EPA 200.7	1304494-001	ND	0.956	0.980	1.00	mg/L	96	99	2 %
		Cadmium, Dissolved	EPA 200.7	1304494-001	ND	0.932	0.966	1.00	mg/L	93	97	4 %
		Calcium, Dissolved	EPA 200.7	1304494-001	38.4	49.0	49.3	10.0	mg/L	106	109	1 %
		Chromium, Dissolved	EPA 200.7	1304494-001	ND	0.939	0.961	1.00	mg/L	94	96	2 %
		Cobalt, Dissolved	EPA 200.7	1304494-001	ND	0.881	0.912	1.00	mg/L	88	91	3 %
		Copper, Dissolved	EPA 200.7	1304494-001	ND	4.51	4.56	5.00	mg/L	90	91	1 %
		Gallium, Dissolved	EPA 200.7	1304494-001	ND	0.951	0.963	1.00	mg/L	95	96	1 %
		Iron, Dissolved	EPA 200.7	1304494-001	ND	0.960	0.969	1.00	mg/L	96	97	1 %
		Lithium, Dissolved	EPA 200.7	1304494-001	ND	0.921	0.924	1.00	mg/L	92	92	<1%
		Magnesium, Dissolved	EPA 200.7	1304494-001	23.6	32.7	32.5	10.0	mg/L	91	89	1 %
		Manganese, Dissolved	EPA 200.7	1304494-001	ND	0.939	0.959	1.00	mg/L	94	96	2 %
		Molybdenum, Dissolved	EPA 200.7	1304494-001	ND	0.987	1.01	1.00	mg/L	96	99	2 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Nickel, Dissolved	EPA 200.7	1304494-001	ND	4.38	4.53	5.00	mg/L	88	91	3 %
		Phosphorus, Dissolved	EPA 200.7	1304494-001	ND	5.08	5.24	5.00	mg/L	100	104	3 %
		Potassium, Dissolved	EPA 200.7	1304494-001	5.58	15.3	15.1	10.0	mg/L	97	95	1 %
		Scandium, Dissolved	EPA 200.7	1304494-001	ND	0.963	0.965	1.00	mg/L	96	96	<1%
		Silver, Dissolved	EPA 200.7	1304494-001	ND	0.086	0.085	0.090	mg/L	95	95	1 %
		Sodium, Dissolved	EPA 200.7	1304494-001	13.3	22.9	22.3	10.0	mg/L	96	90	3 %
		Strontium, Dissolved	EPA 200.7	1304494-001	ND	1.03	1.05	1.00	mg/L	93	95	2 %
		Tin, Dissolved	EPA 200.7	1304494-001	ND	0.969	0.990	1.00	mg/L	101	103	2 %
		Titanium, Dissolved	EPA 200.7	1304494-001	ND	0.995	0.994	1.00	mg/L	99	99	<1%
		Vanadium, Dissolved	EPA 200.7	1304494-001	0.034	0.993	1.01	1.00	mg/L	96	98	2 %
		Zinc, Dissolved	EPA 200.7	1304494-001	ND	0.925	0.966	1.00	mg/L	92	97	4 %
QC13050118	MS 1	Aluminum, Dissolved	EPA 200.7	1304494-002	0.149	1.06	1.05	1.00	mg/L	91	90	1 %
		Barium, Dissolved	EPA 200.7	1304494-002	0.041	0.988	0.977	1.00	mg/L	95	94	1 %
		Beryllium, Dissolved	EPA 200.7	1304494-002	ND	0.982	0.975	1.00	mg/L	98	98	1 %
		Bismuth, Dissolved	EPA 200.7	1304494-002	ND	0.930	0.922	1.00	mg/L	95	94	1 %
		Boron, Dissolved	EPA 200.7	1304494-002	ND	0.934	0.924	1.00	mg/L	96	95	1 %
		Cadmium, Dissolved	EPA 200.7	1304494-002	ND	0.962	0.954	1.00	mg/L	96	95	1 %
		Calcium, Dissolved	EPA 200.7	1304494-002	28.3	37.2	37.7	10.0	mg/L	89	94	1 %
		Chromium, Dissolved	EPA 200.7	1304494-002	ND	0.953	0.940	1.00	mg/L	95	94	1 %
		Cobalt, Dissolved	EPA 200.7	1304494-002	ND	0.908	0.900	1.00	mg/L	91	90	1 %
		Copper, Dissolved	EPA 200.7	1304494-002	ND	4.43	4.34	5.00	mg/L	89	87	2 %
		Gallium, Dissolved	EPA 200.7	1304494-002	ND	0.948	0.937	1.00	mg/L	95	94	1 %
		Iron, Dissolved	EPA 200.7	1304494-002	ND	0.961	0.956	1.00	mg/L	96	96	1 %
		Lithium, Dissolved	EPA 200.7	1304494-002	ND	0.895	0.878	1.00	mg/L	90	88	2 %
		Magnesium, Dissolved	EPA 200.7	1304494-002	22.4	30.9	31.4	10.0	mg/L	85	90	2 %
		Manganese, Dissolved	EPA 200.7	1304494-002	ND	0.950	0.935	1.00	mg/L	95	94	2 %
		Molybdenum, Dissolved	EPA 200.7	1304494-002	ND	0.945	0.969	1.00	mg/L	94	96	3 %
		Nickel, Dissolved	EPA 200.7	1304494-002	ND	4.52	4.48	5.00	mg/L	90	90	1 %
		Phosphorus, Dissolved	EPA 200.7	1304494-002	ND	5.17	5.08	5.00	mg/L	102	100	2 %
		Potassium, Dissolved	EPA 200.7	1304494-002	4.31	13.7	13.6	10.0	mg/L	94	93	1 %
		Scandium, Dissolved	EPA 200.7	1304494-002	ND	0.956	0.954	1.00	mg/L	96	95	<1%
		Silver, Dissolved	EPA 200.7	1304494-002	ND	0.084	0.082	0.090	mg/L	93	91	2 %
		Sodium, Dissolved	EPA 200.7	1304494-002	10.6	19.3	19.0	10.0	mg/L	87	84	2 %
		Strontium, Dissolved	EPA 200.7	1304494-002	ND	1.00	1.01	1.00	mg/L	94	95	1 %
		Tin, Dissolved	EPA 200.7	1304494-002	ND	0.945	0.975	1.00	mg/L	97	100	3 %
		Titanium, Dissolved	EPA 200.7	1304494-002	ND	0.941	0.973	1.00	mg/L	94	97	3 %
		Vanadium, Dissolved	EPA 200.7	1304494-002	0.030	0.993	0.983	1.00	mg/L	96	95	1 %
		Zinc, Dissolved	EPA 200.7	1304494-002	ND	0.975	0.967	1.00	mg/L	98	97	1 %

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY
Specializing in Soil, Hazardous Waste and Water Analysis.
475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1304490
Report Due Date: 5/9/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ____ 5-Day ____ Other ____

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ____

Analyses Requested

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO OF CONTAINERS	Profile II w/o Wad	Uranium	Spl. No.
CF-11-02 (227-367)	Wk:44	04/25/13	9:00	WW	2	X	X	1
K-Spar Breccia 5+ Comp	↓	↓	↓	↓	↓	↓	↓	2
Biotite Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓	3
K-Spar Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓	4
Quartz Monzonite 0-5 Comp	↓	↓	↓	↓	↓	↓	↓	5

1304 490 5 5

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 21.5 °C	4/25/13	1440		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 10				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

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Lab Number 1304490
Report Due Date: 5/9/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard 5-Day Other

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER:

SAMPLE ID/LOCATION	DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium	Spl. No.
CF-11-02 (227-367) Wk:44	04/25/13	9:00	WW	2	X	X	1
K-Spar Breccia 5+ Comp ↓	↓	↓	↓	↓	↓	↓	2
Biotite Breccia 0-5 Comp ↓	↓	↓	↓	↓	↓	↓	3
K-Spar Breccia 0-5 Comp ↓	↓	↓	↓	↓	↓	↓	4
Quartz Monzonite 0-5 Comp ↓	↓	↓	↓	↓	↓	↓	5

1304 490 5 5

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 21.5 °C	4/25/13	1440		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 10				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

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www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

5/23/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1305198*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 5/9/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Jennifer Delaney
QA Specialist

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1305198

General Comments

None

Specific Comments

Due to the sample matrix it was necessary to analyze the following at a dilution:
1305198-002 Potassium
The reporting limits have been adjusted accordingly.

Report Legend

B -- Blank contamination; Analyte detected above the method reporting limit in an associated blank
D -- Reporting limit is elevated due to required sample dilution
DF -- Dilution Factor
HT -- Sample analyzed beyond the accepted holding time
J -- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M -- Reported value is estimated; The sample matrix interfered with the analysis
MCL -- State or EPA Maximum Contamination Level
N -- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC -- Not calculated due to matrix interference
ND -- Non-detect result; Indicates the result was below the reporting limit (RL)
Q -- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
RL -- Reporting Limit or Practical Quantitation Limit
S -- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits
SC -- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438*

Date Printed: 5/23/2013
OrderID: *1305198*

Customer Sample ID: CF-11-02 (0-27) Wk:52
WETLAB Sample ID: 1305198-001

Collect Date/Time: 5/9/2013 09:00
Receive Date: 5/9/2013 01:55

Analyte	Method	Results	Units	DF	RL	Analyzed
General Chemistry						
pH	SM 4500-H+ B	7.44	pH Units	1		5/9/2013
Bicarbonate (HCO3)	SM 2320B	47	mg/L	1	1.0	5/9/2013
Carbonate (CO3)	SM 2320B	ND	mg/L	1	1.0	5/9/2013
Hydroxide (OH)	SM 2320B	ND	mg/L	1	1.0	5/9/2013
Total Alkalinity	SM 2320B	39	mg/L as CaCO3	1	1.0	5/9/2013
Total Dissolved Solids (TDS)	SM 2540C	64	mg/L	1	10	5/14/2013
Anions by Ion Chromatography						
Chloride	EPA 300.0	ND	mg/L	1	1.00	5/10/2013
Fluoride	EPA 300.0	0.85	mg/L	1	0.10	5/10/2013
Sulfate	EPA 300.0	12	mg/L	1	1.0	5/10/2013
Nitrate Nitrogen	EPA 300.0	ND	mg/L	1	0.10	5/10/2013
Nitrite Nitrogen	EPA 300.0	ND	mg/L	1	0.025	5/10/2013
Trace Metals by ICP-OES						
Aluminum	EPA 200.7	0.054	mg/L	1	0.045	5/17/2013
Barium	EPA 200.7	ND	mg/L	1	0.010	5/17/2013
Beryllium	EPA 200.7	ND	mg/L	1	0.0010	5/17/2013
Bismuth	EPA 200.7	ND	mg/L	1	0.10	5/17/2013
Boron	EPA 200.7	ND	mg/L	1	0.10	5/17/2013
Cadmium	EPA 200.7	ND	mg/L	1	0.0010	5/17/2013
Calcium	EPA 200.7	16	mg/L	1	0.50	5/17/2013
Chromium	EPA 200.7	ND	mg/L	1	0.0050	5/17/2013
Cobalt	EPA 200.7	ND	mg/L	1	0.010	5/17/2013
Copper	EPA 200.7	ND	mg/L	1	0.050	5/17/2013
Gallium	EPA 200.7	ND	mg/L	1	0.10	5/17/2013
Iron	EPA 200.7	0.014	mg/L	1	0.010	5/17/2013
Lithium	EPA 200.7	ND	mg/L	1	0.10	5/17/2013
Magnesium	EPA 200.7	2.6	mg/L	1	0.50	5/17/2013
Manganese	EPA 200.7	0.035	mg/L	1	0.0050	5/17/2013
Molybdenum	EPA 200.7	ND	mg/L	1	0.010	5/17/2013
Nickel	EPA 200.7	ND	mg/L	1	0.010	5/17/2013
Phosphorus	EPA 200.7	ND	mg/L	1	0.50	5/17/2013
Potassium	EPA 200.7	1.3	mg/L	1	0.50	5/17/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID: CF-11-02 (0-27) Wk:52 **Collect Date/Time:** 5/9/2013 09:00
WETLAB Sample ID: 1305198-001 **Receive Date:** 5/9/2013 01:55

Analyte	Method	Results	Units	DF	RL	Analyzed
Scandium	EPA 200.7	ND	mg/L	1	0.100	5/17/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	5/17/2013
Sodium	EPA 200.7	0.60	mg/L	1	0.50	5/17/2013
Strontium	EPA 200.7	0.13	mg/L	1	0.10	5/17/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	5/17/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	5/17/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	5/17/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	5/17/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	5/20/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	5/23/2013
Arsenic	EPA 200.8	ND	mg/L	1	0.0050	5/20/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	5/23/2013
Selenium	EPA 200.8	ND	mg/L	1	0.0050	5/20/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	5/23/2013
Uranium	EPA 200.8	ND	mg/L	1	0.0050	5/23/2013
Ion Balance						
Anions	Calculation	1.06	meq/L	1	0.10	
Cations	Calculation	1.08	meq/L	1	0.10	
Error	Calculation	ND	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		5/15/2013

Customer Sample ID: CF-11-02 (367-408) Wk:52 **Collect Date/Time:** 5/9/2013 09:00
WETLAB Sample ID: 1305198-002 **Receive Date:** 5/9/2013 01:55

Analyte	Method	Results	Units	DF	RL	Analyzed
General Chemistry						
pH	SM 4500-H+ B	7.16	pH Units	1		5/9/2013
Bicarbonate (HCO3)	SM 2320B	25	mg/L	1	1.0	5/9/2013
Carbonate (CO3)	SM 2320B	ND	mg/L	1	1.0	5/9/2013
Hydroxide (OH)	SM 2320B	ND	mg/L	1	1.0	5/9/2013
Total Alkalinity	SM 2320B	20	mg/L as CaCO3	1	1.0	5/9/2013
Total Dissolved Solids (TDS)	SM 2540C	45	mg/L	1	10	5/14/2013
Anions by Ion Chromatography						
Chloride	EPA 300.0	ND	mg/L	1	1.00	5/10/2013
Fluoride	EPA 300.0	0.71	mg/L	1	0.10	5/10/2013
Sulfate	EPA 300.0	7.5	mg/L	1	1.0	5/10/2013
Nitrate Nitrogen	EPA 300.0	ND	mg/L	1	0.10	5/10/2013
Nitrite Nitrogen	EPA 300.0	ND	mg/L	1	0.025	5/10/2013
Trace Metals by ICP-OES						
Aluminum	EPA 200.7	0.12	mg/L	1	0.045	5/17/2013
Barium	EPA 200.7	ND	mg/L	1	0.010	5/17/2013
Beryllium	EPA 200.7	ND	mg/L	1	0.0010	5/17/2013
Bismuth	EPA 200.7	ND	mg/L	1	0.10	5/17/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID: CF-11-02 (367-408) Wk:52 **Collect Date/Time:** 5/9/2013 09:00

WETLAB Sample ID: 1305198-002 **Receive Date:** 5/9/2013 01:55

Analyte	Method	Results	Units	DF	RL	Analyzed
Boron	EPA 200.7	ND	mg/L	1	0.10	5/17/2013
Cadmium	EPA 200.7	ND	mg/L	1	0.0010	5/17/2013
Calcium	EPA 200.7	11	mg/L	1	0.50	5/17/2013
Chromium	EPA 200.7	ND	mg/L	1	0.0050	5/17/2013
Cobalt	EPA 200.7	ND	mg/L	1	0.010	5/17/2013
Copper	EPA 200.7	ND	mg/L	1	0.050	5/17/2013
Gallium	EPA 200.7	ND	mg/L	1	0.10	5/17/2013
Iron	EPA 200.7	0.016	mg/L	1	0.010	5/17/2013
Lithium	EPA 200.7	ND	mg/L	1	0.10	5/17/2013
Magnesium	EPA 200.7	ND	mg/L	1	0.50	5/17/2013
Manganese	EPA 200.7	0.028	mg/L	1	0.0050	5/17/2013
Molybdenum	EPA 200.7	ND	mg/L	1	0.010	5/17/2013
Nickel	EPA 200.7	ND	mg/L	1	0.010	5/17/2013
Phosphorus	EPA 200.7	ND	mg/L	1	0.50	5/17/2013
Potassium	EPA 200.7	ND	mg/L	5	2.5	5/22/2013
Scandium	EPA 200.7	ND	mg/L	1	0.100	5/17/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	5/17/2013
Sodium	EPA 200.7	ND	mg/L	1	0.50	5/17/2013
Strontium	EPA 200.7	ND	mg/L	1	0.10	5/17/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	5/17/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	5/17/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	5/17/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	5/17/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	5/20/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	5/23/2013
Arsenic	EPA 200.8	ND	mg/L	1	0.0050	5/20/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	5/23/2013
Selenium	EPA 200.8	ND	mg/L	1	0.0050	5/20/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	5/23/2013
Uranium	EPA 200.8	ND	mg/L	1	0.0050	5/23/2013
Ion Balance						
Anions	Calculation	0.60	meq/L	1	0.10	
Cations	Calculation	0.56	meq/L	1	0.10	
Error	Calculation	3.4	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		5/15/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13050410	Blank 1	Fluoride	EPA 300.0	ND	mg/L
QC13050410	Blank 2	Fluoride	EPA 300.0	ND	mg/L
QC13050413	Blank 1	Chloride	EPA 300.0	ND	mg/L
QC13050413	Blank 2	Chloride	EPA 300.0	ND	mg/L
QC13050413	Blank 3	Chloride	EPA 300.0	ND	mg/L
QC13050415	Blank 1	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13050415	Blank 2	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13050415	Blank 3	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13050417	Blank 1	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13050417	Blank 2	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13050417	Blank 3	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13050419	Blank 1	Sulfate	EPA 300.0	ND	mg/L
QC13050419	Blank 2	Sulfate	EPA 300.0	ND	mg/L
QC13050765	Blank 1	Aluminum, Dissolved	EPA 200.7	ND	mg/L
		Barium, Dissolved	EPA 200.7	ND	mg/L
		Beryllium, Dissolved	EPA 200.7	ND	mg/L
		Bismuth, Dissolved	EPA 200.7	ND	mg/L
		Boron, Dissolved	EPA 200.7	ND	mg/L
		Cadmium, Dissolved	EPA 200.7	ND	mg/L
		Calcium, Dissolved	EPA 200.7	ND	mg/L
		Chromium, Dissolved	EPA 200.7	ND	mg/L
		Cobalt, Dissolved	EPA 200.7	ND	mg/L
		Copper, Dissolved	EPA 200.7	ND	mg/L
		Gallium, Dissolved	EPA 200.7	ND	mg/L
		Iron, Dissolved	EPA 200.7	ND	mg/L
		Lithium, Dissolved	EPA 200.7	ND	mg/L
		Magnesium, Dissolved	EPA 200.7	ND	mg/L
		Manganese, Dissolved	EPA 200.7	ND	mg/L
		Molybdenum, Dissolved	EPA 200.7	ND	mg/L
		Nickel, Dissolved	EPA 200.7	ND	mg/L
		Phosphorus, Dissolved	EPA 200.7	ND	mg/L
		Potassium, Dissolved	EPA 200.7	ND	mg/L
		Scandium, Dissolved	EPA 200.7	ND	mg/L
		Silver, Dissolved	EPA 200.7	ND	mg/L
		Sodium, Dissolved	EPA 200.7	ND	mg/L
		Strontium, Dissolved	EPA 200.7	ND	mg/L
		Tin, Dissolved	EPA 200.7	ND	mg/L
		Titanium, Dissolved	EPA 200.7	ND	mg/L
		Vanadium, Dissolved	EPA 200.7	ND	mg/L
		Zinc, Dissolved	EPA 200.7	ND	mg/L
QC13050820	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13050820	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13050820	Blank 3	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13050842	Blank 1	Uranium, Dissolved	EPA 200.8	ND	mg/L
		Mercury, Dissolved	EPA 200.8	ND	mg/L
		Antimony, Dissolved	EPA 200.8	ND	mg/L

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

QCBatchID	QCType	Parameter	Method	Result	Units
		Arsenic, Dissolved	EPA 200.8	ND	mg/L
		Lead, Dissolved	EPA 200.8	ND	mg/L
		Selenium, Dissolved	EPA 200.8	ND	mg/L
		Thallium, Dissolved	EPA 200.8	ND	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13050410	LCS 1	Fluoride	EPA 300.0	1.89	2.00	95	mg/L
QC13050413	LCS 1	Chloride	EPA 300.0	10.4	10.0	104	mg/L
QC13050415	LCS 1	Nitrite Nitrogen	EPA 300.0	0.494	0.500	99	mg/L
QC13050417	LCS 1	Nitrate Nitrogen	EPA 300.0	2.08	2.00	104	mg/L
QC13050419	LCS 1	Sulfate	EPA 300.0	24.2	25.0	97	mg/L
QC13050427	LCS 1	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13050427	LCS 2	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC13050427	LCS 3	pH	SM 4500-H+ B	7.03	7.00	100	pH Units
QC13050427	LCS 4	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13050428	LCS 1	Total Alkalinity	SM 2320B	100	100	100	mg/L
QC13050428	LCS 2	Total Alkalinity	SM 2320B	99.7	100	100	mg/L
QC13050428	LCS 3	Total Alkalinity	SM 2320B	99.8	100	100	mg/L
QC13050428	LCS 4	Total Alkalinity	SM 2320B	99.4	100	99	mg/L
QC13050428	LCS 5	Total Alkalinity	SM 2320B	99.6	100	100	mg/L
QC13050765	LCS 1	Aluminum, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
		Barium, Dissolved	EPA 200.7	0.979	1.00	98	mg/L
		Beryllium, Dissolved	EPA 200.7	0.984	1.00	98	mg/L
		Bismuth, Dissolved	EPA 200.7	0.969	1.00	97	mg/L
		Boron, Dissolved	EPA 200.7	0.971	1.00	97	mg/L
		Cadmium, Dissolved	EPA 200.7	0.964	1.00	96	mg/L
		Calcium, Dissolved	EPA 200.7	9.70	10.0	97	mg/L
		Chromium, Dissolved	EPA 200.7	0.976	1.00	98	mg/L
		Cobalt, Dissolved	EPA 200.7	0.975	1.00	98	mg/L
		Copper, Dissolved	EPA 200.7	4.75	5.00	95	mg/L
		Gallium, Dissolved	EPA 200.7	0.999	1.00	100	mg/L
		Iron, Dissolved	EPA 200.7	0.996	1.00	100	mg/L
		Lithium, Dissolved	EPA 200.7	1.04	1.00	104	mg/L
		Magnesium, Dissolved	EPA 200.7	9.40	10.0	94	mg/L
		Manganese, Dissolved	EPA 200.7	0.960	1.00	96	mg/L
		Molybdenum, Dissolved	EPA 200.7	0.991	1.00	99	mg/L
		Nickel, Dissolved	EPA 200.7	4.89	5.00	98	mg/L
		Phosphorus, Dissolved	EPA 200.7	4.93	5.00	99	mg/L
		Potassium, Dissolved	EPA 200.7	10.2	10.0	102	mg/L
		Scandium, Dissolved	EPA 200.7	0.978	1.00	98	mg/L
		Silver, Dissolved	EPA 200.7	0.089	0.090	99	mg/L
		Sodium, Dissolved	EPA 200.7	10.3	10.0	103	mg/L
		Strontium, Dissolved	EPA 200.7	1.03	1.00	103	mg/L
		Tin, Dissolved	EPA 200.7	0.956	1.00	96	mg/L
		Titanium, Dissolved	EPA 200.7	0.986	1.00	99	mg/L
		Vanadium, Dissolved	EPA 200.7	0.980	1.00	98	mg/L
		Zinc, Dissolved	EPA 200.7	0.998	1.00	100	mg/L
QC13050820	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	140	150	93	mg/L
QC13050820	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	153	150	102	mg/L
QC13050820	LCS 3	Total Dissolved Solids (TDS)	SM 2540C	140	150	93	mg/L
QC13050842	LCS 1	Uranium, Dissolved	EPA 200.8	0.0102	0.010	102	mg/L
		Mercury, Dissolved	EPA 200.8	0.000923	0.001	92	mg/L
		Antimony, Dissolved	EPA 200.8	0.0099	0.010	99	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
		Arsenic, Dissolved	EPA 200.8	0.0511	0.050	102	mg/L
		Lead, Dissolved	EPA 200.8	0.0101	0.010	101	mg/L
		Selenium, Dissolved	EPA 200.8	0.0479	0.050	96	mg/L
		Thallium, Dissolved	EPA 200.8	0.0102	0.010	102	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC13050427	Duplicate	pH	SM 4500-H+ B	1305125-010	7.06	7.08	pH Units	<1%
QC13050427	Duplicate	pH	SM 4500-H+ B	1305187-002	7.64	7.61	pH Units	<1%
QC13050427	Duplicate	pH	SM 4500-H+ B	1305187-001	7.60	7.60	pH Units	<1%
QC13050427	Duplicate	pH	SM 4500-H+ B	1305187-005	7.46	7.42	pH Units	1 %
QC13050427	Duplicate	pH	SM 4500-H+ B	1305126-001	7.30	7.29	pH Units	<1%
QC13050427	Duplicate	pH	SM 4500-H+ B	1305126-011	9.00	9.05	pH Units	1 %
QC13050427	Duplicate	pH	SM 4500-H+ B	1305192-001	6.20	6.21	pH Units	<1%
QC13050427	Duplicate	pH	SM 4500-H+ B	1305198-002	7.16	7.16	pH Units	<1%
QC13050428	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305125-010	282	280	mg/L	1 %
		Carbonate (CO3)	SM 2320B	1305125-010	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305125-010	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1305125-010	231	230	mg/L as CaCO3	1 %
QC13050428	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305187-002	206	206	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1305187-002	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305187-002	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1305187-002	169	169	mg/L as CaCO3	<1%
QC13050428	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305187-001	198	200	mg/L	1 %
		Carbonate (CO3)	SM 2320B	1305187-001	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305187-001	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1305187-001	163	164	mg/L as CaCO3	1 %
QC13050428	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305187-005	35.2	34.0	mg/L	4 %
		Carbonate (CO3)	SM 2320B	1305187-005	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305187-005	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1305187-005	28.9	27.9	mg/L as CaCO3	4 %
QC13050428	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305126-001	230	230	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1305126-001	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305126-001	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1305126-001	189	189	mg/L as CaCO3	<1%
QC13050428	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305126-011	183	178	mg/L	3 %
		Carbonate (CO3)	SM 2320B	1305126-011	19.9	22.0	mg/L	10 %
		Hydroxide (OH)	SM 2320B	1305126-011	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1305126-011	183	183	mg/L as CaCO3	<1%
QC13050428	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305192-001	39.3	39.2	mg/L	<1%
		Carbonate (CO3)	SM 2320B	1305192-001	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305192-001	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1305192-001	32.2	32.1	mg/L as CaCO3	<1%

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result		Units	RPD
QC13050428	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305198-002	24.6	26.0		mg/L	5 %
		Carbonate (CO3)	SM 2320B	1305198-002	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305198-002	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1305198-002	20.2	21.3		mg/L as CaCO3	5 %
QC13050820	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305187-003	201	196		mg/L	3 %
QC13050820	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305190-001	309	314		mg/L	2 %
QC13050820	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305205-001	25.0	31.0		mg/L	21 %
QC13050820	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305224-001	219	213		mg/L	3 %
QC13050820	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305227-001	36.0	39.0		mg/L	8 %
QC13050820	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305229-002	190	208	Q	mg/L	9 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13050410	MS 1	Fluoride	EPA 300.0	1305173-021	0.127		2.09	2.12	2.00	mg/L	98	100	1 %
QC13050413	MS 1	Chloride	EPA 300.0	1305173-021	ND		5.51	5.55	5.00	mg/L	109	110	1 %
QC13050413	MS 2	Chloride	EPA 300.0	1305198-002	ND		5.27	5.28	5.00	mg/L	104	105	<1%
QC13050415	MS 1	Nitrite Nitrogen	EPA 300.0	1305173-021	ND		0.511	0.515	0.500	mg/L	100	101	1 %
QC13050415	MS 2	Nitrite Nitrogen	EPA 300.0	1305198-002	ND		0.482	0.491	0.500	mg/L	94	96	2 %
QC13050417	MS 1	Nitrate Nitrogen	EPA 300.0	1305173-021	ND		2.27	2.29	2.00	mg/L	111	112	1 %
QC13050417	MS 2	Nitrate Nitrogen	EPA 300.0	1305188-003	5.91		28.7	28.9	2.00	mg/L	114	115	1 %
QC13050419	MS 1	Sulfate	EPA 300.0	1305173-021	38.6		49.7	50.1	10.0	mg/L	111	115	1 %
QC13050765	MS 1	Aluminum, Dissolved	EPA 200.7	1305190-002	ND		1.07	1.07	1.00	mg/L	103	103	<1%
		Barium, Dissolved	EPA 200.7	1305190-002	0.152		1.09	1.10	1.00	mg/L	94	95	1 %
		Beryllium, Dissolved	EPA 200.7	1305190-002	ND		0.987	0.995	1.00	mg/L	99	99	1 %
		Bismuth, Dissolved	EPA 200.7	1305190-002	ND		0.943	0.943	1.00	mg/L	96	96	<1%
		Boron, Dissolved	EPA 200.7	1305190-002	0.140		1.12	1.13	1.00	mg/L	98	99	1 %
		Cadmium, Dissolved	EPA 200.7	1305190-002	0.003		0.927	0.940	1.00	mg/L	92	94	1 %
		Calcium, Dissolved	EPA 200.7	1305190-002	185	SC	212	215	10.0	mg/L	NC	NC	NC
		Chromium, Dissolved	EPA 200.7	1305190-002	ND		0.951	0.958	1.00	mg/L	95	96	1 %
		Cobalt, Dissolved	EPA 200.7	1305190-002	ND		0.862	0.876	1.00	mg/L	86	88	2 %
		Copper, Dissolved	EPA 200.7	1305190-002	ND		4.69	4.71	5.00	mg/L	94	94	<1%
		Gallium, Dissolved	EPA 200.7	1305190-002	ND		1.04	1.04	1.00	mg/L	104	104	<1%
		Iron, Dissolved	EPA 200.7	1305190-002	ND		0.963	0.964	1.00	mg/L	95	96	<1%
		Lithium, Dissolved	EPA 200.7	1305190-002	0.343		1.35	1.38	1.00	mg/L	101	104	2 %
		Magnesium, Dissolved	EPA 200.7	1305190-002	57.2	SC	76.4	75.9	10.0	mg/L	NC	NC	NC
		Manganese, Dissolved	EPA 200.7	1305190-002	ND		0.919	0.924	1.00	mg/L	92	93	1 %
		Molybdenum, Dissolved	EPA 200.7	1305190-002	ND		0.977	0.992	1.00	mg/L	97	99	2 %
		Nickel, Dissolved	EPA 200.7	1305190-002	ND		4.34	4.39	5.00	mg/L	87	88	1 %
		Phosphorus, Dissolved	EPA 200.7	1305190-002	ND		5.20	5.31	5.00	mg/L	102	104	2 %
		Potassium, Dissolved	EPA 200.7	1305190-002	7.29		18.2	18.1	10.0	mg/L	109	108	1 %
		Scandium, Dissolved	EPA 200.7	1305190-002	ND		0.969	0.974	1.00	mg/L	97	97	1 %
		Silver, Dissolved	EPA 200.7	1305190-002	ND		0.092	0.093	0.090	mg/L	99	101	1 %
		Sodium, Dissolved	EPA 200.7	1305190-002	84.9	SC	104	106	10.0	mg/L	NC	NC	NC
		Strontium, Dissolved	EPA 200.7	1305190-002	1.30		2.44	2.48	1.00	mg/L	114	118	2 %
		Tin, Dissolved	EPA 200.7	1305190-002	ND		0.962	0.968	1.00	mg/L	97	98	1 %
		Titanium, Dissolved	EPA 200.7	1305190-002	ND		0.972	0.969	1.00	mg/L	98	98	<1%
		Vanadium, Dissolved	EPA 200.7	1305190-002	0.058		1.02	1.03	1.00	mg/L	96	97	1 %
		Zinc, Dissolved	EPA 200.7	1305190-002	0.030		0.959	0.979	1.00	mg/L	93	95	2 %
QC13050842	MS 1	Uranium, Dissolved	EPA 200.8	1305190-002	ND			NA	0.010	mg/L	NC	NA	NA

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Mercury, Dissolved	EPA 200.8	1305190-002	0.000143	0.000982	0.001002	0.001	mg/L	84	86	2 %
		Antimony, Dissolved	EPA 200.8	1305190-002	ND	0.0102	0.0102	0.010	mg/L	100	100	<1%
		Arsenic, Dissolved	EPA 200.8	1305190-002	ND	0.0563	0.0561	0.050	mg/L	103	102	<1%
		Lead, Dissolved	EPA 200.8	1305190-002	ND	0.0087	0.0087	0.010	mg/L	87	87	<1%
		Selenium, Dissolved	EPA 200.8	1305190-002	0.0098	0.0548	0.0547	0.050	mg/L	90	90	<1%
		Thallium, Dissolved	EPA 200.8	1305190-002	ND	0.0084	0.0083	0.010	mg/L	84	83	1 %

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY

Specializing in Soil, Hazardous Waste and Water Analysis.

475 E. Greg Street #119 | Sparks, Nevada 89431
tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1305198
Report Due Date: 5/23/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Fax 775-356-8917
P.O. Number
Email mli@mettest.com
Collector's Name Robert
Project Name
Project Number 3438

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium	Spl. No.
CF-11-02 (0-27)	Wk:52	05/09/13	9:00	WW	2	X	X	1
CF-11-02 (367-408)	↓	↓	↓	↓	↓	↓	↓	2

1305 1
198 2

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 20.2°C	5/9/13	1355		
Custody Seals Intact? Y N None				
Number of Containers 4				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

WETLAB
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Lab Number 1305198
Report Due Date: 5/23/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Fax 775-356-8917
P.O. Number
Email mli@mettest.com
Collector's Name Robert
Project Name
Project Number 3438

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company ______
Address ______
City, State & Zip ______
Contact ______
Phone ______
Fax ______
Email ______

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium	Spl. No.
CF-11-02 (0-27)	Wk:52	05/09/13	9:00	WW	2	X	X	1
CF-11-02 (367-408)	↓	↓	↓	↓	↓	↓	↓	2

1305 198 1 2

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 20.2°C	5/9/13	1355		
Custody Seals Intact? Y N None				
Number of Containers 4				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

WETLAB
WESTERN ENVIRONMENTAL
TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

5/30/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1305351*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 5/16/2013. Additional comments are located on page 2 of this report.

This is an amended report that includes an adjusted reporting limit for Antimony. If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Jennifer Delaney
QA Specialist

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1305351

General Comments

None

Specific Comments

Due to the sample matrix it was necessary to analyze the following at a dilution:
1305351-001 Antimony, Arsenic, Mercury, Selenium and Thallium
The reporting limits have been adjusted accordingly.

Report Legend

B -- Blank contamination; Analyte detected above the method reporting limit in an associated blank
D -- Reporting limit is elevated due to required sample dilution
DF -- Dilution Factor
HT -- Sample analyzed beyond the accepted holding time
J -- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M -- Reported value is estimated; The sample matrix interfered with the analysis
MCL -- State or EPA Maximum Contamination Level
N -- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC -- Not calculated due to matrix interference
ND -- Non-detect result; Indicates the result was below the reporting limit (RL)
Q -- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
RL -- Reporting Limit or Practical Quantitation Limit
S -- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits
SC -- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438*

Date Printed: 5/30/2013
OrderID: *1305351*

Customer Sample ID: 604 673 Wk:120
WETLAB Sample ID: 1305351-001

Collect Date/Time: 5/16/2013 09:00
Receive Date: 5/16/2013 14:20

Analyte	Method	Results	Units	DF	RL	Analyzed
General Chemistry						
pH	SM 4500-H+ B	4.79	pH Units	1		5/16/2013
Bicarbonate (HCO3)	SM 2320B	ND	mg/L	1	1.0	5/16/2013
Carbonate (CO3)	SM 2320B	ND	mg/L	1	1.0	5/16/2013
Hydroxide (OH)	SM 2320B	ND	mg/L	1	1.0	5/16/2013
Total Alkalinity	SM 2320B	ND	mg/L as CaCO3	1	1.0	5/16/2013
Total Dissolved Solids (TDS)	SM 2540C	66	mg/L	1	10	5/21/2013
Anions by Ion Chromatography						
Chloride	EPA 300.0	ND	mg/L	1	1.00	5/17/2013
Fluoride	EPA 300.0	0.18	mg/L	1	0.10	5/17/2013
Sulfate	EPA 300.0	29	mg/L	1	1.0	5/17/2013
Nitrate Nitrogen	EPA 300.0	ND	mg/L	1	0.10	5/17/2013
Nitrite Nitrogen	EPA 300.0	ND	mg/L	1	0.025	5/17/2013
Trace Metals by ICP-OES						
Aluminum	EPA 200.7	0.20	mg/L	1	0.045	5/24/2013
Barium	EPA 200.7	0.071	mg/L	1	0.010	5/24/2013
Beryllium	EPA 200.7	0.0010	mg/L	1	0.0010	5/24/2013
Bismuth	EPA 200.7	ND	mg/L	1	0.10	5/24/2013
Boron	EPA 200.7	ND	mg/L	1	0.10	5/24/2013
Cadmium	EPA 200.7	0.0014	mg/L	1	0.0010	5/24/2013
Calcium	EPA 200.7	7.7	mg/L	1	0.50	5/24/2013
Chromium	EPA 200.7	ND	mg/L	1	0.0050	5/24/2013
Cobalt	EPA 200.7	ND	mg/L	1	0.010	5/24/2013
Copper	EPA 200.7	3.3	mg/L	1	0.050	5/24/2013
Gallium	EPA 200.7	ND	mg/L	1	0.10	5/24/2013
Iron	EPA 200.7	0.065	mg/L	1	0.010	5/24/2013
Lithium	EPA 200.7	ND	mg/L	1	0.10	5/24/2013
Magnesium	EPA 200.7	1.0	mg/L	1	0.50	5/24/2013
Manganese	EPA 200.7	0.059	mg/L	1	0.0050	5/24/2013
Molybdenum	EPA 200.7	ND	mg/L	1	0.010	5/24/2013
Nickel	EPA 200.7	ND	mg/L	1	0.010	5/24/2013
Phosphorus	EPA 200.7	ND	mg/L	1	0.50	5/24/2013
Potassium	EPA 200.7	1.0	mg/L	1	0.50	5/24/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID: 604 673 Wk:120
WETLAB Sample ID: 1305351-001

Collect Date/Time: 5/16/2013 09:00
Receive Date: 5/16/2013 14:20

Analyte	Method	Results	Units	DF	RL	Analyzed
Scandium	EPA 200.7	ND	mg/L	1	0.100	5/24/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	5/24/2013
Sodium	EPA 200.7	ND	mg/L	1	0.50	5/24/2013
Strontium	EPA 200.7	ND	mg/L	1	0.10	5/24/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	5/24/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	5/24/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	5/24/2013
Zinc	EPA 200.7	0.076	mg/L	1	0.010	5/24/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	2	0.0002	5/28/2013
Antimony	EPA 200.8	ND	mg/L	2	0.010	5/28/2013
Arsenic	EPA 200.8	ND	mg/L	2	0.010	5/28/2013
Lead	EPA 200.8	0.017	mg/L	2	0.0025	5/28/2013
Selenium	EPA 200.8	ND	mg/L	2	0.010	5/28/2013
Thallium	EPA 200.8	ND	mg/L	2	0.0020	5/28/2013
Uranium	EPA 200.8	0.036	mg/L	2	0.0050	5/28/2013
Ion Balance						
Anions	Calculation	0.61	meq/L	1	0.10	
Cations	Calculation	0.63	meq/L	1	0.10	
Error	Calculation	1.0	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		5/22/2013

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13050785	Blank 1	Fluoride	EPA 300.0	ND	mg/L
QC13050785	Blank 2	Fluoride	EPA 300.0	ND	mg/L
QC13050785	Blank 3	Fluoride	EPA 300.0	ND	mg/L
QC13050788	Blank 1	Chloride	EPA 300.0	ND	mg/L
QC13050788	Blank 2	Chloride	EPA 300.0	ND	mg/L
QC13050788	Blank 3	Chloride	EPA 300.0	ND	mg/L
QC13050789	Blank 1	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13050789	Blank 2	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13050789	Blank 3	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13050791	Blank 1	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13050791	Blank 2	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13050791	Blank 3	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13050795	Blank 1	Sulfate	EPA 300.0	ND	mg/L
QC13050795	Blank 2	Sulfate	EPA 300.0	ND	mg/L
QC13050795	Blank 3	Sulfate	EPA 300.0	ND	mg/L
QC13051027	Blank 1	Aluminum	EPA 200.7	ND	mg/L
		Barium	EPA 200.7	ND	mg/L
		Beryllium	EPA 200.7	ND	mg/L
		Bismuth	EPA 200.7	ND	mg/L
		Boron	EPA 200.7	ND	mg/L
		Cadmium	EPA 200.7	ND	mg/L
		Calcium	EPA 200.7	ND	mg/L
		Chromium	EPA 200.7	ND	mg/L
		Cobalt	EPA 200.7	ND	mg/L
		Copper	EPA 200.7	ND	mg/L
		Gallium	EPA 200.7	ND	mg/L
		Iron	EPA 200.7	ND	mg/L
		Lithium	EPA 200.7	ND	mg/L
		Magnesium	EPA 200.7	ND	mg/L
		Manganese	EPA 200.7	ND	mg/L
		Molybdenum	EPA 200.7	ND	mg/L
		Nickel	EPA 200.7	ND	mg/L
		Phosphorus	EPA 200.7	ND	mg/L
		Potassium	EPA 200.7	ND	mg/L
		Scandium	EPA 200.7	ND	mg/L
		Silver	EPA 200.7	ND	mg/L
		Sodium	EPA 200.7	ND	mg/L
		Strontium	EPA 200.7	ND	mg/L
		Tin	EPA 200.7	ND	mg/L
		Titanium	EPA 200.7	ND	mg/L
		Vanadium	EPA 200.7	ND	mg/L
		Zinc	EPA 200.7	ND	mg/L
QC13051075	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13051075	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13051084	Blank 1	Mercury	EPA 200.8	ND	mg/L
		Antimony	EPA 200.8	ND	mg/L

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

QCBatchID	QCType	Parameter	Method	Result	Units
		Arsenic	EPA 200.8	ND	mg/L
		Lead	EPA 200.8	ND	mg/L
		Selenium	EPA 200.8	ND	mg/L
		Thallium	EPA 200.8	ND	mg/L
		Uranium	EPA 200.8	ND	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13050735	LCS 1	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC13050735	LCS 2	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC13050735	LCS 3	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC13050737	LCS 1	Total Alkalinity	SM 2320B	98.7	100	99	mg/L
QC13050737	LCS 2	Total Alkalinity	SM 2320B	99.8	100	100	mg/L
QC13050737	LCS 3	Total Alkalinity	SM 2320B	98.9	100	99	mg/L
QC13050785	LCS 1	Fluoride	EPA 300.0	1.91	2.00	96	mg/L
QC13050788	LCS 1	Chloride	EPA 300.0	10.6	10.0	106	mg/L
QC13050789	LCS 1	Nitrite Nitrogen	EPA 300.0	0.483	0.500	97	mg/L
QC13050791	LCS 1	Nitrate Nitrogen	EPA 300.0	2.13	2.00	106	mg/L
QC13050795	LCS 1	Sulfate	EPA 300.0	24.4	25.0	98	mg/L
QC13051027	LCS 1	Aluminum	EPA 200.7	0.995	1.00	100	mg/L
		Barium	EPA 200.7	0.975	1.00	98	mg/L
		Beryllium	EPA 200.7	0.974	1.00	97	mg/L
		Bismuth	EPA 200.7	0.988	1.00	99	mg/L
		Boron	EPA 200.7	0.950	1.00	95	mg/L
		Cadmium	EPA 200.7	0.982	1.00	98	mg/L
		Calcium	EPA 200.7	9.66	10.0	97	mg/L
		Chromium	EPA 200.7	0.964	1.00	96	mg/L
		Cobalt	EPA 200.7	0.987	1.00	99	mg/L
		Copper	EPA 200.7	4.69	5.00	94	mg/L
		Gallium	EPA 200.7	1.01	1.00	101	mg/L
		Iron	EPA 200.7	0.983	1.00	98	mg/L
		Lithium	EPA 200.7	0.989	1.00	99	mg/L
		Magnesium	EPA 200.7	9.66	10.0	97	mg/L
		Manganese	EPA 200.7	0.969	1.00	97	mg/L
		Molybdenum	EPA 200.7	0.989	1.00	99	mg/L
		Nickel	EPA 200.7	4.88	5.00	98	mg/L
		Phosphorus	EPA 200.7	5.09	5.00	102	mg/L
		Potassium	EPA 200.7	9.83	10.0	98	mg/L
		Scandium	EPA 200.7	0.970	1.00	97	mg/L
		Silver	EPA 200.7	0.089	0.090	99	mg/L
		Sodium	EPA 200.7	10.0	10.0	100	mg/L
		Strontium	EPA 200.7	1.00	1.00	100	mg/L
		Tin	EPA 200.7	0.997	1.00	100	mg/L
		Titanium	EPA 200.7	0.983	1.00	98	mg/L
		Vanadium	EPA 200.7	0.964	1.00	96	mg/L
		Zinc	EPA 200.7	0.997	1.00	100	mg/L
QC13051075	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	152	150	101	mg/L
QC13051075	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	139	150	92	mg/L
QC13051084	LCS 1	Mercury	EPA 200.8	0.001020	0.001	102	mg/L
		Antimony	EPA 200.8	0.0097	0.010	97	mg/L
		Arsenic	EPA 200.8	0.0494	0.050	99	mg/L
		Lead	EPA 200.8	0.0099	0.010	99	mg/L
		Selenium	EPA 200.8	0.0472	0.050	94	mg/L
		Thallium	EPA 200.8	0.0100	0.010	100	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
		Uranium	EPA 200.8	0.0099	0.010	99	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result		Units	RPD
QC13050735	Duplicate	pH	SM 4500-H+ B	1305293-001	7.91	7.93		pH Units	<1%
QC13050735	Duplicate	pH	SM 4500-H+ B	1305293-011	8.74	8.73		pH Units	<1%
QC13050735	Duplicate	pH	SM 4500-H+ B	1305354-001	8.66	8.66		pH Units	<1%
QC13050735	Duplicate	pH	SM 4500-H+ B	1305349-001	7.77	7.78		pH Units	<1%
QC13050735	Duplicate	pH	SM 4500-H+ B	1305358-004	7.69	7.65		pH Units	1 %
QC13050737	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305293-001	138	138		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1305293-001	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305293-001	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1305293-001	113	113		mg/L as CaCO3	<1%
QC13050737	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305293-011	190	193		mg/L	2 %
		Carbonate (CO3)	SM 2320B	1305293-011	14.6	14.6		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305293-011	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1305293-011	180	182		mg/L as CaCO3	2 %
QC13050737	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305354-001	133	132		mg/L	1 %
		Carbonate (CO3)	SM 2320B	1305354-001	10.8	10.1		mg/L	6 %
		Hydroxide (OH)	SM 2320B	1305354-001	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1305354-001	127	125		mg/L as CaCO3	1 %
QC13050737	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305349-001	116	119		mg/L	2 %
		Carbonate (CO3)	SM 2320B	1305349-001	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305349-001	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1305349-001	95.3	97.6		mg/L as CaCO3	2 %
QC13050737	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305358-004	207	207		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1305358-004	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305358-004	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1305358-004	170	170		mg/L as CaCO3	<1%
QC13051075	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305292-001	352	355		mg/L	1 %
QC13051075	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305292-011	167	164		mg/L	2 %
QC13051075	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305293-010	238	223	Q	mg/L	7 %
QC13051075	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305337-006	714	727		mg/L	2 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13050785	MS 1	Fluoride	EPA 300.0	1305352-001	ND		2.08	2.03	2.00	mg/L	103	101	2 %
QC13050785	MS 2	Fluoride	EPA 300.0	1305358-005	0.201		4.02	3.91	2.00	mg/L	95	93	3 %
QC13050788	MS 1	Chloride	EPA 300.0	1305352-001	ND		5.43	5.46	5.00	mg/L	108	108	1 %
QC13050788	MS 2	Chloride	EPA 300.0	1305358-005	13.9		24.9	24.9	5.00	mg/L	110	109	<1%
QC13050789	MS 1	Nitrite Nitrogen	EPA 300.0	1305323-003	ND		0.497	0.504	0.500	mg/L	97	99	1 %
QC13050789	MS 2	Nitrite Nitrogen	EPA 300.0	1305352-001	ND		0.497	0.498	0.500	mg/L	97	97	<1%
QC13050791	MS 1	Nitrate Nitrogen	EPA 300.0	1305323-003	ND		2.31	2.34	2.00	mg/L	113	115	1 %
QC13050791	MS 2	Nitrate Nitrogen	EPA 300.0	1305328-006	ND		2.30	2.31	2.00	mg/L	113	114	<1%
QC13050795	MS 1	Sulfate	EPA 300.0	1305261-003	81.5	SC	93.6	93.6	10.0	mg/L	NC	NC	NC
QC13050795	MS 2	Sulfate	EPA 300.0	1305323-003	6.30		16.2	16.3	10.0	mg/L	99	100	1 %

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13051027	MS 1	Aluminum	EPA 200.7	1305337-004	ND	1.01	1.02	1.00	mg/L	98	99	1 %
		Barium	EPA 200.7	1305337-004	0.182	1.16	1.16	1.00	mg/L	98	98	<1%
		Beryllium	EPA 200.7	1305337-004	ND	0.986	0.991	1.00	mg/L	99	99	1 %
		Bismuth	EPA 200.7	1305337-004	ND	1.05	1.06	1.00	mg/L	105	106	1 %
		Boron	EPA 200.7	1305337-004	1.35	2.33	2.37	1.00	mg/L	98	102	2 %
		Cadmium	EPA 200.7	1305337-004	ND	1.01	1.01	1.00	mg/L	101	101	<1%
		Calcium	EPA 200.7	1305337-004	8.55	17.7	17.5	10.0	mg/L	91	90	1 %
		Chromium	EPA 200.7	1305337-004	ND	0.957	0.958	1.00	mg/L	96	96	<1%
		Cobalt	EPA 200.7	1305337-004	ND	0.980	0.984	1.00	mg/L	98	98	<1%
		Copper	EPA 200.7	1305337-004	ND	5.10	5.15	5.00	mg/L	102	103	1 %
		Gallium	EPA 200.7	1305337-004	ND	0.978	0.989	1.00	mg/L	98	99	1 %
		Iron	EPA 200.7	1305337-004	ND	0.991	1.00	1.00	mg/L	NC	NC	NC
		Lithium	EPA 200.7	1305337-004	0.875	1.81	1.83	1.00	mg/L	94	96	1 %
		Magnesium	EPA 200.7	1305337-004	0.977	10.8	10.8	10.0	mg/L	98	98	<1%
		Manganese	EPA 200.7	1305337-004	0.052	1.02	1.02	1.00	mg/L	97	97	<1%
		Molybdenum	EPA 200.7	1305337-004	ND	0.978	0.985	1.00	mg/L	98	98	1 %
		Nickel	EPA 200.7	1305337-004	ND	4.92	4.92	5.00	mg/L	99	99	<1%
		Phosphorus	EPA 200.7	1305337-004	ND	5.19	5.23	5.00	mg/L	101	102	1 %
		Potassium	EPA 200.7	1305337-004	12.4	22.1	22.2	10.0	mg/L	97	98	<1%
		Scandium	EPA 200.7	1305337-004	ND	0.973	0.979	1.00	mg/L	97	98	1 %
		Silver	EPA 200.7	1305337-004	ND	0.087	0.087	0.090	mg/L	96	96	<1%
		Sodium	EPA 200.7	1305337-004	186	SC 192	194	10.0	mg/L	NC	NC	NC
		Strontium	EPA 200.7	1305337-004	0.318	1.29	1.28	1.00	mg/L	97	96	1 %
		Tin	EPA 200.7	1305337-004	ND	0.979	0.983	1.00	mg/L	99	100	<1%
		Titanium	EPA 200.7	1305337-004	ND	0.987	0.991	1.00	mg/L	99	99	<1%
		Vanadium	EPA 200.7	1305337-004	ND	0.968	0.971	1.00	mg/L	96	97	<1%
		Zinc	EPA 200.7	1305337-004	ND	1.08	1.08	1.00	mg/L	108	108	<1%
QC13051084	MS 1	Mercury	EPA 200.8	1305337-004	ND	0.001400	0.001400	0.001	mg/L	90	90	<1%
		Antimony	EPA 200.8	1305337-004	0.0135	0.0235	0.0241	0.010	mg/L	100	106	3 %
		Arsenic	EPA 200.8	1305337-004	ND	0.0660	0.0684	0.050	mg/L	103	108	4 %
		Lead	EPA 200.8	1305337-004	ND	0.0110	0.0113	0.010	mg/L	97	100	3 %
		Selenium	EPA 200.8	1305337-004	ND	0.0508	0.0515	0.050	mg/L	95	96	1 %
		Thallium	EPA 200.8	1305337-004	ND	0.0111	0.0115	0.010	mg/L	98	102	4 %
		Uranium	EPA 200.8	1305337-004	ND	0.0101	0.0105	0.010	mg/L	95	99	4 %

WETLAB
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TESTING LABORATORY

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Specializing in Soil, Hazardous Waste and Water Analysis.

6/7/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1305511*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 5/23/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Jennifer Delaney
QA Specialist

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1305511

General Comments

None

Specific Comments

Due to the sample matrix it was necessary to analyze the following at a dilution:
- 1305511-003 Molybdenum, Antimony, Arsenic and Selenium
- 1305511-004 Arsenic
- 1305511-005 Molybdenum

The reporting limits have been adjusted accordingly.

Report Legend

B -- Blank contamination; Analyte detected above the method reporting limit in an associated blank

D -- Reporting limit is elevated due to required sample dilution

DF -- Dilution Factor

HT -- Sample analyzed beyond the accepted holding time

J -- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit

M -- Reported value is estimated; The sample matrix interfered with the analysis

MCL -- State or EPA Maximum Contamination Level

N -- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.

NC -- Not calculated due to matrix interference

ND -- Non-detect result; Indicates the result was below the reporting limit (RL)

Q -- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy

RL -- Reporting Limit or Practical Quantitation Limit

S -- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits

SC -- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438*

Date Printed: 6/7/2013
OrderID: *1305511*

Customer Sample ID: CF-11-02 (227-367) Wk:48
WETLAB Sample ID: 1305511-001

Collect Date/Time: 5/23/2013 09:00
Receive Date: 5/23/2013 14:00

Analyte	Method	Results		Units	DF	RL	Analyzed
General Chemistry							
pH	SM 4500-H+ B	7.86	HT	pH Units	1		5/23/2013
Bicarbonate (HCO3)	SM 2320B	58		mg/L	1	1.0	5/23/2013
Carbonate (CO3)	SM 2320B	ND		mg/L	1	1.0	5/23/2013
Hydroxide (OH)	SM 2320B	ND		mg/L	1	1.0	5/23/2013
Total Alkalinity	SM 2320B	47		mg/L as CaCO3	1	1.0	5/23/2013
Total Dissolved Solids (TDS)	SM 2540C	69		mg/L	1	10	5/30/2013
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND		mg/L	1	1.00	5/24/2013
Fluoride	EPA 300.0	0.96		mg/L	1	0.10	5/24/2013
Sulfate	EPA 300.0	3.5		mg/L	1	1.0	5/24/2013
Nitrate Nitrogen	EPA 300.0	ND		mg/L	1	0.10	5/24/2013
Nitrite Nitrogen	EPA 300.0	ND		mg/L	1	0.025	5/24/2013
Trace Metals by ICP-OES							
Aluminum	EPA 200.7	0.16		mg/L	1	0.045	5/31/2013
Barium	EPA 200.7	0.033		mg/L	1	0.010	5/31/2013
Beryllium	EPA 200.7	ND		mg/L	1	0.0010	5/31/2013
Bismuth	EPA 200.7	ND		mg/L	1	0.10	5/31/2013
Boron	EPA 200.7	ND		mg/L	1	0.10	5/31/2013
Cadmium	EPA 200.7	ND		mg/L	1	0.0010	5/31/2013
Calcium	EPA 200.7	16		mg/L	1	0.50	5/31/2013
Chromium	EPA 200.7	ND		mg/L	1	0.0050	5/31/2013
Cobalt	EPA 200.7	ND		mg/L	1	0.010	5/31/2013
Copper	EPA 200.7	ND		mg/L	1	0.050	5/31/2013
Gallium	EPA 200.7	ND		mg/L	1	0.10	5/31/2013
Iron	EPA 200.7	0.092		mg/L	1	0.010	5/31/2013
Lithium	EPA 200.7	ND		mg/L	1	0.10	5/31/2013
Magnesium	EPA 200.7	2.1		mg/L	1	0.50	5/31/2013
Manganese	EPA 200.7	0.022		mg/L	1	0.0050	5/31/2013
Molybdenum	EPA 200.7	ND		mg/L	1	0.010	5/31/2013
Nickel	EPA 200.7	ND		mg/L	1	0.010	5/31/2013
Phosphorus	EPA 200.7	ND		mg/L	1	0.50	5/31/2013
Potassium	EPA 200.7	2.1		mg/L	1	0.50	5/31/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID: CF-11-02 (227-367) Wk:48
WETLAB Sample ID: 1305511-001
Collect Date/Time: 5/23/2013 09:00
Receive Date: 5/23/2013 14:00

Analyte	Method	Results	Units	DF	RL	Analyzed
Scandium	EPA 200.7	ND	mg/L	1	0.100	5/31/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	5/31/2013
Sodium	EPA 200.7	0.58	mg/L	1	0.50	5/31/2013
Strontium	EPA 200.7	0.14	mg/L	1	0.10	5/31/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	6/1/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	6/4/2013
Arsenic	EPA 200.8	ND	mg/L	1	0.0050	6/4/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	6/1/2013
Selenium	EPA 200.8	ND	mg/L	1	0.0050	6/1/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	6/1/2013
Uranium	EPA 200.8	ND	mg/L	1	0.0050	6/1/2013
Ion Balance						
Anions	Calculation	1.07	meq/L	1	0.10	
Cations	Calculation	1.07	meq/L	1	0.10	
Error	Calculation	ND	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		5/30/2013

Customer Sample ID: K-Spar Breccia 5+ Comp Wk:48
WETLAB Sample ID: 1305511-002
Collect Date/Time: 5/23/2013 09:00
Receive Date: 5/23/2013 14:00

Analyte	Method	Results	Units	DF	RL	Analyzed
General Chemistry						
pH	SM 4500-H+ B	7.87 HT	pH Units	1		5/23/2013
Bicarbonate (HCO3)	SM 2320B	68	mg/L	1	1.0	5/23/2013
Carbonate (CO3)	SM 2320B	ND	mg/L	1	1.0	5/23/2013
Hydroxide (OH)	SM 2320B	ND	mg/L	1	1.0	5/23/2013
Total Alkalinity	SM 2320B	56	mg/L as CaCO3	1	1.0	5/23/2013
Total Dissolved Solids (TDS)	SM 2540C	110	mg/L	1	10	5/30/2013
Anions by Ion Chromatography						
Chloride	EPA 300.0	ND	mg/L	1	1.00	5/24/2013
Fluoride	EPA 300.0	1.3	mg/L	1	0.10	5/24/2013
Sulfate	EPA 300.0	22	mg/L	1	1.0	5/24/2013
Nitrate Nitrogen	EPA 300.0	ND	mg/L	1	0.10	5/24/2013
Nitrite Nitrogen	EPA 300.0	ND	mg/L	1	0.025	5/24/2013
Trace Metals by ICP-OES						
Aluminum	EPA 200.7	ND	mg/L	1	0.045	5/31/2013
Barium	EPA 200.7	0.16	mg/L	1	0.010	5/31/2013
Beryllium	EPA 200.7	ND	mg/L	1	0.0010	5/31/2013
Bismuth	EPA 200.7	ND	mg/L	1	0.10	5/31/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID: K-Spar Breccia 5+ Comp Wk:48 **Collect Date/Time:** 5/23/2013 09:00
WETLAB Sample ID: 1305511-002 **Receive Date:** 5/23/2013 14:00

Analyte	Method	Results	Units	DF	RL	Analyzed
Boron	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Cadmium	EPA 200.7	ND	mg/L	1	0.0010	5/31/2013
Calcium	EPA 200.7	28	mg/L	1	0.50	5/31/2013
Chromium	EPA 200.7	ND	mg/L	1	0.0050	5/31/2013
Cobalt	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Copper	EPA 200.7	ND	mg/L	1	0.050	5/31/2013
Gallium	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Iron	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Lithium	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Magnesium	EPA 200.7	1.9	mg/L	1	0.50	5/31/2013
Manganese	EPA 200.7	0.042	mg/L	1	0.0050	5/31/2013
Molybdenum	EPA 200.7	0.050	mg/L	1	0.010	5/31/2013
Nickel	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Phosphorus	EPA 200.7	ND	mg/L	1	0.50	5/31/2013
Potassium	EPA 200.7	2.3	mg/L	1	0.50	5/31/2013
Scandium	EPA 200.7	ND	mg/L	1	0.100	5/31/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	5/31/2013
Sodium	EPA 200.7	0.82	mg/L	1	0.50	5/31/2013
Strontium	EPA 200.7	0.49	mg/L	1	0.10	5/31/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	6/1/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	6/4/2013
Arsenic	EPA 200.8	ND	mg/L	1	0.0050	6/4/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	6/1/2013
Selenium	EPA 200.8	ND	mg/L	1	0.0050	6/1/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	6/1/2013
Uranium	EPA 200.8	0.015	mg/L	1	0.0050	6/1/2013
Ion Balance						
Anions	Calculation	1.64	meq/L	1	0.10	
Cations	Calculation	1.65	meq/L	1	0.10	
Error	Calculation	ND	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		5/30/2013

Customer Sample ID: Biotite Breccia 0-5 Comp Wk:48 **Collect Date/Time:** 5/23/2013 09:00
WETLAB Sample ID: 1305511-003 **Receive Date:** 5/23/2013 14:00

Analyte	Method	Results	Units	DF	RL	Analyzed
General Chemistry						
pH	SM 4500-H+ B	7.86 HT	pH Units	1		5/23/2013
Bicarbonate (HCO3)	SM 2320B	68	mg/L	1	1.0	5/23/2013
Carbonate (CO3)	SM 2320B	ND	mg/L	1	1.0	5/23/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID:	Biotite Breccia 0-5 Comp Wk:48	**Collect Date/Time:**	5/23/2013 09:00
WETLAB Sample ID:	1305511-003	**Receive Date:**	5/23/2013 14:00

Analyte	Method	Results	Units	DF	RL	Analyzed
Hydroxide (OH)	SM 2320B	ND	mg/L	1	1.0	5/23/2013
Total Alkalinity	SM 2320B	56	mg/L as CaCO3	1	1.0	5/23/2013
Total Dissolved Solids (TDS)	SM 2540C	78	mg/L	1	10	5/30/2013
Anions by Ion Chromatography						
Chloride	EPA 300.0	ND	mg/L	1	1.00	5/24/2013
Fluoride	EPA 300.0	1.4	mg/L	1	0.10	5/24/2013
Sulfate	EPA 300.0	12	mg/L	1	1.0	5/24/2013
Nitrate Nitrogen	EPA 300.0	ND	mg/L	1	0.10	5/24/2013
Nitrite Nitrogen	EPA 300.0	ND	mg/L	1	0.025	5/24/2013
Trace Metals by ICP-OES						
Aluminum	EPA 200.7	ND	mg/L	1	0.045	5/31/2013
Barium	EPA 200.7	0.11	mg/L	1	0.010	5/31/2013
Beryllium	EPA 200.7	ND	mg/L	1	0.0010	5/31/2013
Bismuth	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Boron	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Cadmium	EPA 200.7	ND	mg/L	1	0.0010	5/31/2013
Calcium	EPA 200.7	21	mg/L	1	0.50	5/31/2013
Chromium	EPA 200.7	ND	mg/L	1	0.0050	5/31/2013
Cobalt	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Copper	EPA 200.7	ND	mg/L	1	0.050	5/31/2013
Gallium	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Iron	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Lithium	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Magnesium	EPA 200.7	4.0	mg/L	1	0.50	5/31/2013
Manganese	EPA 200.7	0.021	mg/L	1	0.0050	5/31/2013
Molybdenum	EPA 200.7	ND	mg/L	5	0.050	5/31/2013
Nickel	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Phosphorus	EPA 200.7	ND	mg/L	1	0.50	5/31/2013
Potassium	EPA 200.7	1.4	mg/L	1	0.50	5/31/2013
Scandium	EPA 200.7	ND	mg/L	1	0.100	5/31/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	5/31/2013
Sodium	EPA 200.7	ND	mg/L	1	0.50	5/31/2013
Strontium	EPA 200.7	0.26	mg/L	1	0.10	5/31/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	6/1/2013
Antimony	EPA 200.8	ND	mg/L	2	0.0025	6/4/2013
Arsenic	EPA 200.8	ND	mg/L	2	0.010	6/4/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	6/1/2013
Selenium	EPA 200.8	ND	mg/L	2	0.010	6/4/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	6/1/2013
Uranium	EPA 200.8	0.022	mg/L	1	0.0050	6/1/2013
Ion Balance						
Anions	Calculation	1.44	meq/L	1	0.10	

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID: Biotite Breccia 0-5 Comp Wk:48
WETLAB Sample ID: 1305511-003

Collect Date/Time: 5/23/2013 09:00
Receive Date: 5/23/2013 14:00

Analyte	Method	Results	Units	DF	RL	Analyzed
Cations	Calculation	1.41	meq/L	1	0.10	
Error	Calculation	ND	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		5/30/2013

Customer Sample ID: K-Spar Breccia 0-5 Comp Wk:48
WETLAB Sample ID: 1305511-004

Collect Date/Time: 5/23/2013 09:00
Receive Date: 5/23/2013 14:00

Analyte	Method	Results	Units	DF	RL	Analyzed
General Chemistry						
pH	SM 4500-H+ B	7.84 HT	pH Units	1		5/23/2013
Bicarbonate (HCO3)	SM 2320B	63	mg/L	1	1.0	5/23/2013
Carbonate (CO3)	SM 2320B	ND	mg/L	1	1.0	5/23/2013
Hydroxide (OH)	SM 2320B	ND	mg/L	1	1.0	5/23/2013
Total Alkalinity	SM 2320B	52	mg/L as CaCO3	1	1.0	5/23/2013
Total Dissolved Solids (TDS)	SM 2540C	85	mg/L	1	10	5/30/2013
Anions by Ion Chromatography						
Chloride	EPA 300.0	ND	mg/L	1	1.00	5/24/2013
Fluoride	EPA 300.0	1.4	mg/L	1	0.10	5/24/2013
Sulfate	EPA 300.0	12	mg/L	1	1.0	5/24/2013
Nitrate Nitrogen	EPA 300.0	ND	mg/L	1	0.10	5/24/2013
Nitrite Nitrogen	EPA 300.0	ND	mg/L	1	0.025	5/24/2013
Trace Metals by ICP-OES						
Aluminum	EPA 200.7	ND	mg/L	1	0.045	5/31/2013
Barium	EPA 200.7	0.13	mg/L	1	0.010	5/31/2013
Beryllium	EPA 200.7	ND	mg/L	1	0.0010	5/31/2013
Bismuth	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Boron	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Cadmium	EPA 200.7	ND	mg/L	1	0.0010	5/31/2013
Calcium	EPA 200.7	19	mg/L	1	0.50	5/31/2013
Chromium	EPA 200.7	ND	mg/L	1	0.0050	5/31/2013
Cobalt	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Copper	EPA 200.7	ND	mg/L	1	0.050	5/31/2013
Gallium	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Iron	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Lithium	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Magnesium	EPA 200.7	3.9	mg/L	1	0.50	5/31/2013
Manganese	EPA 200.7	0.013	mg/L	1	0.0050	5/31/2013
Molybdenum	EPA 200.7	0.016	mg/L	1	0.010	5/31/2013
Nickel	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Phosphorus	EPA 200.7	ND	mg/L	1	0.50	5/31/2013
Potassium	EPA 200.7	1.4	mg/L	1	0.50	5/31/2013
Scandium	EPA 200.7	ND	mg/L	1	0.100	5/31/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	5/31/2013
Sodium	EPA 200.7	0.51	mg/L	1	0.50	5/31/2013
Strontium	EPA 200.7	0.33	mg/L	1	0.10	5/31/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID: K-Spar Breccia 0-5 Comp Wk:48 **Collect Date/Time:** 5/23/2013 09:00
WETLAB Sample ID: 1305511-004 **Receive Date:** 5/23/2013 14:00

Analyte	Method	Results	Units	DF	RL	Analyzed
Tin	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	6/1/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	6/1/2013
Arsenic	EPA 200.8	ND	mg/L	2	0.010	6/5/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	6/1/2013
Selenium	EPA 200.8	ND	mg/L	1	0.0050	6/1/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	6/1/2013
Uranium	EPA 200.8	0.020	mg/L	1	0.0050	6/1/2013
Ion Balance						
Anions	Calculation	1.36	meq/L	1	0.10	
Cations	Calculation	1.33	meq/L	1	0.10	
Error	Calculation	1.1	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		5/30/2013

Customer Sample ID: Quartz Monzonite 0-5 Comp Wk:48 **Collect Date/Time:** 5/23/2013 09:00
WETLAB Sample ID: 1305511-005 **Receive Date:** 5/23/2013 14:00

Analyte	Method	Results	Units	DF	RL	Analyzed
General Chemistry						
pH	SM 4500-H+ B	8.73 HT	pH Units	1		5/23/2013
Bicarbonate (HCO3)	SM 2320B	56	mg/L	1	1.0	5/23/2013
Carbonate (CO3)	SM 2320B	6.7	mg/L	1	1.0	5/23/2013
Hydroxide (OH)	SM 2320B	ND	mg/L	1	1.0	5/23/2013
Total Alkalinity	SM 2320B	57	mg/L as CaCO3	1	1.0	5/23/2013
Total Dissolved Solids (TDS)	SM 2540C	81	mg/L	1	10	5/30/2013
Anions by Ion Chromatography						
Chloride	EPA 300.0	ND	mg/L	1	1.00	5/24/2013
Fluoride	EPA 300.0	1.2	mg/L	1	0.10	5/24/2013
Sulfate	EPA 300.0	14	mg/L	1	1.0	5/24/2013
Nitrate Nitrogen	EPA 300.0	ND	mg/L	1	0.10	5/24/2013
Nitrite Nitrogen	EPA 300.0	ND	mg/L	1	0.025	5/24/2013
Trace Metals by ICP-OES						
Aluminum	EPA 200.7	ND	mg/L	1	0.045	5/31/2013
Barium	EPA 200.7	0.094	mg/L	1	0.010	5/31/2013
Beryllium	EPA 200.7	ND	mg/L	1	0.0010	5/31/2013
Bismuth	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Boron	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Cadmium	EPA 200.7	ND	mg/L	1	0.0010	5/31/2013
Calcium	EPA 200.7	20	mg/L	1	0.50	5/31/2013
Chromium	EPA 200.7	ND	mg/L	1	0.0050	5/31/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID: Quartz Monzonite 0-5 Comp Wk:48 **Collect Date/Time:** 5/23/2013 09:00

WETLAB Sample ID: 1305511-005 **Receive Date:** 5/23/2013 14:00

Analyte	Method	Results	Units	DF	RL	Analyzed
Cobalt	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Copper	EPA 200.7	ND	mg/L	1	0.050	5/31/2013
Gallium	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Iron	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Lithium	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Magnesium	EPA 200.7	4.2	mg/L	1	0.50	5/31/2013
Manganese	EPA 200.7	0.014	mg/L	1	0.0050	5/31/2013
Molybdenum	EPA 200.7	ND	mg/L	5	0.050	5/31/2013
Nickel	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Phosphorus	EPA 200.7	ND	mg/L	1	0.50	5/31/2013
Potassium	EPA 200.7	1.4	mg/L	1	0.50	5/31/2013
Scandium	EPA 200.7	ND	mg/L	1	0.100	5/31/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	5/31/2013
Sodium	EPA 200.7	0.61	mg/L	1	0.50	5/31/2013
Strontium	EPA 200.7	0.26	mg/L	1	0.10	5/31/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	5/31/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	5/31/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	6/1/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	6/4/2013
Arsenic	EPA 200.8	ND	mg/L	1	0.0050	6/4/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	6/1/2013
Selenium	EPA 200.8	ND	mg/L	1	0.0050	6/4/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	6/1/2013
Uranium	EPA 200.8	0.019	mg/L	1	0.0050	6/1/2013
Ion Balance						
Anions	Calculation	1.50	meq/L	1	0.10	
Cations	Calculation	1.41	meq/L	1	0.10	
Error	Calculation	3.1	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		5/30/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13051110	Blank 1	Fluoride	EPA 300.0	ND	mg/L
QC13051110	Blank 2	Fluoride	EPA 300.0	ND	mg/L
QC13051110	Blank 3	Fluoride	EPA 300.0	ND	mg/L
QC13051115	Blank 1	Chloride	EPA 300.0	ND	mg/L
QC13051115	Blank 2	Chloride	EPA 300.0	ND	mg/L
QC13051115	Blank 3	Chloride	EPA 300.0	ND	mg/L
QC13051120	Blank 1	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13051120	Blank 2	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13051120	Blank 3	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13051125	Blank 1	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13051125	Blank 2	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13051125	Blank 3	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13051129	Blank 1	Sulfate	EPA 300.0	ND	mg/L
QC13051129	Blank 2	Sulfate	EPA 300.0	ND	mg/L
QC13051129	Blank 3	Sulfate	EPA 300.0	ND	mg/L
QC13051328	Blank 1	Aluminum, Dissolved	EPA 200.7	ND	mg/L
		Barium, Dissolved	EPA 200.7	ND	mg/L
		Beryllium, Dissolved	EPA 200.7	ND	mg/L
		Bismuth, Dissolved	EPA 200.7	ND	mg/L
		Boron, Dissolved	EPA 200.7	ND	mg/L
		Cadmium, Dissolved	EPA 200.7	ND	mg/L
		Calcium, Dissolved	EPA 200.7	ND	mg/L
		Chromium, Dissolved	EPA 200.7	ND	mg/L
		Cobalt, Dissolved	EPA 200.7	ND	mg/L
		Copper, Dissolved	EPA 200.7	ND	mg/L
		Gallium, Dissolved	EPA 200.7	ND	mg/L
		Iron, Dissolved	EPA 200.7	ND	mg/L
		Lithium, Dissolved	EPA 200.7	ND	mg/L
		Magnesium, Dissolved	EPA 200.7	ND	mg/L
		Manganese, Dissolved	EPA 200.7	ND	mg/L
		Molybdenum, Dissolved	EPA 200.7	ND	mg/L
		Nickel, Dissolved	EPA 200.7	ND	mg/L
		Phosphorus, Dissolved	EPA 200.7	ND	mg/L
		Potassium, Dissolved	EPA 200.7	ND	mg/L
		Scandium, Dissolved	EPA 200.7	ND	mg/L
		Silver, Dissolved	EPA 200.7	ND	mg/L
		Sodium, Dissolved	EPA 200.7	ND	mg/L
		Strontium, Dissolved	EPA 200.7	ND	mg/L
		Tin, Dissolved	EPA 200.7	ND	mg/L
		Titanium, Dissolved	EPA 200.7	ND	mg/L
		Vanadium, Dissolved	EPA 200.7	ND	mg/L
		Zinc, Dissolved	EPA 200.7	ND	mg/L
QC13051329	Blank 1	Aluminum, Dissolved	EPA 200.7	ND	mg/L
		Barium, Dissolved	EPA 200.7	ND	mg/L
		Beryllium, Dissolved	EPA 200.7	ND	mg/L
		Bismuth, Dissolved	EPA 200.7	ND	mg/L

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

QCBatchID	QCType	Parameter	Method	Result	Units
		Boron, Dissolved	EPA 200.7	ND	mg/L
		Cadmium, Dissolved	EPA 200.7	ND	mg/L
		Calcium, Dissolved	EPA 200.7	ND	mg/L
		Chromium, Dissolved	EPA 200.7	ND	mg/L
		Cobalt, Dissolved	EPA 200.7	ND	mg/L
		Copper, Dissolved	EPA 200.7	ND	mg/L
		Gallium, Dissolved	EPA 200.7	ND	mg/L
		Iron, Dissolved	EPA 200.7	ND	mg/L
		Lithium, Dissolved	EPA 200.7	ND	mg/L
		Magnesium, Dissolved	EPA 200.7	ND	mg/L
		Manganese, Dissolved	EPA 200.7	ND	mg/L
		Molybdenum, Dissolved	EPA 200.7	ND	mg/L
		Nickel, Dissolved	EPA 200.7	ND	mg/L
		Phosphorus, Dissolved	EPA 200.7	ND	mg/L
		Potassium, Dissolved	EPA 200.7	ND	mg/L
		Scandium, Dissolved	EPA 200.7	ND	mg/L
		Silver, Dissolved	EPA 200.7	ND	mg/L
		Sodium, Dissolved	EPA 200.7	ND	mg/L
		Strontium, Dissolved	EPA 200.7	ND	mg/L
		Tin, Dissolved	EPA 200.7	ND	mg/L
		Titanium, Dissolved	EPA 200.7	ND	mg/L
		Vanadium, Dissolved	EPA 200.7	ND	mg/L
		Zinc, Dissolved	EPA 200.7	ND	mg/L
QC13060058	Blank 1	Uranium, Dissolved	EPA 200.8	ND	mg/L
		Mercury, Dissolved	EPA 200.8	ND	mg/L
		Antimony, Dissolved	EPA 200.8	ND	mg/L
		Arsenic, Dissolved	EPA 200.8	ND	mg/L
		Lead, Dissolved	EPA 200.8	ND	mg/L
		Selenium, Dissolved	EPA 200.8	ND	mg/L
		Thallium, Dissolved	EPA 200.8	ND	mg/L
QC13060059	Blank 1	Uranium, Dissolved	EPA 200.8	ND	mg/L
		Mercury, Dissolved	EPA 200.8	ND	mg/L
		Antimony, Dissolved	EPA 200.8	ND	mg/L
		Arsenic, Dissolved	EPA 200.8	ND	mg/L
		Lead, Dissolved	EPA 200.8	ND	mg/L
		Selenium, Dissolved	EPA 200.8	ND	mg/L
		Thallium, Dissolved	EPA 200.8	ND	mg/L
QC13060126	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13060126	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13060126	Blank 3	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13051057	LCS 1	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13051057	LCS 2	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC13051057	LCS 3	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13051057	LCS 4	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13051058	LCS 1	Total Alkalinity	SM 2320B	98.3	100	98	mg/L
QC13051058	LCS 2	Total Alkalinity	SM 2320B	99.2	100	99	mg/L
QC13051058	LCS 3	Total Alkalinity	SM 2320B	99.2	100	99	mg/L
QC13051058	LCS 4	Total Alkalinity	SM 2320B	99.0	100	99	mg/L
QC13051058	LCS 5	Total Alkalinity	SM 2320B	100	100	100	mg/L
QC13051110	LCS 1	Fluoride	EPA 300.0	1.95	2.00	98	mg/L
QC13051115	LCS 1	Chloride	EPA 300.0	10.3	10.0	103	mg/L

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13051120	LCS 1	Nitrite Nitrogen	EPA 300.0	0.484	0.500	97	mg/L
QC13051125	LCS 1	Nitrate Nitrogen	EPA 300.0	2.04	2.00	102	mg/L
QC13051129	LCS 1	Sulfate	EPA 300.0	23.9	25.0	96	mg/L
QC13051328	LCS 1	Aluminum, Dissolved	EPA 200.7	0.969	1.00	97	mg/L
		Barium, Dissolved	EPA 200.7	0.946	1.00	95	mg/L
		Beryllium, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
		Bismuth, Dissolved	EPA 200.7	0.987	1.00	99	mg/L
		Boron, Dissolved	EPA 200.7	0.932	1.00	93	mg/L
		Cadmium, Dissolved	EPA 200.7	0.959	1.00	96	mg/L
		Calcium, Dissolved	EPA 200.7	9.98	10.0	100	mg/L
		Chromium, Dissolved	EPA 200.7	0.939	1.00	94	mg/L
		Cobalt, Dissolved	EPA 200.7	0.940	1.00	94	mg/L
		Copper, Dissolved	EPA 200.7	4.82	5.00	96	mg/L
		Gallium, Dissolved	EPA 200.7	0.955	1.00	96	mg/L
		Iron, Dissolved	EPA 200.7	0.961	1.00	96	mg/L
		Lithium, Dissolved	EPA 200.7	0.943	1.00	94	mg/L
		Magnesium, Dissolved	EPA 200.7	9.22	10.0	92	mg/L
		Manganese, Dissolved	EPA 200.7	0.979	1.00	98	mg/L
		Molybdenum, Dissolved	EPA 200.7	0.894	1.00	89	mg/L
		Nickel, Dissolved	EPA 200.7	4.70	5.00	94	mg/L
		Phosphorus, Dissolved	EPA 200.7	4.58	5.00	92	mg/L
		Potassium, Dissolved	EPA 200.7	9.69	10.0	97	mg/L
		Scandium, Dissolved	EPA 200.7	0.963	1.00	96	mg/L
		Silver, Dissolved	EPA 200.7	0.086	0.090	95	mg/L
		Sodium, Dissolved	EPA 200.7	9.18	10.0	92	mg/L
		Strontium, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
		Tin, Dissolved	EPA 200.7	0.945	1.00	94	mg/L
		Titanium, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Vanadium, Dissolved	EPA 200.7	0.936	1.00	94	mg/L
		Zinc, Dissolved	EPA 200.7	0.929	1.00	93	mg/L
QC13051329	LCS 1	Aluminum, Dissolved	EPA 200.7	0.969	1.00	97	mg/L
		Barium, Dissolved	EPA 200.7	0.946	1.00	95	mg/L
		Beryllium, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
		Bismuth, Dissolved	EPA 200.7	0.987	1.00	99	mg/L
		Boron, Dissolved	EPA 200.7	0.932	1.00	93	mg/L
		Cadmium, Dissolved	EPA 200.7	0.959	1.00	96	mg/L
		Calcium, Dissolved	EPA 200.7	9.98	10.0	100	mg/L
		Chromium, Dissolved	EPA 200.7	0.939	1.00	94	mg/L
		Cobalt, Dissolved	EPA 200.7	0.940	1.00	94	mg/L
		Copper, Dissolved	EPA 200.7	4.82	5.00	96	mg/L
		Gallium, Dissolved	EPA 200.7	0.955	1.00	96	mg/L
		Iron, Dissolved	EPA 200.7	0.961	1.00	96	mg/L
		Lithium, Dissolved	EPA 200.7	0.943	1.00	94	mg/L
		Magnesium, Dissolved	EPA 200.7	9.22	10.0	92	mg/L
		Manganese, Dissolved	EPA 200.7	0.979	1.00	98	mg/L
		Molybdenum, Dissolved	EPA 200.7	0.894	1.00	89	mg/L
		Nickel, Dissolved	EPA 200.7	4.70	5.00	94	mg/L
		Phosphorus, Dissolved	EPA 200.7	4.58	5.00	92	mg/L
		Potassium, Dissolved	EPA 200.7	9.69	10.0	97	mg/L
		Scandium, Dissolved	EPA 200.7	0.963	1.00	96	mg/L
		Silver, Dissolved	EPA 200.7	0.086	0.090	95	mg/L
		Sodium, Dissolved	EPA 200.7	9.18	10.0	92	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
		Strontium, Dissolved	EPA 200.7	1.01	1.00	101	mg/L
		Tin, Dissolved	EPA 200.7	0.945	1.00	94	mg/L
		Titanium, Dissolved	EPA 200.7	1.00	1.00	100	mg/L
		Vanadium, Dissolved	EPA 200.7	0.936	1.00	94	mg/L
		Zinc, Dissolved	EPA 200.7	0.929	1.00	93	mg/L
QC13060058	LCS 1	Uranium, Dissolved	EPA 200.8	0.0100	0.010	100	mg/L
		Mercury, Dissolved	EPA 200.8	0.001077	0.001	108	mg/L
		Antimony, Dissolved	EPA 200.8	0.0094	0.010	94	mg/L
		Arsenic, Dissolved	EPA 200.8	0.0525	0.050	105	mg/L
		Lead, Dissolved	EPA 200.8	0.0098	0.010	98	mg/L
		Selenium, Dissolved	EPA 200.8	0.0477	0.050	96	mg/L
		Thallium, Dissolved	EPA 200.8	0.0098	0.010	98	mg/L
QC13060059	LCS 1	Uranium, Dissolved	EPA 200.8	0.0100	0.010	100	mg/L
		Mercury, Dissolved	EPA 200.8	0.001077	0.001	108	mg/L
		Antimony, Dissolved	EPA 200.8	0.0094	0.010	94	mg/L
		Arsenic, Dissolved	EPA 200.8	0.0525	0.050	105	mg/L
		Lead, Dissolved	EPA 200.8	0.0098	0.010	98	mg/L
		Selenium, Dissolved	EPA 200.8	0.0477	0.050	96	mg/L
		Thallium, Dissolved	EPA 200.8	0.0098	0.010	98	mg/L
QC13060126	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	153	150	102	mg/L
QC13060126	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	151	150	100	mg/L
QC13060126	LCS 3	Total Dissolved Solids (TDS)	SM 2540C	143	150	95	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result		Units	RPD
QC13051057	Duplicate	pH	SM 4500-H+ B	1305455-001	9.17	9.23	HT	pH Units	1 %
QC13051057	Duplicate	pH	SM 4500-H+ B	1305379-001	7.94	7.91		pH Units	<1%
QC13051057	Duplicate	pH	SM 4500-H+ B	1305379-002	7.96	7.99		pH Units	<1%
QC13051057	Duplicate	pH	SM 4500-H+ B	1305379-008	7.48	7.48		pH Units	<1%
QC13051057	Duplicate	pH	SM 4500-H+ B	1305379-010	7.70	7.68		pH Units	<1%
QC13051057	Duplicate	pH	SM 4500-H+ B	1305379-011	8.74	8.72		pH Units	<1%
QC13051057	Duplicate	pH	SM 4500-H+ B	1305531-001	7.38	7.40	HT	pH Units	<1%
QC13051057	Duplicate	pH	SM 4500-H+ B	1305531-002	7.33	7.31	HT	pH Units	<1%
QC13051058	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305455-001	111	108		mg/L	3 %
		Carbonate (CO3)	SM 2320B	1305455-001	44.1	48.0		mg/L	8 %
		Hydroxide (OH)	SM 2320B	1305455-001	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1305455-001	165	168		mg/L as CaCO3	2 %
QC13051058	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305379-001	168	167		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1305379-001	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305379-001	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1305379-001	137	137		mg/L as CaCO3	<1%
QC13051058	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305379-002	162	162		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1305379-002	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305379-002	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1305379-002	133	133		mg/L as CaCO3	<1%
QC13051058	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305379-008	226	225		mg/L	1 %
		Carbonate (CO3)	SM 2320B	1305379-008	ND	ND		mg/L	<1%

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result		Units	RPD
		Hydroxide (OH)	SM 2320B	1305379-008	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1305379-008	185	184		mg/L as CaCO3	1 %
QC13051058	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305379-010	234	234		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1305379-010	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305379-010	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1305379-010	192	192		mg/L as CaCO3	<1%
QC13051058	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305379-011	265	269		mg/L	1 %
		Carbonate (CO3)	SM 2320B	1305379-011	17.1	15.4		mg/L	11 %
		Hydroxide (OH)	SM 2320B	1305379-011	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1305379-011	246	246		mg/L as CaCO3	<1%
QC13051058	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305531-001	201	201		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1305531-001	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305531-001	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1305531-001	165	165		mg/L as CaCO3	<1%
QC13051058	Duplicate	Bicarbonate (HCO3)	SM 2320B	1305531-002	186	185		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1305531-002	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1305531-002	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1305531-002	152	152		mg/L as CaCO3	<1%
QC13060126	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305509-001	11.0	ND		mg/L	59 %
QC13060126	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305532-003	717	683		mg/L	5 %
QC13060126	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305535-001	301	301		mg/L	<1%
QC13060126	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305537-002	345	343		mg/L	1 %
QC13060126	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305544-001	661	658		mg/L	<1%
QC13060126	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1305554-001	279	276	HT	mg/L	1 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13051110	MS 1	Fluoride	EPA 300.0	1305509-001	ND	2.00	2.01	2.00	mg/L	99	100	<1%
QC13051110	MS 2	Fluoride	EPA 300.0	1305530-001	ND	19.6	19.6	2.00	mg/L	95	95	<1%
QC13051115	MS 1	Chloride	EPA 300.0	1305509-001	ND	6.00	6.09	5.00	mg/L	119	120	1 %
QC13051115	MS 2	Chloride	EPA 300.0	1305530-001	822	868	871	5.00	mg/L	92	99	<1%
QC13051120	MS 1	Nitrite Nitrogen	EPA 300.0	1305509-001	ND	0.547	0.555	0.500	mg/L	109	111	1 %
QC13051120	MS 2	Nitrite Nitrogen	EPA 300.0	1305530-001	0.392	5.46	5.50	0.500	mg/L	101	102	1 %
QC13051125	MS 1	Nitrate Nitrogen	EPA 300.0	1305509-001	ND	2.42	2.45	2.00	mg/L	119	121	1 %
QC13051125	MS 2	Nitrate Nitrogen	EPA 300.0	1305530-001	41.9	64.0	64.4	2.00	mg/L	111	113	1 %
QC13051129	MS 1	Sulfate	EPA 300.0	1305509-001	6.35	17.2	17.3	10.0	mg/L	108	110	1 %
QC13051129	MS 2	Sulfate	EPA 300.0	1305530-001	34.7	134	136	10.0	mg/L	100	101	1 %
QC13051328	MS 1	Aluminum, Dissolved	EPA 200.7	1305535-003	ND	0.924	0.910	1.00	mg/L	91	90	2 %
		Barium, Dissolved	EPA 200.7	1305535-003	0.117	1.05	1.03	1.00	mg/L	93	91	2 %
		Beryllium, Dissolved	EPA 200.7	1305535-003	ND	1.02	1.01	1.00	mg/L	102	101	1 %
		Bismuth, Dissolved	EPA 200.7	1305535-003	ND	0.941	0.931	1.00	mg/L	96	95	1 %
		Boron, Dissolved	EPA 200.7	1305535-003	ND	1.03	1.02	1.00	mg/L	98	97	1 %
		Cadmium, Dissolved	EPA 200.7	1305535-003	ND	0.945	0.925	1.00	mg/L	95	93	2 %
		Calcium, Dissolved	EPA 200.7	1305535-003	56.3	65.8	63.8	10.0	mg/L	95	75	3 %
		Chromium, Dissolved	EPA 200.7	1305535-003	ND	0.939	0.924	1.00	mg/L	94	92	2 %
		Cobalt, Dissolved	EPA 200.7	1305535-003	ND	0.907	0.891	1.00	mg/L	91	89	2 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Copper, Dissolved	EPA 200.7	1305535-003	ND	4.78	4.73	5.00	mg/L	96	95	1 %
		Gallium, Dissolved	EPA 200.7	1305535-003	ND	0.963	0.958	1.00	mg/L	96	95	1 %
		Iron, Dissolved	EPA 200.7	1305535-003	ND	0.990	0.958	1.00	mg/L	99	96	3 %
		Lithium, Dissolved	EPA 200.7	1305535-003	ND	0.929	0.918	1.00	mg/L	92	91	1 %
		Magnesium, Dissolved	EPA 200.7	1305535-003	8.48	17.4	16.8	10.0	mg/L	89	83	4 %
		Manganese, Dissolved	EPA 200.7	1305535-003	ND	0.954	0.936	1.00	mg/L	97	95	2 %
		Molybdenum, Dissolved	EPA 200.7	1305535-003	ND	0.911	0.902	1.00	mg/L	91	90	1 %
		Nickel, Dissolved	EPA 200.7	1305535-003	ND	4.50	4.43	5.00	mg/L	90	89	2 %
		Phosphorus, Dissolved	EPA 200.7	1305535-003	ND	4.76	4.75	5.00	mg/L	94	94	<1%
		Potassium, Dissolved	EPA 200.7	1305535-003	2.90	12.7	12.4	10.0	mg/L	98	95	2 %
		Scandium, Dissolved	EPA 200.7	1305535-003	ND	0.968	0.962	1.00	mg/L	97	96	1 %
		Silver, Dissolved	EPA 200.7	1305535-003	ND	0.086	0.084	0.090	mg/L	95	93	2 %
		Sodium, Dissolved	EPA 200.7	1305535-003	13.4	22.7	22.2	10.0	mg/L	93	88	2 %
		Strontium, Dissolved	EPA 200.7	1305535-003	0.291	1.30	1.25	1.00	mg/L	101	96	4 %
		Tin, Dissolved	EPA 200.7	1305535-003	ND	0.918	0.908	1.00	mg/L	98	97	1 %
		Titanium, Dissolved	EPA 200.7	1305535-003	ND	1.02	1.01	1.00	mg/L	102	101	1 %
		Vanadium, Dissolved	EPA 200.7	1305535-003	0.022	0.978	0.963	1.00	mg/L	96	94	2 %
		Zinc, Dissolved	EPA 200.7	1305535-003	ND	0.927	0.927	1.00	mg/L	93	93	<1%
QC13051329	MS 1	Aluminum, Dissolved	EPA 200.7	1305535-004	ND	0.926	0.937	1.00	mg/L	91	92	1 %
		Barium, Dissolved	EPA 200.7	1305535-004	0.110	1.04	1.06	1.00	mg/L	93	95	2 %
		Beryllium, Dissolved	EPA 200.7	1305535-004	ND	1.01	1.01	1.00	mg/L	101	101	<1%
		Bismuth, Dissolved	EPA 200.7	1305535-004	ND	0.934	0.949	1.00	mg/L	95	97	2 %
		Boron, Dissolved	EPA 200.7	1305535-004	ND	1.03	1.05	1.00	mg/L	99	101	2 %
		Cadmium, Dissolved	EPA 200.7	1305535-004	ND	0.935	0.954	1.00	mg/L	94	95	2 %
		Calcium, Dissolved	EPA 200.7	1305535-004	56.2	65.9	66.3	10.0	mg/L	97	101	1 %
		Chromium, Dissolved	EPA 200.7	1305535-004	ND	0.941	0.958	1.00	mg/L	94	96	2 %
		Cobalt, Dissolved	EPA 200.7	1305535-004	ND	0.912	0.921	1.00	mg/L	91	92	1 %
		Copper, Dissolved	EPA 200.7	1305535-004	ND	4.76	4.77	5.00	mg/L	95	95	<1%
		Gallium, Dissolved	EPA 200.7	1305535-004	ND	0.979	0.982	1.00	mg/L	98	98	<1%
		Iron, Dissolved	EPA 200.7	1305535-004	ND	0.968	0.985	1.00	mg/L	97	99	2 %
		Lithium, Dissolved	EPA 200.7	1305535-004	ND	0.937	0.931	1.00	mg/L	93	92	1 %
		Magnesium, Dissolved	EPA 200.7	1305535-004	8.23	16.8	16.9	10.0	mg/L	86	87	1 %
		Manganese, Dissolved	EPA 200.7	1305535-004	ND	0.938	0.955	1.00	mg/L	96	97	2 %
		Molybdenum, Dissolved	EPA 200.7	1305535-004	ND	0.911	0.921	1.00	mg/L	91	92	1 %
		Nickel, Dissolved	EPA 200.7	1305535-004	ND	4.53	4.60	5.00	mg/L	91	92	2 %
		Phosphorus, Dissolved	EPA 200.7	1305535-004	ND	4.78	4.85	5.00	mg/L	95	96	1 %
		Potassium, Dissolved	EPA 200.7	1305535-004	2.44	12.4	12.3	10.0	mg/L	100	99	1 %
		Scandium, Dissolved	EPA 200.7	1305535-004	ND	0.973	0.976	1.00	mg/L	97	98	<1%
		Silver, Dissolved	EPA 200.7	1305535-004	ND	0.085	0.087	0.090	mg/L	95	97	2 %
		Sodium, Dissolved	EPA 200.7	1305535-004	14.7	24.2	24.3	10.0	mg/L	95	96	<1%
		Strontium, Dissolved	EPA 200.7	1305535-004	0.301	1.29	1.28	1.00	mg/L	99	98	1 %
		Tin, Dissolved	EPA 200.7	1305535-004	ND	0.898	0.911	1.00	mg/L	95	97	1 %
		Titanium, Dissolved	EPA 200.7	1305535-004	ND	1.01	1.01	1.00	mg/L	101	101	<1%
		Vanadium, Dissolved	EPA 200.7	1305535-004	0.023	0.980	0.998	1.00	mg/L	96	97	2 %
		Zinc, Dissolved	EPA 200.7	1305535-004	ND	0.927	0.937	1.00	mg/L	93	94	1 %
QC13060058	MS 1	Uranium, Dissolved	EPA 200.8	1305535-003	ND	0.0114	0.0114	0.010	mg/L	99	99	<1%
		Mercury, Dissolved	EPA 200.8	1305535-003	ND	0.001011	0.001057	0.001	mg/L	99	104	4 %
		Antimony, Dissolved	EPA 200.8	1305535-003	ND	0.0093	0.0095	0.010	mg/L	92	94	2 %
		Arsenic, Dissolved	EPA 200.8	1305535-003	ND	0.0567	0.0573	0.050	mg/L	105	106	1 %
		Lead, Dissolved	EPA 200.8	1305535-003	ND	0.0096	0.0097	0.010	mg/L	96	97	1 %
		Selenium, Dissolved	EPA 200.8	1305535-003	ND	0.0483	0.0483	0.050	mg/L	91	91	<1%
		Thallium, Dissolved	EPA 200.8	1305535-003	ND	0.0094	0.0094	0.010	mg/L	94	94	<1%

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13060059	MS 1	Uranium, Dissolved	EPA 200.8	1305535-004	ND	0.0129	0.0129	0.010	mg/L	100	100	<1%
		Mercury, Dissolved	EPA 200.8	1305535-004	ND	0.001030	0.001060	0.001	mg/L	99	102	3 %
		Antimony, Dissolved	EPA 200.8	1305535-004	ND	0.0093	0.0094	0.010	mg/L	92	93	1 %
		Arsenic, Dissolved	EPA 200.8	1305535-004	ND	0.0524	0.0523	0.050	mg/L	98	98	<1%
		Lead, Dissolved	EPA 200.8	1305535-004	ND	0.0097	0.0097	0.010	mg/L	96	97	<1%
		Selenium, Dissolved	EPA 200.8	1305535-004	ND	0.0486	0.0483	0.050	mg/L	92	91	1 %
		Thallium, Dissolved	EPA 200.8	1305535-004	ND	0.0094	0.0095	0.010	mg/L	94	95	1 %

WETLAB
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tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1305571
Report Due Date: 6/7/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ____ 5-Day ____ Other ____

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ____

Analyses Requested

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium	Spl. No.
CF-11-02 (227-367)	Wk:48	05/23/13	9:00	WW	2	X	X	1
K-Spar Breccia 5+ Comp	↓	↓	↓	↓	↓	↓	↓	2
Biotite Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓	3
K-Spar Breccia 0-5 Comp	↓	↓	↓	↓	↓	↓	↓	4
Quartz Monzonite 0-5 Comp	↓	↓	↓	↓	↓	↓	↓	5

1305 5
511 5

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 19.5 °C	5/23/13	1400		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 10				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

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tel (775) 355-0202 | fax (775) 355-0817 | www.WETLaboratory.com

Lab Number 1305571
Report Due Date: 6/7/13
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Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company ______
Address ______
City, State & Zip ______
Contact ______
Phone ______
Fax ______
Email ______

Additional Information

Fax Results	Y	N	To: Client	Billing
Email Results	Y	N	To: Client	Billing
Compliance Monitoring	Y	N		
Fax Results to State EPA	Y	N		

Sample Type Codes

DW = Drinking Water	SD = Solid
WW = Wastewater	SO = Soil
SW = Surface Water	HW = Hazardous Waste
MW = Monitoring Well	OTHER: ______

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
CF-11-02 (227-367)	Wk:48	05/23/13	9:00	WW	2	X	X									1
K-Spar Breccia 5+ Comp	↓	↓	↓	↓	↓	↓	↓									2
Biotite Breccia 0-5 Comp																3
K-Spar Breccia 0-5 Comp																4
Quartz Monzonite 0-5 Comp																5

1305 5
511 5

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 19.5 °C	5/23/13	1400		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 10				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

WETLAB
WESTERN ENVIRONMENTAL
TESTING LABORATORY

www.WETLaboratory.com

Specializing in Soil, Hazardous Waste and Water Analysis.

6/21/2013

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina

OrderID: *1306122*

Dear: Mike Medina

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, 18th & 19th editions, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 6/6/2013. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Andy Smith
QA Manager

Western Environmental Testing Laboratory
Report Comments

McClelland Laboratory - 1306122

General Comments

None

Specific Comments

None

Report Legend

B	-- Blank contamination; Analyte detected above the method reporting limit in an associated blank
D	-- Reporting limit is elevated due to required sample dilution
DF	-- Dilution Factor
HT	-- Sample analyzed beyond the accepted holding time
J	-- The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	-- Reported value is estimated; The sample matrix interfered with the analysis
MCL	-- State or EPA Maximum Contamination Level
N	-- There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	-- Not calculated due to matrix interference
ND	-- Non-detect result; Indicates the result was below the reporting limit (RL)
Q	-- Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
RL	-- Reporting Limit or Practical Quantitation Limit
S	-- Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits
SC	-- Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered

Western Environmental Testing Laboratory
Analytical Report

McClelland Laboratory
1016 Greg Street
Sparks, NV 89431
Attn: Mike Medina
Phone: (775) 356-1300 **Fax:** (775) 356-8917
PO\Project: *3438*

Date Printed: 6/21/2013
OrderID: *1306122*

Customer Sample ID: CF-11-02 (0-27) Wk:56
WETLAB Sample ID: 1306122-001

Collect Date/Time: 6/6/2013 09:00
Receive Date: 6/6/2013 14:15

Analyte	Method	Results		Units	DF	RL	Analyzed
General Chemistry							
Temperature at pH	NA	24		°C	1		6/6/2013
pH	SM 4500-H+ B	6.99	HT	pH Units	1		6/6/2013
Bicarbonate (HCO3)	SM 2320B	25		mg/L	1	1.0	6/6/2013
Carbonate (CO3)	SM 2320B	ND		mg/L	1	1.0	6/6/2013
Hydroxide (OH)	SM 2320B	ND		mg/L	1	1.0	6/6/2013
Total Alkalinity	SM 2320B	21		mg/L as CaCO3	1	1.0	6/6/2013
Total Dissolved Solids (TDS)	SM 2540C	42		mg/L	1	10	6/12/2013
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND		mg/L	1	1.00	6/7/2013
Fluoride	EPA 300.0	0.79		mg/L	1	0.10	6/7/2013
Sulfate	EPA 300.0	9.0		mg/L	1	1.0	6/7/2013
Nitrate Nitrogen	EPA 300.0	ND		mg/L	1	0.10	6/7/2013
Nitrite Nitrogen	EPA 300.0	ND		mg/L	1	0.025	6/7/2013
Trace Metals by ICP-OES							
Aluminum	EPA 200.7	0.13		mg/L	1	0.045	6/17/2013
Barium	EPA 200.7	ND		mg/L	1	0.010	6/17/2013
Beryllium	EPA 200.7	ND		mg/L	1	0.0010	6/17/2013
Bismuth	EPA 200.7	ND		mg/L	1	0.10	6/17/2013
Boron	EPA 200.7	ND		mg/L	1	0.10	6/17/2013
Cadmium	EPA 200.7	ND		mg/L	1	0.0010	6/17/2013
Calcium	EPA 200.7	13		mg/L	1	0.50	6/17/2013
Chromium	EPA 200.7	ND		mg/L	1	0.0050	6/17/2013
Cobalt	EPA 200.7	ND		mg/L	1	0.010	6/17/2013
Copper	EPA 200.7	ND		mg/L	1	0.050	6/17/2013
Gallium	EPA 200.7	ND		mg/L	1	0.10	6/17/2013
Iron	EPA 200.7	ND		mg/L	1	0.010	6/17/2013
Lithium	EPA 200.7	ND		mg/L	1	0.10	6/17/2013
Magnesium	EPA 200.7	ND		mg/L	1	0.50	6/17/2013
Manganese	EPA 200.7	0.028		mg/L	1	0.0050	6/17/2013
Molybdenum	EPA 200.7	ND		mg/L	1	0.010	6/17/2013
Nickel	EPA 200.7	ND		mg/L	1	0.010	6/17/2013
Phosphorus	EPA 200.7	ND		mg/L	1	0.50	6/17/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Customer Sample ID: CF-11-02 (0-27) Wk:56
WETLAB Sample ID: 1306122-001
Collect Date/Time: 6/6/2013 09:00
Receive Date: 6/6/2013 14:15

Analyte	Method	Results	Units	DF	RL	Analyzed
Potassium	EPA 200.7	0.50	mg/L	1	0.50	6/17/2013
Scandium	EPA 200.7	ND	mg/L	1	0.100	6/17/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	6/17/2013
Sodium	EPA 200.7	ND	mg/L	1	0.50	6/17/2013
Strontium	EPA 200.7	ND	mg/L	1	0.10	6/17/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	6/17/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	6/17/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	6/17/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	6/17/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	6/19/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	6/19/2013
Arsenic	EPA 200.8	ND	mg/L	1	0.0050	6/20/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	6/19/2013
Selenium	EPA 200.8	ND	mg/L	1	0.0050	6/19/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	6/19/2013
Uranium	EPA 200.8	ND	mg/L	1	0.0050	6/19/2013
Ion Balance						
Anions	Calculation	0.64	meq/L	1	0.10	
Cations	Calculation	0.68	meq/L	1	0.10	
Error	Calculation	2.9	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		6/14/2013

Customer Sample ID: CF-11-02 (367-408) Wk:56
WETLAB Sample ID: 1306122-002
Collect Date/Time: 6/6/2013 09:00
Receive Date: 6/6/2013 14:15

Analyte	Method	Results	Units	DF	RL	Analyzed
General Chemistry						
Temperature at pH	NA	23.8	°C	1		6/6/2013
pH	SM 4500-H+ B	7.64 HT	pH Units	1		6/6/2013
Bicarbonate (HCO3)	SM 2320B	47	mg/L	1	1.0	6/6/2013
Carbonate (CO3)	SM 2320B	ND	mg/L	1	1.0	6/6/2013
Hydroxide (OH)	SM 2320B	ND	mg/L	1	1.0	6/6/2013
Total Alkalinity	SM 2320B	39	mg/L as CaCO3	1	1.0	6/6/2013
Total Dissolved Solids (TDS)	SM 2540C	64	mg/L	1	10	6/12/2013
Anions by Ion Chromatography						
Chloride	EPA 300.0	ND	mg/L	1	1.00	6/7/2013
Fluoride	EPA 300.0	0.94	mg/L	1	0.10	6/7/2013
Sulfate	EPA 300.0	17	mg/L	1	1.0	6/7/2013
Nitrate Nitrogen	EPA 300.0	ND	mg/L	1	0.10	6/7/2013
Nitrite Nitrogen	EPA 300.0	ND	mg/L	1	0.025	6/7/2013
Trace Metals by ICP-OES						
Aluminum	EPA 200.7	ND	mg/L	1	0.045	6/17/2013
Barium	EPA 200.7	ND	mg/L	1	0.010	6/17/2013

Customer Sample ID: CF-11-02 (367-408) Wk:56 **Collect Date/Time:** 6/6/2013 09:00

WETLAB Sample ID: 1306122-002 **Receive Date:** 6/6/2013 14:15

Analyte	Method	Results	Units	DF	RL	Analyzed
Beryllium	EPA 200.7	ND	mg/L	1	0.0010	6/17/2013
Bismuth	EPA 200.7	ND	mg/L	1	0.10	6/17/2013
Boron	EPA 200.7	ND	mg/L	1	0.10	6/17/2013
Cadmium	EPA 200.7	ND	mg/L	1	0.0010	6/17/2013
Calcium	EPA 200.7	20	mg/L	1	0.50	6/17/2013
Chromium	EPA 200.7	ND	mg/L	1	0.0050	6/17/2013
Cobalt	EPA 200.7	ND	mg/L	1	0.010	6/17/2013
Copper	EPA 200.7	ND	mg/L	1	0.050	6/17/2013
Gallium	EPA 200.7	ND	mg/L	1	0.10	6/17/2013
Iron	EPA 200.7	ND	mg/L	1	0.010	6/17/2013
Lithium	EPA 200.7	ND	mg/L	1	0.10	6/17/2013
Magnesium	EPA 200.7	3.1	mg/L	1	0.50	6/17/2013
Manganese	EPA 200.7	0.035	mg/L	1	0.0050	6/17/2013
Molybdenum	EPA 200.7	ND	mg/L	1	0.010	6/17/2013
Nickel	EPA 200.7	ND	mg/L	1	0.010	6/17/2013
Phosphorus	EPA 200.7	ND	mg/L	1	0.50	6/17/2013
Potassium	EPA 200.7	0.91	mg/L	1	0.50	6/17/2013
Scandium	EPA 200.7	ND	mg/L	1	0.100	6/17/2013
Silver	EPA 200.7	ND	mg/L	1	0.0050	6/17/2013
Sodium	EPA 200.7	ND	mg/L	1	0.50	6/17/2013
Strontium	EPA 200.7	0.16	mg/L	1	0.10	6/17/2013
Tin	EPA 200.7	ND	mg/L	1	0.10	6/17/2013
Titanium	EPA 200.7	ND	mg/L	1	0.10	6/17/2013
Vanadium	EPA 200.7	ND	mg/L	1	0.010	6/17/2013
Zinc	EPA 200.7	ND	mg/L	1	0.010	6/17/2013
Trace Metals by ICP-MS						
Mercury	EPA 200.8	ND	mg/L	1	0.00010	6/19/2013
Antimony	EPA 200.8	ND	mg/L	1	0.0025	6/19/2013
Arsenic	EPA 200.8	ND	mg/L	1	0.0050	6/20/2013
Lead	EPA 200.8	ND	mg/L	1	0.0025	6/19/2013
Selenium	EPA 200.8	ND	mg/L	1	0.0050	6/19/2013
Thallium	EPA 200.8	ND	mg/L	1	0.0010	6/19/2013
Uranium	EPA 200.8	ND	mg/L	1	0.0050	6/19/2013
Ion Balance						
Anions	Calculation	1.17	meq/L	1	0.10	
Cations	Calculation	1.28	meq/L	1	0.10	
Error	Calculation	4.2	%	1	1.0	
Sample Preparation						
Trace Metals Digestion	EPA 200.2	Complete		1		6/14/2013

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC13060271	Blank 1	Fluoride	EPA 300.0	ND	mg/L
QC13060271	Blank 2	Fluoride	EPA 300.0	ND	mg/L
QC13060271	Blank 3	Fluoride	EPA 300.0	ND	mg/L
QC13060273	Blank 1	Chloride	EPA 300.0	ND	mg/L
QC13060273	Blank 2	Chloride	EPA 300.0	ND	mg/L
QC13060273	Blank 3	Chloride	EPA 300.0	ND	mg/L
QC13060275	Blank 1	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13060275	Blank 2	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13060275	Blank 3	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC13060278	Blank 1	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13060278	Blank 2	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC13060281	Blank 1	Sulfate	EPA 300.0	ND	mg/L
QC13060281	Blank 2	Sulfate	EPA 300.0	ND	mg/L
QC13060281	Blank 3	Sulfate	EPA 300.0	ND	mg/L
QC13060579	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13060579	Blank 2	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13060579	Blank 3	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC13060635	Blank 1	Aluminum	EPA 200.7	ND	mg/L
		Barium	EPA 200.7	ND	mg/L
		Beryllium	EPA 200.7	ND	mg/L
		Bismuth	EPA 200.7	ND	mg/L
		Boron	EPA 200.7	ND	mg/L
		Cadmium	EPA 200.7	ND	mg/L
		Calcium	EPA 200.7	ND	mg/L
		Chromium	EPA 200.7	ND	mg/L
		Cobalt	EPA 200.7	ND	mg/L
		Copper	EPA 200.7	ND	mg/L
		Gallium	EPA 200.7	ND	mg/L
		Iron	EPA 200.7	ND	mg/L
		Lithium	EPA 200.7	ND	mg/L
		Magnesium	EPA 200.7	ND	mg/L
		Manganese	EPA 200.7	ND	mg/L
		Molybdenum	EPA 200.7	ND	mg/L
		Nickel	EPA 200.7	ND	mg/L
		Phosphorus	EPA 200.7	ND	mg/L
		Potassium	EPA 200.7	ND	mg/L
		Scandium	EPA 200.7	ND	mg/L
		Silver	EPA 200.7	ND	mg/L
		Sodium	EPA 200.7	ND	mg/L
		Strontium	EPA 200.7	ND	mg/L
		Tin	EPA 200.7	ND	mg/L
		Titanium	EPA 200.7	ND	mg/L
		Vanadium	EPA 200.7	ND	mg/L
		Zinc	EPA 200.7	ND	mg/L
QC13060763	Blank 1	Mercury	EPA 200.8	ND	mg/L
		Antimony	EPA 200.8	ND	mg/L

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

QCBatchID	QCType	Parameter	Method	Result	Units
		Arsenic	EPA 200.8	ND	mg/L
		Lead	EPA 200.8	ND	mg/L
		Selenium	EPA 200.8	ND	mg/L
		Thallium	EPA 200.8	ND	mg/L
		Uranium	EPA 200.8	ND	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC13060269	LCS 1	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13060269	LCS 2	pH	SM 4500-H+ B	7.00	7.00	100	pH Units
QC13060269	LCS 3	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC13060269	LCS 4	pH	SM 4500-H+ B	7.01	7.00	100	pH Units
QC13060271	LCS 1	Fluoride	EPA 300.0	2.13	2.00	106	mg/L
QC13060273	LCS 1	Chloride	EPA 300.0	10.8	10.0	108	mg/L
QC13060275	LCS 1	Nitrite Nitrogen	EPA 300.0	0.503	0.500	101	mg/L
QC13060278	LCS 1	Nitrate Nitrogen	EPA 300.0	2.18	2.00	109	mg/L
QC13060280	LCS 1	Total Alkalinity	SM 2320B	99.0	100	99	mg/L
QC13060280	LCS 2	Total Alkalinity	SM 2320B	98.9	100	99	mg/L
QC13060280	LCS 3	Total Alkalinity	SM 2320B	99.0	100	99	mg/L
QC13060280	LCS 4	Total Alkalinity	SM 2320B	99.4	100	99	mg/L
QC13060280	LCS 5	Total Alkalinity	SM 2320B	108	100	108	mg/L
QC13060281	LCS 1	Sulfate	EPA 300.0	27.1	25.0	109	mg/L
QC13060579	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	155	150	103	mg/L
QC13060579	LCS 2	Total Dissolved Solids (TDS)	SM 2540C	139	150	92	mg/L
QC13060579	LCS 3	Total Dissolved Solids (TDS)	SM 2540C	149	150	100	mg/L
QC13060635	LCS 1	Aluminum	EPA 200.7	1.01	1.00	101	mg/L
		Barium	EPA 200.7	0.994	1.00	99	mg/L
		Beryllium	EPA 200.7	0.977	1.00	98	mg/L
		Bismuth	EPA 200.7	0.997	1.00	100	mg/L
		Boron	EPA 200.7	0.982	1.00	98	mg/L
		Cadmium	EPA 200.7	1.00	1.00	100	mg/L
		Calcium	EPA 200.7	10.4	10.0	104	mg/L
		Chromium	EPA 200.7	0.972	1.00	97	mg/L
		Cobalt	EPA 200.7	0.978	1.00	98	mg/L
		Copper	EPA 200.7	4.86	5.00	97	mg/L
		Gallium	EPA 200.7	1.00	1.00	100	mg/L
		Iron	EPA 200.7	0.973	1.00	97	mg/L
		Lithium	EPA 200.7	0.972	1.00	97	mg/L
		Magnesium	EPA 200.7	9.70	10.0	97	mg/L
		Manganese	EPA 200.7	0.987	1.00	99	mg/L
		Molybdenum	EPA 200.7	0.985	1.00	98	mg/L
		Nickel	EPA 200.7	4.97	5.00	99	mg/L
		Phosphorus	EPA 200.7	5.01	5.00	100	mg/L
		Potassium	EPA 200.7	10.1	10.0	101	mg/L
		Scandium	EPA 200.7	0.981	1.00	98	mg/L
		Silver	EPA 200.7	0.091	0.090	101	mg/L
		Sodium	EPA 200.7	9.91	10.0	99	mg/L
		Strontium	EPA 200.7	0.999	1.00	100	mg/L
		Tin	EPA 200.7	0.966	1.00	97	mg/L
		Titanium	EPA 200.7	0.975	1.00	98	mg/L
		Vanadium	EPA 200.7	0.990	1.00	99	mg/L
		Zinc	EPA 200.7	0.988	1.00	99	mg/L
QC13060763	LCS 1	Mercury	EPA 200.8	0.000951	0.001	95	mg/L
		Antimony	EPA 200.8	0.0100	0.010	100	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
		Arsenic	EPA 200.8	0.0481	0.050	96	mg/L
		Lead	EPA 200.8	0.0099	0.010	99	mg/L
		Selenium	EPA 200.8	0.0503	0.050	101	mg/L
		Thallium	EPA 200.8	0.0097	0.010	97	mg/L
		Uranium	EPA 200.8	0.0098	0.010	98	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result		Units	RPD
QC13060269	Duplicate	pH	SM 4500-H+ B	1306105-001	7.43	7.48	HT	pH Units	1 %
QC13060269	Duplicate	pH	SM 4500-H+ B	1306113-008	7.26	7.27	HT	pH Units	<1%
QC13060269	Duplicate	pH	SM 4500-H+ B	1306124-001	8.83	8.85	HT	pH Units	<1%
QC13060269	Duplicate	pH	SM 4500-H+ B	1306102-001	7.81	7.80	HT	pH Units	<1%
QC13060269	Duplicate	pH	SM 4500-H+ B	1306102-002	7.99	8.00	HT	pH Units	<1%
QC13060269	Duplicate	pH	SM 4500-H+ B	1306107-011	9.55	9.65	HT	pH Units	1 %
QC13060269	Duplicate	pH	SM 4500-H+ B	1306136-002	7.89	7.89	HT	pH Units	<1%
QC13060269	Duplicate	pH	SM 4500-H+ B	1306136-007	7.11	7.56	HT,Q	pH Units	6 %
QC13060280	Duplicate	Bicarbonate (HCO3)	SM 2320B	1306105-001	170	171		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1306105-001	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1306105-001	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1306105-001	140	140		mg/L as CaCO3	<1%
QC13060280	Duplicate	Bicarbonate (HCO3)	SM 2320B	1306113-008	371	371		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1306113-008	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1306113-008	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1306113-008	305	304		mg/L as CaCO3	<1%
QC13060280	Duplicate	Bicarbonate (HCO3)	SM 2320B	1306124-001	154	152		mg/L	1 %
		Carbonate (CO3)	SM 2320B	1306124-001	17.8	19.1		mg/L	7 %
		Hydroxide (OH)	SM 2320B	1306124-001	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1306124-001	155	156		mg/L as CaCO3	<1%
QC13060280	Duplicate	Bicarbonate (HCO3)	SM 2320B	1306102-001	203	202		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1306102-001	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1306102-001	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1306102-001	167	166		mg/L as CaCO3	<1%
QC13060280	Duplicate	Bicarbonate (HCO3)	SM 2320B	1306102-002	237	237		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1306102-002	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1306102-002	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1306102-002	194	194		mg/L as CaCO3	<1%
QC13060280	Duplicate	Bicarbonate (HCO3)	SM 2320B	1306107-011	22.9	20.4		mg/L	12 %
		Carbonate (CO3)	SM 2320B	1306107-011	19.8	21.5		mg/L	8 %
		Hydroxide (OH)	SM 2320B	1306107-011	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1306107-011	51.7	52.4		mg/L as CaCO3	1 %
QC13060280	Duplicate	Bicarbonate (HCO3)	SM 2320B	1306136-002	139	139		mg/L	<1%
		Carbonate (CO3)	SM 2320B	1306136-002	ND	ND		mg/L	<1%
		Hydroxide (OH)	SM 2320B	1306136-002	ND	ND		mg/L	<1%
		Total Alkalinity	SM 2320B	1306136-002	114	114		mg/L as CaCO3	<1%

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC13060280	Duplicate	Bicarbonate (HCO3)	SM 2320B	1306136-007	174	176	mg/L	1 %
		Carbonate (CO3)	SM 2320B	1306136-007	ND	ND	mg/L	<1%
		Hydroxide (OH)	SM 2320B	1306136-007	ND	ND	mg/L	<1%
		Total Alkalinity	SM 2320B	1306136-007	143	145	mg/L as CaCO3	1 %
QC13060579	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1306107-005	1308	1308	mg/L	<1%
QC13060579	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1306107-012	885	870	mg/L	2 %
QC13060579	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1306122-001	42.0	37.0	mg/L	13 %
QC13060579	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1306148-001	797	798	mg/L	<1%
QC13060579	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1306150-002	932	940	mg/L	1 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC13060271	MS 1	Fluoride	EPA 300.0	1306075-021	0.154		2.13	2.23	2.00	mg/L	99	104	5 %
QC13060271	MS 2	Fluoride	EPA 300.0	1306122-002	0.939		2.70	2.71	2.00	mg/L	88	89	<1%
QC13060273	MS 1	Chloride	EPA 300.0	1306075-021	ND		5.52	5.72	5.00	mg/L	108	112	4 %
QC13060273	MS 2	Chloride	EPA 300.0	1306122-002	ND		5.17	5.20	5.00	mg/L	102	103	1 %
QC13060275	MS 1	Nitrite Nitrogen	EPA 300.0	1306075-021	ND		0.501	0.518	0.500	mg/L	100	104	3 %
QC13060275	MS 2	Nitrite Nitrogen	EPA 300.0	1306122-002	ND		0.448	0.454	0.500	mg/L	90	91	1 %
QC13060278	MS 1	Nitrate Nitrogen	EPA 300.0	1306122-002	ND		2.06	2.08	2.00	mg/L	102	103	1 %
QC13060281	MS 1	Sulfate	EPA 300.0	1306075-021	39.9		50.4	50.9	10.0	mg/L	105	110	1 %
QC13060281	MS 2	Sulfate	EPA 300.0	1306122-002	17.2		26.5	26.6	10.0	mg/L	93	94	<1%
QC13060635	MS 1	Aluminum	EPA 200.7	1306126-001	ND		1.07	1.05	1.00	mg/L	107	105	2 %
		Barium	EPA 200.7	1306126-001	0.081		1.05	1.03	1.00	mg/L	97	95	2 %
		Beryllium	EPA 200.7	1306126-001	ND		0.964	0.961	1.00	mg/L	96	96	<1%
		Bismuth	EPA 200.7	1306126-001	ND		0.991	0.994	1.00	mg/L	100	100	<1%
		Boron	EPA 200.7	1306126-001	2.52		3.54	3.43	1.00	mg/L	102	91	3 %
		Cadmium	EPA 200.7	1306126-001	ND		0.992	0.973	1.00	mg/L	99	97	2 %
		Calcium	EPA 200.7	1306126-001	36.7	M	36.3	45.3	10.0	mg/L	NC	NC	NC
		Chromium	EPA 200.7	1306126-001	ND		0.921	0.898	1.00	mg/L	92	90	3 %
		Cobalt	EPA 200.7	1306126-001	ND		0.911	0.905	1.00	mg/L	91	91	1 %
		Copper	EPA 200.7	1306126-001	ND		4.88	4.88	5.00	mg/L	98	98	<1%
		Gallium	EPA 200.7	1306126-001	ND		1.04	1.02	1.00	mg/L	104	102	2 %
		Iron	EPA 200.7	1306126-001	ND	M	0.847	1.09	1.00	mg/L	NC	NC	NC
		Lithium	EPA 200.7	1306126-001	0.597	M	1.52	1.90	1.00	mg/L	NC	NC	NC
		Magnesium	EPA 200.7	1306126-001	17.3	M	21.4	26.7	10.0	mg/L	NC	NC	NC
		Manganese	EPA 200.7	1306126-001	0.054		1.00	0.985	1.00	mg/L	95	93	2 %
		Molybdenum	EPA 200.7	1306126-001	ND		0.987	0.990	1.00	mg/L	98	98	<1%
		Nickel	EPA 200.7	1306126-001	ND		4.67	4.59	5.00	mg/L	93	92	2 %
		Phosphorus	EPA 200.7	1306126-001	ND		5.19	5.17	5.00	mg/L	101	100	<1%
		Potassium	EPA 200.7	1306126-001	22.2	M	30.0	37.3	10.0	mg/L	NC	NC	NC
		Scandium	EPA 200.7	1306126-001	ND		0.958	0.955	1.00	mg/L	96	95	<1%
		Silver	EPA 200.7	1306126-001	ND		0.090	0.090	0.090	mg/L	100	100	<1%
		Sodium	EPA 200.7	1306126-001	113	SC	101	125	10.0	mg/L	NC	NC	NC
		Strontium	EPA 200.7	1306126-001	0.489	M	1.22	1.54	1.00	mg/L	NC	NC	NC
		Tin	EPA 200.7	1306126-001	ND		0.842	0.842	1.00	mg/L	94	94	<1%
		Titanium	EPA 200.7	1306126-001	ND	M	0.831	1.04	1.00	mg/L	NC	NC	NC
		Vanadium	EPA 200.7	1306126-001	0.046		1.02	1.01	1.00	mg/L	97	96	1 %
		Zinc	EPA 200.7	1306126-001	ND		0.982	0.947	1.00	mg/L	98	95	4 %
QC13060763	MS 1	Mercury	EPA 200.8	1306126-001	ND		0.000963	0.000938	0.001	mg/L	94	91	3 %
		Antimony	EPA 200.8	1306126-001	ND		0.0106	0.0105	0.010	mg/L	106	105	1 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result	MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
		Arsenic	EPA 200.8	1306126-001	0.0876	0.1455	0.1500	0.050	mg/L	116	125	3 %
		Lead	EPA 200.8	1306126-001	ND	0.0094	0.0094	0.010	mg/L	93	92	<1%
		Selenium	EPA 200.8	1306126-001	ND	0.0477	0.0490	0.050	mg/L	91	93	3 %
		Thallium	EPA 200.8	1306126-001	ND	0.0091	0.0092	0.010	mg/L	90	91	1 %
		Uranium	EPA 200.8	1306126-001	0.0077	0.0177	0.0177	0.010	mg/L	100	100	<1%

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

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Lab Number 1306122
Report Due Date: 6/20/13
Page 1 of 1

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Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard ______ 5-Day ______ Other ______

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER: ______

Analyses Requested

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium									Spl. No.
CF-11-02 (0-27)	Wk:56	06/06/13	9:00	WW	2	X	X									1
CF-11-02 (367-408)	↓	↓	↓	↓	↓	↓	↓									2

1306 5
122 2

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 23.2°C	6/6/13	1415		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 4				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

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Report Due Date: 6/20/13
Page 1 of 1

Client McClelland Laboratories, Inc.
Address 1016 Greg Street
City, State & Zip Sparks, NV 89431
Contact Mike Medina
Phone 775-356-1300
Collector's Name Robert
Fax 775-356-8917
Project Name
P.O. Number
Project Number 3438
Email mli@mettest.com

Turnaround Time
Standard______ 5-Day______ Other______

Billing Address (if different than Client Address):
Company
Address
City, State & Zip
Contact
Phone
Fax
Email

Additional Information

Fax Results Y N To: Client Billing
Email Results Y N To: Client Billing
Compliance Monitoring Y N
Fax Results to State EPA Y N

Sample Type Codes

DW = Drinking Water
WW = Wastewater
SW = Surface Water
MW = Monitoring Well
SD = Solid
SO = Soil
HW = Hazardous Waste
OTHER:______

Analyses Requested

SAMPLE ID/LOCATION		DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Profile II w/o Wad	Uranium	Spl. No.
CF-11-02 (0-27)	Wk:56	06/06/13	9:00	WW	2	X	X	1
CF-11-02 (367-408)	↓	↓	↓	↓	↓	↓	↓	2

1306 5
122 2

Instructions/Comments/Special Requirements:

SAMPLE RECEIPT	DATE	TIME	Samples Relinquished By	Samples Received By
Temperature 23.2°C	6/6/13	1415		
Custody Seals Intact? Y N [✓ None]				
Number of Containers 4				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compesation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

301.2E

Appendix B – Mineralogy Report for Humidity Cell Test Samples

MINERALOGICAL ANALYSIS OF HUMIDITY CELL SAMPLES FOR THE COPPER FLAT PROJECT, NEW MEXICO

Prepared For

THEMAC Resources Group Ltd.

Report Prepared by

srk consulting

SRK Consulting (UK) Limited

U3939

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MINERALOGICAL ANALYSIS OF HUMIDITY CELL SAMPLES FOR THE COPPER FLAT PROJECT, NEW MEXICO

1 INTRODUCTION

As part of the assessment of Acid Rock Drainage and Metal Leaching (ARDML) for the Copper Flat project, New Mexico, eight samples of the humidity cell testwork (HCT) material were submitted for mineralogical assessment. These samples were selected to assess the speciation and textures of the sulfide minerals, and in particular to determine what implications these may have for the lack of acid-generation observed in several of the samples during the HCT programme. This assessment forms part of the wider geochemical characterisation study for the Copper Flat Project. Of the eight submitted samples, seven represented humidity cell residues (i.e. post-leach material from the HCT programme), whilst the eighth was a pre-leach sample for one of the humidity cells. A brief summary of the eight samples submitted is provided in Table 1-1, below.

Table 1-1: Samples selected for mineralogical assessment

Sample ID	Details	Material type	Sample selection rationale
SRK 0854	HCT residue	Transitional ore	Sample from the Sternberg lode (mineralised material), which developed moderately acidic pH conditions (pH 5) during the HCT programme.
SRK 0858	HCT residue	Transitional waste	The only truly PAF cell in the HCT program, with HCT results confirming that active sulfide weathering was occurring in this cell.
SRK 0867	HCT residue	Transitional ore	Pre-HCT mineralogical data available. Included for comparison purposes.
SRK 0872	HCT residue	Transitional waste	Predicted PAF by ABA/NAG testwork, but neutral in HCT. Mineralogy required to confirm why no acid generation occurring.
604673	HCT residue	Sulfide waste	Predicted PAF by ABA/NAG testwork, but truly acidic conditions did not develop in the HCT (although pH did decline over course of testwork).
CF-02 (0-27)	HCT residue	Transitional waste	Predicted PAF by ABA/NAG testwork, but neutral in HCT. Mineralogy required to confirm why no acid generation occurring.
604767	HCT residue	Sulfide ore	Predicted PAF by ABA/NAG testwork, but neutral in HCT. Mineralogy required to confirm why no acid generation occurring.
CF-11-02 (0-27)	Original (pre-leach) sample	Transitional waste	Pre-HCT leached material for sample CF-02 0-27

The material types that were submitted for mineralogical analysis consisted of Transitional Waste (4 samples), Transitional Ore (2 samples), Sulfide Waste (1 sample) and Sulfide Ore (1 sample) (Table 1-1). In all cases the major mineralogy consisted of quartz, albite and orthoclase with significant alteration of the feldspar minerals to illite and kaolinite. Clinochlore was also observed as minor mineral within four of the samples. There were no significant differences between the alteration proportions of the feldspar minerals across the varying samples.

2 METHODOLOGY

The mineralogical examination was undertaken using petrographic microscopy (both transmitted and reflected light), scanning electron microscopy (SEM) and fine powder X-Ray Diffraction (XRD). Samples were prepared from the humidity cell residue material as polished thin sections (for optical microscopy and SEM). XRD analysis was carried out on pulverised samples of the residue material.

Optical Microscopy

The principal method of mineralogical analysis used for this study is Optical Microscopy. This was completed on polished thin sections of core material. A Meiji MX9000 microscope fitted with a mounted Canon EOS 600D digital camera has been used in this study.

Scanning Electron Microscopy

Semi-quantitative energy dispersive analysis of minerals present within the polished thin sections was carried out using a S360 Scanning Electron Microscope with INCA wave-and energy-dispersive X-Ray spectroscopy at the Department of Earth Sciences, Cardiff, UK. This method allows micro-chemical data to be collected that reports the chemical composition of the surface of the mineral phase in the polished section. The electron beam utilised to gather the information required is approximately 1 to 5 µm in diameter, so even very small phases can be quantified.

X-Ray Diffraction

X-Ray Diffraction analysis was carried out using a Philips PW1710 Powder Diffractometer at the Department of Earth Science, Cardiff University, UK. Bulk analyses were carried out on samples. Scans were run using Cu Kα radiation at 35kV and 40mA, between 2 and 70 °2θ at a scan speed of 0.04 °2θ/s. From the scans, phases were identified and from the peak areas, semi quantitative analysis was performed and a percentage of each phase present calculated.

3 SUMMARY OF FINDINGS

This section provides a summary of the mineralogical results. Detailed descriptions of each of the samples (including photo micrographs of the polished thin sections) are provided in Sections 4 to 11, below.

The main sulfide minerals observed were pyrite (FeS_2) and chalcopyrite ($CuFeS_2$), which were present in all eight samples submitted for testing (Table 3-2). Galena (PbS) and molybenite (MoS_2) were also observed in two of the samples, with molybdenite in a further third. Covellite (CuS) was observed in both the pre- and post-leach material for sample CF-11-02 (0-27ft). Texturally, there were two clear patterns for the occurrence of chalcopyrite and pyrite. Chalcopyrite tended to be fine-grained and encapsulated within quartz-feldspar composite particles. The only exceptions to this were samples SRK0854 which produced acidic conditions during the HCT and the pre-leach sample for CF-11-02 (0-27ft). This indicates that the textural occurrence of chalcopyrite in cell SRK084 likely contributed to its breakdown and subsequent acid generation in this cell.

Pyrite within the samples was typically found to occur as either fine-grained crystals encapsulated in quartz-feldspar composite particles or as medium-grained euhedral crystals that are liberated. In general, all medium-grained liberated examples of pyrite showed partial fracturing, occasionally to the point of disaggregation (i.e. fractures were connecting and the grains were beginning to crumble). However, comparison with the pre-leach material demonstrates that the pyrite frequently exhibited this fractured texture *prior* to the humidity cell test, indicating that the fracturing and disaggregation observed in the post-HCT samples may not relate to breakdown of the sulfides during the test, but rather that this is a pre-existing texture. Furthermore, comparison with the humidity cell results demonstrates that this textural occurrence of pyrite only occasionally led to acid-generation (for example in cells SRK0858 and SRK0854), and that sulfate release from the humidity cells was typically slow, with low effluent concentrations.

Sulfate rims around the pyrite grains (indicative of pyrite oxidation) were typically only observed in samples that developed acid conditions during the HCT (i.e., SRK0854, SRK0858 and 604673). Although, limited evidence of sulfide oxidation was observed in several of the other samples (SRK0867, SRK0872 and CF-11-02 (0-27)) from the presence of jarosite and schwertmannite in association with sulfide grains, this was not seen to lead to acid generation in these cells. This may be due to the slow weathering rate of the pyrite grains, their equigranular grain shape and the presence of mafic buffering minerals such as phlogopite in addition to small amounts of calcite in some of the samples.

Identifying potential mineralogical controls that could account for the lack of acid generation in several of the humidity cells is complex but comes down to three factors;

1. The nature of the sulfides as coarse- or well-crystallized grains, meaning they are thermodynamically stable and difficult to weather;
2. The inclusion of many of the finer-grained sulfides (particularly chalcopyrite) in non-reactive silicate gangue;
3. The presence of acid buffering silicate minerals, especially chlorite group minerals and also to a limited extent, the small amounts of calcite concentrations present in the samples.

These factors are discussed in more detail below.

Sulfide mineral texture

Much of the pyrite in the post-HCT samples is present as medium-grained, well-crystallised and liberated crystals, which show evidence of fracturing and partial disaggregation. Although this textural occurrence would theoretically suggest that the pyrite grains are available for weathering/oxidation reactions, acidic conditions were not realized in the majority of cells despite prolonged testing. It is possible that the coarse-grained and equigranular nature of the pyrite in the Copper Flat material means it is more likely to be thermodynamically stable and difficult to weather. Reasons for slow pyrite weathering have also been the topic of recent research and some have suggested that it may also relate to the trace element content of the pyrite, with the presence of cobalt and nickel slowing the rate of reaction (Lehner et al. 2007; Lehner and Savage, 2008; Parbhaker-Fox et al., 2013). Furthermore, there is little evidence of significant sulfide weathering in the majority of samples, demonstrating that the lack of acid generation may be explained by the stability of the sulfides rather than by significant neutralization in the cells.

Inclusion of sulfides in non-reactive silicate gangue

Encapsulation of chalcopyrite within a silicate (quartz-feldspar) gangue was found to be common within the Copper Flat samples and there was also a limited amount of pyrite encapsulation. This textural occurrence should limit the availability of these sulfide minerals for oxidation/weathering reactions, thus limiting the potential for acid generation. The only post-leach sample in which chalcopyrite occurred as medium-grained and liberated crystals was sample SRK0854, which was one of the only cells to produce acidic conditions during the HCT. This supports the assumption that the textural occurrence of chalcopyrite in cell SRK0854 likely contributed to its breakdown and subsequent acid generation in this cell.

The presence of buffering silicate minerals

Although the occurrence of acid buffering carbonate minerals in the samples was found to be limited, the presence of silicate minerals such as phlogopite and clinochlore were more abundant and may offer some silicate buffering potential. Carbonate minerals in the form of calcite or ankerite were only observed in four of the eight cells at proportions of generally less than one percent (1%) by area. In general the carbonates were very fine-grained and frequently encapsulated within quartz-feldspar composites, indicating they may not be available to contribute to acid buffering reactions, or at least slow to react and their proportions are too low to account for significant acid-neutralization in the cells. The ABA testwork results (SRK, 2013) are consistent with these observations and demonstrate that carbonate proportions are considerably lower than the sulfide proportions. The encapsulation of carbonates may also account for the fact that generally greater than 70% of the original neutralization potential was remaining in the cells at the end of the humidity cell testwork period.

Despite the limited presence of carbonate minerals in the samples, the silicate minerals phlogopite and/or chlinochlore were observed in all eight samples submitted for testing. These minerals are known to offer some buffering capacity and may be one of the reasons why acidic conditions were not achieved in several of the Copper Flat humidity cells.

3.1 Additional Mineralogical Observations

For the three cells that showed evidence of acid-generation during the HCT program (SRK0854, SRK0858 and 604673), there is an interesting correlation with copper release from the humidity cells (Table 3-1). This may relate to the proportion of liberated chalcopyrite or copper sulfate minerals present in the initial (i.e. pre-leach) samples. Coarse liberated chalcopyrite grains were observed in cell SRK0854 which presented the greatest copper release during the HCT. Similarly, the presence of copper sulfate minerals such as brochantite have been previously identified from grab sample assessment as being a likely component of the transitional samples. Although copper sulfate minerals were not identified in the current mineralogical assessment, this likely relates to the flushing of these minerals (i.e. consumption) during the HCT testwork. It may therefore be the breakdown of these copper sulfate minerals that are driving the observed acid-generation in these cells and the apparent slow reactivity of the pyrite grains may lead to increased or eventual initiation of acid-generation over much longer timescales.

Table 3-1: Mineralogy sample HCT copper release

Material type	Sample ID	Final HCT pH	Head Copper Assay (mg/kg)	Residue Copper Assay (mg/kg)	Cumulative Copper Release During HCT (mg/kg)	% of Copper Assay Mobilized During HCT
Sulfide Ore	604 767	7.83	5,972	5,970	2	0.04%
Sulfide Waste	604 673	4.94	1,198	1,150	48	4.04%
Transitional Ore	SRK 0854	5.12	9,780	7,490	2,290	23.4%
	SRK 0867	7.57	2,415	2,400	15	0.64%
Transitional Waste	SRK 0858	2.49	562	249	313	55.7%
	SRK 0872	7.28	875	870	5	0.61%
	CF-11-02 (0-27)	7.80	1,371	1,370	1	0.11%

🟥 Indicates acidic conditions achieved in HCT testwork

Table 3-2: Summary of Minerals Found by XRD and in Thin Section and Polished Block

		SRK Sample ID	**SRK0854**	**SRK0858**	**SRK0867**	**SRK0872**	**604673**	**604767**	**CF-11-02**	**CF-11-02 (Pre HCT)**
		HCT Behaviour	**PAF**	**PAF**	**NAF**	**NAF**	**PAF**	**NAF**	**NAF**	**NAF**
		Lithology →	Transitional Ore	Transitional Waste	Transitional Ore	Transitional Waste	Sulfide Waste	Sulfide Ore	Transitional Waste	Transitional Waste
		Ideal chemistry ↓								
	Quartz	SiO_2	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	Thorite	$(Th,U)SiO_4$			X					
	Titanite	$CaTi(SiO_4)O$			X	X				
	Magnetite	Fe_3O_4	X			X				
	Fluorite	CaF_2						X		
	Zircon	$ZrSiO_4$							X	
	Rutile	TiO_2	X	X		X	X	X	X	X
Clay Minerals	Kaolinite	$AlSi_2O_5(OH)_4$		XX	XX	XX		XX		
	Illite	$K_{0.65}Al_2[(Si,Al)_4O_{10}](OH)_2$	XXX	XX	XXX	XXX	XX	XXX	XXX	XXX
	Clinochlore	$(Mg,Fe^{2+})_5Al(AlSi_3O_{10})(OH)_8$	XX			X	XX	X	XX	XX
	Phlogopite	$KMg_3(AlSi_3O_{10})(OH,F)_2$		X	X	X		X	X	X
Feldspars	Albite	$NaAlSi_3O_8$	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	Orthoclase	$(K,Na)AlSi_3O_8$	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Phosphates & Sulfates	Monazite	$(Ce,La,Nd,Th)(PO_4)$			X					
	Jarosite	$KFe^{3+}_3(SO_4)_2(OH)_6$		X	X					
	Schwertmannite	$Fe_8O_8(OH)_6(SO_4).nH_2O$	X	X		X	X		X	X
	Fluorapatite	$Ca_5(PO_4)_3F$	X	X		X		X	X	X
	Baryte	$BaSO_4$				X		X		
Carbonates	Ankerite	$Ca(Fe^{2+},Mg)(CO_3)_2$						X		X
	Calcite	$CaCO_3$			X				X	
Sulfides	Covellite	CuS							X	X
	Chalcopyrite	$CuFeS_2$	X	X	X	X	X	X	X	X
	Galena	PbS	X					X		
	Molybdenite	MoS	X				X	X		
	Pyrite	FeS_2	X	X	X	X	X	X	X	X
X	Trace Minerals (<1% by area)									
XX	Minor Minerals (1-10% by area)									
XXX	Major Minerals (> 10% by area)									

4 SRK0854

This sample represents transitional ore material and predominantly consists of quartz, albite and orthoclase, with the latter feldspar minerals being considerably altered to illite. The sample contains 0.88% sulfide sulfur (SRK, 2013) in the form of chalcopyrite, galena, molybdenite and pyrite. Of these, pyrite and chalcopyrite are the most abundant. Texturally, the pyrite and chalcopyrite grains are either medium-grained and liberated or fine-grained and encapsulated. In contrast to other samples, the chalcopyrite grains are more frequently observed as medium-grained and liberated.

Breakdown of sulfide grains was observed in this sample, with brown sulfate phases being present around the edges of some of the sulfide grains (see Figure 4-1). The iron-sulfate mineral was identified as schwertmannite on the basis of the low sulfur to iron ratio.. This is indicative of sulfide oxidation in this cell and is supported by the moderately acidic pH conditions (pH 5) that developed in this cell during the HCT.

Table 4-1: Table of Minerals Found in Sample SRK 0854 and Their Abundance

Trace Minerals (≤1%)	Minor Minerals (1%–10%)	Major Minerals (10% <)
Magnetite	Clinochlore	Quartz
Rutile		Illite
Fluorapatite		Albite
Chalcopyrite		Orthoclase
Galena		
Molybdenite		
Pyrite		
Schwertmannite		

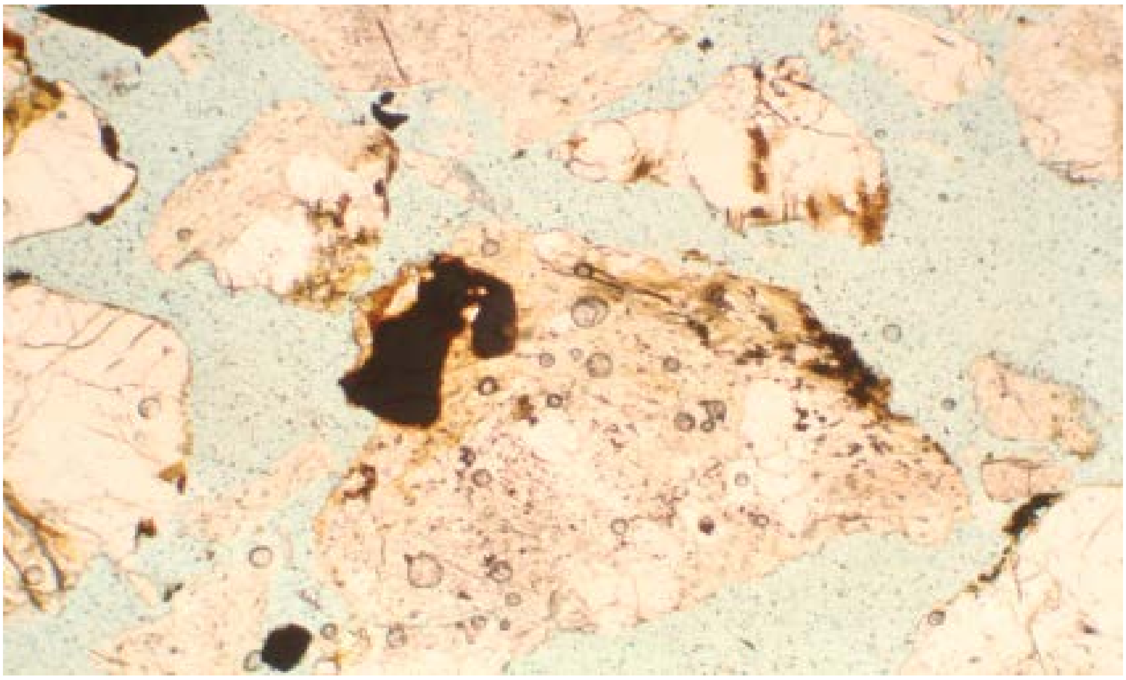

Figure 4-1: Sample SRK 0854 Plane Polarized Image (x5 magnification)

Particles of quartz and feldspar with sulfide inclusions. Just to the left of the centre of the field of view is an opaque pyrite grain showing brown sulfate weathering around the edges. This indicates sulfide breakdown was beginning to occur within the cell.

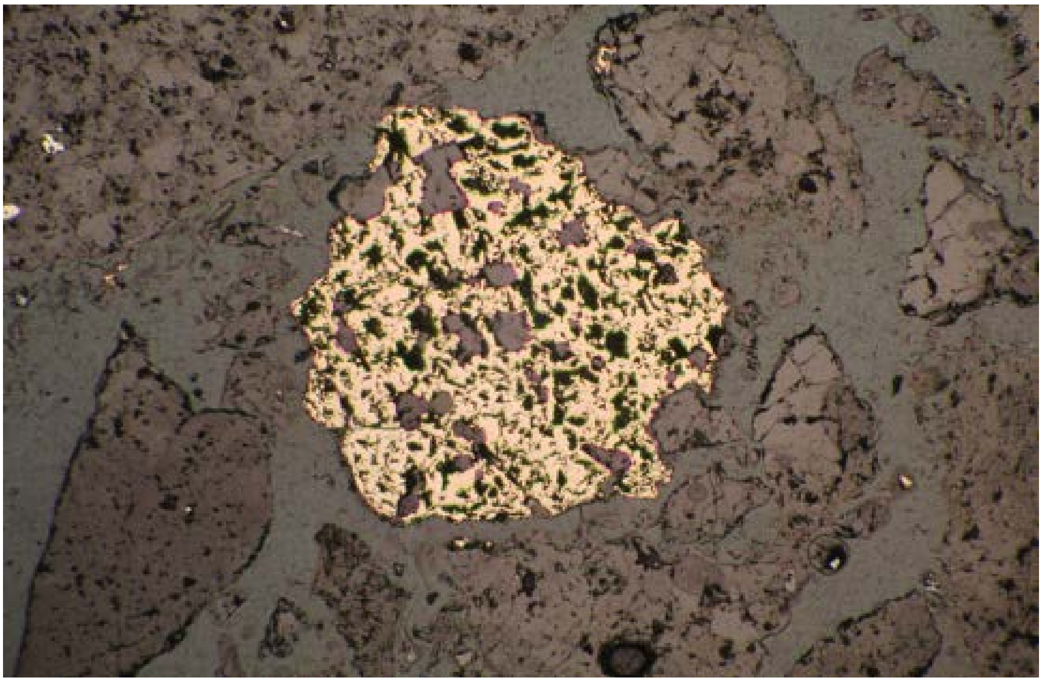

Figure 4-2: Sample SRK 0854 Reflected Light Image (x5 magnification)

Coarse, granular chalcopyrite grain. The chalcopyrite contains minor inclusions of quartz and feldspar and thus form a coarse poikiolitic shape.

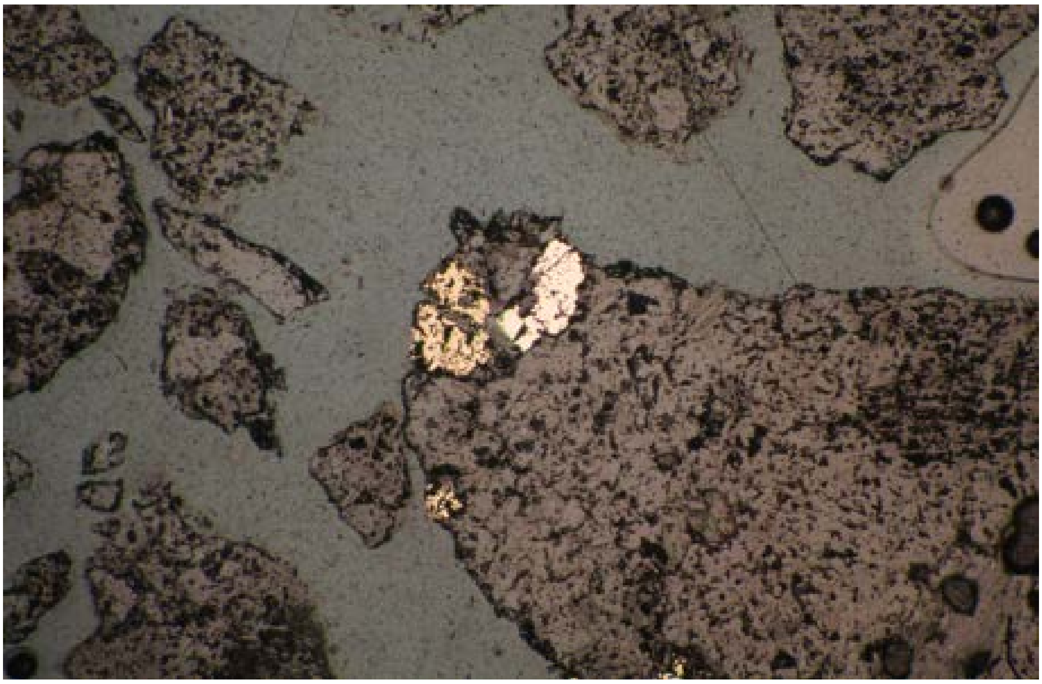

Figure 4-3: Sample SRK 0854 Reflected Light Image (x5 magnification)

Medium-grained chalcopyrite and pyrite grains hosted along the edge of a quartz-feldspar composite particle. These show partial encapsulation but can expect to weather in the long term.

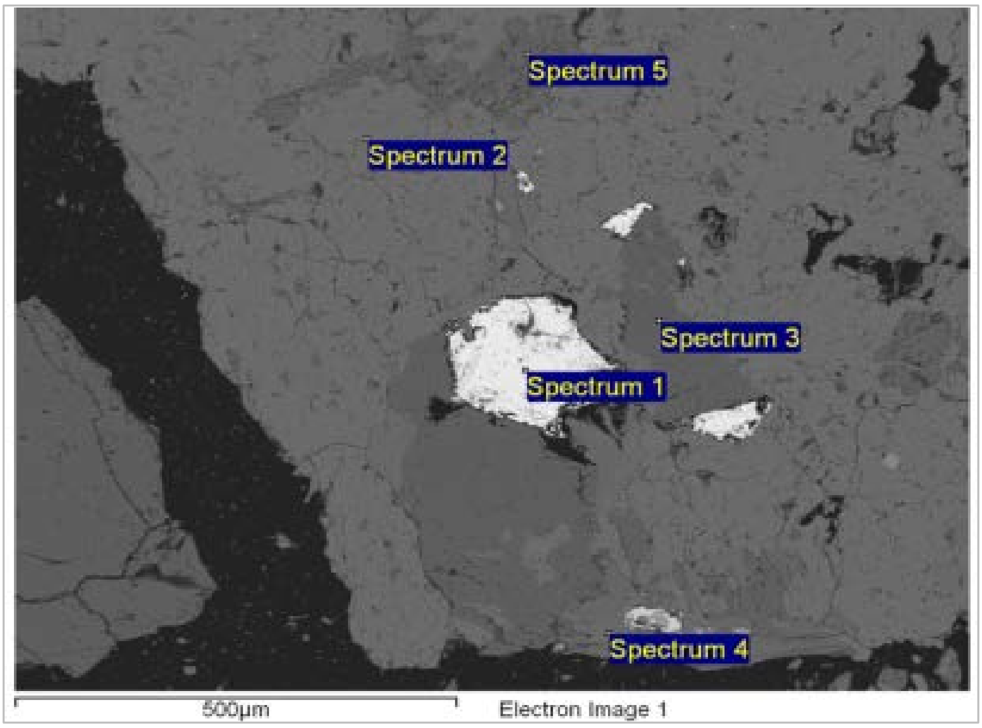

Figure 4-4: Sample SRK 0854 Back Scatter Image

Composite particle consisting of encapsulated chalcopyrite (Spectrum 1) hosted within orthoclase (Spectrum 2), quartz (Spectrum 3), illite (Spectrum 4) and albite (Spectrum 5).

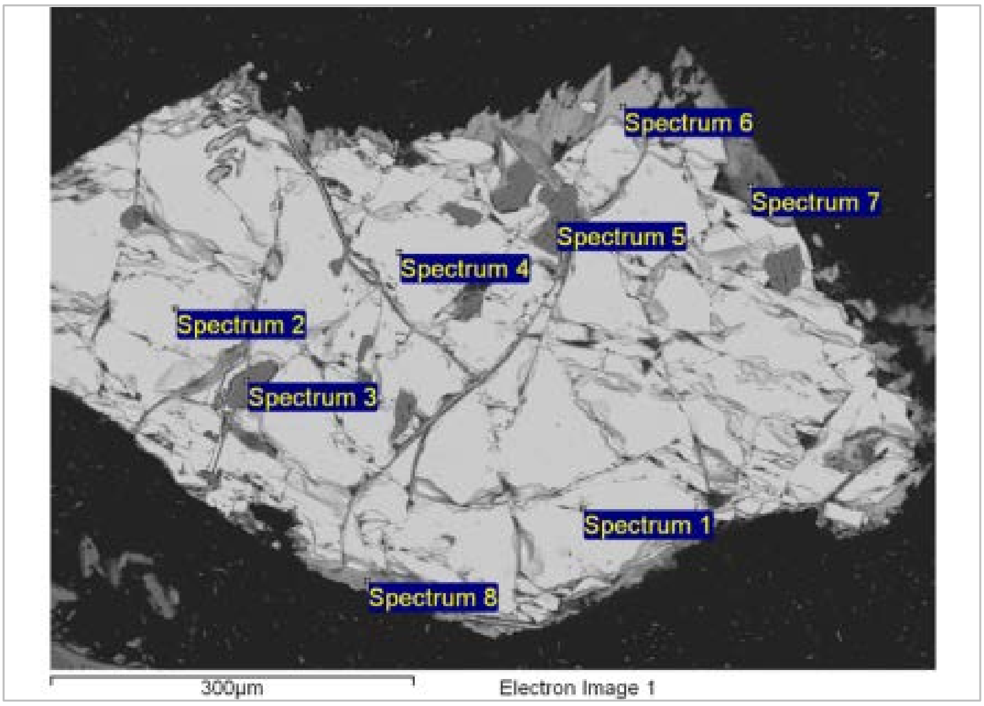

Figure 4-5: Sample SRK 0854 Back Scatter Image

Medium-grained liberated pyrite (Spectra 1, 2 & 4) showing considerable internal fracturing and partial breakdown along the mineral edge. There are inclusions of orthoclase (Spectra 3 & 5). Magnetite is forming on the rim (Spectrum 6), along with some schwertmannite (Spectra 7 & 8).

5 SRK0858

This sample represents transitional waste material and predominantly consists of quartz, albite and orthoclase, with the latter feldspar minerals considerably altered to illite and kaolinite. It contains 0.62% sulfide sulfur (SRK, 2013) in the form of chalcopyrite and pyrite. Chalcopyrite is usually observed as fine-grained and encapsulated within relatively inert silicate gangue. Pyrite may also be fine-grained and encapsulated but is frequently observed as medium-grained, liberated particles, showing partial fracturing and disaggregation. The liberated nature of the sulfide minerals may account for the acidic conditions that developed in this cell during the HCT.

Breakdown of sulfide grains was observed in this sample, with brown sulfate phases being present around the edges of some of the sulfide grains. The iron-sulfate minerals were identified as schwertmannite on the basis of SEM identification of a low sulfur to iron ratio. Jarosite was also identified from the SEM analysis. This is indicative of sulfide oxidation in this cell and is supported by the acidic pH conditions (pH 2.5) that developed in this cell during the HCT. The acidic pH conditions that were attained in the cell indicate that the rate of sulfide oxidation must have been sufficient to overcome any inherent buffering from the mafic gangue mineral phlogopite.

Table 5-1: Table of Minerals Found in Sample SRK 0858 and Their Abundance

Trace Minerals (≤1%)	Minor Minerals (1%–10%)	Major Minerals (10% <)
Rutile	Illite	Quartz
Fluorapatite	Kaolinite	Albite
Jarosite		Orthoclase
Schwertmannite		
Phlogopite		
Chalcopyrite		
Pyrite		

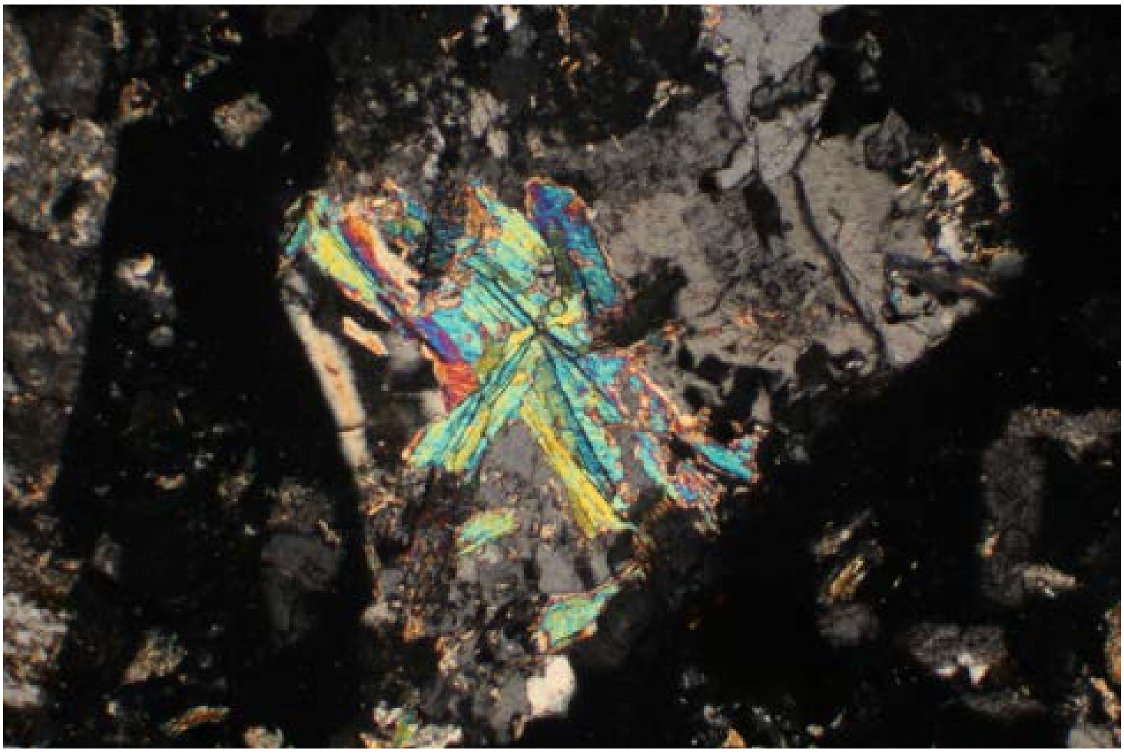

Figure 5-1: Sample SRK 0858 Cross Polarized Image (x5 magnification)

Coarse muscovite grains within a composite particle also consisting of quartz and feldspar.

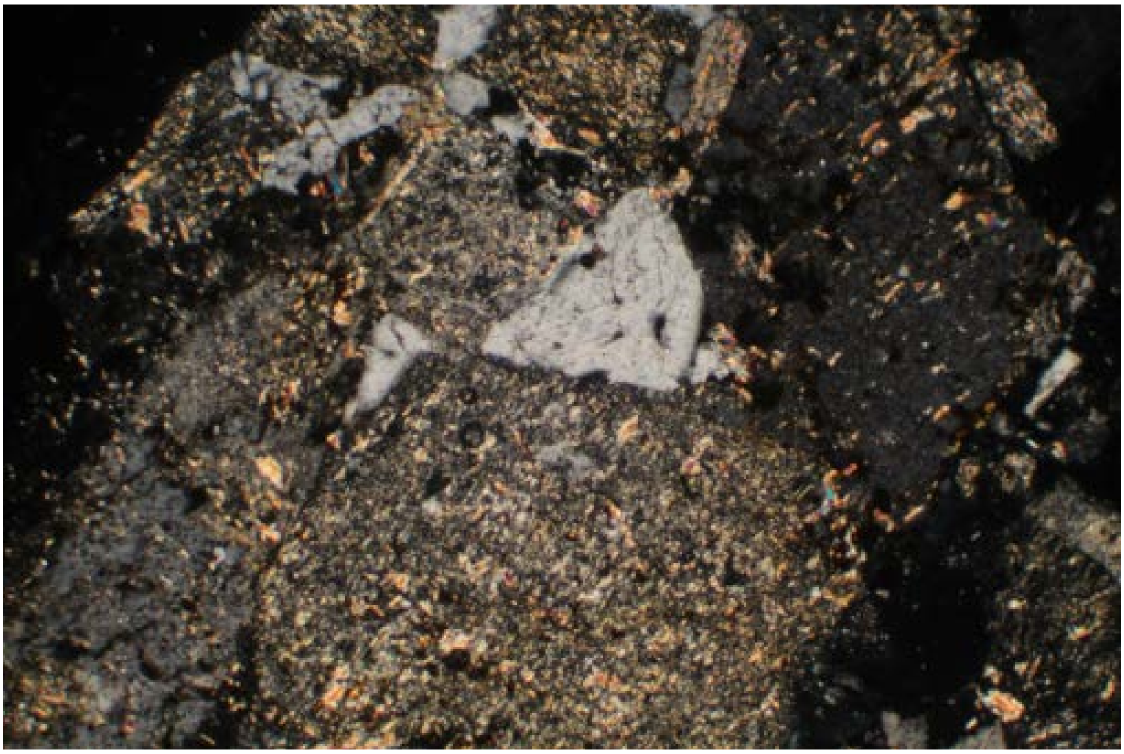

Figure 5-2: Sample SRK 0858 Cross Polarized Image (x5 magnification)

Composite particle of quartz, albite and orthoclase with the feldspar minerals showing pervasive alteration to illite and lesser kaolinite. This degree of alteration was typical across all analysed samples.

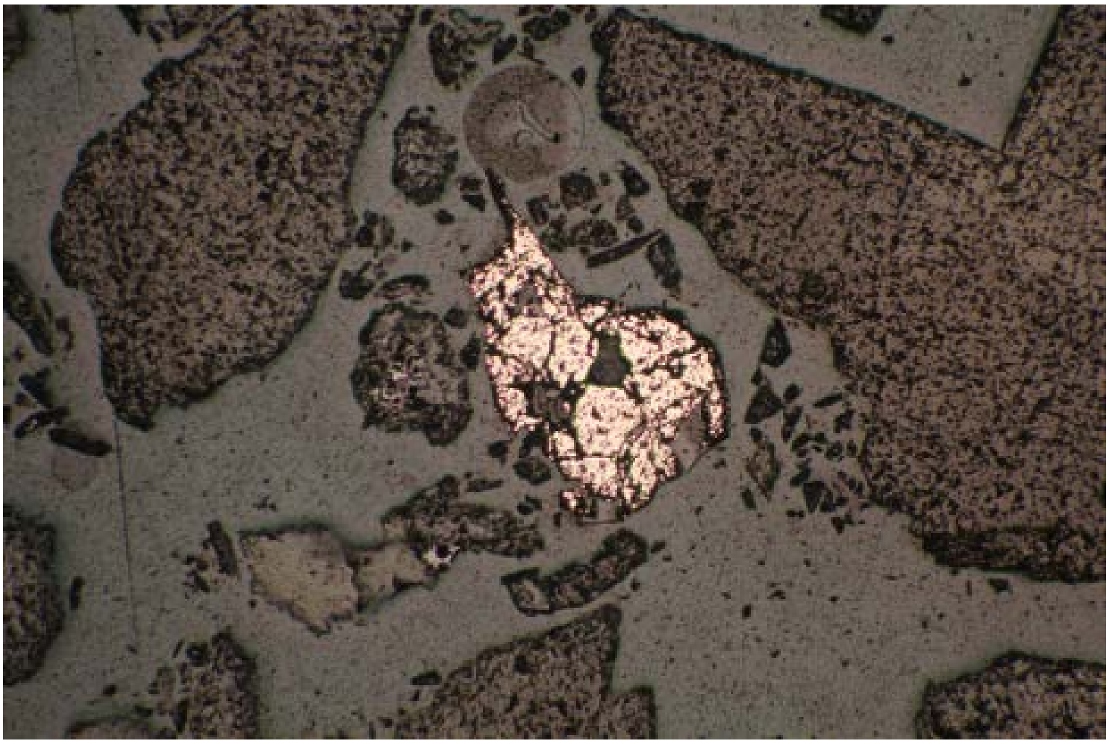

Figure 5-3: Sample SRK 0858 Reflected Light Image (x5 magnification)

Coarse liberated pyrite grain showing a high degree of internal fracturing and granulation.

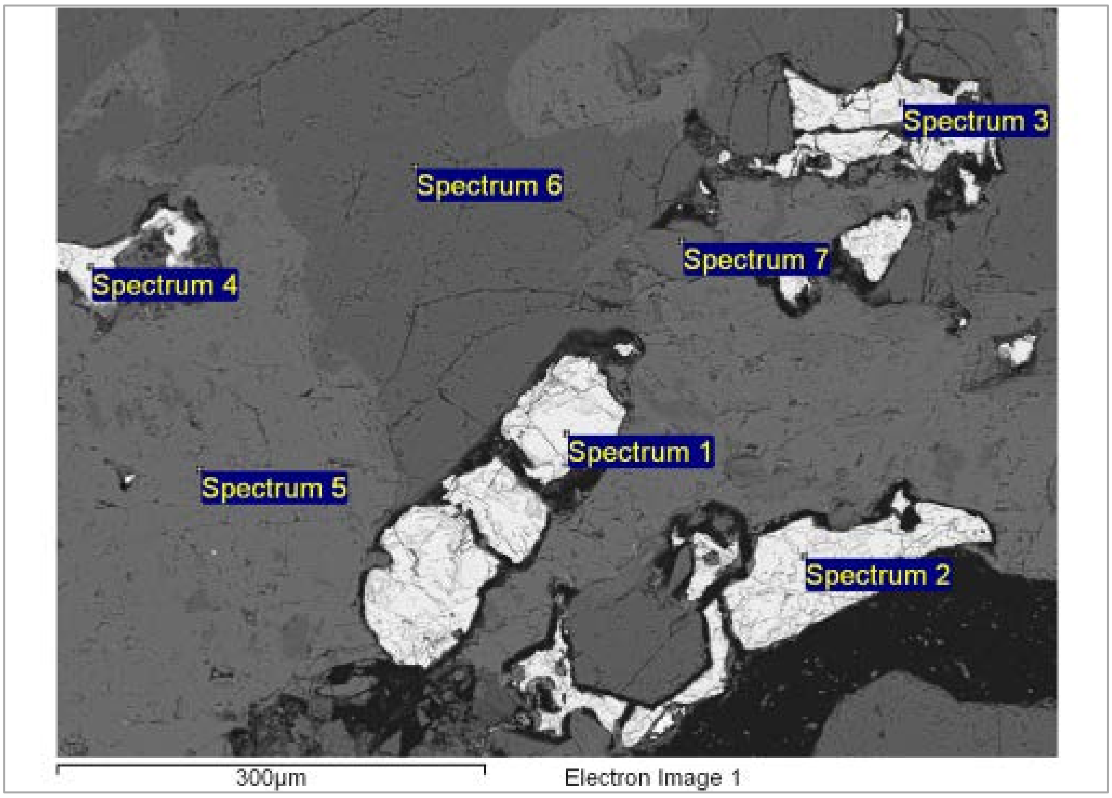

Figure 5-4: Sample SRK 0858 Back Scatter Image

Grains of chalcopyrite (Spectra 1 -4) that are either partially of completely encapsulated within a composite orthoclase-quartz-illite particle (Spectra 5, 6 & 7 respectively).

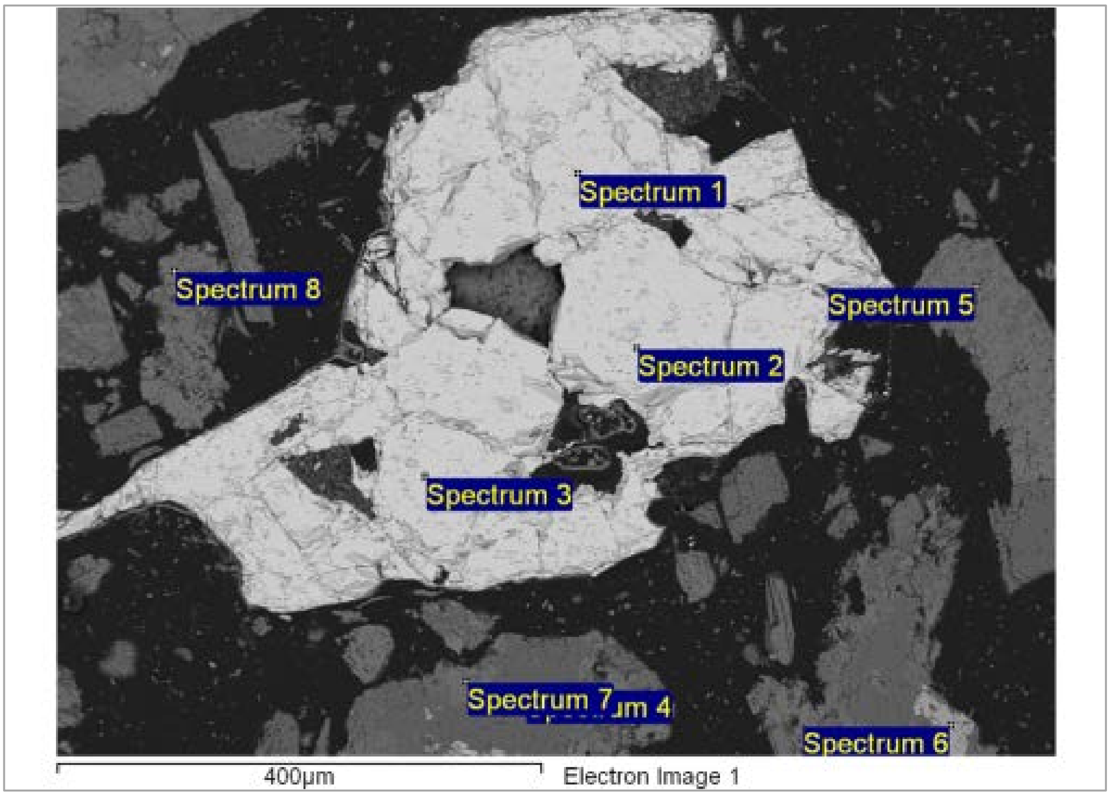

Figure 5-5: Sample SRK 0858 Back Scatter Image

Medium-grained pyrite (Spectra 1 – 3) fragment surrounded by particles of quartz (Spectrum 4), orthoclase (Spectra 5, 7 & 8) and rutile (Spectrum 6). There is little evidence for the formation of Fe-Sulfates along the rim of the particle.

6 SRK0867

This sample represents transitional ore material and predominantly consists of quartz, albite and orthoclase, with these feldspar minerals being considerably altered to illite and kaolinite. It contains 0.77% sulfide sulfur (SRK, 2013) in the form of chalcopyrite and pyrite. Chalcopyrite is usually observed as fine-grained and encapsulated within relatively inert silicate gangue. Pyrite may also be fine-grained and encapsulated but is frequently observed as medium-grained, liberated particles, showing partial fracturing and disaggregation.

Although some sulfide oxidation is observed in this sample, and the presence of jarosite is noted, no acid-generation was apparent. This may be due to the slow weathering rate of the pyrite grains, their equigranular grain shape and the presence of mafic buffering minerals such as phlogopite. Small amounts of calcite (<1% by area) were also observed by SEM within the sample which would provide some buffering potential.

Table 6-1: Table of Minerals Found in Sample SRK 0867 and Their Abundance

Trace Minerals (≤1%)	Minor Minerals (1%–10%)	Major Minerals (10% <)
Thorite	Kaolinite	Quartz
Titanite		Albite
Phlogopite		Orthoclase
Monazite		Illite
Jarosite		
Calcite		
Chalcopyrite		
Pyrite		

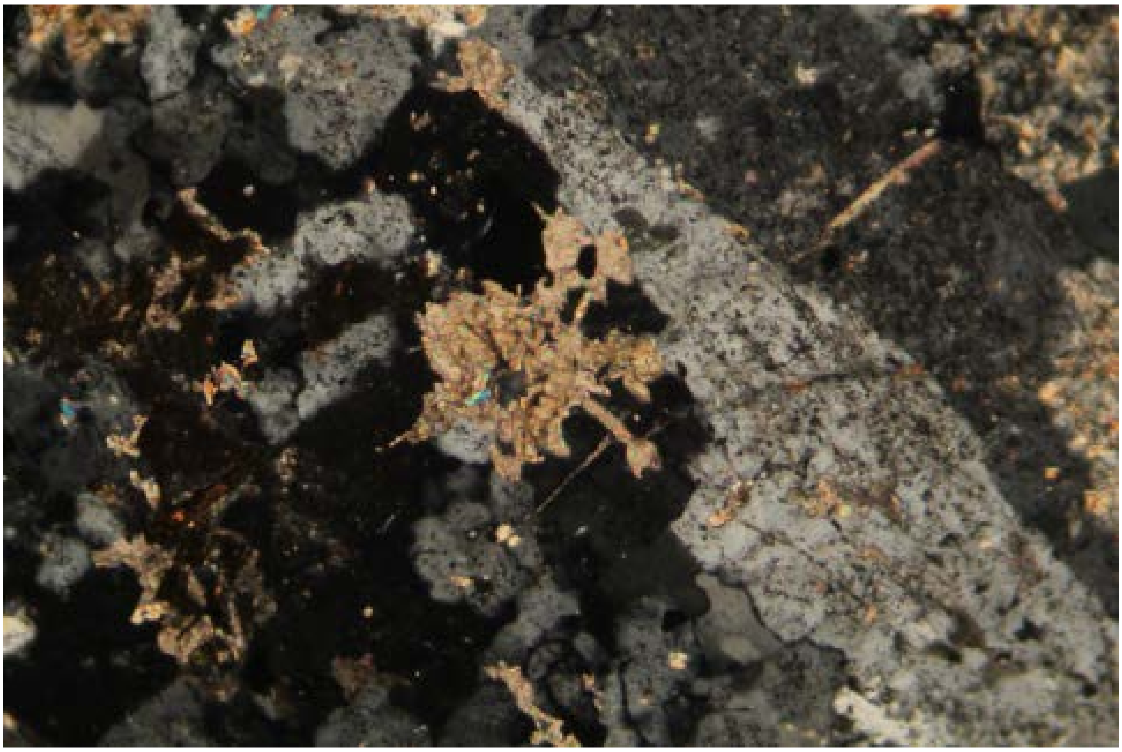

Figure 6-1: Sample SRK 0867 Cross Polarized Image (x10 magnification)

Fine-grained calcite included within a composite particle of quartz and feldspar

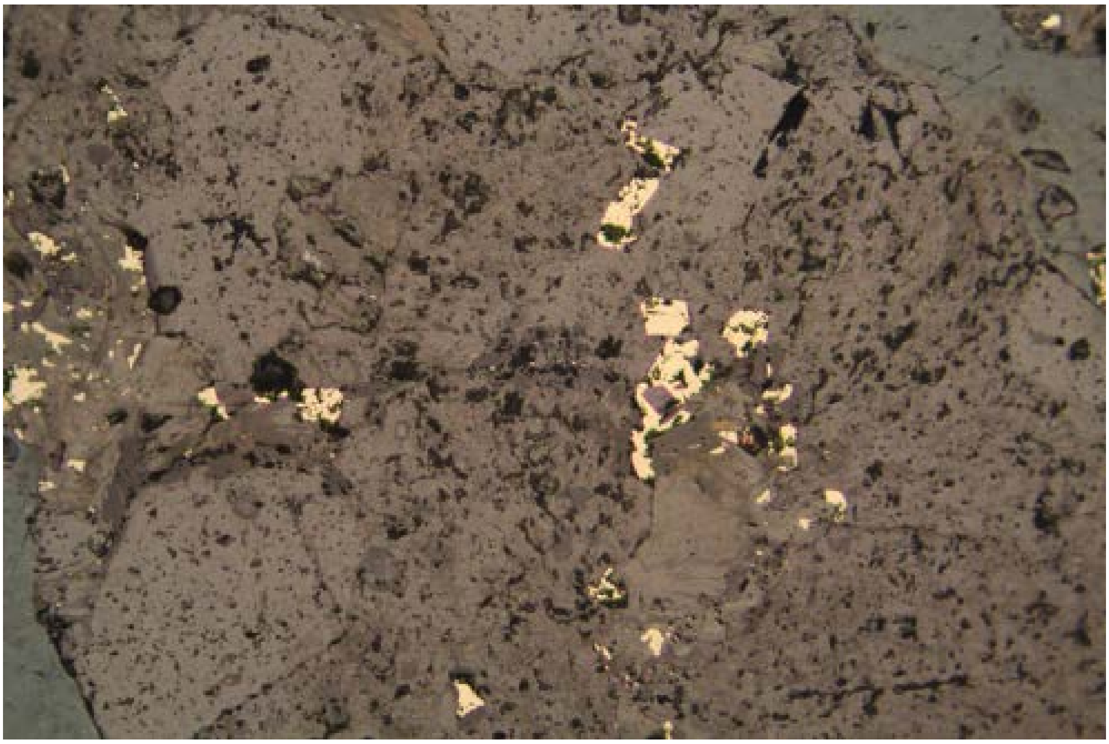

Figure 6-2: Sample SRK 0867 Cross Polarized Image (x5 magnification)

Fine-grained chalcopyrite encapsulated within a composite quartz-feldspar particle.

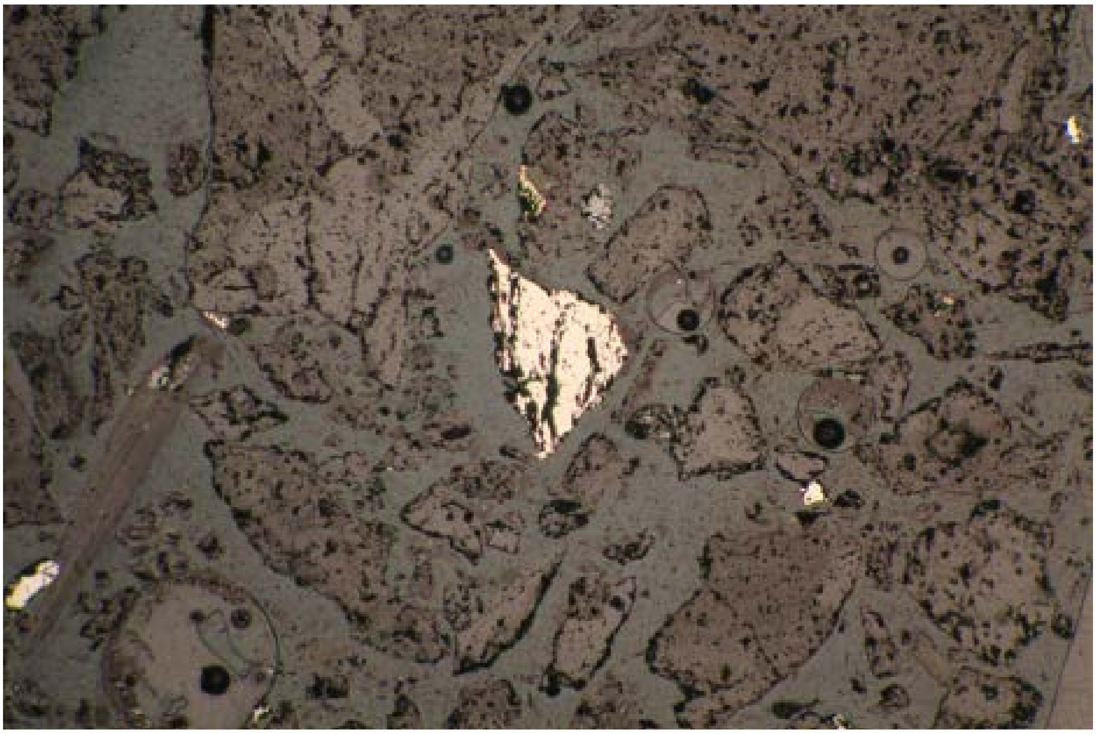

Figure 6-3: Sample SRK 0867 Reflected Light Image (x5 magnification)

Large liberated pyrite grain with internal fracturing.

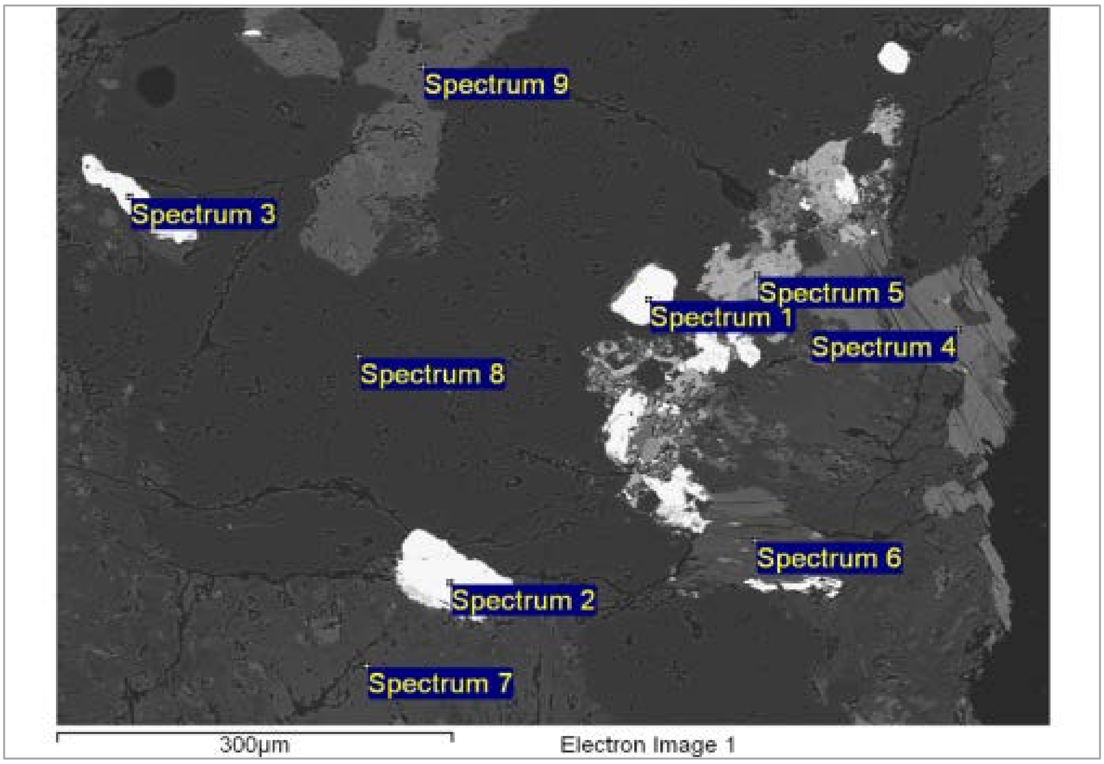

Figure 6-4: Sample SRK 0867 Back Scatter Image

Small grains of pyrite (Spectra 1 & 3), and thorite (Spectrum 3) encapsulated within a composite particle that consists of phlogopite (Spectrum 4), rutile (Spectrum 5), illite (Spectrum 6), albite (Spectrum 7), quartz (Spectrum 8) and orthoclase (Spectrum 9).

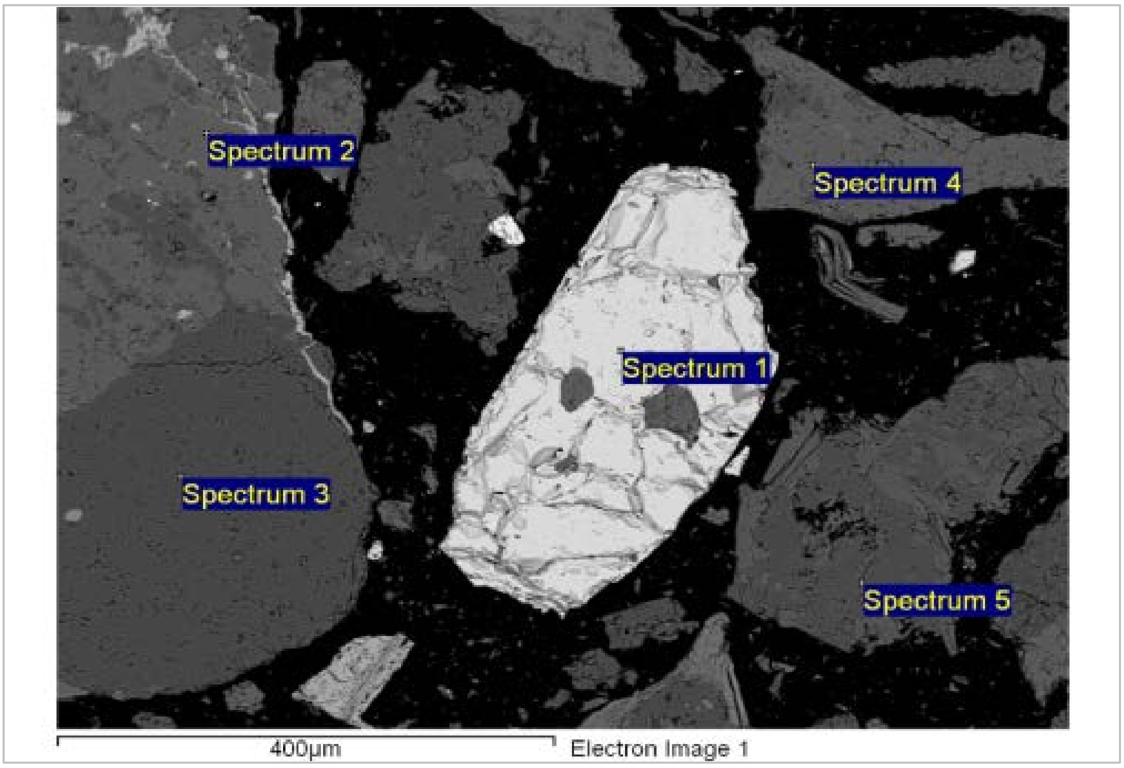

Figure 6-5: Sample SRK 0867 Back Scatter Image

Medium-grained liberated pyrite (Spectrum 1) with inclusions of quartz. This is surrounded by particles fo orthoclase (Spectra 2 & 4), quartz (Spectrum 3) and albite (Spectrum 5).

7 SRK0872

This sample is of transitional waste material and predominantly consists of quartz, albite and orthoclase, with the latter feldspar minerals being considerably altered to illite and kaolinite. It contains about 1.05% sulfide sulfur (SRK, 2013) which is deported as the minerals chalcopyrite and pyrite. Chalcopyrite is usually observed as fine-grained and encapsulated within relatively inert silicate gangue. Pyrite may also be fine-grained and encapsulated but is frequently observed as medium-grained, liberated particles, showing partial fracturing and disaggregation.

Although some sulfide oxidation is observed in this sample no acid-generation was apparent during the HCT. This may be due to the slow weathering rate of the pyrite grains, their equigranular grain shape and the presence of mafic buffering minerals such as phlogopite and clinochlore. In one instance titanite is observed as inclusions within pyrite and is itself weathering quicker than the pyrite. This means it is acting as a sacrificial anode, actively inhibiting the rate of pyrite oxidation. This may also be occurring in the previous sample where titanite was observed, though not immediately in association with pyrite.

Table 7-1: Table of Minerals Found in Sample SRK 0872 and Their Abundance

Trace Minerals (≤1%)	Minor Minerals (1%–10%)	Major Minerals (10% <)
Titanite	Kaolinite	Quartz
Magnetite		Albite
Clinochlore		Orthoclase
Phlogopite		Illite
Fluorapatite		
Schwertmannite		
Baryte		
Chalcopyrite		
Pyrite		

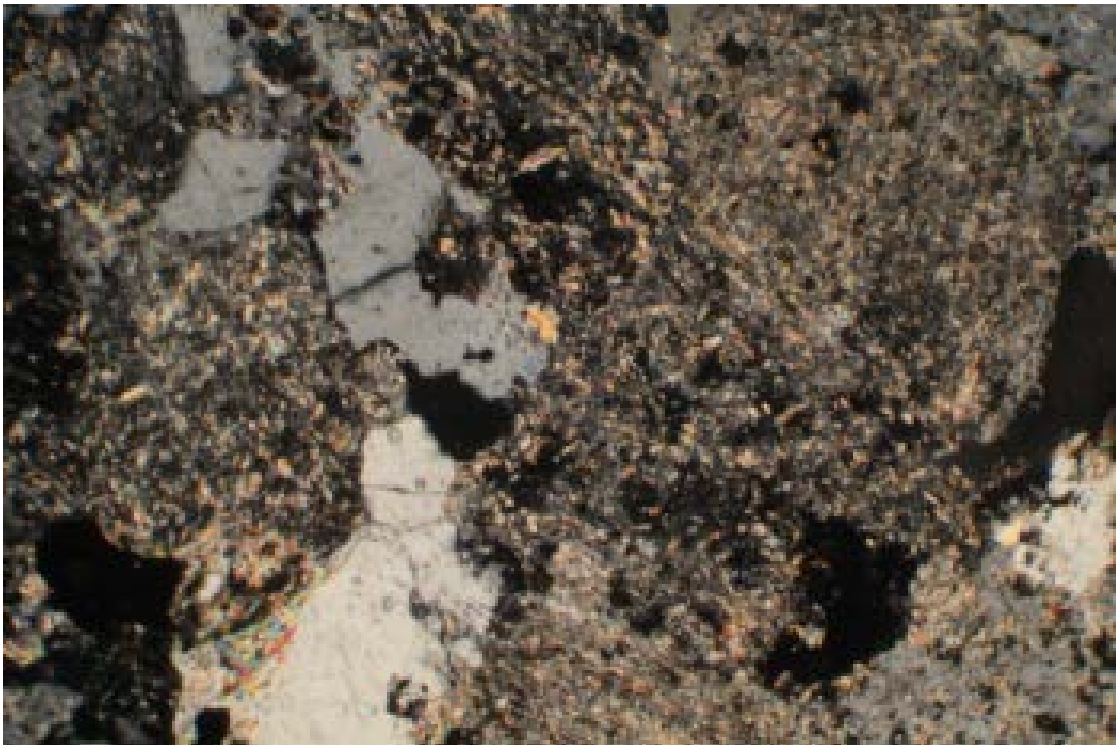

Figure 7-1: Sample SRK 0872 Plane Polarized Image (x5 magnification)

Highly altered quartz-feldspar composite typical of the dominant silicate mineralogy observed throughout the slides. The feldspar grains (albite and orthoclase) show predominant breakdown to illite with subordinate kaolinite formation.

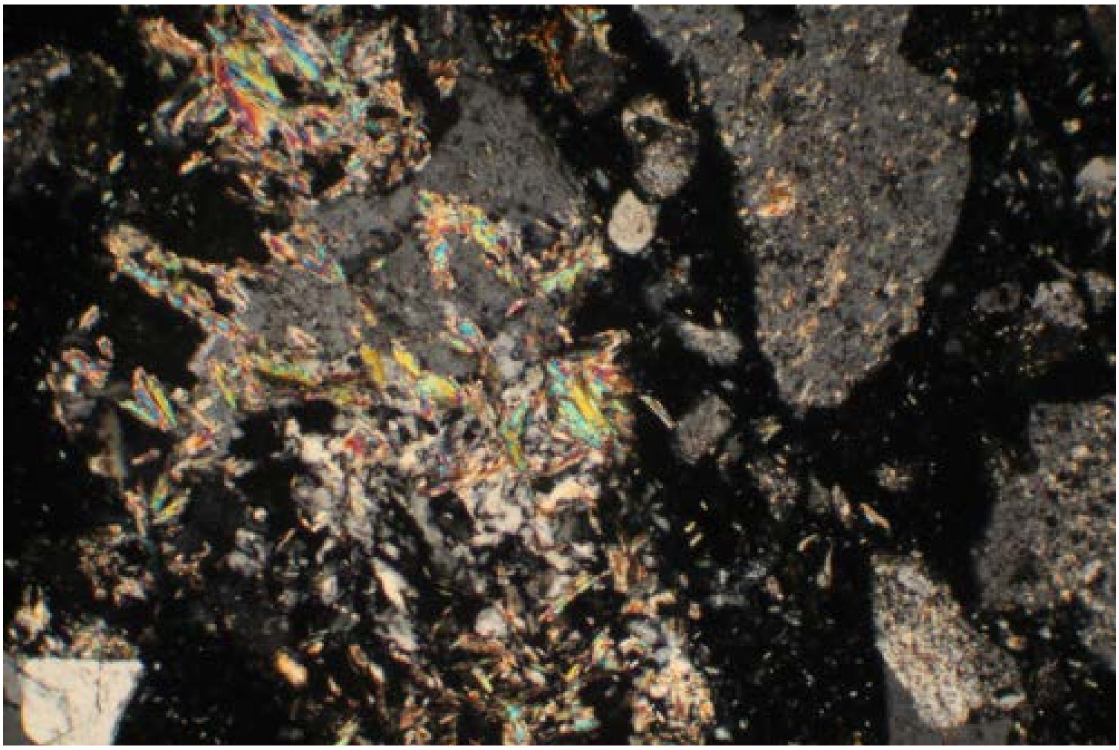

Figure 7-2: Sample SRK 0872 Cross Polarized Image (x5 magnification)

Multiple grains of fine illite to muscovite within quartz-feldspar dominant particles

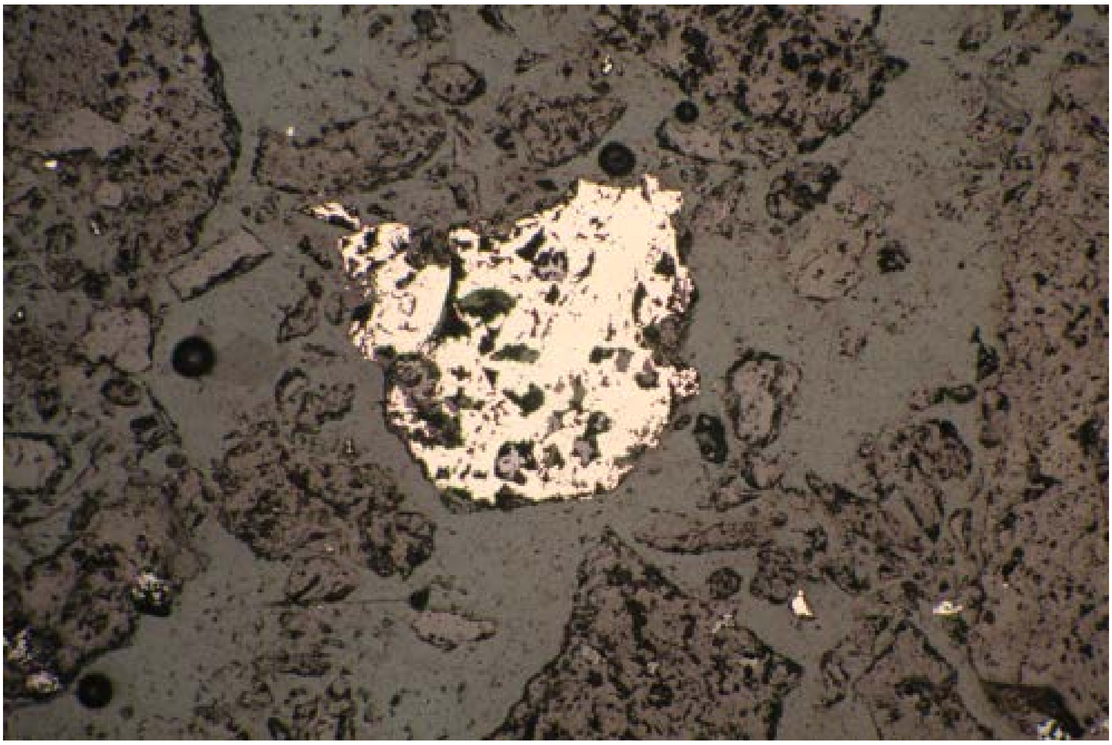

Figure 7-3: Sample SRK 0872 Reflected Light Image (x5 magnification)

Large liberated pyrite grain with internal fracturing.

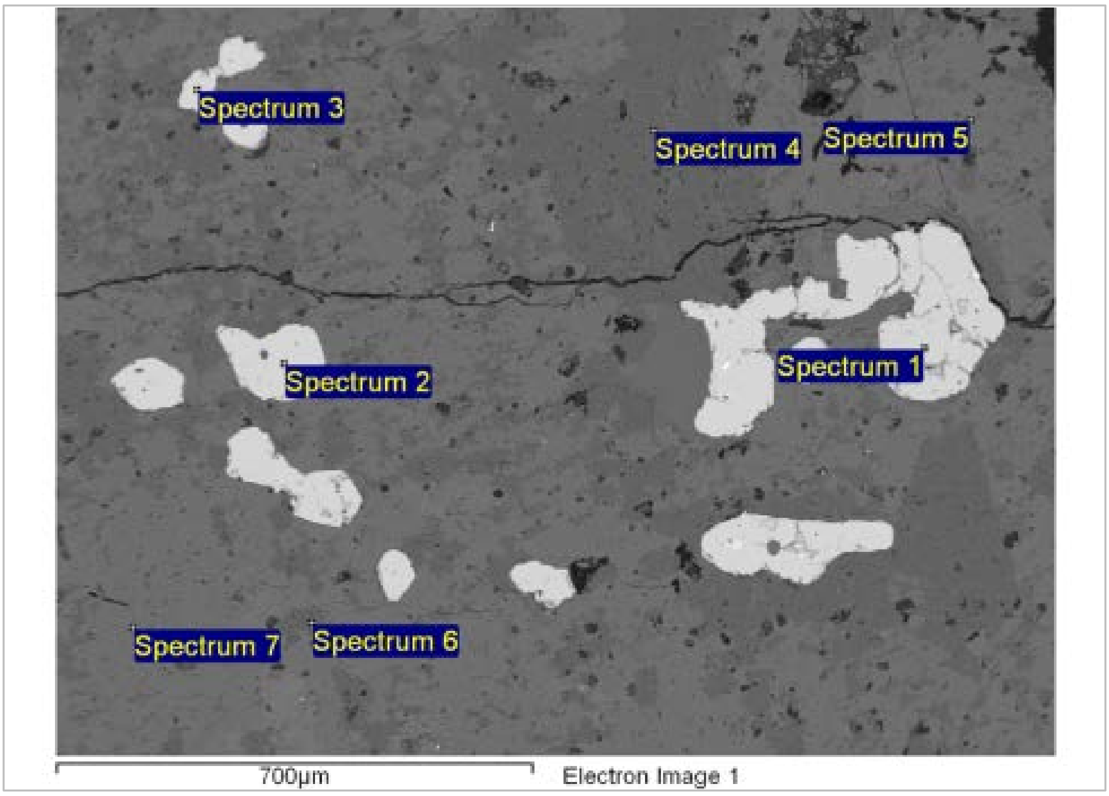

Figure 7-4: Sample SRK 0872 Back Scatter Image

Fine to medium-grained pyrite particles (Spectra 1 – 3) included within a composite particle that consists of albite (Spectra 4 & 5), orthoclase (Spectrum 6) and orthoclase (Spectrum 7).

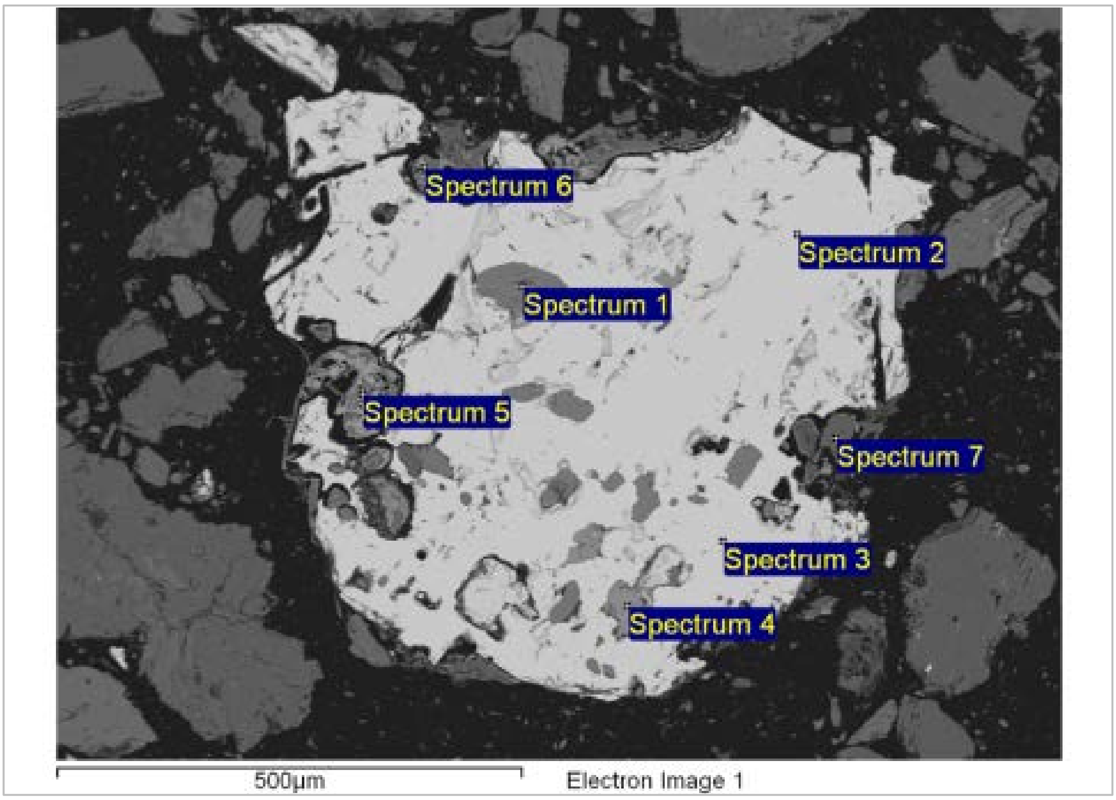

Figure 7-5: Sample SRK 0872 Back Scatter Image

SEM image of the medium-grained pyrite (Spectra 2 & 3) in Figure 7-3. This contains inclusions of phlogopite (Spectrum 1) and titanite (Spectrum 4). Spectra 5 & 6 are of titanite that is progressively braking down to rutile and kaolinite. Spectrum 7 is albite. In this instance the titanite is weathering faster than the pyrite, thereby acting as a sacrificial anode and inhibiting the rate of pyrite oxidation

8 604673

This sample is of sulfide waste material and predominantly consists of quartz, albite and orthoclase, with the latter feldspar minerals having been considerably altered to illite and kaolinite. It contains about 0.4% sulfide sulfur in the form of chalcopyrite, molybdenite and pyrite. Chalcopyrite is usually observed as fine-grained and encapsulated within relatively inert silicate gangue. Pyrite may also be fine-grained and encapsulated but is frequently observed as medium-grained, liberated particles, showing partial fracturing and disaggregation.

Breakdown of sulfide grains was observed in this sample, with brown sulfate phases being present around the edges of some of the sulfide grains. The iron-sulfate minerals were identified as schwertmannite on the basis of SEM identification of a low sulfur to iron ratio. This is indicative of sulfide oxidation in this cell and is supported by the moderately acidic pH conditions (pH 5) that developed in this cell during the HCT. The rate of sulfide oxidation must have been sufficient to overcome any inherent buffering from the mafic gangue mineral clinochlore.

Table 8-1: Table of Minerals Found in Sample 604673 and Their Abundance

Trace Minerals (≤1%)	Minor Minerals (1%–10%)	Major Minerals (10% <)
Rutile	Illite	Quartz
Chalcopyrite	Clinochlore	Albite
Molybdenite		Orthoclase
Pyrite		
Schwertmannite		

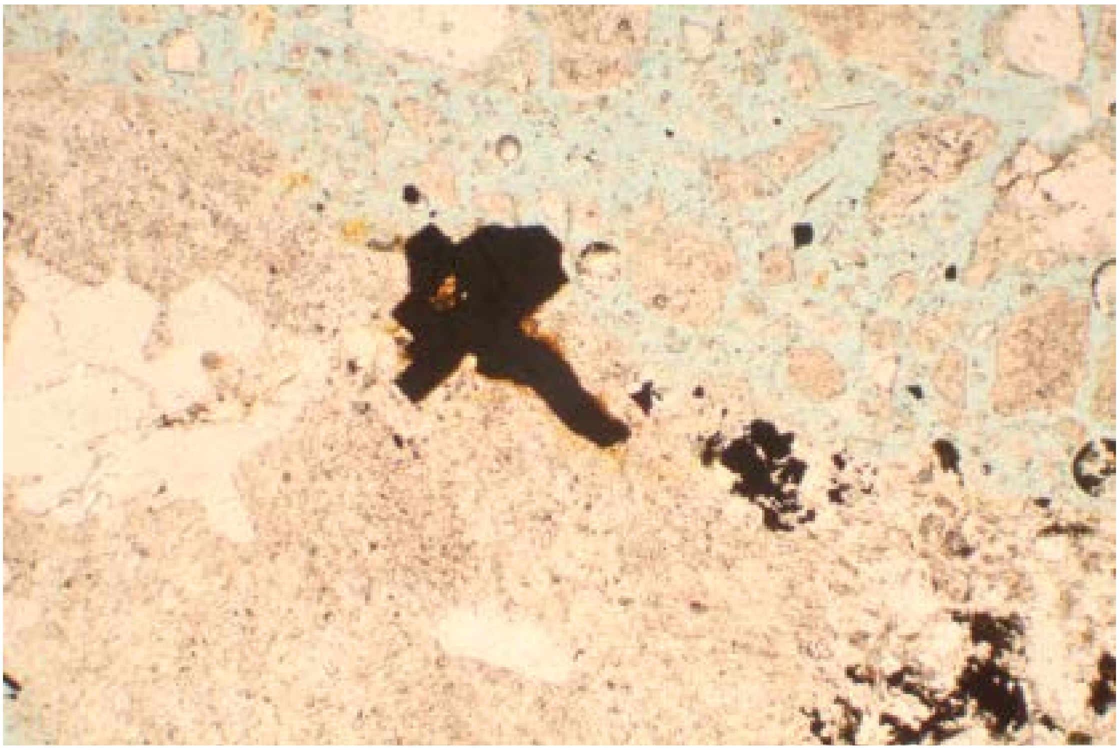

Figure 8-1: Sample 604673 Plane Polarized Image (x5 magnification)

Medium-grained pyrite grain showing partial alteration to sulfates, most likely jarosite, along the rim. This is included within a quartz-feldspar composite, where the feldspar grains show considerable alteration to illite and kaolinite.

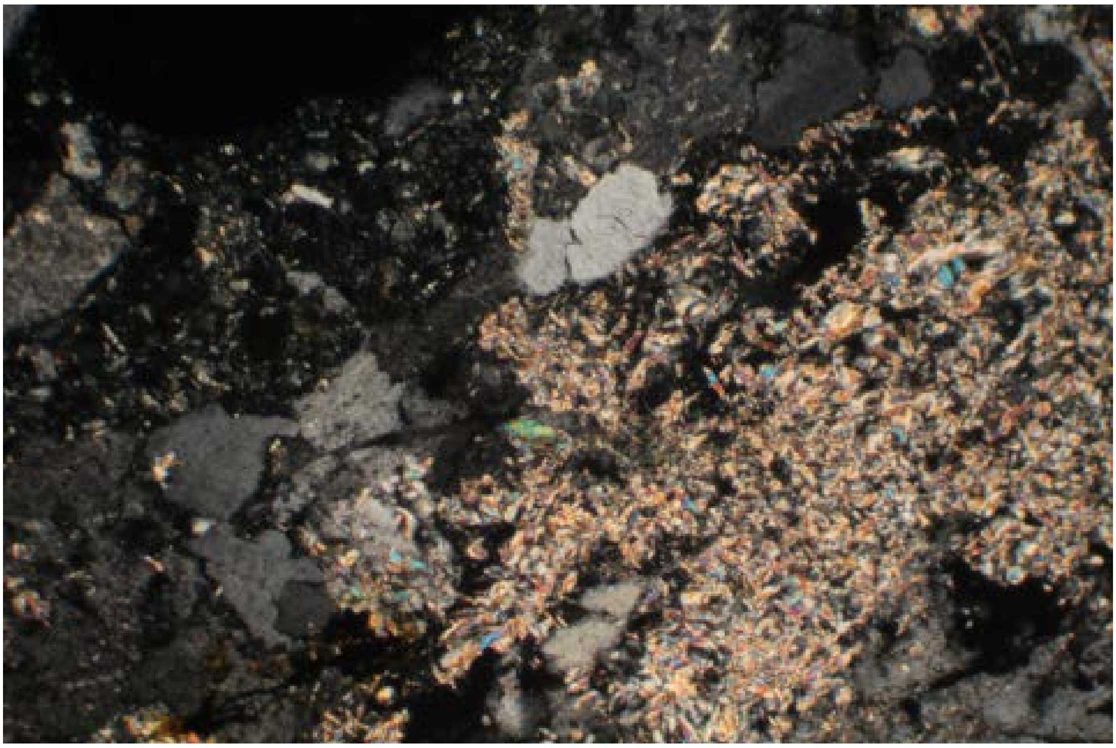

Figure 8-2: Sample 604673 Cross Polarized Image (x5 magnification)

Good example of the alteration of feldspar (albite and orthoclase) to fine-grained illite and kaolinite. This texture is typical of feldspar alteration throughout the sample.

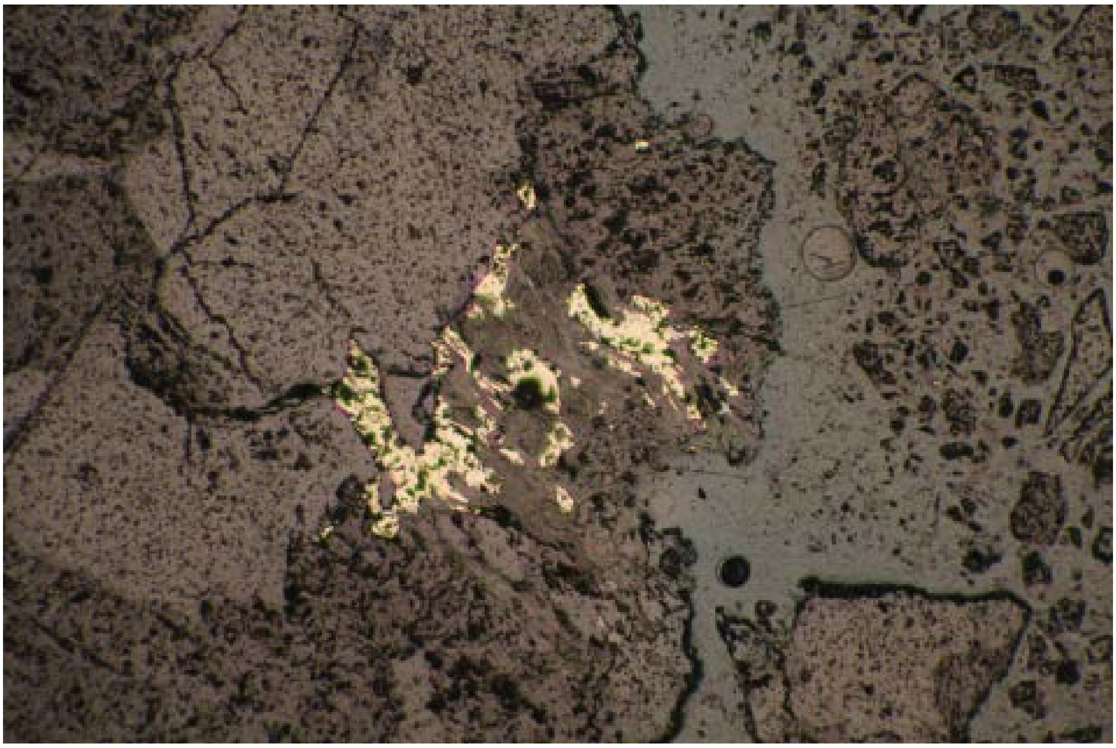

Figure 8-3: Sample 604673 Reflected Light Image (x5 magnification)

Very fine-grained chalcopyrite included within quartz-feldspar grains. This is typical of much of the copper-sulfide mineralisation within this sample.

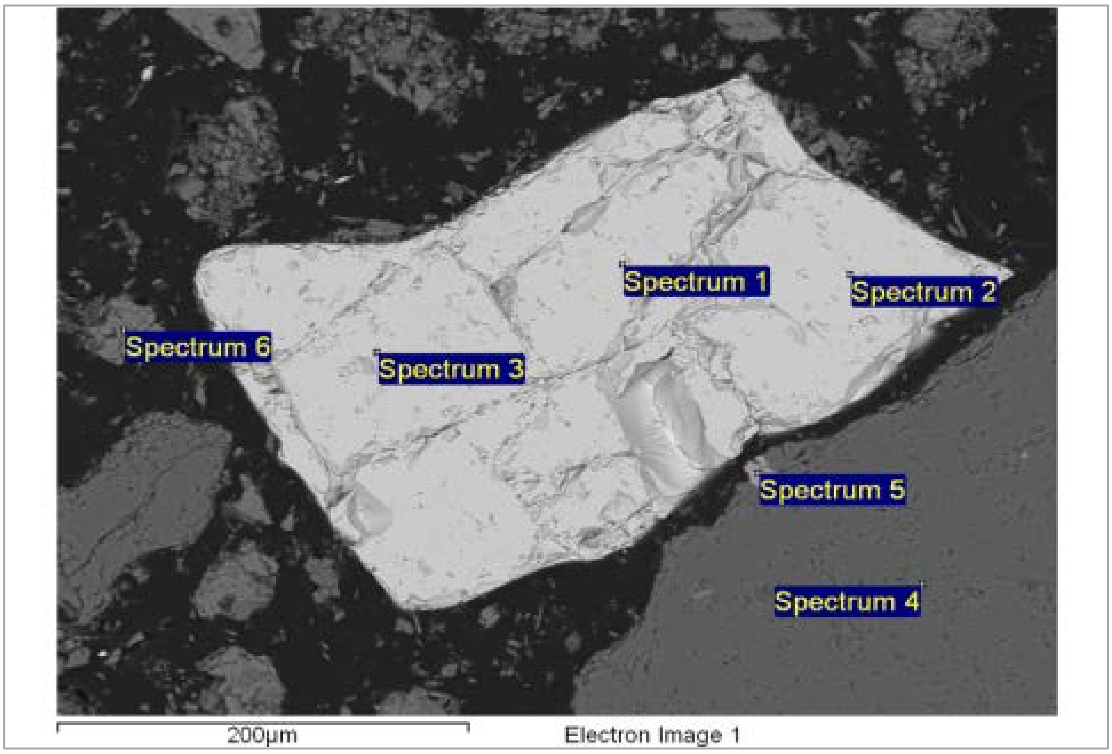

Figure 8-4: **Sample 604673 Back Scatter Image**

Fully liberated medium-grained pyrite (Spectra 1 – 3) showing internal fracturing but no discernible breakdown to iron-sulfate minerals such as schwertmannite. This is surrounded by particles of quartz (Spectrum 4), rutile (Spectrum 5) and orthoclase (Spectrum 6).

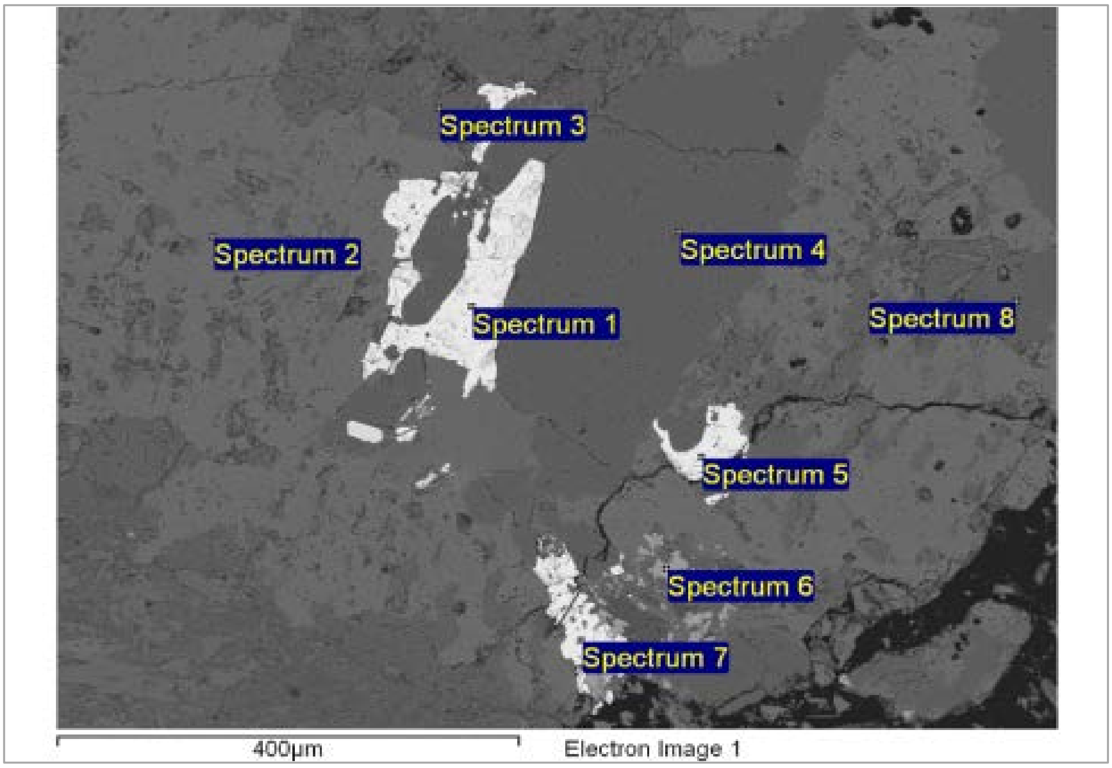

Figure 8-5: **Sample 604673 Back Scatter Image**

Fine-grained inclusions of chalcopyrite (Spectra 1, 5 ,6 & 7) within a composite grain that consists of orthoclase (Spectrum 2), albite (Spectrum 3) and quartz (Spectra 4 & 8).

9 604767

This sample is of sulfide ore material and predominantly consists of quartz, albite and orthoclase, with the feldspar minerals having been considerably altered to illite and kaolinite. It contains 2.13% sulfide sulfur (SRK, 2013) in the form of chalcopyrite, galena, molybdenite and pyrite. Chalcopyrite is usually observed as fine-grained and encapsulated minerals. Pyrite may also be fine-grained and encapsulated but is frequently observed as medium-grained, liberated particles, showing partial fracturing and disaggregation.

Some of the pyrite grains in this sample show increased levels of fracturing (Figure 9-2), which is consistent with longer exposure to weathering during the extended 86 weeks of humidity cell testing. However, despite this there is limited evidence for sulfate formation which is consistent with the lack of acid-generation. This may be due to the slow weathering rate of the pyrite grains and their equigranular grain shape.

Table 9-1: Table of Minerals Found in Sample 604767 and Their Abundance

Trace Minerals (≤1%)	Minor Minerals (1%–10%)	Major Minerals (10% <)
Fluorapatite	Kaolinite	Quartz
Fluorite		Albite
Rutile		Orthoclase
Baryte		Illite
Ankerite		
Chalcopyrite		
Galena		
Molybdenite		
Pyrite		
Clinochlore		
Phlogopite		

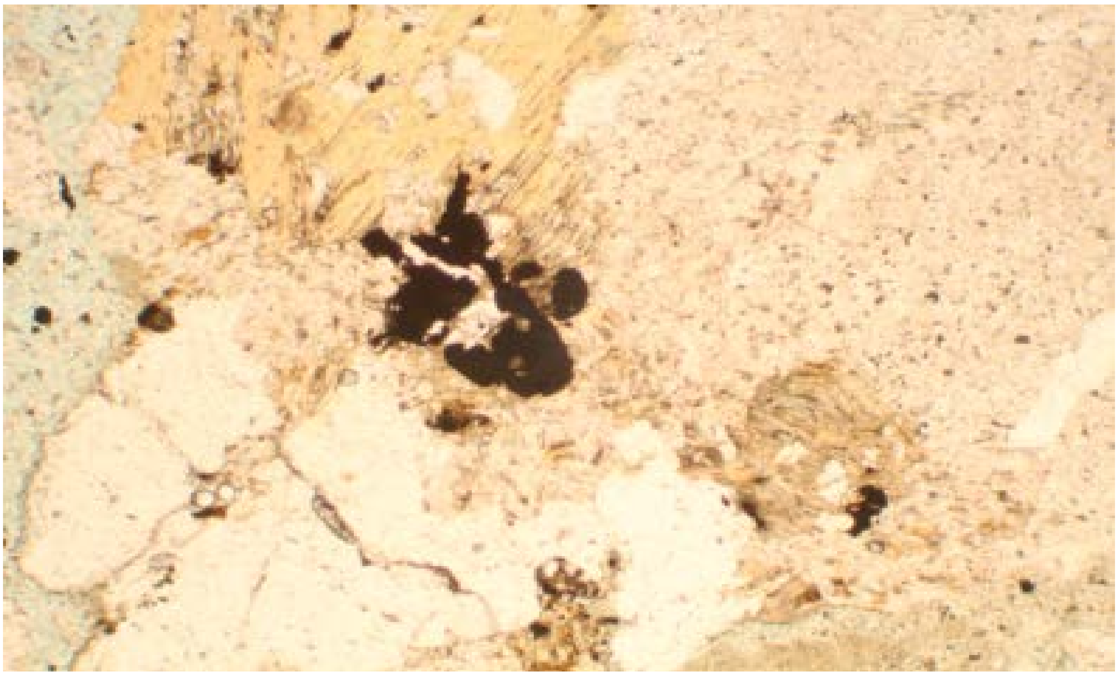

Figure 9-1: Sample 604767 Plane Polarized Image (x5 magnification)

Large opaque sulfide grain nearly fully encapsulated within a composite particle which consists of quartz, altered feldspar and phlogopite.

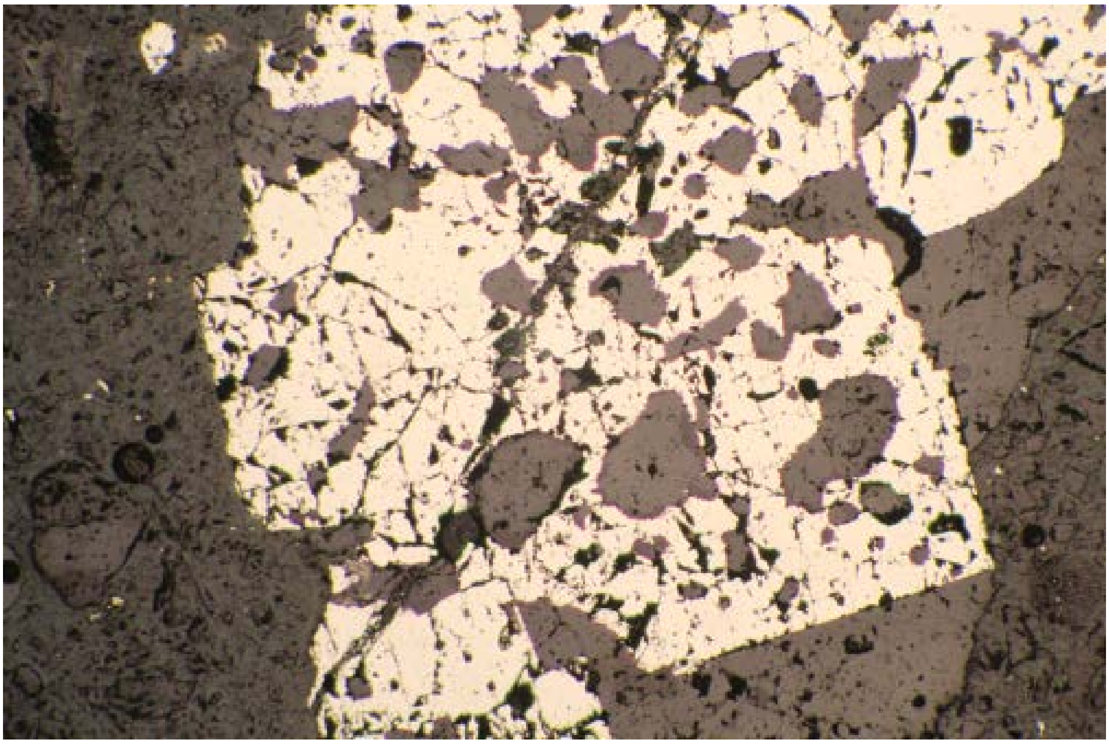

Figure 9-2: Sample 604767 Cross Polarized Image (x5 magnification)

Large poikiolitic pyrite grain with good liberation along most of the left hand rim. This also shows increased fracturing consistent with longer exposure to weathering during the humidity cell testing.

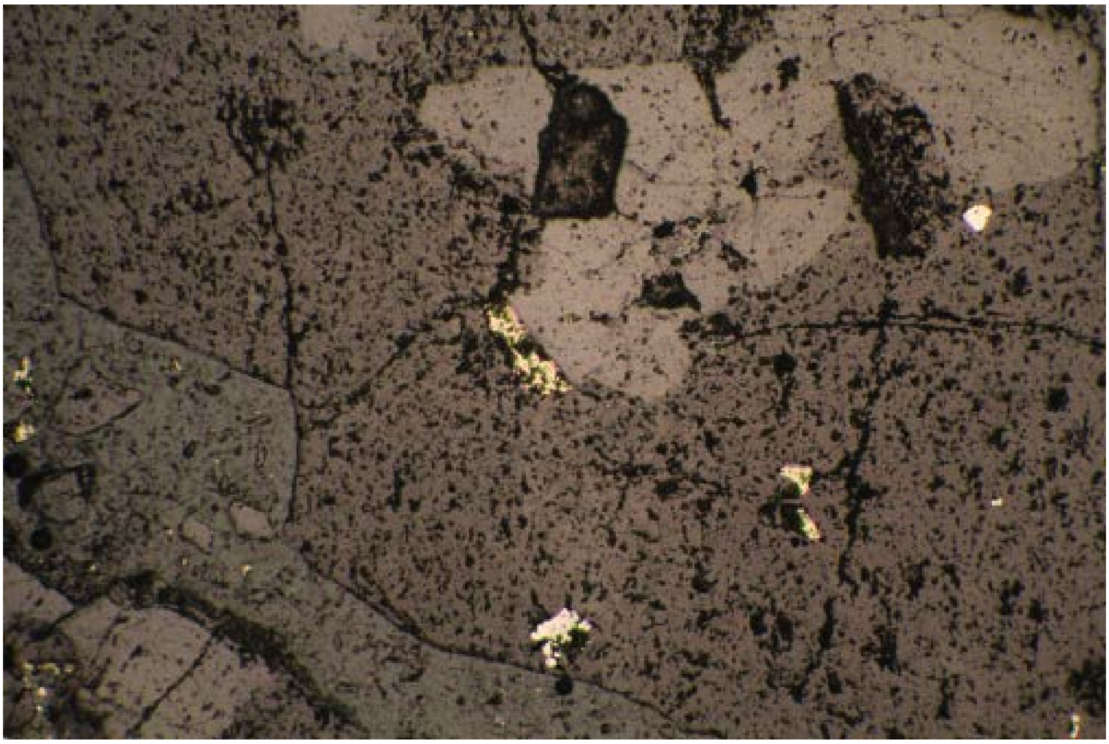

Figure 9-3: Sample 604767 Reflected Light Image (x5 magnification)

Inclusions of fine-grained sulfides with quartz-feldspar composite particles. In the centre of the field of view is a fully encapsulated chalcopyrite grain whilst to the right and below this grain are inclusions of pyrite.

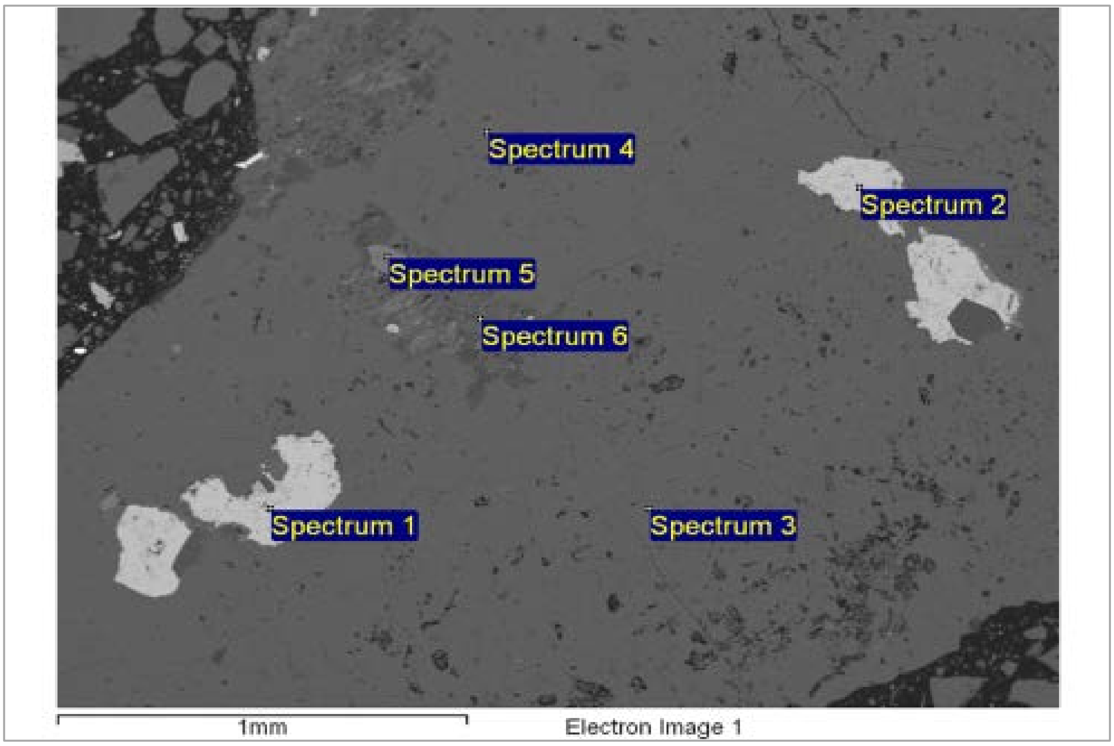

Figure 9-4: Sample 604767 Back Scatter Image

Fine-grained chalcopyrite (Spectra 1 & 2) within a composite grain that consists of orthoclase (Spectra 3 & 4), fluorapatite (Spectrum 5) and ankerite (Spectrum 6).

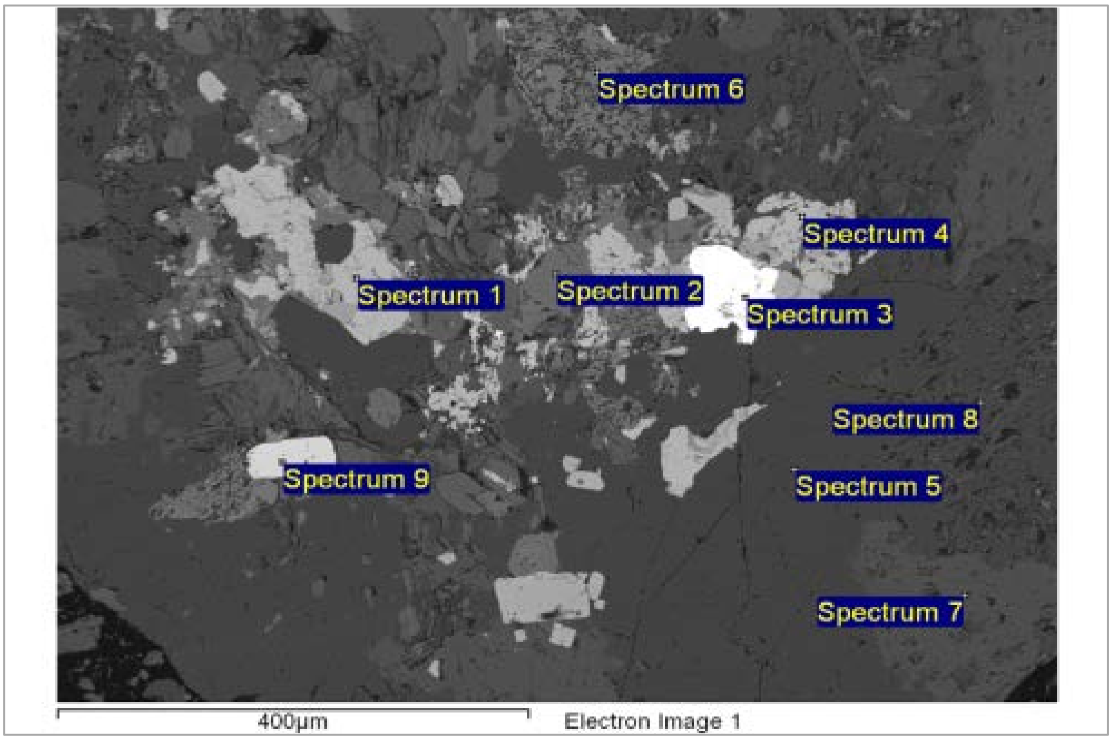

Figure 9-5: Sample 604767 Back Scatter Image

Complex composite grain containing encapsulated chalcopyrite (Spectra 1 & 4), thorite

(Spectrum 3) and molybdenite (Spectrum 9). Associated with these grains are fluorapatite (Spectrum 2) and rutile (Spectrum 6). The main minerals within the composite are quartz (Spectrum 5), orthoclase (Spectrum 7) and illite (Spectrum 8).

10 CF-11-02 (0-27FT) POST-LEACH

This sample represents transitional waste material and predominantly consists of quartz, albite and orthoclase, with the feldspar minerals having been considerably altered to illite. It contains 1.4% sulfide sulfur (SRK, 2013) in the form of chalcopyrite, covellite and pyrite. Chalcopyrite is usually observed as fine-grained and encapsulated minerals. Pyrite may also be fine-grained and encapsulated but is frequently observed as medium-grained, liberated particles, showing partial fracturing and disaggregation.

Small amounts of calcite (<1% by area) were observed by SEM within the sample. This cell still had greater than 90% of this calcite buffering potential remaining after 60 weeks of testing, indicating that the rate of calcite dissolution is very slow. Some sulfide oxidation is observed in this sample, and the presence of schwertmannite is noted, however no acid-generation was apparent. This may be due to the slow weathering rate of the pyrite grains, their equigranular grain shape and the presence of acid-buffering minerals such as calcite, phlogopite and clinochlore.

Table 10-1: Table of Minerals Found in Sample CF-11-02 (0-27ft) Post-Leach and Their Abundance

Trace Minerals (≤1%)	Minor Minerals (1%–10%)	Major Minerals (10% <)
Zircon	Clinochlore	Quartz
Rutile		Albite
Fluorapatite		Orthoclase
Calcite		Illite
Covellite		
Chalcopyrite		
Pyrite		
Schwertmannite		

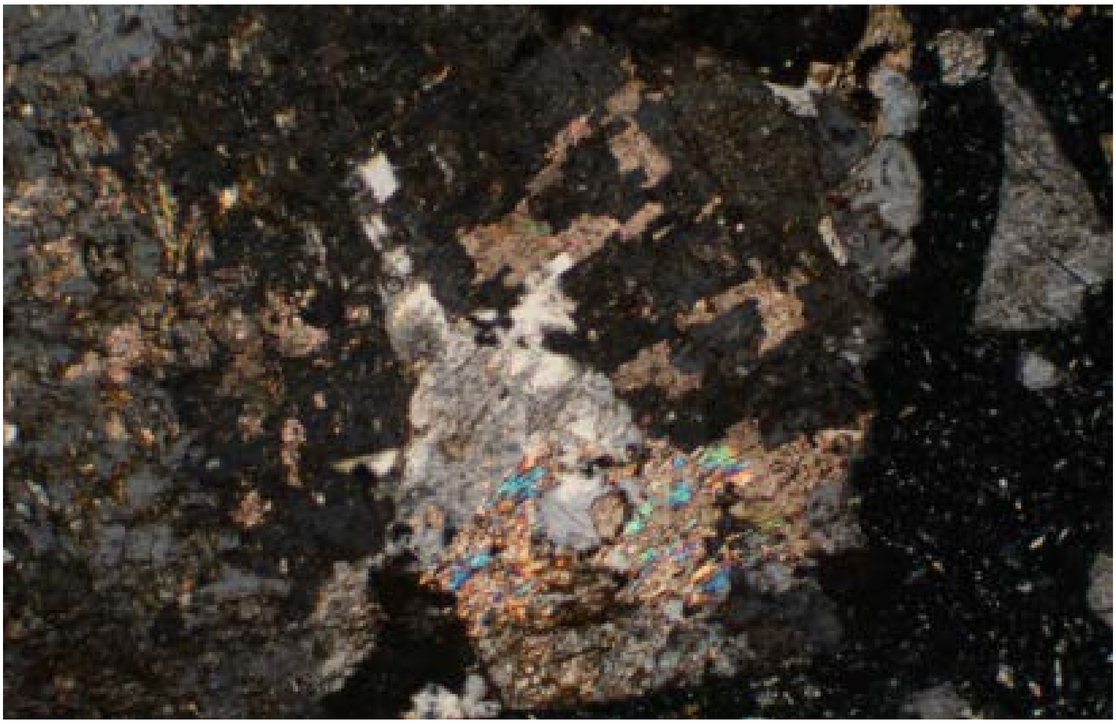

Figure 10-1: Sample CF-11-02 (0-27) Post-Leach Cross Polarized Image (x5 magnification)

Large quartz-feldspar composite with the feldspar showing partial alteration to illite and subordinate kaolinite. Along with the illite is some fine-grained calcite which is also located interstitially to the quartz and feldspar grains.

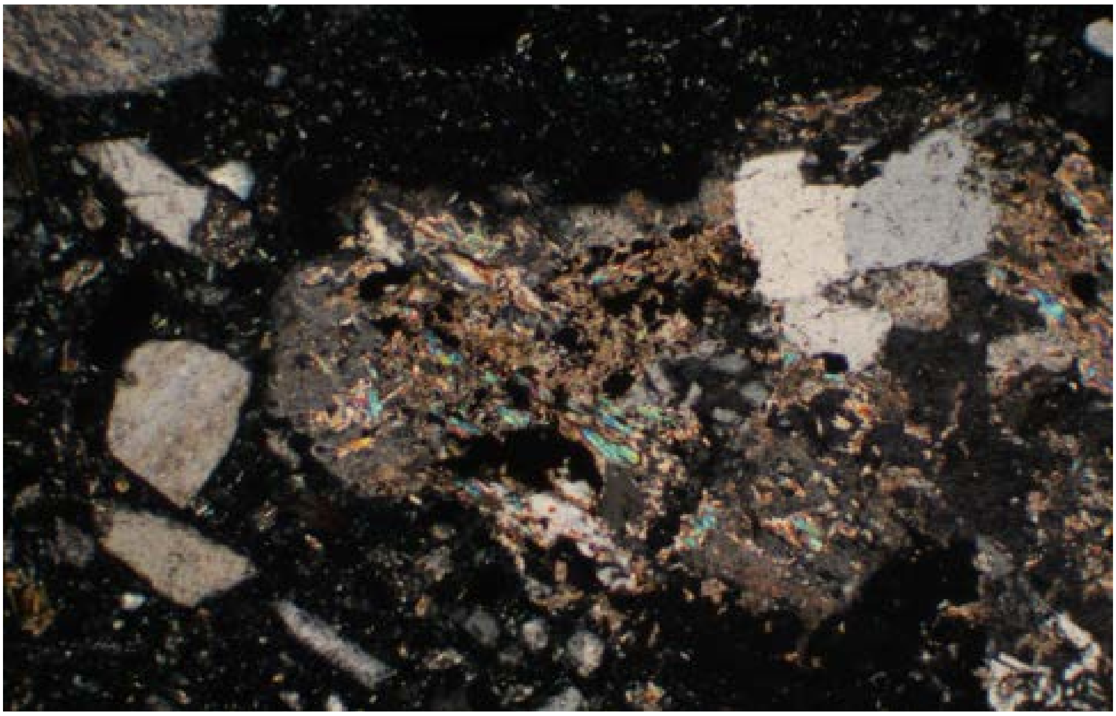

Figure 10-2: Sample CF-11-02 (0-27) Post-Leach Cross Polarized Image (x5 magnification)

Composite particle consisting of quartz and feldspar with partial alteration of the latter to illite. In the centre of the particle are encapsulated opaque sulfide grains partially surrounded by fine-grained calcite.

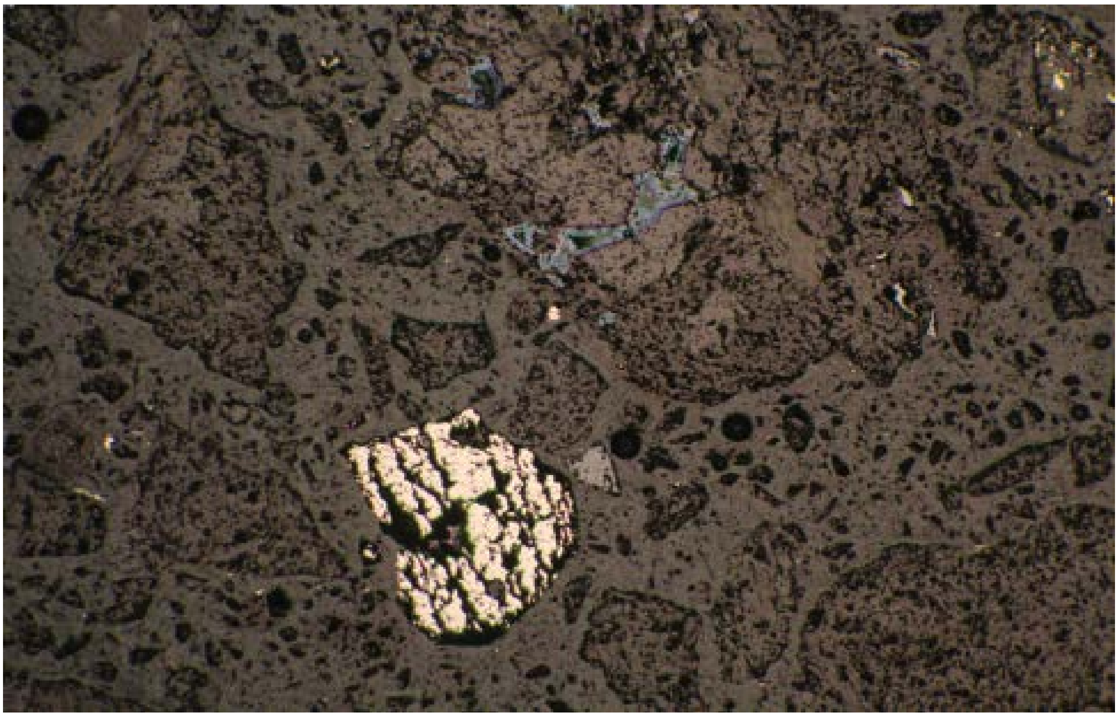

Figure 10-3: Sample CF-11-02 (0-27) Post-Leach Reflected Light Image (x5 magnification)

Coarse pyrite grain in the lower portion of the field of view. This is a fully liberated grain with considerable internal fracturing. To the top of the field of view are some blue copper sulfide minerals (covellite) which are predominantly encapsulated within a quartz-feldspar grain.

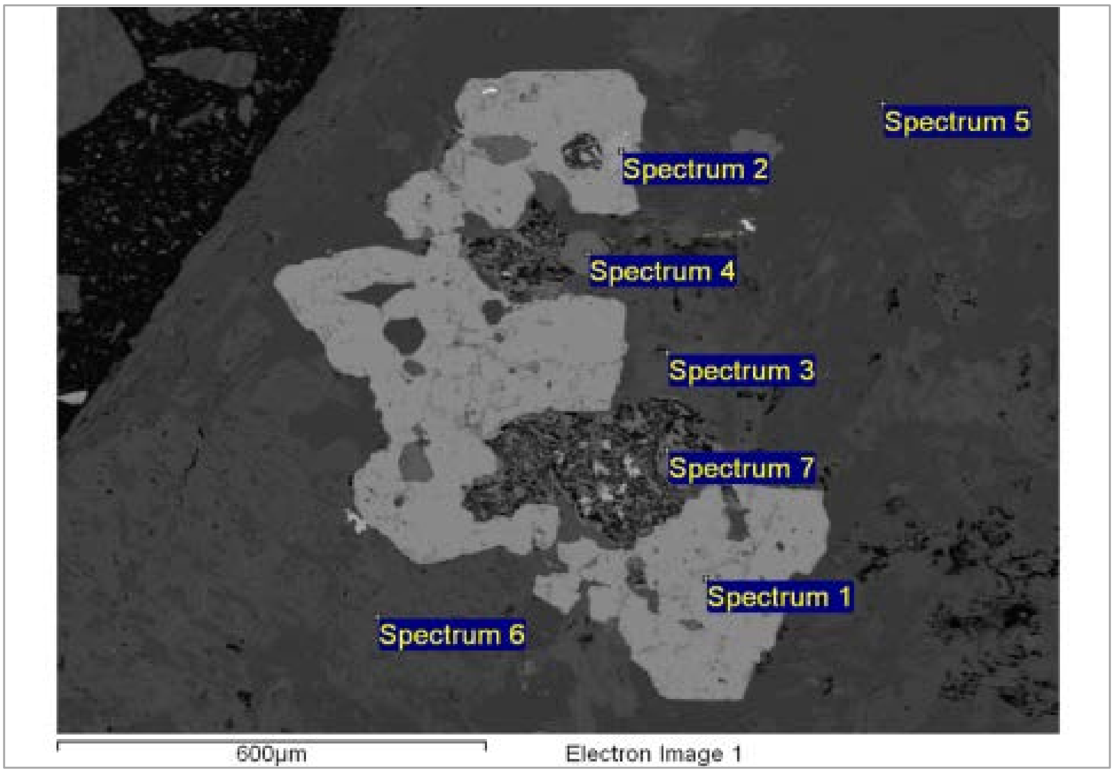

Figure 10-4: Sample CF-11-02 (0-27) Post-Leach Back Scatter Image

Medium-grained pyrite (Spectrum 1), with a small inclusion of zircon (Spectrum 2). This is encapsulated within a composite particles that consists of ankerite (Spectra 3 & 7), fluorapatite (Spectrum 4), quartz (Spectrum 5), orthoclase (Spectrum 6).

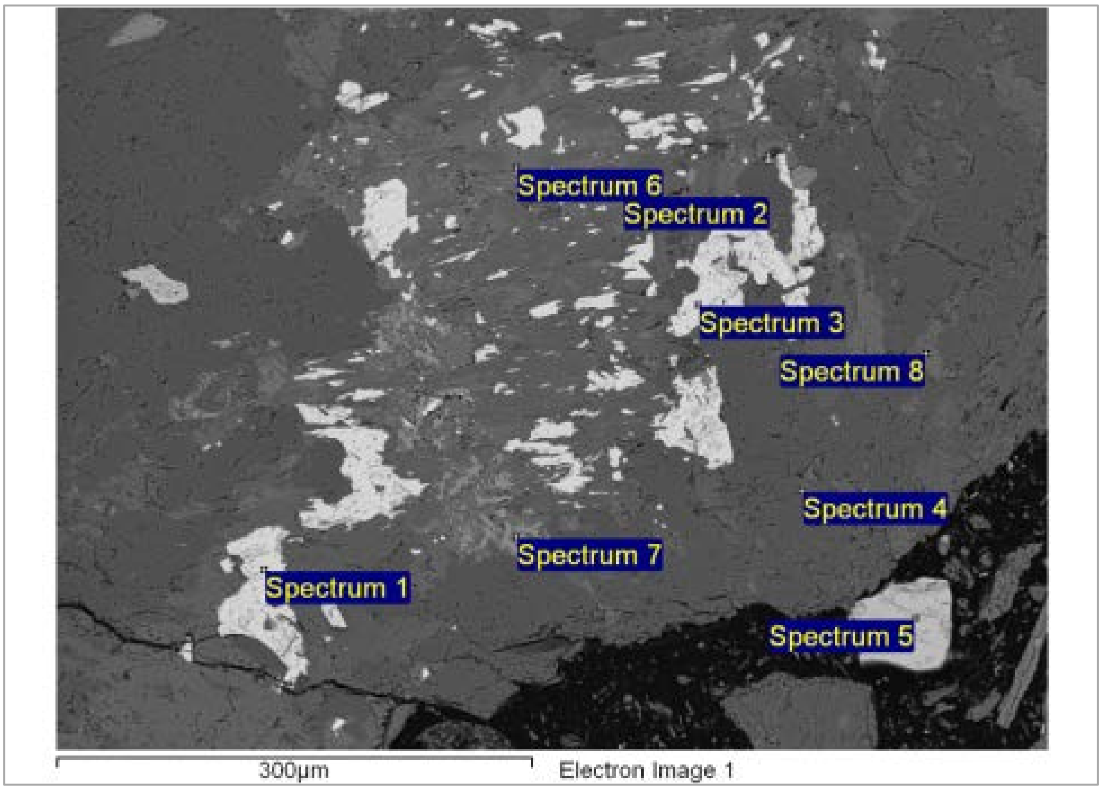

Figure 10-5: Sample CF-11-02 (0-27) Post-Leach Back Scatter Image

Fine-grained chalcopyrite (Spectra 1 & 3) associated with ankerite (Spectra 2, 6 & 8), albite (Spectrum 4) and rutile (Spectrum 7). Spectrum 5 is of a liberated pyrite grain.

11 CF-11-02 (0-27FT) PRE-LEACH

This sample is of transitional waste material and is the pre-leach/pre-HCT sample for sample CF-11-02 (0-27ft) described in Section 10. The sample predominantly consists of quartz, albite and orthoclase, with the latter feldspar minerals having been considerably altered to illite and kaolinite. It contains 2.13% sulfide sulfur (SRK, 2013) in the form of chalcopyrite and pyrite. Pyrite may be fine-grained and encapsulated but is frequently observed as medium-grained, liberated particles, showing partial fracturing and disaggregation. Coarse copper sulfide minerals (chalcopyrite and covellite) are observed as well liberated and medium-grained, as well as fine-grained and encapsulated.

It is noted that the medium-grained pyrite grains in this pre-leach sample already show partial fracturing and disaggregation. The extent of this fracturing and disaggregation is not too dissimilar to that observed in the humidity cell residue despite having not undergone any testwork itself. This provides added confirmation that the pyrite weathering rate within the analysed samples is generally slow or very slow, and that some (or all) of the fracturing may be pre-existing within the samples, rather than having occurred during the humidity cell test.

Table 11-1: Table of Minerals Found in Sample CF-11-02 (0-27ft) Pre-Leach and Their Abundance

Trace Minerals (≤1%)	Minor Minerals (1%–10%)	Major Minerals (10% <)
Rutile	Clinchlore	Quartz
Phlogopite		Albite
Fluorapatite		Orthoclase
Ankerite		Illite
Covellite		
Chalcopyrite		
Pyrite		

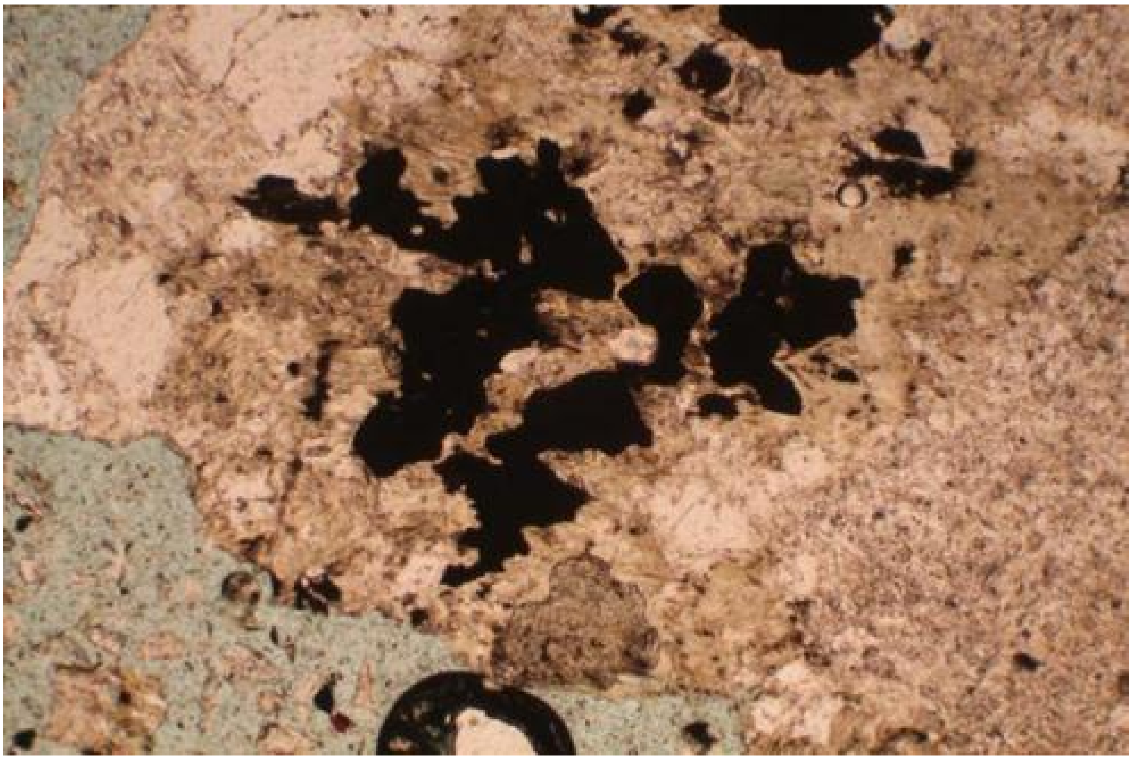

Figure 11-1: Sample CF-11-02 (0-27) Pre-Leach Plane Polarized Image (x5 magnification)

Large, nearly fully enclosed grain of pyrite associated with phlogopite and hosted within a composite particle predominantly consisting of quartz and feldspar.

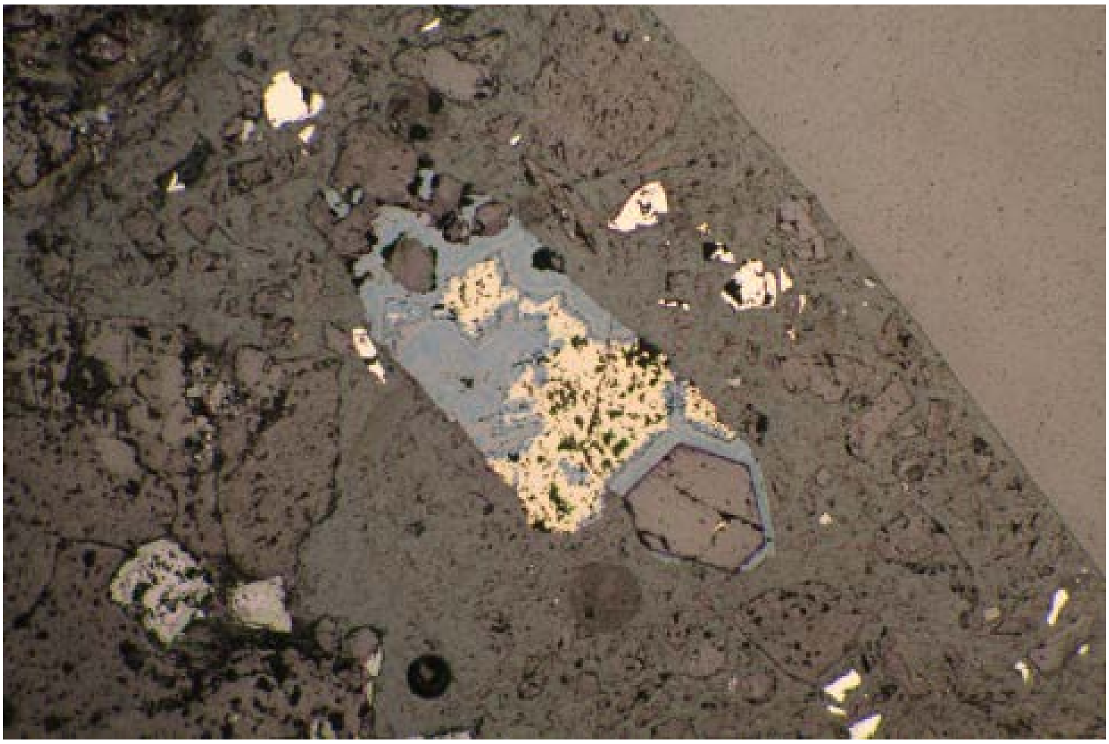

Figure 11-2: Sample CF-11-02 (0-27) Pre-Leach Cross Polarized Image (x5 magnification)

Coarse chalcopyrite grain associated with quartz grains and showing partial alteration to covellite (light blue).

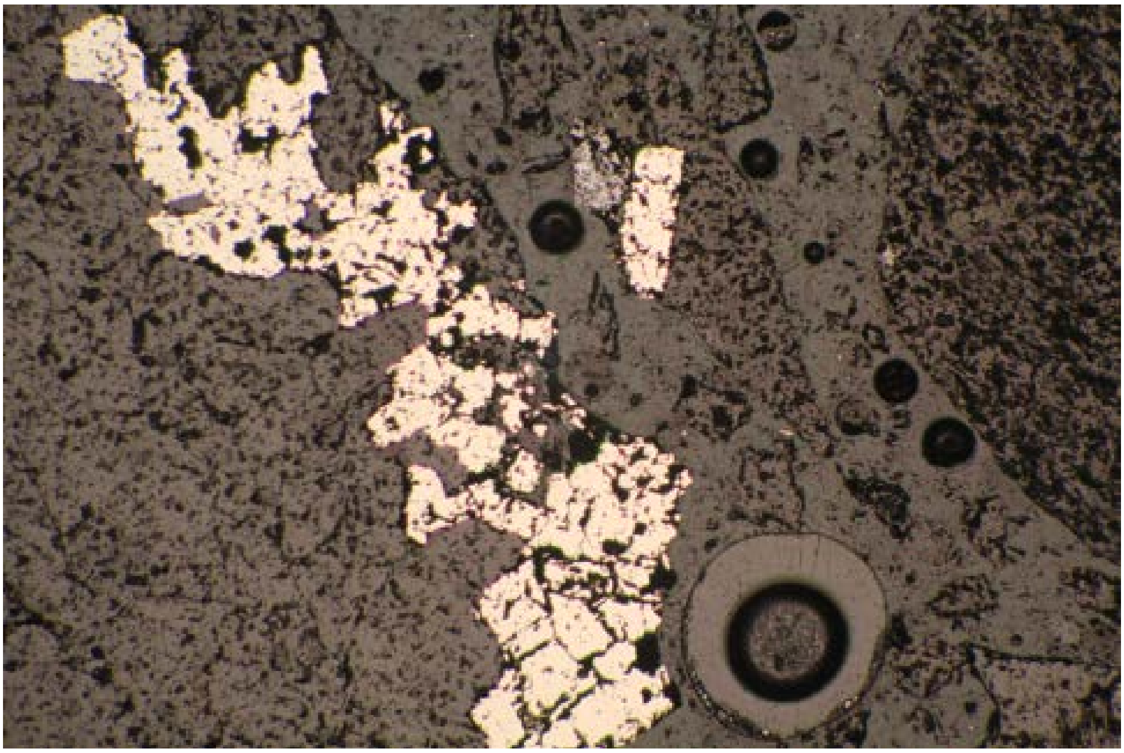

Figure 11-3: Sample CF-11-02 (0-27) Pre-Leach Reflected Light Image (x5 magnification)

Coarse pyrite particle hosted along one edge of composite quartz-feldspar grain. The pyrite is predominantly encapsulated but shows partial liberation and greater fracture density along the lower right portion of the grain.

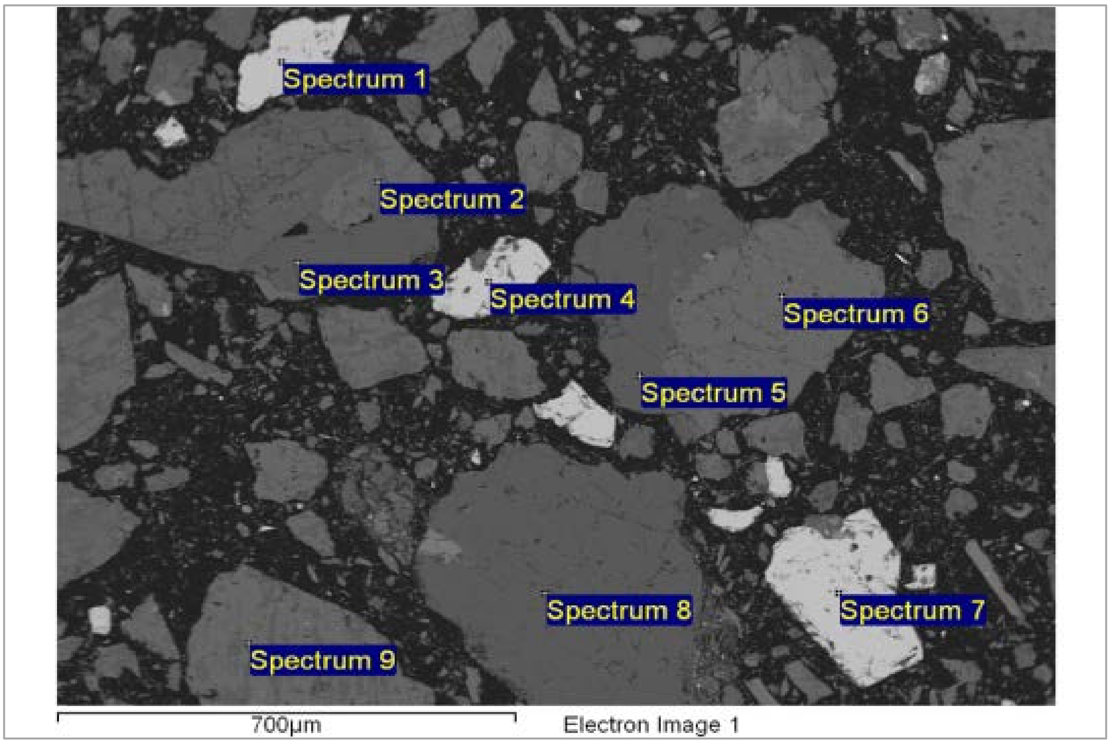

Figure 11-4: Sample CF-11-02 (0-27) Pre-Leach Back Scatter Image

A series of liberated medium-grained pyrite grains (Spectra 1, 4 & 7) associated with particles of orthoclase (Spectra 2, 6 & 9) and quartz (Spectra 3 & 5).

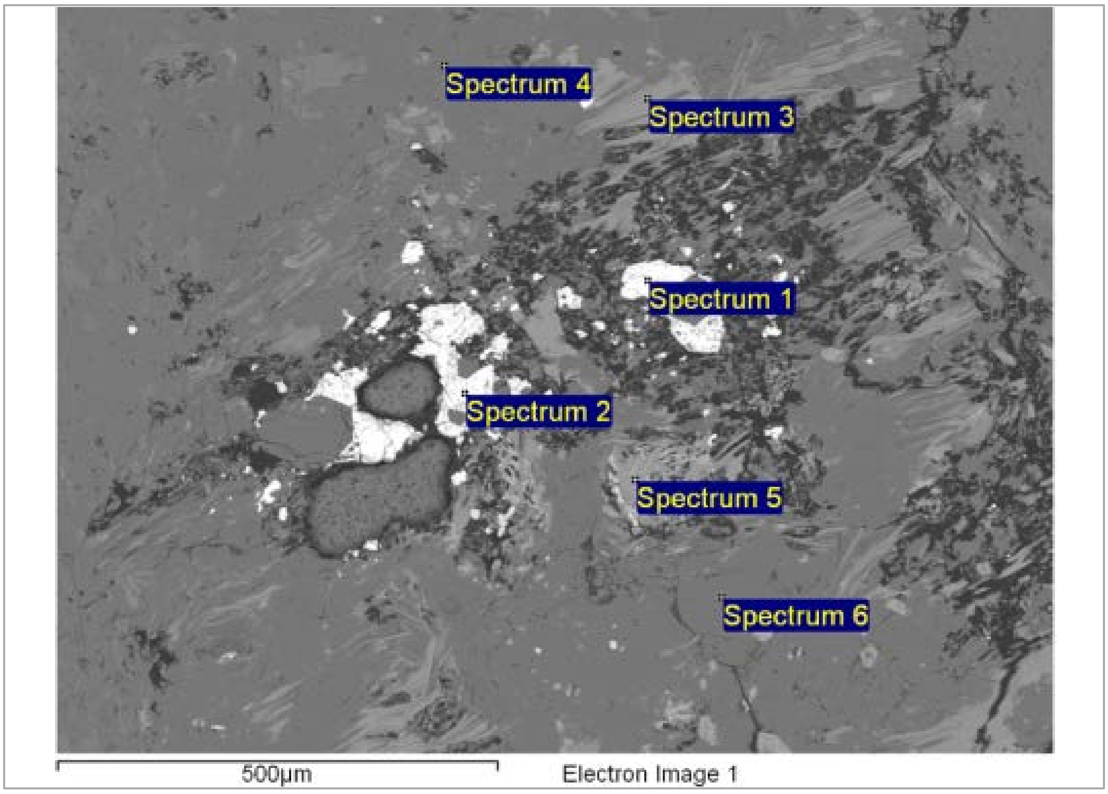

Figure 11-5: Sample CF-11-02 (0-27) Pre-Leach Back Scatter Image

Fine-grained chalcopyrite (Spectra 1 & 2) within a composite of chamosite (Spectra 3 & 5), albite (Spectrum 4) and quartz (Spectrum 6).

12 XRD RESULTS

A summary of the XRD results are provided in Table 12-1 to Table 12-8 and in Figure 12-1 to Figure 12-8, below.

Table 12-1: Summary of XRD results for sample SRK 0854

Phase Found	Percentage
Quartz	37
Albite	32
Orthoclase	19
Illite	10
Clinochlore	2

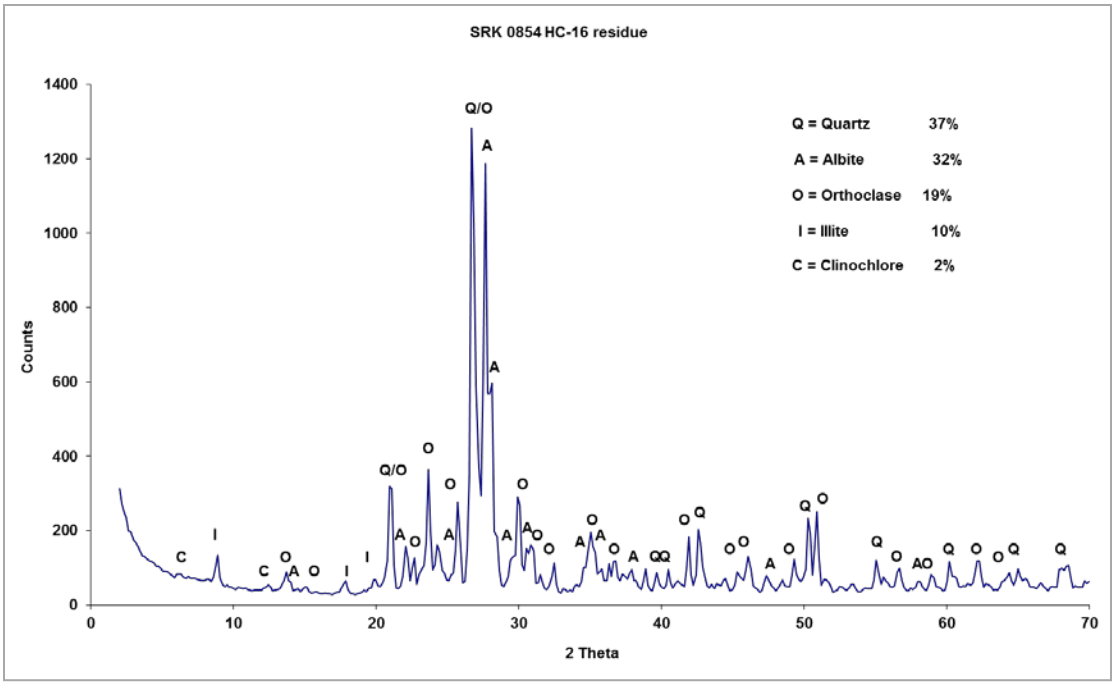

Figure 12-1: XRD scan for sample SRK 0854

Table 12-2: Summary of XRD results for sample SRK 0858

Phase Found	Percentage
Orthoclase	33
Quartz	30
Albite	28
Illite	7
Kaolinite	2

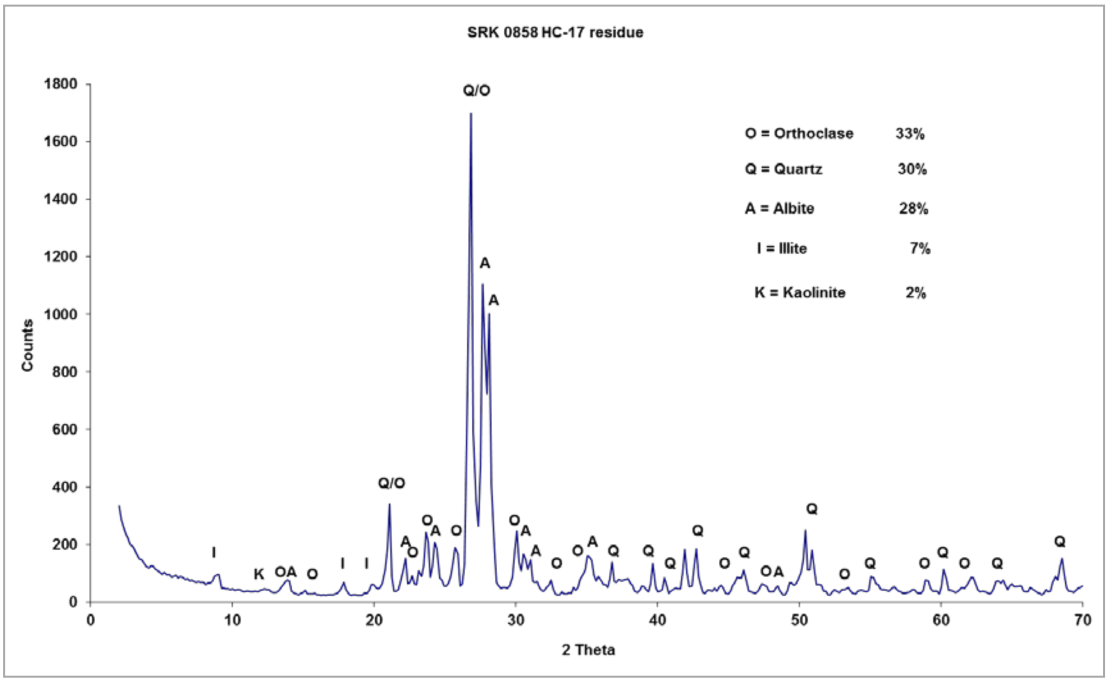

Figure 12-2: XRD scan for sample SRK 0858

Table 12-3: Summary of XRD results for sample SRK 0867

Phase Found	Percentage
Quartz	31
Orthoclase	30
Albite	24
Illite	11
Kaolinite	4

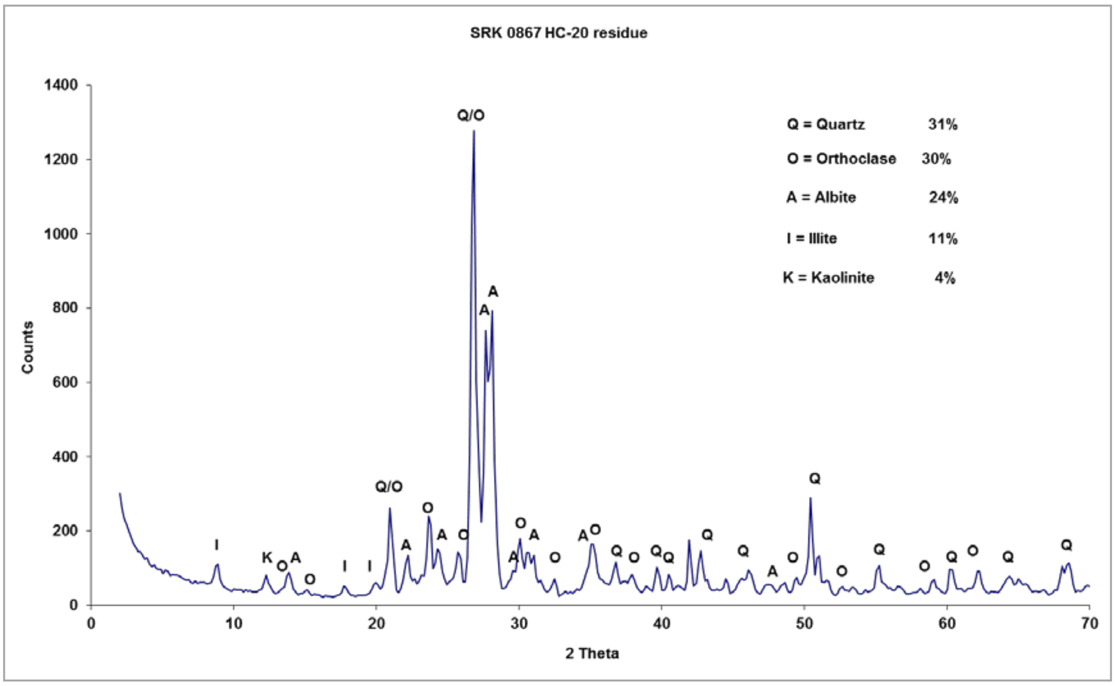

Figure 12-3: XRD scan for sample SRK 0867

Table 12-4: Summary of XRD results for sample SRK 0872

Phase Found	Percentage
Orthoclase	30
Quartz	30
Albite	22
Illite	15
Kaolinite	3

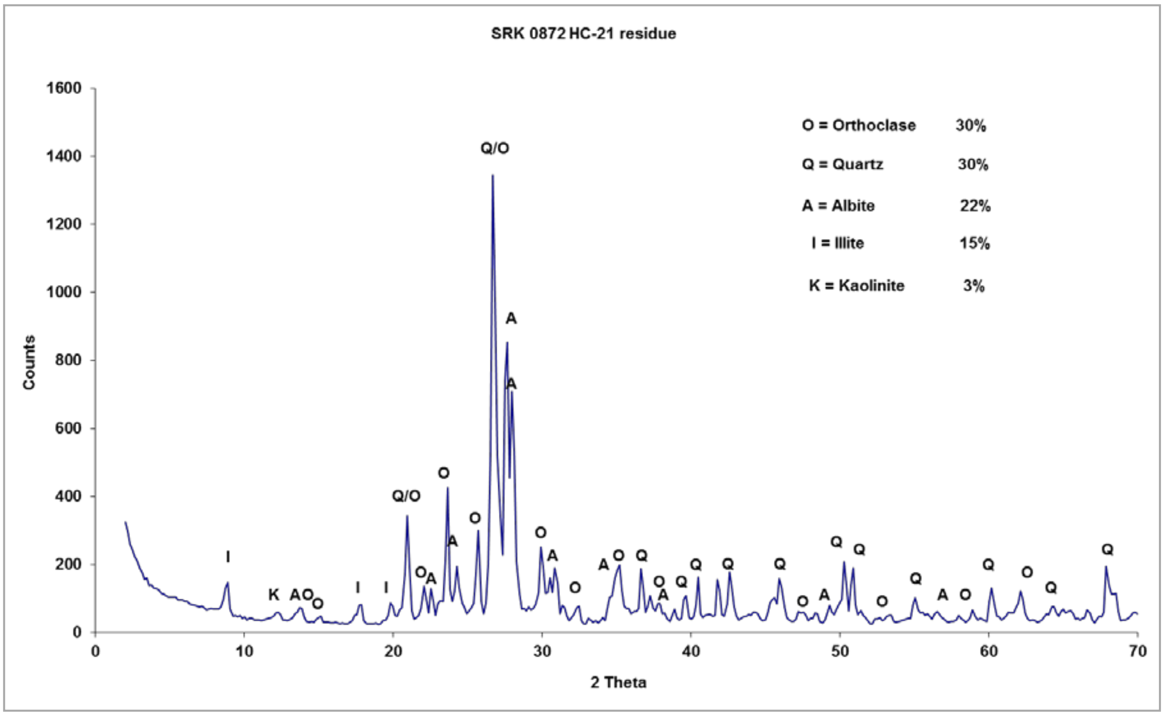

Figure 12-4: XRD scan for sample SRK 0872

Table 12-5: Summary of XRD results for sample 604673

Phase Found	Percentage
Quartz	45
Albite	33
Orthoclase	15
Illite	6
Clinochlore	1

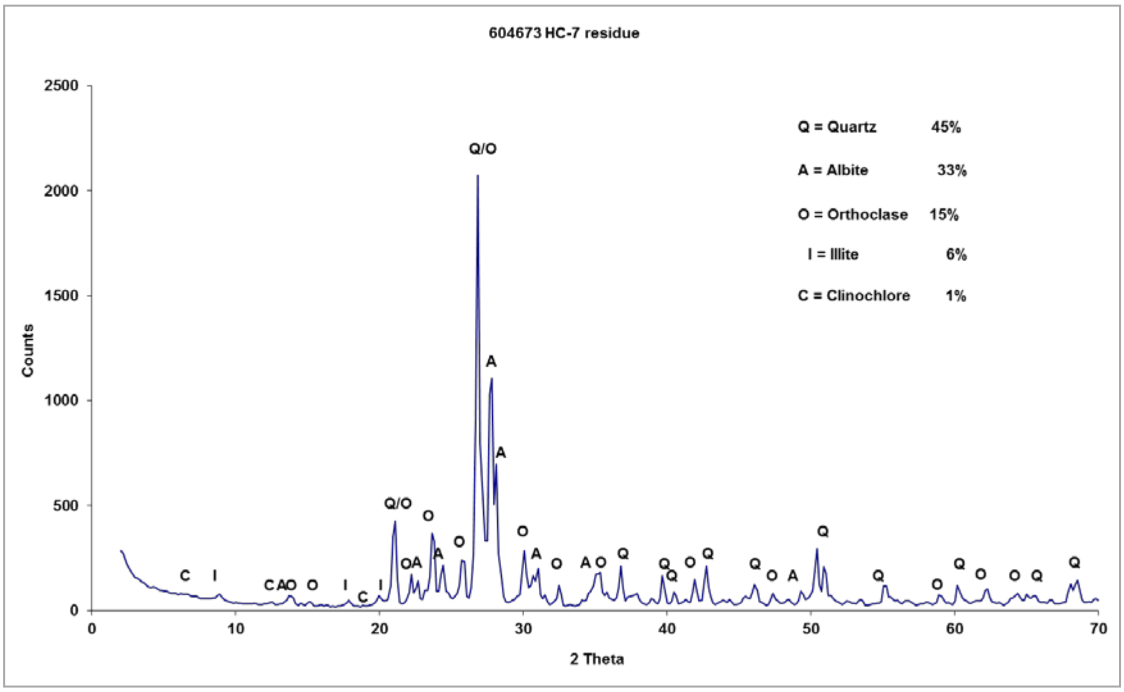

Figure 12-5: XRD scan for sample 604673

Table 12-6: Summary of XRD results for sample CF-11-02 (0-27) post-leach material

Phase Found	Percentage
Albite	41
Quartz	26
Orthoclase	16
Illite	15
Clinochlore	2

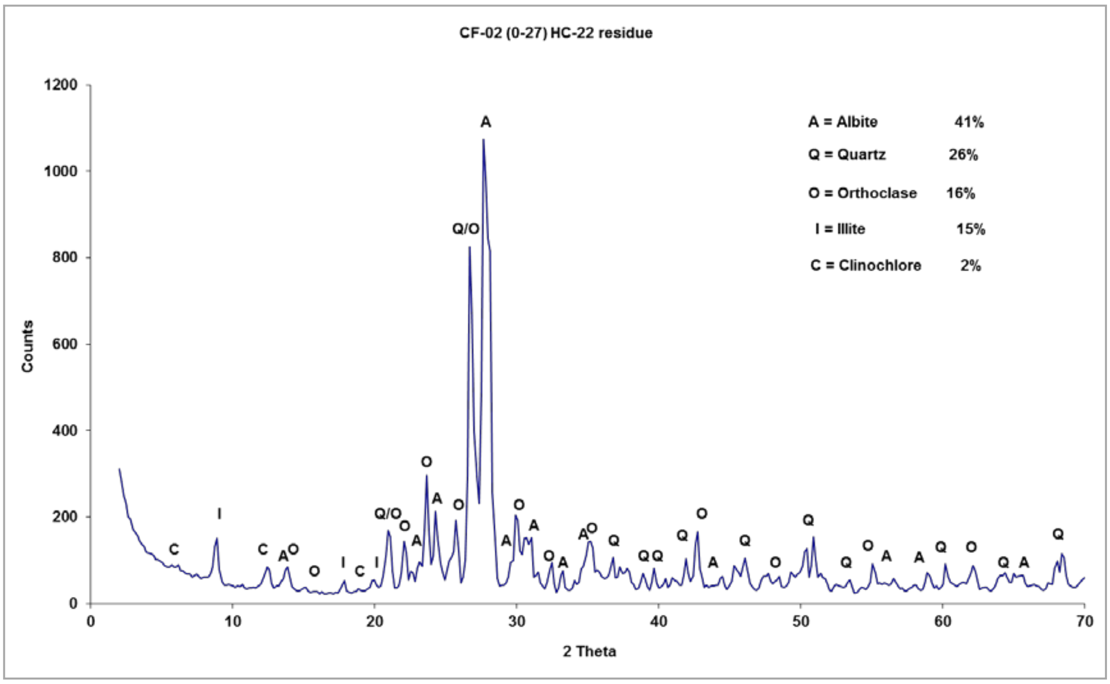

Figure 12-6: XRD scan for sample CF-11-02 (0-27) post-leach material

Table 12-7: Summary of XRD results for sample 604767

Phase Found	Percentage
Albite	36%
Quartz	30
Orthoclase	20
Illite	12
Kaolinite	2

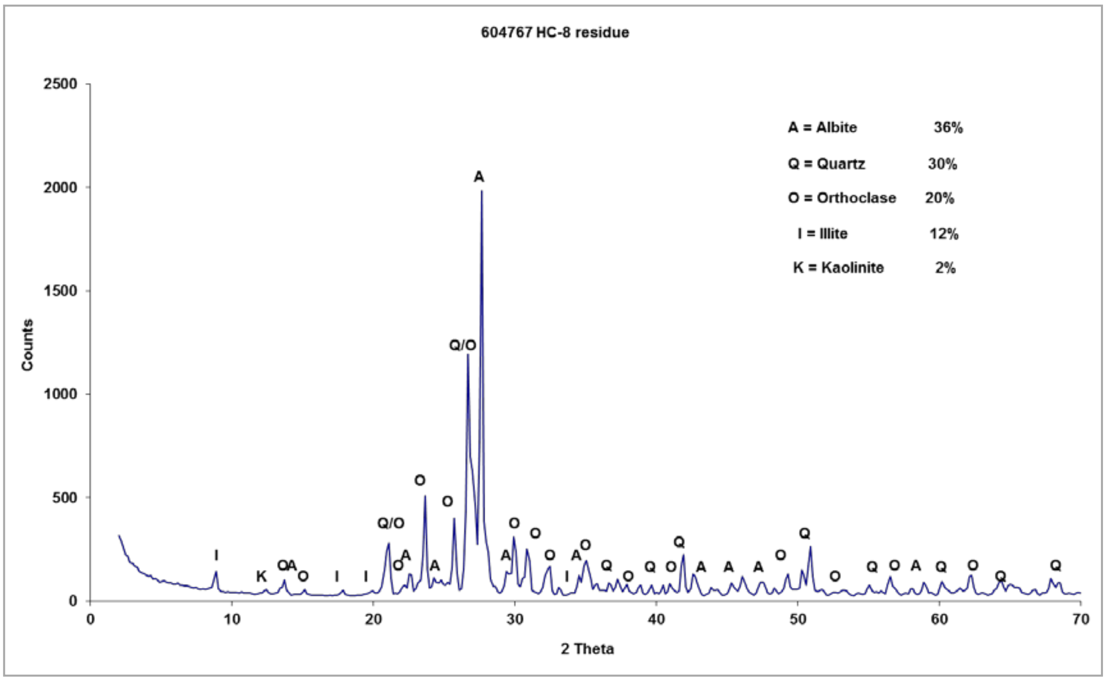

Figure 12-7: XRD scan for sample 604767

Table 12-8: Summary of XRD results for sample CD-11-02 (0-27) pre-leach material

Phase Found	Percentage
Albite	35
Quartz	24
Illite	21
Orthoclase	18
Clinochlore	2

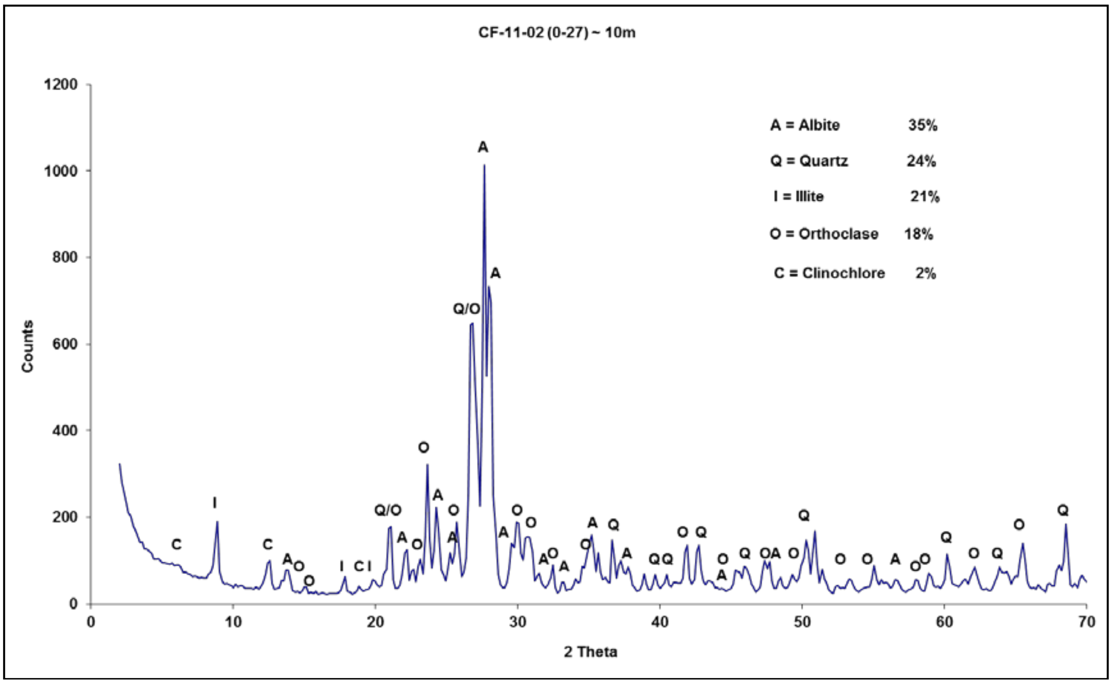

Figure 12-8: XRD scan for sample CD-11-02 (0-27) pre-leach material

13 REFERENCES

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Appendix C – Termination Test Results

McClelland Reports

**Table . - ICP Metals Analysis Results, Humidity Cell Residues,
Copper Flat Project**

	Sample						
Analysis, mg/kg	604 562	604 569	604 606	604 653	604 656	604 669	604 673
Ag	5.64	1.13	1.25	1.44	1.56	2.27	0.67
Al	83,400	87,500	80,900	86,900	81,000	77,100	72,200
As	0.9	0.8	0.5	0.5	0.4	1.9	1.0
Ba	760	630	580	770	740	520	430
Be	2.79	3.81	3.75	3.11	2.53	3.30	3.14
Bi	2.97	0.56	0.67	0.62	0.74	2.00	0.34
Ca	15,400	11,100	12,500	17,000	24,400	3,200	1,700
Cd	5.36	0.19	0.12	0.21	<0.02	0.94	0.11
Ce	84.3	93.8	91.8	76.9	71.7	96.0	90.9
Co	12.3	8.7	6.1	9.1	7.1	6.8	3
Cr	7	6	6	7	6	2	<1
Cs	8.03	7.99	7.36	7.19	6.86	8.41	6.16
Cu	5,370	1,480	1,605	2,090	2,260	3,260	1,150
Fe	30,100	29,000	19,400	32,700	23,500	16,600	8,200
Ga	20.8	22.1	20.0	21.9	20.3	20.3	19.40
Ge	0.25	0.26	0.24	0.26	0.24	0.08	0.15
Hf	1.0	1.3	1.3	0.8	0.8	1.9	2.8
Hg	0.02	<0.01	<0.01	0.01	0.01	0.02	0.01
In	0.173	0.062	0.046	0.099	0.082	0.083	0.026
K	48,800	47,300	49,600	47,100	48,100	55,900	50,300
La	43.0	47.1	48.1	38.1	35.1	48.1	46.6
Li	20.5	16.2	13.0	14.1	11.5	10.3	6.0
Mg	5,200	4,100	2,800	4,100	4,400	2,300	1,100
Mn	650	366	177	532	654	319	31
Mo	18.50	4.45	11.10	51.4	444	87.6	155.0
Na	15,900	24,100	21,600	24,800	14,100	14,700	18,800
Nb	10.9	15.7	16.2	13.9	12.8	15.7	15.4
Ni	1.9	1.7	1.5	1.9	1.5	1.2	1.0
P	870	670	470	760	760	430	150
Pb	416	21.4	17.0	21.4	14.5	111.5	21.3
Rb	322	312	323	286	274	324	216
Re	0.036	0.005	0.010	0.100	0.187	0.075	0.172
S	16,900	12,300	8,900	9,600	7,500	8,200	4,700
Sb	0.84	0.28	0.22	0.25	0.52	0.37	0.22
Sc	6.6	5.4	3.9	6.3	5.8	3.5	1.6
Se	4	3	3	3	3	2	2
Sn	5.7	4.8	4.3	4.8	3.5	3.6	1.7
Sr	479	510	420	640	481	271	236
Ta	0.73	1.03	1.16	0.88	0.80	1.34	1.27
Te	0.63	0.18	0.19	0.16	0.27	0.26	0.08
Th	20.3	25.3	32.0	18.3	17.4	29.7	35.3
Ti	2,190	2,130	1,700	2,420	2,280	1,590	740
Tl	2.13	1.89	1.85	1.70	1.64	1.98	2.01
U	4.2	6.5	8.2	4.7	4.6	7.1	7.7
V	50	40	27	47	44	28	9
W	15.9	9.6	8.5	7.0	10.5	10.0	7.0
Y	25.3	28.9	25.5	28.2	27.4	25.0	18.0
Zn	686	36	25	56	49	112	12
Zr	20.3	26.3	33.6	16.5	16.3	41.1	64.4
Chemex Report #	RE11261455	RE11261455	RE11261455	RE11261455	RE11261455	RE12282178	RE13120456

Table . - ICP Metals Analysis Results, Humidity Cell Residues, Copper Flat Project Samples

	Sample						
Analysis, mg/kg	604 767	604 787	604 811	604 854	604 862	604 867	605 033
Ag	5.18	5.01	2.11	3.45	4.67	11.15	2.39
Al	77,100	73,100	69,700	82,100	71,800	69,900	81,100
As	15.3	8.9	8.4	17.9	11.0	1.6	4.8
Ba	1,020	740	800	1,450	1,070	800	980
Be	2.15	3.19	2.01	1.07	1.95	1.33	1.92
Bi	1.93	1.43	1.25	0.99	2.07	34.5	3.01
Ca	4,500	10,500	12,400	8,500	11,100	6,600	14,200
Cd	2.80	1.22	1.13	1.79	0.44	1.40	0.96
Ce	64.9	73.8	52.8	196.5	205	>500	47.0
Co	24.5	9.9	12.6	12.3	14.7	16.3	7.4
Cr	2	<1	7	4	3	6	7
Cs	7.15	9.48	6.90	6.31	24.0	24.5	9.17
Cu	5,970	5,960	2,580	4,490	5,140	14,300	2,080
Fe	36,200	31,000	27,000	27,700	125,500	109,500	48,300
Ga	18.00	20.8	17.85	19.35	30.3	31.1	23.4
Ge	0.14	0.21	0.22	0.26	0.35	0.61	0.21
Hf	1.0	1.4	0.9	0.8	0.6	0.8	1.5
Hg	<0.01	0.06	0.01	0.01	0.01	0.01	0.01
In	0.174	0.146	0.061	0.080	0.115	0.346	0.063
K	63,300	51,000	47,700	45,600	54,300	49,600	49,400
La	33.6	38.9	28.1	132.5	155.5	1,020	24.6
Li	13.3	25.9	20.2	10.5	53.8	45.7	33.7
Mg	3,500	4,000	3,900	3,300	18,100	16,000	7,700
Mn	306	269	256	228	747	548	470
Mo	26.1	135.0	97.0	473	558	496	58.6
Na	10,500	13,000	8,200	8,700	5,800	6,900	18,700
Nb	9.9	13.3	9.7	10.2	5.1	4.7	8.8
Ni	3.9	2.4	3.8	3.8	9.5	12.2	4.5
P	540	450	670	1,360	890	1,170	500
Pb	100.5	67.5	50.9	32.8	9.8	10.1	39.7
Rb	208	277	265	200	436	396	316
Re	0.045	0.112	0.100	0.590	0.592	0.343	0.059
S	26,200	13,300	14,600	17,400	15,100	27,400	12,300
Sb	0.42	0.74	0.36	0.80	0.71	0.17	0.45
Sc	4.1	4.8	4.2	2.9	18.7	6.3	7.2
Se	6	5	4	5	5	13	2
Sn	2.2	3.0	2.5	2.3	2.9	5.2	2.8
Sr	323	310	251	372	263	295	448
Ta	0.86	1.06	0.68	0.73	0.27	0.28	0.57
Te	1.12	0.39	0.52	0.22	0.69	3.94	1.29
Th	34.3	25.5	24.5	12.1	45.3	93.4	17.5
Ti	1,360	1,690	1,490	1,510	1,890	1,850	1,910
Tl	2.25	1.94	1.85	2.32	2.72	2.94	1.69
U	13.8	9.1	4.9	3.7	5.4	3.7	5.8
V	50	37	41	39	173	133	105
W	11.7	10.1	14.2	14.0	6.1	8.3	6.8
Y	19.1	20.0	16.6	18.3	10.0	13.4	17.5
Zn	309	155	159	234	123	202	135
Zr	29.5	34.9	23.6	21.1	17.8	27.0	52.1
Chemex Report #	RE13143328	RE12056288	RE11261455	RE11261455	RE11261455	RE11261455	RE11261455

**Table . - ICP Metals Analysis Results, Humidity Cell Residues,
Copper Flat Project Samples**

	Sample						
Analysis, mg/kg	605 153	SRK 0854	SRK 0858	SRK 0864	SRK 0866	SRK 0867	SRK0872
Ag	0.57	4.80	0.37	0.25	0.13	1.49	0.65
Al	85,500	79,500	79,600	95,000	95,400	74,600	78,500
As	0.5	4.1	1.2	0.8	0.9	5.1	2.4
Ba	1,400	1,150	710	760	720	760	830
Be	2.58	2.76	3.60	1.75	1.78	3.54	3.20
Bi	0.42	2.01	2.14	0.19	0.87	1.20	1.53
Ca	22,200	4,400	4,300	43,900	40,200	5,700	3,700
Cd	1.10	<0.5	0.04	3.16	0.05	0.40	0.24
Ce	44.3	102.0	52.8	47.1	55.1	72.7	71.2
Co	5.8	5.2	5.4	24.4	16.4	8.2	7.2
Cr	8	4	2	47	14	6	4
Cs	11.50	5.76	7.66	5.75	4.96	7.11	6.60
Cu	613	7,490	249	540	175.5	2,400	870
Fe	23,700	20,100	22,500	61,000	58,200	21,200	22,700
Ga	19.90	19.60	20.0	21.3	22.9	21.5	19.00
Ge	0.20	0.20	0.07	0.21	0.24	0.18	0.20
Hf	1.6	1.5	1.3	3.2	1.3	1.5	1.6
Hg	0.02	0.04	<0.01	0.01	0.01	0.11	0.02
In	0.034	0.198	0.039	0.081	0.087	0.077	0.025
K	34,700	60,900	50,000	26,800	23,600	45,800	52,600
La	19.5	67.6	26.9	20.5	24.2	39.4	36.5
Li	31.5	15.2	11.2	12.0	8.0	11.6	11.3
Mg	4,600	2,500	2,000	17,800	13,700	2,700	2,300
Mn	894	62	79	1,150	776	166	112
Mo	21.7	621	5.90	1.78	2.72	66.1	12.30
Na	25,500	19,000	23,900	23,400	26,800	21,400	19,200
Nb	8.8	10.2	11.1	8.6	8.4	11.4	9.5
Ni	3.2	3.3	1.0	25.6	7.3	6.4	1.8
P	590	590	460	2,330	2,430	490	370
Pb	28.2	71.8	15.4	10.2	6.9	29.8	35.1
Rb	229	311	282	110.5	134.5	249	290
Re	0.021	0.991	0.006	0.003	0.002	0.098	0.018
S	5,900	9,500	8,500	100	2,300	9,600	15,200
Sb	0.35	1.15	0.21	0.42	0.30	5.80	0.56
Sc	4.5	4.0	3.9	18.9	16.4	4.5	4.1
Se	1	8	2	2	2	3	4
Sn	2.8	15.1	4.9	2.5	4.4	52.4	5.1
Sr	597	432	462	855	756	410	338
Ta	0.58	0.69	0.89	0.53	0.45	0.82	0.61
Te	0.06	0.64	0.29	<0.05	0.30	0.41	0.24
Th	10.9	17.7	17.0	5.5	4.9	19.3	16.6
Ti	1,690	1,520	1,950	6,000	5,180	1,560	1,230
Tl	1.31	1.98	1.94	1.12	1.15	1.82	2.06
U	3.2	3.7	4.3	2.2	1.4	5.3	4.0
V	36	34	37	163	133	31	30
W	8.1	8.1	9.8	1.6	4.3	8.2	11.1
Y	17.3	15.8	14.7	28.4	28.4	18.0	13.2
Zn	192	55	18	131	47	73	32
Zr	54.7	41.5	26.5	131.0	47.5	39.3	40.4
Chemex Report #	RE11261455	RE13033765	RE12282178	RE11261455	RE11261455	RE12056288	RE13033765

Table . - ICP Metals Analysis Results, Humidity Cell Residues,

Copper Flat Project Samples

	Sample						
Analysis, mg/kg	CF-11-02 (0-27)	CF-11-02 (367-408)	CF-11-02 (227-367) Flotation Tailings	CF-11-02 (52-117) Flotation Tailings	K-Spar Breccia 5+ Comp. Flotation Tailings	Biotite Breccia 5+ Comp. Flotation Tailings	Quartz Monzonite 5+ Comp. Flotation Tailings
Ag	1.47	1.38	0.70	0.59	1.44	0.88	0.76
Al	83,700	82,600	85,900	80,000	74,000	73,400	75,500
As	3.6	1.8	1.4	0.5	2.2	1.2	<0.2
Ba	820	750	830	880	900	1,080	850
Be	3.83	4.25	4.26	3.94	3.00	2.34	3.45
Bi	5.42	0.50	0.64	0.83	1.11	0.44	0.48
Ca	12,100	15,700	16,900	15,400	14,800	11,300	12,900
Cd	0.31	0.24	0.16	0.13	0.55	0.31	0.12
Ce	88.7	88.8	70.6	76.7	51.3	90.2	79.7
Co	8.7	7.9	1.4	1.4	6.2	3.5	1.2
Cr	1	1	8	9	15	7	10
Cs	9.96	7.37	9.08	10.15	11.80	10.65	9.29
Cu	1,370	1,470	273	269	881	747	396
Fe	33,800	31,500	26,000	26,600	13,900	20,500	15,100
Ga	24.2	23.7	21.4	22.0	16.25	19.75	19.05
Ge	0.19	0.24	0.14	0.19	0.13	0.19	0.18
Hf	1.5	1.3	1.3	1.4	1.1	1.1	1.3
Hg	0.01	0.05	<0.1	0.01	0.01	0.01	0.01
In	0.070	0.084	0.049	0.062	0.036	0.021	0.023
K	51,900	48,700	47,200	50,800	47,500	64,100	52,200
La	40.0	41.0	32.9	33.9	24.4	50.8	40.6
Li	16.3	13.5	14.0	13.4	20.2	21.2	21.5
Mg	4,600	4,900	5,300	5,700	3,700	7,500	4,800
Mn	286	369	359	355	214	398	231
Mo	2.60	4.75	2.89	2.90	49.8	14.20	35.1
Na	25,100	27,000	28,700	27,100	17,000	15,800	21,500
Nb	11.8	14.7	13.5	14.3	8.2	10.1	12.9
Ni	2.3	3.5	3.6	3.7	5.8	5.4	5.7
P	870	730	880	900	430	1,010	550
Pb	21.4	18.2	24.1	16.7	62.2	15.1	12.6
Rb	316	295	302	319	272	363	309
Re	<0.002	0.002	<0.002	<0.002	0.053	0.016	0.041
S	17,300	11,000	400	500	3,600	2,400	700
Sb	0.96	0.83	0.23	0.19	0.35	0.35	0.29
Sc	6.8	6.5	6.0	6.4	3.2	4.3	3.6
Se	3	3	2	2	1	2	2
Sn	6.7	5.4	5.9	6.6	2.7	2.4	3.6
Sr	601	672	789	731	333	350	466
Ta	0.80	1.00	0.85	0.88	0.61	0.71	0.87
Te	2.89	0.17	0.42	0.17	0.30	0.08	0.09
Th	18.2	20.9	13.9	15.9	20.3	22.3	21.0
Ti	2,450	2,450	2,660	2,800	1,300	1,760	1,810
Tl	2.42	1.97	1.93	2.26	1.49	2.03	1.74
U	4.9	5.7	4.7	4.8	6.1	5.2	5.4
V	57	47	55	59	29	48	36
W	25.9	18.6	16.4	24.5	10.7	7.0	11.6
Y	28.1	34.6	29.3	29.8	16.8	18.9	23.2
Zn	46	42	41	35	77	54	30
Zr	23.8	21.7	20.9	25.2	34.9	31.0	34.1
Chemex Report #	RE13143042	RE13143042	RE13143328	RE13082519	RE13143328	RE13082519	RE13082519

**Table . - ICP Metals Analysis Results, Humidity Cell Residues,
Copper Flat Project Samples**

	Sample			
Analysis, mg/kg	Biotite Breccia 0-5 Comp. Flotation Tailings	K-Spar Breccia 0-5 Comp. Flotation Tailings	Quartz Monzonite 0-5 Comp. Flotation Tailings	Cu R. Tail
Ag	0.72	0.69	0.60	1.07
Al	72,900	80,800	78,600	75,100
As	7.9	6.7	3.2	5.2
Ba	850	930	740	800
Be	2.53	3.13	3.81	3.16
Bi	0.67	0.76	0.56	0.61
Ca	13,200	13,700	14,400	15,200
Cd	0.75	0.57	0.77	0.79
Ce	59.5	75.1	73.7	64.6
Co	12.4	11.4	9.3	7.6
Cr	280	284	269	17
Cs	8.06	7.84	7.97	8.28
Cu	180.0	216	191.5	740
Fe	31,900	24,600	21,400	25,200
Ga	18.00	18.10	17.90	20.2
Ge	0.16	0.15	0.18	0.10
Hf	1.1	1.2	1.2	1.0
Hg	0.01	0.01	0.01	0.03
In	0.019	0.022	0.022	0.037
K	53,400	53,100	49,600	52,500
La	31.7	40.1	37.4	31.0
Li	23.3	17.3	14.7	21.3
Mg	4,900	3,800	3,300	4,600
Mn	391	281	299	454
Mo	37.3	32.1	27.9	17.25
Na	13,900	17,200	20,100	17,400
Nb	9.1	9.8	12.0	10.5
Ni	181.5	196.5	174.5	13.0
P	520	520	550	640
Pb	34.5	29.0	33.1	57.5
Rb	318	311	296	313
Re	0.038	0.019	0.019	0.016
S	10,700	10,000	7,600	7,700
Sb	0.43	0.33	0.42	0.46
Sc	4.3	3.8	3.8	4.8
Se	3	3	2	1
Sn	2.5	3.2	3.7	3.3
Sr	329	407	435	363
Ta	0.66	0.71	0.86	0.82
Te	0.21	0.25	0.21	0.22
Th	21.2	21.2	21.0	22.6
Ti	1,560	1,540	1,700	1,740
Tl	1.69	1.75	1.74	1.86
U	5.5	5.0	5.3	6.0
V	55	42	34	47
W	7.8	8.6	8.5	9.1
Y	18.6	20.6	22.6	20.1
Zn	103	78	97	117
Zr	28.8	32.6	30.3	25.7
Chemex Report #	RE13143328	RE13143328	RE13143328	RE12282178

Chemex Reports

ALS Minerals

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To: MCCLELLAND LABS
1016 GREG ST
SPARKS NV 89431

Page: 1
Finalized Date: 3-JAN-2012
Account: EIM

CERTIFICATE RE11261455

Project: 3438
P.O. No.:
This report is for 13 Crushed Rock samples submitted to our lab in Reno, NV, USA on 13-DEC-2011.

The following have access to data associated with this certificate:

CHRISTINE DEBURLE	JACK MCPARTLAND	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-22	Sample login - Rcd w/o BarCode
PUL-QC	Pulverizing QC Test
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
ME-OG62	Ore Grade Elements - Four Acid	ICP-AES
Cu-OG62	Ore Grade Cu - Four Acid	VARIABLE
ME-MS61	48 element four acid ICP-MS	
Hg-CV41	Trace Hg - cold vapor/AAS	FIMS

The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim 'or deposit has been determined based on the results of assays of multiple samples of geological materials collected by the prospective investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed pro ect Statement required by Nevada State Law NRS 519

To: MCCLELLAND LABS
ATTN: JACK MCPARTLAND
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:
Colin Ramshaw, Vancouver Laboratory Manager

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Page: 2 - A
Total # Pages: 2 (A - D)
Plus Appendix Pages
Finalized Date: 3- JAN- 2012
Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE11261455

Sample Description	Method	WEI- 21	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61
	Analyte	Recvd Wt.	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe
	Units	kg	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%
	LOR	0.02	0.01	0.01	0.2	10	0.05	0.01	0.01	0.02	0.01	0.1	1	0.05	0.2	0.01
3438- SRK- 0864		0.22	0.25	9.50	0.8	760	1.75	0.19	4.39	3.16	47.1	24.4	47	5.75	540	6.10
3438- SRK- 0866		0.22	0.13	9.54	0.9	720	1.78	0.87	4.02	0.05	55.1	16.4	14	4.96	175.5	5.82
3438- 604- 033		0.22	2.39	8.11	4.8	980	1.92	3.01	1.42	0.96	47.0	7.4	7	9.17	2080	4.83
3438- 604- 153		0.20	0.57	8.55	0.5	1400	2.58	0.42	2.22	1.10	44.3	5.8	8	11.50	613	2.37
3438- 604- 562		0.24	5.64	8.34	0.9	760	2.79	2.97	1.54	5.36	84.3	12.3	7	8.03	5370	3.01
3438- 604- 569		0.24	1.13	8.75	0.8	630	3.81	0.56	1.11	0.19	93.8	8.7	6	7.99	1480	2.90
3438- 604- 606		0.22	1.25	8.09	0.5	580	3.75	0.67	1.25	0.12	91.8	6.1	6	7.36	1605	1.94
3438- 604- 653		0.22	1.44	8.69	0.5	770	3.11	0.62	1.70	0.21	76.9	9.1	7	7.19	2090	3.27
3438- 604- 656		0.24	1.56	8.10	0.4	740	2.53	0.74	2.44	<0.02	71.7	7.1	6	6.86	2260	2.35
3438- 604- 811		0.22	2.11	6.97	8.4	800	2.01	1.25	1.24	1.13	52.8	12.6	7	6.90	2580	2.70
3438- 604- 854		0.22	3.45	8.21	17.9	1450	1.07	0.99	0.85	1.79	196.5	12.3	4	6.31	4490	2.77
3438- 604- 862		0.24	4.67	7.18	11.0	1070	1.95	2.07	1.11	0.44	205	14.7	3	24.0	5140	12.55
3438- 604- 867		0.22	11.15	6.99	1.6	800	1.33	34.5	0.66	1.40	>500	16.3	6	24.5	>10000	10.95

***** See Appendix Page for comments regarding this certificate *****

To: MCCLELLAND LABS
1016 GREG ST
SPARKS NV 89431

Project: 3438

CERTIFICATE OF ANALYSIS RE11261455

Sample Description	Method Analyte Units LOR	ME- MS61 Ga ppm 0.05	ME- MS61 Ge ppm 0.05	ME- MS61 Hf ppm 0.1	Hg- CV41 Hg ppm 0.01	ME- MS61 In ppm 0.005	ME- MS61 K % 0.01	ME- MS61 La ppm 0.5	ME- MS61 Li ppm 0.2	ME- MS61 Mg % 0.01	ME- MS61 Mn ppm 5	ME- MS61 Mo ppm 0.05	ME- MS61 Na % 0.01	ME- MS61 Nb ppm 0.1	ME- MS61 Ni ppm 0.2	ME- MS61 P ppm 10
3438- SRK- 0864		21.3	0.21	3.2	0.01	0.081	2.68	20.5	12.0	1.78	1150	1.78	2.34	8.6	25.6	2330
3438- SRK- 0866		22.9	0.24	1.3	0.01	0.087	2.36	24.2	8.0	1.37	776	2.72	2.68	8.4	7.3	2430
3438- 604- 033		23.4	0.21	1.5	0.01	0.063	4.94	24.6	33.7	0.77	470	58.6	1.87	8.8	4.5	500
3438- 604- 153		19.90	0.20	1.6	0.02	0.034	3.47	19.5	31.5	0.46	894	21.7	2.55	8.8	3.2	590
3438- 604- 562		20.8	0.25	1.0	0.02	0.173	4.88	43.0	20.5	0.52	650	18.50	1.59	10.9	1.9	870
3438- 604- 569		22.1	0.26	1.3	<0.01	0.062	4.73	47.1	16.2	0.41	366	4.45	2.41	15.7	1.7	670
3438- 604- 606		20.0	0.24	1.3	<0.01	0.046	4.96	48.1	13.0	0.28	177	11.10	2.16	16.2	1.5	470
3438- 604- 653		21.9	0.26	0.8	0.01	0.099	4.71	38.1	14.1	0.41	532	51.4	2.48	13.9	1.9	760
3438- 604- 656		20.3	0.24	0.8	0.01	0.082	4.81	35.1	11.5	0.44	654	444	1.41	12.8	1.5	760
3438- 604- 811		17.85	0.22	0.9	0.01	0.061	4.77	28.1	20.2	0.39	256	97.0	0.82	9.7	3.8	670
3438- 604- 854		19.35	0.26	0.8	0.01	0.080	4.56	132.5	10.5	0.33	228	473	0.87	10.2	3.8	1360
3438- 604- 862		30.3	0.35	0.6	0.01	0.115	5.43	155.5	53.8	1.81	747	558	0.58	5.1	9.5	890
3438- 604- 867		31.1	0.61	0.8	0.01	0.346	4.96	1020	45.7	1.60	548	496	0.69	4.7	12.2	1170

***** See Appendix Page for comments regarding this certificate *****

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To: MCCLELLAND LABS
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Project: 3438

CERTIFICATE OF ANALYSIS RE11261455

Sample Description	Method Analyte Units LOR	ME- MS61 Pb ppm 0.5	ME- MS61 Rb ppm 0.1	ME- MS61 Re ppm 0.002	ME- MS61 S % 0.01	ME- MS61 Sb ppm 0.05	ME- MS61 Sc ppm 0.1	ME- MS61 Se ppm 1	ME- MS61 Sn ppm 0.2	ME- MS61 Sr ppm 0.2	ME- MS61 Ta ppm 0.05	ME- MS61 Te ppm 0.05	ME- MS61 Th ppm 0.2	ME- MS61 Ti % 0.005	ME- MS61 Tl ppm 0.02	ME- MS61 U ppm 0.1
3438- SRK- 0864		10.2	110.5	0.003	0.01	0.42	18.9	2	2.5	855	0.53	<0.05	5.5	0.600	1.12	2.2
3438- SRK- 0866		6.9	134.5	0.002	0.23	0.30	16.4	2	4.4	756	0.45	0.30	4.9	0.518	1.15	1.4
3438- 604- 033		39.7	316	0.059	1.23	0.45	7.2	2	2.8	448	0.57	1.29	17.5	0.191	1.69	5.8
3438- 604- 153		28.2	229	0.021	0.59	0.35	4.5	1	2.8	597	0.58	0.06	10.9	0.169	1.31	3.2
3438- 604- 562		416	322	0.036	1.69	0.84	6.6	4	5.7	479	0.73	0.63	20.3	0.219	2.13	4.2
3438- 604- 569		21.4	312	0.005	1.23	0.28	5.4	3	4.8	510	1.03	0.18	25.3	0.213	1.89	6.5
3438- 604- 606		17.0	323	0.010	0.89	0.22	3.9	3	4.3	420	1.16	0.19	32.0	0.170	1.85	8.2
3438- 604- 653		21.4	286	0.100	0.96	0.25	6.3	3	4.8	640	0.88	0.16	18.3	0.242	1.70	4.7
3438- 604- 656		14.5	274	0.187	0.75	0.52	5.8	3	3.5	481	0.80	0.27	17.4	0.228	1.64	4.6
3438- 604- 811		50.9	265	0.100	1.46	0.36	4.2	4	2.5	251	0.68	0.52	24.5	0.149	1.85	4.9
3438- 604- 854		32.8	200	0.590	1.74	0.80	2.9	5	2.3	372	0.73	0.22	12.1	0.151	2.32	3.7
3438- 604- 862		9.8	436	0.592	1.51	0.71	18.7	5	2.9	263	0.27	0.69	45.3	0.189	2.72	5.4
3438- 604- 867		10.1	396	0.343	2.74	0.17	6.3	13	5.2	295	0.28	3.94	93.4	0.185	2.94	3.7

***** See Appendix Page for comments regarding this certificate *****

Project: 3438

CERTIFICATE OF ANALYSIS RE11261455

Sample Description	Method Analyte Units LOR	ME- MS61 V ppm 1	ME- MS61 W ppm 0.1	ME- MS61 Y ppm 0.1	ME- MS61 Zn ppm 2	ME- MS61 Zr ppm 0.5	Cu- OG62 Cu % 0.001
3438- SRK- 0864		163	1.6	28.4	131	131.0	
3438- SRK- 0866		133	4.3	28.4	47	47.5	
3438- 604- 033		105	6.8	17.5	135	52.1	
3438- 604- 153		36	8.1	17.3	192	54.7	
3438- 604- 562		50	15.9	25.3	686	20.3	
3438- 604- 569		40	9.6	28.9	36	26.3	
3438- 604- 606		27	8.5	25.5	25	33.6	
3438- 604- 653		47	7.0	28.2	56	16.5	
3438- 604- 656		44	10.5	27.4	49	16.3	
3438- 604- 811		41	14.2	16.6	159	23.6	
3438- 604- 854		39	14.0	18.3	234	21.1	
3438- 604- 862		173	6.1	10.0	123	17.8	
3438- 604- 867		133	8.3	13.4	202	27.0	1.430

***** See Appendix Page for comments regarding this certificate *****

ALS USA Inc.
4977 Energy Way
Reno NV 89502
Phone: 775 356 5395 Fax: 775 355 0179 www.alsglobal.com

To: MCCLELLAND LABS
1016 GREG ST
SPARKS NV 89431

Project: 3438

CERTIFICATE OF ANALYSIS RE11261455

Method	CERTIFICATE COMMENTS
ME-MS61	Interference: Mo> 400ppm on ICP-MS Cd,ICP-AES results shown.
ME-MS61	REE's may not be totally soluble in this method.

ALS Minerals

ALS USA Inc.

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Page: 1
Finalized Date: 25- MAR- 2012
Account: EIM

CERTIFICATE RE12056288

Project: 3438
P.O. No.:
This report is for 2 Crushed Rock samples submitted to our lab in Reno, NV, USA on 13- MAR- 2012.

The following have access to data associated with this certificate:

CHRISTINE DEBURLE	JACK MCPARTLAND	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI- 21	Received Sample Weight
LOG- 22	Sample login - Rcd w/o BarCode
CRU- 31	Fine crushing - 70% <2mm
PUL- 31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
Hg- CV41	Trace Hg - cold vapor/AAS	FIMS
ME- MS61	48 element four acid ICP- MS	

The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim 'or deposit has been determined based on the results of assays of multiple samples of geological materials collected by the prospective investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed project. Statement required by Nevada State Law NRS 519

To: MCCLELLAND LABS
ATTN: JACK MCPARTLAND
1016 GREG ST
SPARKS NV 89431

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:
Colin Ramshaw, Vancouver Laboratory Manager

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Total # Pages: 2 (A - D)
Plus Appendix Pages
Finalized Date: 25- MAR- 2012
Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE12056288

Sample Description	Method	WEI- 21	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61
	Analyte	Recvd Wt.	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe
	Units	kg	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%
	LOR	0.02	0.01	0.01	0.2	10	0.05	0.01	0.01	0.02	0.01	0.1	1	0.05	0.2	0.01
3438- SRK- 0867- (HC- 20)		0.20	1.49	7.46	5.1	760	3.54	1.20	0.57	0.40	72.7	8.2	6	7.11	2400	2.12
3438- 604- 787- (HC- 9)		0.20	5.01	7.31	8.9	740	3.19	1.43	1.05	1.22	73.8	9.9	<1	9.48	5960	3.10

***** See Appendix Page for comments regarding this certificate *****

To: MCCLELLAND LABS
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Project: 3438

CERTIFICATE OF ANALYSIS RE12056288

Sample Description	Method Analyte Units LOR	ME- MS61 Ga ppm 0.05	ME- MS61 Ge ppm 0.05	ME- MS61 Hf ppm 0.1	Hg- CV41 Hg ppm 0.01	ME- MS61 In ppm 0.005	ME- MS61 K % 0.01	ME- MS61 La ppm 0.5	ME- MS61 Li ppm 0.2	ME- MS61 Mg % 0.01	ME- MS61 Mn ppm 5	ME- MS61 Mo ppm 0.05	ME- MS61 Na % 0.01	ME- MS61 Nb ppm 0.1	ME- MS61 Ni ppm 0.2	ME- MS61 P ppm 10
3438- SRK- 0867- (HC- 20)		21.5	0.18	1.5	0.11	0.077	4.58	39.4	11.6	0.27	166	66.1	2.14	11.4	6.4	490
3438- 604- 787- (HC- 9)		20.8	0.21	1.4	0.06	0.146	5.10	38.9	25.9	0.40	269	135.0	1.30	13.3	2.4	450

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Project: 3438

CERTIFICATE OF ANALYSIS RE12056288

Sample Description / Method / Analyte / Units / LOR	ME- MS61 Pb ppm 0.5	ME- MS61 Rb ppm 0.1	ME- MS61 Re ppm 0.002	ME- MS61 S % 0.01	ME- MS61 Sb ppm 0.05	ME- MS61 Sc ppm 0.1	ME- MS61 Se ppm 1	ME- MS61 Sn ppm 0.2	ME- MS61 Sr ppm 0.2	ME- MS61 Ta ppm 0.05	ME- MS61 Te ppm 0.05	ME- MS61 Th ppm 0.2	ME- MS61 Ti % 0.005	ME- MS61 Tl ppm 0.02	ME- MS61 U ppm 0.1
3438- SRK- 0867- (HC- 20)	29.8	249	0.098	0.96	5.80	4.5	3	52.4	410	0.82	0.41	19.3	0.156	1.82	5.3
3438- 604- 787- (HC- 9)	67.5	277	0.112	1.33	0.74	4.8	5	3.0	310	1.06	0.39	25.5	0.169	1.94	9.1

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Finalized Date: 25- MAR- 2012
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Project: 3438

CERTIFICATE OF ANALYSIS RE12056288

Sample Description	Method Analyte Units LOR	ME- MS61 V ppm 1	ME- MS61 W ppm 0.1	ME- MS61 Y ppm 0.1	ME- MS61 Zn ppm 2	ME- MS61 Zr ppm 0.5
3438- SRK- 0867- (HC- 20)		31	8.2	18.0	73	39.3
3438- 604- 787- (HC- 9)		37	10.1	20.0	155	34.9

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Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 25- MAR- 2012
Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE12056288

Method	CERTIFICATE COMMENTS
ME- MS61	REE's may not be totally soluble in this method.

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Page: 1
Finalized Date: 13- MAY- 2013
Account: EIM

CERTIFICATE RE13082519

Project: 3438
P.O. No.:
This report is for 3 Crushed Rock samples submitted to our lab in Reno, NV, USA on 6- MAY- 2013.

The following have access to data associated with this certificate:

CHRISTINE DEBURLE	JACK MCPARTLAND	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI- 21	Received Sample Weight
LOG- 22	Sample login - Rcd w/o BarCode
PUL- 31	Pulverize split to 85% < 75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
Hg- CV41	Trace Hg - cold vapor/AAS	FIMS
ME- MS61	48 element four acid ICP- MS	

The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim 'or deposit has been determined based on the results of assays of multiple samples of geological materials collected by the prospective investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed project. Statement required by Nevada State Law NRS 519

To: MCCLELLAND LABS
ATTN: JACK MCPARTLAND
1016 GREG ST
SPARKS NV 89431

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:
Colin Ramshaw, Vancouver Laboratory Manager

ALS Minerals

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Total # Pages: 2 (A - D)
Plus Appendix Pages
Finalized Date: 13- MAY- 2013
Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13082519

Sample Description	Method Analyte Units LOR	WEI- 21 Recvd Wt. kg 0.02	ME- MS61 Ag ppm 0.01	ME- MS61 Al % 0.01	ME- MS61 As ppm 0.2	ME- MS61 Ba ppm 10	ME- MS61 Be ppm 0.05	ME- MS61 Bi ppm 0.01	ME- MS61 Ca % 0.01	ME- MS61 Cd ppm 0.02	ME- MS61 Ce ppm 0.01	ME- MS61 Co ppm 0.1	ME- MS61 Cr ppm 1	ME- MS61 Cs ppm 0.05	ME- MS61 Cu ppm 0.2	ME- MS61 Fe % 0.01
3438- HC- 25- Residue		0.28	0.59	8.00	0.5	880	3.94	0.83	1.54	0.13	76.7	1.4	9	10.15	269	2.66
3438- HC- 27- Residue		0.26	0.88	7.34	1.2	1080	2.34	0.44	1.13	0.31	90.2	3.5	7	10.65	747	2.05
3438- HC- 28- Residue		0.27	0.76	7.55	<0.2	850	3.45	0.48	1.29	0.12	79.7	1.2	10	9.29	396	1.51

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Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13082519

Sample Description	Method Analyte Units LOR	ME- MS61 Ga ppm 0.05	ME- MS61 Ge ppm 0.05	ME- MS61 Hf ppm 0.1	Hg- CV41 Hg ppm 0.01	ME- MS61 In ppm 0.005	ME- MS61 K % 0.01	ME- MS61 La ppm 0.5	ME- MS61 Li ppm 0.2	ME- MS61 Mg % 0.01	ME- MS61 Mn ppm 5	ME- MS61 Mo ppm 0.05	ME- MS61 Na % 0.01	ME- MS61 Nb ppm 0.1	ME- MS61 Ni ppm 0.2	ME- MS61 P ppm 10
3438- HC- 25- Residue		22.0	0.19	1.4	0.01	0.062	5.08	33.9	13.4	0.57	355	2.90	2.71	14.3	3.7	900
3438- HC- 27- Residue		19.75	0.19	1.1	0.01	0.021	6.41	50.8	21.2	0.75	398	14.20	1.58	10.1	5.4	1010
3438- HC- 28- Residue		19.05	0.18	1.3	0.01	0.023	5.22	40.6	21.5	0.48	231	35.1	2.15	12.9	5.7	550

***** See Appendix Page for comments regarding this certificate *****

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Finalized Date: 13- MAY- 2013
Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13082519

Sample Description	Method Analyte Units LOR	ME- MS61 Pb ppm 0.5	ME- MS61 Rb ppm 0.1	ME- MS61 Re ppm 0.002	ME- MS61 S % 0.01	ME- MS61 Sb ppm 0.05	ME- MS61 Sc ppm 0.1	ME- MS61 Se ppm 1	ME- MS61 Sn ppm 0.2	ME- MS61 Sr ppm 0.2	ME- MS61 Ta ppm 0.05	ME- MS61 Te ppm 0.05	ME- MS61 Th ppm 0.2	ME- MS61 Ti % 0.005	ME- MS61 Tl ppm 0.02	ME- MS61 U ppm 0.1
3438- HC- 25- Residue		16.7	319	<0.002	0.05	0.19	6.4	2	6.6	731	0.88	0.17	15.9	0.280	2.26	4.8
3438- HC- 27- Residue		15.1	363	0.016	0.24	0.35	4.3	2	2.4	350	0.71	0.08	22.3	0.176	2.03	5.2
3438- HC- 28- Residue		12.6	309	0.041	0.07	0.29	3.6	2	3.6	466	0.87	0.09	21.0	0.181	1.74	5.4

***** See Appendix Page for comments regarding this certificate *****

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Project: 3438

CERTIFICATE OF ANALYSIS RE13082519

Sample Description	Method Analyte Units LOR	ME- MS61 V ppm 1	ME- MS61 W ppm 0.1	ME- MS61 Y ppm 0.1	ME- MS61 Zn ppm 2	ME- MS61 Zr ppm 0.5
3438- HC- 25- Residue		59	24.5	29.8	35	25.2
3438- HC- 27- Residue		48	7.0	18.9	54	31.0
3438- HC- 28- Residue		36	11.6	23.2	30	34.1

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Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 13- MAY- 2013
Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13082519

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

REE's may not be totally soluble in this method.

Applies to Method: ME- MS61

LABORATORY ADDRESSES

Processed at ALS Reno located at 4977 Energy Way, Reno, NV, USA.

Applies to Method: LOG- 22 PUL- 31 WEI- 21

Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

Applies to Method: Hg- CV41 ME- MS61

ALS Minerals

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Page: 1
Finalized Date: 12-JUL-2013
Account: EIM

CERTIFICATE RE13120456

Project: 3438
P.O. No.:
This report is for 1 Crushed Rock sample submitted to our lab in Reno, NV, USA on 1-JUL-2013.

The following have access to data associated with this certificate:

CHRISTINE DEBURLE	JACK MCPARTLAND	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-22	Sample login - Rcd w/o BarCode
PUL-31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
Hg-CV41	Trace Hg - cold vapor/AAS	FIMS
ME-MS61	48 element four acid ICP-MS	

The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim 'or deposit has been determined based on the results of assays of multiple samples of geological materials collected by the prospective Investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed project. Statement required by Nevada State Law NRS 519

To: MCCLELLAND LABS
ATTN: JACK MCPARTLAND
1016 GREG ST
SPARKS NV 89431

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:
Colin Ramshaw, Vancouver Laboratory Manager

To: MCCLELLAND LABS
1016 GREG ST
SPARKS NV 89431

Project: 3438

CERTIFICATE OF ANALYSIS RE13120456

Sample Description	Method Analyte Units LOR	WEI- 21 Recvd Wt. kg 0.02	ME- MS61 Ag ppm 0.01	ME- MS61 Al % 0.01	ME- MS61 As ppm 0.2	ME- MS61 Ba ppm 10	ME- MS61 Be ppm 0.05	ME- MS61 Bi ppm 0.01	ME- MS61 Ca % 0.01	ME- MS61 Cd ppm 0.02	ME- MS61 Ce ppm 0.01	ME- MS61 Co ppm 0.1	ME- MS61 Cr ppm 1	ME- MS61 Cs ppm 0.05	ME- MS61 Cu ppm 0.2	ME- MS61 Fe % 0.01
3438- 604673- HC- 7- Residue		0.27	0.67	7.22	1.0	430	3.14	0.34	0.17	0.11	90.9	3.0	<1	6.16	1150	0.82

***** See Appendix Page for comments regarding this certificate *****

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Project: 3438

CERTIFICATE OF ANALYSIS RE13120456

Method	ME-MS61	ME-MS61	ME-MS61	Hg-CV41	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61
Analyte	Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P
Units	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm
Sample Description / LOR	0.05	0.05	0.1	0.01	0.005	0.01	0.5	0.2	0.01	5	0.05	0.01	0.1	0.2	10
3438-604673-HC-7-Residue	19.40	0.15	2.8	0.01	0.026	5.03	46.6	6.0	0.11	31	155.0	1.88	15.4	1.0	150

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Total # Pages: 2 (A - D)
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Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13120456

Sample Description	Method Analyte Units LOR	ME- MS61 Pb ppm 0.5	ME- MS61 Rb ppm 0.1	ME- MS61 Re ppm 0.002	ME- MS61 S % 0.01	ME- MS61 Sb ppm 0.05	ME- MS61 Sc ppm 0.1	ME- MS61 Se ppm 1	ME- MS61 Sn ppm 0.2	ME- MS61 Sr ppm 0.2	ME- MS61 Ta ppm 0.05	ME- MS61 Te ppm 0.05	ME- MS61 Th ppm 0.2	ME- MS61 Ti % 0.005	ME- MS61 Tl ppm 0.02	ME- MS61 U ppm 0.1
3438- 604673- HC- 7- Residue		21.3	216	0.172	0.47	0.22	1.6	2	1.7	236	1.27	0.08	35.3	0.074	2.01	7.7

***** See Appendix Page for comments regarding this certificate *****

ALS USA Inc.

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Finalized Date: 12-JUL-2013
Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13120456

Sample Description	Method Analyte Units LOR	ME-MS61 V ppm 1	ME-MS61 W ppm 0.1	ME-MS61 Y ppm 0.1	ME-MS61 Zn ppm 2	ME-MS61 Zr ppm 0.5
3438-604673-HC-7-Residue		9	7.0	18.0	12	64.4

***** See Appendix Page for comments regarding this certificate *****

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Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13120456

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method:	REE's may not be totally soluble in this method. ME- MS61

LABORATORY ADDRESSES

	Processed at ALS Reno located at 4977 Energy Way, Reno, NV, USA.		
Applies to Method:	LOG- 22	PUL- 31	WEI- 21
	Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.		
Applies to Method:	Hg- CV41	ME- MS61	

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Page: 1
Finalized Date: 15- AUG- 2013
Account: EIM

CERTIFICATE RE13143042

Project: 3438
P.O. No.:
This report is for 2 Crushed Rock samples submitted to our lab in Reno, NV, USA on 7- AUG- 2013.

The following have access to data associated with this certificate:

CHRISTINE DEBURLE	JACK MCPARTLAND	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI- 21	Received Sample Weight
LOG- 22	Sample login - Rcd w/o BarCode
PUL- 31	Pulverize split to 85% < 75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
Hg- CV41	Trace Hg - cold vapor/AAS	FIMS
ME- MS61	48 element four acid ICP- MS	

The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim 'or deposit has been determined based on the results of assays of multiple samples of geological materials collected by the prospective investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed project. Statement required by Nevada State Law NRS 519

To: MCCLELLAND LABS
ATTN: JACK MCPARTLAND
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***** See Appendix Page for comments regarding this certificate *****

Signature:
Colin Ramshaw, Vancouver Laboratory Manager

ALS Minerals

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Plus Appendix Pages
Finalized Date: 15- AUG- 2013
Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13143042

Sample Description	Method	WEI- 21	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61
	Analyte	Recvd Wt.	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe
	Units	kg	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%
	LOR	0.02	0.01	0.01	0.2	10	0.05	0.01	0.01	0.02	0.01	0.1	1	0.05	0.2	0.01
3438- HC- 22- Residue		0.28	1.47	8.37	3.6	820	3.83	5.42	1.21	0.31	88.7	8.7	1	9.96	1370	3.38
3438- HC- 23- Residue		0.28	1.38	8.26	1.8	750	4.25	0.50	1.57	0.24	88.8	7.9	1	7.37	1470	3.15

***** See Appendix Page for comments regarding this certificate *****

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Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13143042

Sample Description	Method Analyte Units LOR	ME- MS61 Ga ppm 0.05	ME- MS61 Ge ppm 0.05	ME- MS61 Hf ppm 0.1	Hg- CV41 Hg ppm 0.01	ME- MS61 In ppm 0.005	ME- MS61 K % 0.01	ME- MS61 La ppm 0.5	ME- MS61 Li ppm 0.2	ME- MS61 Mg % 0.01	ME- MS61 Mn ppm 5	ME- MS61 Mo ppm 0.05	ME- MS61 Na % 0.01	ME- MS61 Nb ppm 0.1	ME- MS61 Ni ppm 0.2	ME- MS61 P ppm 10
3438- HC- 22- Residue		24.2	0.19	1.5	0.01	0.070	5.19	40.0	16.3	0.46	286	2.60	2.51	11.8	2.3	870
3438- HC- 23- Residue		23.7	0.24	1.3	0.05	0.084	4.87	41.0	13.5	0.49	369	4.75	2.70	14.7	3.5	730

***** See Appendix Page for comments regarding this certificate *****

ALS Minerals

ALS USA Inc.
4977 Energy Way
Reno NV 89502
Phone: 775 356 5395 Fax: 775 355 0179 www.alsglobal.com

To: MCCLELLAND LABS
1016 GREG ST
SPARKS NV 89431

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Finalized Date: 15- AUG- 2013
Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13143042

Sample Description	Method Analyte Units LOR	ME- MS61 Pb ppm 0.5	ME- MS61 Rb ppm 0.1	ME- MS61 Re ppm 0.002	ME- MS61 S % 0.01	ME- MS61 Sb ppm 0.05	ME- MS61 Sc ppm 0.1	ME- MS61 Se ppm 1	ME- MS61 Sn ppm 0.2	ME- MS61 Sr ppm 0.2	ME- MS61 Ta ppm 0.05	ME- MS61 Te ppm 0.05	ME- MS61 Th ppm 0.2	ME- MS61 Ti % 0.005	ME- MS61 Tl ppm 0.02	ME- MS61 U ppm 0.1
3438- HC- 22- Residue		21.4	316	<0.002	1.73	0.96	6.8	3	6.7	601	0.80	2.89	18.2	0.245	2.42	4.9
3438- HC- 23- Residue		18.2	295	0.002	1.10	0.83	6.5	3	5.4	672	1.00	0.17	20.9	0.245	1.97	5.7

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Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13143042

Sample Description	Method Analyte Units LOR	ME- MS61 V ppm 1	ME- MS61 W ppm 0.1	ME- MS61 Y ppm 0.1	ME- MS61 Zn ppm 2	ME- MS61 Zr ppm 0.5
3438- HC- 22- Residue		57	25.9	28.1	46	23.8
3438- HC- 23- Residue		47	18.6	34.6	42	21.7

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Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13143042

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

	REE's may not be totally soluble in this method.		
Applies to Method:	ME- MS61		

LABORATORY ADDRESSES

	Processed at ALS Reno located at 4977 Energy Way, Reno, NV, USA.		
Applies to Method:	LOG- 22	PUL- 31	WEI- 21
	Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.		
Applies to Method:	Hg- CV41	ME- MS61	

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Page: 1
Finalized Date: 26- FEB- 2013
Account: EIM

CERTIFICATE RE13033765

Project: 3438
P.O. No.:
This report is for 2 Crushed Rock samples submitted to our lab in Reno, NV, USA on 20- FEB- 2013.

The following have access to data associated with this certificate:

CHRISTINE DEBURLE	JACK MCPARTLAND	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI- 21	Received Sample Weight
LOG- 22	Sample login - Rcd w/o BarCode
PUL- 31	Pulverize split to 85% < 75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
Hg- CV41	Trace Hg - cold vapor/AAS	FIMS
ME- MS61	48 element four acid ICP- MS	

The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim 'or deposit has been determined based on the results of assays of multiple samples of geological materials collected by the prospective investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed project. Statement required by Nevada State Law NRS 519

To: MCCLELLAND LABS
ATTN: JACK MCPARTLAND
1016 GREG ST
SPARKS NV 89431

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:
Colin Ramshaw, Vancouver Laboratory Manager

ALS Minerals

ALS USA Inc.

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Total # Pages: 2 (A - D)
Plus Appendix Pages
Finalized Date: 26- FEB- 2013
Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13033765

Sample Description															
Method	WEI- 21	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61
Analyte	Recvd Wt.	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe
Units	kg	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%
LOR	0.02	0.01	0.01	0.2	10	0.05	0.01	0.01	0.02	0.01	0.1	1	0.05	0.2	0.01
3438- SRK- 0854- HC- 16- Residue	0.27	4.80	7.95	4.1	1150	2.76	2.01	0.44	<0.5	102.0	5.2	4	5.76	7490	2.01
3438- SRK- 0872- HC- 21- Residue	0.27	0.65	7.85	2.4	830	3.20	1.53	0.37	0.24	71.2	7.2	4	6.60	870	2.27

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Finalized Date: 26- FEB- 2013
Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13033765

Sample Description	Method Analyte Units LOR	ME- MS61 Ga ppm 0.05	ME- MS61 Ge ppm 0.05	ME- MS61 Hf ppm 0.1	Hg- CV41 Hg ppm 0.01	ME- MS61 In ppm 0.005	ME- MS61 K % 0.01	ME- MS61 La ppm 0.5	ME- MS61 Li ppm 0.2	ME- MS61 Mg % 0.01	ME- MS61 Mn ppm 5	ME- MS61 Mo ppm 0.05	ME- MS61 Na % 0.01	ME- MS61 Nb ppm 0.1	ME- MS61 Ni ppm 0.2	ME- MS61 P ppm 10
3438- SRK- 0854- HC- 16- Residue		19.60	0.20	1.5	0.04	0.198	6.09	67.6	15.2	0.25	62	621	1.90	10.2	3.3	590
3438- SRK- 0872- HC- 21- Residue		19.00	0.20	1.6	0.02	0.025	5.26	36.5	11.3	0.23	112	12.30	1.92	9.5	1.8	370

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Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13033765

Sample Description / Method / Analyte / Units / LOR	ME- MS61 Pb ppm 0.5	ME- MS61 Rb ppm 0.1	ME- MS61 Re ppm 0.002	ME- MS61 S % 0.01	ME- MS61 Sb ppm 0.05	ME- MS61 Sc ppm 0.1	ME- MS61 Se ppm 1	ME- MS61 Sn ppm 0.2	ME- MS61 Sr ppm 0.2	ME- MS61 Ta ppm 0.05	ME- MS61 Te ppm 0.05	ME- MS61 Th ppm 0.2	ME- MS61 Ti % 0.005	ME- MS61 Tl ppm 0.02	ME- MS61 U ppm 0.1
3438- SRK- 0854- HC- 16- Residue	71.8	311	0.991	0.95	1.15	4.0	8	15.1	432	0.69	0.64	17.7	0.152	1.98	3.7
3438- SRK- 0872- HC- 21- Residue	35.1	290	0.018	1.52	0.56	4.1	4	5.1	338	0.61	0.24	16.6	0.123	2.06	4.0

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Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13033765

Sample Description	Method	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61
	Analyte	V	W	Y	Zn	Zr
	Units	ppm	ppm	ppm	ppm	ppm
	LOR	1	0.1	0.1	2	0.5
3438- SRK- 0854- HC- 16- Residue		34	8.1	15.8	55	41.5
3438- SRK- 0872- HC- 21- Residue		30	11.1	13.2	32	40.4

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Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13033765

Method	CERTIFICATE COMMENTS
ME- MS61	Interference: Mo> 400ppm on ICP- MS Cd,ICP- AES results shown.
ME- MS61	REE's may not be totally soluble in this method.

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Page: 1
Finalized Date: 10- DEC- 2012
Account: EIM

CERTIFICATE RE12282178

Project: 3438
P.O. No.:
This report is for 3 Crushed Rock samples submitted to our lab in Reno, NV, USA on 29- NOV- 2012.

The following have access to data associated with this certificate:

CHRISTINE DEBURLE	JACK MCPARTLAND	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI- 21	Received Sample Weight
LOG- 22	Sample login - Rcd w/o BarCode
PUL- 31	Pulverize split to 85% < 75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
Hg- CV41	Trace Hg - cold vapor/AAS	FIMS
ME- MS61	48 element four acid ICP- MS	

The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim 'or deposit has been determined based on the results of assays of multiple samples of geological materials collected by the prospective Investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed project. Statement required by Nevada State Law NRS 519

To: MCCLELLAND LABS
ATTN: JACK MCPARTLAND
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SPARKS NV 89431

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:
Colin Ramshaw, Vancouver Laboratory Manager

ALS USA Inc.

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Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE12282178

Method	WEI- 21	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61
Analyte	Recvd Wt.	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe
Units	kg	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%
Sample Description LOR	0.02	0.01	0.01	0.2	10	0.05	0.01	0.01	0.02	0.01	0.1	1	0.05	0.2	0.01
3438- HC- 1- Copper- Flat- Cu- Ro.Tail	0.22	1.07	7.51	5.2	800	3.16	0.61	1.52	0.79	64.6	7.6	17	8.28	740	2.52
3438- HC- 6- 604669	0.23	2.27	7.71	1.9	520	3.30	2.00	0.32	0.94	96.0	6.8	2	8.41	3260	1.66
3438- HC- 17- SRK0858	0.23	0.37	7.96	1.2	710	3.60	2.14	0.43	0.04	52.8	5.4	2	7.66	249	2.25

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Project: 3438

CERTIFICATE OF ANALYSIS RE12282178

Sample Description	Method Analyte Units LOR	ME- MS61 Ga ppm 0.05	ME- MS61 Ge ppm 0.05	ME- MS61 Hf ppm 0.1	Hg- CV41 Hg ppm 0.01	ME- MS61 In ppm 0.005	ME- MS61 K % 0.01	ME- MS61 La ppm 0.5	ME- MS61 Li ppm 0.2	ME- MS61 Mg % 0.01	ME- MS61 Mn ppm 5	ME- MS61 Mo ppm 0.05	ME- MS61 Na % 0.01	ME- MS61 Nb ppm 0.1	ME- MS61 Ni ppm 0.2	ME- MS61 P ppm 10
3438- HC- 1- Copper- Flat- Cu- Ro.Tail		20.2	0.10	1.0	0.03	0.037	5.25	31.0	21.3	0.46	454	17.25	1.74	10.5	13.0	640
3438- HC- 6- 604669		20.3	0.08	1.9	0.02	0.083	5.59	48.1	10.3	0.23	319	87.6	1.47	15.7	1.2	430
3438- HC- 17- SRK0858		20.0	0.07	1.3	<0.01	0.039	5.00	26.9	11.2	0.20	79	5.90	2.39	11.1	1.0	460

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Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE12282178

Sample Description / Method Analyte Units LOR	ME- MS61 Pb ppm 0.5	ME- MS61 Rb ppm 0.1	ME- MS61 Re ppm 0.002	ME- MS61 S % 0.01	ME- MS61 Sb ppm 0.05	ME- MS61 Sc ppm 0.1	ME- MS61 Se ppm 1	ME- MS61 Sn ppm 0.2	ME- MS61 Sr ppm 0.2	ME- MS61 Ta ppm 0.05	ME- MS61 Te ppm 0.05	ME- MS61 Th ppm 0.2	ME- MS61 Ti % 0.005	ME- MS61 Tl ppm 0.02	ME- MS61 U ppm 0.1
3438- HC- 1- Copper- Flat- Cu- Ro.Tail	57.5	313	0.016	0.77	0.46	4.8	1	3.3	363	0.82	0.22	22.6	0.174	1.86	6.0
3438- HC- 6- 604669	111.5	324	0.075	0.82	0.37	3.5	2	3.6	271	1.34	0.26	29.7	0.159	1.98	7.1
3438- HC- 17- SRK0858	15.4	282	0.006	0.85	0.21	3.9	2	4.9	462	0.89	0.29	17.0	0.195	1.94	4.3

09010

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Project: 3438

CERTIFICATE OF ANALYSIS RE12282178

Sample Description	Method Analyte Units LOR	ME- MS61 V ppm 1	ME- MS61 W ppm 0.1	ME- MS61 Y ppm 0.1	ME- MS61 Zn ppm 2	ME- MS61 Zr ppm 0.5
3438- HC- 1- Copper- Flat- Cu- Ro.Tail		47	9.1	20.1	117	25.7
3438- HC- 6- 604669		28	10.0	25.0	112	41.1
3438- HC- 17- SRK0858		37	9.8	14.7	18	26.5

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Project: 3438

CERTIFICATE OF ANALYSIS   RE12282178

Method	CERTIFICATE COMMENTS
ME- MS61	REE's may not be totally soluble in this method.

ALS Minerals

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Page: 1
Finalized Date: 16- AUG- 2013
Account: EIM

CERTIFICATE RE13143328

Project: 3438
P.O. No.:
This report is for 6 Crushed Rock samples submitted to our lab in Reno, NV, USA on 8- AUG- 2013.

The following have access to data associated with this certificate:

CHRISTINE DEBURLE	JACK MCPARTLAND	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI- 21	Received Sample Weight
LOG- 22	Sample login - Rcd w/o BarCode
PUL- 31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
Hg- CV41	Trace Hg - cold vapor/AAS	FIMS
ME- MS61	48 element four acid ICP- MS	

The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim 'or deposit has been determined based on the results of assays of multiple samples of geological materials collected by the prospective investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed project. Statement required by Nevada State Law NRS 519

To: MCCLELLAND LABS
ATTN: JACK MCPARTLAND
1016 GREG ST
SPARKS NV 89431

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:
Colin Ramshaw, Vancouver Laboratory Manager

ALS Minerals

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Project: 3438

CERTIFICATE OF ANALYSIS RE13143328

Sample Description	Method	WEI- 21	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61
	Analyte	Recvd Wt.	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe
	Units	kg	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%
	LOR	0.02	0.01	0.01	0.2	10	0.05	0.01	0.01	0.02	0.01	0.1	1	0.05	0.2	0.01
3438- HC- 24- Residue		0.28	0.70	8.59	1.4	830	4.26	0.64	1.69	0.16	70.6	1.4	8	9.08	273	2.60
3438- HC- 26- Residue		0.27	1.44	7.40	2.2	900	3.00	1.11	1.48	0.55	51.3	6.2	15	11.80	881	1.39
3438- HC- 29- Residue		0.27	0.72	7.29	7.9	850	2.53	0.67	1.32	0.75	59.5	12.4	280	8.06	180.0	3.19
3438- HC- 30- Residue		0.27	0.69	8.08	6.7	930	3.13	0.76	1.37	0.57	75.1	11.4	284	7.84	216	2.46
3438- HC- 31- Residue		0.27	0.60	7.86	3.2	740	3.81	0.56	1.44	0.77	73.7	9.3	269	7.97	191.5	2.14
3438- HC- 8- Residue		0.27	5.18	7.71	15.3	1020	2.15	1.93	0.45	2.80	64.9	24.5	2	7.15	5970	3.62

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CERTIFICATE OF ANALYSIS RE13143328

Sample Description	Method	ME- MS61	ME- MS61	ME- MS61	Hg- CV41	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61	ME- MS61
	Analyte	Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P
	Units	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm
	LOR	0.05	0.05	0.1	0.01	0.005	0.01	0.5	0.2	0.01	5	0.05	0.01	0.1	0.2	10
3438- HC- 24- Residue		21.4	0.14	1.3	<0.1	0.049	4.72	32.9	14.0	0.53	359	2.89	2.87	13.5	3.6	880
3438- HC- 26- Residue		16.25	0.13	1.1	0.01	0.036	4.75	24.4	20.2	0.37	214	49.8	1.70	8.2	5.8	430
3438- HC- 29- Residue		18.00	0.16	1.1	0.01	0.019	5.34	31.7	23.3	0.49	391	37.3	1.39	9.1	181.5	520
3438- HC- 30- Residue		18.10	0.15	1.2	0.01	0.022	5.31	40.1	17.3	0.38	281	32.1	1.72	9.8	196.5	520
3438- HC- 31- Residue		17.90	0.18	1.2	0.01	0.022	4.96	37.4	14.7	0.33	299	27.9	2.01	12.0	174.5	550
3438- HC- 8- Residue		18.00	0.14	1.0	<0.01	0.174	6.33	33.6	13.3	0.35	306	26.1	1.05	9.9	3.9	540

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Project: 3438

CERTIFICATE OF ANALYSIS RE13143328

Sample Description / Method / Analyte / Units / LOR	ME- MS61 Pb ppm 0.5	ME- MS61 Rb ppm 0.1	ME- MS61 Re ppm 0.002	ME- MS61 S % 0.01	ME- MS61 Sb ppm 0.05	ME- MS61 Sc ppm 0.1	ME- MS61 Se ppm 1	ME- MS61 Sn ppm 0.2	ME- MS61 Sr ppm 0.2	ME- MS61 Ta ppm 0.05	ME- MS61 Te ppm 0.05	ME- MS61 Th ppm 0.2	ME- MS61 Ti % 0.005	ME- MS61 Tl ppm 0.02	ME- MS61 U ppm 0.1
3438- HC- 24- Residue	24.1	302	<0.002	0.04	0.23	6.0	2	5.9	789	0.85	0.42	13.9	0.266	1.93	4.7
3438- HC- 26- Residue	62.2	272	0.053	0.36	0.35	3.2	1	2.7	333	0.61	0.30	20.3	0.130	1.49	6.1
3438- HC- 29- Residue	34.5	318	0.038	1.07	0.43	4.3	3	2.5	329	0.66	0.21	21.2	0.156	1.69	5.5
3438- HC- 30- Residue	29.0	311	0.019	1.00	0.33	3.8	3	3.2	407	0.71	0.25	21.2	0.154	1.75	5.0
3438- HC- 31- Residue	33.1	296	0.019	0.76	0.42	3.8	2	3.7	435	0.86	0.21	21.0	0.170	1.74	5.3
3438- HC- 8- Residue	100.5	208	0.045	2.62	0.42	4.1	6	2.2	323	0.86	1.12	34.3	0.136	2.25	13.8

***** See Appendix Page for comments regarding this certificate *****

To: MCCLELLAND LABS
1016 GREG ST
SPARKS NV 89431

Project: 3438

CERTIFICATE OF ANALYSIS RE13143328

Sample Description	Method Analyte Units LOR	ME- MS61 V ppm 1	ME- MS61 W ppm 0.1	ME- MS61 Y ppm 0.1	ME- MS61 Zn ppm 2	ME- MS61 Zr ppm 0.5
3438- HC- 24- Residue		55	16.4	29.3	41	20.9
3438- HC- 26- Residue		29	10.7	16.8	77	34.9
3438- HC- 29- Residue		55	7.8	18.6	103	28.8
3438- HC- 30- Residue		42	8.6	20.6	78	32.6
3438- HC- 31- Residue		34	8.5	22.6	97	30.3
3438- HC- 8- Residue		50	11.7	19.1	309	29.5

***** See Appendix Page for comments regarding this certificate *****

ALS Minerals
ALS USA Inc.
4977 Energy Way
Reno NV 89502
Phone: 775 356 5395 Fax: 775 355 0179 www.alsglobal.com

To: MCCLELLAND LABS
1016 GREG ST
SPARKS NV 89431

Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 16- AUG- 2013
Account: EIM

Project: 3438

CERTIFICATE OF ANALYSIS RE13143328

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

REE's may not be totally soluble in this method.
Applies to Method: ME- MS61

Detection limits on samples requiring dilutions due to interferences or high concentration levels have been increased according to the dilution factor.
Applies to Method: Hg- CV41

LABORATORY ADDRESSES

Processed at ALS Reno located at 4977 Energy Way, Reno, NV, USA.
Applies to Method: LOG- 22 PUL- 31 WEI- 21

Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.
Applies to Method: Hg- CV41 ME- MS61

SVL Reports

One Government Gulch - PO Box 929 Kellogg ID 83837-0929 (208) 784-1258 Fax (208) 783-0891

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W4A0022**
Reported: 17-Jan-14 08:59

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Sampled By	Date Received
3438 SRK0854 HC-16 RESIDUE	W4A0022-01	Soil	30-Dec-13 09:00	TJ	03-Jan-2014
3438 SRK0872 HC-21 RESIDUE	W4A0022-02	Soil	30-Dec-13 09:00	TJ	03-Jan-2014

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested. Non-Detects are reported at the MDL.
Sample preparation is defined by the client as per their Data Quality Objectives.
This report supercedes any previous reports for this Work Order. The complete report includes pages for each sample, a full QC report, and a notes section.
The results presented in this report relate only to the samples, and meet all requirements of the NELAC Standards unless otherwise noted.

(Q6) SVL received the following containers outside of published EPA guidelines for preservation temperatures (0-6°C).
The guidelines do not pertain to nitric-preserved metals.

Default Cooler (Received Temperature: 9.8°C)

Labnumber	Container	Client ID	Labnumber	Container	Client ID
W4A0022-01 A	Bag	3438 SRK0854 HC-16 RESIDUE	W4A0022-01 B	Manila Pulverize	3438 SRK0854 HC-16 RESIDUE
W4A0022-02 A	Bag	3438 SRK0872 HC-21 RESIDUE	W4A0022-02 B	Manila Pulverize	3438 SRK0872 HC-21 RESIDUE

Case Narrative

Nevada does not accredit for NAG titration.

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W4A0022**
Reported: 17-Jan-14 08:59

Client Sample ID: **3438 SRK0854 HC-16 RESIDUE**
SVL Sample ID: **W4A0022-01 (Soil)**

Sample Report Page 1 of 1

Sampled: 30-Dec-13 09:00
Received: 03-Jan-14
Sampled By: TJ

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Classical Chemistry Parameters										
NAG	**NAG pH @20.3°C**	4.01	pH Units				W403132	AGF	01/16/14 14:25	
NAG	NAG@pH 4.5	0	kg H2SO4/T	0.1			W403132	AGF	01/16/14 14:25	
NAG	NAG@pH 7	0	kg H2SO4/T	0.1			W403132	AGF	01/16/14 14:25	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W4A0022**
Reported: 17-Jan-14 08:59

Client Sample ID: **3438 SRK0872 HC-21 RESIDUE**
SVL Sample ID: **W4A0022-02 (Soil)**

Sample Report Page 1 of 1

Sampled: 30-Dec-13 09:00
Received: 03-Jan-14
Sampled By: TJ

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Classical Chemistry Parameters										
NAG	**NAG pH @20.5°C**	2.82	pH Units				W403132	AGF	01/16/14 14:25	
NAG	**NAG@pH 4.5**	15.4	kg H2SO4/T	0.1			W403132	AGF	01/16/14 14:25	
NAG	**NAG@pH 7**	10.0	kg H2SO4/T	0.1			W403132	AGF	01/16/14 14:25	

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John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W4A0022**
Reported: 17-Jan-14 08:59

Quality Control - LABORATORY CONTROL SAMPLE Data

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Classical Chemistry Parameters									
NAG	NAG pH	pH Units	7.33	7.93	92.4	90 - 110	W403132	16-Jan-14	

Quality Control - DUPLICATE Data

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Classical Chemistry Parameters									
NAG	NAG pH	pH Units	3.74	3.72	0.5	20	W403132	16-Jan-14	
NAG	NAG@pH 4.5	kg H2SO4/T	0.6	0.6	0.0	20	W403132	16-Jan-14	
NAG	NAG@pH 7	kg H2SO4/T	20.2	20.6	1.9	20	W403132	16-Jan-14	

Notes and Definitions

LCS	Laboratory Control Sample (Blank Spike)
RPD	Relative Percent Difference
UDL	A result is less than the detection limit
R > 4S	% recovery not applicable, sample concentration more than four times greater than spike level
<RL	A result is less than the reporting limit
MRL	Method Reporting Limit
MDL	Method Detection Limit
N/A	Not Applicable

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McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
3438 HC-25 RESIDUE	W3L0454-01	Solid	06-May-13 09:00	27-Dec-2013
3438 HC-27 RESIDUE	W3L0454-02	Solid	06-May-13 09:00	27-Dec-2013
3438 HC-28 RESIDUE	W3L0454-03	Solid	06-May-13 09:00	27-Dec-2013
3438 604669 HC-6	W3L0454-04	Solid	—	27-Dec-2013
3438 604787 HC-9	W3L0454-05	Solid	—	27-Dec-2013
3438 SRK 0858 HC-17	W3L0454-06	Solid	—	27-Dec-2013
3438 SRK 0867 HC-20	W3L0454-07	Solid	—	27-Dec-2013
3438-01 COPPER FLAT CU R TAIL HC-1	W3L0454-08	Solid	—	27-Dec-2013
3438-604673 HC-7 RESIDUE	W3L0454-09	Solid	—	27-Dec-2013
HC-24 RESIDUE	W3L0454-10	Solid	08-Aug-13 11:00	27-Dec-2013
HC-29 RESIDUE	W3L0454-11	Solid	08-Aug-13 11:00	27-Dec-2013
HC-26 RESIDUE	W3L0454-12	Solid	08-Aug-13 11:00	27-Dec-2013
HC-30 RESIDUE	W3L0454-13	Solid	08-Aug-13 11:00	27-Dec-2013
HC-31 RESIDUE	W3L0454-14	Solid	08-Aug-13 11:00	27-Dec-2013
HC-8 RESIDUE	W3L0454-15	Solid	08-Aug-13 11:00	27-Dec-2013
HC-22 RESIDUE	W3L0454-16	Solid	07-Aug-13 11:00	27-Dec-2013
HC-23 RESIDUE	W3L0454-17	Solid	07-Aug-13 11:00	27-Dec-2013

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested. Non-Detects are reported at the MDL.
Sample preparation is defined by the client as per their Data Quality Objectives.
This report supercedes any previous reports for this Work Order. The complete report includes pages for each sample, a full QC report, and a notes section.
The results presented in this report relate only to the samples, and meet all requirements of the NELAC Standards unless otherwise noted.

Case Narrative

Nevada does not accredit for NAG.

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

Client Sample ID: **3438 HC-25 RESIDUE**
SVL Sample ID: **W3L0454-01 (Solid)**

Sample Report Page 1 of 1

Sampled: 06-May-13 09:00
Received: 27-Dec-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Classical Chemistry Parameters										
NAG	**NAG pH @21.3°C**	8.00	pH Units				W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 4.5	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 7	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

SVL holds the following certifications:
AZ:0538, **CA**:2080, **FL**(**NELAC**):E87993, **ID**:ID00019 & ID00965 (Microbiology), **NV**:ID000192007A, **WA**:C573

McClelland Laboratories Inc	**Project Name: MLI: 3438**
1016 Greg Street	Work Order: **W3L0454**
Sparks, NV 89431	Reported: 13-Jan-14 15:29

Client Sample ID: **3438 HC-27 RESIDUE**
SVL Sample ID: **W3L0454-02 (Solid)**

Sample Report Page 1 of 1

Sampled: 06-May-13 09:00
Received: 27-Dec-13
Sampled By:

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
NAG	**NAG pH @21.0°C**	8.20	pH Units				W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 4.5	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 7	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

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John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

Client Sample ID: **3438 HC-28 RESIDUE**
SVL Sample ID: **W3L0454-03 (Solid)**

Sample Report Page 1 of 1

Sampled: 06-May-13 09:00
Received: 27-Dec-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Classical Chemistry Parameters										
NAG	**NAG pH @21.5°C**	8.74	pH Units				W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 4.5	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 7	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

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McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

Client Sample ID: **3438 604669 HC-6**
SVL Sample ID: **W3L0454-04 (Solid)**

Sample Report Page 1 of 1

Sampled: —
Received: 27-Dec-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Classical Chemistry Parameters										
NAG	**NAG pH @21.4°C**	2.95	pH Units				W402104	AGF	01/13/14 12:30	
NAG	**NAG@pH 4.5**	4.5	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	**NAG@pH 7**	5.8	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

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John Kern

John Kern
Laboratory Director

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McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

Client Sample ID: **3438 604787 HC-9**
SVL Sample ID: **W3L0454-05 (Solid)**

Sample Report Page 1 of 1

Sampled: —
Received: 27-Dec-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Classical Chemistry Parameters										
NAG	**NAG pH @21.3°C**	4.96	pH Units				W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 4.5	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 7	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

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John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

Client Sample ID: **3438 SRK 0858 HC-17**
SVL Sample ID: **W3L0454-06 (Solid)**

Sample Report Page 1 of 1

Sampled: —
Received: 27-Dec-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Classical Chemistry Parameters										
NAG	**NAG pH @20.2°C**	2.59	pH Units				W402104	AGF	01/13/14 12:30	
NAG	**NAG@pH 4.5**	14.4	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	**NAG@pH 7**	1.9	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

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John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

Client Sample ID: **3438 SRK 0867 HC-20**
SVL Sample ID: **W3L0454-07 (Solid)**

Sample Report Page 1 of 1

Sampled: —
Received: 27-Dec-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Classical Chemistry Parameters										
NAG	**NAG pH @19.8°C**	2.81	pH Units				W402104	AGF	01/13/14 12:30	
NAG	**NAG@pH 4.5**	6.4	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	**NAG@pH 7**	5.2	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

Client Sample ID: **3438-01 COPPER FLAT CU R TAIL HC-1**
SVL Sample ID: **W3L0454-08 (Solid)**

Sample Report Page 1 of 1

Sampled: —
Received: 27-Dec-13
Sampled By:

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
NAG	**NAG pH @20.0°C**	9.88	pH Units				W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 4.5	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 7	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

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John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

Client Sample ID: **3438-604673 HC-7 RESIDUE**
SVL Sample ID: **W3L0454-09 (Solid)**

Sample Report Page 1 of 1

Sampled: —
Received: 27-Dec-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Classical Chemistry Parameters										
NAG	**NAG pH @19.8°C**	2.78	pH Units				W402104	AGF	01/13/14 12:30	
NAG	**NAG@pH 4.5**	6.8	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	**NAG@pH 7**	2.9	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

Client Sample ID: **HC-24 RESIDUE**
SVL Sample ID: **W3L0454-10 (Solid)**

Sample Report Page 1 of 1

Sampled: 08-Aug-13 11:00
Received: 27-Dec-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Classical Chemistry Parameters										
NAG	**NAG pH @21.0°C**	6.99	pH Units				W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 4.5	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 7	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

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John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

Client Sample ID: **HC-29 RESIDUE**
SVL Sample ID: **W3L0454-11 (Solid)**

Sample Report Page 1 of 1

Sampled: 08-Aug-13 11:00
Received: 27-Dec-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Classical Chemistry Parameters										
NAG	**NAG pH @20.6°C**	8.40	pH Units				W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 4.5	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 7	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

Client Sample ID: **HC-26 RESIDUE**
SVL Sample ID: **W3L0454-12 (Solid)**

Sample Report Page 1 of 1

Sampled: 08-Aug-13 11:00
Received: 27-Dec-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Classical Chemistry Parameters										
NAG	**NAG pH @21.0°C**	9.64	pH Units				W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 4.5	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 7	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

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Laboratory Director

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AZ:0538, **CA**:2080, **FL**(**NELAC**):E87993, **ID**:ID00019 & ID00965 (Microbiology), **NV**:ID000192007A, **WA**:C573

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McClelland Laboratories Inc	**Project Name: MLI: 3438**
1016 Greg Street	Work Order: **W3L0454**
Sparks, NV 89431	Reported: 13-Jan-14 15:29

Client Sample ID: **HC-30 RESIDUE**

SVL Sample ID: **W3L0454-13 (Solid)**

Sample Report Page 1 of 1

Sampled: 08-Aug-13 11:00
Received: 27-Dec-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Classical Chemistry Parameters										
NAG	**NAG pH @20.2°C**	8.25	pH Units				W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 4.5	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 7	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc	**Project Name: MLI: 3438**
1016 Greg Street	Work Order: **W3L0454**
Sparks, NV 89431	Reported: 13-Jan-14 15:29

Client Sample ID: **HC-31 RESIDUE**
SVL Sample ID: **W3L0454-14 (Solid)**

Sample Report Page 1 of 1

Sampled: 08-Aug-13 11:00
Received: 27-Dec-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Classical Chemistry Parameters										
NAG	**NAG pH @19.9°C**	8.20	pH Units				W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 4.5	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	NAG@pH 7	0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

Client Sample ID: **HC-8 RESIDUE**
SVL Sample ID: **W3L0454-15 (Solid)**

Sample Report Page 1 of 1

Sampled: 08-Aug-13 11:00
Received: 27-Dec-13
Sampled By:

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
NAG	**NAG pH @19.4°C**	2.63	pH Units				W402104	AGF	01/13/14 12:30	
NAG	**NAG@pH 4.5**	8.0	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	**NAG@pH 7**	9.5	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

Client Sample ID: **HC-22 RESIDUE**
SVL Sample ID: **W3L0454-16 (Solid)**

Sample Report Page 1 of 1

Sampled: 07-Aug-13 11:00
Received: 27-Dec-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Classical Chemistry Parameters										
NAG	**NAG pH @19.6°C**	2.69	pH Units				W402104	AGF	01/13/14 12:30	
NAG	**NAG@pH 4.5**	13.2	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	**NAG@pH 7**	3.9	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

Client Sample ID: **HC-23 RESIDUE**
SVL Sample ID: **W3L0454-17 (Solid)**

Sample Report Page 1 of 1

Sampled: 07-Aug-13 11:00
Received: 27-Dec-13
Sampled By:

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
NAG	**NAG pH @19.7°C**	2.85	pH Units				W402104	AGF	01/13/14 12:30	
NAG	**NAG@pH 4.5**	6.6	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	
NAG	**NAG@pH 7**	5.8	kg H2SO4/T	0.1			W402104	AGF	01/13/14 12:30	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

SVL holds the following certifications:
AZ:0538, **CA**:2080, **FL**(**NELAC**):E87993, **ID**:ID00019 & ID00965 (Microbiology), **NV**:ID000192007A, **WA**:C573

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3L0454**
Reported: 13-Jan-14 15:29

Quality Control - LABORATORY CONTROL SAMPLE Data

Classical Chemistry Parameters

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
NAG	NAG pH	pH Units	7.34	7.93	92.6	90 - 110	W402104	13-Jan-14	

Quality Control - DUPLICATE Data

Classical Chemistry Parameters

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
NAG	NAG pH	pH Units	7.98	8.00	0.3	20	W402104	13-Jan-14	
NAG	NAG@pH 4.5	kg H2SO4/T	0	0	UDL	20	W402104	13-Jan-14	
NAG	NAG@pH 7	kg H2SO4/T	0	0	UDL	20	W402104	13-Jan-14	

Notes and Definitions

LCS	Laboratory Control Sample (Blank Spike)
RPD	Relative Percent Difference
UDL	A result is less than the detection limit
R > 4S	% recovery not applicable, sample concentration more than four times greater than spike level
<RL	A result is less than the reporting limit
MRL	Method Reporting Limit
MDL	Method Detection Limit
N/A	Not Applicable

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3H0326**
Reported: 27-Aug-13 10:14

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Sampled By	Date Received
HC-22 RESIDUE	W3H0326-01	Soil	07-Aug-13 11:00	CK	13-Aug-2013
HC-23 RESIDUE	W3H0326-02	Soil	07-Aug-13 11:00	CK	13-Aug-2013

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested. Non-Detects are reported at the MDL.
Sample preparation is defined by the client as per their Data Quality Objectives.
This report supercedes any previous reports for this Work Order. The complete report includes pages for each sample, a full QC report, and a notes section.
The results presented in this report relate only to the samples, and meet all requirements of the NELAC Standards unless otherwise noted.

Case Narrative

Nevada does not accredit for ABA and Sulfur Forms. HCl wash added per NDEP directive.

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3H0326**
Reported: 27-Aug-13 10:14

Client Sample ID: **HC-22 RESIDUE**
SVL Sample ID: **W3H0326-01 (Soil)**

Sample Report Page 1 of 1

Sampled: 07-Aug-13 11:00
Received: 13-Aug-13
Sampled By: CK

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	-23.7	TCaCO3/kT	0.3			N/A		08/22/13 15:26	
Modified Sobek	**AGP**	45.6	TCaCO3/kT	0.3			N/A		08/22/13 15:26	
Modified Sobek	**ANP**	21.9	TCaCO3/kT	0.3	0.1		W334117	MCE	08/22/13 15:11	A5
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W334117	MCE	08/22/13 15:26	
Modified Sobek	**Non-Sulfate Sulfur**	1.46	%	0.01	0.006		W334117	MCE	08/22/13 14:08	
Modified Sobek	**Pyritic Sulfur**	1.46	%	0.01			N/A		08/22/13 15:26	
Modified Sobek	**Sulfate Sulfur**	0.25	%	0.01			N/A		08/22/13 14:08	
Modified Sobek	**Total Sulfur**	1.71	%	0.01	0.006		W334117	MCE	08/20/13 12:47	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	-12.8	TCaCO3/kT	0.3			N/A		08/22/13 16:39	
Modified Sobek	**AGP-HCl**	34.7	TCaCO3/kT	0.3			N/A		08/22/13 16:39	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W334117	MCE	08/22/13 15:26	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	1.11	%	0.01	0.006		W334117	MCE	08/22/13 16:39	
Modified Sobek	**Pyritic Sulfur-HCl**	1.11	%	0.01			N/A		08/22/13 16:39	
Modified Sobek	**Sulfate Sulfur-HCl**	0.60	%	0.01			N/A		08/22/13 16:39	
Modified Sobek	**Total Sulfur**	1.71	%	0.01	0.006		W334117	MCE	08/20/13 12:47	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
USDA HB60(21a)	**Paste pH @21.7°C**	8.11	pH Units				W334297	AGF	08/27/13 08:19	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3H0326**
Reported: 27-Aug-13 10:14

Client Sample ID: **HC-23 RESIDUE**
SVL Sample ID: **W3H0326-02 (Soil)**

Sample Report Page 1 of 1

Sampled: 07-Aug-13 11:00
Received: 13-Aug-13
Sampled By: CK

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Acid/Base Accounting & Sulfur Forms										
Modified Sobek	**ABA**	-1.8	TCaCO3/kT	0.3			N/A		08/22/13 15:29	
Modified Sobek	**AGP**	19.2	TCaCO3/kT	0.3			N/A		08/22/13 15:29	
Modified Sobek	**ANP**	17.4	TCaCO3/kT	0.3	0.1		W334117	MCE	08/22/13 15:11	A5
Modified Sobek	**Non-extractable Sulfur**	0.01	%	0.01	0.006		W334117	MCE	08/22/13 15:29	
Modified Sobek	**Non-Sulfate Sulfur**	0.63	%	0.01	0.006		W334117	MCE	08/22/13 14:11	
Modified Sobek	**Pyritic Sulfur**	0.61	%	0.01			N/A		08/22/13 15:29	
Modified Sobek	**Sulfate Sulfur**	0.46	%	0.01			N/A		08/22/13 14:11	
Modified Sobek	**Total Sulfur**	1.09	%	0.01	0.006		W334117	MCE	08/20/13 12:50	
Acid/Base Accounting & Sulfur Forms (HCl Wash)										
Modified Sobek	**ABA-HCl**	12.8	TCaCO3/kT	0.3			N/A		08/22/13 16:41	
Modified Sobek	**AGP-HCl**	4.6	TCaCO3/kT	0.3			N/A		08/22/13 16:41	
Modified Sobek	**Non-extractable Sulfur**	0.01	%	0.01	0.006		W334117	MCE	08/22/13 15:29	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.16	%	0.01	0.006		W334117	MCE	08/22/13 16:41	
Modified Sobek	**Pyritic Sulfur-HCl**	0.15	%	0.01			N/A		08/22/13 16:41	
Modified Sobek	**Sulfate Sulfur-HCl**	0.93	%	0.01			N/A		08/22/13 16:41	
Modified Sobek	**Total Sulfur**	1.09	%	0.01	0.006		W334117	MCE	08/20/13 12:50	
Classical Chemistry Parameters										
USDA HB60(21a)	**Paste pH @22.0°C**	8.34	pH Units				W334297	AGF	08/27/13 08:19	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern
Laboratory Director

McClelland Laboratories Inc	**Project Name: MLI: 3438**
1016 Greg Street	Work Order: **W3H0326**
Sparks, NV 89431	Reported: 27-Aug-13 10:14

Quality Control - BLANK Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	<0.3	0.1	0.3	W334117	22-Aug-13	
Modified Sobek	Non-Sulfate Sulfur	%	<0.01	0.006	0.01	W334117	22-Aug-13	
Modified Sobek	Non-Sulfate Sulfur	%	<0.01	0.006	0.01	W334117	23-Aug-13	
Modified Sobek	Total Sulfur	%	<0.01	0.006	0.01	W334117	20-Aug-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	0.006	0.01	W334117	22-Aug-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Modified Sobek	Non-Sulfate Sulfur-HCl	%	<0.01	0.006	0.01	W334117	22-Aug-13	
Modified Sobek	Total Sulfur	%	<0.01	0.006	0.01	W334117	20-Aug-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	0.006	0.01	W334117	22-Aug-13	

Quality Control - LABORATORY CONTROL SAMPLE Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	219	216	101	80 - 120	W334117	22-Aug-13	
Modified Sobek	Total Sulfur	%	0.89	0.00		80 - 120	W334117	20-Aug-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Modified Sobek	Total Sulfur	%	0.89	0.00		80 - 120	W334117	20-Aug-13	

Classical Chemistry Parameters

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
USDA HB60(21a)	Paste pH	pH Units	7.47	7.40	101	93.7 - 106.3	W334297	27-Aug-13	

Quality Control - DUPLICATE Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	6.0	6.0	0.0	20	W334117	22-Aug-13	
Modified Sobek	Non-Sulfate Sulfur	%	0.05	0.04	12.5	20	W334117	23-Aug-13	
Modified Sobek	Non-Sulfate Sulfur	%	0.05	0.06	12.4	20	W334117	22-Aug-13	
Modified Sobek	Total Sulfur	%	<0.01	<0.01	<RL	20	W334117	20-Aug-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	<0.01	UDL	20	W334117	22-Aug-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Modified Sobek	Non-Sulfate Sulfur-HCl	%	0.10	0.08	21.5	20	W334117	22-Aug-13	R2B
Modified Sobek	Total Sulfur	%	<0.01	<0.01	<RL	20	W334117	20-Aug-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	<0.01	UDL	20	W334117	22-Aug-13	

Classical Chemistry Parameters

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
USDA HB60(21a)	Paste pH	pH Units	8.42	8.51	1.1	20	W334297	27-Aug-13	

Notes and Definitions

A5	5 g of sample used in ANP analysis
R2B	RPD exceeded the laboratory acceptance limit.
LCS	Laboratory Control Sample (Blank Spike)
RPD	Relative Percent Difference
UDL	A result is less than the detection limit
R > 4S	% recovery not applicable, sample concentration more than four times greater than spike level
<RL	A result is less than the reporting limit
MRL	Method Reporting Limit
MDL	Method Detection Limit
N/A	Not Applicable

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3H0280**
Reported: 26-Aug-13 12:59

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Sampled By	Date Received
HC-24 RESIDUE	W3H0280-01	Soil	08-Aug-13 11:00	CK	12-Aug-2013
HC-29 RESIDUE	W3H0280-02	Soil	08-Aug-13 11:00	CK	12-Aug-2013
HC-26 RESIDUE	W3H0280-03	Soil	08-Aug-13 11:00	CK	12-Aug-2013
HC-30 RESIDUE	W3H0280-04	Soil	08-Aug-13 11:00	CK	12-Aug-2013
HC-31 RESIDUE	W3H0280-05	Soil	08-Aug-13 11:00	CK	12-Aug-2013
HC-8 RESIDUE	W3H0280-06	Soil	08-Aug-13 11:00	CK	12-Aug-2013

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested. Non-Detects are reported at the MDL.
Sample preparation is defined by the client as per their Data Quality Objectives.
This report supercedes any previous reports for this Work Order. The complete report includes pages for each sample, a full QC report, and a notes section.
The results presented in this report relate only to the samples, and meet all requirements of the NELAC Standards unless otherwise noted.

Case Narrative

Nevada does not accredit for ABA and Sulfur Forms. HCl wash added per NDEP directive.

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3H0280**
Reported: 26-Aug-13 12:59

Client Sample ID: **HC-24 RESIDUE**
SVL Sample ID: **W3H0280-01 (Soil)**

Sample Report Page 1 of 1

Sampled: 08-Aug-13 11:00
Received: 12-Aug-13
Sampled By: CK

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Acid/Base Accounting & Sulfur Forms										
Modified Sobek	**ABA**	20.5	TCaCO3/kT	0.3			N/A		08/22/13 15:11	
Modified Sobek	**AGP**	0.9	TCaCO3/kT	0.3			N/A		08/22/13 15:03	
Modified Sobek	**ANP**	21.4	TCaCO3/kT	0.3	0.1		W334117	MCE	08/22/13 15:11	A5
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W334117	MCE	08/22/13 15:03	
Modified Sobek	**Non-Sulfate Sulfur**	0.03	%	0.01	0.006		W334117	MCE	08/22/13 13:39	
Modified Sobek	**Pyritic Sulfur**	0.03	%	0.01			N/A		08/22/13 15:03	
Modified Sobek	**Sulfate Sulfur**	0.01	%	0.01			N/A		08/22/13 13:39	
Modified Sobek	**Total Sulfur**	0.04	%	0.01	0.006		W334117	MCE	08/20/13 12:29	
Acid/Base Accounting & Sulfur Forms (HCl Wash)										
Modified Sobek	**ABA-HCl**	20.8	TCaCO3/kT	0.3			N/A		08/22/13 16:15	
Modified Sobek	**AGP-HCl**	0.6	TCaCO3/kT	0.3			N/A		08/22/13 16:15	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W334117	MCE	08/22/13 15:03	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.02	%	0.01	0.006		W334117	MCE	08/22/13 16:15	
Modified Sobek	**Pyritic Sulfur-HCl**	0.02	%	0.01			N/A		08/22/13 16:15	
Modified Sobek	**Sulfate Sulfur-HCl**	0.02	%	0.01			N/A		08/22/13 16:15	
Modified Sobek	**Total Sulfur**	0.04	%	0.01	0.006		W334117	MCE	08/20/13 12:29	
Classical Chemistry Parameters										
USDA HB60(21a)	**Paste pH @22.2°C**	8.38	pH Units				W334274	MCE	08/23/13 15:44	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3H0280**
Reported: 26-Aug-13 12:59

Client Sample ID: **HC-29 RESIDUE**
SVL Sample ID: **W3H0280-02 (Soil)**

Sample Report Page 1 of 1

Sampled: 08-Aug-13 11:00
Received: 12-Aug-13
Sampled By: CK

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Acid/Base Accounting & Sulfur Forms										
Modified Sobek	**ABA**	9.1	TCaCO3/kT	0.3			N/A		08/22/13 15:11	
Modified Sobek	**AGP**	25.2	TCaCO3/kT	0.3			N/A		08/22/13 15:06	
Modified Sobek	**ANP**	34.3	TCaCO3/kT	0.3	0.1		W334117	MCE	08/22/13 15:11	A5
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W334117	MCE	08/22/13 15:06	
Modified Sobek	**Non-Sulfate Sulfur**	0.81	%	0.01	0.006		W334117	MCE	08/22/13 13:43	
Modified Sobek	**Pyritic Sulfur**	0.81	%	0.01			N/A		08/22/13 15:06	
Modified Sobek	**Sulfate Sulfur**	0.19	%	0.01			N/A		08/22/13 13:43	
Modified Sobek	**Total Sulfur**	1.00	%	0.01	0.006		W334117	MCE	08/20/13 12:32	
Acid/Base Accounting & Sulfur Forms (HCl Wash)										
Modified Sobek	**ABA-HCl**	16.7	TCaCO3/kT	0.3			N/A		08/22/13 16:24	
Modified Sobek	**AGP-HCl**	17.7	TCaCO3/kT	0.3			N/A		08/22/13 16:24	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W334117	MCE	08/22/13 15:06	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.56	%	0.01	0.006		W334117	MCE	08/22/13 16:24	
Modified Sobek	**Pyritic Sulfur-HCl**	0.56	%	0.01			N/A		08/22/13 16:24	
Modified Sobek	**Sulfate Sulfur-HCl**	0.44	%	0.01			N/A		08/22/13 16:24	
Modified Sobek	**Total Sulfur**	1.00	%	0.01	0.006		W334117	MCE	08/20/13 12:32	
Classical Chemistry Parameters										
USDA HB60(21a)	**Paste pH @21.9°C**	8.14	pH Units				W334274	MCE	08/23/13 15:44	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

One Government Gulch - PO Box 929 Kellogg ID 83837-0929 (208) 784-1258 Fax (208) 783-0891

McClelland Laboratories Inc	**Project Name: MLI: 3438**
1016 Greg Street	Work Order: **W3H0280**
Sparks, NV 89431	Reported: 26-Aug-13 12:59

Client Sample ID: **HC-26 RESIDUE**
SVL Sample ID: **W3H0280-03 (Soil)**

Sample Report Page 1 of 1

Sampled: 08-Aug-13 11:00
Received: 12-Aug-13
Sampled By: CK

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	26.9	TCaCO3/kT	0.3			N/A		08/22/13 15:15	
Modified Sobek	**AGP**	7.9	TCaCO3/kT	0.3			N/A		08/22/13 15:15	
Modified Sobek	**ANP**	34.8	TCaCO3/kT	0.3	0.1		W334117	MCE	08/22/13 15:11	A5
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W334117	MCE	08/22/13 15:15	
Modified Sobek	**Non-Sulfate Sulfur**	0.25	%	0.01	0.006		W334117	MCE	08/22/13 13:46	
Modified Sobek	**Pyritic Sulfur**	0.25	%	0.01			N/A		08/22/13 15:15	
Modified Sobek	**Sulfate Sulfur**	0.07	%	0.01			N/A		08/22/13 13:46	
Modified Sobek	**Total Sulfur**	0.32	%	0.01	0.006		W334117	MCE	08/20/13 12:35	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	28.8	TCaCO3/kT	0.3			N/A		08/22/13 16:27	
Modified Sobek	**AGP-HCl**	6.0	TCaCO3/kT	0.3			N/A		08/22/13 16:27	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W334117	MCE	08/22/13 15:15	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.19	%	0.01	0.006		W334117	MCE	08/22/13 16:27	
Modified Sobek	**Pyritic Sulfur-HCl**	0.19	%	0.01			N/A		08/22/13 16:27	
Modified Sobek	**Sulfate Sulfur-HCl**	0.13	%	0.01			N/A		08/22/13 16:27	
Modified Sobek	**Total Sulfur**	0.32	%	0.01	0.006		W334117	MCE	08/20/13 12:35	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
USDA HB60(21a)	**Paste pH @21.9°C**	8.09	pH Units				W334274	MCE	08/23/13 15:44	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc	**Project Name: MLI: 3438**
1016 Greg Street	Work Order: **W3H0280**
Sparks, NV 89431	Reported: 26-Aug-13 12:59

Client Sample ID: **HC-30 RESIDUE**
SVL Sample ID: **W3H0280-04 (Soil)**

Sample Report Page 1 of 1

Sampled: 08-Aug-13 11:00
Received: 12-Aug-13
Sampled By: CK

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	8.5	TCaCO3/kT	0.3			N/A		08/22/13 15:18	
Modified Sobek	**AGP**	22.3	TCaCO3/kT	0.3			N/A		08/22/13 15:18	
Modified Sobek	**ANP**	30.8	TCaCO3/kT	0.3	0.1		W334117	MCE	08/22/13 15:11	A5
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W334117	MCE	08/22/13 15:18	
Modified Sobek	**Non-Sulfate Sulfur**	0.71	%	0.01	0.006		W334117	MCE	08/22/13 13:56	
Modified Sobek	**Pyritic Sulfur**	0.71	%	0.01			N/A		08/22/13 15:18	
Modified Sobek	**Sulfate Sulfur**	0.18	%	0.01			N/A		08/22/13 13:56	
Modified Sobek	**Total Sulfur**	0.90	%	0.01	0.006		W334117	MCE	08/20/13 12:38	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	12.9	TCaCO3/kT	0.3			N/A		08/22/13 16:30	
Modified Sobek	**AGP-HCl**	17.9	TCaCO3/kT	0.3			N/A		08/22/13 16:30	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W334117	MCE	08/22/13 15:18	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.57	%	0.01	0.006		W334117	MCE	08/22/13 16:30	
Modified Sobek	**Pyritic Sulfur-HCl**	0.57	%	0.01			N/A		08/22/13 16:30	
Modified Sobek	**Sulfate Sulfur-HCl**	0.33	%	0.01			N/A		08/22/13 16:30	
Modified Sobek	**Total Sulfur**	0.90	%	0.01	0.006		W334117	MCE	08/20/13 12:38	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
USDA HB60(21a)	**Paste pH @21.7°C**	8.11	pH Units				W334274	MCE	08/23/13 15:44	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3H0280**
Reported: 26-Aug-13 12:59

Client Sample ID: **HC-31 RESIDUE**
SVL Sample ID: **W3H0280-05 (Soil)**

Sample Report Page 1 of 1

Sampled: 08-Aug-13 11:00
Received: 12-Aug-13
Sampled By: CK

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	13.8	TCaCO3/kT	0.3			N/A		08/22/13 15:21	
Modified Sobek	**AGP**	18.0	TCaCO3/kT	0.3			N/A		08/22/13 15:21	
Modified Sobek	**ANP**	31.8	TCaCO3/kT	0.3	0.1		W334117	MCE	08/22/13 15:11	A5
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W334117	MCE	08/22/13 15:21	
Modified Sobek	**Non-Sulfate Sulfur**	0.58	%	0.01	0.006		W334117	MCE	08/22/13 13:59	
Modified Sobek	**Pyritic Sulfur**	0.58	%	0.01			N/A		08/22/13 15:21	
Modified Sobek	**Sulfate Sulfur**	0.16	%	0.01			N/A		08/22/13 13:59	
Modified Sobek	**Total Sulfur**	0.73	%	0.01	0.006		W334117	MCE	08/20/13 12:41	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	18.1	TCaCO3/kT	0.3			N/A		08/22/13 16:33	
Modified Sobek	**AGP-HCl**	13.7	TCaCO3/kT	0.3			N/A		08/22/13 16:33	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W334117	MCE	08/22/13 15:21	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.44	%	0.01	0.006		W334117	MCE	08/22/13 16:33	
Modified Sobek	**Pyritic Sulfur-HCl**	0.44	%	0.01			N/A		08/22/13 16:33	
Modified Sobek	**Sulfate Sulfur-HCl**	0.29	%	0.01			N/A		08/22/13 16:33	
Modified Sobek	**Total Sulfur**	0.73	%	0.01	0.006		W334117	MCE	08/20/13 12:41	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
USDA HB60(21a)	**Paste pH @21.9°C**	8.00	pH Units				W334274	MCE	08/23/13 15:44	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3H0280**
Reported: 26-Aug-13 12:59

Client Sample ID: **HC-8 RESIDUE**
SVL Sample ID: **W3H0280-06 (Soil)**

Sample Report Page 1 of 1

Sampled: 08-Aug-13 11:00
Received: 12-Aug-13
Sampled By: CK

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	-51.6	TCaCO3/kT	0.3			N/A		08/22/13 15:23	
Modified Sobek	**AGP**	67.5	TCaCO3/kT	0.3			N/A		08/22/13 15:23	
Modified Sobek	**ANP**	15.9	TCaCO3/kT	0.3	0.1		W334117	MCE	08/22/13 15:11	A5
Modified Sobek	**Non-extractable Sulfur**	0.02	%	0.01	0.006		W334117	MCE	08/22/13 15:23	
Modified Sobek	**Non-Sulfate Sulfur**	2.18	%	0.01	0.006		W334117	MCE	08/22/13 14:04	
Modified Sobek	**Pyritic Sulfur**	2.16	%	0.01			N/A		08/22/13 15:23	
Modified Sobek	**Sulfate Sulfur**	0.30	%	0.01			N/A		08/22/13 14:04	
Modified Sobek	**Total Sulfur**	2.48	%	0.01	0.006		W334117	MCE	08/20/13 12:44	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	-16.9	TCaCO3/kT	0.3			N/A		08/22/13 16:36	
Modified Sobek	**AGP-HCl**	32.8	TCaCO3/kT	0.3			N/A		08/22/13 16:36	
Modified Sobek	**Non-extractable Sulfur**	0.02	%	0.01	0.006		W334117	MCE	08/22/13 15:23	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	1.07	%	0.01	0.006		W334117	MCE	08/22/13 16:36	
Modified Sobek	**Pyritic Sulfur-HCl**	1.05	%	0.01			N/A		08/22/13 16:36	
Modified Sobek	**Sulfate Sulfur-HCl**	1.41	%	0.01			N/A		08/22/13 16:36	
Modified Sobek	**Total Sulfur**	2.48	%	0.01	0.006		W334117	MCE	08/20/13 12:44	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
USDA HB60(21a)	**Paste pH @21.7°C**	7.68	pH Units				W334274	MCE	08/23/13 15:44	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

Quality Control - BLANK Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	<0.3	0.1	0.3	W334117	22-Aug-13	
Modified Sobek	Non-Sulfate Sulfur	%	<0.01	0.006	0.01	W334117	22-Aug-13	
Modified Sobek	Non-Sulfate Sulfur	%	<0.01	0.006	0.01	W334117	23-Aug-13	
Modified Sobek	Total Sulfur	%	<0.01	0.006	0.01	W334117	20-Aug-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	0.006	0.01	W334117	22-Aug-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Modified Sobek	Non-Sulfate Sulfur-HCl	%	<0.01	0.006	0.01	W334117	22-Aug-13	
Modified Sobek	Total Sulfur	%	<0.01	0.006	0.01	W334117	20-Aug-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	0.006	0.01	W334117	22-Aug-13	

Quality Control - LABORATORY CONTROL SAMPLE Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	219	216	101	80 - 120	W334117	22-Aug-13	
Modified Sobek	Total Sulfur	%	0.89	0.00		80 - 120	W334117	20-Aug-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Modified Sobek	Total Sulfur	%	0.89	0.00		80 - 120	W334117	20-Aug-13	

Classical Chemistry Parameters

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
USDA HB60(21a)	Paste pH	pH Units	7.32	7.40	98.9	93.7 - 106.3	W334274	23-Aug-13	

Quality Control - DUPLICATE Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	6.0	6.0	0.0	20	W334117	22-Aug-13	
Modified Sobek	Non-Sulfate Sulfur	%	0.05	0.04	12.5	20	W334117	23-Aug-13	
Modified Sobek	Non-Sulfate Sulfur	%	0.05	0.06	12.4	20	W334117	22-Aug-13	
Modified Sobek	Total Sulfur	%	<0.01	<0.01	<RL	20	W334117	20-Aug-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	<0.01	UDL	20	W334117	22-Aug-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Modified Sobek	Non-Sulfate Sulfur-HCl	%	0.10	0.08	21.5	20	W334117	22-Aug-13	R2B
Modified Sobek	Total Sulfur	%	<0.01	<0.01	<RL	20	W334117	20-Aug-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	<0.01	UDL	20	W334117	22-Aug-13	

Classical Chemistry Parameters

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
USDA HB60(21a)	Paste pH	pH Units	7.31	7.25	0.8	20	W334274	23-Aug-13	

Notes and Definitions

A5	5 g of sample used in ANP analysis
R2B	RPD exceeded the laboratory acceptance limit.
LCS	Laboratory Control Sample (Blank Spike)
RPD	Relative Percent Difference
UDL	A result is less than the detection limit
R > 4S	% recovery not applicable, sample concentration more than four times greater than spike level
<RL	A result is less than the reporting limit
MRL	Method Reporting Limit
MDL	Method Detection Limit
N/A	Not Applicable

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3G0094**
Reported: 15-Jul-13 11:50

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Sampled By	Date Received
3438-604673 HC-7 RESIDUE	W3G0094-01	Soil	—	Gene McClelland	03-Jul-2013

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested. Non-Detects are reported at the MDL.
Sample preparation is defined by the client as per their Data Quality Objectives.
This report supercedes any previous reports for this Work Order. The complete report includes pages for each sample, a full QC report, and a notes section.
The results presented in this report relate only to the samples, and meet all requirements of the NELAC Standards unless otherwise noted.

Case Narrative

Nevada does not accredit for ABA and Sulfur Forms. HCl wash added per NDEP directive.

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3G0094**
Reported: 15-Jul-13 11:50

Client Sample ID: **3438-604673 HC-7 RESIDUE**
SVL Sample ID: **W3G0094-01 (Soil)**

Sample Report Page 1 of 1

Sampled: —
Received: 03-Jul-13
Sampled By: Gene McClelland

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	-8.6	TCaCO3/kT	0.3			N/A		07/11/13 10:46	
Modified Sobek	**AGP**	9.6	TCaCO3/kT	0.3			N/A		07/10/13 14:37	
Modified Sobek	**ANP**	1.0	TCaCO3/kT	0.3	0.1		W328085	AGF	07/11/13 10:46	A5
Modified Sobek	**Non-extractable Sulfur**	0.02	%	0.01	0.006		W328085	AGF	07/10/13 14:37	
Modified Sobek	**Non-Sulfate Sulfur**	0.33	%	0.01	0.006		W328085	AGF	07/10/13 14:01	
Modified Sobek	**Pyritic Sulfur**	0.31	%	0.01			N/A		07/10/13 14:37	
Modified Sobek	**Sulfate Sulfur**	0.18	%	0.01			N/A		07/10/13 14:01	
Modified Sobek	**Total Sulfur**	0.51	%	0.01	0.006		W328085	AGF	07/09/13 12:27	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	-8.1	TCaCO3/kT	0.3			N/A		07/11/13 10:46	
Modified Sobek	**AGP-HCl**	9.1	TCaCO3/kT	0.3			N/A		07/10/13 15:08	
Modified Sobek	**Non-extractable Sulfur**	0.02	%	0.01	0.006		W328085	AGF	07/10/13 14:37	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.31	%	0.01	0.006		W328085	AGF	07/10/13 15:08	
Modified Sobek	**Pyritic Sulfur-HCl**	0.29	%	0.01			N/A		07/10/13 15:08	
Modified Sobek	**Sulfate Sulfur-HCl**	0.20	%	0.01			N/A		07/10/13 15:08	
Modified Sobek	**Total Sulfur**	0.51	%	0.01	0.006		W328085	AGF	07/09/13 12:27	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
USDA HB60(21a)	**Paste pH @21.2°C**	5.39	pH Units				W328149	AGF	07/10/13 08:40	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

Quality Control - BLANK Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	<0.3	0.1	0.3	W328085	11-Jul-13	
Modified Sobek	Non-Sulfate Sulfur	%	<0.01	0.006	0.01	W328085	10-Jul-13	
Modified Sobek	Total Sulfur	%	<0.01	0.006	0.01	W328085	09-Jul-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	0.006	0.01	W328085	10-Jul-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Modified Sobek	Non-Sulfate Sulfur-HCl	%	<0.01	0.006	0.01	W328085	10-Jul-13	
Modified Sobek	Total Sulfur	%	<0.01	0.006	0.01	W328085	09-Jul-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	0.006	0.01	W328085	10-Jul-13	

Quality Control - LABORATORY CONTROL SAMPLE Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	205	216	94.8	80 - 120	W328085	11-Jul-13	
Modified Sobek	Total Sulfur	%	0.94	0.00		80 - 120	W328085	09-Jul-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Modified Sobek	Total Sulfur	%	0.94	0.00		80 - 120	W328085	09-Jul-13	

Classical Chemistry Parameters

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
USDA HB60(21a)	Paste pH	pH Units	7.50	7.40	101	93.7 - 106.3	W328149	10-Jul-13	

Quality Control - DUPLICATE Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	307	302	1.6	20	W328085	11-Jul-13	
Modified Sobek	Non-Sulfate Sulfur	%	2.34	2.36	0.9	20	W328085	10-Jul-13	D2
Modified Sobek	Non-Sulfate Sulfur	%	<0.01	<0.01	UDL	20	W328085	09-Jul-13	
Modified Sobek	Total Sulfur	%	<0.01	<0.01	UDL	20	W328085	09-Jul-13	
Modified Sobek	Non-extractable Sulfur	%	0.06	0.08	33.8	20	W328085	10-Jul-13	R2B
Modified Sobek	Non-extractable Sulfur	%	<0.01	<0.01	UDL	20	W328085	09-Jul-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Modified Sobek	Non-Sulfate Sulfur-HCl	%	1.05	1.23	15.5	20	W328085	10-Jul-13	D2
Modified Sobek	Non-Sulfate Sulfur-HCl	%	<0.01	<0.01	UDL	20	W328085	09-Jul-13	
Modified Sobek	Total Sulfur	%	<0.01	<0.01	UDL	20	W328085	09-Jul-13	
Modified Sobek	Non-extractable Sulfur	%	0.06	0.08	33.8	20	W328085	10-Jul-13	R2B
Modified Sobek	Non-extractable Sulfur	%	<0.01	<0.01	UDL	20	W328085	09-Jul-13	

Quality Control - DUPLICATE Data (Continued)

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Classical Chemistry Parameters									
USDA HB60(21a)	Paste pH	pH Units	5.43	5.39	0.7	20	W328149	10-Jul-13	

Notes and Definitions

A5	5 g of sample used in ANP analysis
D2	Sample required dilution due to high concentration of target analyte.
R2B	RPD exceeded the laboratory acceptance limit.
LCS	Laboratory Control Sample (Blank Spike)
RPD	Relative Percent Difference
UDL	A result is less than the detection limit
R > 4S	% recovery not applicable, sample concentration more than four times greater than spike level
<RL	A result is less than the reporting limit
MRL	Method Reporting Limit
MDL	Method Detection Limit
N/A	Not Applicable

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438-01
Work Order: **W3E0635**
Reported: 11-Jun-13 08:55

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
3438 604669 HC-6	W3E0635-01	Solid	—	29-May-2013
3438 604787 HC-9	W3E0635-02	Solid	—	29-May-2013
3438 SRK 0858 HC-17	W3E0635-03	Solid	—	29-May-2013
3438 SRK 0867 HC-20	W3E0635-04	Solid	—	29-May-2013
3438-01 COPPER FLAT CU R TAIL HC-1	W3E0635-05	Solid	—	29-May-2013

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested. Non-Detects are reported at the MDL.
Sample preparation is defined by the client as per their Data Quality Objectives.
This report supercedes any previous reports for this Work Order. The complete report includes pages for each sample, a full QC report, and a notes section.
The results presented in this report relate only to the samples, and meet all requirements of the NELAC Standards unless otherwise noted.

Case Narrative

Nevada does not accredit for ABA and Sulfur Forms. HCl wash added per NDEP directive.

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438-01
Work Order: **W3E0635**
Reported: 11-Jun-13 08:55

Client Sample ID: **3438 604669 HC-6**
SVL Sample ID: **W3E0635-01 (Solid)**

Sample Report Page 1 of 1

Sampled: —
Received: 29-May-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Acid/Base Accounting & Sulfur Forms										
Modified Sobek	**ABA**	-15.7	TCaCO3/kT	0.3			N/A		06/05/13 14:51	
Modified Sobek	**AGP**	19.2	TCaCO3/kT	0.3			N/A		06/04/13 13:33	
Modified Sobek	**ANP**	3.5	TCaCO3/kT	0.3	0.1		W322115	AGF	06/05/13 14:51	A5
Modified Sobek	**Non-extractable Sulfur**	0.05	%	0.01	0.006		W322115	MCE	06/04/13 13:33	
Modified Sobek	**Non-Sulfate Sulfur**	0.66	%	0.01	0.006		W322115	MCE	06/04/13 12:54	
Modified Sobek	**Pyritic Sulfur**	0.61	%	0.01			N/A		06/04/13 13:33	
Modified Sobek	**Sulfate Sulfur**	0.17	%	0.01			N/A		06/04/13 12:54	
Modified Sobek	**Total Sulfur**	0.83	%	0.01	0.006		W322115	MCE	06/03/13 10:26	
Acid/Base Accounting & Sulfur Forms (HCl Wash)										
Modified Sobek	**ABA-HCl**	-8.6	TCaCO3/kT	0.3			N/A		06/05/13 14:51	
Modified Sobek	**AGP-HCl**	12.1	TCaCO3/kT	0.3			N/A		06/04/13 14:09	
Modified Sobek	**Non-extractable Sulfur**	0.05	%	0.01	0.006		W322115	MCE	06/04/13 13:33	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.43	%	0.01	0.006		W322115	MCE	06/04/13 14:09	
Modified Sobek	**Pyritic Sulfur-HCl**	0.39	%	0.01			N/A		06/04/13 14:09	
Modified Sobek	**Sulfate Sulfur-HCl**	0.40	%	0.01			N/A		06/04/13 14:09	
Modified Sobek	**Total Sulfur**	0.83	%	0.01	0.006		W322115	MCE	06/03/13 10:26	
Classical Chemistry Parameters										
USDA HB60(21a)	**Paste pH @20.8°C**	7.51	pH Units				W322198	MCE	06/07/13 14:30	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Nan Wilson
Deputy Technical Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438-01
Work Order: **W3E0635**
Reported: 11-Jun-13 08:55

Client Sample ID: **3438 604787 HC-9**
SVL Sample ID: **W3E0635-02 (Solid)**

Sample Report Page 1 of 1

Sampled: —
Received: 29-May-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Acid/Base Accounting & Sulfur Forms										
Modified Sobek	**ABA**	-5.0	TCaCO3/kT	0.3			N/A		06/05/13 14:51	
Modified Sobek	**AGP**	35.9	TCaCO3/kT	0.3			N/A		06/04/13 13:36	
Modified Sobek	**ANP**	31.0	TCaCO3/kT	0.3	0.1		W322115	AGF	06/05/13 14:51	A5
Modified Sobek	**Non-extractable Sulfur**	0.09	%	0.01	0.006		W322115	MCE	06/04/13 13:36	
Modified Sobek	**Non-Sulfate Sulfur**	1.24	%	0.01	0.006		W322115	MCE	06/04/13 12:58	
Modified Sobek	**Pyritic Sulfur**	1.15	%	0.01			N/A		06/04/13 13:36	
Modified Sobek	**Sulfate Sulfur**	0.27	%	0.01			N/A		06/04/13 12:58	
Modified Sobek	**Total Sulfur**	1.51	%	0.01	0.006		W322115	MCE	06/03/13 10:29	
Acid/Base Accounting & Sulfur Forms (HCl Wash)										
Modified Sobek	**ABA-HCl**	12.2	TCaCO3/kT	0.3			N/A		06/05/13 14:51	
Modified Sobek	**AGP-HCl**	18.8	TCaCO3/kT	0.3			N/A		06/04/13 14:12	
Modified Sobek	**Non-extractable Sulfur**	0.09	%	0.01	0.006		W322115	MCE	06/04/13 13:36	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.69	%	0.01	0.006		W322115	MCE	06/04/13 14:12	
Modified Sobek	**Pyritic Sulfur-HCl**	0.60	%	0.01			N/A		06/04/13 14:12	
Modified Sobek	**Sulfate Sulfur-HCl**	0.82	%	0.01			N/A		06/04/13 14:12	
Modified Sobek	**Total Sulfur**	1.51	%	0.01	0.006		W322115	MCE	06/03/13 10:29	
Classical Chemistry Parameters										
USDA HB60(21a)	**Paste pH @20.7°C**	7.75	pH Units				W322198	MCE	06/07/13 14:30	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Nan Wilson
Deputy Technical Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438-01
Work Order: **W3E0635**
Reported: 11-Jun-13 08:55

Client Sample ID: **3438 SRK 0858 HC-17**
SVL Sample ID: **W3E0635-03 (Solid)**

Sample Report Page 1 of 1

Sampled: —
Received: 29-May-13
Sampled By:

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	-16.1	TCaCO3/kT	0.3			N/A		06/05/13 14:51	
Modified Sobek	**AGP**	16.1	TCaCO3/kT	0.3			N/A		06/04/13 13:39	
Modified Sobek	ANP	< 0.3	TCaCO3/kT	0.3	0.1		W322115	AGF	06/05/13 14:51	A5
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W322115	MCE	06/04/13 13:39	
Modified Sobek	**Non-Sulfate Sulfur**	0.52	%	0.01	0.006		W322115	MCE	06/04/13 13:02	
Modified Sobek	**Pyritic Sulfur**	0.52	%	0.01			N/A		06/04/13 13:39	
Modified Sobek	**Sulfate Sulfur**	0.30	%	0.01			N/A		06/04/13 13:02	
Modified Sobek	**Total Sulfur**	0.82	%	0.01	0.006		W322115	MCE	06/03/13 10:32	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	-17.1	TCaCO3/kT	0.3			N/A		06/05/13 14:51	
Modified Sobek	**AGP-HCl**	17.1	TCaCO3/kT	0.3			N/A		06/04/13 14:14	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W322115	MCE	06/04/13 13:39	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.55	%	0.01	0.006		W322115	MCE	06/04/13 14:14	
Modified Sobek	**Pyritic Sulfur-HCl**	0.55	%	0.01			N/A		06/04/13 14:14	
Modified Sobek	**Sulfate Sulfur-HCl**	0.27	%	0.01			N/A		06/04/13 14:14	
Modified Sobek	**Total Sulfur**	0.82	%	0.01	0.006		W322115	MCE	06/03/13 10:32	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
USDA HB60(21a)	**Paste pH @20.6°C**	3.95	pH Units				W322198	MCE	06/07/13 14:30	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Nan Wilson
Deputy Technical Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438-01
Work Order: **W3E0635**
Reported: 11-Jun-13 08:55

Client Sample ID: **3438 SRK 0867 HC-20**
SVL Sample ID: **W3E0635-04 (Solid)**

Sample Report Page 1 of 1

Sampled: —
Received: 29-May-13
Sampled By:

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	-18.2	TCaCO3/kT	0.3			N/A		06/05/13 14:51	
Modified Sobek	**AGP**	24.7	TCaCO3/kT	0.3			N/A		06/04/13 13:42	
Modified Sobek	**ANP**	6.5	TCaCO3/kT	0.3	0.1		W322115	AGF	06/05/13 14:51	A5
Modified Sobek	**Non-extractable Sulfur**	0.02	%	0.01	0.006		W322115	MCE	06/04/13 13:42	
Modified Sobek	**Non-Sulfate Sulfur**	0.81	%	0.01	0.006		W322115	MCE	06/04/13 13:07	
Modified Sobek	**Pyritic Sulfur**	0.79	%	0.01			N/A		06/04/13 13:42	
Modified Sobek	**Sulfate Sulfur**	0.27	%	0.01			N/A		06/04/13 13:07	
Modified Sobek	**Total Sulfur**	1.08	%	0.01	0.006		W322115	MCE	06/03/13 10:35	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	-14.9	TCaCO3/kT	0.3			N/A		06/05/13 14:51	
Modified Sobek	**AGP-HCl**	21.4	TCaCO3/kT	0.3			N/A		06/04/13 14:17	
Modified Sobek	**Non-extractable Sulfur**	0.02	%	0.01	0.006		W322115	MCE	06/04/13 13:42	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.70	%	0.01	0.006		W322115	MCE	06/04/13 14:17	
Modified Sobek	**Pyritic Sulfur-HCl**	0.68	%	0.01			N/A		06/04/13 14:17	
Modified Sobek	**Sulfate Sulfur-HCl**	0.38	%	0.01			N/A		06/04/13 14:17	
Modified Sobek	**Total Sulfur**	1.08	%	0.01	0.006		W322115	MCE	06/03/13 10:35	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
USDA HB60(21a)	**Paste pH @20.7°C**	7.57	pH Units				W322198	MCE	06/07/13 14:30	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Nan Wilson
Deputy Technical Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438-01
Work Order: **W3E0635**
Reported: 11-Jun-13 08:55

Client Sample ID: **3438-01 COPPER FLAT CU R TAIL HC-1**
SVL Sample ID: **W3E0635-05 (Solid)**

Sample Report Page 1 of 1

Sampled: —
Received: 29-May-13
Sampled By:

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	15.6	TCaCO3/kT	0.3			N/A		06/05/13 14:51	
Modified Sobek	**AGP**	17.9	TCaCO3/kT	0.3			N/A		06/04/13 13:44	
Modified Sobek	**ANP**	33.5	TCaCO3/kT	0.3	0.1		W322115	AGF	06/05/13 14:51	A5
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W322115	MCE	06/04/13 13:44	
Modified Sobek	**Non-Sulfate Sulfur**	0.57	%	0.01	0.006		W322115	MCE	06/04/13 13:10	
Modified Sobek	**Pyritic Sulfur**	0.57	%	0.01			N/A		06/04/13 13:44	
Modified Sobek	**Sulfate Sulfur**	0.23	%	0.01			N/A		06/04/13 13:10	
Modified Sobek	**Total Sulfur**	0.80	%	0.01	0.006		W322115	MCE	06/03/13 10:38	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	16.8	TCaCO3/kT	0.3			N/A		06/05/13 14:51	
Modified Sobek	**AGP-HCl**	16.7	TCaCO3/kT	0.3			N/A		06/04/13 14:20	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W322115	MCE	06/04/13 13:44	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.54	%	0.01	0.006		W322115	MCE	06/04/13 14:20	
Modified Sobek	**Pyritic Sulfur-HCl**	0.54	%	0.01			N/A		06/04/13 14:20	
Modified Sobek	**Sulfate Sulfur-HCl**	0.27	%	0.01			N/A		06/04/13 14:20	
Modified Sobek	**Total Sulfur**	0.80	%	0.01	0.006		W322115	MCE	06/03/13 10:38	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
USDA HB60(21a)	**Paste pH @20.7°C**	8.09	pH Units				W322198	MCE	06/07/13 14:30	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Nan Wilson
Deputy Technical Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438-01
Work Order: **W3E0635**
Reported: 11-Jun-13 08:55

Quality Control - BLANK Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	<0.3	0.1	0.3	W322115	05-Jun-13	
Modified Sobek	Non-Sulfate Sulfur	%	<0.01	0.006	0.01	W322115	04-Jun-13	
Modified Sobek	Total Sulfur	%	<0.01	0.006	0.01	W322115	03-Jun-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	0.006	0.01	W322115	04-Jun-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Modified Sobek	Non-Sulfate Sulfur-HCl	%	<0.01	0.006	0.01	W322115	04-Jun-13	
Modified Sobek	Total Sulfur	%	<0.01	0.006	0.01	W322115	03-Jun-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	0.006	0.01	W322115	04-Jun-13	

Quality Control - LABORATORY CONTROL SAMPLE Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	210	216	97.2	80 - 120	W322115	05-Jun-13	
Modified Sobek	Total Sulfur	%	1.07	0.00		80 - 120	W322115	03-Jun-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Modified Sobek	Total Sulfur	%	1.07	0.00		80 - 120	W322115	03-Jun-13	

Classical Chemistry Parameters

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
USDA HB60(21a)	Paste pH	pH Units	7.56	7.40	102	93.7 - 106.3	W322198	07-Jun-13	

Quality Control - DUPLICATE Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	15.0	14.5	3.4	20	W322115	05-Jun-13	
Modified Sobek	Non-Sulfate Sulfur	%	<0.01	<0.01	UDL	20	W322115	04-Jun-13	
Modified Sobek	Non-Sulfate Sulfur	%	<0.01	<0.01	UDL	20	W322115	03-Jun-13	
Modified Sobek	Total Sulfur	%	<0.01	<0.01	UDL	20	W322115	03-Jun-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	<0.01	UDL	20	W322115	04-Jun-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	<0.01	UDL	20	W322115	03-Jun-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Modified Sobek	Non-Sulfate Sulfur-HCl	%	0.03	0.03	10.3	20	W322115	04-Jun-13	
Modified Sobek	Non-Sulfate Sulfur-HCl	%	<0.01	<0.01	UDL	20	W322115	03-Jun-13	
Modified Sobek	Total Sulfur	%	<0.01	<0.01	UDL	20	W322115	03-Jun-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	<0.01	UDL	20	W322115	04-Jun-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	<0.01	UDL	20	W322115	03-Jun-13	

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438-01
Work Order: **W3E0635**
Reported: 11-Jun-13 08:55

Quality Control - DUPLICATE Data (Continued)

Classical Chemistry Parameters

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
USDA HB60(21a)	Paste pH	pH Units	7.43	7.51	1.1	20	W322198	07-Jun-13	

Notes and Definitions

A5	5 g of sample used in ANP analysis
LCS	Laboratory Control Sample (Blank Spike)
RPD	Relative Percent Difference
UDL	A result is less than the detection limit
R > 4S	% recovery not applicable, sample concentration more than four times greater than spike level
<RL	A result is less than the reporting limit
MRL	Method Reporting Limit
MDL	Method Detection Limit
N/A	Not Applicable

SVL holds the following certifications:
AZ:0538, **CA**:2080, **FL**(**NELAC**):E87993, **ID**:ID00019 & ID00965 (Microbiology), **NV**:ID000192007A, **WA**:C573

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3E0194**
Reported: 16-May-13 13:59

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
3438 HC-25 RESIDUE	W3E0194-01	Soil	06-May-13 09:00	08-May-2013
3438 HC-27 RESIDUE	W3E0194-02	Soil	06-May-13 09:00	08-May-2013
3438 HC-28 RESIDUE	W3E0194-03	Soil	06-May-13 09:00	08-May-2013

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested. Non-Detects are reported at the MDL.
Sample preparation is defined by the client as per their Data Quality Objectives.
This report supercedes any previous reports for this Work Order. The complete report includes pages for each sample, a full QC report, and a notes section.
The results presented in this report relate only to the samples, and meet all requirements of the NELAC Standards unless otherwise noted.

Case Narrative

Nevada does not accredit for ABA and Sulfur Forms. HCl wash added per NDEP directive.

McClelland Laboratories Inc	**Project Name: MLI: 3438**
1016 Greg Street	Work Order: **W3E0194**
Sparks, NV 89431	Reported: 16-May-13 13:59

Client Sample ID: **3438 HC-25 RESIDUE**

SVL Sample ID: **W3E0194-01 (Soil)**

Sample Report Page 1 of 1

Sampled: 06-May-13 09:00
Received: 08-May-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Acid/Base Accounting & Sulfur Forms										
Modified Sobek	**ABA**	23.3	TCaCO3/kT	0.3			N/A		05/14/13 14:36	
Modified Sobek	**AGP**	0.7	TCaCO3/kT	0.3			N/A		05/14/13 13:47	
Modified Sobek	**ANP**	24.0	TCaCO3/kT	0.3	0.1		W319299	AGF	05/14/13 14:36	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W319299	MCE	05/14/13 13:47	
Modified Sobek	**Non-Sulfate Sulfur**	0.02	%	0.01	0.006		W319299	MCE	05/14/13 13:11	
Modified Sobek	**Pyritic Sulfur**	0.02	%	0.01			N/A		05/14/13 13:47	
Modified Sobek	**Sulfate Sulfur**	0.02	%	0.01			N/A		05/14/13 13:11	
Modified Sobek	**Total Sulfur**	0.05	%	0.01	0.006		W319299	MCE	05/13/13 09:49	
Acid/Base Accounting & Sulfur Forms (HCl Wash)										
Modified Sobek	**ABA-HCl**	23.2	TCaCO3/kT	0.3			N/A		05/14/13 14:36	
Modified Sobek	**AGP-HCl**	0.8	TCaCO3/kT	0.3			N/A		05/14/13 14:02	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W319299	MCE	05/14/13 13:47	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.03	%	0.01	0.006		W319299	MCE	05/14/13 14:02	
Modified Sobek	**Pyritic Sulfur-HCl**	0.03	%	0.01			N/A		05/14/13 14:02	
Modified Sobek	**Sulfate Sulfur-HCl**	0.02	%	0.01			N/A		05/14/13 14:02	
Modified Sobek	**Total Sulfur**	0.05	%	0.01	0.006		W319299	MCE	05/13/13 09:49	
Classical Chemistry Parameters										
USDA HB60(21a)	**Paste pH @21.2°C**	8.28	pH Units				W320015	AGF	05/16/13 11:45	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3E0194**
Reported: 16-May-13 13:59

Client Sample ID: **3438 HC-27 RESIDUE**
SVL Sample ID: **W3E0194-02 (Soil)**

Sample Report Page 1 of 1

Sampled: 06-May-13 09:00
Received: 08-May-13
Sampled By:

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	26.8	TCaCO3/kT	0.3			N/A		05/14/13 14:36	
Modified Sobek	**AGP**	4.1	TCaCO3/kT	0.3			N/A		05/14/13 13:50	
Modified Sobek	**ANP**	30.9	TCaCO3/kT	0.3	0.1		W319299	AGF	05/14/13 14:36	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W319299	MCE	05/14/13 13:50	
Modified Sobek	**Non-Sulfate Sulfur**	0.13	%	0.01	0.006		W319299	MCE	05/14/13 13:15	
Modified Sobek	**Pyritic Sulfur**	0.13	%	0.01			N/A		05/14/13 13:50	
Modified Sobek	**Sulfate Sulfur**	0.08	%	0.01			N/A		05/14/13 13:15	
Modified Sobek	**Total Sulfur**	0.21	%	0.01	0.006		W319299	MCE	05/13/13 09:52	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	27.2	TCaCO3/kT	0.3			N/A		05/14/13 14:36	
Modified Sobek	**AGP-HCl**	3.7	TCaCO3/kT	0.3			N/A		05/14/13 14:05	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W319299	MCE	05/14/13 13:50	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.12	%	0.01	0.006		W319299	MCE	05/14/13 14:05	
Modified Sobek	**Pyritic Sulfur-HCl**	0.12	%	0.01			N/A		05/14/13 14:05	
Modified Sobek	**Sulfate Sulfur-HCl**	0.10	%	0.01			N/A		05/14/13 14:05	
Modified Sobek	**Total Sulfur**	0.21	%	0.01	0.006		W319299	MCE	05/13/13 09:52	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
USDA HB60(21a)	**Paste pH @20.5°C**	8.39	pH Units				W320015	AGF	05/16/13 11:45	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3E0194**
Reported: 16-May-13 13:59

Client Sample ID: **3438 HC-28 RESIDUE**
SVL Sample ID: **W3E0194-03 (Soil)**

Sample Report Page 1 of 1

Sampled: 06-May-13 09:00
Received: 08-May-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Acid/Base Accounting & Sulfur Forms										
Modified Sobek	**ABA**	25.4	TCaCO3/kT	0.3			N/A		05/14/13 14:36	
Modified Sobek	**AGP**	1.1	TCaCO3/kT	0.3			N/A		05/14/13 13:53	
Modified Sobek	**ANP**	26.5	TCaCO3/kT	0.3	0.1		W319299	AGF	05/14/13 14:36	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W319299	MCE	05/14/13 13:53	
Modified Sobek	**Non-Sulfate Sulfur**	0.03	%	0.01	0.006		W319299	MCE	05/14/13 13:17	
Modified Sobek	**Pyritic Sulfur**	0.03	%	0.01			N/A		05/14/13 13:53	
Modified Sobek	**Sulfate Sulfur**	0.04	%	0.01			N/A		05/14/13 13:17	
Modified Sobek	**Total Sulfur**	0.07	%	0.01	0.006		W319299	MCE	05/13/13 09:55	
Acid/Base Accounting & Sulfur Forms (HCl Wash)										
Modified Sobek	**ABA-HCl**	25.7	TCaCO3/kT	0.3			N/A		05/14/13 14:36	
Modified Sobek	**AGP-HCl**	0.8	TCaCO3/kT	0.3			N/A		05/14/13 14:13	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.006		W319299	MCE	05/14/13 13:53	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.03	%	0.01	0.006		W319299	MCE	05/14/13 14:13	
Modified Sobek	**Pyritic Sulfur-HCl**	0.03	%	0.01			N/A		05/14/13 14:13	
Modified Sobek	**Sulfate Sulfur-HCl**	0.04	%	0.01			N/A		05/14/13 14:13	
Modified Sobek	**Total Sulfur**	0.07	%	0.01	0.006		W319299	MCE	05/13/13 09:55	
Classical Chemistry Parameters										
USDA HB60(21a)	**Paste pH @20.6°C**	8.34	pH Units				W320015	AGF	05/16/13 11:45	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3E0194**
Reported: 16-May-13 13:59

Quality Control - BLANK Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	<0.3	0.1	0.3	W319299	14-May-13	
Modified Sobek	Non-Sulfate Sulfur	%	<0.01	0.006	0.01	W319299	14-May-13	
Modified Sobek	Total Sulfur	%	<0.01	0.006	0.01	W319299	13-May-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	0.006	0.01	W319299	14-May-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Modified Sobek	Non-Sulfate Sulfur-HCl	%	<0.01	0.006	0.01	W319299	14-May-13	
Modified Sobek	Total Sulfur	%	<0.01	0.006	0.01	W319299	13-May-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	0.006	0.01	W319299	14-May-13	

Quality Control - LABORATORY CONTROL SAMPLE Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	223	216	103	80 - 120	W319299	14-May-13	
Modified Sobek	Total Sulfur	%	1.02	0.00		80 - 120	W319299	13-May-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Modified Sobek	Total Sulfur	%	1.02	0.00		80 - 120	W319299	13-May-13	

Classical Chemistry Parameters

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
USDA HB60(21a)	Paste pH	pH Units	7.43	7.40	100	93.7 - 106.3	W320015	16-May-13	

Quality Control - DUPLICATE Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	26.0	24.0	7.8	20	W319299	14-May-13	
Modified Sobek	Non-Sulfate Sulfur	%	0.02	0.02	5.6	20	W319299	14-May-13	
Modified Sobek	Total Sulfur	%	0.05	0.05	4.7	20	W319299	13-May-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	<0.01	UDL	20	W319299	14-May-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Modified Sobek	Non-Sulfate Sulfur-HCl	%	0.01	0.03	51.6	20	W319299	14-May-13	R2B
Modified Sobek	Total Sulfur	%	0.05	0.05	4.7	20	W319299	13-May-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	<0.01	UDL	20	W319299	14-May-13	

Classical Chemistry Parameters

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
USDA HB60(21a)	Paste pH	pH Units	8.24	8.28	0.5	20	W320015	16-May-13	

McClelland Laboratories Inc	**Project Name: MLI: 3438**
1016 Greg Street	Work Order: **W3E0194**
Sparks, NV 89431	Reported: 16-May-13 13:59

Notes and Definitions

R2B	RPD exceeded the laboratory acceptance limit.
LCS	Laboratory Control Sample (Blank Spike)
RPD	Relative Percent Difference
UDL	A result is less than the detection limit
R > 4S	% recovery not applicable, sample concentration more than four times greater than spike level
<RL	A result is less than the reporting limit
MRL	Method Reporting Limit
MDL	Method Detection Limit
N/A	Not Applicable

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3B0421**
Reported: 07-Mar-13 12:09

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
3438 SRK 0854 HC-16 RESIDUE	W3B0421-01	Soil	21-Feb-13 09:00	25-Feb-2013
3438 SRK 0872 HC-21 RESIDUE	W3B0421-02	Soil	21-Feb-13 09:00	25-Feb-2013

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested. Non-Detects are reported at the MDL.
Sample preparation is defined by the client as per their Data Quality Objectives.
This report supercedes any previous reports for this Work Order. The complete report includes pages for each sample, a full QC report, and a notes section.
The results presented in this report relate only to the samples, and meet all requirements of the NELAC Standards unless otherwise noted.

Case Narrative

Nevada does not accredit for ABA and Sulfur Forms. HCl wash added per NDEP directive.

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3B0421**
Reported: 07-Mar-13 12:09

Client Sample ID: **3438 SRK 0854 HC-16 RESIDUE**
SVL Sample ID: **W3B0421-01 (Soil)**

Sample Report Page 1 of 1

Sampled: 21-Feb-13 09:00
Received: 25-Feb-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Acid/Base Accounting & Sulfur Forms										
Modified Sobek	**ABA**	-18.2	TCaCO3/kT	0.3			N/A		03/04/13 13:36	
Modified Sobek	**AGP**	19.8	TCaCO3/kT	0.3			N/A		03/04/13 13:36	
Modified Sobek	**ANP**	1.5	TCaCO3/kT	0.3	0.1		W309098	AGF	03/01/13 14:15	
Modified Sobek	**Non-extractable Sulfur**	0.05	%	0.01	0.004		W309098	MCE	03/04/13 13:36	
Modified Sobek	**Non-Sulfate Sulfur**	0.68	%	0.01	0.004		W309098	MCE	03/04/13 12:33	
Modified Sobek	**Pyritic Sulfur**	0.63	%	0.01			N/A		03/04/13 13:36	
Modified Sobek	**Sulfate Sulfur**	0.33	%	0.01			N/A		03/04/13 12:33	
Modified Sobek	**Total Sulfur**	1.01	%	0.01	0.004		W309098	MCE	02/27/13 12:56	
Acid/Base Accounting & Sulfur Forms (HCl Wash)										
Modified Sobek	**ABA-HCl**	-10.2	TCaCO3/kT	0.3			N/A		03/04/13 14:34	
Modified Sobek	**AGP-HCl**	11.7	TCaCO3/kT	0.3			N/A		03/04/13 14:34	
Modified Sobek	**Non-extractable Sulfur**	0.05	%	0.01	0.004		W309098	MCE	03/04/13 13:36	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.42	%	0.01	0.004		W309098	MCE	03/04/13 14:34	
Modified Sobek	**Pyritic Sulfur-HCl**	0.38	%	0.01			N/A		03/04/13 14:34	
Modified Sobek	**Sulfate Sulfur-HCl**	0.59	%	0.01			N/A		03/04/13 14:34	
Modified Sobek	**Total Sulfur**	1.01	%	0.01	0.004		W309098	MCE	02/27/13 12:56	
Classical Chemistry Parameters										
USDA HB60(21a)	**Paste pH @20.6°C**	5.45	pH Units				W309281	MCE	03/06/13 11:45	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3B0421**
Reported: 07-Mar-13 12:09

Client Sample ID: **3438 SRK 0872 HC-21 RESIDUE**
SVL Sample ID: **W3B0421-02 (Soil)**

Sample Report Page 1 of 1

Sampled: 21-Feb-13 09:00
Received: 25-Feb-13
Sampled By:

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	-34.5	TCaCO3/kT	0.3			N/A		03/04/13 13:39	
Modified Sobek	**AGP**	36.1	TCaCO3/kT	0.3			N/A		03/04/13 13:39	
Modified Sobek	**ANP**	1.5	TCaCO3/kT	0.3	0.1		W309098	AGF	03/01/13 14:15	
Modified Sobek	**Non-extractable Sulfur**	0.02	%	0.01	0.004		W309098	MCE	03/04/13 13:39	
Modified Sobek	**Non-Sulfate Sulfur**	1.17	%	0.01	0.004		W309098	MCE	03/04/13 12:37	
Modified Sobek	**Pyritic Sulfur**	1.15	%	0.01			N/A		03/04/13 13:39	
Modified Sobek	**Sulfate Sulfur**	0.45	%	0.01			N/A		03/04/13 12:37	
Modified Sobek	**Total Sulfur**	1.62	%	0.01	0.004		W309098	MCE	02/27/13 12:59	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	-26.7	TCaCO3/kT	0.3			N/A		03/04/13 14:37	
Modified Sobek	**AGP-HCl**	28.2	TCaCO3/kT	0.3			N/A		03/04/13 14:37	
Modified Sobek	**Non-extractable Sulfur**	0.02	%	0.01	0.004		W309098	MCE	03/04/13 13:39	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.92	%	0.01	0.004		W309098	MCE	03/04/13 14:37	
Modified Sobek	**Pyritic Sulfur-HCl**	0.90	%	0.01			N/A		03/04/13 14:37	
Modified Sobek	**Sulfate Sulfur-HCl**	0.70	%	0.01			N/A		03/04/13 14:37	
Modified Sobek	**Total Sulfur**	1.62	%	0.01	0.004		W309098	MCE	02/27/13 12:59	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
USDA HB60(21a)	**Paste pH @20.5°C**	7.37	pH Units				W309281	MCE	03/06/13 11:45	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern

John Kern
Laboratory Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W3B0421**
Reported: 07-Mar-13 12:09

Quality Control - BLANK Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	<0.3	0.1	0.3	W309098	01-Mar-13	
Modified Sobek	Non-Sulfate Sulfur	%	<0.01	0.004	0.01	W309098	04-Mar-13	
Modified Sobek	Non-Sulfate Sulfur	%	<0.01	0.004	0.01	W309098	06-Mar-13	
Modified Sobek	Total Sulfur	%	<0.01	0.004	0.01	W309098	27-Feb-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	0.004	0.01	W309098	04-Mar-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Modified Sobek	Non-Sulfate Sulfur-HCl	%	<0.01	0.004	0.01	W309098	04-Mar-13	
Modified Sobek	Total Sulfur	%	<0.01	0.004	0.01	W309098	27-Feb-13	
Modified Sobek	Non-extractable Sulfur	%	<0.01	0.004	0.01	W309098	04-Mar-13	

Quality Control - LABORATORY CONTROL SAMPLE Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	209	216	96.8	80 - 120	W309098	01-Mar-13	
Modified Sobek	Total Sulfur	%	1.02	0.942	108	80 - 120	W309098	27-Feb-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Modified Sobek	Total Sulfur	%	1.02	0.942	108	80 - 120	W309098	27-Feb-13	

Classical Chemistry Parameters

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
USDA HB60(21a)	Paste pH	pH Units	7.48	7.40	101	93.7 - 106.3	W309281	06-Mar-13	

Quality Control - DUPLICATE Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	762	762	0.0	20	W309098	01-Mar-13	
Modified Sobek	Non-Sulfate Sulfur	%	0.15	0.18	18.3	20	W309098	06-Mar-13	
Modified Sobek	Total Sulfur	%	<0.02	<0.02	UDL	20	W309098	27-Feb-13	D1
Modified Sobek	Non-extractable Sulfur	%	0.12	0.13	10.4	20	W309098	04-Mar-13	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Modified Sobek	Non-Sulfate Sulfur-HCl	%	0.15	0.17	13.2	20	W309098	04-Mar-13	
Modified Sobek	Total Sulfur	%	<0.02	<0.02	UDL	20	W309098	27-Feb-13	D1
Modified Sobek	Non-extractable Sulfur	%	0.12	0.13	10.4	20	W309098	04-Mar-13	

Classical Chemistry Parameters

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
USDA HB60(21a)	Paste pH	pH Units	8.20	8.19	0.1	20	W309281	06-Mar-13	

Notes and Definitions

D1	Sample required dilution due to matrix.
LCS	Laboratory Control Sample (Blank Spike)
RPD	Relative Percent Difference
UDL	A result is less than the detection limit
R > 4S	% recovery not applicable, sample concentration more than four times greater than spike level
<RL	A result is less than the reporting limit
MRL	Method Reporting Limit
MDL	Method Detection Limit
N/A	Not Applicable

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W1L0313**
Reported: 06-Jan-12 17:07

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Sampled By	Date Received
SRK 0866	W1L0313-01	Soil	13-Dec-11 09:00	TJ	15-Dec-2011
SRK 0864	W1L0313-02	Soil	13-Dec-11 09:00	TJ	15-Dec-2011
604 033	W1L0313-03	Soil	13-Dec-11 09:00	TJ	15-Dec-2011
604 153	W1L0313-04	Soil	13-Dec-11 09:00	TJ	15-Dec-2011
604 562	W1L0313-05	Soil	13-Dec-11 09:00	TJ	15-Dec-2011
604 569	W1L0313-06	Soil	13-Dec-11 09:00	TJ	15-Dec-2011
604 606	W1L0313-07	Soil	13-Dec-11 09:00	TJ	15-Dec-2011
604 653	W1L0313-08	Soil	13-Dec-11 09:00	TJ	15-Dec-2011
604 656	W1L0313-09	Soil	13-Dec-11 09:00	TJ	15-Dec-2011
604 811	W1L0313-10	Soil	13-Dec-11 09:00	TJ	15-Dec-2011
604 854	W1L0313-11	Soil	13-Dec-11 09:00	TJ	15-Dec-2011
604 862	W1L0313-12	Soil	13-Dec-11 09:00	TJ	15-Dec-2011
604 867	W1L0313-13	Soil	13-Dec-11 09:00	TJ	15-Dec-2011

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested. Non-Detects are reported at the MDL.
Sample preparation is defined by the client as per their Data Quality Objectives.
This report supercedes any previous reports for this Work Order. The complete report includes pages for each sample, a full QC report, and a notes section.
The results presented in this report relate only to the samples, and meet all requirements of the NELAC Standards unless otherwise noted.

Case Narrative

Nevada does not accredit for NAG, ABA and Sulfur Forms. HCl wash added per NDEP directive.

One Government Gulch - PO Box 929 Kellogg ID 83837-0929 (208) 784-1258 Fax (208) 783-0891

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W1L0313**
Reported: 06-Jan-12 17:07

Client Sample ID: **SRK 0866**
SVL Sample ID: **W1L0313-01 (Soil)**

Sample Report Page 1 of 1

Sampled: 13-Dec-11 09:00
Received: 15-Dec-11
Sampled By: TJ

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Acid/Base Accounting & Sulfur Forms										
Modified Sobek	**ABA**	9.3	TCaCO3/kT	0.3			N/A		12/22/11 09:09	
Modified Sobek	**AGP**	5.5	TCaCO3/kT	0.3			N/A		12/22/11 09:09	
Modified Sobek	**ANP**	14.8	TCaCO3/kT	0.3	0.1		W152101	AGF	12/21/11 14:24	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.004		W152101	MAD	12/22/11 09:09	
Modified Sobek	**Non-Sulfate Sulfur**	0.18	%	0.01	0.004		W152101	MAD	12/21/11 11:41	
Modified Sobek	**Pyritic Sulfur**	0.18	%	0.01			N/A		12/22/11 09:09	
Modified Sobek	**Sulfate Sulfur**	0.08	%	0.01			N/A		12/21/11 11:41	
Modified Sobek	**Total Sulfur**	0.26	%	0.01	0.004		W152101	MAD	12/20/11 14:07	
Acid/Base Accounting & Sulfur Forms (HCl Wash)										
Modified Sobek	**ABA-HCl**	9.7	TCaCO3/kT	0.3			N/A		12/22/11 09:09	
Modified Sobek	**AGP-HCl**	5.1	TCaCO3/kT	0.3			N/A		12/22/11 09:09	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.004		W152101	MAD	12/22/11 09:09	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.16	%	0.01	0.004		W152101	MAD	12/22/11 08:18	
Modified Sobek	**Pyritic Sulfur-HCl**	0.16	%	0.01			N/A		12/22/11 09:09	
Modified Sobek	**Sulfate Sulfur-HCl**	0.09	%	0.01			N/A		12/22/11 08:18	
Modified Sobek	**Total Sulfur**	0.26	%	0.01	0.004		W152101	MAD	12/20/11 14:07	
Classical Chemistry Parameters										
NAG	**NAG pH @26.8°C**	3.83	pH Units				W152256	MAD	12/23/11 12:32	
NAG	**NAG@pH 4.5**	3.54	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
NAG	**NAG@pH 7**	2.16	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
USDA HB60(21a)	**Paste pH @20.4°C**	8.04	pH Units				W152266	MAD	12/27/11 10:12	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Kirby Gray

Kirby Gray
Technical Director

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1016 Greg Street
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Project Name: MLI: 3438
Work Order: **W1L0313**
Reported: 06-Jan-12 17:07

Client Sample ID: **SRK 0864**
SVL Sample ID: **W1L0313-02 (Soil)**

Sample Report Page 1 of 1

Sampled: 13-Dec-11 09:00
Received: 15-Dec-11
Sampled By: TJ

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	22.3	TCaCO3/kT	0.3			N/A		12/22/11 09:18	
Modified Sobek	AGP	< 0.3	TCaCO3/kT	0.3			N/A		12/22/11 09:18	
Modified Sobek	**ANP**	22.3	TCaCO3/kT	0.3	0.1		W152101	AGF	12/21/11 14:24	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.004		W152101	MAD	12/22/11 09:18	
Modified Sobek	**Non-Sulfate Sulfur**	0.01	%	0.01	0.004		W152101	MAD	12/21/11 11:44	
Modified Sobek	Pyritic Sulfur	< 0.01	%	0.01			N/A		12/22/11 09:18	
Modified Sobek	**Sulfate Sulfur**	0.01	%	0.01			N/A		12/21/11 11:44	
Modified Sobek	**Total Sulfur**	0.01	%	0.01	0.004		W152101	MAD	12/20/11 14:10	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	22.3	TCaCO3/kT	0.3			N/A		12/22/11 09:18	
Modified Sobek	AGP-HCl	< 0.3	TCaCO3/kT	0.3			N/A		12/22/11 09:18	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.004		W152101	MAD	12/22/11 09:18	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.01	%	0.01	0.004		W152101	MAD	12/22/11 08:20	
Modified Sobek	Pyritic Sulfur-HCl	< 0.01	%	0.01			N/A		12/22/11 09:18	
Modified Sobek	**Sulfate Sulfur-HCl**	0.01	%	0.01			N/A		12/22/11 08:20	
Modified Sobek	**Total Sulfur**	0.01	%	0.01	0.004		W152101	MAD	12/20/11 14:10	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
NAG	**NAG pH @27.8°C**	7.04	pH Units				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 4.5	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 7	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
USDA HB60(21a)	**Paste pH @19.9°C**	8.19	pH Units				W152266	MAD	12/27/11 10:12	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Kirby Gray

Kirby Gray
Technical Director

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Project Name: MLI: 3438
Work Order: **W1L0313**
Reported: 06-Jan-12 17:07

Client Sample ID: **604 033**
SVL Sample ID: **W1L0313-03 (Soil)**

Sample Report Page 1 of 1

Sampled: 13-Dec-11 09:00
Received: 15-Dec-11
Sampled By: TJ

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Acid/Base Accounting & Sulfur Forms										
Modified Sobek	**ABA**	-3.7	TCaCO3/kT	0.3			N/A		12/22/11 09:21	
Modified Sobek	**AGP**	28.5	TCaCO3/kT	0.3			N/A		12/22/11 09:21	
Modified Sobek	**ANP**	24.7	TCaCO3/kT	0.3	0.1		W152101	AGF	12/21/11 14:24	
Modified Sobek	**Non-extractable Sulfur**	0.01	%	0.01	0.004		W152101	MAD	12/22/11 09:21	
Modified Sobek	**Non-Sulfate Sulfur**	0.91	%	0.01	0.004		W152101	MAD	12/21/11 11:47	
Modified Sobek	**Pyritic Sulfur**	0.91	%	0.01			N/A		12/22/11 09:21	
Modified Sobek	**Sulfate Sulfur**	0.30	%	0.01			N/A		12/21/11 11:47	
Modified Sobek	**Total Sulfur**	1.21	%	0.01	0.004		W152101	MAD	12/20/11 14:13	
Acid/Base Accounting & Sulfur Forms (HCl Wash)										
Modified Sobek	**ABA-HCl**	-1.2	TCaCO3/kT	0.3			N/A		12/22/11 09:21	
Modified Sobek	**AGP-HCl**	25.9	TCaCO3/kT	0.3			N/A		12/22/11 09:21	
Modified Sobek	**Non-extractable Sulfur**	0.01	%	0.01	0.004		W152101	MAD	12/22/11 09:21	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.83	%	0.01	0.004		W152101	MAD	12/22/11 08:23	
Modified Sobek	**Pyritic Sulfur-HCl**	0.83	%	0.01			N/A		12/22/11 09:21	
Modified Sobek	**Sulfate Sulfur-HCl**	0.38	%	0.01			N/A		12/22/11 08:23	
Modified Sobek	**Total Sulfur**	1.21	%	0.01	0.004		W152101	MAD	12/20/11 14:13	
Classical Chemistry Parameters										
NAG	**NAG pH @25.3°C**	8.04	pH Units				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 4.5	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 7	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
USDA HB60(21a)	**Paste pH @19.9°C**	8.05	pH Units				W152266	MAD	12/27/11 10:12	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Kirby Gray

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Project Name: MLI: 3438
Work Order: **W1L0313**
Reported: 06-Jan-12 17:07

Client Sample ID: **604 153**
SVL Sample ID: **W1L0313-04 (Soil)**

Sample Report Page 1 of 1

Sampled: 13-Dec-11 09:00
Received: 15-Dec-11
Sampled By: TJ

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Acid/Base Accounting & Sulfur Forms										
Modified Sobek	**ABA**	23.6	TCaCO3/kT	0.3			N/A		12/22/11 09:24	
Modified Sobek	**AGP**	14.5	TCaCO3/kT	0.3			N/A		12/22/11 09:24	
Modified Sobek	**ANP**	38.1	TCaCO3/kT	0.3	0.1		W152101	AGF	12/21/11 14:24	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.004		W152101	MAD	12/22/11 09:24	
Modified Sobek	**Non-Sulfate Sulfur**	0.46	%	0.01	0.004		W152101	MAD	12/21/11 11:51	
Modified Sobek	**Pyritic Sulfur**	0.46	%	0.01			N/A		12/22/11 09:24	
Modified Sobek	**Sulfate Sulfur**	0.09	%	0.01			N/A		12/21/11 11:51	
Modified Sobek	**Total Sulfur**	0.56	%	0.01	0.004		W152101	MAD	12/20/11 14:16	
Acid/Base Accounting & Sulfur Forms (HCl Wash)										
Modified Sobek	**ABA-HCl**	23.1	TCaCO3/kT	0.3			N/A		12/22/11 09:24	
Modified Sobek	**AGP-HCl**	15.0	TCaCO3/kT	0.3			N/A		12/22/11 09:24	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.004		W152101	MAD	12/22/11 09:24	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.48	%	0.01	0.004		W152101	MAD	12/22/11 08:26	
Modified Sobek	**Pyritic Sulfur-HCl**	0.48	%	0.01			N/A		12/22/11 09:24	
Modified Sobek	**Sulfate Sulfur-HCl**	0.07	%	0.01			N/A		12/22/11 08:26	
Modified Sobek	**Total Sulfur**	0.56	%	0.01	0.004		W152101	MAD	12/20/11 14:16	
Classical Chemistry Parameters										
NAG	**NAG pH @25.5°C**	7.97	pH Units				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 4.5	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 7	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
USDA HB60(21a)	**Paste pH @19.6°C**	8.11	pH Units				W152266	MAD	12/27/11 10:12	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

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Technical Director

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Project Name: MLI: 3438
Work Order: **W1L0313**
Reported: 06-Jan-12 17:07

Client Sample ID: **604 562**
SVL Sample ID: **W1L0313-05 (Soil)**

Sample Report Page 1 of 1

Sampled: 13-Dec-11 09:00
Received: 15-Dec-11
Sampled By: TJ

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	-11.7	TCaCO3/kT	0.3			N/A		12/22/11 09:27	
Modified Sobek	**AGP**	44.9	TCaCO3/kT	0.3			N/A		12/22/11 09:27	
Modified Sobek	**ANP**	33.1	TCaCO3/kT	0.3	0.1		W152101	AGF	12/21/11 14:24	
Modified Sobek	**Non-extractable Sulfur**	0.03	%	0.01	0.004		W152101	MAD	12/22/11 09:27	
Modified Sobek	**Non-Sulfate Sulfur**	1.47	%	0.01	0.004		W152101	MAD	12/21/11 12:01	
Modified Sobek	**Pyritic Sulfur**	1.44	%	0.01			N/A		12/22/11 09:27	
Modified Sobek	**Sulfate Sulfur**	0.27	%	0.01			N/A		12/21/11 12:01	
Modified Sobek	**Total Sulfur**	1.74	%	0.01	0.004		W152101	MAD	12/20/11 14:19	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	-1.1	TCaCO3/kT	0.3			N/A		12/22/11 09:27	
Modified Sobek	**AGP-HCl**	34.2	TCaCO3/kT	0.3			N/A		12/22/11 09:27	
Modified Sobek	**Non-extractable Sulfur**	0.03	%	0.01	0.004		W152101	MAD	12/22/11 09:27	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	1.13	%	0.01	0.004		W152101	MAD	12/22/11 08:29	
Modified Sobek	**Pyritic Sulfur-HCl**	1.10	%	0.01			N/A		12/22/11 09:27	
Modified Sobek	**Sulfate Sulfur-HCl**	0.61	%	0.01			N/A		12/22/11 08:29	
Modified Sobek	**Total Sulfur**	1.74	%	0.01	0.004		W152101	MAD	12/20/11 14:19	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
NAG	**NAG pH @25.5°C**	8.10	pH Units				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 4.5	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 7	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
USDA HB60(21a)	**Paste pH @20.0°C**	7.84	pH Units				W152266	MAD	12/27/11 10:12	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Kirby Gray

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Technical Director

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Project Name: MLI: 3438
Work Order: **W1L0313**
Reported: 06-Jan-12 17:07

Client Sample ID: **604 569**
SVL Sample ID: **W1L0313-06 (Soil)**

Sample Report Page 1 of 1

Sampled: 13-Dec-11 09:00
Received: 15-Dec-11
Sampled By: TJ

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Acid/Base Accounting & Sulfur Forms										
Modified Sobek	**ABA**	-15.4	TCaCO3/kT	0.3			N/A		12/22/11 09:30	
Modified Sobek	**AGP**	32.2	TCaCO3/kT	0.3			N/A		12/22/11 09:30	
Modified Sobek	**ANP**	16.8	TCaCO3/kT	0.3	0.1		W152101	AGF	12/21/11 14:24	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.004		W152101	MAD	12/22/11 09:30	
Modified Sobek	**Non-Sulfate Sulfur**	1.03	%	0.01	0.004		W152101	MAD	12/21/11 12:05	
Modified Sobek	**Pyritic Sulfur**	1.03	%	0.01			N/A		12/22/11 09:30	
Modified Sobek	**Sulfate Sulfur**	0.28	%	0.01			N/A		12/21/11 12:05	
Modified Sobek	**Total Sulfur**	1.31	%	0.01	0.004		W152101	MAD	12/20/11 14:28	
Acid/Base Accounting & Sulfur Forms (HCl Wash)										
Modified Sobek	**ABA-HCl**	-12.1	TCaCO3/kT	0.3			N/A		12/22/11 09:30	
Modified Sobek	**AGP-HCl**	28.9	TCaCO3/kT	0.3			N/A		12/22/11 09:30	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.004		W152101	MAD	12/22/11 09:30	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.92	%	0.01	0.004		W152101	MAD	12/22/11 08:32	
Modified Sobek	**Pyritic Sulfur-HCl**	0.92	%	0.01			N/A		12/22/11 09:30	
Modified Sobek	**Sulfate Sulfur-HCl**	0.39	%	0.01			N/A		12/22/11 08:32	
Modified Sobek	**Total Sulfur**	1.31	%	0.01	0.004		W152101	MAD	12/20/11 14:28	
Classical Chemistry Parameters										
NAG	**NAG pH @25.2°C**	8.01	pH Units				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 4.5	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 7	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
USDA HB60(21a)	**Paste pH @20.3°C**	8.19	pH Units				W152266	MAD	12/27/11 10:12	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Kirby Gray

Kirby Gray
Technical Director

SVL holds the following certifications:
AZ:0538, **CA**:2080, **FL**(**NELAC**):E87993, **ID**:ID00019 & ID00965 (Microbiology), **NV**:ID000192007A, **WA**:1268

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W1L0313**
Reported: 06-Jan-12 17:07

Client Sample ID: **604 606**
SVL Sample ID: **W1L0313-07 (Soil)**

Sample Report Page 1 of 1

Sampled: 13-Dec-11 09:00
Received: 15-Dec-11
Sampled By: TJ

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	-1.8	TCaCO3/kT	0.3			N/A		12/22/11 09:32	
Modified Sobek	**AGP**	22.1	TCaCO3/kT	0.3			N/A		12/22/11 09:32	
Modified Sobek	**ANP**	20.3	TCaCO3/kT	0.3	0.1		W152101	AGF	12/21/11 14:24	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.004		W152101	MAD	12/22/11 09:32	
Modified Sobek	**Non-Sulfate Sulfur**	0.71	%	0.01	0.004		W152101	MAD	12/21/11 12:08	
Modified Sobek	**Pyritic Sulfur**	0.71	%	0.01			N/A		12/22/11 09:32	
Modified Sobek	**Sulfate Sulfur**	0.26	%	0.01			N/A		12/21/11 12:08	
Modified Sobek	**Total Sulfur**	0.96	%	0.01	0.004		W152101	MAD	12/20/11 14:31	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	1.6	TCaCO3/kT	0.3			N/A		12/22/11 09:32	
Modified Sobek	**AGP-HCl**	18.7	TCaCO3/kT	0.3			N/A		12/22/11 09:32	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.004		W152101	MAD	12/22/11 09:32	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.60	%	0.01	0.004		W152101	MAD	12/22/11 08:35	
Modified Sobek	**Pyritic Sulfur-HCl**	0.60	%	0.01			N/A		12/22/11 09:32	
Modified Sobek	**Sulfate Sulfur-HCl**	0.37	%	0.01			N/A		12/22/11 08:35	
Modified Sobek	**Total Sulfur**	0.96	%	0.01	0.004		W152101	MAD	12/20/11 14:31	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
NAG	**NAG pH @25.6°C**	8.13	pH Units				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 4.5	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 7	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
USDA HB60(21a)	**Paste pH @20.2°C**	8.10	pH Units				W152266	MAD	12/27/11 10:12	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Kirby Gray

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Technical Director

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Project Name: MLI: 3438
Work Order: **W1L0313**
Reported: 06-Jan-12 17:07

Client Sample ID: **604 653**
SVL Sample ID: **W1L0313-08 (Soil)**

Sample Report Page 1 of 1

Sampled: 13-Dec-11 09:00
Received: 15-Dec-11
Sampled By: TJ

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	-3.2	TCaCO3/kT	0.3			N/A		12/22/11 09:35	
Modified Sobek	**AGP**	24.0	TCaCO3/kT	0.3			N/A		12/22/11 09:35	
Modified Sobek	**ANP**	20.8	TCaCO3/kT	0.3	0.1		W152101	AGF	12/21/11 14:24	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.004		W152101	MAD	12/22/11 09:35	
Modified Sobek	**Non-Sulfate Sulfur**	0.77	%	0.01	0.004		W152101	MAD	12/21/11 12:12	
Modified Sobek	**Pyritic Sulfur**	0.77	%	0.01			N/A		12/22/11 09:35	
Modified Sobek	**Sulfate Sulfur**	0.19	%	0.01			N/A		12/21/11 12:12	
Modified Sobek	**Total Sulfur**	0.96	%	0.01	0.004		W152101	MAD	12/20/11 14:34	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	ABA-HCl	< 0.3	TCaCO3/kT	0.3			N/A		12/22/11 09:35	
Modified Sobek	**AGP-HCl**	20.9	TCaCO3/kT	0.3			N/A		12/22/11 09:35	
Modified Sobek	Non-extractable Sulfur	< 0.01	%	0.01	0.004		W152101	MAD	12/22/11 09:35	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.67	%	0.01	0.004		W152101	MAD	12/22/11 08:44	
Modified Sobek	**Pyritic Sulfur-HCl**	0.67	%	0.01			N/A		12/22/11 09:35	
Modified Sobek	**Sulfate Sulfur-HCl**	0.29	%	0.01			N/A		12/22/11 08:44	
Modified Sobek	**Total Sulfur**	0.96	%	0.01	0.004		W152101	MAD	12/20/11 14:34	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
NAG	**NAG pH @25.3°C**	8.17	pH Units				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 4.5	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 7	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
USDA HB60(21a)	**Paste pH @20.3°C**	8.01	pH Units				W152266	MAD	12/27/11 10:12	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Kirby Gray

Kirby Gray
Technical Director

McClelland Laboratories Inc	**Project Name: MLI: 3438**
1016 Greg Street	Work Order: **W1L0313**
Sparks, NV 89431	Reported: 06-Jan-12 17:07

Client Sample ID: **604 656**
SVL Sample ID: **W1L0313-09 (Soil)**

Sample Report Page 1 of 1

Sampled: 13-Dec-11 09:00
Received: 15-Dec-11
Sampled By: TJ

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	32.1	TCaCO3/kT	0.3			N/A		12/22/11 09:38	
Modified Sobek	**AGP**	19.4	TCaCO3/kT	0.3			N/A		12/22/11 09:38	
Modified Sobek	**ANP**	51.4	TCaCO3/kT	0.3	0.1		W152101	AGF	12/21/11 14:24	
Modified Sobek	**Non-extractable Sulfur**	0.04	%	0.01	0.004		W152101	MAD	12/22/11 09:38	
Modified Sobek	**Non-Sulfate Sulfur**	0.66	%	0.01	0.004		W152101	MAD	12/21/11 12:15	
Modified Sobek	**Pyritic Sulfur**	0.62	%	0.01			N/A		12/22/11 09:38	
Modified Sobek	**Sulfate Sulfur**	0.04	%	0.01			N/A		12/21/11 12:15	
Modified Sobek	**Total Sulfur**	0.70	%	0.01	0.004		W152101	MAD	12/20/11 14:37	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	37.8	TCaCO3/kT	0.3			N/A		12/22/11 09:38	
Modified Sobek	**AGP-HCl**	13.7	TCaCO3/kT	0.3			N/A		12/22/11 09:38	
Modified Sobek	**Non-extractable Sulfur**	0.04	%	0.01	0.004		W152101	MAD	12/22/11 09:38	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.48	%	0.01	0.004		W152101	MAD	12/22/11 08:46	
Modified Sobek	**Pyritic Sulfur-HCl**	0.44	%	0.01			N/A		12/22/11 09:38	
Modified Sobek	**Sulfate Sulfur-HCl**	0.22	%	0.01			N/A		12/22/11 08:46	
Modified Sobek	**Total Sulfur**	0.70	%	0.01	0.004		W152101	MAD	12/20/11 14:37	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
NAG	**NAG pH @24.7°C**	7.97	pH Units				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 4.5	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 7	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
USDA HB60(21a)	**Paste pH @20.0°C**	7.62	pH Units				W152266	MAD	12/27/11 10:12	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Kirby Gray

Kirby Gray
Technical Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W1L0313**
Reported: 06-Jan-12 17:07

Client Sample ID: **604 811**
SVL Sample ID: **W1L0313-10 (Soil)**

Sample Report Page 1 of 1

Sampled: 13-Dec-11 09:00
Received: 15-Dec-11
Sampled By: TJ

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Acid/Base Accounting & Sulfur Forms										
Modified Sobek	**ABA**	-13.3	TCaCO3/kT	0.3			N/A		12/22/11 09:41	
Modified Sobek	**AGP**	42.5	TCaCO3/kT	0.3			N/A		12/22/11 09:41	
Modified Sobek	**ANP**	29.2	TCaCO3/kT	0.3	0.1		W152101	AGF	12/21/11 14:24	
Modified Sobek	**Non-extractable Sulfur**	0.03	%	0.01	0.004		W152101	MAD	12/22/11 09:41	
Modified Sobek	**Non-Sulfate Sulfur**	1.39	%	0.01	0.004		W152101	MAD	12/21/11 12:19	
Modified Sobek	**Pyritic Sulfur**	1.36	%	0.01			N/A		12/22/11 09:41	
Modified Sobek	**Sulfate Sulfur**	0.15	%	0.01			N/A		12/21/11 12:19	
Modified Sobek	**Total Sulfur**	1.54	%	0.01	0.004		W152101	MAD	12/20/11 14:39	
Acid/Base Accounting & Sulfur Forms (HCl Wash)										
Modified Sobek	**ABA-HCl**	-4.2	TCaCO3/kT	0.3			N/A		12/22/11 09:41	
Modified Sobek	**AGP-HCl**	33.4	TCaCO3/kT	0.3			N/A		12/22/11 09:41	
Modified Sobek	**Non-extractable Sulfur**	0.03	%	0.01	0.004		W152101	MAD	12/22/11 09:41	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	1.10	%	0.01	0.004		W152101	MAD	12/22/11 08:49	
Modified Sobek	**Pyritic Sulfur-HCl**	1.07	%	0.01			N/A		12/22/11 09:41	
Modified Sobek	**Sulfate Sulfur-HCl**	0.44	%	0.01			N/A		12/22/11 08:49	
Modified Sobek	**Total Sulfur**	1.54	%	0.01	0.004		W152101	MAD	12/20/11 14:39	
Classical Chemistry Parameters										
NAG	**NAG pH @24.3°C**	7.94	pH Units				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 4.5	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 7	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
USDA HB60(21a)	**Paste pH @20.1°C**	7.79	pH Units				W152266	MAD	12/27/11 10:12	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Kirby Gray

Kirby Gray
Technical Director

SVL holds the following certifications:
AZ:0538, **CA**:2080, **FL**(**NELAC**):E87993, **ID**:ID00019 & ID00965 (Microbiology), **NV**:ID000192007A, **WA**:1268

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W1L0313**
Reported: 06-Jan-12 17:07

Client Sample ID: **604 854**
SVL Sample ID: **W1L0313-11 (Soil)**

Sample Report Page 1 of 1

Sampled: 13-Dec-11 09:00
Received: 15-Dec-11
Sampled By: TJ

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	-18.1	TCaCO3/kT	0.3			N/A		12/22/11 09:44	
Modified Sobek	**AGP**	40.3	TCaCO3/kT	0.3			N/A		12/22/11 09:44	
Modified Sobek	**ANP**	22.3	TCaCO3/kT	0.3	0.1		W152101	AGF	12/21/11 14:24	
Modified Sobek	**Non-extractable Sulfur**	0.02	%	0.01	0.004		W152101	MAD	12/22/11 09:44	
Modified Sobek	**Non-Sulfate Sulfur**	1.31	%	0.01	0.004		W152101	MAD	12/21/11 12:24	
Modified Sobek	**Pyritic Sulfur**	1.29	%	0.01			N/A		12/22/11 09:44	
Modified Sobek	**Sulfate Sulfur**	0.45	%	0.01			N/A		12/21/11 12:24	
Modified Sobek	**Total Sulfur**	1.76	%	0.01	0.004		W152101	MAD	12/20/11 14:42	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	-4.4	TCaCO3/kT	0.3			N/A		12/22/11 09:44	
Modified Sobek	**AGP-HCl**	26.6	TCaCO3/kT	0.3			N/A		12/22/11 09:44	
Modified Sobek	**Non-extractable Sulfur**	0.02	%	0.01	0.004		W152101	MAD	12/22/11 09:44	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.87	%	0.01	0.004		W152101	MAD	12/22/11 08:52	
Modified Sobek	**Pyritic Sulfur-HCl**	0.85	%	0.01			N/A		12/22/11 09:44	
Modified Sobek	**Sulfate Sulfur-HCl**	0.89	%	0.01			N/A		12/22/11 08:52	
Modified Sobek	**Total Sulfur**	1.76	%	0.01	0.004		W152101	MAD	12/20/11 14:42	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
NAG	**NAG pH @24.1°C**	5.66	pH Units				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 4.5	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 7	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
USDA HB60(21a)	**Paste pH @20.0°C**	8.03	pH Units				W152266	MAD	12/27/11 10:12	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Kirby Gray

Kirby Gray
Technical Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W1L0313**
Reported: 06-Jan-12 17:07

Client Sample ID: **604 862**
SVL Sample ID: **W1L0313-12 (Soil)**

Sample Report Page 1 of 1

Sampled: 13-Dec-11 09:00
Received: 15-Dec-11
Sampled By: TJ

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	-4.5	TCaCO3/kT	0.3			N/A		12/22/11 09:53	
Modified Sobek	**AGP**	41.1	TCaCO3/kT	0.3			N/A		12/22/11 09:53	
Modified Sobek	**ANP**	36.6	TCaCO3/kT	0.3	0.1		W152101	AGF	12/21/11 14:24	
Modified Sobek	**Non-extractable Sulfur**	0.03	%	0.01	0.004		W152101	MAD	12/22/11 09:53	
Modified Sobek	**Non-Sulfate Sulfur**	1.34	%	0.01	0.004		W152101	MAD	12/21/11 12:28	
Modified Sobek	**Pyritic Sulfur**	1.31	%	0.01			N/A		12/22/11 09:53	
Modified Sobek	**Sulfate Sulfur**	0.32	%	0.01			N/A		12/21/11 12:28	
Modified Sobek	**Total Sulfur**	1.66	%	0.01	0.004		W152101	MAD	12/20/11 14:45	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	12.4	TCaCO3/kT	0.3			N/A		12/22/11 09:53	
Modified Sobek	**AGP-HCl**	24.2	TCaCO3/kT	0.3			N/A		12/22/11 09:53	
Modified Sobek	**Non-extractable Sulfur**	0.03	%	0.01	0.004		W152101	MAD	12/22/11 09:53	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	0.80	%	0.01	0.004		W152101	MAD	12/22/11 08:55	
Modified Sobek	**Pyritic Sulfur-HCl**	0.77	%	0.01			N/A		12/22/11 09:53	
Modified Sobek	**Sulfate Sulfur-HCl**	0.86	%	0.01			N/A		12/22/11 08:55	
Modified Sobek	**Total Sulfur**	1.66	%	0.01	0.004		W152101	MAD	12/20/11 14:45	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
NAG	**NAG pH @23.6°C**	7.78	pH Units				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 4.5	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 7	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
USDA HB60(21a)	**Paste pH @20.1°C**	7.64	pH Units				W152266	MAD	12/27/11 10:12	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Kirby Gray

Kirby Gray
Technical Director

McClelland Laboratories Inc
1016 Greg Street
Sparks, NV 89431

Project Name: MLI: 3438
Work Order: **W1L0313**
Reported: 06-Jan-12 17:07

Client Sample ID: **604 867**
SVL Sample ID: **W1L0313-13 (Soil)**

Sample Report Page 1 of 1

Sampled: 13-Dec-11 09:00
Received: 15-Dec-11
Sampled By: TJ

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA**	-57.9	TCaCO3/kT	0.3			N/A		12/22/11 09:56	
Modified Sobek	**AGP**	81.6	TCaCO3/kT	0.3			N/A		12/22/11 09:56	
Modified Sobek	**ANP**	23.7	TCaCO3/kT	0.3	0.1		W152101	AGF	12/21/11 14:24	
Modified Sobek	**Non-extractable Sulfur**	0.05	%	0.01	0.004		W152101	MAD	12/22/11 09:56	
Modified Sobek	**Non-Sulfate Sulfur**	2.66	%	0.01	0.004		W152101	MAD	12/21/11 12:32	
Modified Sobek	**Pyritic Sulfur**	2.61	%	0.01			N/A		12/22/11 09:56	
Modified Sobek	**Sulfate Sulfur**	0.22	%	0.01			N/A		12/21/11 12:32	
Modified Sobek	**Total Sulfur**	2.88	%	0.01	0.004		W152101	MAD	12/20/11 14:48	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Modified Sobek	**ABA-HCl**	-13.2	TCaCO3/kT	0.3			N/A		12/22/11 09:56	
Modified Sobek	**AGP-HCl**	37.0	TCaCO3/kT	0.3			N/A		12/22/11 09:56	
Modified Sobek	**Non-extractable Sulfur**	0.05	%	0.01	0.004		W152101	MAD	12/22/11 09:56	
Modified Sobek	**Non-Sulfate Sulfur-HCl**	1.23	%	0.01	0.004		W152101	MAD	12/22/11 08:58	
Modified Sobek	**Pyritic Sulfur-HCl**	1.18	%	0.01			N/A		12/22/11 09:56	
Modified Sobek	**Sulfate Sulfur-HCl**	1.65	%	0.01			N/A		12/22/11 08:58	
Modified Sobek	**Total Sulfur**	2.88	%	0.01	0.004		W152101	MAD	12/20/11 14:48	

Classical Chemistry Parameters

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
NAG	**NAG pH @23.8°C**	4.21	pH Units				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 4.5	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
NAG	NAG@pH 7	N/A	kg H2SO4/T				W152256	MAD	12/23/11 12:32	
USDA HB60(21a)	**Paste pH @19.9°C**	7.66	pH Units				W152266	MAD	12/27/11 10:12	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Kirby Gray

Kirby Gray
Technical Director

Quality Control - BLANK Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	<0.3	0.1	0.3	W152101	21-Dec-11	
Modified Sobek	Non-Sulfate Sulfur	%	<0.01	0.004	0.01	W152101	21-Dec-11	
Modified Sobek	Total Sulfur	%	<0.01	0.004	0.01	W152101	20-Dec-11	
Modified Sobek	Non-extractable Sulfur	%	<0.01	0.004	0.01	W152101	22-Dec-11	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Modified Sobek	Non-Sulfate Sulfur-HCl	%	<0.01	0.004	0.01	W152101	22-Dec-11	
Modified Sobek	Total Sulfur	%	<0.01	0.004	0.01	W152101	20-Dec-11	
Modified Sobek	Non-extractable Sulfur	%	<0.01	0.004	0.01	W152101	22-Dec-11	

Quality Control - LABORATORY CONTROL SAMPLE Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	35.1	33.2	106	80 - 120	W152101	21-Dec-11	
Modified Sobek	Total Sulfur	%	0.96	0.942	102	80 - 120	W152101	20-Dec-11	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Modified Sobek	Total Sulfur	%	0.96	0.942	102	80 - 120	W152101	20-Dec-11	

Classical Chemistry Parameters

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
USDA HB60(21a)	Paste pH	pH Units	8.12	8.18	99.3	93.7 - 106.3	W152266	27-Dec-11	

Quality Control - DUPLICATE Data

Acid/Base Accounting & Sulfur Forms

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Modified Sobek	ANP	TCaCO3/kT	12.9	14.8	14.3	20	W152101	21-Dec-11	
Modified Sobek	Non-Sulfate Sulfur	%	0.20	0.18	9.7	20	W152101	21-Dec-11	
Modified Sobek	Total Sulfur	%	0.24	0.26	7.7	20	W152101	20-Dec-11	
Modified Sobek	Non-extractable Sulfur	%	<0.01	<0.01	UDL	20	W152101	22-Dec-11	

Acid/Base Accounting & Sulfur Forms (HCl Wash)

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Modified Sobek	Non-Sulfate Sulfur-HCl	%	0.21	0.16	25.5	20	W152101	22-Dec-11	R2
Modified Sobek	Total Sulfur	%	0.24	0.26	7.7	20	W152101	20-Dec-11	
Modified Sobek	Non-extractable Sulfur	%	<0.01	<0.01	UDL	20	W152101	22-Dec-11	

Classical Chemistry Parameters

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
NAG	NAG pH	pH Units	6.14	6.15	0.2	20	W152256	23-Dec-11	
NAG	NAG@pH 4.5	kg H2SO4/T	N/A	0.00		20	W152256	23-Dec-11	
NAG	NAG@pH 7	kg H2SO4/T	N/A	0.00		20	W152256	23-Dec-11	
USDA HB60(21a)	Paste pH	pH Units	7.99	8.04	0.6	20	W152266	27-Dec-11	

Notes and Definitions

R2	RPD exceeded the laboratory acceptance limit.
LCS	Laboratory Control Sample (Blank Spike)
RPD	Relative Percent Difference
UDL	A result is less than the detection limit
R > 4S	% recovery not applicable, sample concentration more than four times greater than spike level
<RL	A result is less than the reporting limit
MRL	Method Reporting Limit
MDL	Method Detection Limit
N/A	Not Applicable

MODEL OF GROUNDWATER FLOW IN THE ANIMAS UPLIFT AND PALOMAS BASIN, COPPER FLAT PROJECT, SIERRA COUNTY, NEW MEXICO

prepared by

Michael A. Jones

John W. Shomaker, PhD, CPG

Steven T. Finch, Jr., CPG

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2611 Broadbent Parkway NE
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prepared for

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2424 Louisiana Blvd NE, Suite 301
Albuquerque, NM 87110

February 21, 2014

MODEL OF GROUNDWATER FLOW IN THE ANIMAS UPLIFT AND PALOMAS BASIN, COPPER FLAT PROJECT, SIERRA COUNTY, NEW MEXICO

prepared by

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2424 Louisiana Blvd NE, Suite 301
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February 21, 2014

MODEL OF GROUNDWATER FLOW IN THE ANIMAS UPLIFT AND PALOMAS BASIN, COPPER FLAT PROJECT, SIERRA COUNTY, NEW MEXICO

EXECUTIVE SUMMARY

This report documents a numerical model of groundwater flow in and around Copper Flat, near Hillsboro, New Mexico. The model was developed and calibrated based on previously available information and on new studies of the system. The calibrated model will be used to project the effects, to groundwater and surface water, of the proposed development of the Copper Flat Mine.

The report first introduces the study area then summarizes the climate and meteorology, hydrology and water balance, and geology and hydrogeology of the area. Then an overall conceptual model of the hydrological and hydrogeological system is presented, followed by a presentation of data available to confirm and calibrate the model. Next the numerical model is presented, including model structure, inputs and calibration. Finally, the sensitivity of model results to unknown parameters is evaluated.

Extensive information on the system is available, from previous studies and previous mine operations, and from new studies including the 2012 extended well field pumping test. The model accurately represents the conceptual model and accurately reproduces the calibration data, particularly the results of the 2012 well field pumping test. As a result the model is considered suitable for use in projecting the effects of future well field pumping.

The calibrated model will be used to generate projections related to the results and effects of mine development. Projections will be generated as required and reported separately. Results of interest include the following:

- Groundwater drawdown due to water-supply pumping, for selected mine development scenarios
- Effects on surface discharge to the Las Animas Creek and Rio Grande systems
- Long-term post-mining residual groundwater drawdown and effects to surface discharge
- Potential ground subsidence due to groundwater drawdown
- Open pit dewatering rates and groundwater drawdown in bedrock
- Post-mining open-pit water level and water balance
- Down-gradient migration of potential leakage from tailings and waste rock storage facilities

The large amount of information has allowed development of a model that can reliably project effects of future development. In particular, aquifer properties around the well field are relatively known, and sensitivity of the primary model projection results, groundwater drawdown and surface discharge changes due to well field pumping, to plausible variation in model inputs, is low.

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MODEL OF GROUNDWATER FLOW IN THE ANIMAS UPLIFT AND PALOMAS BASIN, COPPER FLAT PROJECT, SIERRA COUNTY, NEW MEXICO

1.0 INTRODUCTION

The report presents a numerical model of the hydrogeological system in the area of the Copper Flat Project (Project) near Truth or Consequences, New Mexico. The Project location is shown on Figure 1.1.

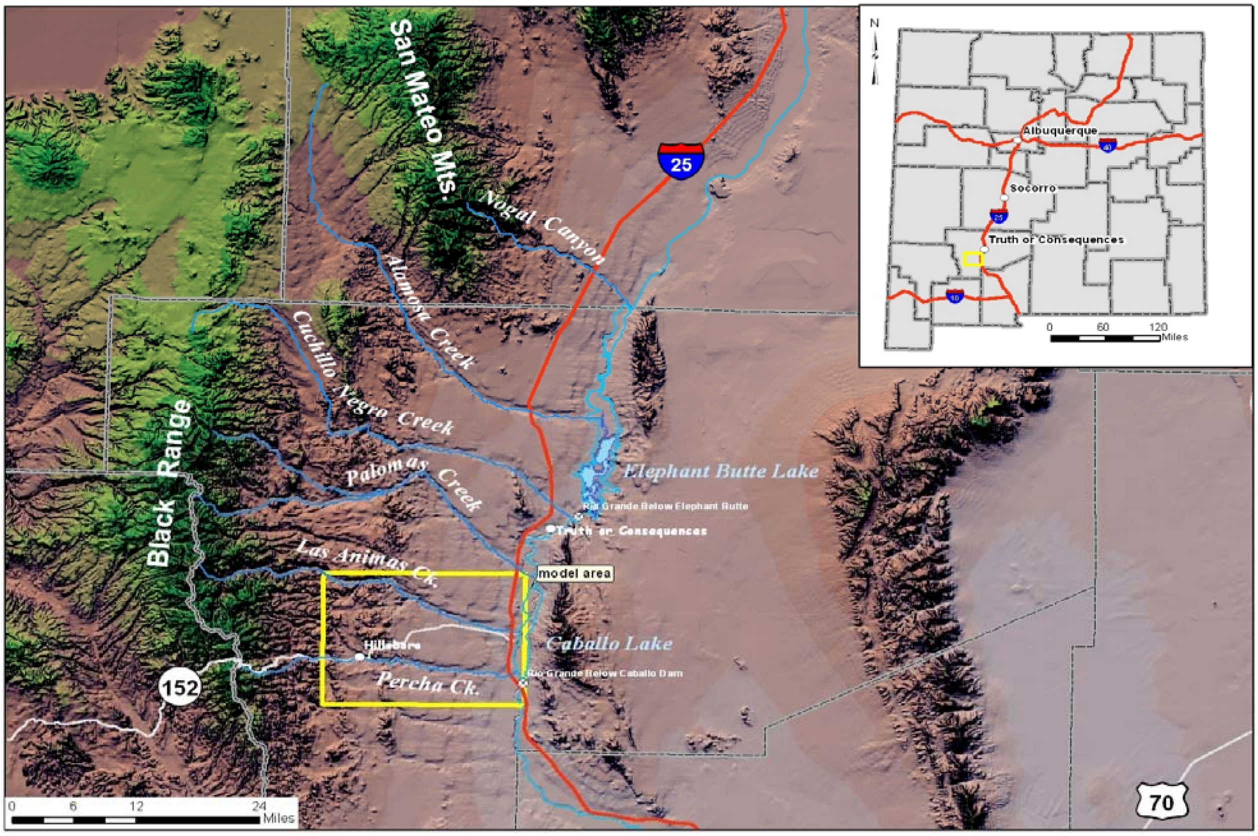


Figure 1.1. Copper Flat Project location.

The report first summarizes the climate and meteorology of the study area, then summarizes the hydrology and estimates a basin water balance. Then the geological and hydrogeological framework is presented. These are used to formulate and present a conceptual model of the system. Then the data available for model calibration are presented, followed by the details of the numerical model and results of the model calibration. Finally, sensitivity of model results to unknown parameters is evaluated. Model projections of the effects of the proposed mining project are reported separately.

2.0 CLIMATE AND METEOROLOGY

Precipitation and evaporation in the study area are examined using data from regional meteorological stations. The station at Hillsboro, New Mexico, has a long record (with at least partial data from 1893), is located nearby (about 4 miles from the Copper Flat open pit), and is at a similar elevation (5,270 ft above mean sea level (amsl)) as the Copper Flat Mine site. Locations of the Hillsboro station and other meteorological stations along the east side of the Black Range are shown on Figure 2.1.

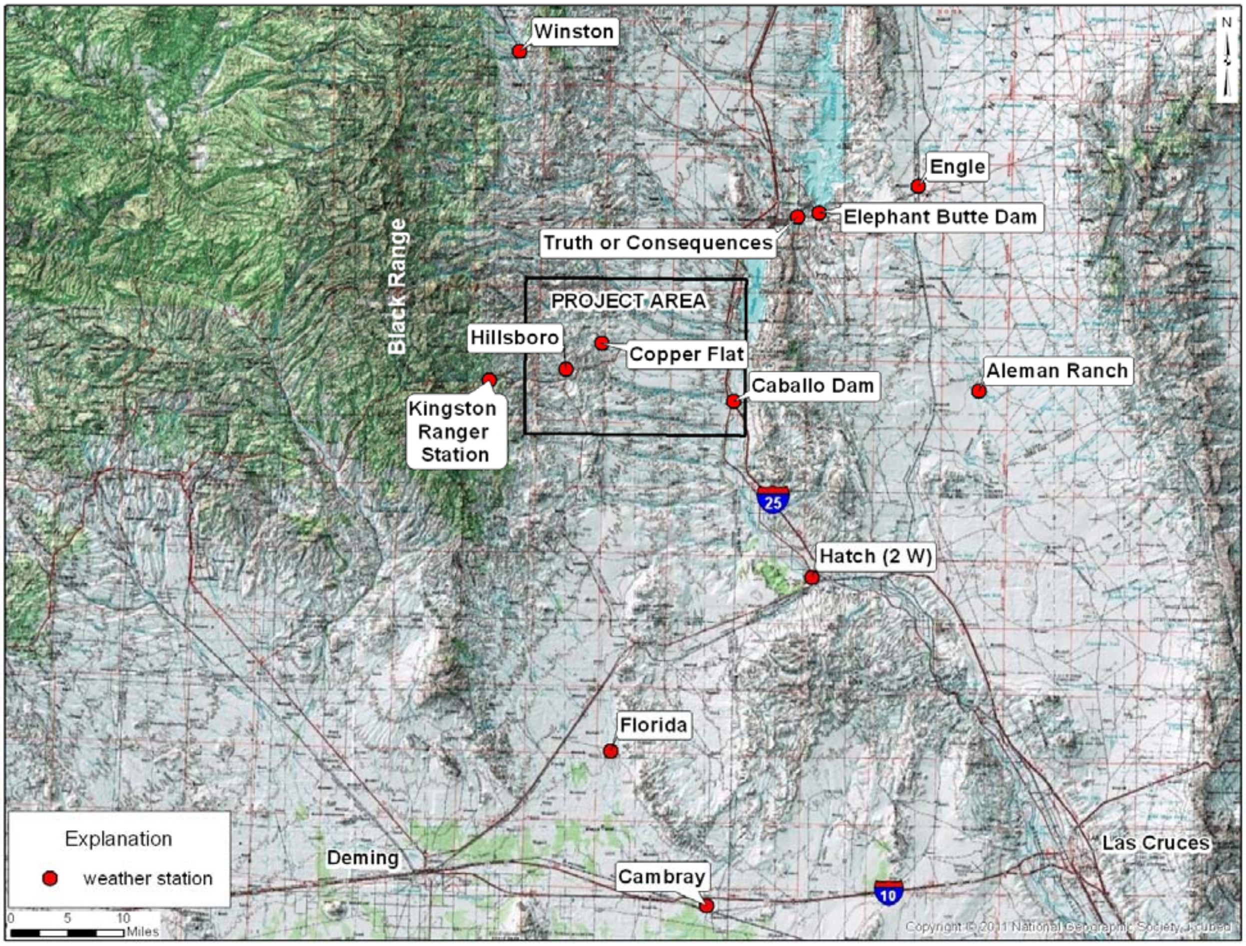


Figure 2.1. Locations of meteorological stations surrounding the Project area.

2.1 Annual Precipitation

The range of variability between wet and dry climatic conditions is seen in the annual precipitation recorded at Hillsboro from 1925 through 2010, shown on Figure 2.2. Annual precipitation ranges from less than 5 to more than 20 inches per year (in./yr) and averages about 12.5 in. Copper Flat weather station recorded 7.7 in. of precipitation in 2011, and 3.8 in. in 2012, signifying drought conditions during this period.

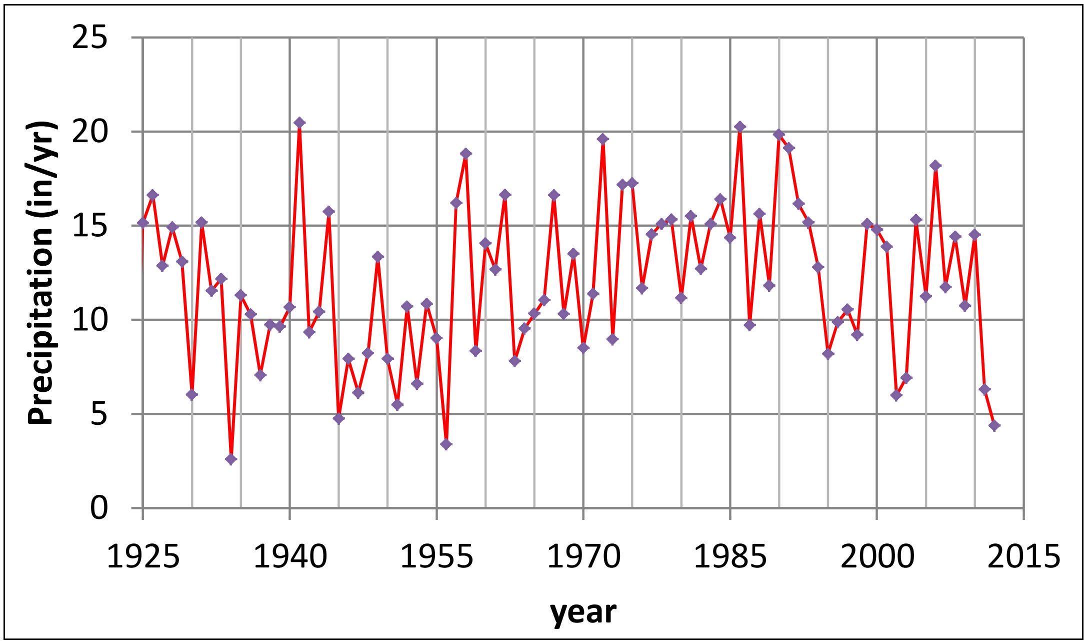


Figure 2.2. Recorded annual precipitation at Hillsboro meteorological station.

2.2 Precipitation Events

The frequency and magnitude of precipitation events are examined in the statistical distribution of daily precipitation at Hillsboro, shown on Figure 2.3. Daily precipitation of 1 in. or more occurs, on average, twice per year. Storm events of magnitude 2 in. can be expected to occur every 4 years, and the 100-year storm event is about 3.5 in.

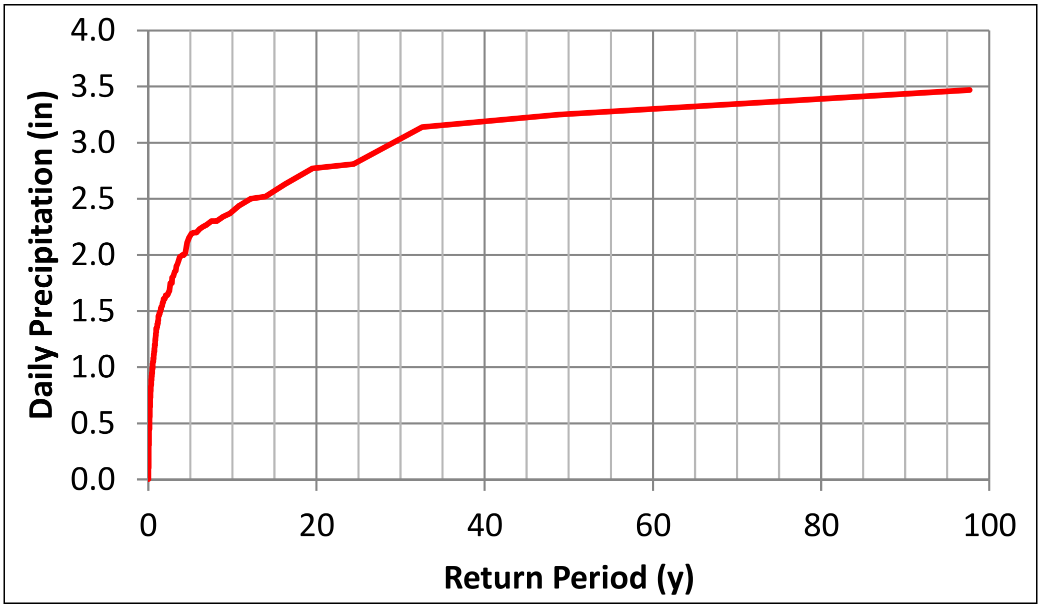


Figure 2.3. Distribution of daily precipitation at Hillsboro meteorological station.

2.3 Precipitation and Elevation

Precipitation is known to increase with elevation, and the bulk of surface-water runoff and groundwater recharge in the study area is generated by precipitation on the higher elevations of the Percha Creek and Las Animas Creek watersheds.

Mean annual precipitation was compared to elevation for other meteorological stations east of the Black Range as shown on Figure 2.4. The best-fit linear relationship estimates about 8.6 in./yr mean annual precipitation at elevation 4,000 ft amsl, and about 26.2 in./yr at elevation 10,000 ft amsl, approximately the maximum in the study area.

Given the large spatial and temporal variability of annual precipitation, the trend line shown on Figure 2.4 does not characterize precipitation patterns in any detail. It does however give realistic average precipitation rates for the study area that increase with elevation. The average annual precipitation trend shown on Figure 2.4 is used below to compute a realistic upper bound for basin water yield (water yield is a portion of total precipitation over the basin).

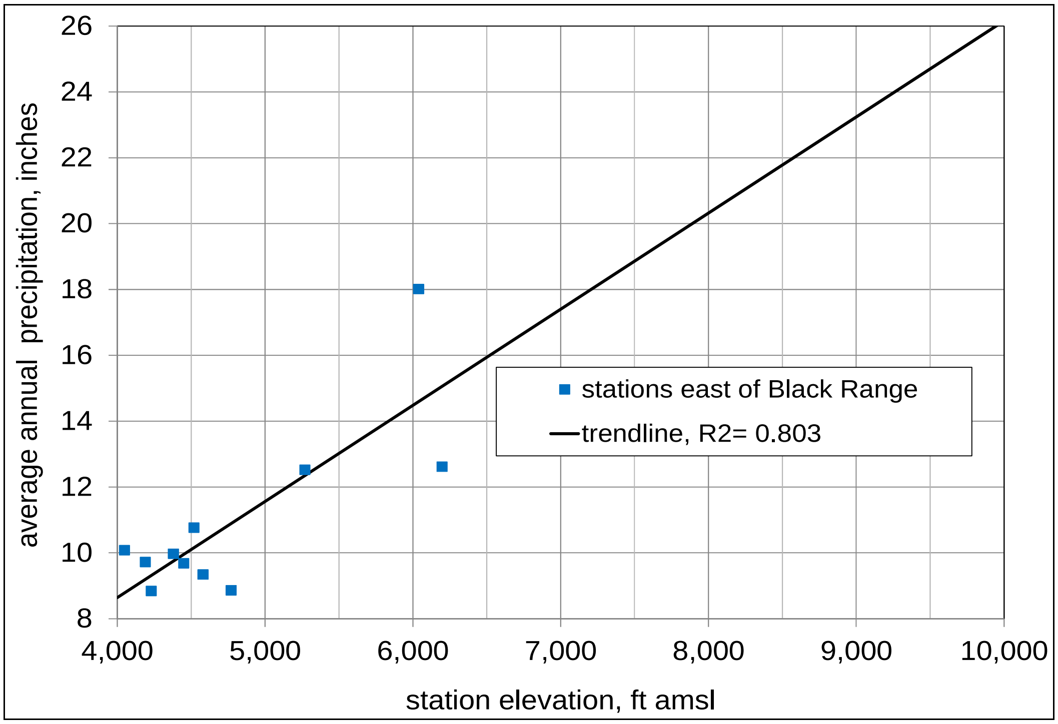


Figure 2.4. Mean annual precipitation versus elevation of meteorological station.

2.4 Evaporation and Transpiration

Most precipitation evaporates where it falls, or is consumed (transpired) by nearby vegetation. Of the remaining precipitation, most eventually discharges down-gradient as evapotranspiration (ET) from vegetated areas and open water surfaces.

Potential ET, or the maximum evaporation and plant transpiration that can occur given full availability of water, is a function of geographical and climatic conditions and is commonly estimated using the Penman-Monteith equations (Monteith, 1965). These relate maximum ET (ET_0) to meteorological parameters including temperature, relative humidity and wind speed, and to geographical parameters (latitude and time of year).

Annual ET_0 computed from results at Hillsboro meteorological station (incomplete weather data for 1997 and 1998 filled in with data from comparable years) is shown on Figure 2.5 to be about 60 in./yr. This compares well to previous estimates (SRK, 1997) of 65 in./yr of potential evaporation, and 64.6 in./yr estimated as 74 percent (an accepted conversion factor for the region (NOAA, 1982) between pan evaporation and evaporation from a normal open water surface) of Copper Flat pan evaporation (measured between October 2010 and September 2011, except for four winter months. The missing months were estimated by extrapolation of Hillsboro ET_0 data). Actual evaporation or ET is less, depending on sun and wind exposure, ground conditions, and availability of water.

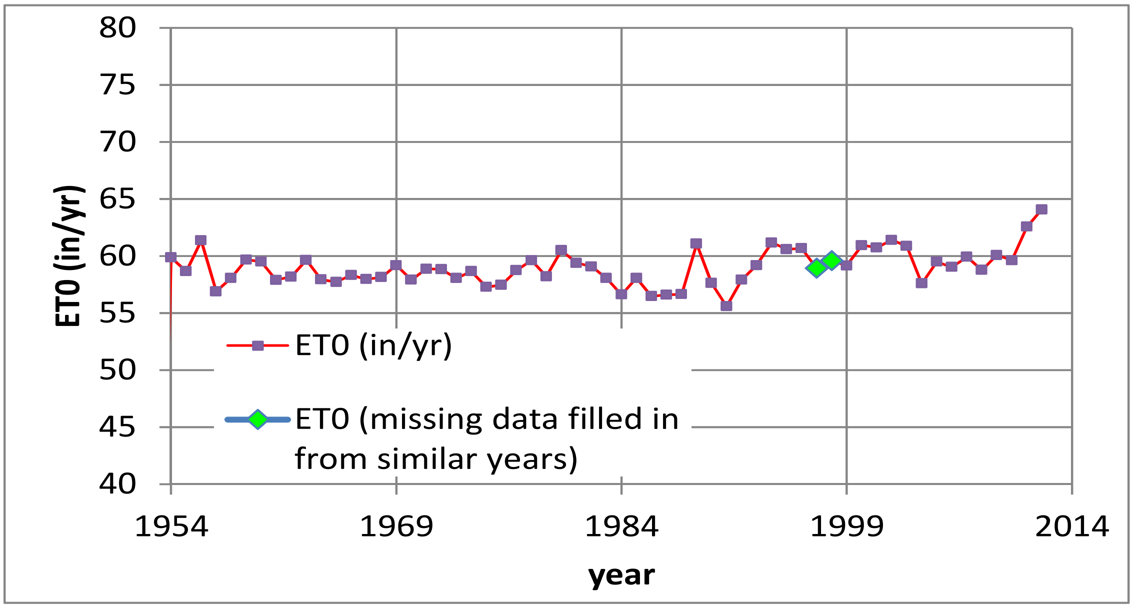


Figure 2.5. Computed Penman-Monteith evapotranspiration (ET_0) at Hillsboro meteorological station.

Evaporation in the study area is higher at lower elevations. An estimate of reservoir evaporation along the Rio Grande (Middle Rio Grande Endangered Species Collaborative, 2003) is:

$$\text{annual evaporation} = 135.8 \text{ in.} - (0.0135 \text{ in./ft amsl}) * Z,$$

where,

Z is elevation in feet above mean sea level (ft amsl).

The equation predicts evaporation of 62.4 in./yr at the Copper Flat open pit (elevation 5,440 ft amsl), in agreement with the above-presented estimates, and 79.1 in./yr at Caballo Lake (elevation 4,200 ft amsl), in agreement (equivalent to 74 percent of pan evaporation) with measurements at Caballo Dam (WRCC, 2012).

The estimated average evaporation, precipitation (from Fig. 2.4) and net evaporation for Caballo Lake and the Copper Flat open pit are presented in Table 2.1.

Table 2.1. Estimated average total and net reservoir evaporation

location	elevation (ft amsl)	mean annual precipitation (in.)	annual reservoir evaporation (in.)	net evaporation (in./yr)
Caballo Lake	4,200	9.2	79.1	69.9
Copper Flat open pit	5,440	12.8	64.6	51.8

ft amsl - feet above mean sea level

3.0 HYDROLOGY AND WATER BALANCE

Topographic basins of the study area are shown on Figure 3.1 and include Las Animas Creek and Percha Creek watersheds as well as the Grayback and Greenhorn Arroyo drainages. A portion of the original Grayback Arroyo watershed (approximately 230 acres) now drains to the Copper Flat open pit.

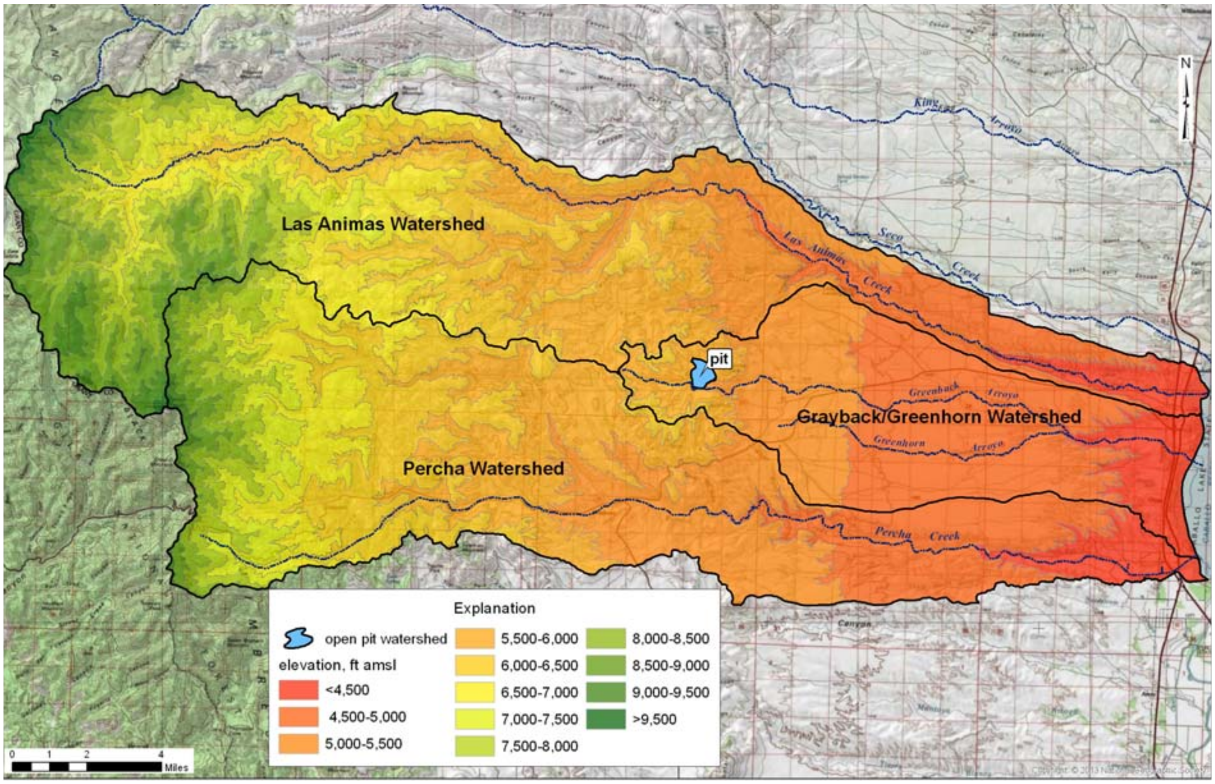


Figure 3.1. Study area watersheds.

3.1 Watershed Area and Precipitation

The areas of each of the watersheds within defined elevation bands are listed on Table 3.1. The mean annual precipitation (Fig. 2.4) estimated for the midpoint of each band is presented on Table 3.2, along with the estimated total annual volume of precipitation for each watershed.

3.2 Runoff and Groundwater Recharge

Basin water yield (surface water runoff plus groundwater recharge) is estimated here following the method of Maxey and Eakin (1949), in which estimated mean annual precipitation, a function of elevation, is correlated with an independent estimate of discharge. The result is a set of recharge factors, defined as the proportion of precipitation that becomes runoff or recharge (excess precipitation), for a given level of mean annual precipitation (an elevation band).

Table 3.1. Study area watershed areas and hypsometry

elevation range (ft amsl)	Las Animas watershed	Percha watershed	Grayback / Greenhorn watershed	open pit watershed
	area (acres)			
<4,500	2,888	3,576	4,539	
4,500-5,000	7,030	11,035	17,095	
5,000-5,500	8,412	12,614	9,708	230
5,500-6,000	14,539	14,072	2,864	
6,000-6,500	12,369	13,030	635	
6,500-7,000	10,279	8,219		
7,000-7,500	6,507	5,355		
7,500-8,000	5,808	4,159		
8,000-8,500	6,160	3,021		
8,500-9,000	6,362	1,749		
>9,000	3,305	509		
total	**83,659**	**77,339**	**34,841**	**230**

ft amsl - feet above mean sea level

Table 3.2. Study area precipitation by watershed and elevation band

midpoint elevation (ft amsl)	precipitation (in./yr)	Las Animas watershed	Percha watershed	Grayback / Greenhorn watershed	open pit watershed
		precipitation (ac-ft/yr)			
4,350	9.7	2,326	2,880	3,655	
4,750	10.8	6,345	9,961	15,431	
5,250	12.3	8,617	12,921	9,944	236
5,750	13.8	16,661	16,126	3,282	
6,250	15.2	15,679	16,516	804	
6,750	16.7	14,279	11,417		
7,250	18.1	9,832	8,091		
7,750	19.6	9,482	6,790		
8,250	21.0	10,805	5,298		
8,750	22.5	11,933	3,280		
9,500	24.7	6,802	1,048		
total		**112,761**	**94,328**	**33,116**	**236**

ft amsl - feet above mean sea level
ac-ft/yr - acre-feet per year

Some example sets of recharge factors are presented in Table 3.3. These include the formulation of Bennett and Finch (2002) used to estimate recharge in the trans-Pecos region of Texas, that was subsequently used to estimate recharge to the Salt Basin in New Mexico and Texas (JSAI, 2010), and the Davis Mountains/Salt Basin in Texas (LBG-Guyton, 2004).

Another example is that of Maxey and Eakin (1949), which studied dry, closed basins in southern Nevada, estimating discharge as playa ET. This example was modified by McDonald-Morrissey (1998) in BLM (2000), in a study of wetter, exoreic (outflowing) basins along the Carlin Trend in northern Nevada. Total basin discharge was estimated from gaged surface flows and from ET in vegetated areas.

Actual runoff and recharge are influenced by site-specific conditions including topography, soil type and thickness, land cover, and surface geology. However, in the absence of an independent estimate of discharge, the previously published estimates may indicate a potential range of basin water yield.

The above formulas suggest, respectively, a study-area water balance of 8,000 ac-ft/yr (Bennett and Finch), 30,000 ac-ft/yr (Maxey and Eakin) and 51,000 ac-ft/yr (BLM). In the absence of other information, water yield of the study area is anticipated to be within the range of these estimates, or between about 8,000 and 50,000 ac-ft/yr. This range of yield is compared below to a basin-specific estimate of discharge.

Table 3.3. Published recharge factors

midpoint elevation (ft amsl)	precipitation (in./yr)	fraction of precipitation that becomes runoff and/or recharge		
		Bennett and Finch (2002)	Maxey - Eakin (1949)	BLM (2000)
4,350	9.7	0.00	0.03	0.03
4,750	10.8	0.00	0.03	0.03
5,250	12.3	0.00	0.07	0.07
5,750	13.8	0.02	0.07	0.07
6,250	15.2	0.03	0.15	0.3
6,750	16.7	0.04	0.15	0.3
7,250	18.1	0.05	0.15	0.3
7,750	19.6	0.07	0.15	0.3
8,250	21.0	0.08	0.25	0.45
8,750	22.5	0.09	0.25	0.45
9,500	24.7	0.11	0.25	0.45

BLM - U.S. Bureau of Land Management ft amsl - feet above mean sea level

3.3 Discharge

Discharge from the study area occurs mainly as groundwater and surface-water discharge to Caballo Lake and the Rio Grande, and as ET discharge from riparian and irrigated areas along Las Animas and Percha Creeks. Areas of open-water evaporation and of ET discharge, in and near the study area, are shown on Figure 3.2.

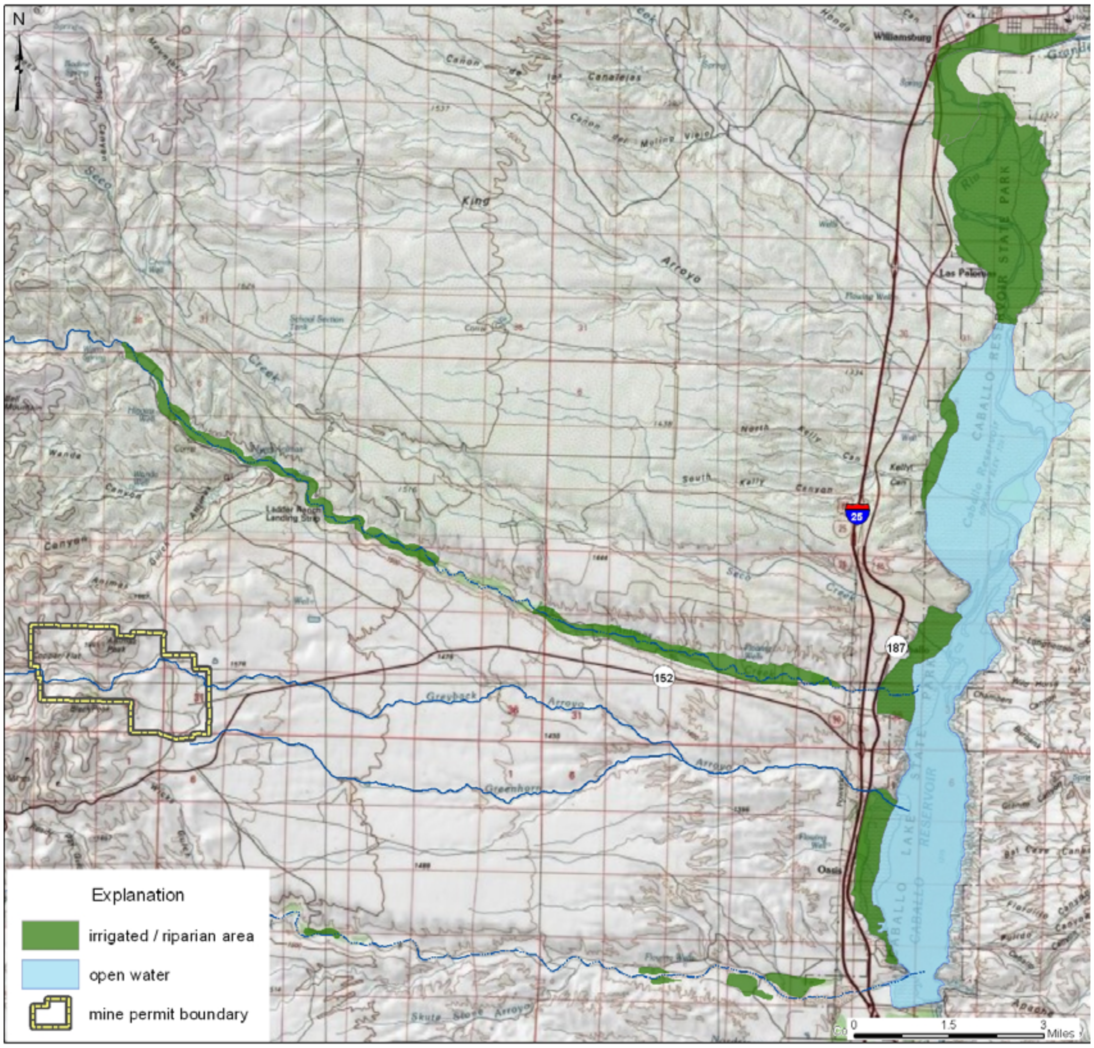


Figure 3.2. Discharge areas.

The Caballo Lake and North Caballo Lake discharge areas shown on Figure 3.2 are only partly supplied from the study area. Water is also provided by:

- Direct contribution from the Rio Grande upstream; based on average daily discharge below Elephant Butte dam (U.S. Geological Survey (USGS) station No. 08361000) and below Caballo dam (USGS station No. 08362500) from 1938 through 2010, an average of 12,364 ac-ft/yr more water is released from Elephant Butte (into Caballo) than from Caballo.

- Runoff from the watersheds east of Caballo Lake. These basins lack large high-altitude catchment areas and yield less water than basins west of the lake. They will, however, contribute water to Caballo after major precipitation events.
- Contribution from the Palomas Creek (catchment area 233,942 ac) and Cuchillo Creek (catchment area 235,493 ac) basins north of the study area, with similar hypsometry to the study area basins. Assuming water yield proportional to (elevation-weighted) catchment area (Table 3.1), Palomas and Cuchillo Creek basins would be expected to produce about 71 percent of the total yield from the basins west of Caballo, with the study area basins contributing the remainder.

Evaporation/ET for Caballo Lake and for the study area watersheds is estimated on Table 3.4; ET from irrigated crops or riparian vegetation was estimated at 36 in./yr. Net evaporation for Caballo Lake, estimated at about 70 in./yr (Table 2.1), was rounded down to 60 in./yr, to account for runoff from the east side of the lake. Net evaporation for North Caballo Lake and ET for Rio Grande riparian areas were estimated as the average of combined net Caballo evaporation and riparian ET rate, or 48 in./yr.

Table 3.4. Estimated evaporation and evapotranspiration (ET)

	area (acre)	net evaporation and ET (ft/yr)	net evaporation and ET (ac-ft/yr)
Caballo Lake (water surface at 4,200 ft amsl)	6,344	5	31,720
North Caballo Lake / Rio Grande riparian area	5,214	4	20,856
Las Animas Creek irrigated / riparian area	1,421	3	4,263
Percha Creek irrigated / riparian area	280	3	840
Copper Flat open pit water surface	5	4	20
total			**57,699**

ac-ft/yr - acre-feet per year

ft amsl - feet above mean sea level

3.4 Water Balance

The Caballo Lake and North Caballo Lake discharge components in Table 3.4, totaling 52,576 acre-feet per year (ac-ft/yr), are only partly supplied from the study area. In order to estimate the portion provided from the study area, the following adjustments were made:

- Based on USGS gage data discussed above (Sec. 3.3), 12,364 ac-ft/yr is assumed to be provided by the Rio Grande upstream of Caballo Lake.
- The estimated rate of evaporation from Caballo Lake was rounded down to account for runoff from the watersheds east of the lake as described above.

- Of the remaining Caballo Lake and North Caballo Lake discharge (40,212 ac-ft/yr), 71 percent was assumed to be provided by the Palomas and Cuchillo Creek Basins, as discussed above. The remainder was assumed to be generated within the study area.

Based on the discharge estimates in Table 3.4 and the adjustments listed above, an estimated water balance for the study area is presented in Table 3.5. The system receives water as runoff and recharge to the four watersheds listed in the upper part of the table. The estimated water yield of about 17,000 ac-ft/yr falls within the range of water yield (8,000-50,000 ac-ft/yr) estimated in Section 3.2 above.

The system discharges water as groundwater outflow and ET, as listed in the lower part of the table. The main component of discharge is groundwater flow to the Rio Grande / Caballo system. There is discharge of ET from three of the four watersheds, but not from Grayback/Greenhorn, which has no significant groundwater discharge area (depth to water is too great for ET of groundwater).

Table 3.5. Estimated water balance

runoff and recharge (ac-ft/yr)	
Las Animas Creek	10,709
Percha Creek	6,074
Grayback and Greenhorn Arroyos	201
Copper Flat open pit	1
total	**16,985**
discharge (ac-ft/yr)	
Las Animas Creek irrigated and riparian area	4,262
Percha Creek irrigated and riparian area	839
discharge to Rio Grande and Caballo Reservoir	11,850
Copper Flat open pit	20
total	**16,971**

ac-ft/yr - acre-feet per year

The water balance in Table 3.5 may also be compared with the water balance of the Upper Mimbres Basin, located on the opposite side of the Black Range from the study area, with a similar distribution of elevations. The average yield of the 300,000-acre basin above the Faywood gaging station is estimated (based on gaged flows) at 26,700 ac-ft/yr (White, 1930). The same per-acre water yield in the study area would be 17,450 ac-ft/yr, similar to the estimate given in Table 3.5.

4.0 GEOLOGY AND HYDROGEOLOGY

The surface-water basins discussed above are shown on Figure 4.1, along with the smaller groundwater-flow model domain. Although most of the precipitation that recharges the groundwater system originates in the upper part of the watersheds (left-hand side of Fig. 4.1, outside of the groundwater study area), the main groundwater systems are found in sedimentary deposits downstream.

The study area consists of three major hydrogeologic zones (Fig. 4.1), shown in west-east cross-section on Figure 4.2. The three zones are 1) The sediment-filled Animas Graben west of the Animas Uplift and east of the Black Range mountain block, 2) The Animas Uplift, the bedrock in which the ore body is located, and 3) the Palomas Basin, the main sedimentary basin along the Rio Grande rift east of the Animas Uplift, in which the mine water-supply wells are located.

The Animas Graben between the Black Range and the Animas Uplift drains north to Animas Creek and south to Percha Creek via Warm Springs Valley. Santa Fe Group (SFG) sedimentary deposits overlie older sedimentary bedrock units (Fig. 4.2).

The Animas Uplift in the vicinity of Copper Flat (Fig. 4.1) consists of crystalline bedrock that conducts little water. The Copper Flat open pit and the main part of the other Project facilities, including waste rock and tailings storage facilities, would be located on the Animas Uplift. To the north and south of the Copper Flat area the Animas Uplift consists of sedimentary rocks that conduct more groundwater flow.

The Palomas (geologic) Basin lies within the Lower Rio Grande Underground Water (administrative) Basin. Parts of the waste rock and tailings storage facilities would be located overlying the western margin of the Palomas Basin. The Project water-supply wells are completed within the SFG aquifer between Las Animas Creek and Percha Creek (Fig. 4.1), and will be the main source of groundwater and surface-water effects of the Project.

The Project water-supply wells are completed within the Palomas Graben (Fig. 4.2), a significant geological and hydrogeological feature within the Palomas Basin. The feature was identified in the 1970s (Dunn, 1984), during water-supply exploration for the previous Copper Flat mine. The graben was identified as the western-most part of the Palomas basin with sufficient aquifer productivity to develop an adequate water supply.

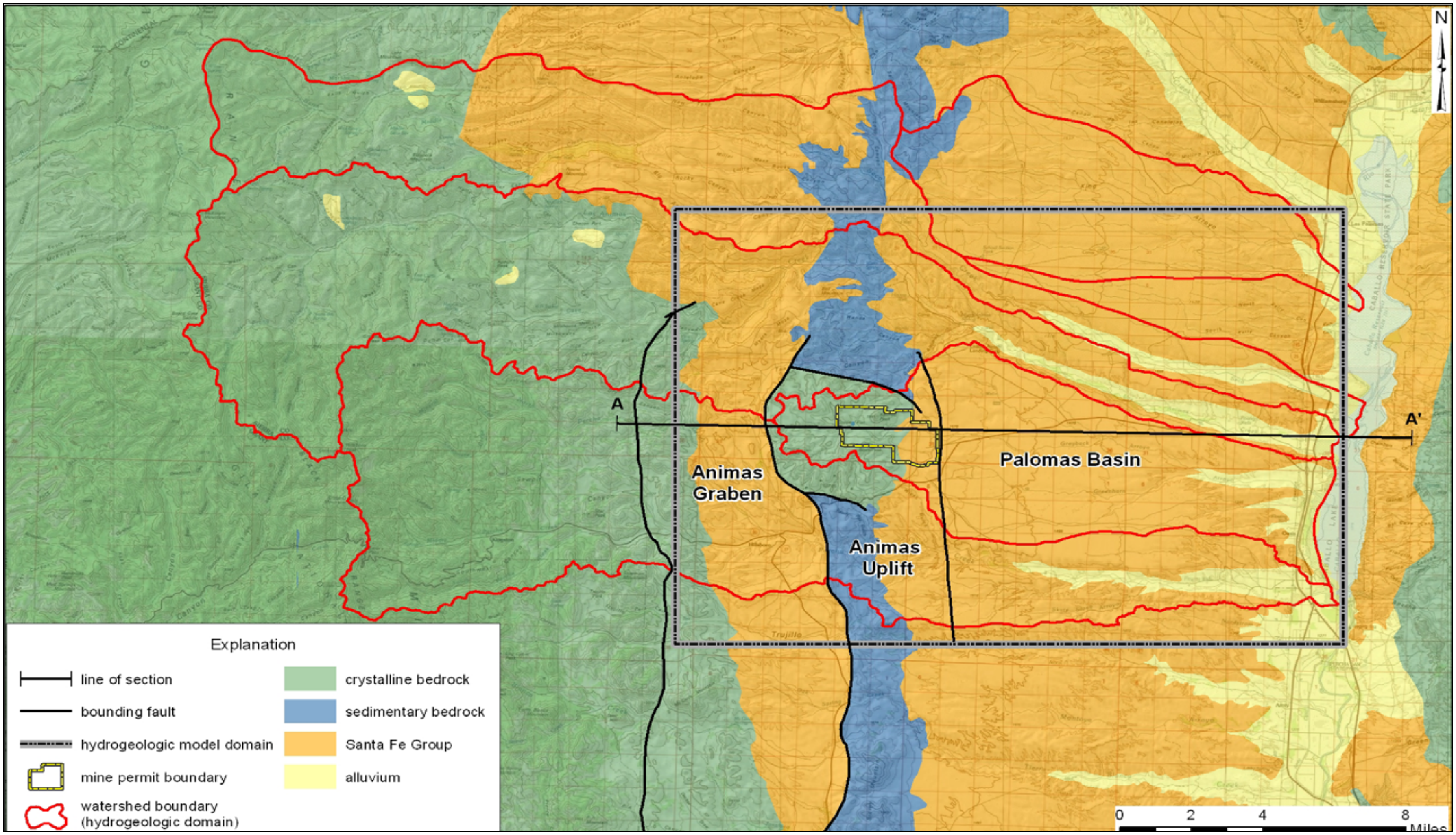
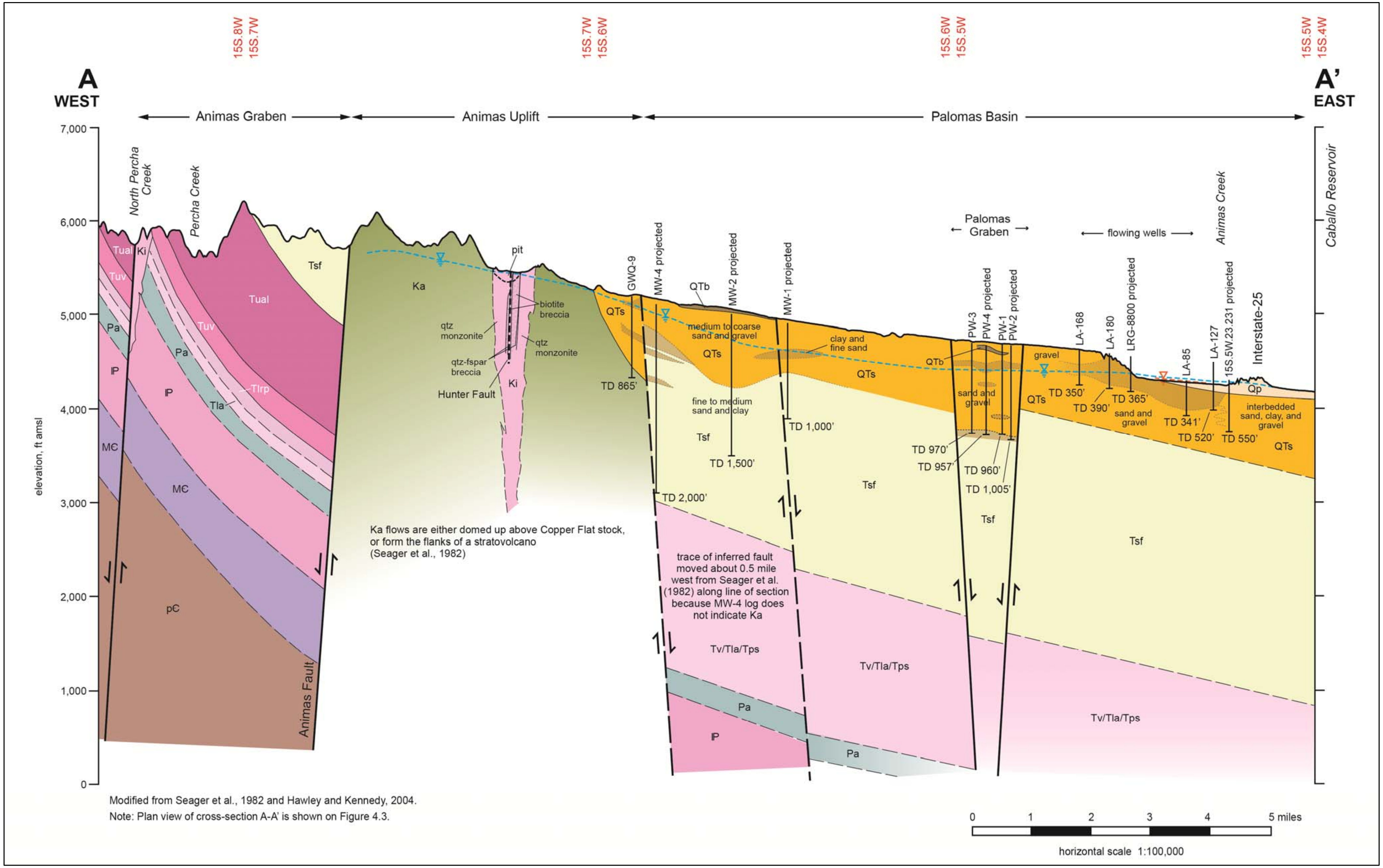


Figure 4.1. Hydrogeologic zones.



Modified from Seager et al., 1982 and Hawley and Kennedy, 2004.

Note: Plan view of cross-section A-A' is shown on Figure 4.3.

Figure 4.2. Hydrogeologic zones, west-to-east cross-section.

4.1 Geology

The geologic description is adapted from Shomaker (1993), who cites Harley (1934), Hedlund (1975), Dunn (1982), and Seager et al. (1982). An extended bibliography of geology references is presented as Appendix A. The geologic map of the study area is presented on Figure 4.3. Three major geologic subdivisions (Figs. 4.1 and 4.2), the Animas Uplift, the Animas Graben east of the Black Range, and the Palomas Basin, are described below.

4.1.1 Animas Uplift

The Animas Uplift is an upthrown block, ranging from less than 2 to about 4 miles wide, bounded by north-south trending faults (Fig. 4.1). The Copper Flat ore body is located within a nearly circular remnant of a Cretaceous-age andesite volcano about 4 miles in diameter that is part of the Animas Uplift. Drilling has shown that andesite is present to a depth of more than 3,000 ft (Dunn, 1982, p. 314).

The hills surrounding Copper Flat, referred to as the Hillsboro Hills, consist of Cretaceous-age andesite flows, breccias, and volcaniclastic rocks that were erupted from the volcano (McLemore, 2001; Raugust and McLemore, 2004).

The volcano intrudes through the Paleozoic-age sedimentary rock sequence. The andesite is bounded on the north and south by Paleozoic-age limestone, and on the east by the SFG sediments of the Palomas Basin, in fault contact. On the west, the andesite body is in fault contact with Paleozoic-age limestone, Tertiary-age volcanic rocks, and overlying SFG sediments of the Animas Graben (Fig. 4.2).

The ore body itself is in the Copper Flat quartz monzonite stock, within the body of andesite. The quartz monzonite porphyry intruded the vent of the volcano, and then dikes and mineralized veins intruded the monzonite porphyry and radiated outward from the porphyry into faults and fracture zones in the andesite. The porphyry copper deposit is concentrated within a breccia pipe in the quartz monzonite stock.

4.1.2 Graben West of Animas Uplift

West of the Animas Uplift, between it and the Black Range, lies a half-graben in which Tertiary-age alluvial-fan deposits, sandstones, and mudstones of the SFG overlie Tertiary-age volcanic rocks and Paleozoic-age sedimentary rocks. Dips are eastward, and the half-graben is bounded on the east by normal faults. The Santa Fe beds may reach a thickness of 1,000 ft on the east side of the half-graben (Seager et al., 1982, sheet 2).

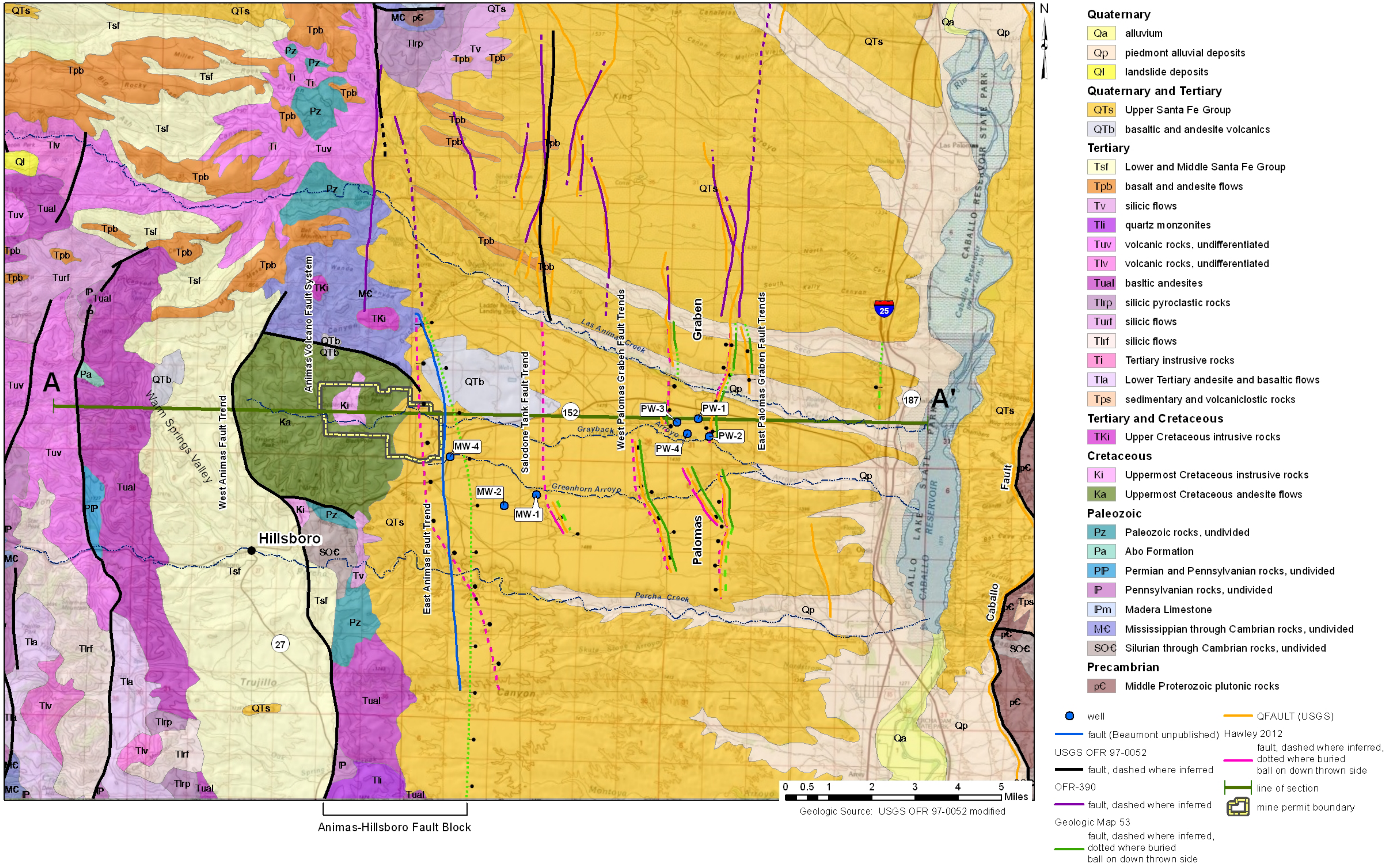


Figure 4.3. Geologic map of study area.

4.1.3 Palomas Basin

The Palomas Basin is a sediment-filled structural trough about 35 miles long by 12 miles wide. It is part of the Rio Grande rift, a north-south trending zone of approximately east-west oriented extension that bisects the state of New Mexico. The extension is caused by the Colorado Plateau crustal block pulling away from the High Plains block, which stretches and thins the Earth's crust in the area of the rift (Seager and Morgan, 1979).

Rio Grande rift extension began in southern New Mexico about 36 million years ago in late Eocene time, with the rate of extension peaking between 16 and 10 million years ago, in Miocene time (Lozinsky, 1986; Mack, 2004). The axial basins (such as the Palomas Basin) are in the form of half-grabens that are tilted strongly toward the east or the west, depending on which side of the main rift fault the basin is located.

The Palomas Basin is an eastward-tilted half graben as evidenced by gravity data and by geologic mapping of eastward dips of Santa Fe Group beds along the western edge of the basin (Lozinsky, 1986). The basin is defined between the north-south trending Caballo and Animas-Hillsboro fault blocks (Fig 4.3; Kelley, 1955; Kelley and Silver, 1952). Most of the displacement has occurred on the east side of the Palomas Basin along the Caballo Fault (the main rift fault system).

Basin-fill thickness is probably greater than 6,000 ft along the eastern side of the Palomas Basin (Lozinsky, 1986, figure 2). Basin-fill thickness is greater than 2,000 ft at well MW-4 (Fig. 4.3), located in the thinner western part of the basin, near the Animas Uplift.

The sedimentation of the Palomas Basin occurred contemporaneously with the down-dropping of the half graben and the rise of the Animas Uplift (Mack, 2004). Las Animas and Percha Creeks were established prior to structural development of the Animas Uplift and maintained the water course by channel cutting through the bedrock units, and downstream deposition of fluvial sediments in the Palomas Basin (Mack, 2004).

North-south extensional faulting followed the formation of the Palomas Basin and deposition of the majority of the Santa Fe Group sediments. North-south faults within the Santa Fe Group Sediments have been mapped by Kelley et al. (unpublished, 1979), Seager et al. (1982), Harrison et al. (1993), and Hawley (unpublished, 2012).

North-south extensional faulting formed the Palomas Graben (Figs. 4.2 and 4.3) which filled with sediments that are coarser-grained than the Santa Fe Group sediments on either side. The Palomas Graben was identified as a productive aquifer, and the Copper Flat well field was completed within it in the mid-1970s.

The faults forming the Palomas Graben are mapped from Percha Creek north to about Palomas Creek. However, similar north-south trending faults mapped by Harrison et al. (1993) suggest the Palomas Graben may continue as far north as the San Mateo Mountains (Hawley, personal communication, 2012). The graben is thought to be an ancestral tributary of the Rio Grande which joins the main channel south of the study area.

The mapped individual fault segments (Fig. 4.3) form several continuous north-south fault trends. A summary of the fault trends, from west to east, follows:

1. West Animas Fault Trend – north-south fault that forms boundary between Animas half-graben and west side of Animas Uplift. Normal fault downthrown on the west side. Primary references Murray (1959); Hedlund (1975).

2. Animas Volcano Fault System – faults formed around andesite volcano, downthrown on exterior side of volcano. Primary references Harley (1934); Hedlund (1975); Dunn (1982).

3. East Animas Fault Trend – north-south normal fault that forms boundary between Animas Uplift and Palomas Basin. Downthrown on east side. Mapped as inferred fault at slightly different longitude by Seager et al. (1982) than by Hawley (2012). Key references include Harrison et al. (1993), Beaumont (2011), JSAI (2011a), and Hawley (2012). Work performed by JSAI (2011a) and Beaumont (2011) is based on analysis of well logs and lineaments identified from aerial photographs.

4. Saladone Tank Fault Trend – north-south normal fault down thrown on the east side. Mapped by Kelley et al. (1979), Seager et al. (1982), Harrison et al. (1993), and Hawley (2012).

5. West Palomas Graben Fault Trends – north-south normal faults downthrown on the east side. Forms western boundary of the Palomas Graben. Faults mapped by Kelley et al. (1979), Seager et al. (1982), Harrison et al. (1993), and Hawley (2012).

6. East Palomas Graben Fault Trends – north-south normal faults downthrown on the west side. Forms eastern boundary of the Palomas Graben. Faults mapped by Kelley et al. (1979), Seager et al. (1982), Harrison et al. (1993), and Hawley (2012).

4.2 Hydrogeology

Hydrogeologic units, aquifer characteristics, and recharge and discharge locations are discussed below for the three geologic subdivisions of the study area. A hydrogeologic map of the study area is shown with surface water features and mapped springs on Figure 4.4.

Some of the mapped springs, such as "Las Animas Creek Community Spring" (Murray, 1959) and "LA-52" (Davie and Spiegel, 1967), were identified long ago and may no longer flow. However, the locations identified within the Santa Fe Group lie along the main faults, demonstrating the structural controls on groundwater flow.

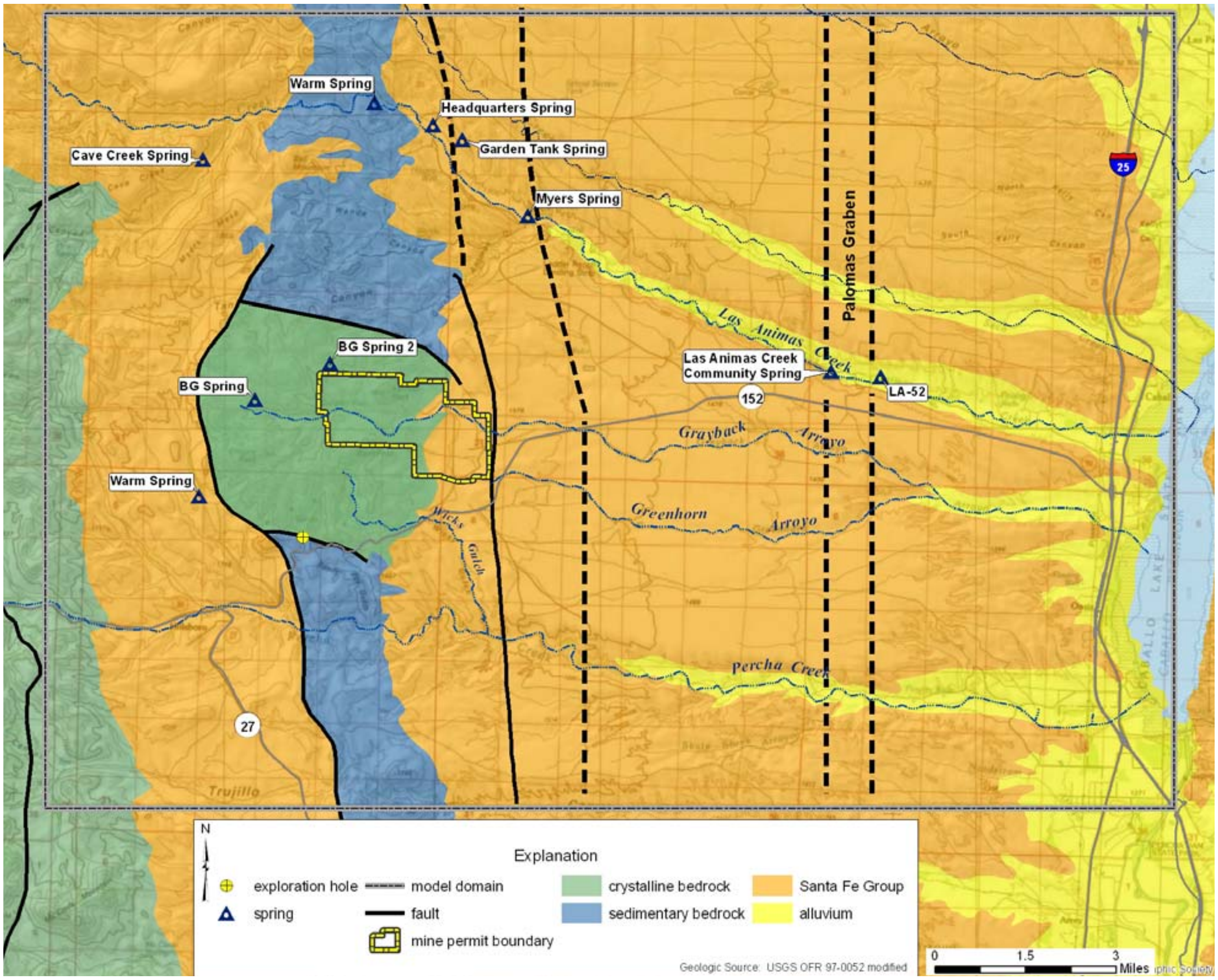


Figure 4.4. Hydrogeologic units and mapped spring locations.

4.2.1 Animas Uplift

Hydrogeologic units in the Animas Uplift include the relatively impermeable andesite and monzonite of the Copper Flat area and the relatively permeable carbonate rocks and other sedimentary rocks to the north and south of Copper Flat.

Groundwater recharge from local precipitation to the quartz monzonite and andesite is limited by low hydraulic conductivity. Recharge to the limestone outcrop areas north and south of the andesite is greater. Recharge to the limestone also includes infiltration of runoff generated at higher elevation, from the Las Animas Creek and Percha Creek watersheds.

Groundwater discharges from the limestone at the foot of the uplift, as spring flow (Fig. 4.4) and base flow to Percha and Las Animas Creeks. Groundwater discharges from the andesite as subsurface flow across the fault contacts with the Palomas Basin, and as evaporation from the open pit.

The existing Copper Flat open pit, which the New Mexico Copper Corporation (NMCC) proposes to expand, was excavated in 1982 by Quintana Minerals. The Quintana pit was excavated to a maximum depth corresponding to elevation 5,400 ft amsl. The current water level in the pit is about 5,439 ft amsl (April 2013). The pre-mining groundwater level (without lake evaporation) was about 5,450 ft amsl (JSAI, 2011b).

The low hydraulic conductivity of the quartz monzonite and andesite is reflected in the low pumping rates required in 1982 to dewater the Quintana pit. The dewatering rate required to maintain the greater-than 45-ft drawdown, in an excavation about 100 ft by 200 ft in area at maximum depth, was estimated at 22 gallons per minute (gpm) (Shomaker, 1993). SRK (1997) reports pumping rates up to 50 gpm. The range in reported dewatering rates was likely due to the variability of precipitation and runoff to the pit.

The low conductivity of the andesite and monzonite are confirmed below in the evaluation of the pit water balance (Sec. 5.4) and in the results of the 2011 pit-area pressure-injection testing (Sec. 5.4.1). It can be expected that the hydraulic conductivity of rock deeper in the andesite and quartz monzonite will have still lower hydraulic conductivity, because of the decrease in weathering effects and the closing of fractures with depth. The andesite acts as a hydrologic containment vessel for the existing and proposed open pits.

The radiating dikes and veins may be inferred to have relatively low conductivity as well. Several mine shafts in Wicks Gulch (Fig. 4.4) were examined, and found to be almost full of water; if there were significant hydraulic conductivity, either along fractures or through the rock matrix, water levels would be closer to the elevation of nearby surface channels.

Away from the andesite body, where the Animas Uplift consists of fractured, predominantly limestone and dolomite bedrock, it is likely that significant permeability has developed by the combination of fracturing and enlargement of fracture-openings by dissolution of carbonate minerals. This hypothesis is supported by the account of an air-drilled exploration hole (Fig. 4.4) in SW/4 SE/4 Sec. 3, T. 16 S., R. 7 W, which was abandoned because large water production overcame the capacity of the compressor to continue circulation (Sonny Hale, personal communication). The well is close to the fault which offsets the andesite against the predominantly limestone Paleozoic-age section.

4.2.2 Graben West of Animas Uplift

Local precipitation, and runoff from the Black Range, provide groundwater recharge to the graben. Discharge occurs mainly as spring flow and possibly also as subsurface discharge to the Animas Uplift. Spring flow in the Warm Springs drainage discharges as base flow to Percha Creek. The emergence of water at Warm Springs (Fig. 4.4) at the eastern edge of the graben demonstrates that the andesite of the Animas Uplift acts at depth as a barrier to flow from the graben. Groundwater in the graben flows west to east across the Animas Uplift, south toward Percha Creek and north toward Las Animas Creek, flowing around the body of low-permeability andesite (Fig. 4.4).

The contrast between the chemical makeup of water from Warm Springs, as compared with water from wells and springs within the Animas Uplift (Newcomer and Finch, 1993), indicates that the source of Warm Springs water is not within the uplift, as might otherwise be inferred from the relative heads at the spring and at wells and springs within the uplift (Fig. 4.4).

4.2.3 Palomas Basin

Water recharges the Palomas Basin at its western edge, through alluvial fans at the edge of the Animas Uplift, including infiltration of runoff from Greenhorn and Grayback Arroyos and infiltration of base flow and runoff from the upper catchments of Las Animas and Percha Creeks.

Groundwater flows mainly east toward the Rio Grande and Caballo Lake. Calibration of the groundwater-flow model (Sec. 6.0) presented below also suggests that there is a north-to-south component of groundwater flow within the Palomas graben, discharging toward the Rio Grande system south of the study area.

Besides discharging to the Rio Grande and Caballo, groundwater also discharges locally, by pumping, from flowing wells, and as evapotranspiration from irrigated and riparian vegetated areas along Las Animas Creek and Percha Creek. The principal water-bearing sediments of the Palomas Basin are (1) alluvial-fan deposits, fluvial sands and gravels of the Santa Fe Group, and (2) alluvium in the inner valleys of the Rio Grande and principal tributaries (Hawley and Kennedy, 2004).

Davie and Spiegel (1967, p. 9) describe the Santa Fe Group in Las Animas Creek area as consisting of (a) an alluvial fan facies, interfingering eastward with (b) a clay facies, possibly representing the distal or deltaic beds of the alluvial fan facies, which in turn interfingers with (c) an axial river facies consisting of well-sorted sand and gravel containing well-rounded quartzite pebbles. The sediments are stratified and in general dip to the east.

Geologic logs from wells along Las Animas Creek provide evidence that the coarse-grained sediments in the Palomas Graben are overlain by a clay layer that creates perched groundwater conditions in the alluvium along Animas Creek.

Stratification and heterogeneity of the SFG creates confined conditions at depth in the lower Palomas Basin. Seepage along Percha Creek, Grayback Arroyo, Greenhorn Arroyo, and Las Animas Creek alluvial systems recharges the SFG sediments in the upper basin and the recharge pressures the stratified sediments down-dip, creating upward vertical gradients in the lower basin. Overlying clay beds create artesian conditions in the basin down-dip of recharge zones.

Artesian pressures are relatively low, generally less than 10 ft of head above land surface. A survey of artesian wells (Shomaker, unpublished) from 1993 has been updated (JSAI, 2011c), indicating reduction of artesian flow and pressure over 18 years. The history and effects of artesian discharge are discussed further below.

4.3 Hydrogeologic Conceptual Model

The hydrogeologic system described above is summarized on Figure 4.5, a map of hydrogeologic units, and on Figure 4.6, a map of the boundary conditions (inflows and outflows of water) on the system. (Note that Figure 4.6 does not indicate the riparian area along Percha Creek near Hillsboro; the stream system on upper Percha is fed by local precipitation and runoff, not by regional groundwater discharge.) The hydrogeologic units (Fig. 4.5) and boundary conditions (Fig. 4.6) presented form the basis of the numerical groundwater-flow model.

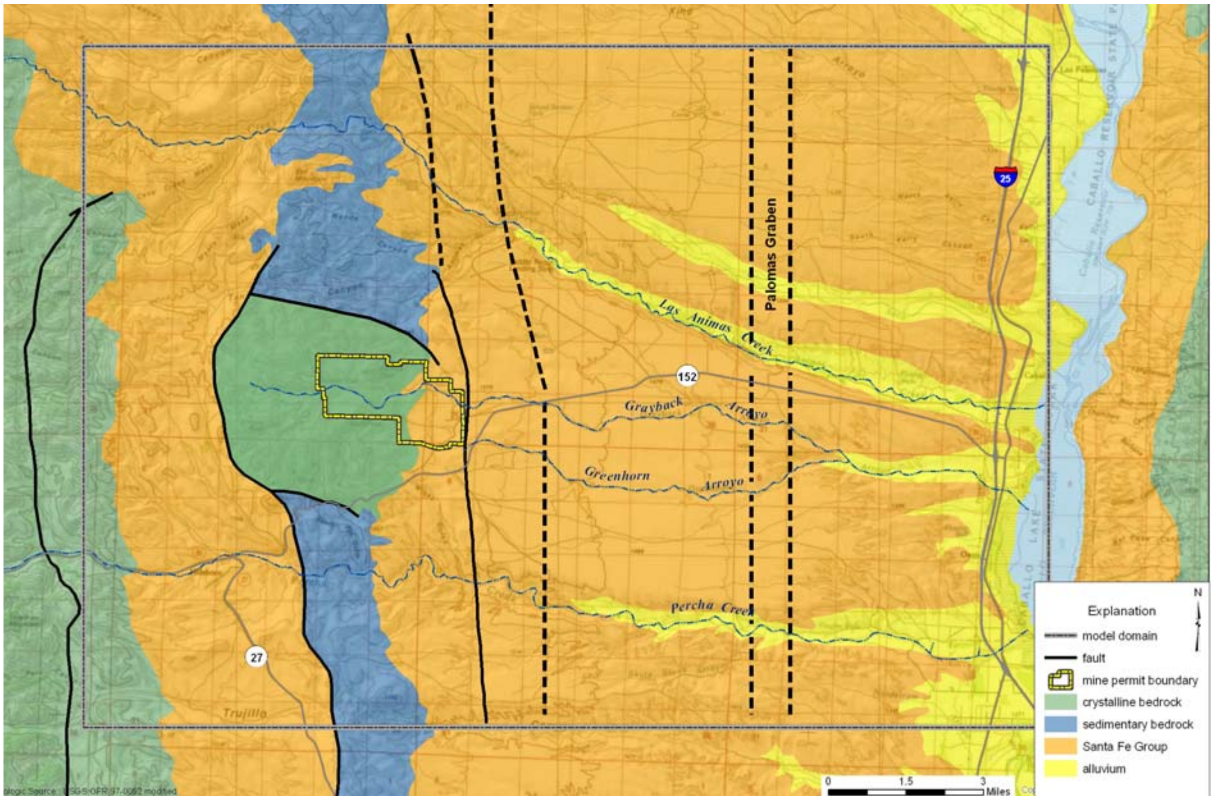


Figure 4.5. Hydrogeologic map of study area.

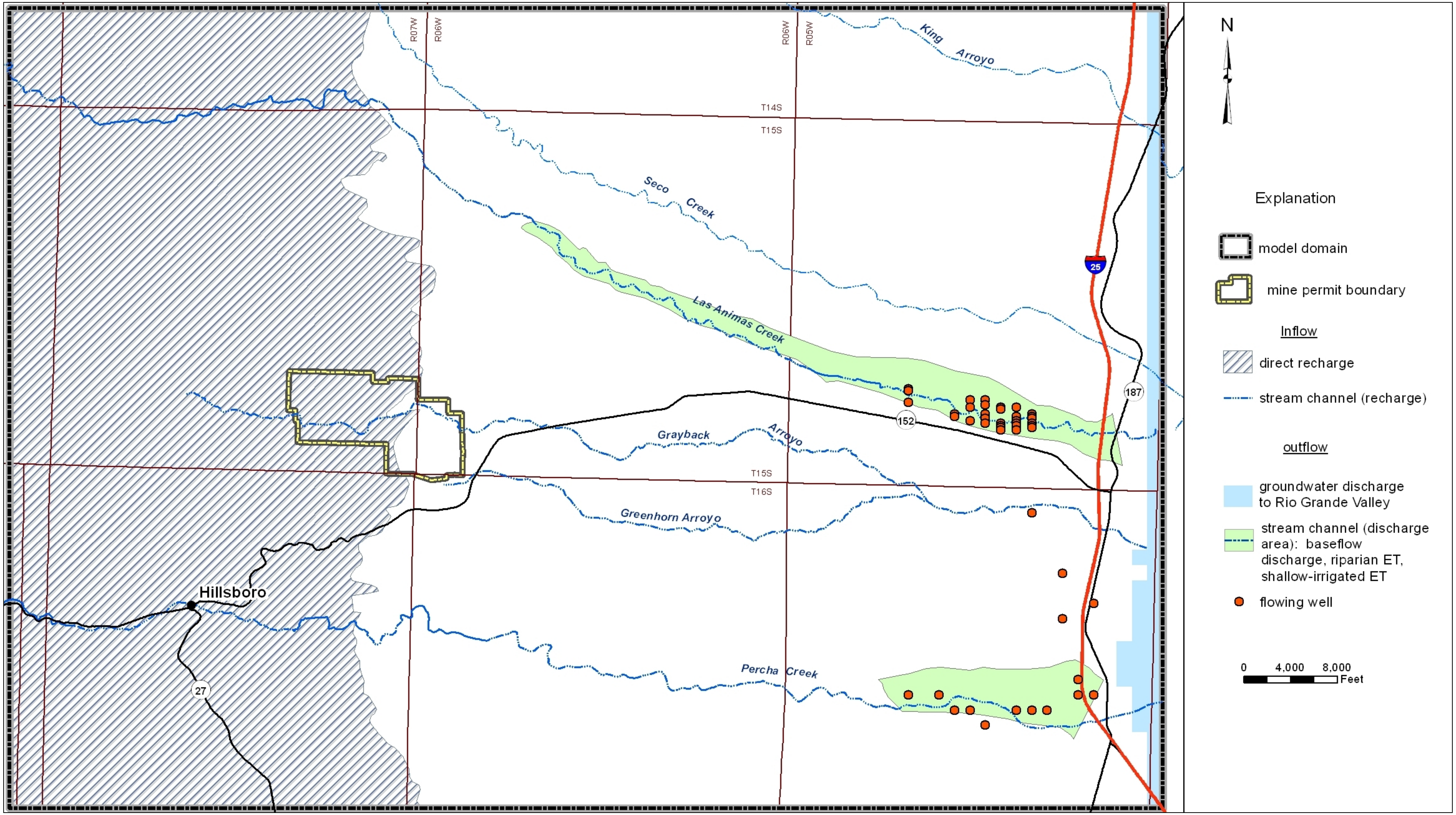


Figure 4.6. Hydrogeologic boundary conditions

5.0 CALIBRATION DATA

This section describes the data on aquifer stresses and responses available to guide the development and calibration of a numerical groundwater-flow model. These include information on (1) regional water levels, (2) the Palomas Graben and the area of the water-supply wells (well field), (3) the former tailings facility, (4) the open pit, and (5) the artesian zone in the lower Las Animas Creek and lower Percha Creek basins.

5.1 Regional Water Levels

Locations of wells and water-level measurements are presented with recent (December, 2012) potentiometric surface contours on Figure 5.1. Interpreted contours are shown for three aquifers: (1) bedrock and SFG of the Animas Uplift and Animas Graben, (2) the SFG aquifer of the Palomas Basin, and (3) the shallow alluvial aquifer along Las Animas Creek. Groundwater levels range from above 5,800 ft amsl at the western edge of the Animas graben to about 4,200 ft amsl at Caballo Lake.

Piezometers and production wells discussed below are shown on Figure 5.2. Available well construction diagrams are presented in Appendix B.

5.2 Well Field Area

The NMCC water supply wells (PW-1, PW-2, PW-3, and PW-4) were constructed and tested in 1975-80 (Green and Halpenny, 1976, 1980). Local transmissivity of the SFG aquifer is estimated below from the PW-1 and PW-2 test data. Effects of the period of well field operation, from March through June 1982, are then discussed. Next, results of a 1994 pumping test of MW-9, evaluating vertical transmission of effects, is presented. Finally, results of the 2012 aquifer test are discussed.

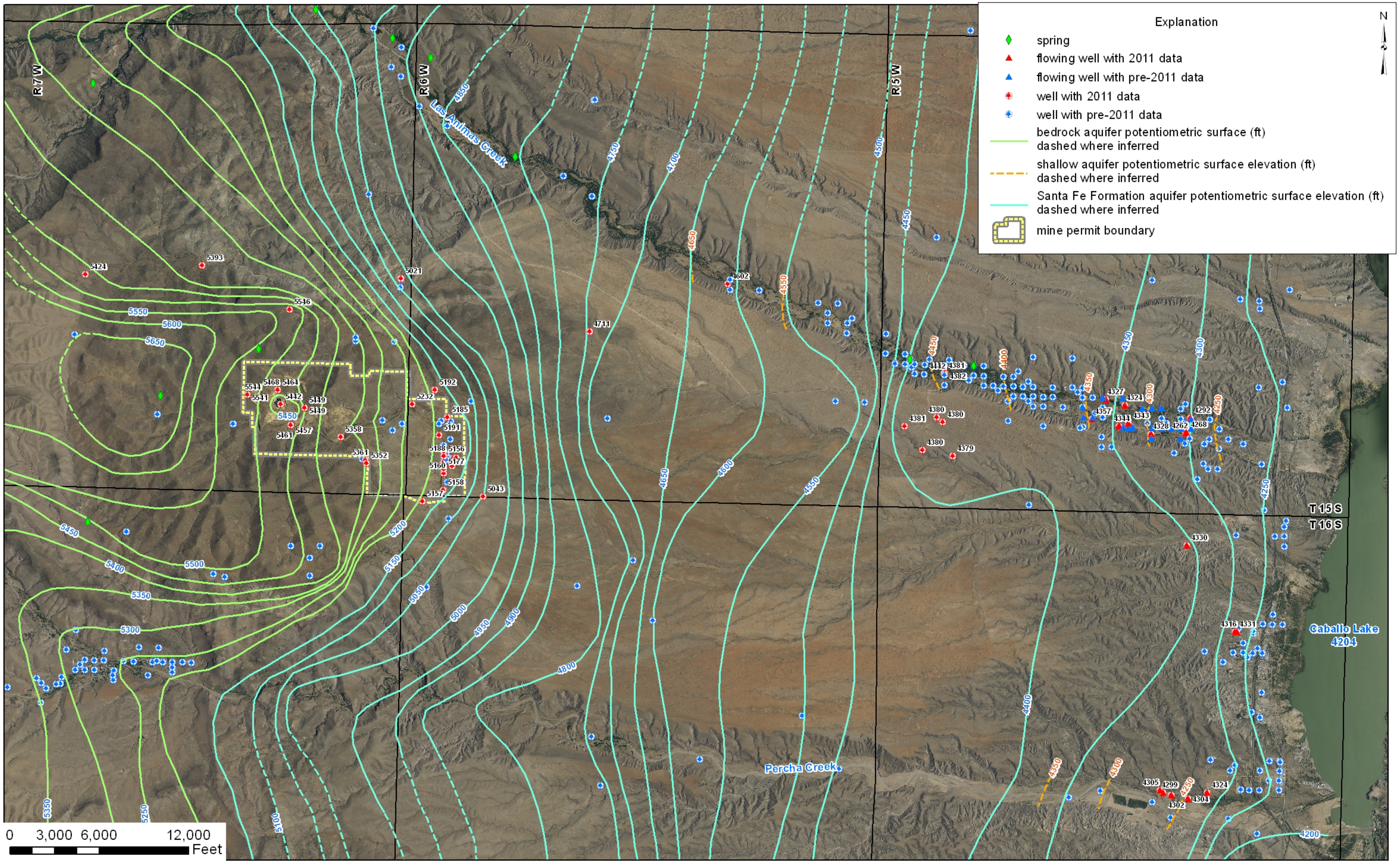


Figure 5.1. Regional water-level measurements and potentiometric surface contours.

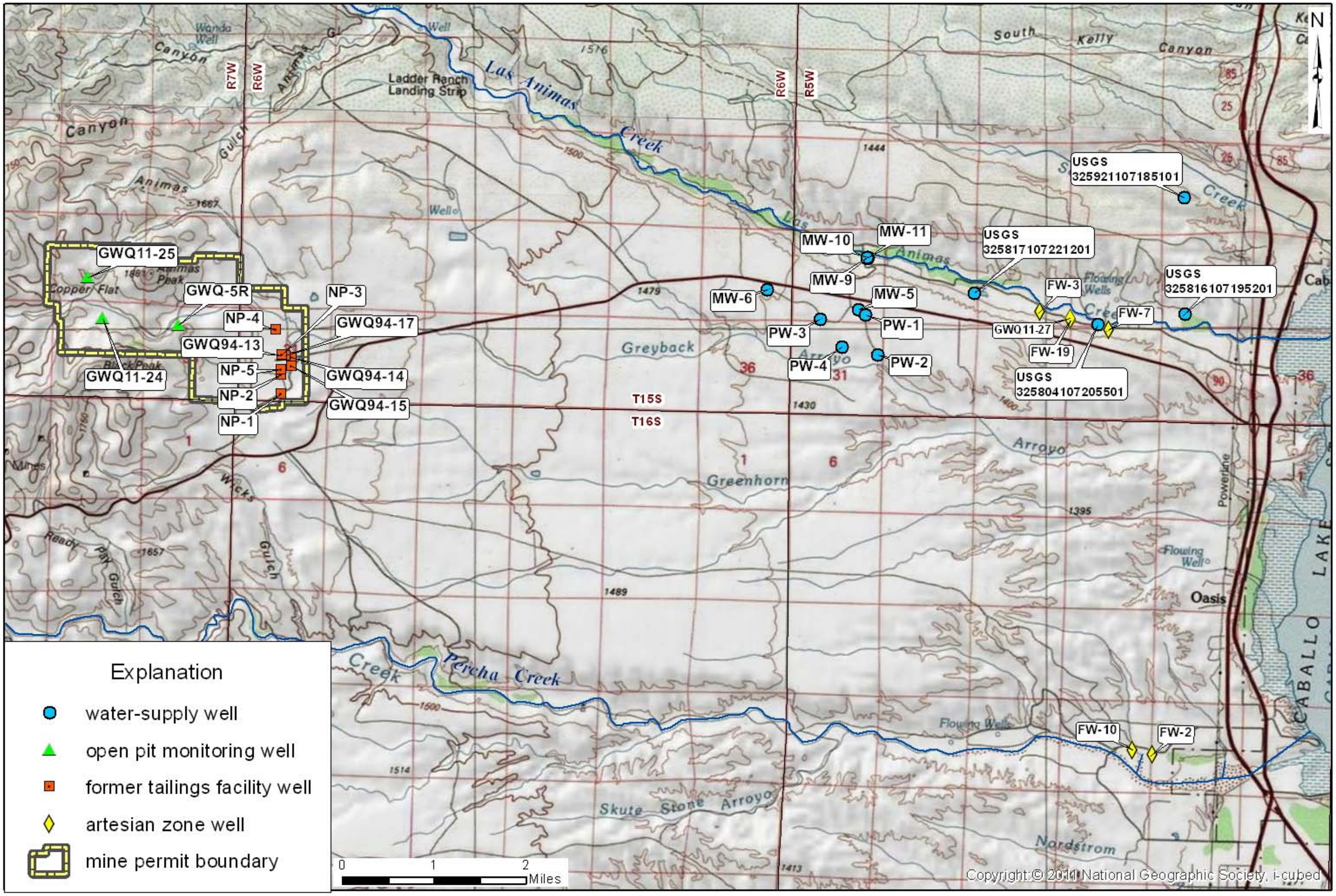


Figure 5.2. Well locations.

5.2.1 Initial Production Well Testing, 1975-1976

PW-2 was pumped at 2,020 gpm for 72 hours in January 1976 (Appendix C1). Measured drawdown and recovery at observation wells PW-1 and MW-5 are shown on Figures 5.3 and 5.4. Aquifer transmissivity is estimated at about 20,000 ft^2/day by matching the solution of Theis (1938) to measured drawdown and recovery at PW-1 and MW-5 (WDC, 1976).

Measured drawdown and recovery at the pumping well PW-2, is shown on Figure 5.5, along with the Theis solution match. In addition, because the PW-2 curves exhibit a shape characteristic of a leaky confined aquifer, the modified Theis solution of Hantush (1956) is shown as an alternate analysis.

PW-1 was pumped at 1,500 gpm for 70 hours in December 1975 (WDC, 1976). Measured drawdown and recovery at observation well MW-5 are shown on Figure 5.6. Aquifer transmissivity of about 17,000 ft^2/day is estimated by matching the solution of Theis (1938) to measured drawdown and recovery at MW-5, and to measured recovery at the pumping well PW-1, shown on Figure 5.7. In addition, the PW-1 curves exhibit a "leaky" shape and a Hantush curve match is shown as an alternate analysis.

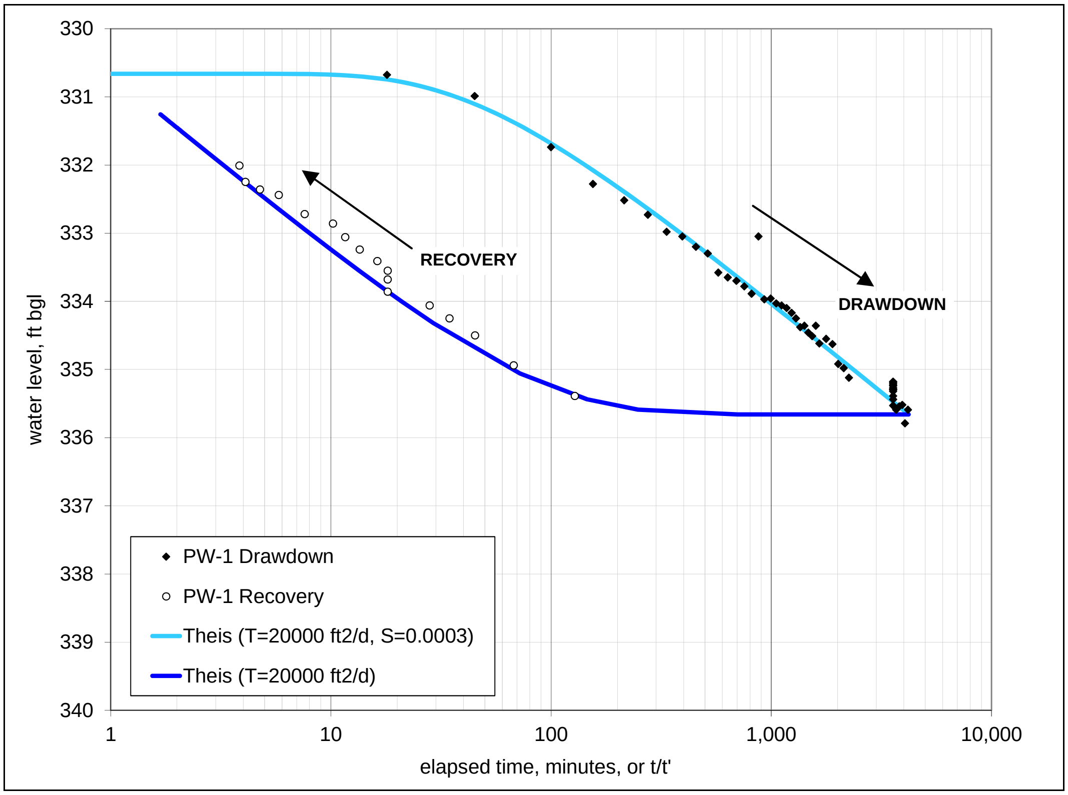


Figure 5.3. Drawdown and recovery in PW-1 during January 1976 PW-2 pumping test.

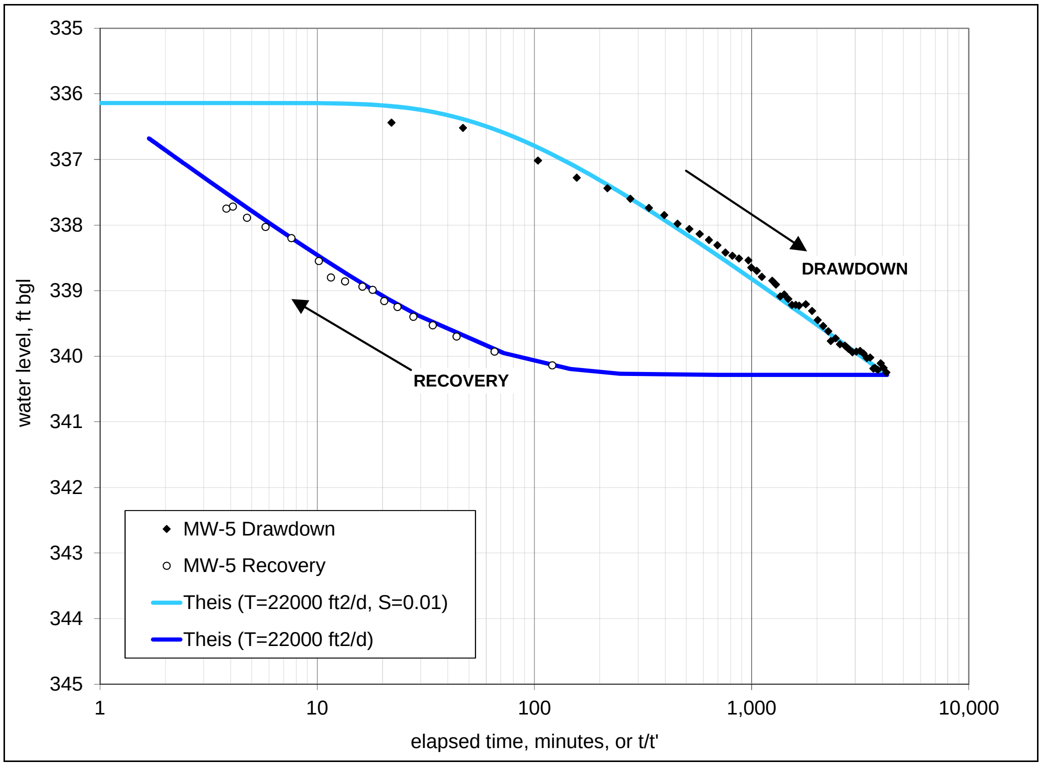


Figure 5.4. Drawdown and recovery in MW-5 during January 1976 PW-2 pumping test.

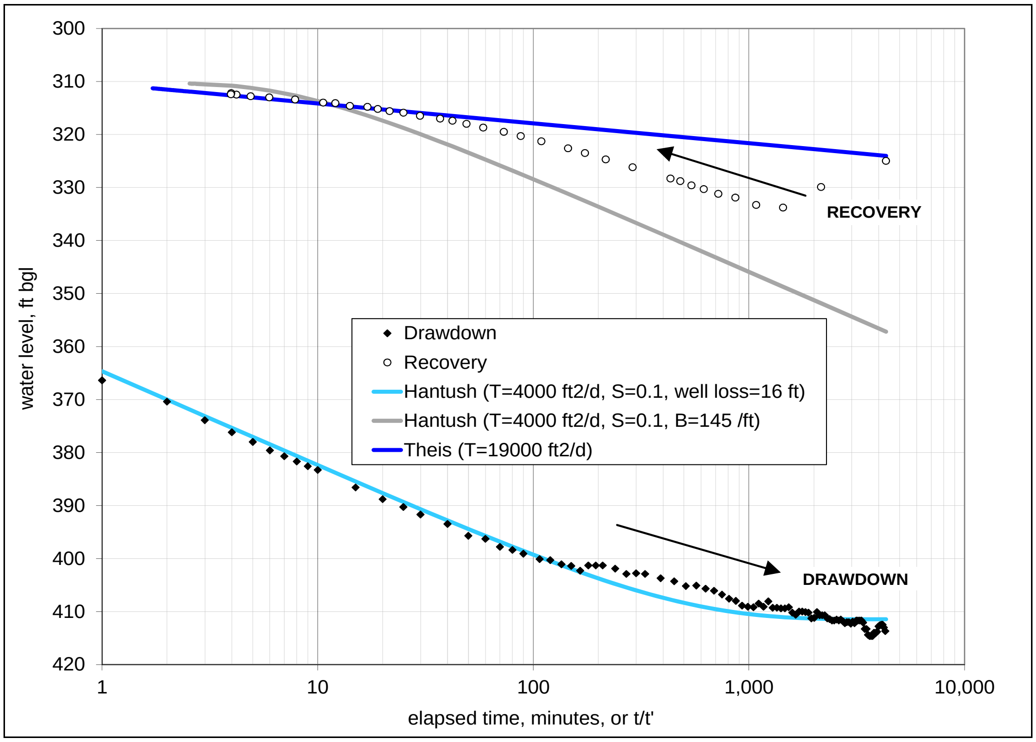


Figure 5.5. Drawdown and recovery in PW-2 during January 1976 PW-2 pumping test.

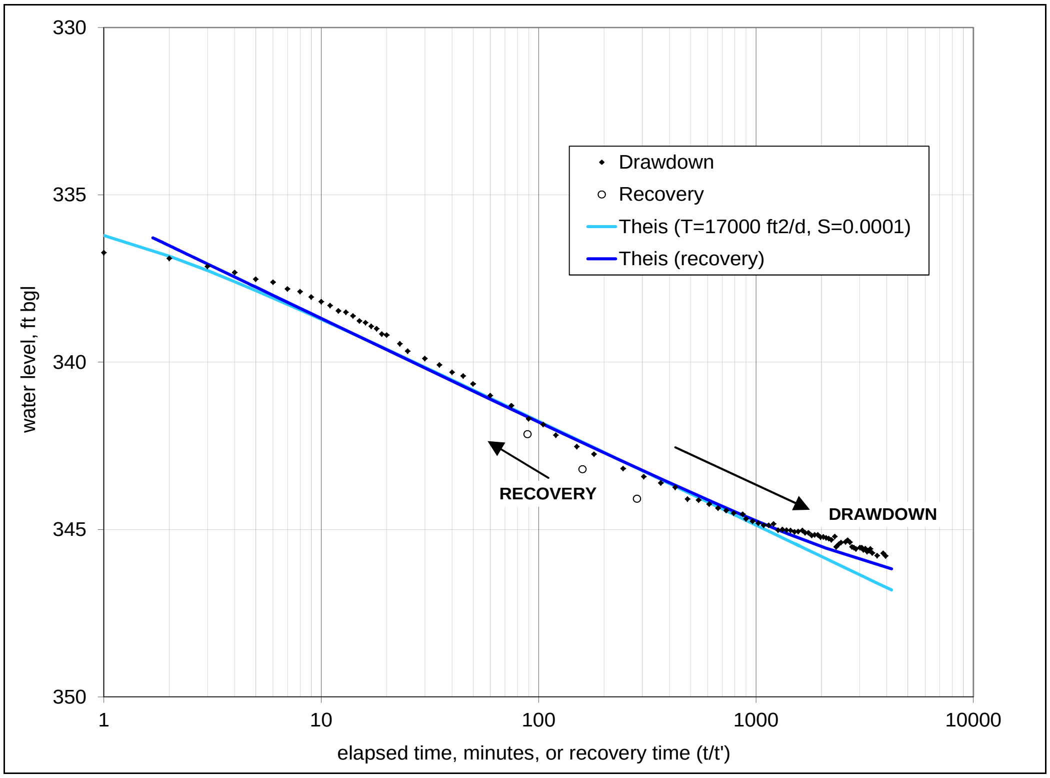


Figure 5.6. Drawdown and recovery in MW-5 during December 1975 PW-1 pumping test.

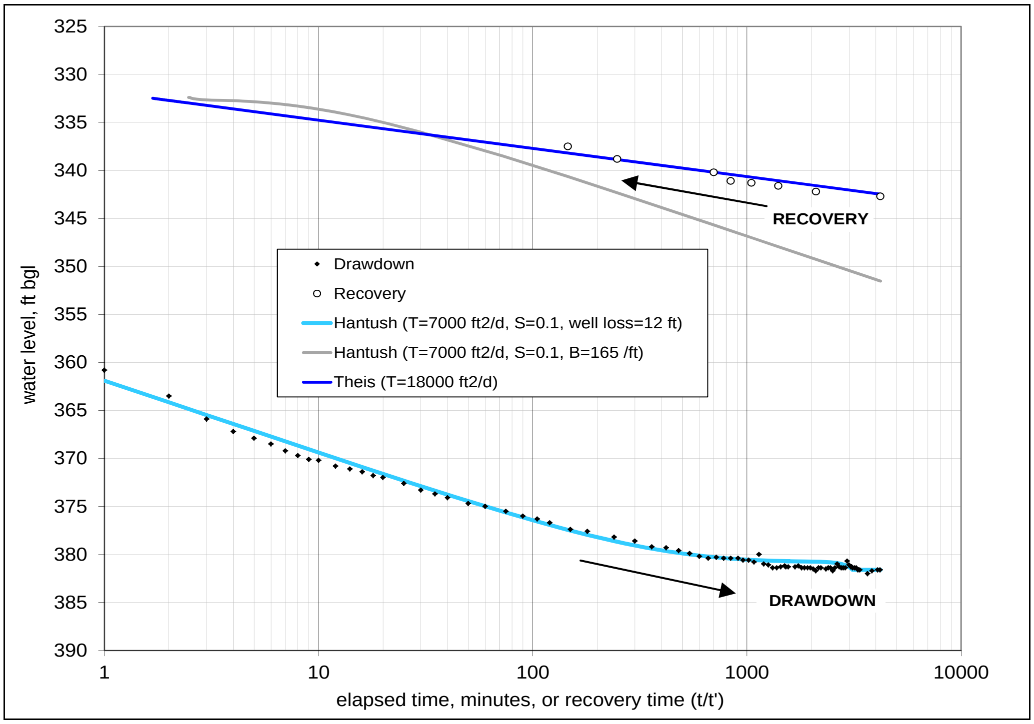


Figure 5.7. Drawdown and recovery in PW-1 during December 1975 PW-1 pumping test.

5.2.2 Period of Mine Operation, 1982

The well field was operated for 4 months from March through June 1982, at an average pumping rate of 2,272 gpm. Some pumping, averaging 40 gpm, continued for 16 months more. Average pumping rates (Bailey, 2010) are presented in Table 5.1. Total volume pumped for 1980-83 was 1,317 ac-ft.

Water levels measured in MW-5, in the immediate area of the production wells, are shown along with well field pumping on Figure 5.8, showing about 20 ft of water level drawdown due to pumping.

West of the well field, no response to pumping can be seen in water levels at MW-6, shown on Figure 5.9.

Long-term water-level trends from MW-6 show a slow rise of approximately 170 ft over 30 years. When compared to other wells in the region, water-quality data indicates groundwater from MW-6 has an anomalously high sodium chloride component. Furthermore, there are mapped north-south fault traces in the immediate vicinity of MW-6 (Seager, et al. 1982; Hawley, 2012).

Water Development Corporation (1975) reported the following: "the anomalous highs to which the water level recovered indicated that the well was being recharged by an unknown source of water (either perched water or possibly slow seepage up the well bore from the sand stringers underlying the clay layer) and that the aquifer materials were too plugged with drilling mud to allow this water to move freely into the formation."

Over time, as MW-6 was pumped, the well slowly developed and became hydraulically connected to sodium-chloride groundwater locally upwelling along an extensional fault zone. Sodium-chloride groundwater is known to upwell along structures in the Rio Grande Rift (Witcher et al., 2004). In conclusion, the observed groundwater head and water level trend from MW-6 is not representative of the regional Santa Fe Group aquifer system.

Table 5.1. Recorded average well field pumping in gallons per minute

1980	1	Jul-82	70	Mar-83	29
1981	1	Aug-82	43	Apr-83	31
Jan-82	29	Sep-82	60	May-83	68
Feb-82	29	Oct-82	34	Jun-83	26
Mar-82	1,817	Nov-82	40	Jul-83	43
Apr-82	3,042	Dec-82	43	Aug-83	25
May-82	1,501	Jan-83	43	Sep-83	16
Jun-82	2,727	Feb-83	48	Oct-83	29

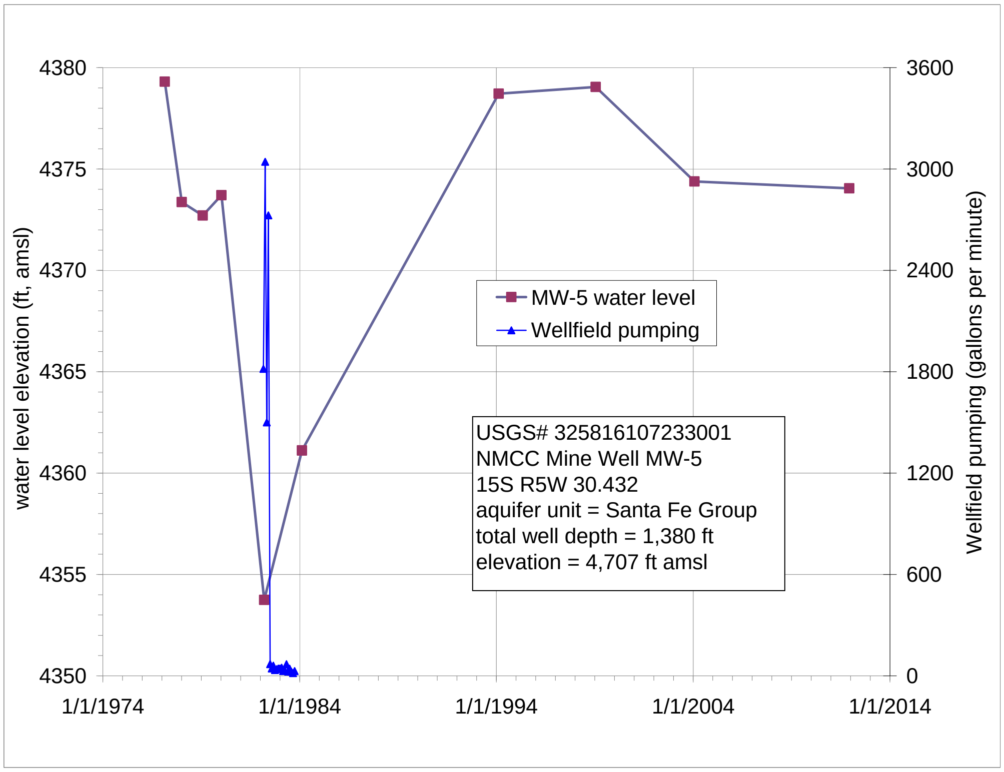


Figure 5.8. Well field pumping history and water level in MW-5.

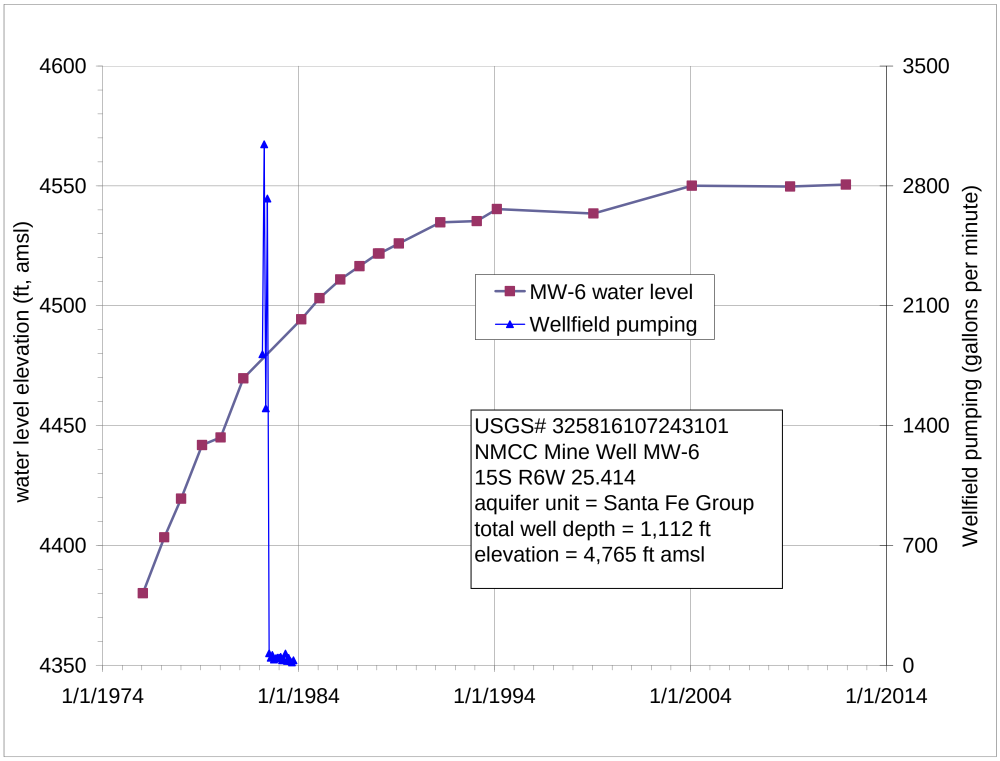


Figure 5.9. Well field pumping history and water level in MW-6.

Water levels in four wells monitored by the USGS, located east of the well field along Las Animas Creek and Seco Creek (Fig. 5.2), are shown on Figure 5.10 along with the recorded well field pumping. There is no clear response to pumping seen in any of the wells.

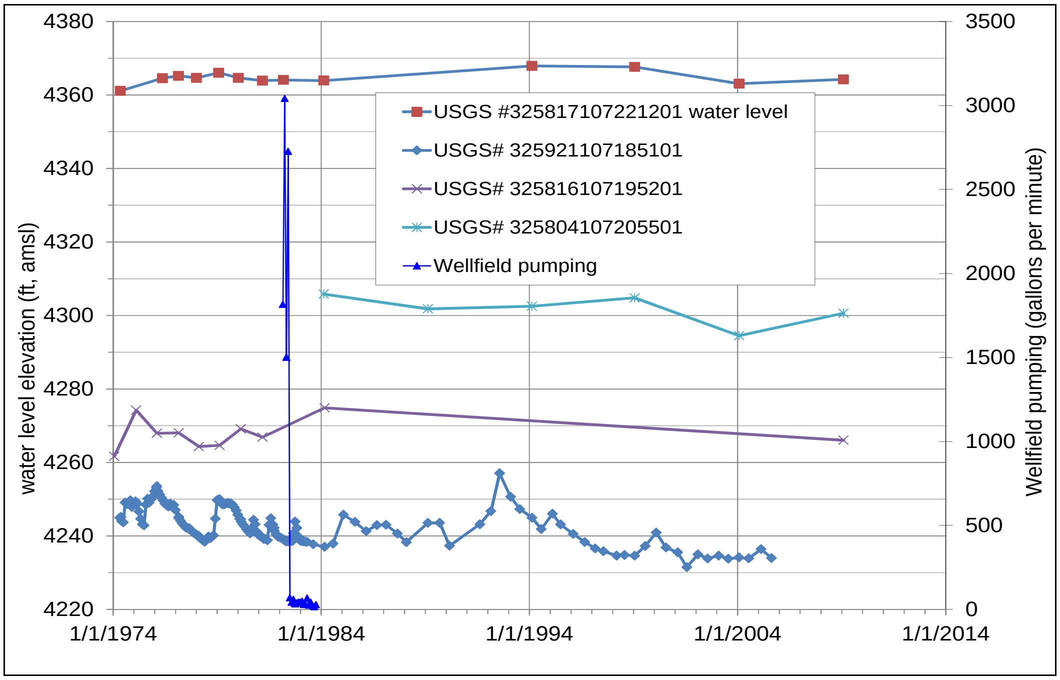


Figure 5.10. Well field pumping history and water level in USGS wells.

5.2.3 MW-9 Test, October 1994

Well MW-9, in the Palomas Graben near Las Animas Creek (Fig. 5.2.), is completed at a depth of about 250 ft. MW-10 and MW-11 are each about 50 horizontal ft from MW-9. MW-10 is completed at a depth of 125 ft and MW-11 at 37 ft. Responses at MW-10 and MW-11 to pumping at MW-9 therefore characterize the resistance to vertical flow through the SFG and alluvial aquifers.

In order to characterize vertical hydraulic communication between the SFG and alluvial aquifers (Adrian Brown Consultants, 1996), MW-9 was pumped at 90 gpm for 24 hours (Appendix C2). Drawdown and recovery at MW-9 are presented on Figure 5.11 along with a matching Hantush leaky-aquifer type-curve corresponding with transmissivity of 900 ft^2/day.

Drawdown and recovery in MW-10 are shown on Figure 5.12, showing a small response (<1 ft) to pumping, indicating possible limited vertical transmission of effects, but also showing more fluctuation due to background influences than drawdown in response to pumping. No response to pumping was detected in the shallow alluvium well MW-11; water levels rose during the test, as shown on Figure 5.13 (no analytical curves are shown on Figures 5.12 and 5.13, as the measured data show no drawdown-recovery trends to analyze).

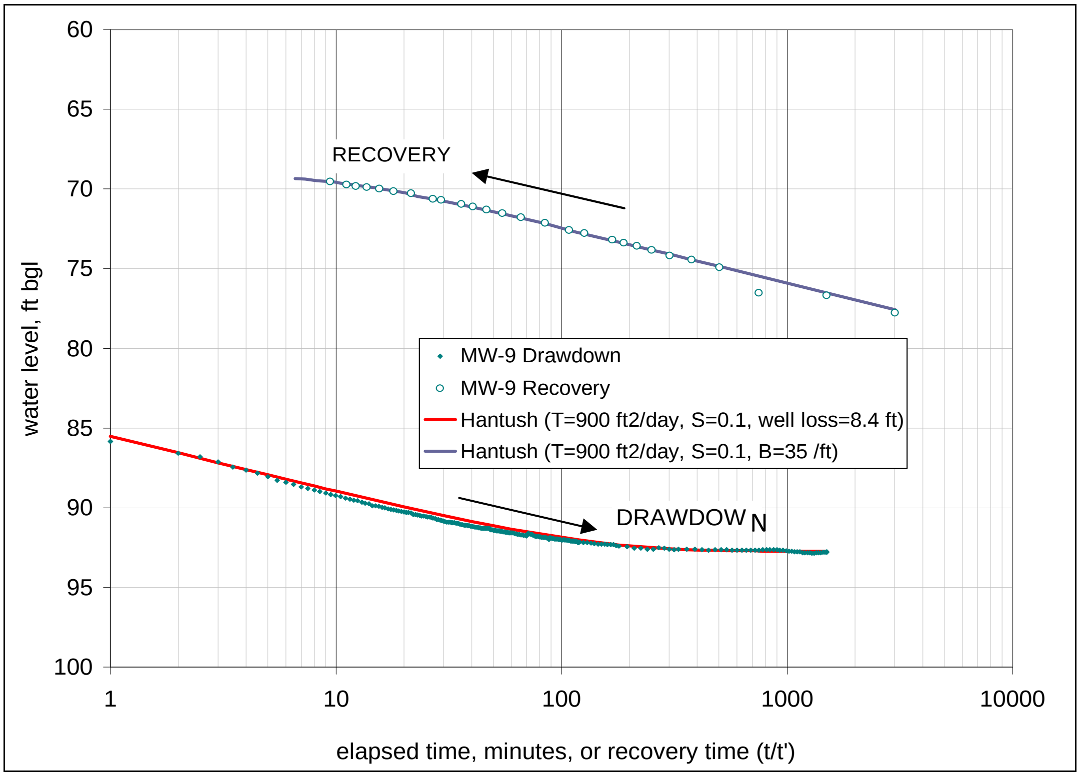


Figure 5.11. Drawdown and recovery in MW-9 during 1994 pumping test.

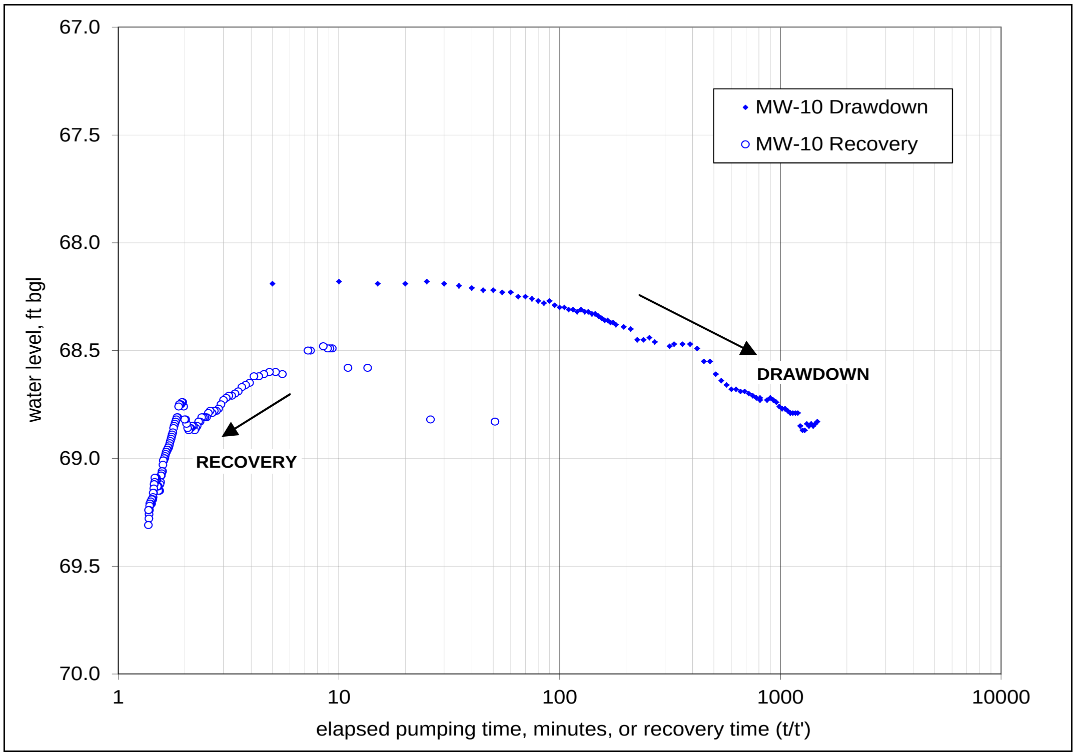


Figure 5.12. Drawdown and recovery in MW-10 during and after 1994 pumping of MW-9.

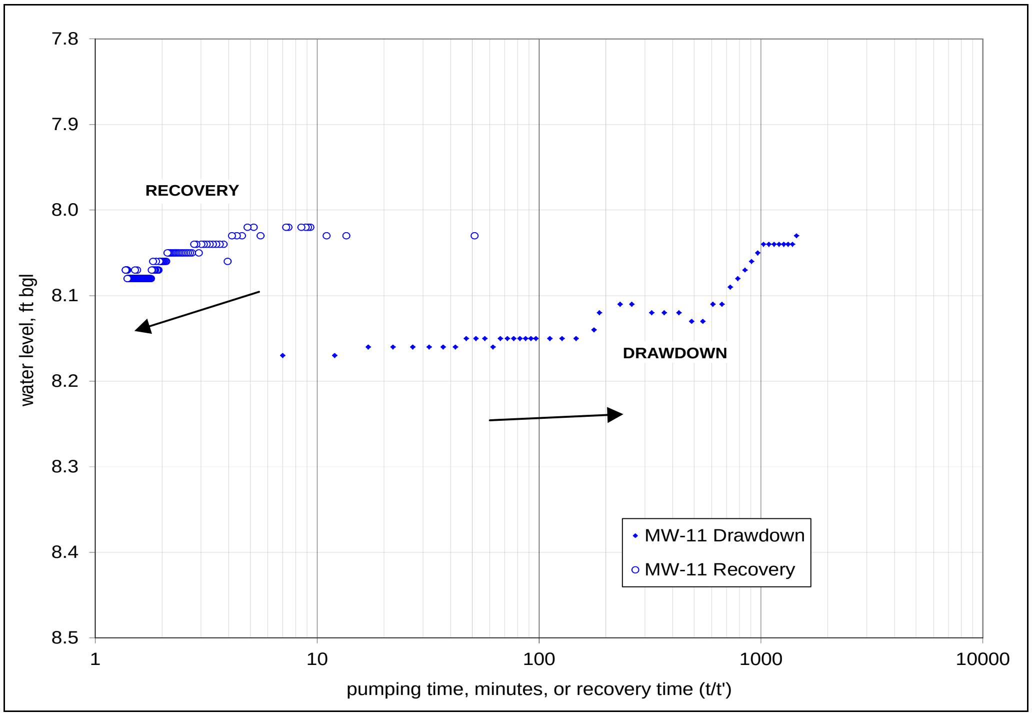


Figure 5.13. Drawdown and recovery in MW-11 during and after 1994 pumping of MW-9.

5.2.4 December, 2012 Aquifer Test

Pumping of wells PW-1 and PW-3 began on 19 November 2012 with initial testing of the pumps, circuitry and plumbing. Sustained pumping began on 3 December, was interrupted by technical difficulties on 8 December, resumed on 10 December and continued until 21 December 2012. Recorded pumping periods and rates are shown on Figure 5.14. Measured pumping-well and observation-well water levels are presented in Appendix C3. Due to the multiple pumping wells, periods and rates, the 2012 aquifer test is not easily characterized using the analytical type curves shown on Figures 5.3 through 5.7 and 5.11 above.

In addition, the analytical type curves do not reflect the particular geometry of the aquifer including the Palomas Graben. Wells within the Palomas Graben did not respond to pumping as they would in an extensive aquifer; initial drawdown was rapid and followed a semi-linear trend with time. Initial post-pumping water-level recovery was also rapid. These drawdown and recovery responses to pumping are characteristic of a high-transmissivity, semi-isolated hydrogeologic unit of finite size (the Palomas Graben).

The 2012 test is analyzed using the numerical model (Section 6.4.3 below). Measured responses in the pumping and observation wells shown on Figure 5.15 were used to calibrate the aquifer parameters for the numerical model, particularly the aquifer parameters of the Palomas Graben (Table 6.1 below) and the conductive properties of the graben-bounding faults (Table 6.2).

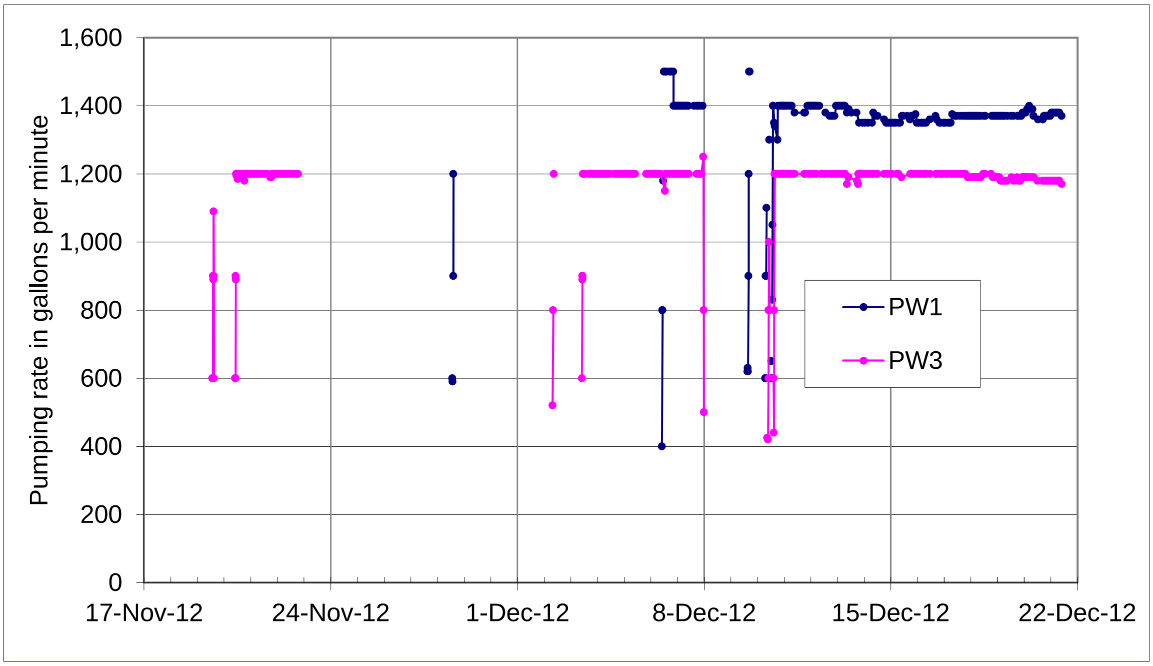


Figure 5.14. Measured aquifer test pumping rates.

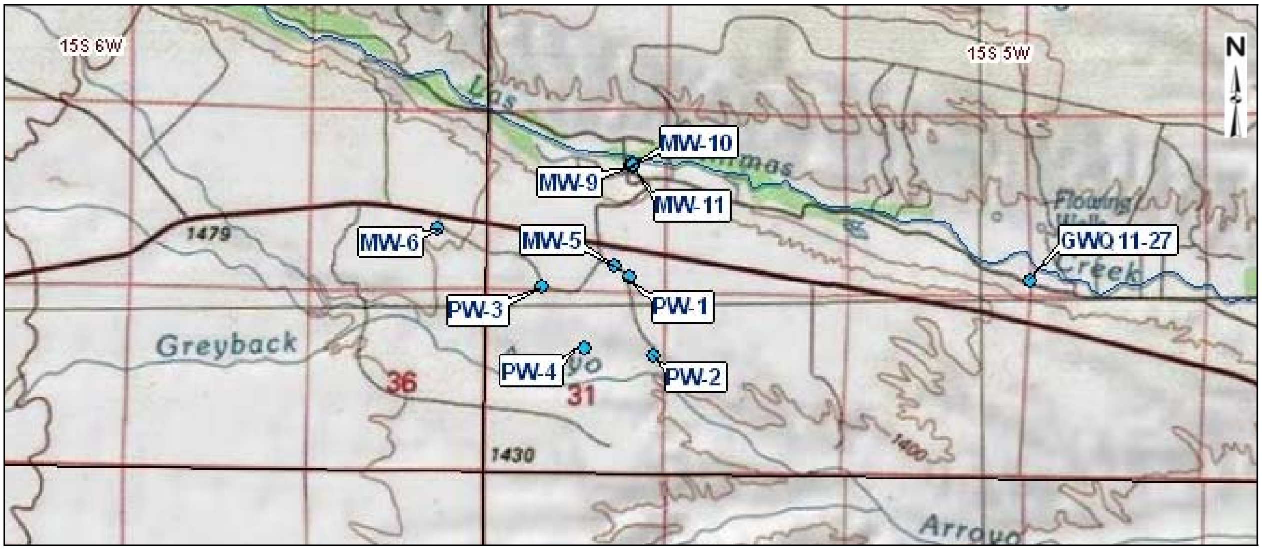


Figure 5.15. Aquifer test pumping and observation wells.

5.3 Tailings Impoundment Area

During and after the period of mine operations in 1982, the groundwater system beneath the unlined tailings facility was recharged by seepage from the tailings, in the portion of the impoundment overlying alluvium. Measured tailings-area (Fig. 5.2) water levels, shown on Figure 5.16, indicate 60 to 70 ft of water-level rise that has persisted to the present, indicating a fault, or other barrier to flow, holding the water in place.

Transmissivity in the range of 100 to 240 ft^2/day is estimated for this area at the edge of the SFG aquifer, based on the results of a 1994 aquifer test at well GWQ94-17, presented below.

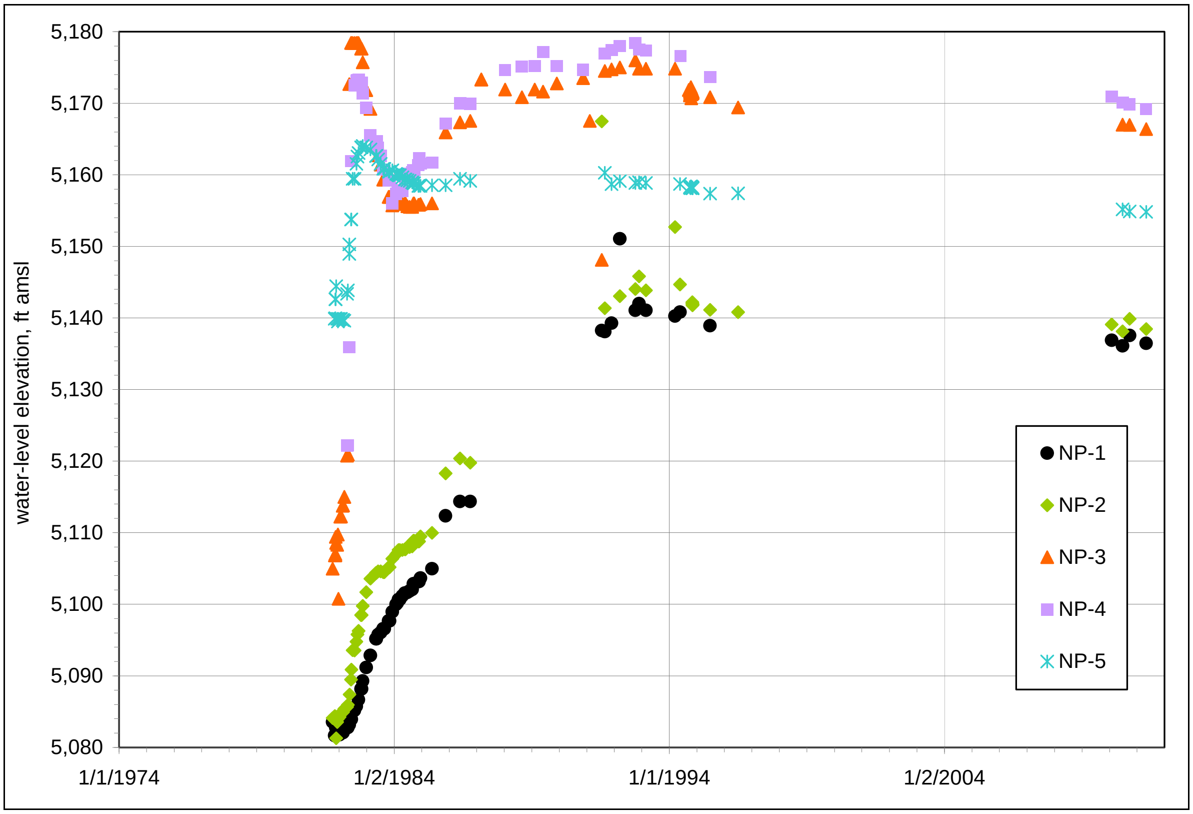


Figure 5.16. Tailings-area water levels.

5.3.1 GWQ94-17 Test, November 1994

As part of an investigation of leakage from, and groundwater flow beneath, the existing tailings impoundment (Adrian Brown Consultants, 1996), well GWQ94-17 was pumped at 23 gpm for 4,688 minutes (3.3 days), with responses measured in GWQ-13, GWQ-14 and GWQ-15 (Fig. 5.2). Complete test results are presented as Appendix C4.

Drawdown and recovery in GWQ-13 and GWQ-14 are presented on Figures 5.17 and 5.18 respectively, along with analytical (Theis, 1938) solutions. Drawdown in GWQ-15 is presented on Figure 5.19 (recovery data were unavailable) along with two Theis solutions, respectively matching distinct early and late-time trends and showing a range of possible transmissivity. Recovery in the pumping well GWQ-17 is presented on Figure 5.20 (pumping water level was constant at about 123 ft).

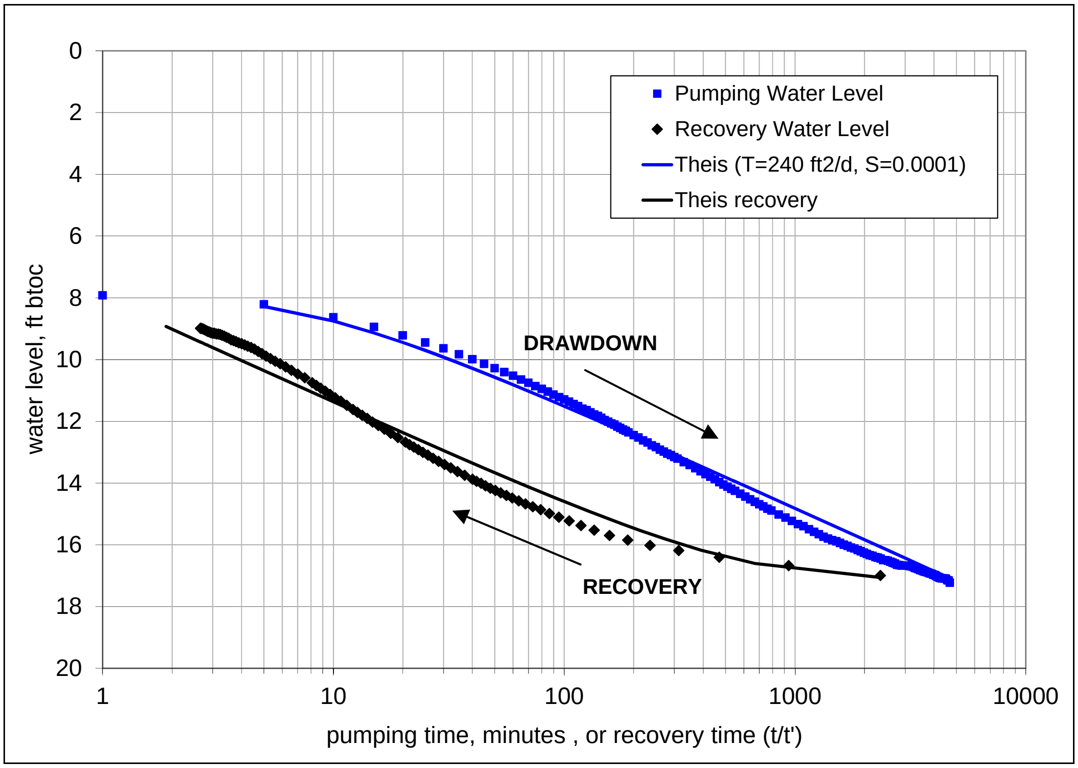


Figure 5.17. Drawdown and recovery in GWQ-13 during 1994 GWQ-17 pumping test.

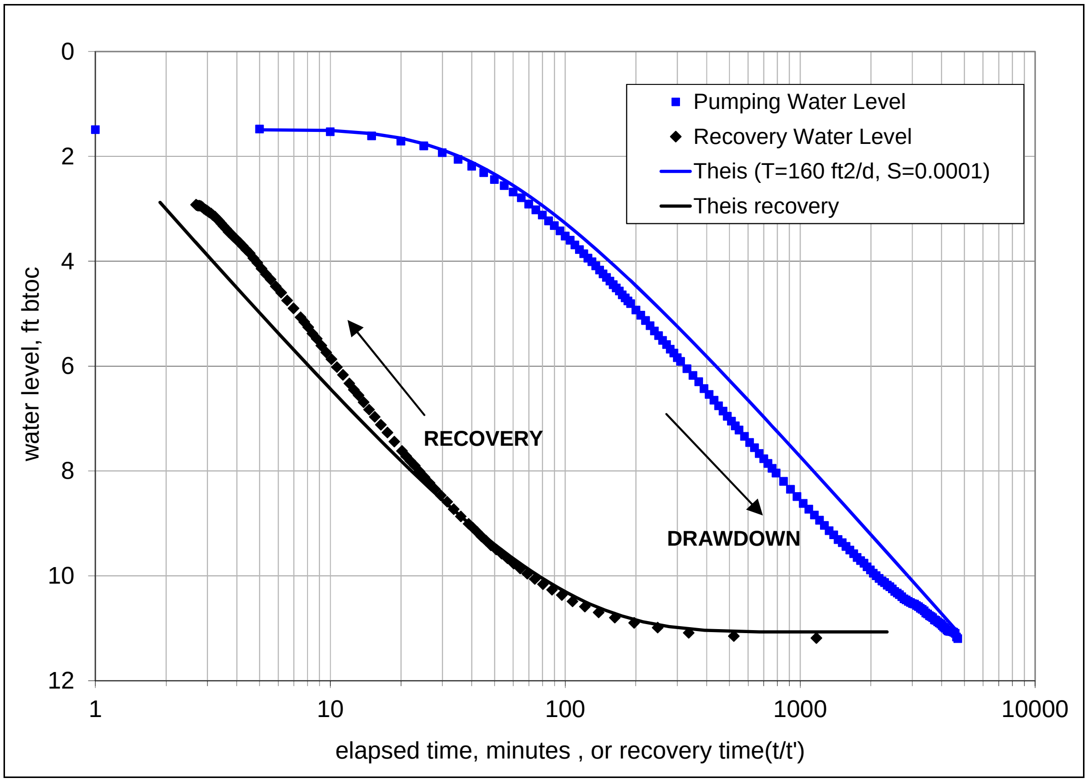


Figure 5.18. Drawdown and recovery in GWQ-14 during 1994 GWQ-17 pumping test.

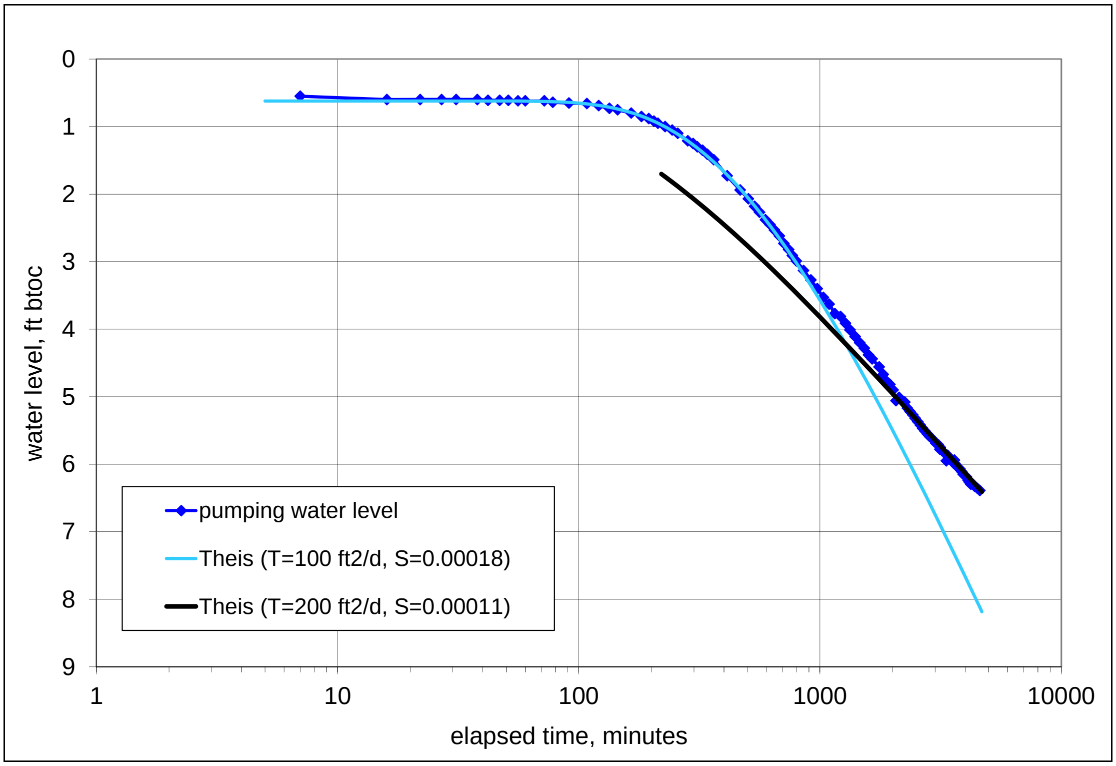


Figure 5.19. Drawdown in GWQ-15 during 1994 GWQ-17 pumping test.

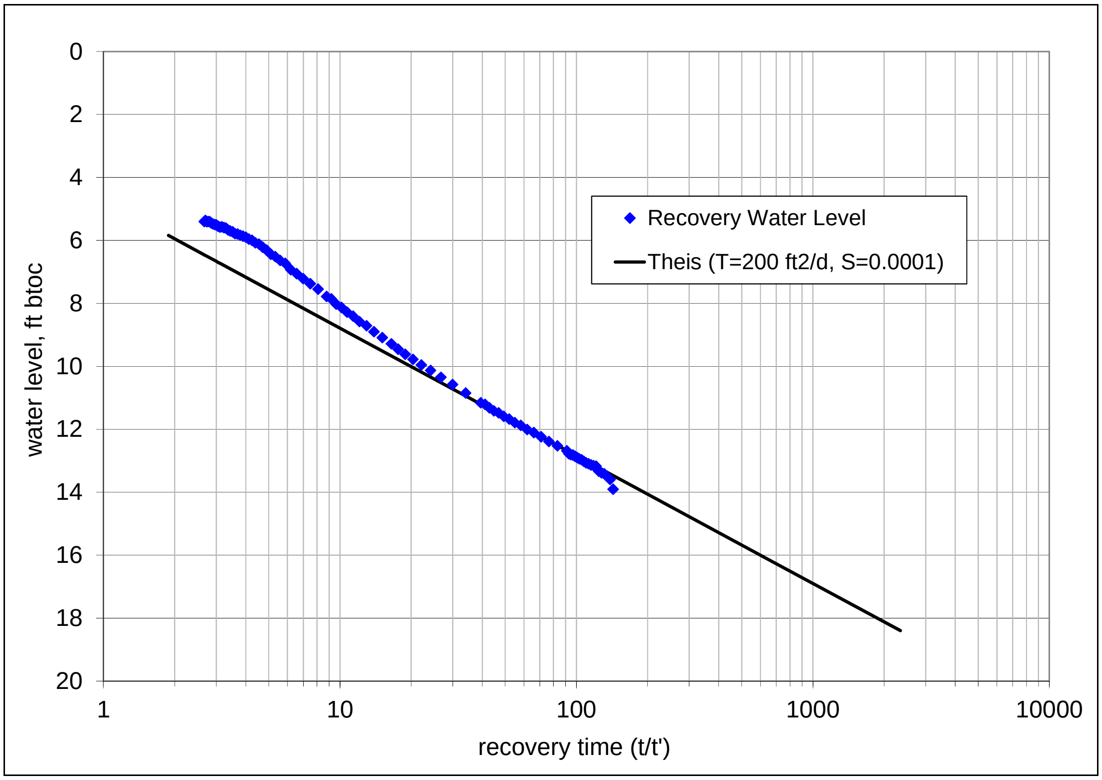


Figure 5.20. Recovery in GWQ-17 after 1994 pumping test.

5.4 Open Pit Area

The historical water level in the open pit has ranged between 5,435 and 5,450 ft amsl, corresponding to a water-surface area between 5 and 14 acres. Based on an evaporation rate of 64.6 in./yr (Table 2.1), annual open-pit evaporation has ranged from about 16 gpm to 45 gpm.

This discharge is supported by a combination of groundwater inflow, direct precipitation and runoff. Based on precipitation records it is estimated that the annual pit water balance (16 to 45 gpm of discharge by evaporation) is provided by 6 to 10 gpm of groundwater inflow and the rest (6 to 40 gpm) by precipitation and runoff.

The groundwater inflow component would increase with future pit expansion and dewatering. The post-mining open pit, larger and deeper than the existing pit, would have a larger groundwater inflow and larger evaporation.

Current pit water levels are below 5,440 ft amsl, with water balance in the low range of the estimate. The pit is a hydrologic sink, as shown on the contour map of the local piezometric surface, Figure 5.21.

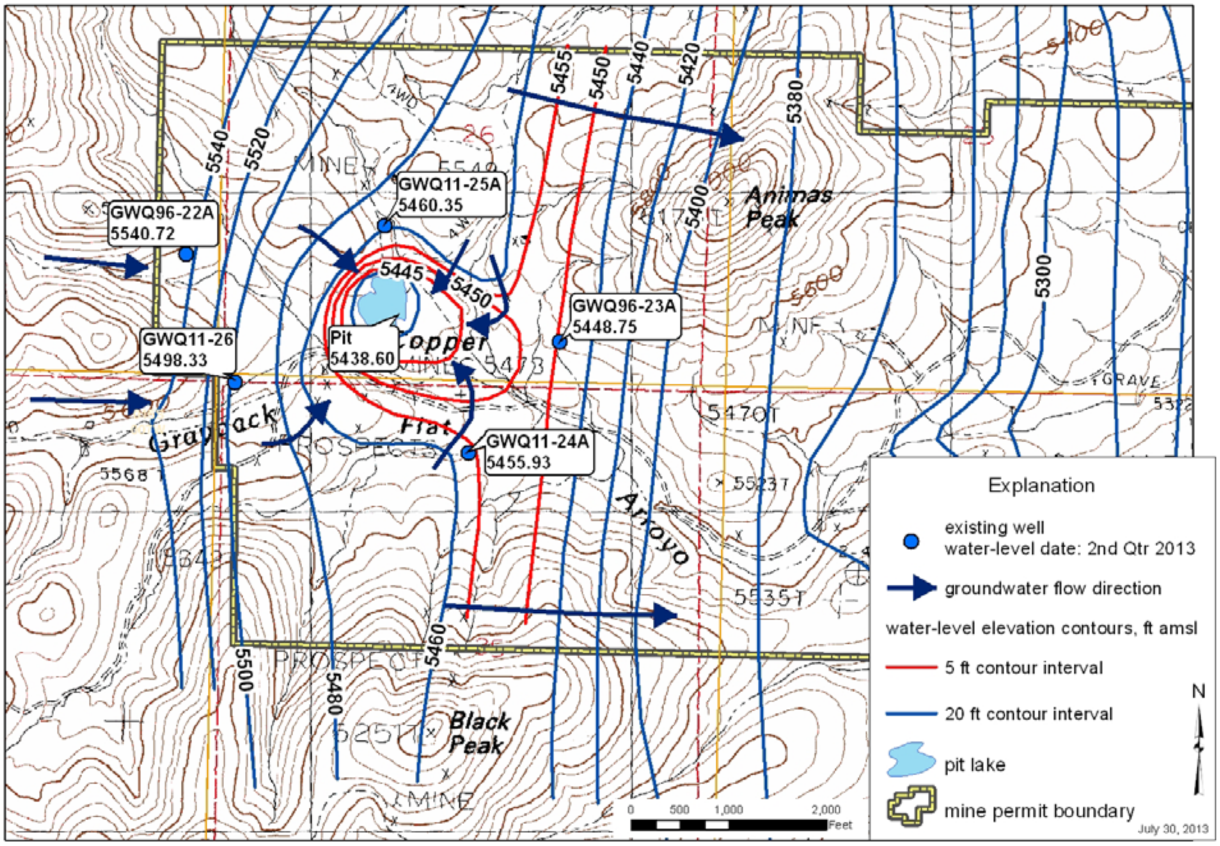


Figure 5.21. Measured pit-area groundwater levels.

5.4.1 Pit Area Pressure-Injection Tests, September 2011

Pressure-injection testing in the bedrock around the pit, in wells GWQ 5-R, GWQ 11-24, and GWQ 11-25 (Appendix C5), is summarized in Table 5.2. Apparent permeability of the bedrock ranges from near zero, to about 0.1 ft/day in the most fractured zones.

Table 5.2. Summary of pressure-injection test results

borehole and zone	depth interval (ft)	apparent permeability	
		(cm/sec)	(ft/day)
GWQ 5-R, Zone 1	64-100	~0	~0
GWQ 11-24, Zone 1	100-147	7×10^{-6}	0.02
GWQ 11-24, Zone 2	150-197	3.0×10^{-5}	0.085
GWQ 11-24, Zone 3	204-251	4.9×10^{-5}	0.14
GWQ 11-25, Zone 1	100-148	~0	~0
GWQ 11-25, Zone 2	150-198	2.9×10^{-5}	0.081
GWQ 11-25, Zone 3	207-251	2.6×10^{-5}	0.074

cm/sec - centimeters per second

5.5 Flowing Wells

The first artesian wells in the study area were drilled in the late 1930s. Most of the artesian wells were drilled prior to the New Mexico Office of the State Engineer (NMOSE) declaration of Las Animas Creek and Lower Rio Grande Underground Water Basins in 1968 and 1980, respectively.

Flow from selected artesian wells (Fig. 5.2) has been measured by Murray (1959), Davie and Spiegel (1967), JSAI (1995), and JSAI (2011c). A summary of aggregate measured artesian flow rates is presented in Table 5.3. Note that the "total artesian flow" estimates in Table 5.3 considered only a partial sample of flowing wells in the area; total artesian discharge for the study area is greater than the flows presented in Table 5.3.

Table 5.3. Summary of measured artesian flow rates

source	number of wells	year	total artesian flow (gpm)	comments
Murray (1959)	23	1946	460	included Percha, Las Animas Creek, and Oasis areas
Davie and Spiegel (1967)	29	1966	1,186	Las Animas Creek area only
JSAI (1995)	12	1995	1,319	survey limited to accessible wells with owner permission
JSAI (2011c)	21	2011	222	survey limited to accessible wells with owner permission

JSAI - John Shomaker & Associates, Inc. gpm - gallons per minute

Construction details for the artesian wells are limited, but it appears a number of artesian wells were drilled without proper annular seals to prevent flow of water from the artesian zone into the overlying alluvium and stream channels. Furthermore, many of the artesian wells were never valved, and therefore left open to flow continuously at the land surface. Valves to regulate artesian flow, and metering, have been conditions to permits since the State Engineer declaration of the basin.

Over the last 50 years significant changes in flow rates have been observed in the few artesian wells that have time-series data. Measured artesian flow rates over time are presented in Figure 5.22, showing declines in flow rates from individual wells (except, apparently, from FW-7) along Percha and Las Animas Creeks.

There are many factors that affect artesian flow, including time of year, climatic conditions, and water level in Caballo Reservoir. Some wells may have been modified, repaired, or re-drilled. Upward leakage via artesian wells and open flow, however, appear to be mainly responsible for the long-term decline in artesian flow rates.

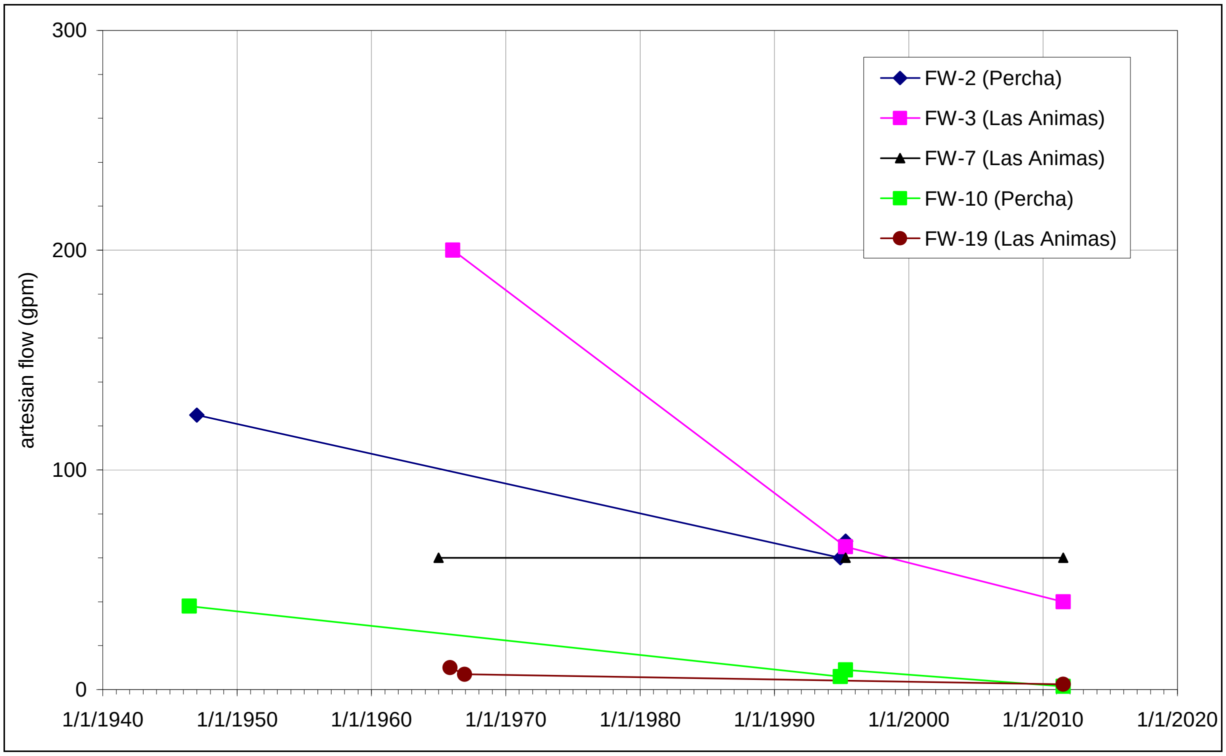


Figure 5.22. Measured artesian flow rates.

6.0 NUMERICAL MODEL

The computer program used for the hydrologic model is a version of the U.S. Geological Survey *Modular Three-Dimensional Finite Difference Ground-Water Flow Model, MODFLOW* (McDonald and Harbaugh, 1988). Modifications to the original computer program are documented in Appendix D.

Inputs to the model include (1) hydraulic parameters that control the flow of water within the model domain, and (2) boundary conditions that control the addition and removal of water to and from the model domain.

Several model simulations were developed representing different time periods and conditions:

1. **Steady-state**: Represents hypothetical pre-development steady conditions, used as starting condition for the pre-mining transient simulation.
2. **Pre-mining** (transient): Simulates the period 1940 to mid-1980, including the effect of flowing artesian wells on the system.
3. **Mining and post-mining**: Simulates the period from mid-1980 through November, 2012 including the brief period of mine operation in 1982 and the post-mining period.
4. **Aquifer test**: Simulates the period from the start of the 2012 well-field pumping test (late November, 2012), through year 2014.
5. **Future-mining scenarios**: Simulate the estimated water demand for selected scenarios. In addition, a no-mining scenario simulates continued background conditions. The effects of each mining scenario, including groundwater level drawdown and surface-discharge reduction, were evaluated by comparing results of each simulation to the equivalent results of the no-mining scenario.
6. **Future-post-mining scenarios**: Simulate the post-mining period for each future-mining (and no-mining) scenario, including continued surface-discharge effects and recovery of water levels in the SFG aquifer and in the open pit.

6.1 Model Discretization

The model grid, consisting of 87 rows, 109 columns, and 4 layers, is shown on Figure 6.1. Horizontal grid spacing ranges from 200 ft in the pit area, increasing to 1/4 mile (1,320 ft) away from the mine. Layer 1 is active only along lower Las Animas and Percha Creeks and near the axis of the Rio Grande, representing the shallow aquifer composed of alluvium and SFG sediments, with modeled thickness ranging from 100 to 200 ft. Layers 2 through 4 represent the SFG aquifer and different bedrock units, with modeled thicknesses ranging from 500 to 3,000 ft (Table 6.1).

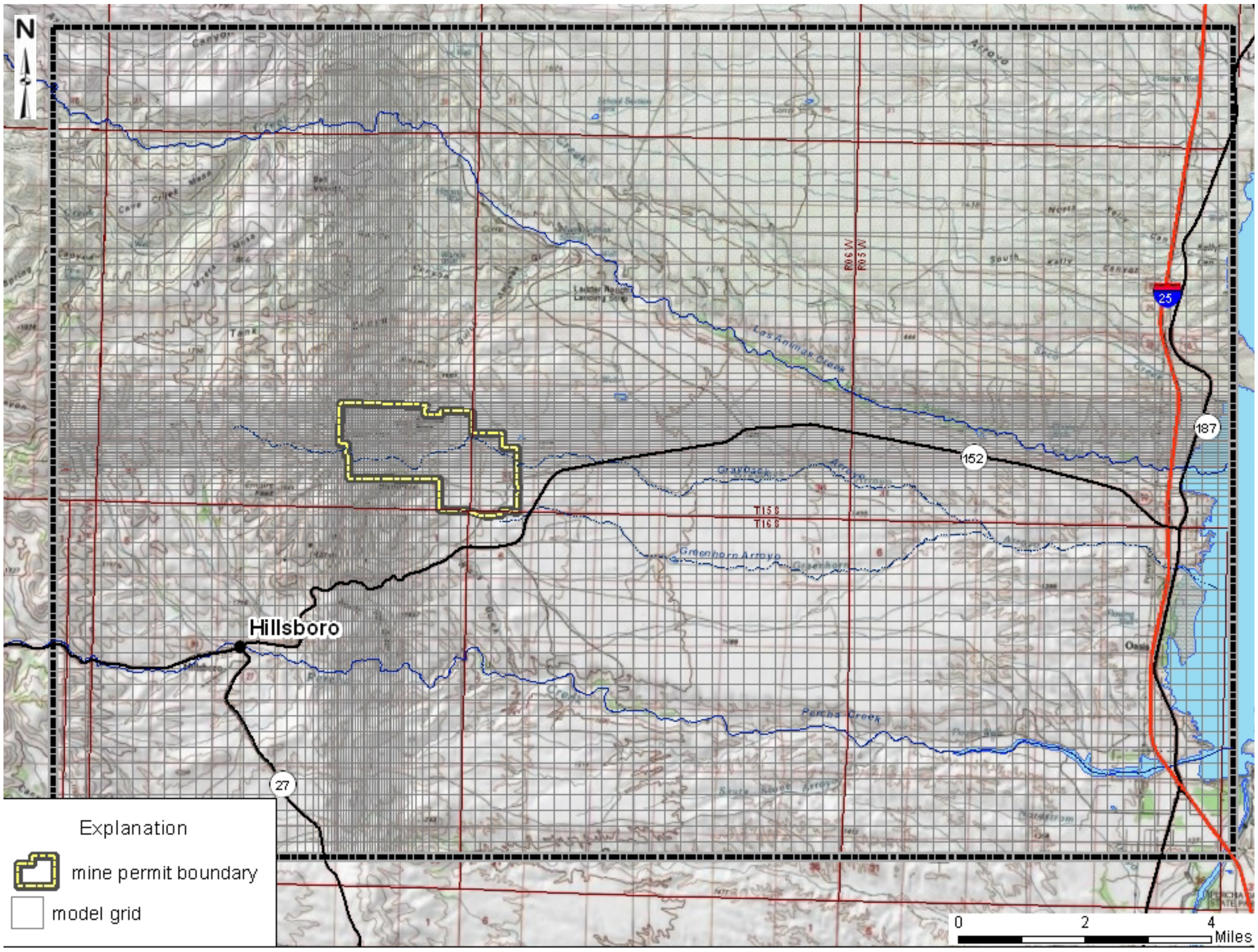


Figure 6.1. Model domain and grid.

6.2 Aquifer Parameters

Hydrogeologic units and fault barriers represented in each model layer are shown for layers 1 and 2 on Figures 6.2 and 6.3, and for layers 3 and 4 on Figures 6.4 and 6.5. Modeled aquifer parameters for each unit are shown on Table 6.1. Conductances of modeled fault barriers are shown on Table 6.2.

The layer 1 zones shown on Figure 6.2 include the shallow aquifer alluvium-SFG package along Las Animas Creek and a second, thicker zone along lower Animas, lower Percha and the Rio Grande Valley. Modeled aquifer parameters are shown on Table 6.1.

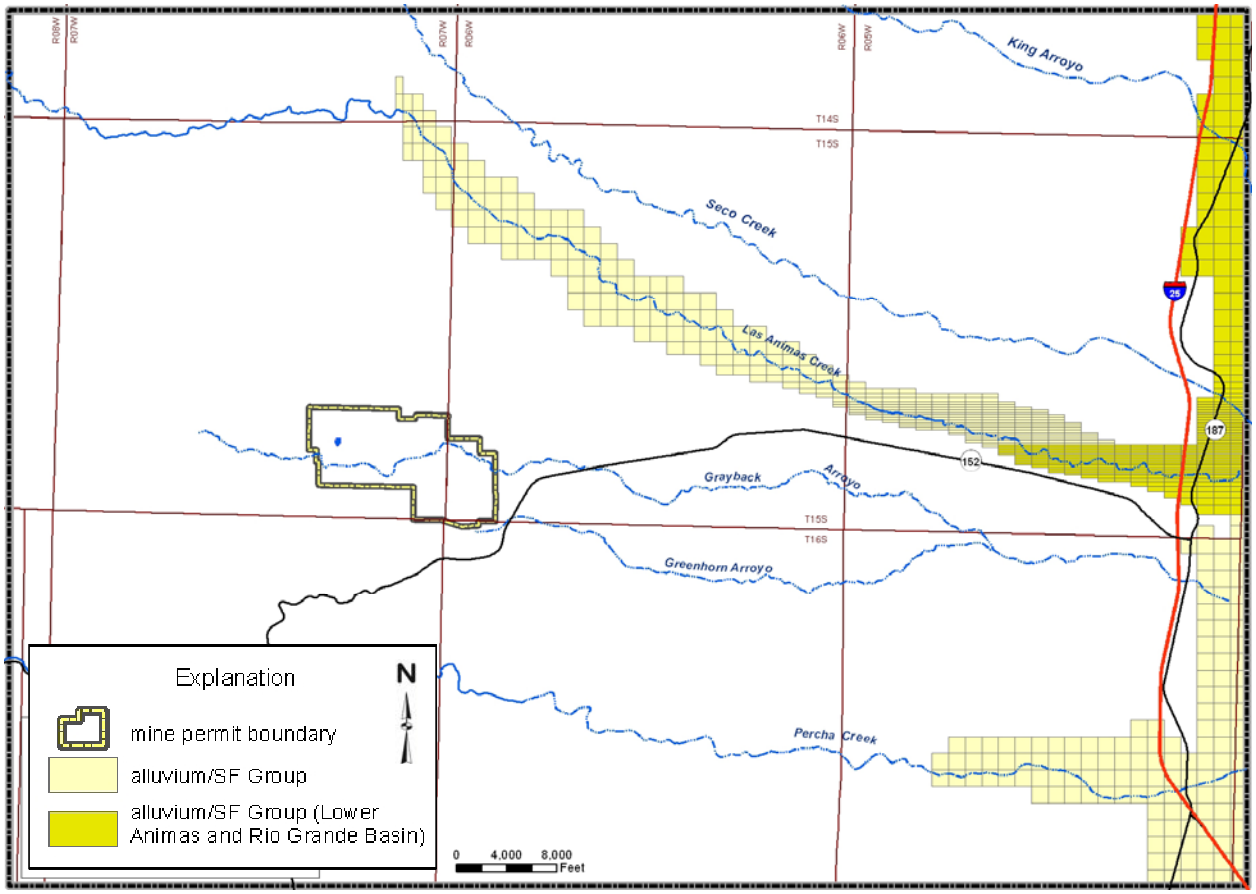


Figure 6.2. Layer 1 hydrogeologic zones

The modeled aquifer parameters (Table 6.1) include a high-transmissivity zone representing the Palomas Graben (Figs. 6.3, 6.4, and 6.5). The 2012 aquifer test results and subsequent model calibration further support the existence of the feature. Aquifer parameters of the graben (Table 6.1) and conductances of its bounding faults (Table 6.2) are based mainly on model calibration to the 2012 aquifer test results (Section 6.4.3 below).

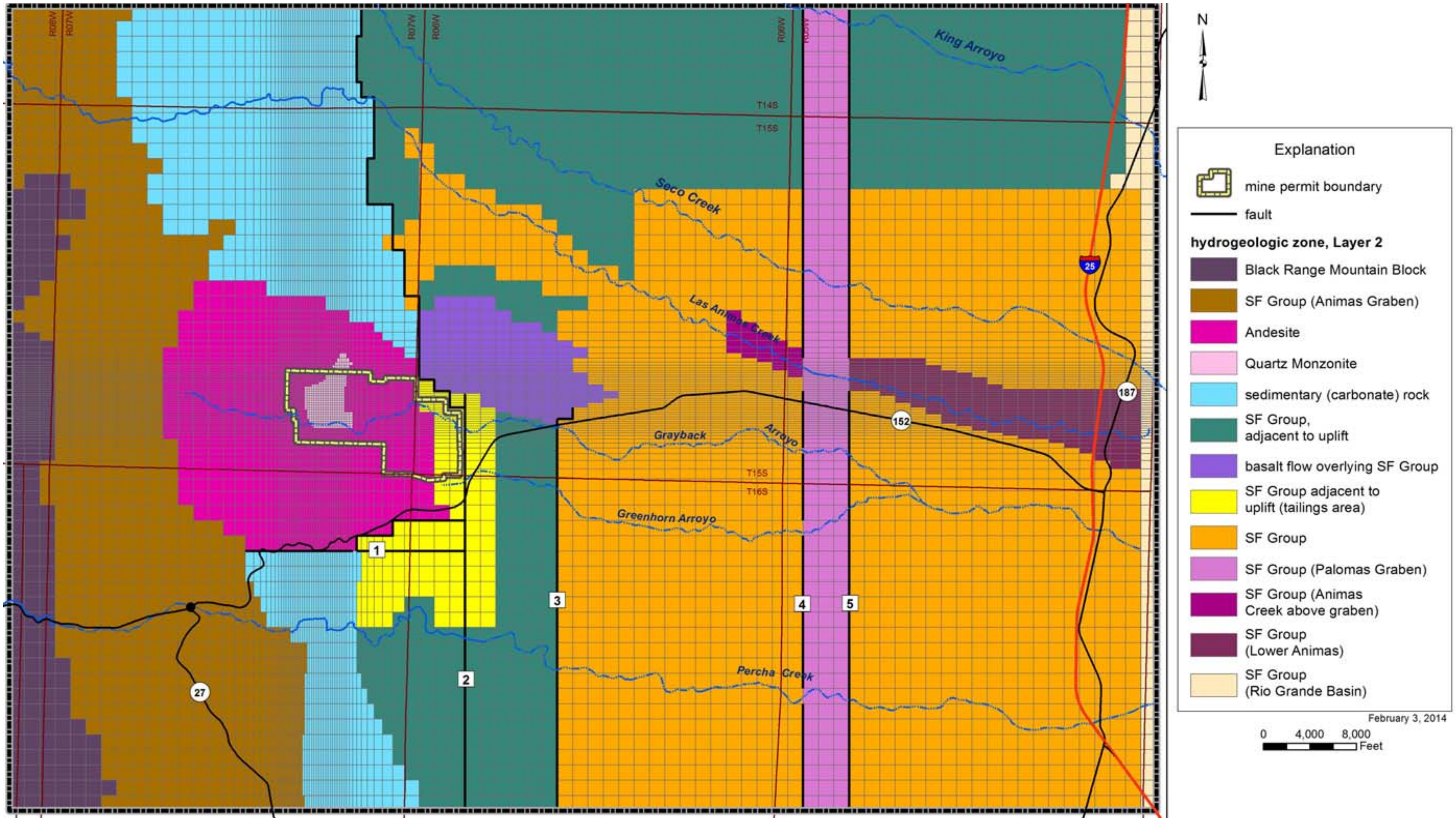


Figure 6.3. Layer 2 hydrogeologic zones.

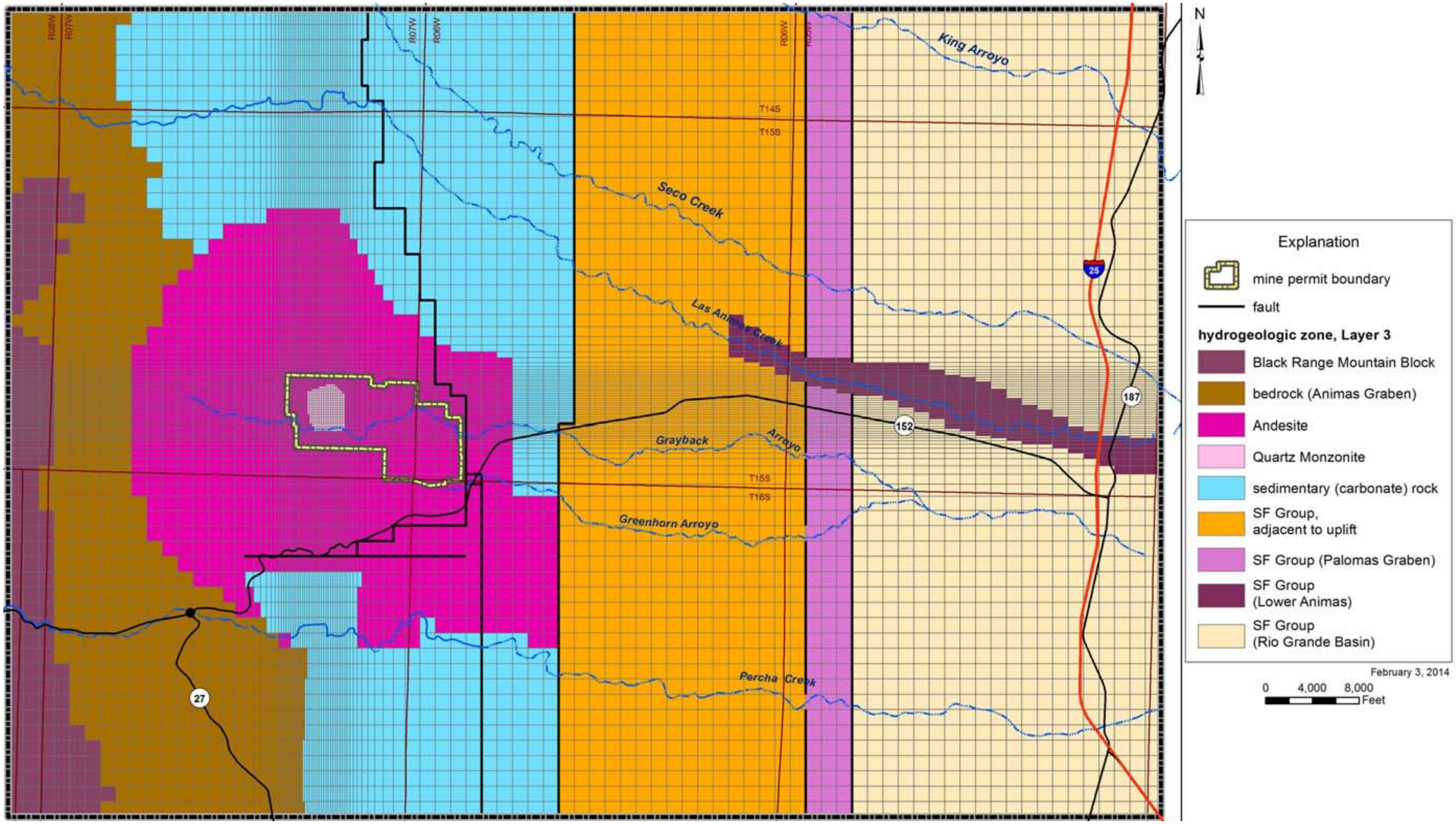


Figure 6.4. Layer 3 hydrogeologic zones.

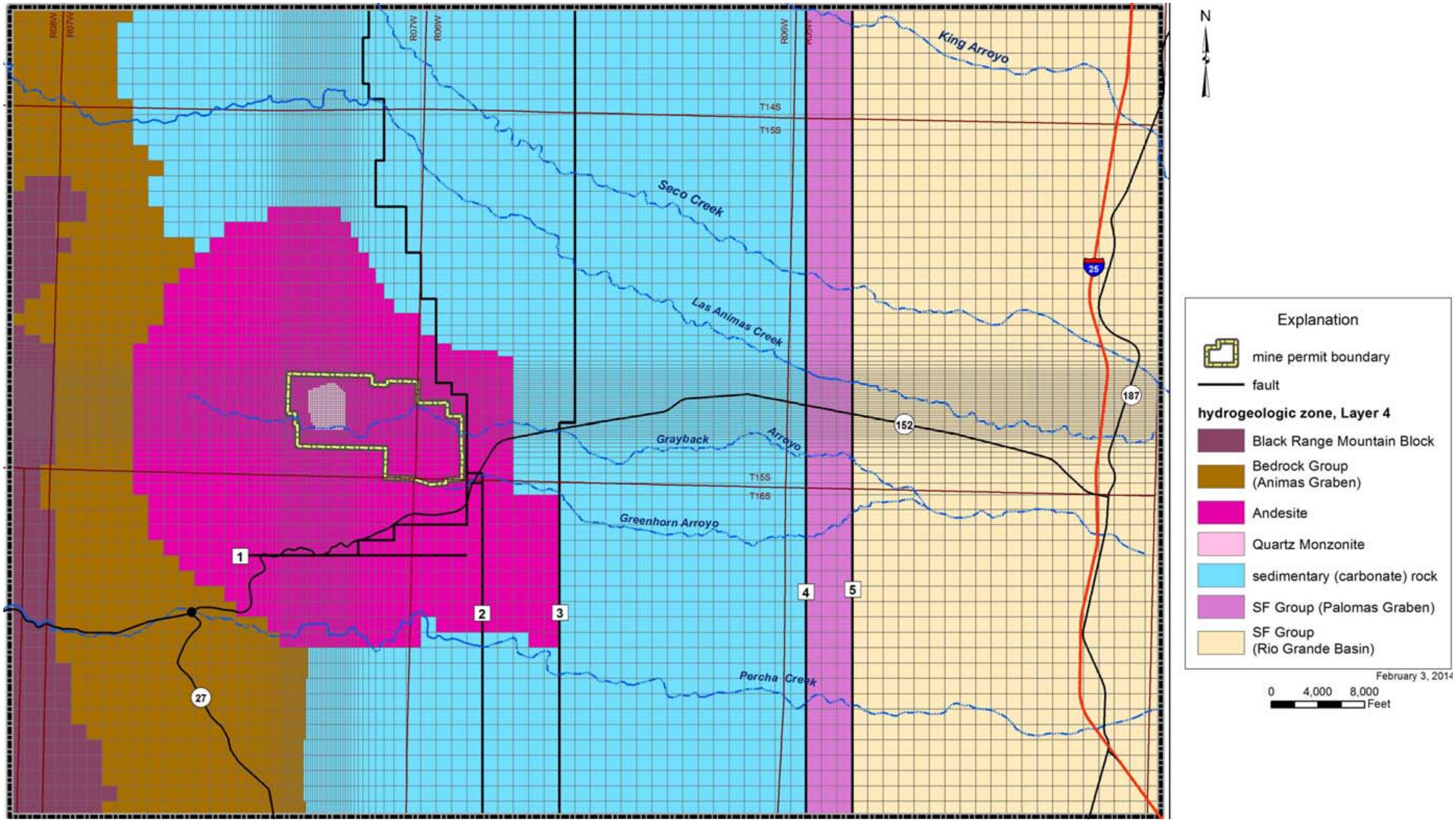


Figure 6.5. Layer 4 hydrogeologic zones.

The modeled aquifer parameters shown on Table 6.1 are based primarily on calibration of the model as a representation of the real system that is consistent with the different sources of information presented in Sections 3, 4 and 5 above. The model calibration results are presented below.

Different aquifer parameters are known with different degrees of certainty. Plausible ranges for different parameters, and the sensitivity of model results to variation of parameters within the plausible range, are discussed in Section 7 below.

Table 6.1. Modeled aquifer parameters

Hydrogeologic Unit	Transmissivity (ft^2/dy)	Saturated Thickness (ft)	Hydraulic Conductivity (ft/dy)	Vertical Anisotropy (ratio)	Specific Yield (%)	Storage Coefficient (%)
Layer 1						
Alluvium / SF Group	2,400	100	24.000	2.50E-04	10%	
Alluvium / SF Group (Lower Animas and Rio Grande Basin)	10,000	200	50.000	1.60E-04	10%	
Layer 2						
Black Range Mountain Block	2	1,000	0.002	0.01	0.1%	0.1%
SF Group (Animas Graben)	500	500	1.000	0.01	10%	10%
Andesite	2	1,000	0.002	0.01	0.1%	0.1%
Quartz Monzonite	2	1,000	0.002	0.01	0.1%	0.1%
Sedimentary (carbonate) rock	80	1,000	0.080	0.01	0.5%	0.5%
SF Group adjacent to uplift, edge of basin	200	1,000	0.200	1.0	5%	5%
SF Group adjacent to uplift (Upper Animas)	40	200	0.200	0.01	5%	5%
Basalt flow overlying SF Group	0.2	200	0.001	0.01	1%	1%
SF Group	900	1,000	0.900	0.01	10%	0.1%
SF Group (Palomas Graben)	1000	1000	10.000	1.0	10%	0.2%
SF Group (Animas Creek above graben)	2000	200	10.000	0.0001	10%	0.1%
SF Group (Lower Animas)	20000	1,000	20.000	0.01	10%	0.1%
SF Group (Rio Grande Basin)	20000	1000	20.000	1.0	10%	0.1%
Layer 3						
Black Range Mountain Block	2	2,000	0.001	0.01		0.01%
Bedrock (Graben)	700	1,000	0.700	0.01		0.01%
Andesite	2	2,000	0.001	0.01		0.01%
Quartz Monzonite	2	2,000	0.001	0.01		0.01%
Sedimentary (carbonate) rock	100	2,000	0.050	0.01		0.01%
SF Group, adjacent to uplift	400	2,000	0.200	0.01		0.4%
SF Group (Palomas Graben))	8,000	2,000	4.000	1.0		0.4%
SF Group, lower Animas	10,000	1,000	10.000	0.01		0.1%
SF Group (Rio Grande Basin)	800	2,000	0.400	0.01		0.4%
Layer 4						
Black Range Mountain Block	3	3,000	0.001	0.01		0.01%
Bedrock (Graben)	100	2,000	0.050	0.01		0.01%
Andesite	3	3,000	0.001	0.01		0.01%
Quartz Monzonite	3	3,000	0.001	0.01		0.01%
Sedimentary (carbonate) rock	150	3,000	0.050	0.01		0.01%
SF Group (Palomas Graben)	2,000	3,000	0.667	0.01		1%
SF Group (Rio Grande Basin)	2,000	3,000	0.667	0.01		0.6%

The modeled fault barriers are based on geologic interpretation and on model calibration. The barriers mainly represent a series of parallel north-south trending faults (Hawley, personal communication, 2012). The barriers shown on Figures 6.3 through 6.5 are simulated with conductance (transmissivity / fault thickness) shown on Table 6.2. The fault barriers include (Fig. 6.3):

1. A fault along the south side of the andesite cone, separating andesite from carbonate rock (Animas volcano fault system).
2. The mountain front fault (East Animas fault trend), generally following the bedrock / SFG contact, but running east of an embayment of SFG in the area of the 1982 tailings impoundment.
3. A parallel fault, east of the mountain front (Saladone Tank fault trend).
4. The west boundary of the Palomas Graben (West Palomas Graben Fault trend).
5. The east boundary of the Palomas Graben (East Palomas Graben Fault trend).

Conductance of the fault south of the andesite was based on the rapid change of water levels from the andesite to Percha Creek. Conductance of the mountain-front fault was based in part on the sustained elevated water levels in the vicinity of the tailings impoundment. The Saladone tank fault trend conductance was based on regional water-level gradient.

The Palomas graben-bounding fault conductances were based mainly on results of the 2012 aquifer test (Section 6.4.3 below). The west graben-bounding fault is simulated as a strong barrier to flow using a small conductance. The east graben-bounding fault is simulated as a weak barrier to flow using a large conductance; resistance to flow across the east edge of the graben is accomplished mostly by the simulated permeability contrast.

Table 6.2. Modeled fault barrier conductance

	fault	section	layer 2 conductance (ft/day)	layers 3-4 conductance (ft/day)
1.	andesite south boundary		1.0E-04	2.0E-05
2.	mountain-front fault	north	8.0E-02	1.2E-01
		mountain front center: andesite, TSF embayment	5.0E-03	1.0E-10
		south	5.0E-08	2.0E-07
3.	Saladone Tank trend		1.0E-03	1.0E-03
4.	Palomas Graben west		1.0E-08	1.0E-08
5.	Palomas Graben east		1.0E+00	1.0E+00

6.3 Boundary Conditions

Model boundary conditions fall under the categories of (1) natural boundary conditions including direct recharge, stream-channel runoff and infiltration, base flow discharge, evapotranspiration and groundwater discharge to the Rio Grande Basin, and (2) anthropogenic boundary conditions including flowing wells, mine water-supply wells, the current and future open pits, and infiltration from the 1982 tailings impoundment.

Anthropogenic boundary conditions in the shallow systems along Animas Creek and Percha Creek are for purposes of the model considered natural boundary conditions. The different discharges from the shallow systems, including natural ET, crop ET supplied by wells or surface diversions, pumping from wells for stock or domestic use, and discharge from flowing wells, cannot at present be meaningfully distinguished.

The natural boundary conditions are applied to all model simulations: steady-state, historical pre-mining, historical mining and post-mining, aquifer test, future mining, and future post-mining.

The anthropogenic boundary conditions are applied to the historical pre-mining (flowing wells only) and historical mining and post-mining (flowing wells, mine water-supply wells, open pit and tailings infiltration) simulations as described below.

Different anthropogenic boundary conditions (future water-supply pumping, future open pit) apply to the future mining and future post-mining simulations, which are reported separately.

6.3.1 Natural Boundary Conditions

Natural boundary conditions represented in the model are shown on Figure 6.6 and include the following:

- Direct recharge of precipitation to groundwater is represented as a specified-flow boundary condition, using MODFLOW module RCH. Direct recharge rates are shown on Figure 6.6.

- Stream-channel runoff, infiltration of stream flow to groundwater, and discharge of groundwater to stream channels, are represented using module RIV2. In addition to simulation of Las Animas Creek, Percha Creek, and Grayback and Greenhorn Arroyos, model calibration required consideration of runoff in Seco Creek and King Arroyo to the north of the main study area watersheds.

- Evaporation and ET of groundwater along Animas and Percha Creeks is represented using module EVT.

- Groundwater discharge to the Rio Grande Basin and Caballo Reservoir is simulated with head-dependent boundary conditions using module GHB.

- Groundwater flow in the Palomas Graben, into the model domain at the north end and out at the south end, is simulated with head-dependent boundary conditions using module GHB.

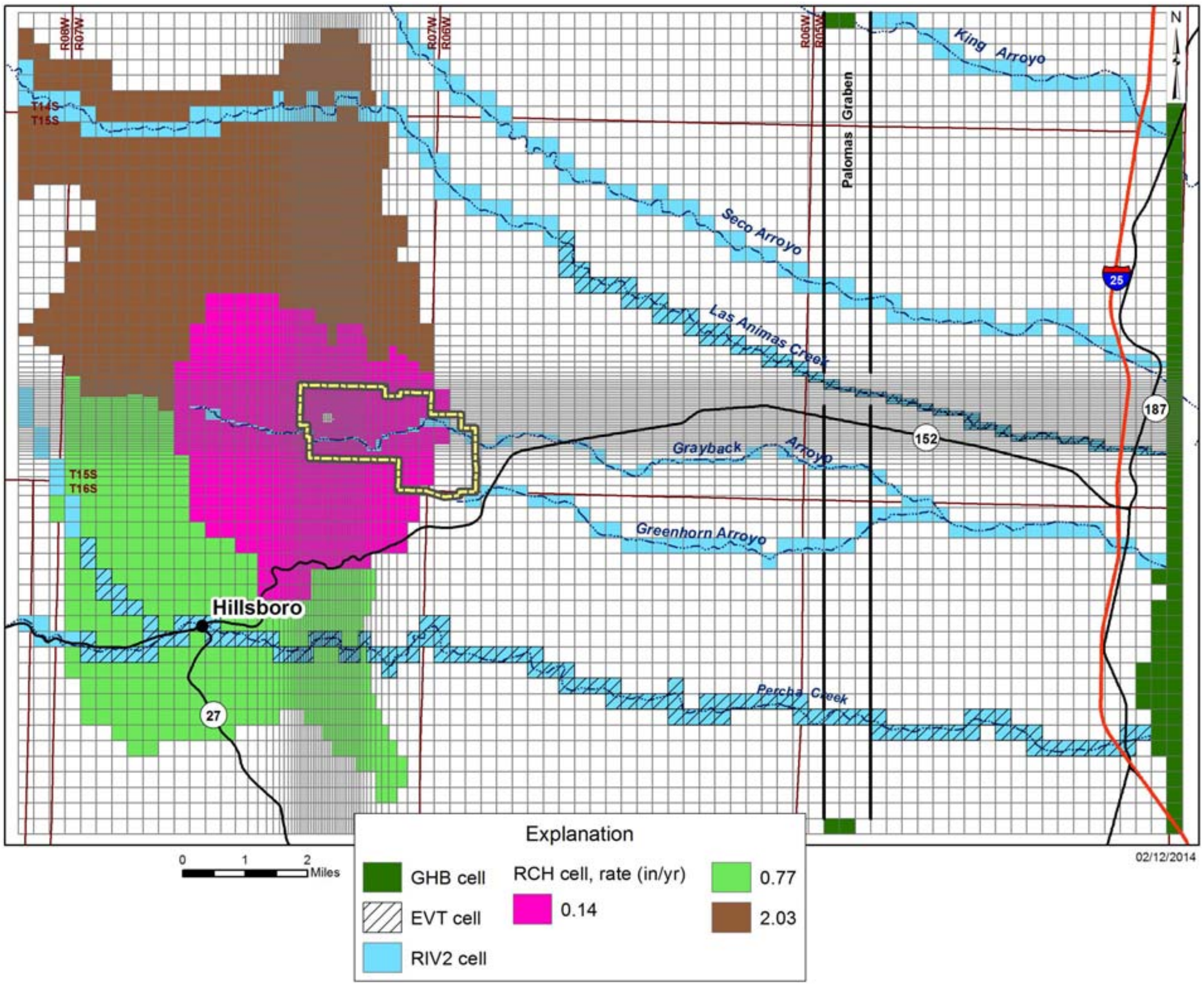


Figure 6.6. Natural boundary conditions.

RIV2 cells are grouped into reaches to define the stream network; each reach defines a length of stream, with a defined downstream reach, and total flow is tracked downstream. Infiltration to groundwater from RIV2 cells is limited to the simulated stream flow. Base flow discharge from groundwater to RIV2 cells is added to the total flow available for infiltration downstream.

Runoff is added at the upstream end of each reach. For each cell within a reach, infiltration to groundwater or discharge from groundwater is computed, and the resulting total flow, if any, is passed to the next cell downstream.

Flow between RIV2 cells and the corresponding aquifer model cell is computed based on RIV2 cell conductance, multiplied by either (1) the stream stage-aquifer head difference (aquifer in contact with stream bed) or (2) the stream stage-streambed bottom difference (aquifer below stream bed). Infiltration to the aquifer is further limited to the amount of simulated flow available in the stream.

The model reproduces the observed pattern of stream flow in the region; runoff is generated in the mountain watersheds, flows downstream until it crosses the mountain front, where it recharges the Santa Fe Group aquifer. Farther below the mountain front, streams flow only after storm events. Still further downstream, near the bottom of the basin, the streams emerge again as groundwater enters the channels as base flow.

The stream reaches defined are listed on Table 6.3, along with simulated annual runoff to each reach. RIV2 cell parameters include elevation and conductance. Conductance is computed from the length of stream in each cell and from hydraulic conductivity and thickness of the underlying material. Modeled RIV2 cell hydraulic conductivities are listed by reach and material, in downstream order, on Table 6.3. Elevation for RIV2 cells was determined from USGS topographic maps. Thickness of streambed was assumed at 1 ft.

EVT cell parameters include ET surface elevation, annual average potential ET rate of 64.6 in./yr and extinction depth of 15 ft. ET from each EVT cell is computed as the potential ET rate whenever water level is at or above the ET surface elevation (depth-to-water of zero), decreasing linearly to zero at the extinction depth. ET is zero for water levels below the extinction depth.

GHB cells simulate groundwater flow from the model area to the Rio Grande basin. GHB cell parameters include elevation, specified at 4,200 ft amsl, and conductance, calibrated at 100 ft^2/day in the north part (rows 1-60), 10,000 ft^2/day along the axis of Las Animas Creek (rows 61-73), and 1,000 ft^2/day in the south part, adjacent to Caballo Reservoir. Flow is computed as the product of GHB conductance and the difference between GHB elevation and aquifer head in the model cell.

Table 6.3. Stream reach specifications

reach No.	name	downstream reach	runoff (ac-ft/yr)	streambed hydraulic conductivity (ft/day)	underlying material
1	Upper Percha	2	5,249	0.001	bedrock
				1	SFG (graben)
2	Lower Percha	none	0	0.001	bedrock
				1	SFG (graben)
				0.1	carbonate bedrock (uplift)
				10	SFG
				20	alluvium
3	Las Animas	none	7,898	1	SFG (graben)
				0.1	carbonate bedrock (uplift)
				1	SFG
				24	alluvium
4	Grayback	6	74	0.001	bedrock
				1	SFG
5	Upper Greenhorn	6	66	1	SFG
6	Lower Greenhorn	none	0	10	alluvium
7	Seco Creek	none	18	0.15	SFG
				0.8	SFG (Las Animas Creek)
				20	alluvium
8	King Arroyo	none	0	0.15	SFG
				20	alluvium

ac-ft/yr - acre-feet per year
SFG - Santa Fe Group

6.3.2 Anthropogenic Boundary Conditions

Anthropogenic boundary conditions represented in the model include discharge from artesian wells, pumping from mine water supply wells, infiltration beneath the 1982 (historical) tailings impoundment, and the open pit. Locations of model-simulated anthropogenic boundary conditions are shown on Figure 6.7.

Flow from artesian wells was simulated as drain (head-dependent, outflow only) boundary conditions with MODFLOW module DRN. Flow from each DRN cell is computed as the product of DRN conductance (assumed at 1,000 ft^2/day, or 5.2 gpm/ft of head above the discharge elevation) and aquifer cell head minus DRN elevation. Flow is zero when aquifer cell head is below DRN elevation.

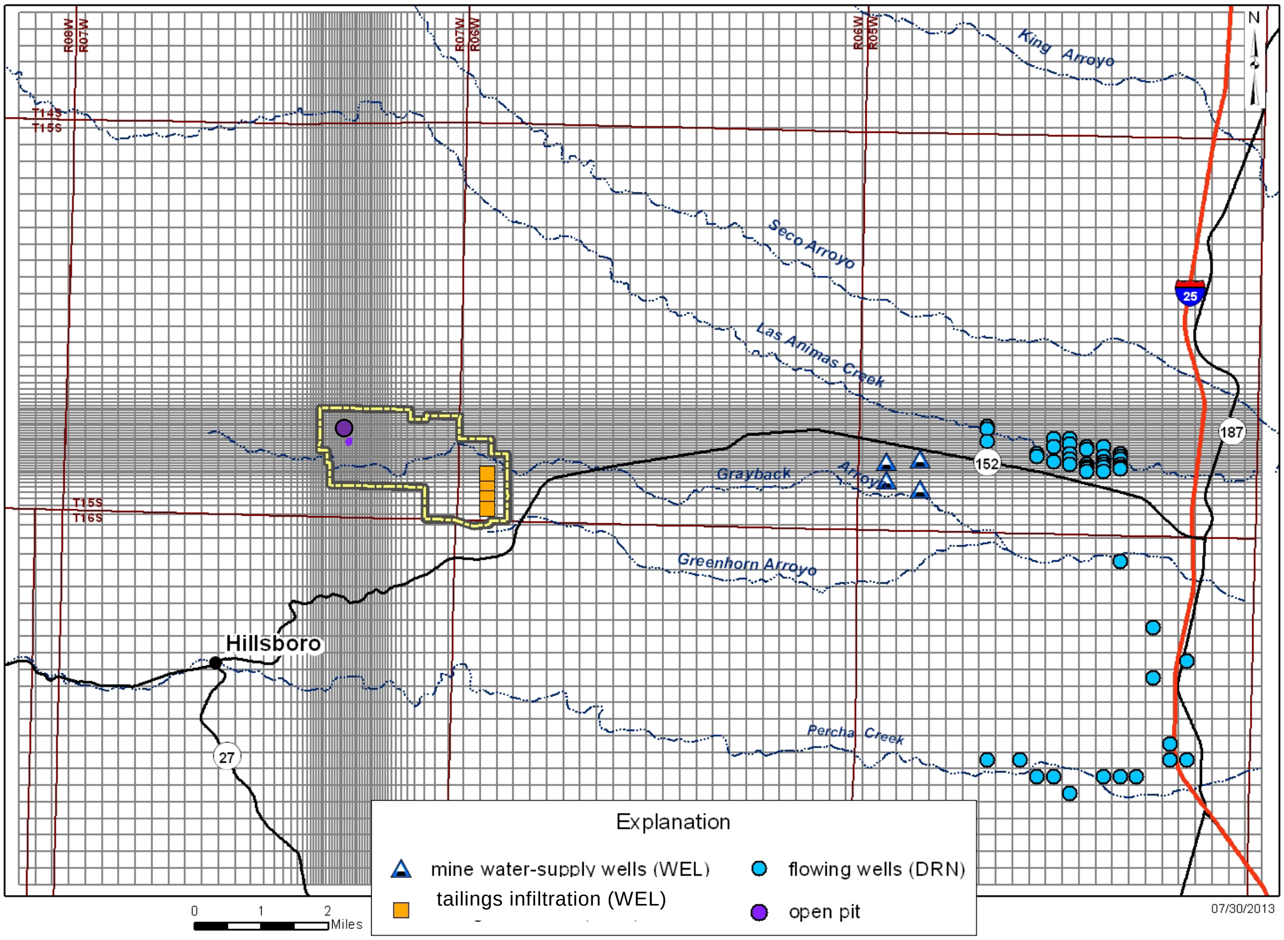


Figure 6.7. Anthropogenic boundary conditions.

Historical pumping from mine water supply wells was simulated as specified-flow boundary conditions with MODFLOW module WEL. Pumping rates were specified from Table 5.1. Pumping during the 2012 aquifer test was simulated using module LAK2, in order to simulate in-bore water levels in the pumping wells.

Infiltration from the historical tailings impoundment was also simulated as specified-flow boundary conditions using WEL. Infiltration rates were estimated based on model calibration, constrained by an upper limit based on the amount of water actually added to the impoundment (Fig. 6.8).

Water level and water balance of the open pit were simulated using MODFLOW module LAK2. The geometry of the existing pit is represented in the historical post-mining simulation, as shown by the actual and simulated pit water stage – area curves presented on Figure 6.9 (Note that Figure 6.9 does not represent model calibration; it simply verifies the accurate simulation of the current pit geometry.).

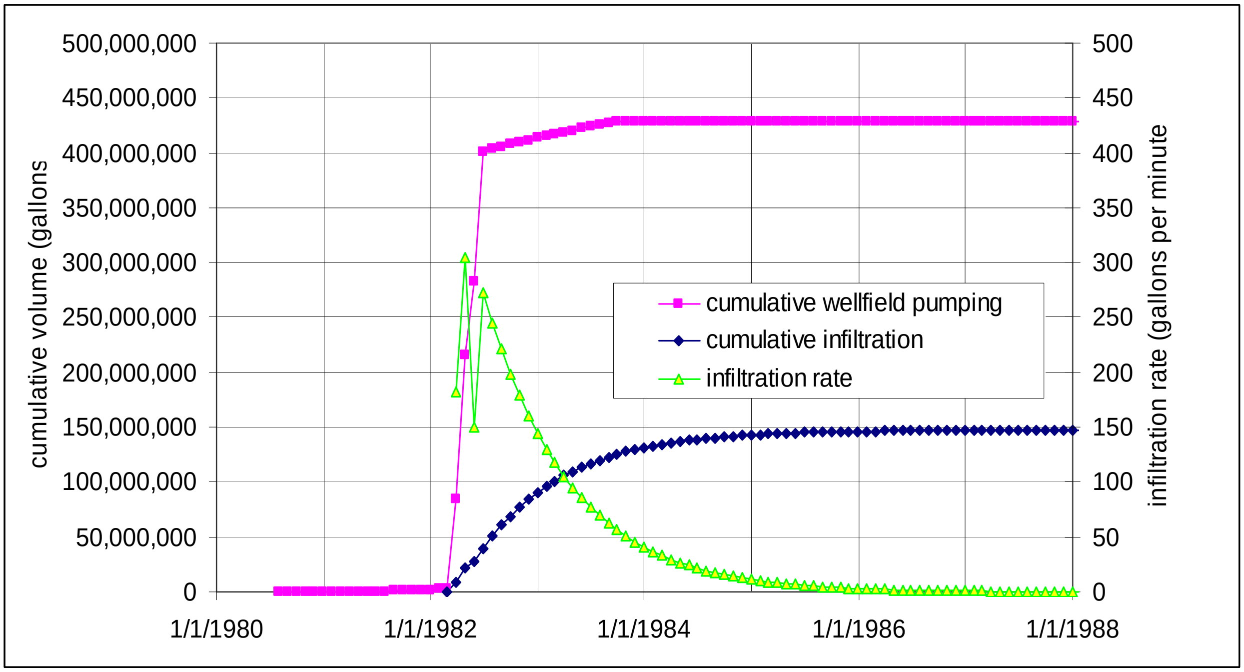


Figure 6.8. Modeled historical tailings infiltration.

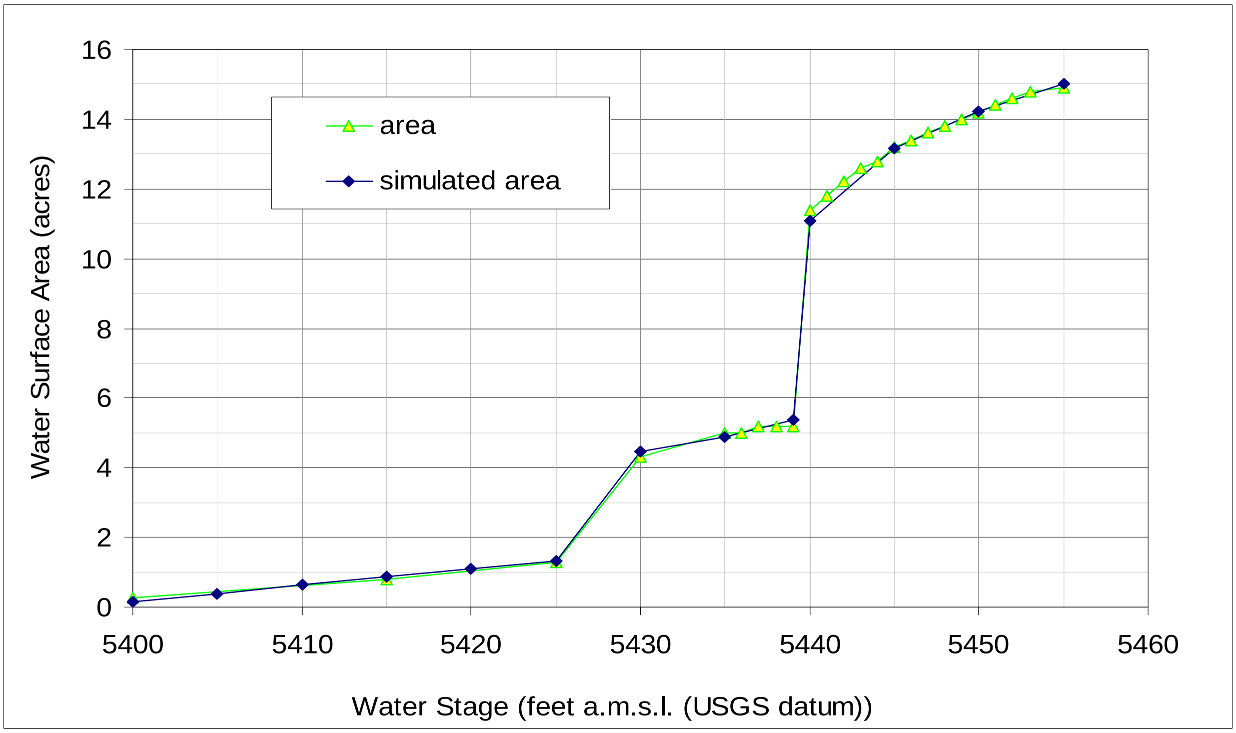


Figure 6.9. Existing open pit water elevation - water surface area relationship.

Hydrologic parameters for the open pit, including monthly average precipitation and evaporation rates, and runoff coefficients for the pit walls and for the 230-acre pit watershed, are listed on Table 6.4.

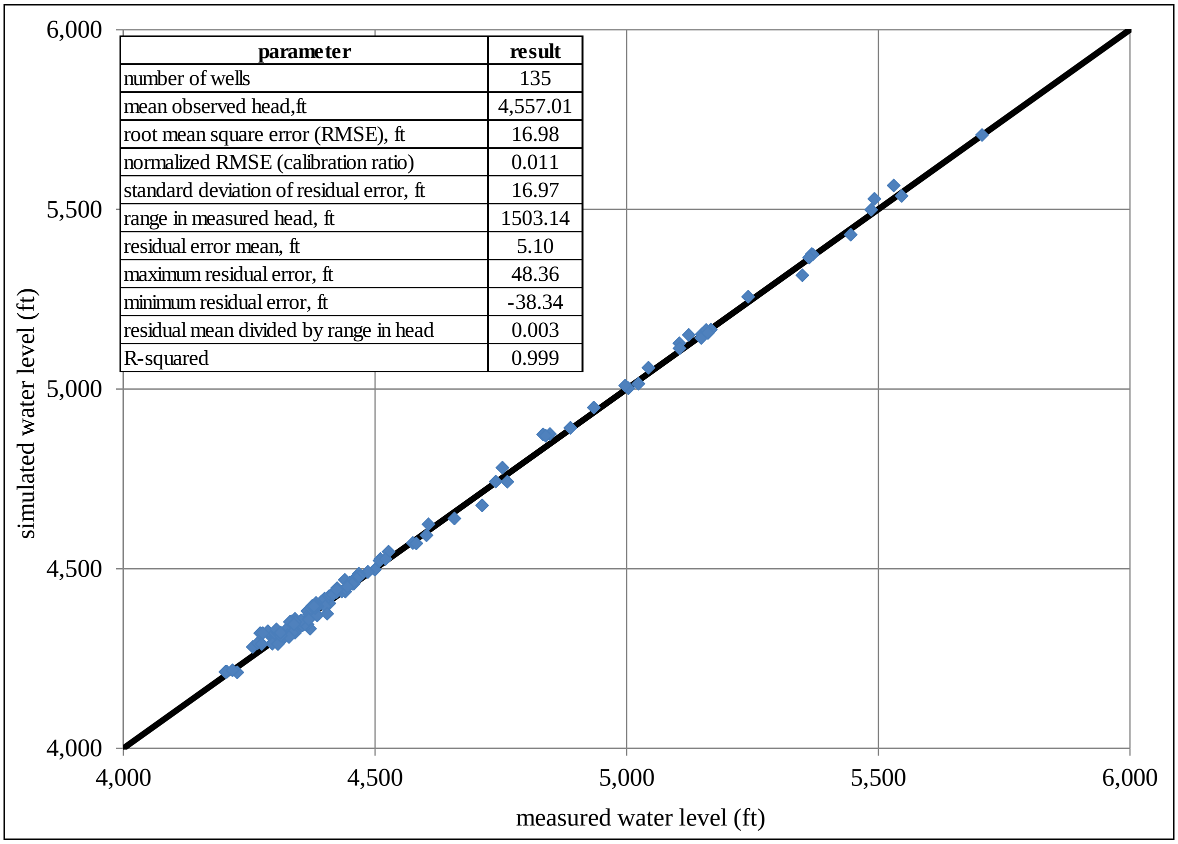
Table 6.4. Simulated open-pit hydrologic parameters

meteorological parameters		
month	**average precipitation (inches)**	**average evaporation (inches)**
Jan	0.6	3.2
Feb	0.6	4.2
Mar	0.4	6.4
Apr	0.3	7.1
May	0.5	8.4
Jun	0.7	10.7
Jul	2.3	7.8
Aug	2.5	4.5
Sep	2.1	4.6
Oct	1.2	3.0
Nov	0.6	2.8
Dec	0.8	2.1
total	12.5	64.6
runoff coefficients		**(percent of precipitation)**
pit wall		0.30
watershed		0.05

6.4 Model Results and Calibration

6.4.1 Steady-State Simulation

Estimated and simulated steady-state water levels are compared on Figure 6.10. The simulated steady-state basin water balance is shown on Table 6.5. Contours of the simulated steady-state water table are shown on Figure 6.11.



parameter	result
number of wells	135
mean observed head,ft	4,557.01
root mean square error (RMSE), ft	16.98
normalized RMSE (calibration ratio)	0.011
standard deviation of residual error, ft	16.97
range in measured head, ft	1503.14
residual error mean, ft	5.10
maximum residual error, ft	48.36
minimum residual error, ft	-38.34
residual mean divided by range in head	0.003
R-squared	0.999

Figure 6.10. Comparison of measured and simulated water levels.

Table 6.5. Simulated steady-state water balance

	watershed				**TOTAL**
	Animas	**Percha**	**Grayback / Greenhorn**	**Seco / King**	
direct recharge	2,811	825	61	0	3,697
runoff	7,898	5,249	140	18	13,305
groundwater inflow	0	0	0	1,829	1,829
TOTAL IN (ac-ft/yr)					**18,831**
evapotranspiration	2,587	1,708	0	0	4,295
groundwater discharge	7,905	1,261	2,168	1,939	13,273
surface-water discharge	948	315	0	0	1,263
TOTAL OUT (ac-ft/yr)					**18,831**

ac-ft/yr - acre-feet per year

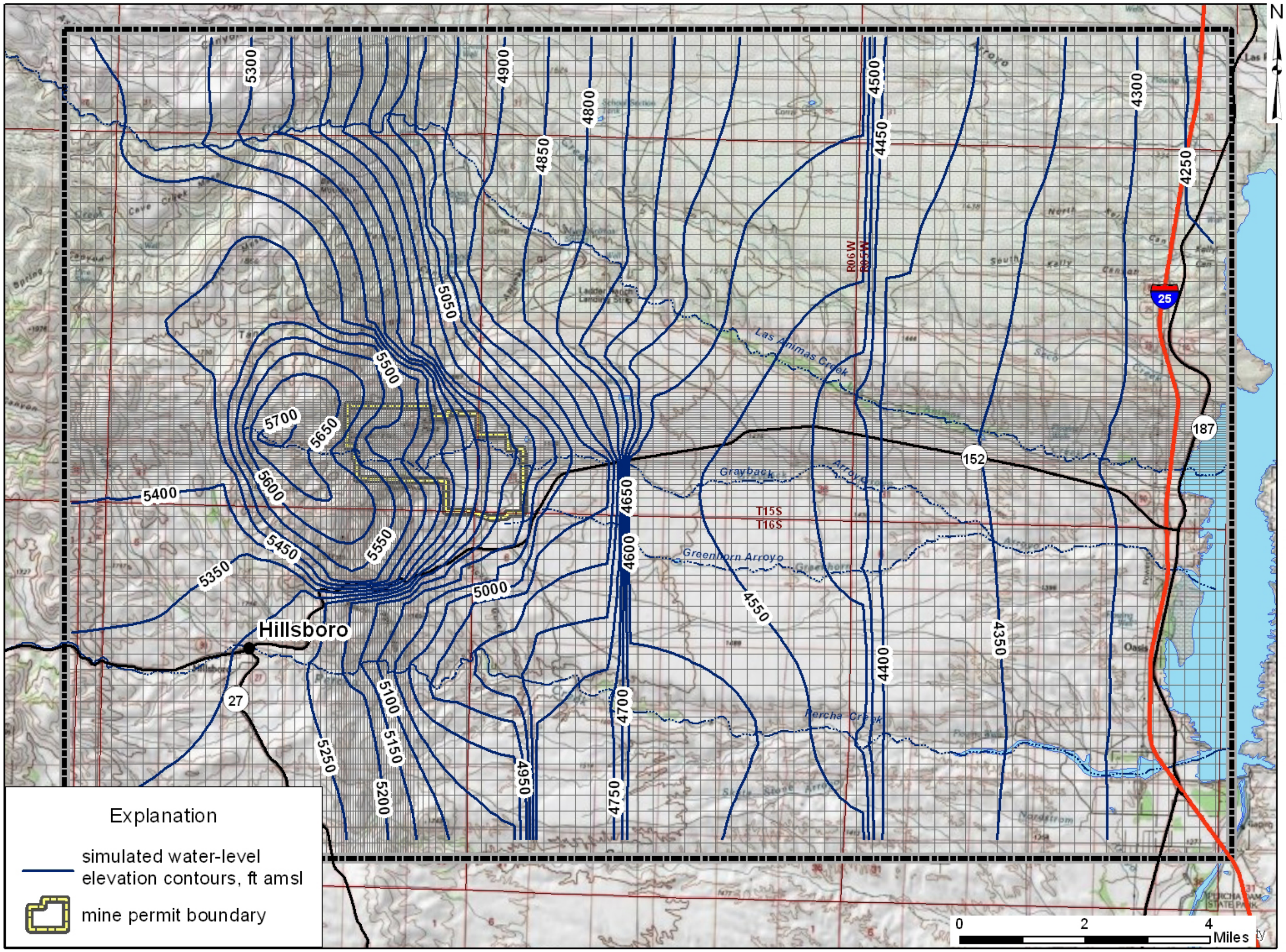


Figure 6.11. Contours of simulated 2012 groundwater levels.

6.4.2 Historical Transient Simulation

The historical transient simulations include the pre-mining (1940 to June 1980), and mining and post-mining (June 1980 to November 2012) simulations. Measured and simulated water-level hydrographs are compared for calibration well locations shown on Figure 6.12. Measured and simulated water levels are presented on Figures 6.13 through 6.27.

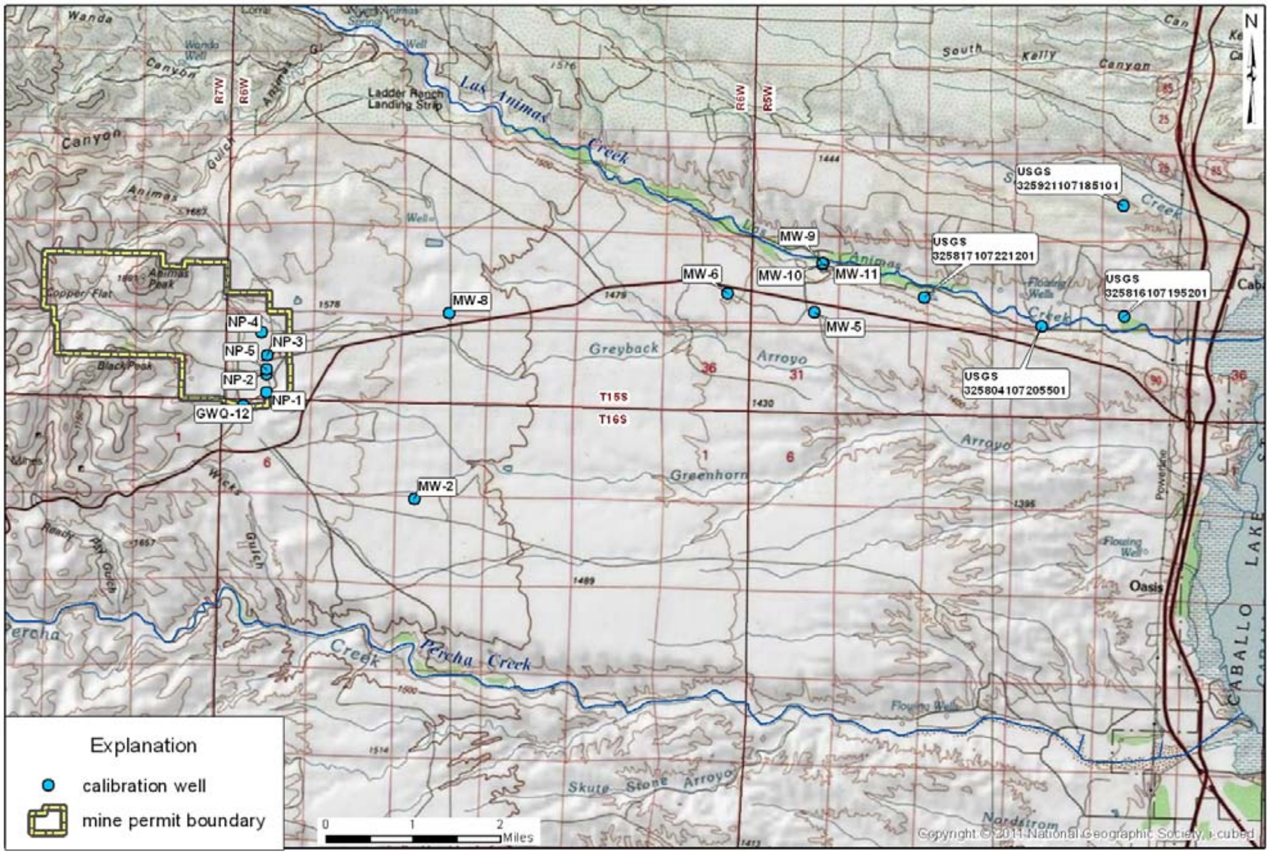


Figure 6.12. Locations of measured water-level hydrographs.

Measured and simulated water levels near the well field, at MW-5, are presented on Figure 6.13, showing drawdown and recovery in response to the period of well field operation in 1982. Measured and simulated water-level changes are in agreement. The small difference (~10 ft) between measured and simulated water-level elevations is appropriate, considering the range of water levels represented by a single model cell, and the fact that the well is not at the cell center.

Measured and simulated water levels west of the well field, at MW-6, are shown on Figure 6.14. The 35-year, 175-ft rise in the measured MW-6 water level (discussed in Section 5.2.2 above) is not simulated in the model.

Measured and simulated water levels north of the well field along Las Animas Creek, at MW-9, -10 and -11, are shown on Figure 6.15. The measured water levels include data from the mid-1990s as well as data from 2012. The vertical gradient measured between the shallow well (MW-11) and the deeper wells (MW-10 and -9) is reproduced in the model.

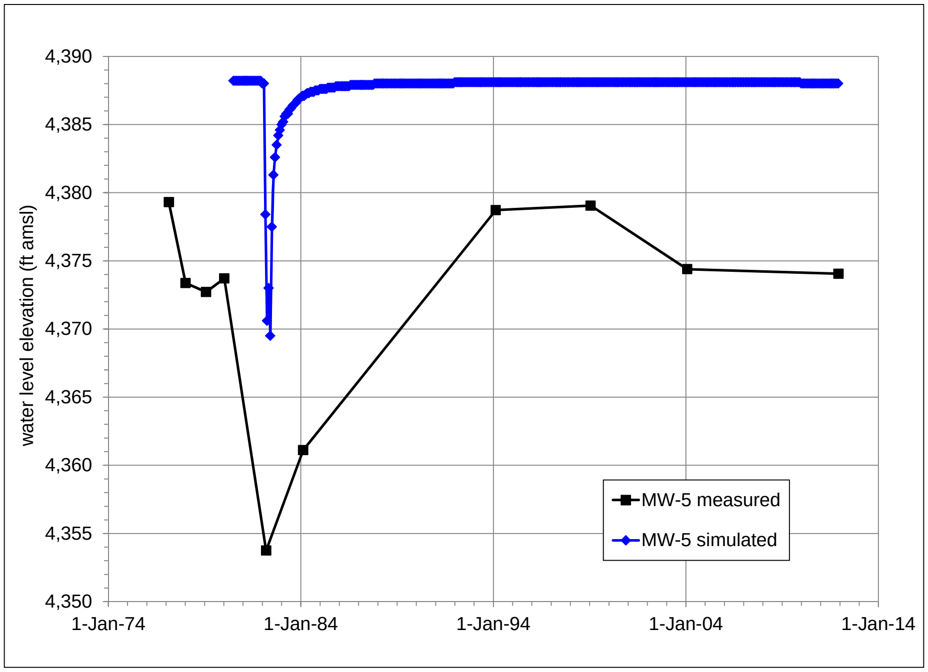


Figure 6.13. Measured and simulated water-level hydrographs in MW-5.

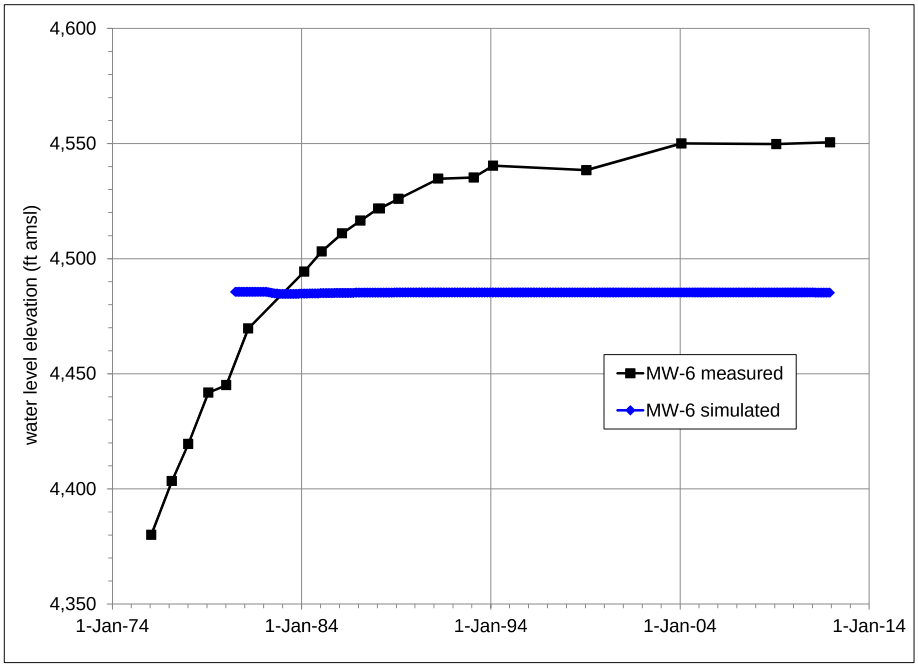


Figure 6.14. Measured and simulated water-level hydrographs in MW-6.

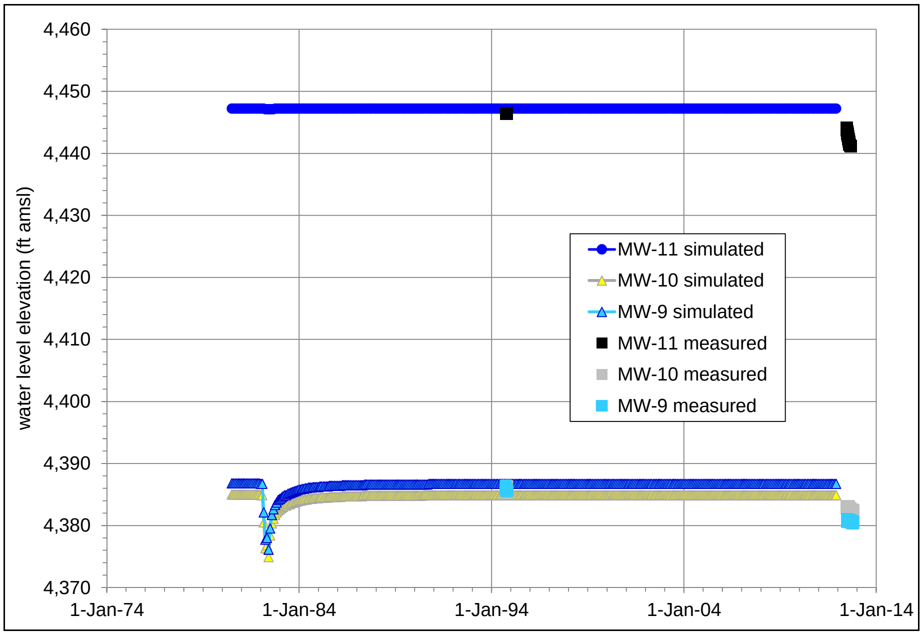


Figure 6.15. Measured and simulated water-level hydrographs in MW-9, MW-10, and MW-11.

Measured and simulated water levels farther down Las Animas Creek (Fig. 5.2) are shown on Figures 6.16 through 6.19. The background variation in the measured water levels reflects unidentified local and temporal stresses that are not simulated in the model. The model simulates the measured water levels generally within the range of water-level variation found in a single model cell in this area. The simulation is acceptably accurate considering the water-level variation within a single cell and the not-simulated local processes affecting the measured water level.

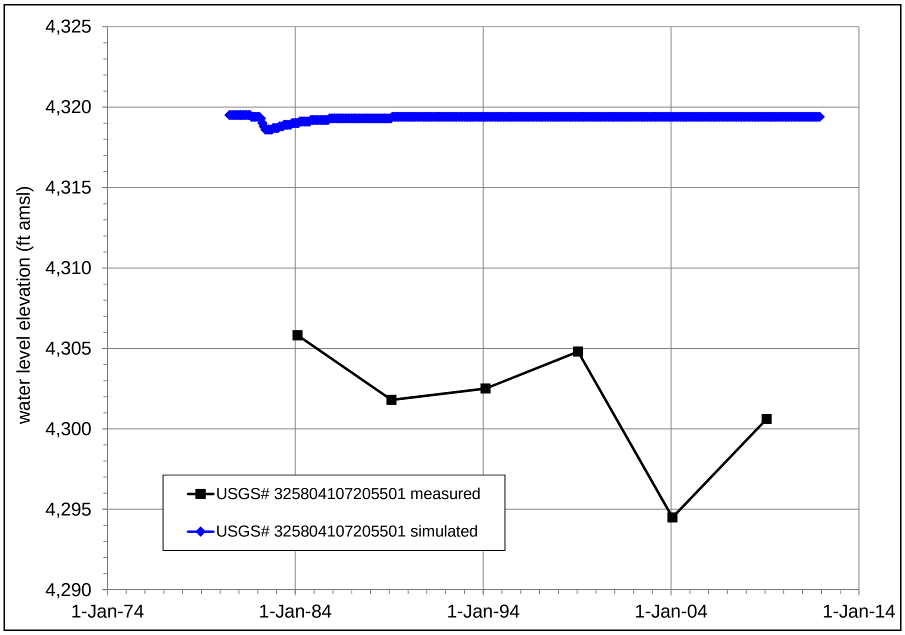


Figure 6.16. Measured and simulated water-level hydrographs in USGS No. 325804107205501.

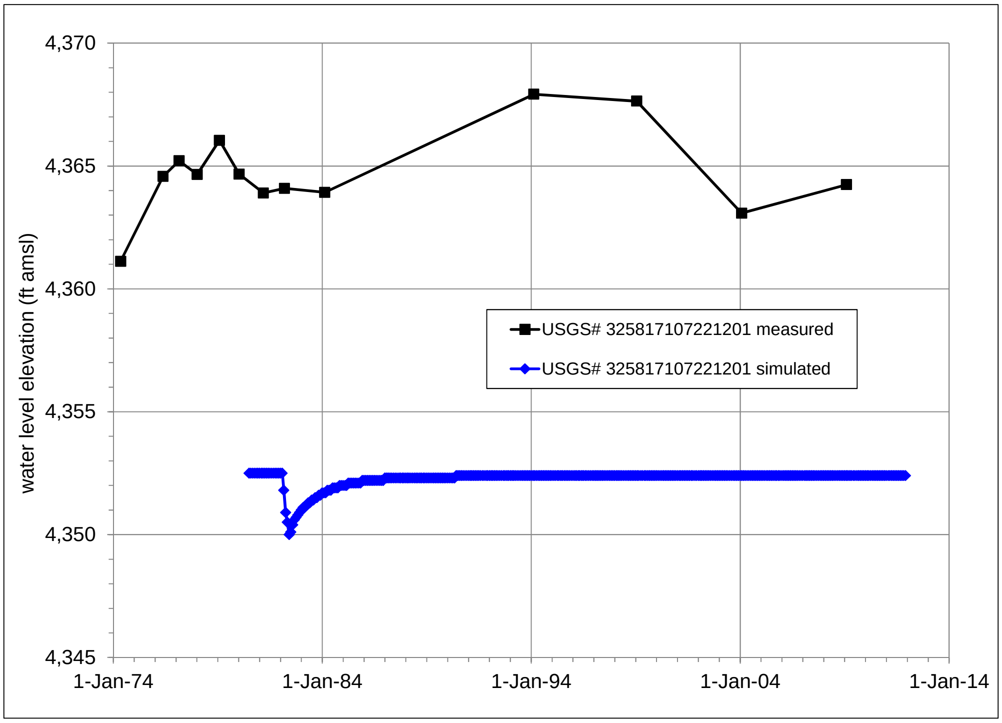


Figure 6.17. Measured and simulated water-level hydrographs in USGS No. 325817107221201.

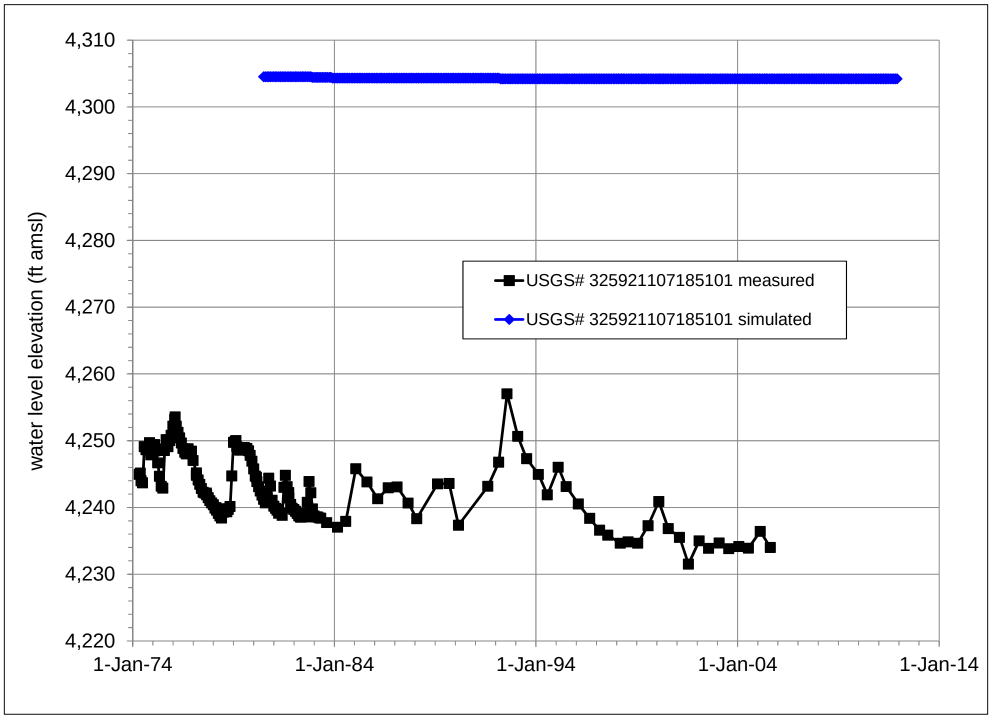


Figure 6.18. Measured and simulated water-level hydrographs in USGS No. 325921107185101.

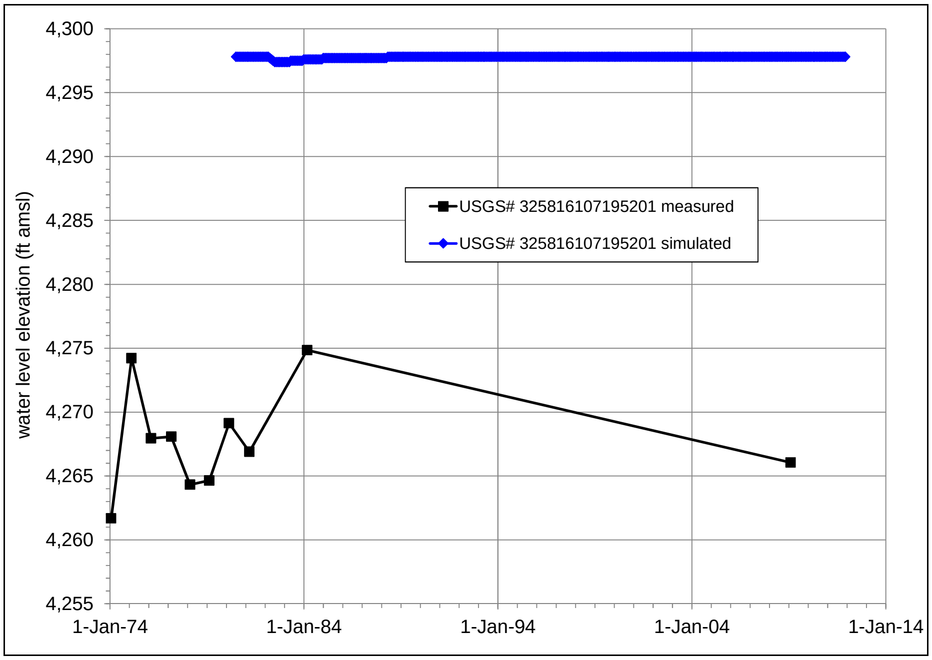


Figure 6.19. Measured and simulated water-level hydrographs in USGS No. 325816107195201.

Measured and simulated water levels downstream of the tailings impoundment (Fig. 5.2), at MW-2 and MW-8, are shown on Figures 6.20 and 6.21, also showing substantial background water-level fluctuations not simulated in the model. The simulation is acceptably accurate considering the amount of water-level variation within a single cell and the not-simulated local processes affecting the measured water level.

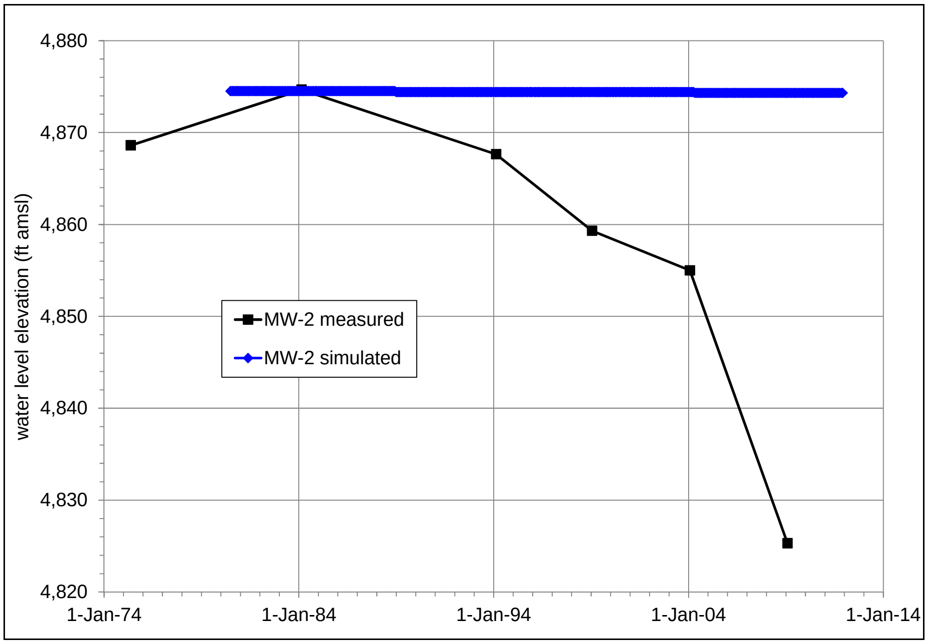


Figure 6.20. Measured and simulated water-level hydrographs in MW-2.

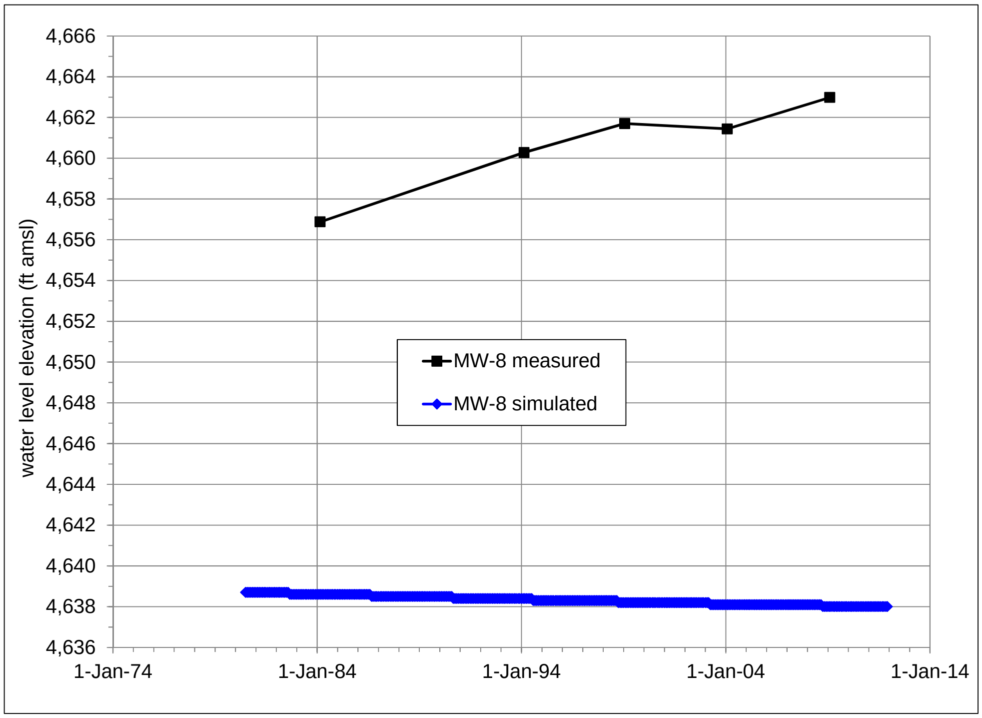


Figure 6.21. Measured and simulated water-level hydrographs in MW-8.

Measured and simulated water levels in the vicinity of the 1982 tailings impoundment (Fig. 5.2) are shown on Figures 6.22 through 6.27. The model reproduces the phenomenon of sustained elevated water levels measured in the vicinity of the impoundment, caused by a fault barrier to the east. The barrier appears to largely contain seepage from the tailings within the fault-bounded block.

Simulated water levels do not exactly match the measured, which indicate even less flow across the fault barrier than is simulated. The measured water levels also reflect unknown local processes and uncertainty in measurements taken over several periods. However the major feature, that of sustained elevated water levels caused by the dam effect of the fault barrier, is reproduced. Seepage from the tailings has mainly been contained behind the fault and has not flowed down gradient.

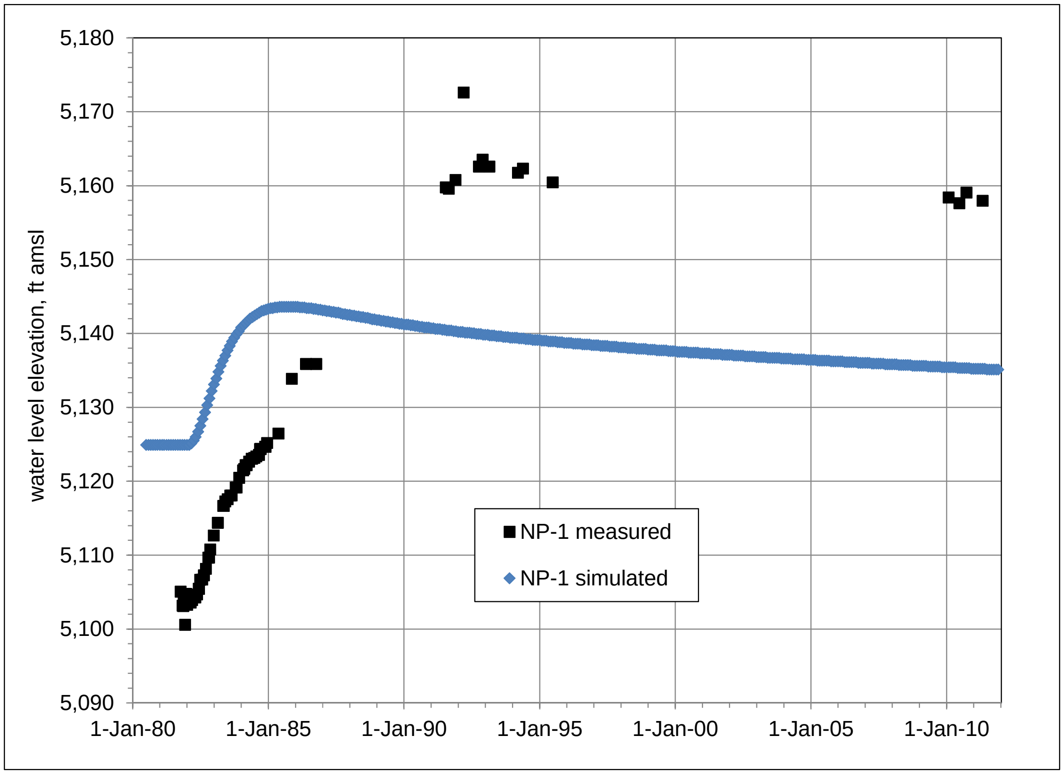


Figure 6.22. Measured and simulated water-level hydrographs in NP-1.

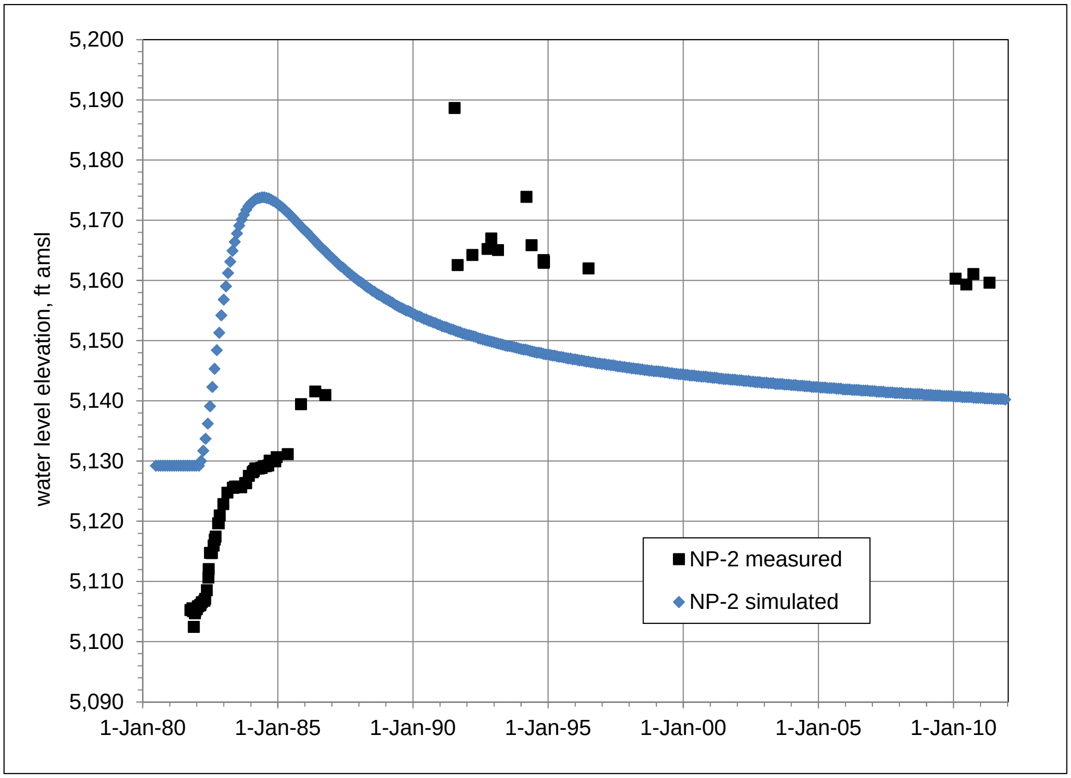


Figure 6.23. Measured and simulated water-level hydrographs in NP-2.

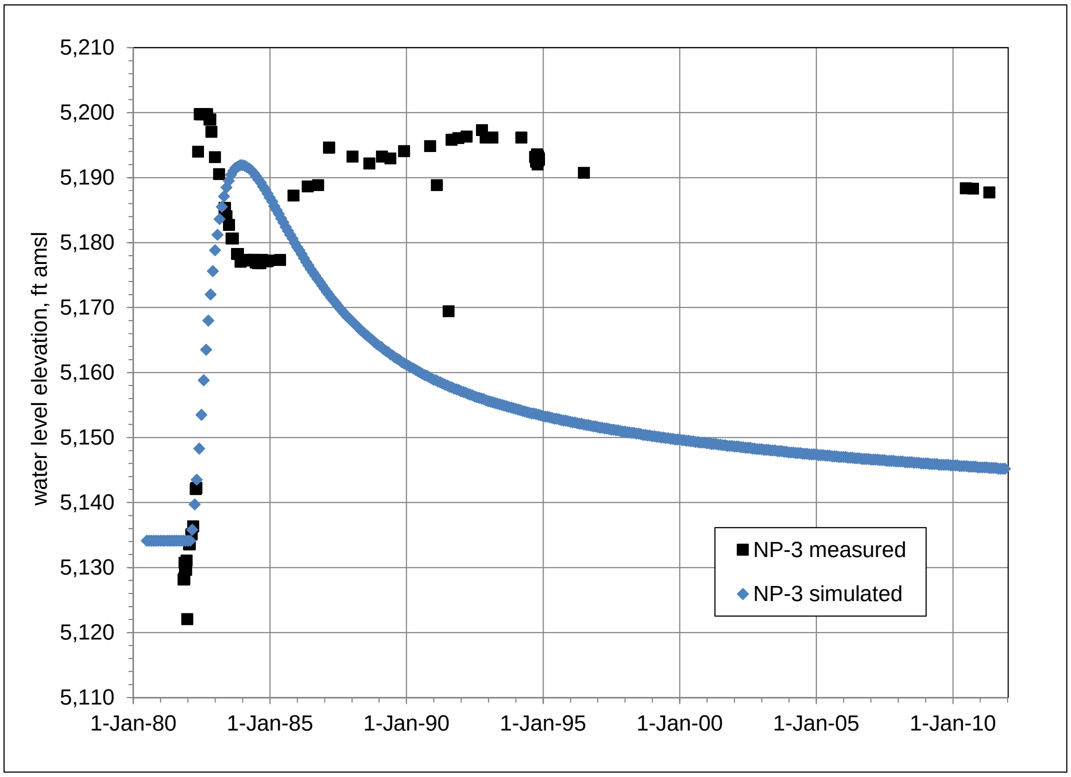


Figure 6.24. Measured and simulated water-level hydrographs in NP-3.

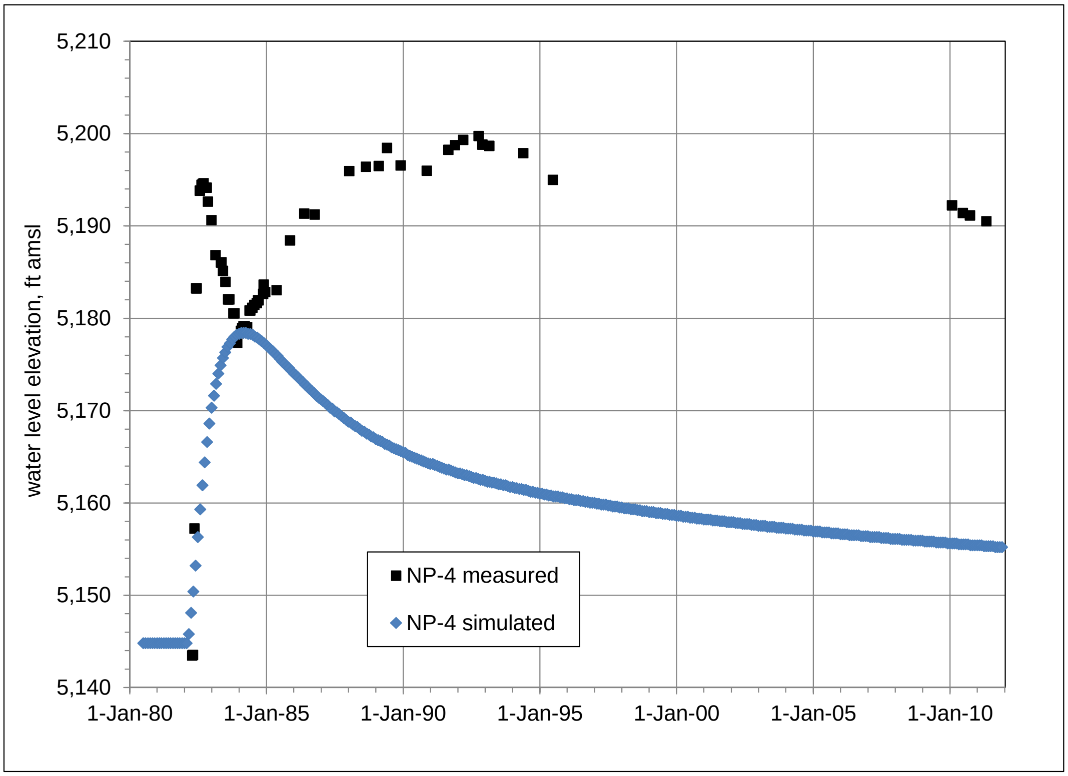


Figure 6.25. Measured and simulated water-level hydrographs in NP-4.

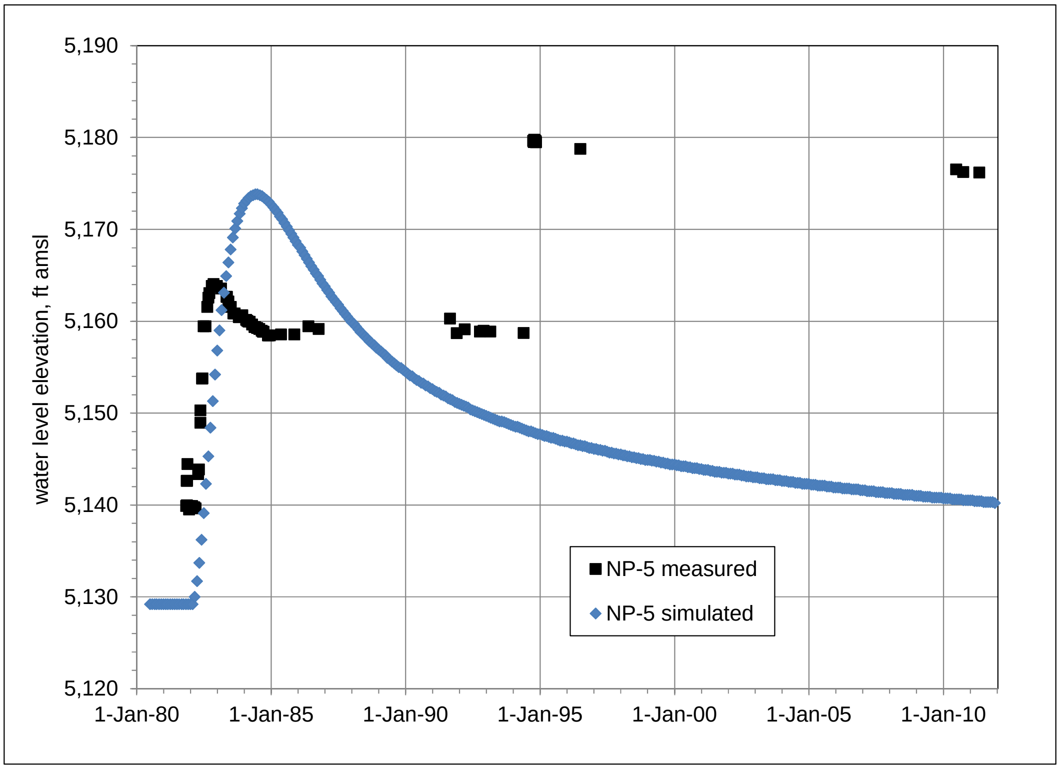


Figure 6.26. Measured and simulated water-level hydrographs in NP-5.

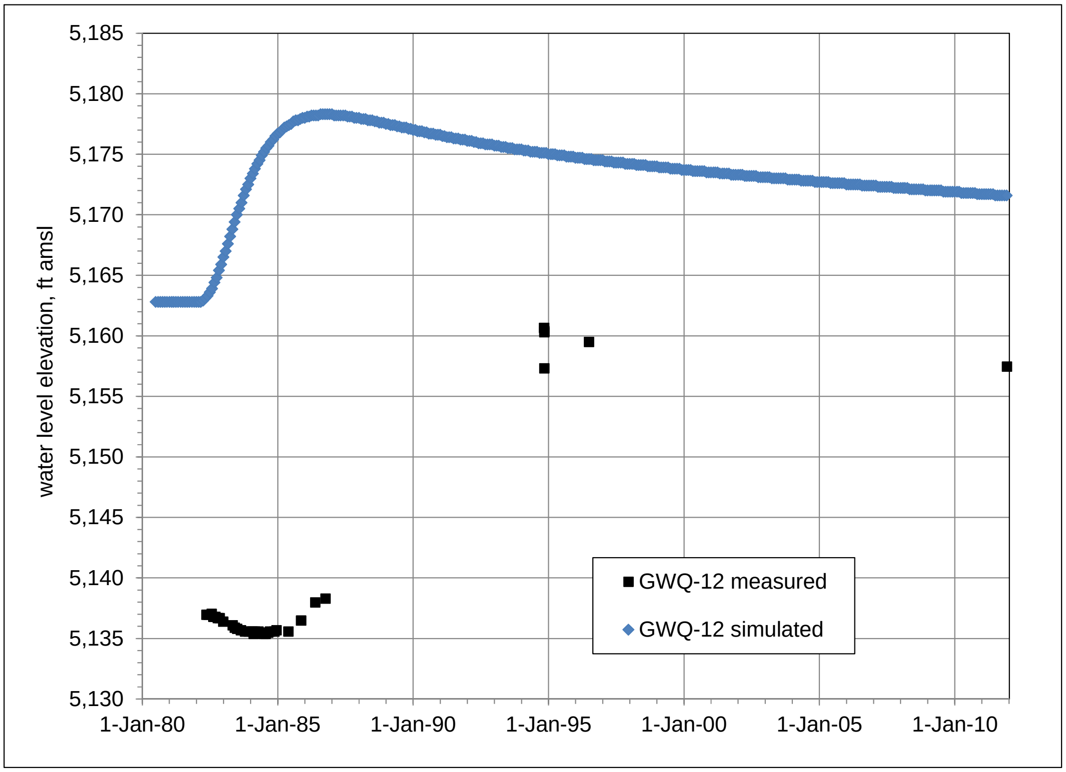


Figure 6.27. Measured and simulated water-level hydrographs in GWQ-12.

Simulated water level and water balance for the current open pit are shown on Table 6.6, indicating general agreement with current measured pit water level and estimated pit water balance. The future (larger and deeper) open pit, both during dewatering and after mining, will have more groundwater inflow with a larger water surface and more evaporation.

Table 6.6. Simulation results for current open pit

water level (ft amsl)	5,433	
water surface area (acres)	4.8	
simulated annual average water balance		
	ac-ft/yr	**gpm**
precipitation and runoff	18.4	11.4
groundwater inflow	6.7	4.2
TOTAL IN (ac-ft/yr)	**25.1**	**15.5**
evaporation out	25.1	15.5
TOTAL OUT (ac-ft/yr)	**25.1**	**15.5**

ac-ft/yr - acre-feet per year

The model correctly simulates the location of graining stream reaches, in the upper parts of the Animas Creek and Percha Creek watersheds over the Animas Uplift. Below the uplift, the streams generally lose flow to the SFG aquifer. However, in the alluvial aquifer along lower Animas Creek, and in the lowest parts of Percha Creek and Greenhorn Arroyo, the model simulates alternating gaining and losing river segments. This is partly an artifact of model discretization (caused by the relatively large change in river stage from cell to cell), but also reflects the reality of a water table that is close to land surface and may rise above the stream bed intermittently or seasonally, causing the stream to flow.

Simulated total flowing-well discharge over time for the study area is shown on Figure 6.28. There are no data for calibrating the total flowing-well discharge, except that the simulated flow should exceed the totals shown on Table 5.3 (and does). The model result represents the known background (independent of the Project) trend of drawdown in the model area. The model-simulated artesian well locations are shown on Figure 6.29, indicating which locations were still flowing (in the model) as of November, 2012.

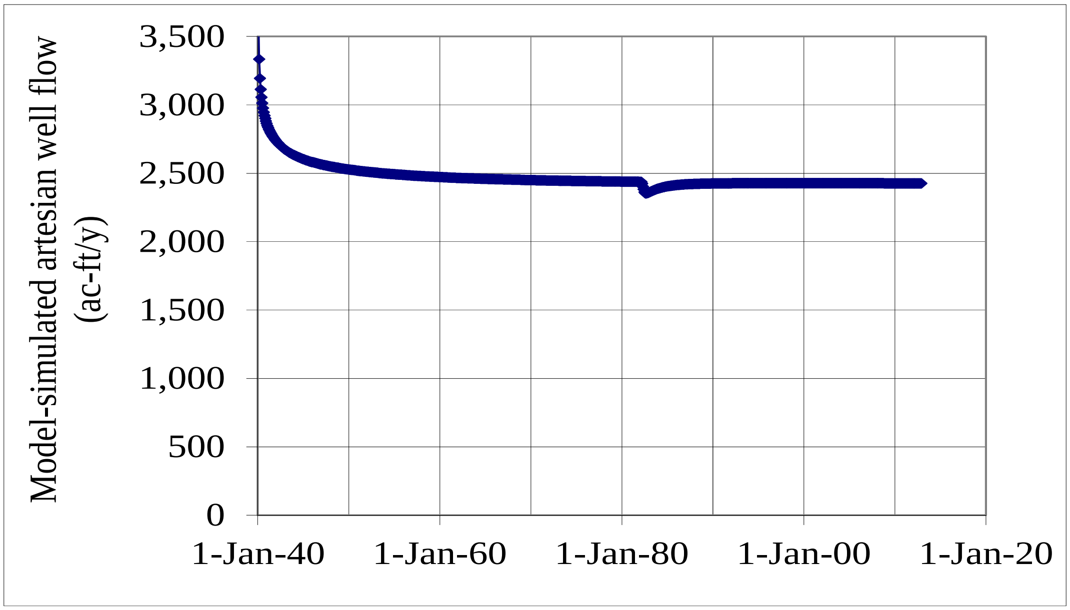


Figure 6.28. Simulated artesian well discharge.

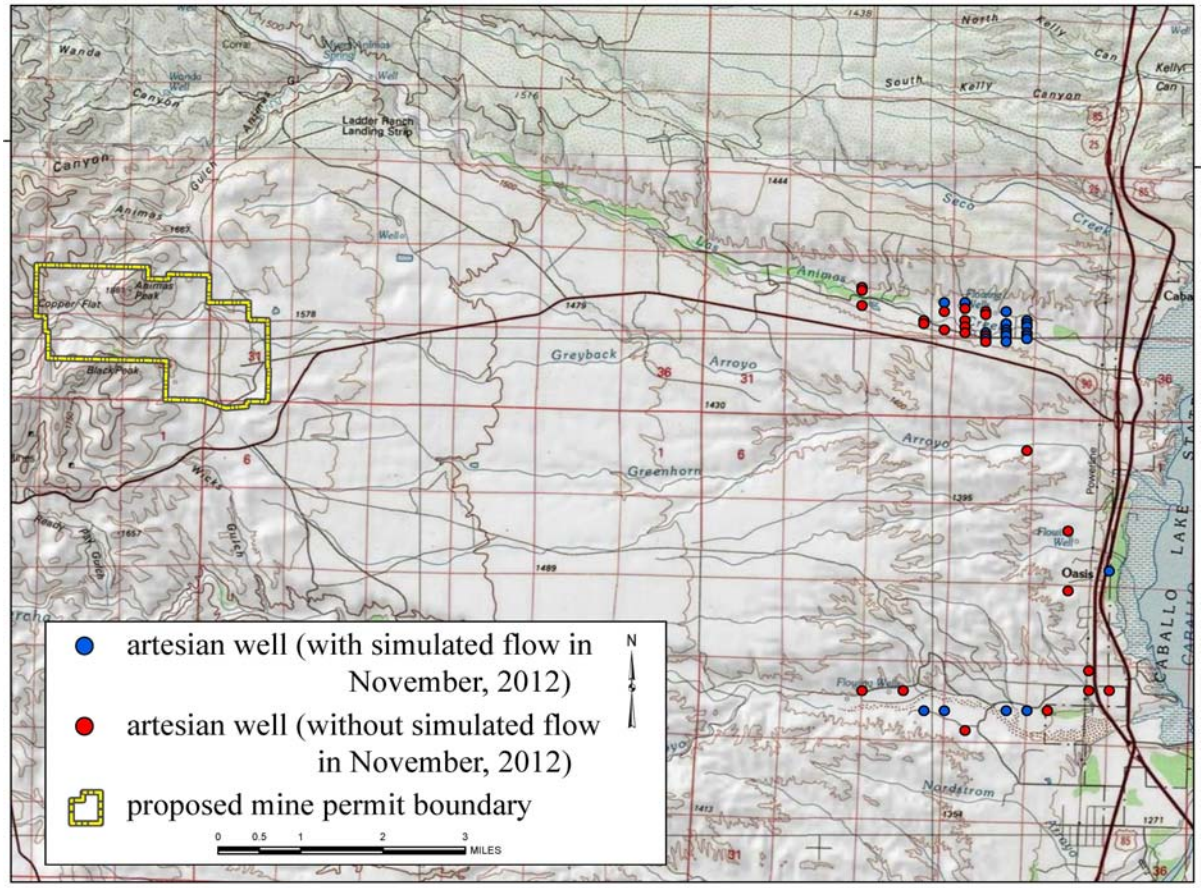


Figure 6.29. Simulated artesian wells, discharging and not discharging in November 2012.

6.4.3 Aquifer Test Simulation

Pumping of wells PW-1 and PW-3 began in late November 2012 and continued, with two stops and starts, until 21 December 2012. Recorded pumping periods and rates (Fig. 5.14) were simulated in the model using MODFLOW module LAK2 (JSAI, 2010), which simulates water level inside the pumping bores in addition to the withdrawal from the aquifer. Water-level responses were measured at locations shown on Figure 6.30. Measured and simulated aquifer test drawdown and recovery are presented on Figures 6.31 through 6.39.

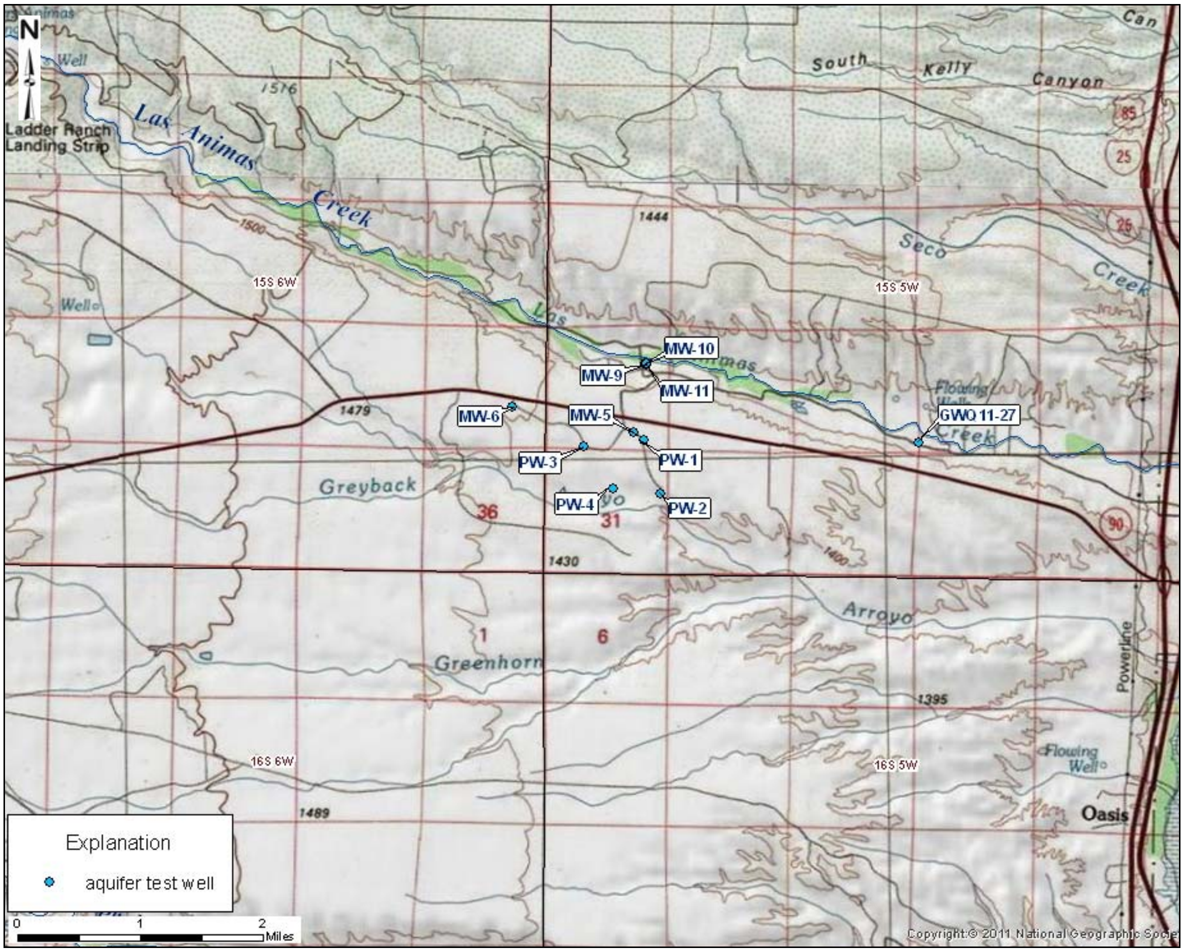


Figure 6.30. 2012 aquifer test pumping and observation locations.

Measured and simulated drawdown in the pumping wells, PW-1 and PW-3, are shown on Figures 6.31 and 6.32. Simulated water levels in the well-bore, and in the adjacent aquifer, are shown on both figures. The simulated and measured well-bore water levels agree, although the measured water level in PW-3 shows an unexplained additional decline, late in the pumping period, that is not simulated in the model. The difference between well-bore and aquifer water levels characterizes the well losses and pumping efficiency of PW-1 and PW-3.

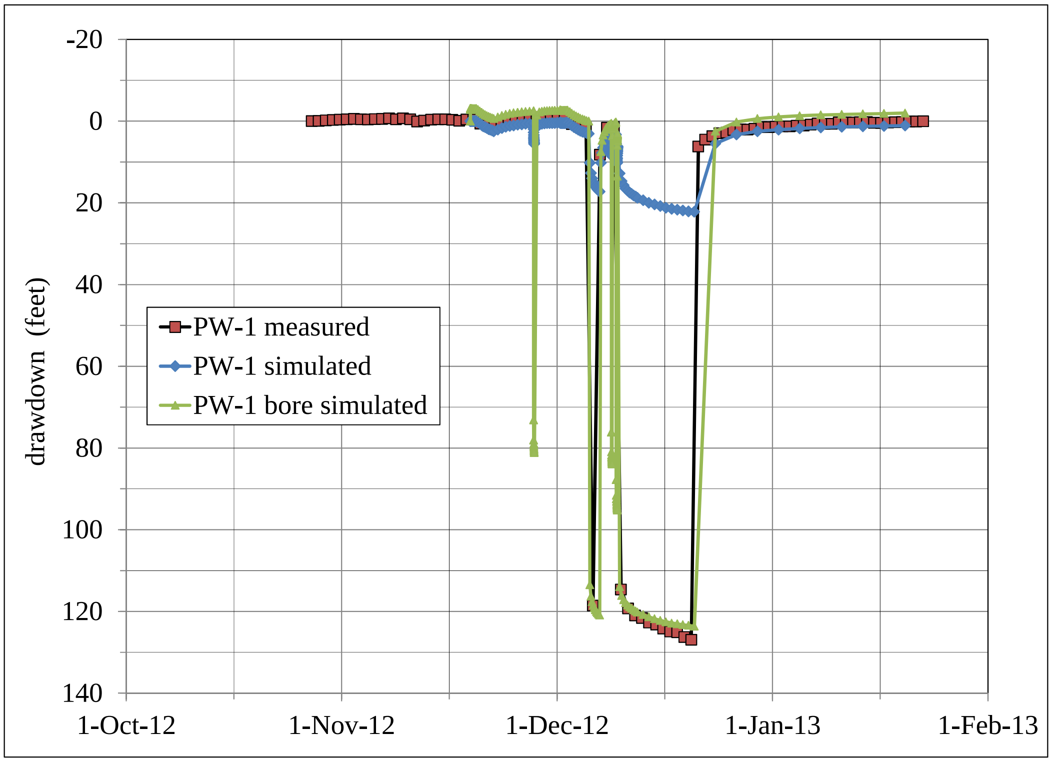


Figure 6.31. Measured and simulated water-level hydrographs in PW-1.

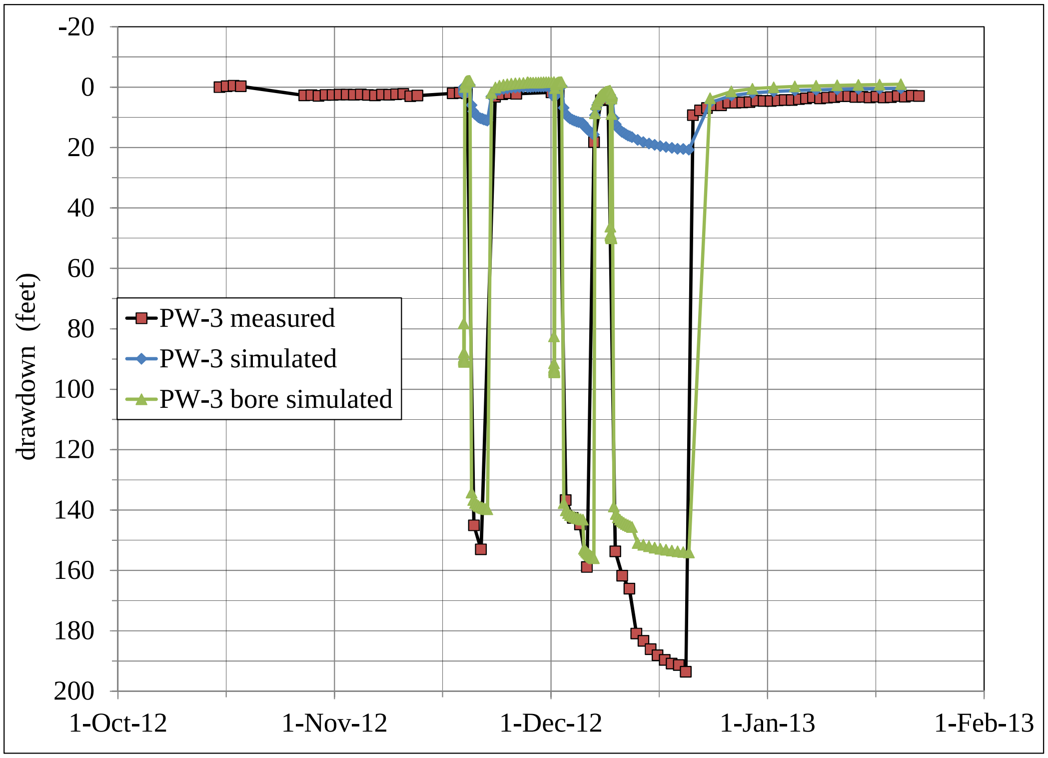


Figure 6.32. Measured and simulated water-level hydrographs in PW-3.

Measured and simulated drawdown elsewhere in the well field area, at PW-2, PW-4, and MW-5, are shown on Figures 6.33, 6.34, and 6.35. For unknown local reasons, measured drawdown in PW-2 (Fig. 6.34) is less than simulated, and less than would be expected from the results at PW-2 (Fig. 6.33) and MW-5 (Fig. 6.35).

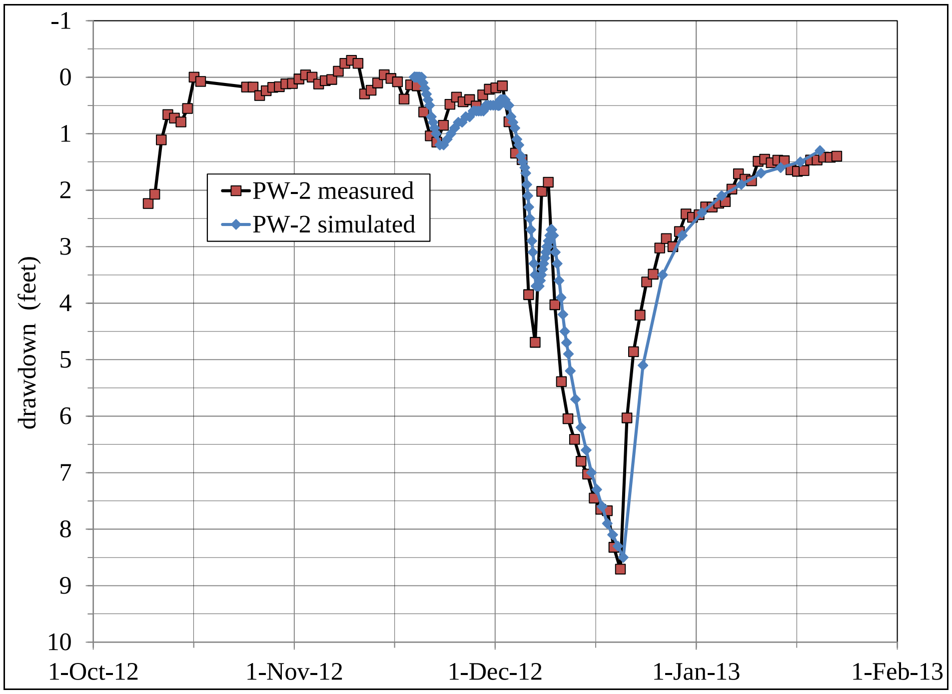


Figure 6.33. Measured and simulated water-level hydrographs in PW-2.

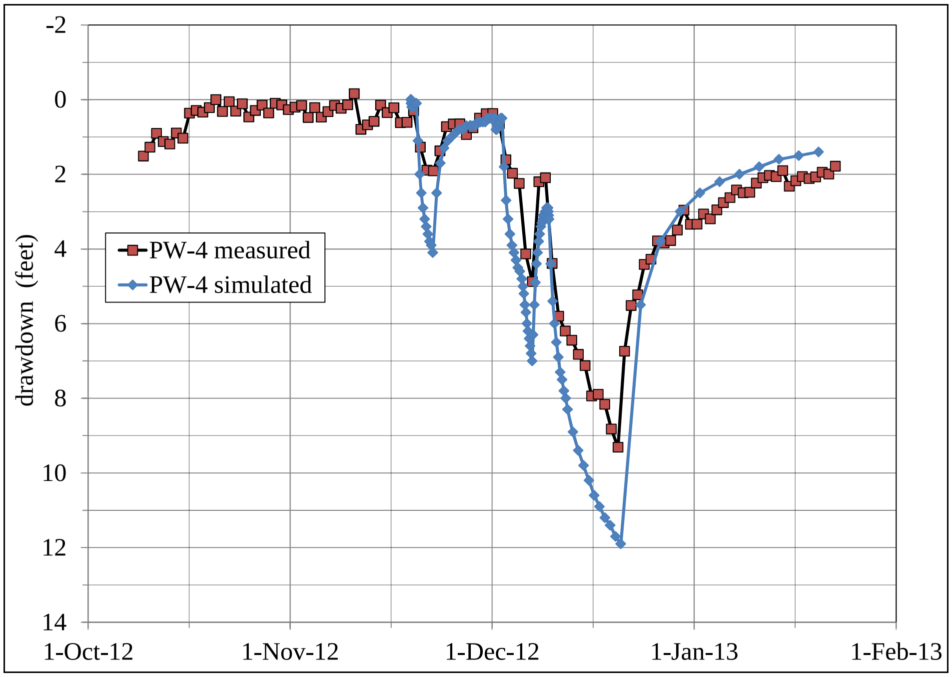


Figure 6.34. Measured and simulated water-level hydrographs in PW-4.

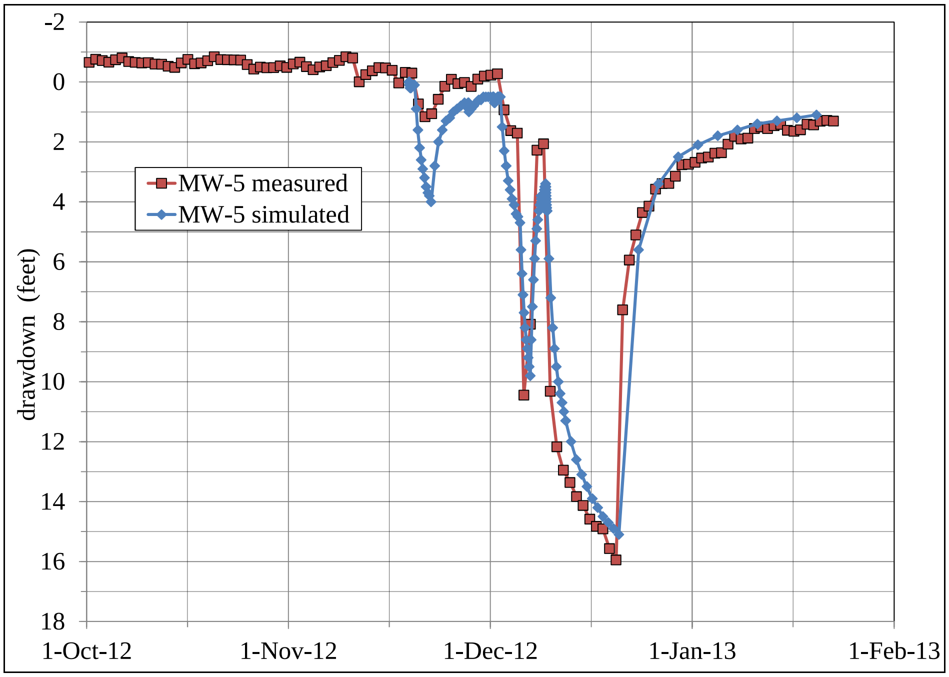


Figure 6.35. Measured and simulated water-level hydrographs in MW-5.

The rapid initial response, semi-linear drawdown trend and rapid recovery measured in the well field area is not characteristic of the response in an extensive aquifer, but in a limited-size, high-permeability unit (the Palomas graben) partly isolated from surrounding hydrogeologic units.

This response is reproduced in the model using a combination of (1) leaky fault barriers bounding the Palomas Graben, (2) high permeability within the graben and (3) lower permeability units adjacent to the graben. The combination reproduces both the aquifer test response and the overall background water levels and gradients in the basin.

Measured and simulated drawdown north of the well field along Las Animas Creek (Fig. 6.30) is shown for the SFG aquifer (wells MW-9 and MW-10) on Figure 6.36 and for the alluvium (well MW-11) on Figure 6.37.

The sharp initial drawdown and rapid recovery in the SFG aquifer is similar to that in the other Palomas Graben wells (Figs. 6.31 through 6.35). The response in the SFG aquifer (Fig. 6.36), and the lack of response in the alluvium (Fig. 6.37) are both reproduced in the model.

Instead of responding to the aquifer test, measured water levels in the very shallow (37 ft) well MW-11 (Fig. 6.37) can be seen to be rising before and throughout the test, due to some local influence, such as a neighboring well stopping pumping.

Measured and simulated drawdown east of the well field, at GWQ11-27 (Fig. 6.30), is shown on Figure 6.38. The model-simulated response is not as rapid or as large as the apparent measured response, but the figure also shows substantial background water-level fluctuation that is not part of the aquifer test response.

Measured and simulated drawdown west of the well field, at MW-6 (Fig. 6.30), is shown on Figure 6.39. The measured data shown on the figure consist of the highest water level measured each day; actual water levels in MW-6, an actively-used pumping well, fluctuate over tens of feet as the pump starts and stops. The data shown on the figure correspond to the water level measured each morning, just before the pump was started.

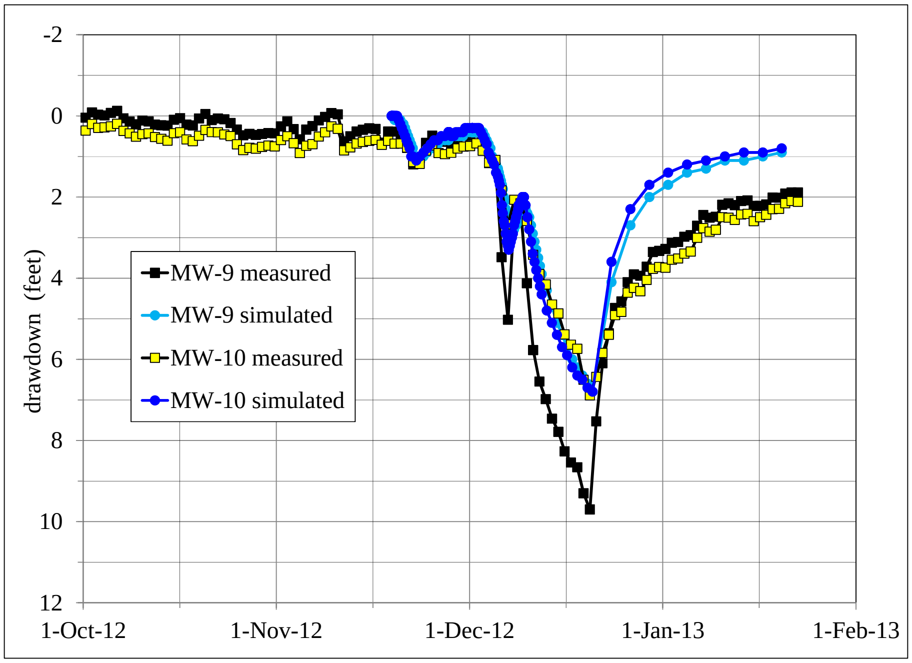


Figure 6.36. Measured and simulated water-level hydrographs in MW-9 and MW-10.

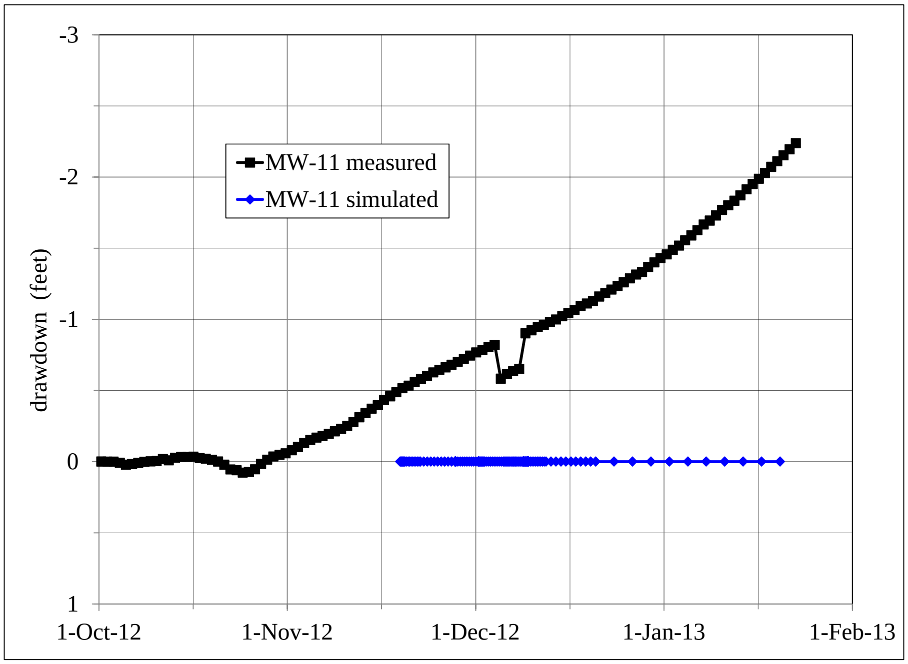


Figure 6.37. Measured and simulated water-level hydrographs in MW-11.

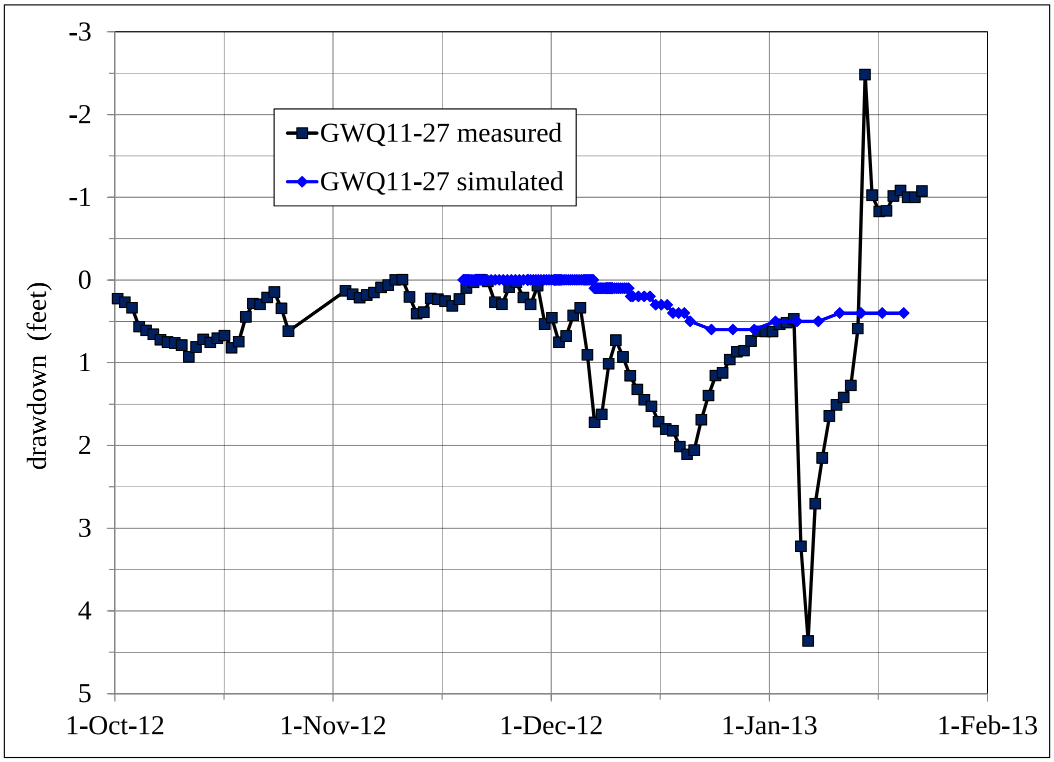


Figure 6.38. Measured and simulated water-level hydrographs in GWQ11-27.

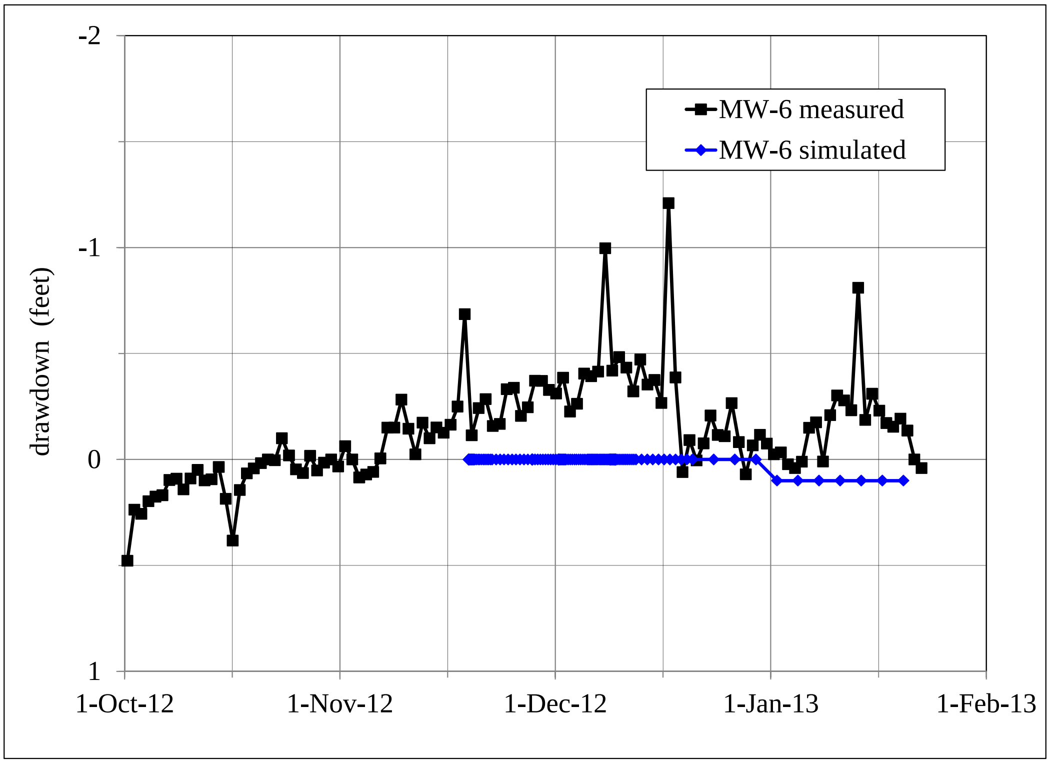


Figure 6.39. Measured and simulated water-level hydrographs in MW-6.

7.0 SENSITIVITY OF MODEL RESULTS

The sensitivity of model results to different parameters is discussed below.

First, the sensitivity of calibration results to model parameters is presented. These indicate which parameters are known with more confidence, or better constrained by data, and which are more unknown or uncertain. This helps to define a range of plausible values for each parameter.

Then the sensitivity of model projection results, within the plausible range of values for different parameters, is evaluated, to indicate a probable range of results. This quantifies the level of uncertainty in the model predictions and defines a range of likely outcomes.

7.1 Sensitivity of Calibration Results

The sensitivity of results to changes in model parameters was investigated during development of the model, in order to improve model calibration. An example of this is given on Figure 7.1, showing the simulation of the 2012 aquifer test for different modeled levels of vertical anisotropy in the Palomas Graben.

The results suggest important vertical flow upward into the strata from which the wells pump. The sediments filling the Palomas Graben are therefore modeled as an isotropic unit, with equal horizontal and vertical permeability (Table 6.1).

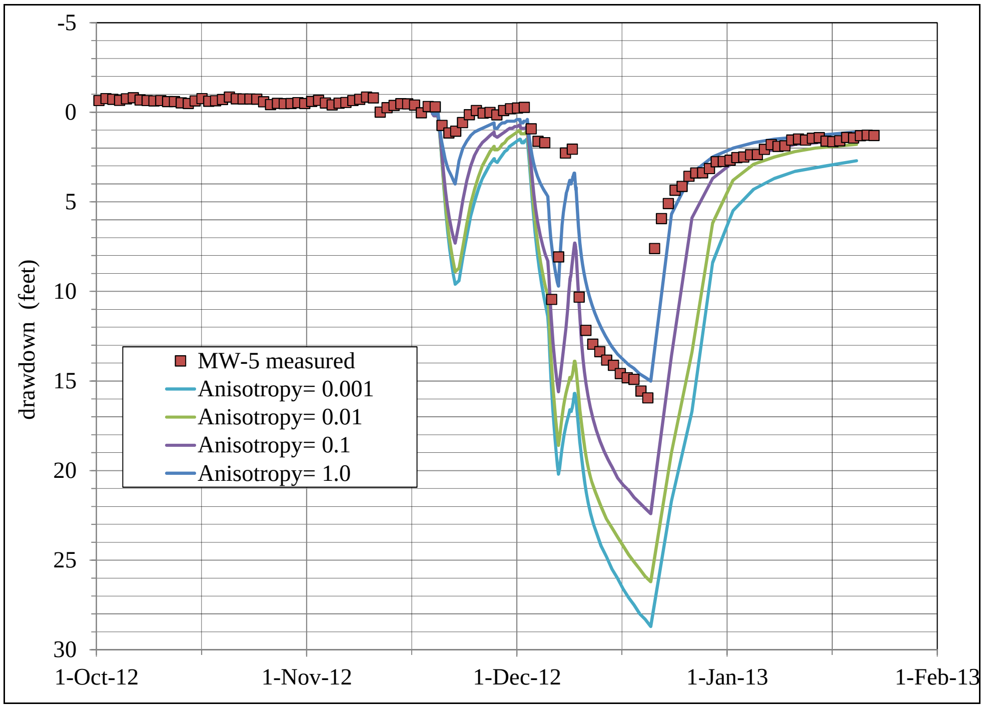


Figure 7.1. Simulated aquifer-test drawdown in well MW-5 for different vertical anisotropy values.

A related example is shown on Figure 7.2, showing the simulation of the 2012 aquifer test for different horizontal permeability of the Palomas Graben. Results show improved calibration for higher permeability. The final modeled permeability was 10 ft/d for the strata in which the well field is completed, with a total aquifer transmissivity of 20,000 ft^2/d (Table 6.1).

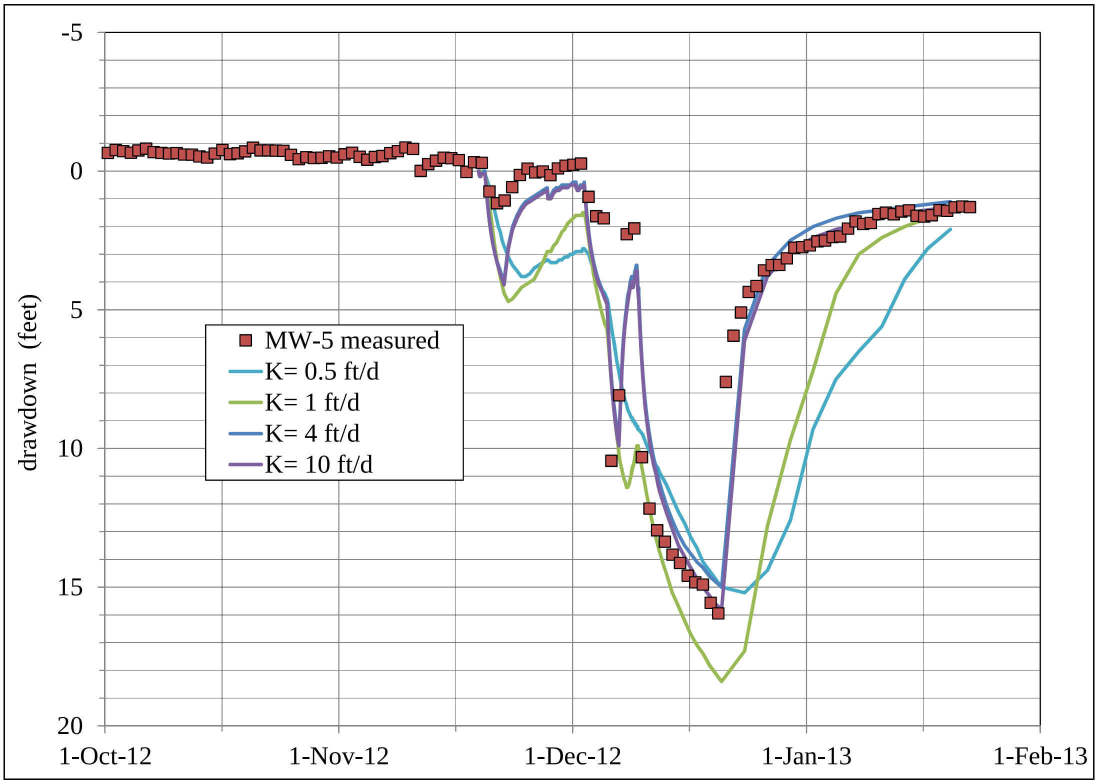


Figure 7.2. Simulated aquifer-test drawdown in well MW-5 for different hydraulic conductivity values.

Another example tests the conceptual model of a linearly extensive Palomas Graben. Figure 7.3 presents simulated 2012 aquifer test drawdown at observation well MW-5, with and without the north-south (GHB) boundary conditions in the Palomas Graben. The model calibration suggests that, if there were no significant north-south flow path in the graben, there would have been more aquifer test drawdown, with slower water-level recovery.

Based on the aquifer test results and model calibration, the Palomas Graben appears to be a linear feature of significant north-south extent; the aquifer test drawdown was characteristic of the response of a semi-infinite linear feature of finite width.

Based on the sensitivity results above, the transmissivity and vertical anisotropy of the highly-transmissive Palomas Graben are considered to be relatively well-known parameters, whose range of possible values is constrained by data.

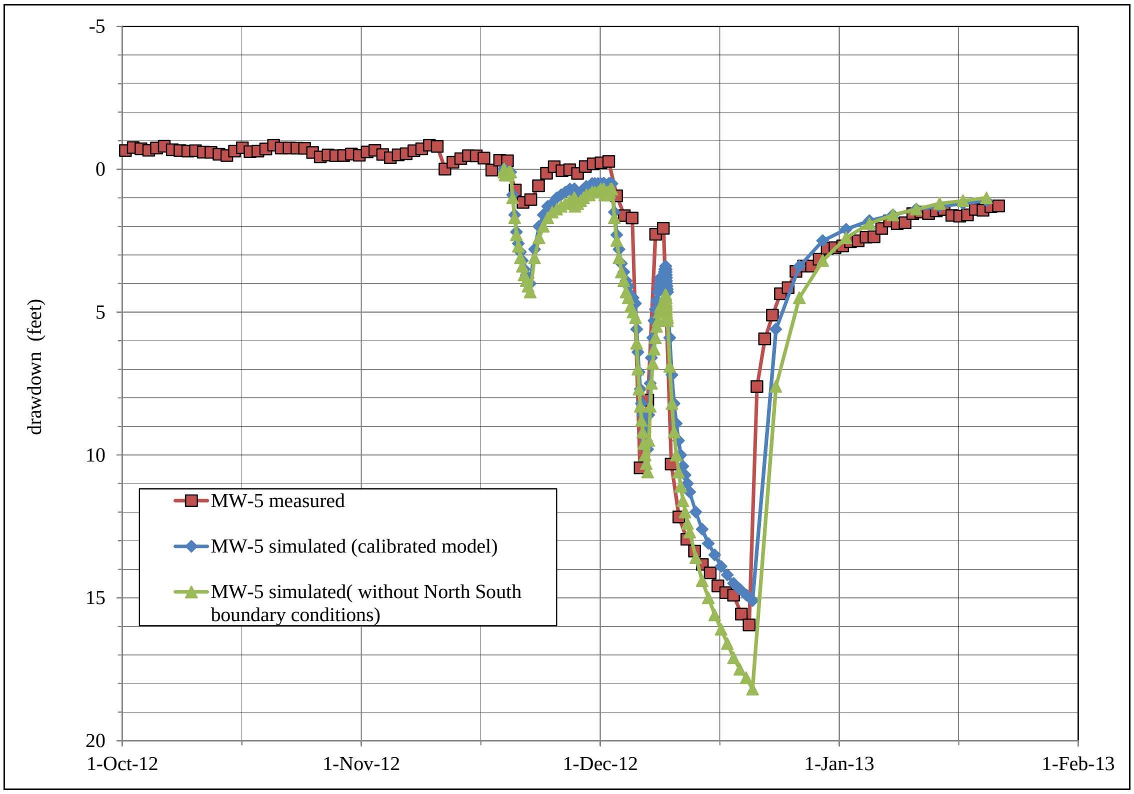


Figure 7.3. Simulated aquifer-test drawdown in well MW-5
with and without Palomas Graben boundary conditions

The hydraulic characteristics of the faults bounding the Palomas Graben are also reasonably known:

- The east bounding fault is weakly resistant to flow (Table 6.2). Based on model calibration, the resistance is not greater than simulated. The east bounding fault could be simulated with zero resistance (and compensating reduced transmissivity east of the graben), with little effect on calibration or projection results.

- The west bounding fault is strongly resistant to flow (Table 6.2). This resistance is important to overall model calibration (Fig. 6.10) and to aquifer test calibration. Simulating greater resistance (smaller conductance on Table 6.2) across the already low-permeability fault makes little difference to calibration or projection results. Simulating less resistance to the west degrades the model calibration and slightly attenuates the projected effects east of the graben.

Away from the Palomas Graben, the properties of the SFG aquifer are less well-known. However, based on aquifer test results and model calibration information the SFG aquifer along Animas Creek (Fig. 6.2) is identified to be similarly transmissive (Table 6.1).

The properties of the alluvial aquifer along Animas Creek are not known in detail, but the alluvium can be assumed to be conductive and to have substantial storage capacity. Measured historical water levels at MW-9, MW-10 and MW-11, results of the 1994 MW-9 pumping test (Fig. 5.13), and results of the 2012 well field pumping test (Fig. 6.37), all show that the alluvial aquifer does not respond readily to pumping in the underlying SFG aquifer.

To summarize the constraints on parameters:

1. Properties of the SFG sediments in the Palomas Graben are reasonably well-known based on calibration to aquifer test results. The graben aquifer is relatively transmissive both horizontally and vertically.
2. Properties of the SFG sediments along Animas Creek are somewhat known based on aquifer test results and other model calibration. The SFG aquifer along Animas Creek is also relatively transmissive.
3. Properties of the alluvial aquifer along Animas Creek are somewhat known, based on overall model calibration and on general material properties. Multiple aquifer test results (Sections 5.2.2, 5.2.3, and 5.2.4) indicate that the alluvial aquifer is substantially isolated from the SFG aquifer.

The above constraints narrow the plausible ranges of the main model result (the projection of groundwater drawdown and surface discharge reduction, resulting from proposed operation of the well field). The sensitivity of this result to variation of model parameters within plausible ranges is discussed below.

7.2 Sensitivity of Projection Results

The sensitivity of model projections to unknown parameters is of importance in evaluating the effects of the proposed project. Because model projections are reported separately, this report does not present results of specific projections. The general sensitivity of all projection scenarios to unknown parameters is discussed here.

The main effects of the project would be associated with pumping of the well field, including groundwater drawdown and surface discharge changes. The high-transmissivity features of the Palomas Graben and the SFG aquifer along Animas Creek largely control the pattern of groundwater drawdown and the effects on discharge. The projected groundwater drawdown spreads throughout the high-transmissivity features, and magnitude of drawdown is proportional to the total volume of water pumped. The discharge effects develop over the life of mine and dissipate over a similar period.

This basic result is controlled by the known high-transmissivity features. Variations of aquifer parameters for these features, within plausible ranges, do not change the basic result, and can only marginally affect the shape and size of the drawdown cone and the timing of the discharge changes. This was confirmed during model calibration by comparing the results of different preliminary projection scenarios, using different preliminary model versions.

While the basic result is insensitive to changes in aquifer parameter values, variation in the model boundary conditions controlling groundwater discharge to the Rio Grande Basin (MODFLOW module GHB) can have more effect. The conductance of the GHB boundaries (Sec. 6.3.1) were adjusted both up and down one order of magnitude, and results of a sample projection compared to results obtained using the calibrated model.

An increase in the already-large conductance does not substantially change model results; the GHB boundaries are simulated with sufficiently large conductance that they function essentially as constant-head boundary conditions, maintaining a constant water level along the east edge of the model domain.

A decrease in GHB conductance, however, reduces simulated discharge to the Rio Grande system, and increases simulated discharge to the Animas Creek and Percha Creek systems. Projected effects on discharge to the Rio Grande system are smaller, and projected effects on discharge to the Animas Creek and Percha Creek systems are larger. Total discharge and total effect on discharge are unchanged.

In summary, the aquifer properties near the well field are relatively well-known, due to the 2012 aquifer test. The aquifer properties farther away do not substantially affect the size or shape of the predicted groundwater drawdown cone, or its rate of dissipation. The identified high-transmissivity units govern the propagation of groundwater drawdown and the resulting water balance effects.

Reasonable variation in boundary condition parameters such as GHB conductance do not substantially change the overall projected effects, but can affect the predicted distribution of those effects between groundwater discharge to the Rio Grande system and discharge to the Animas Creek and Percha Creek systems.

8.0 CONCLUSIONS

A numerical model of groundwater flow in and around Copper Flat, near Hillsboro, New Mexico was developed and calibrated based on previously available information and on new studies of the system. The calibrated model will be used to project the effects, to groundwater and surface water, of the proposed development of the Copper Flat mine.

First, the climate and meteorology, hydrology and water balance, and geology and hydrogeology, of the study area were summarized. Then a conceptual model of the hydrological and hydrogeological system was presented. Important hydrogeological features are the high-transmissivity Palomas Graben and a high-transmissivity zone along the axis of Animas Creek.

Next, the data available to confirm and calibrate the model were presented. Extensive information is available, from previous studies and previous mine operations, and from new studies including the 2012 extended well field test and the 2011 pit-area pressure-injection testing. The large amount of information has allowed development of a model that can reliably project effects of future development.

Next the numerical model was presented, including model structure, inputs and calibration. The model accurately represents the conceptual model and accurately reproduces the calibration data, particularly the results of the 2012 extended well field pumping test. As a result the model is considered suitable for use in projecting the effects of future well field pumping.

Finally the sensitivity of model results to unknown parameters was evaluated. The existing information, including the 2012 aquifer test, characterizes the main SFG aquifer units and narrows the range of parameter uncertainty in the vicinity of the well field. Sensitivity of the primary model projection results, groundwater drawdown and surface discharge changes due to well field pumping, is low.

The calibrated model will be used to generate projections related to the results and effects of mine development. Projections will be generated as required and reported separately. Results of interest include the following:

- Groundwater drawdown due to water-supply pumping, for selected mine development scenarios
- Effects on surface discharge to the Las Animas Creek and Rio Grande systems
- Long-term post-mining residual groundwater drawdown and effects to surface discharge
- Potential ground subsidence due to groundwater drawdown
- Open pit dewatering rates and groundwater drawdown in bedrock
- Post-mining open-pit water level and water balance
- Down-gradient migration of potential leakage from tailings and waste rock storage facilities

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APPENDICES

Appendix A.

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Appendix B.

Well Construction Diagrams

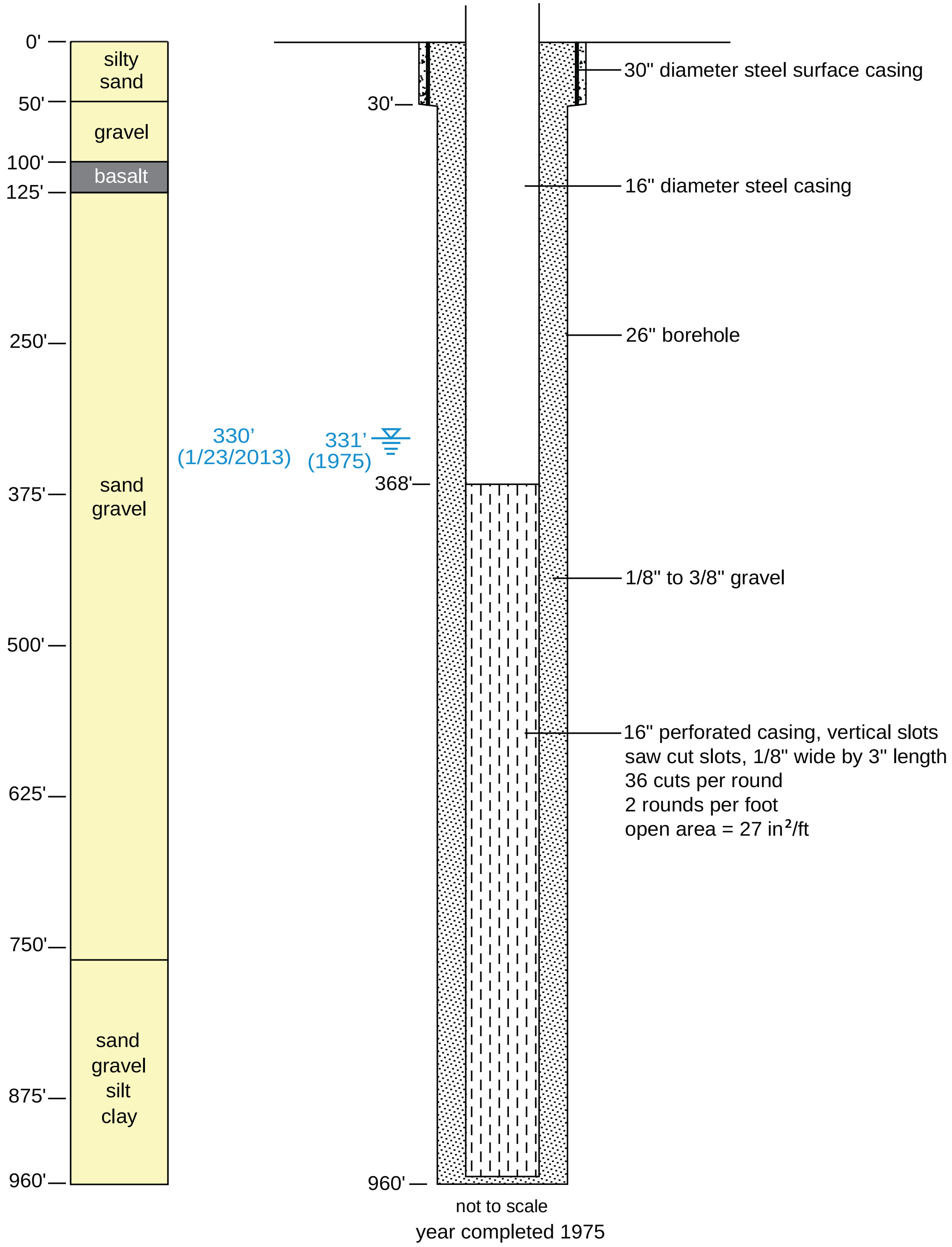


Figure B1. Well completion diagram for LRG-4652 (PW-1), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

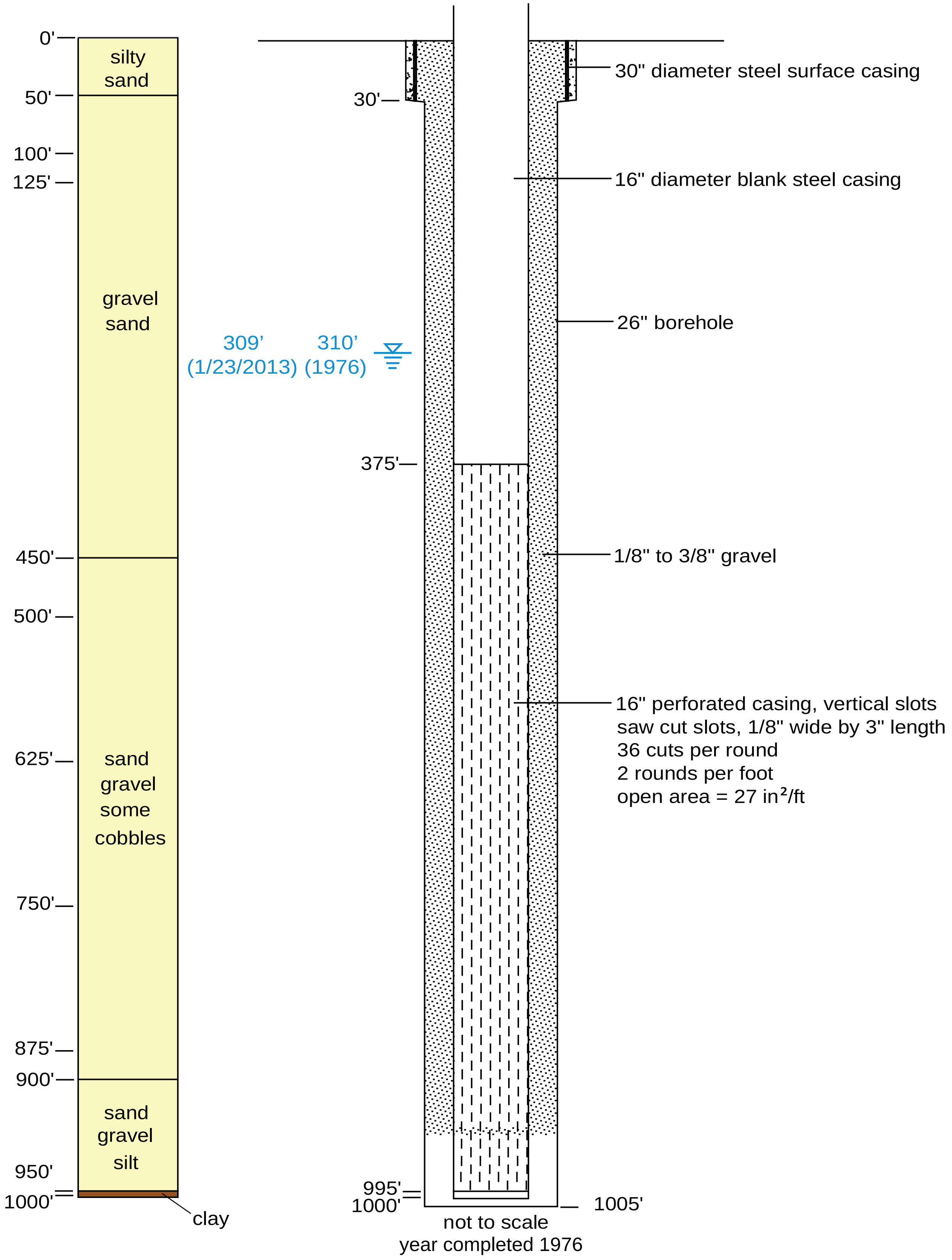


Figure B2. Well completion diagram for LRG-4652-S (PW-2), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

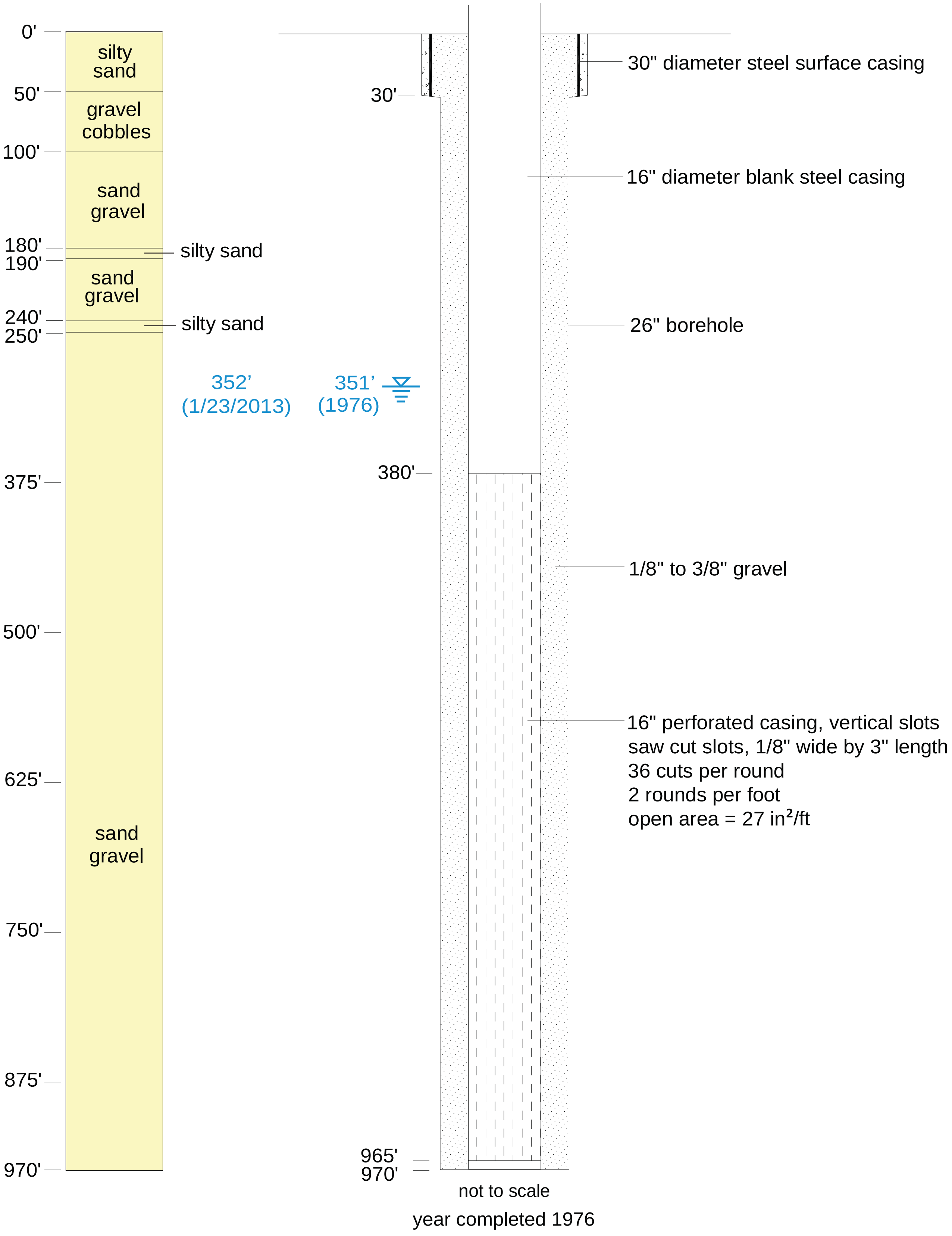


Figure B3. Well completion diagram for LRG-4652-S-2 (PW-3), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

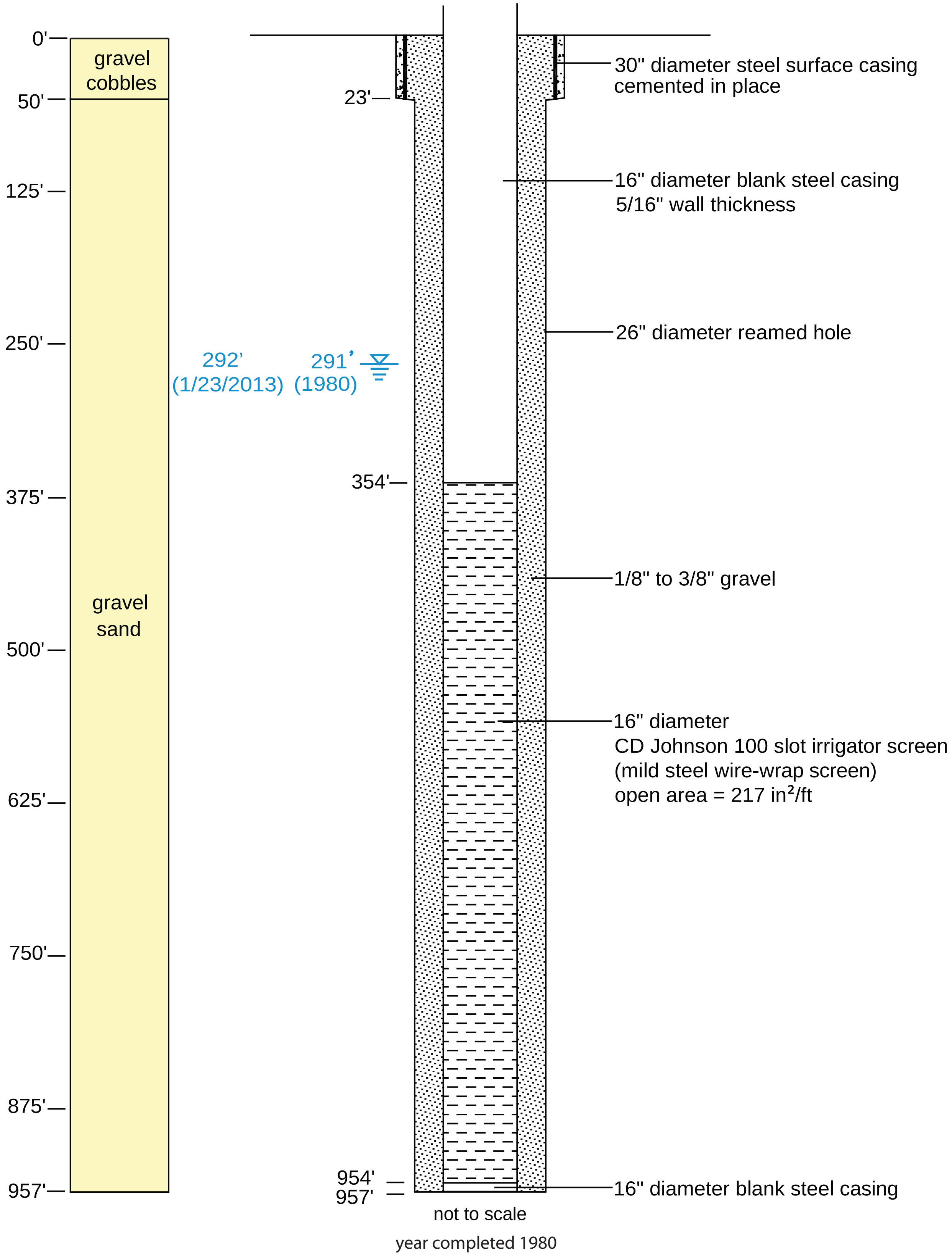


Figure B4. Well completion diagram for LRG-4652-S-3 (PW-4), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

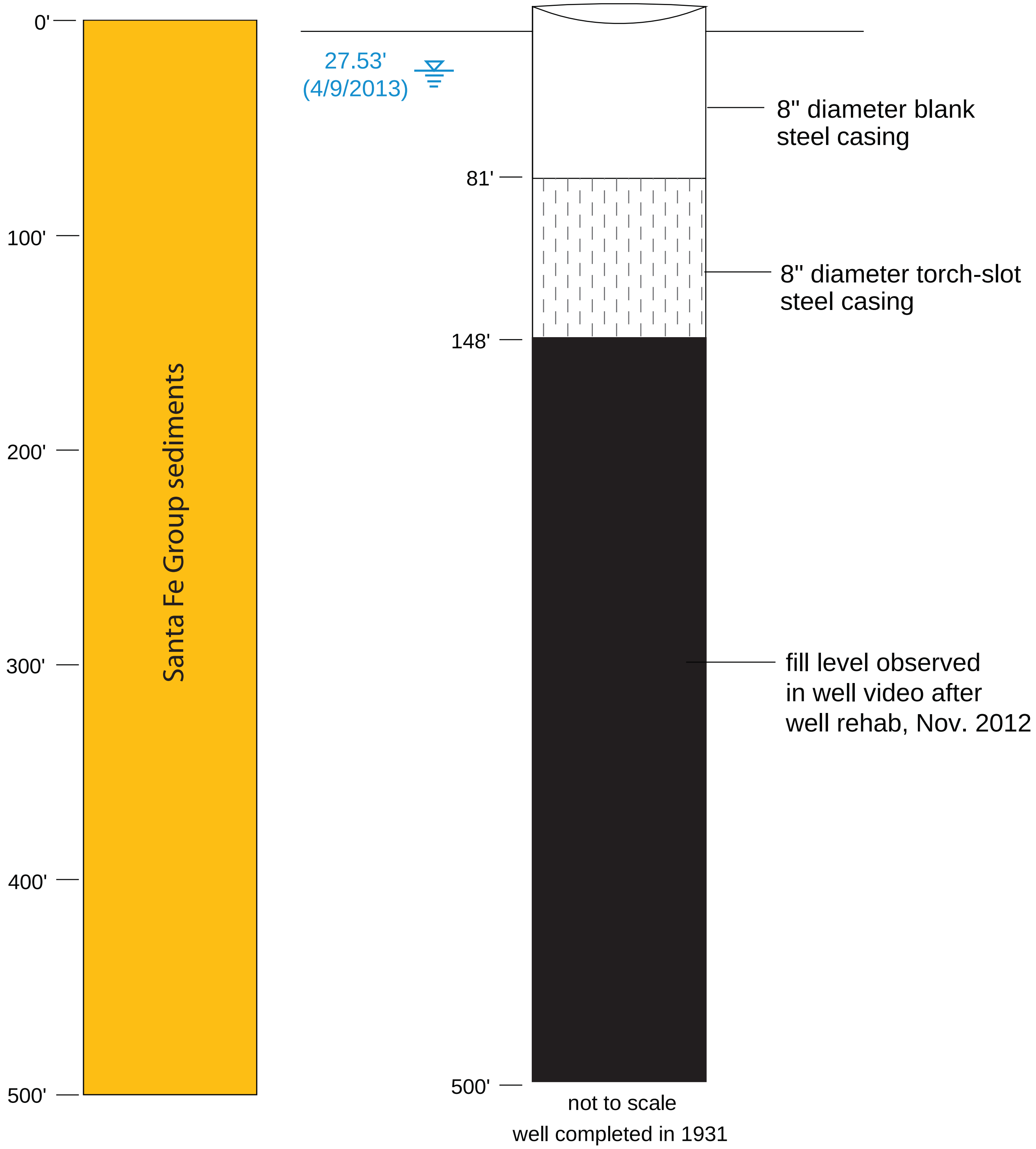


Figure B5. Well completion diagram for LRG-4652-S-4 (GWQ-8), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

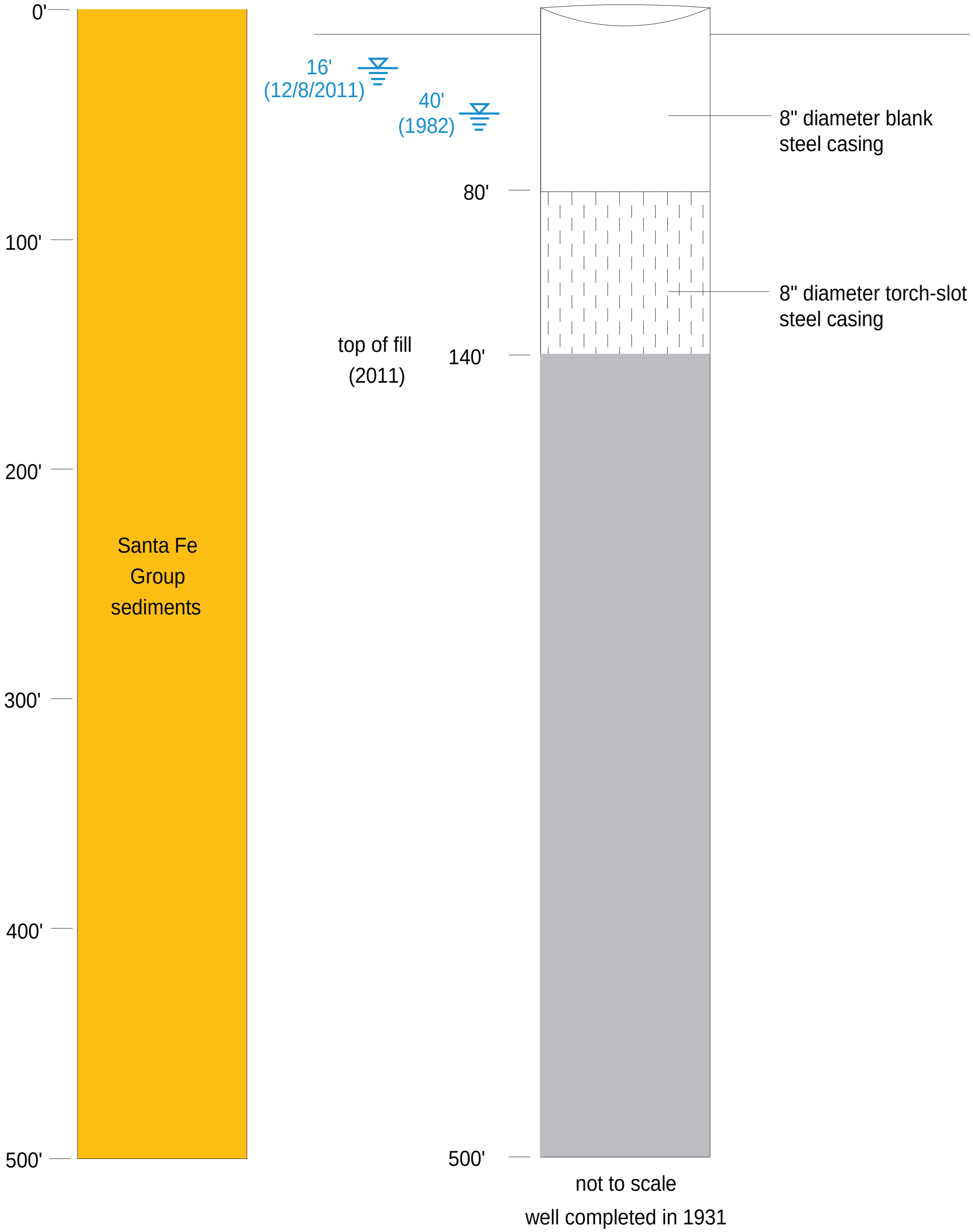


Figure B6. Well completion diagram for LRG-4652-S-5 (McCravery-Grayback), Copper Flat Mine, Sierra County, New Mexico.

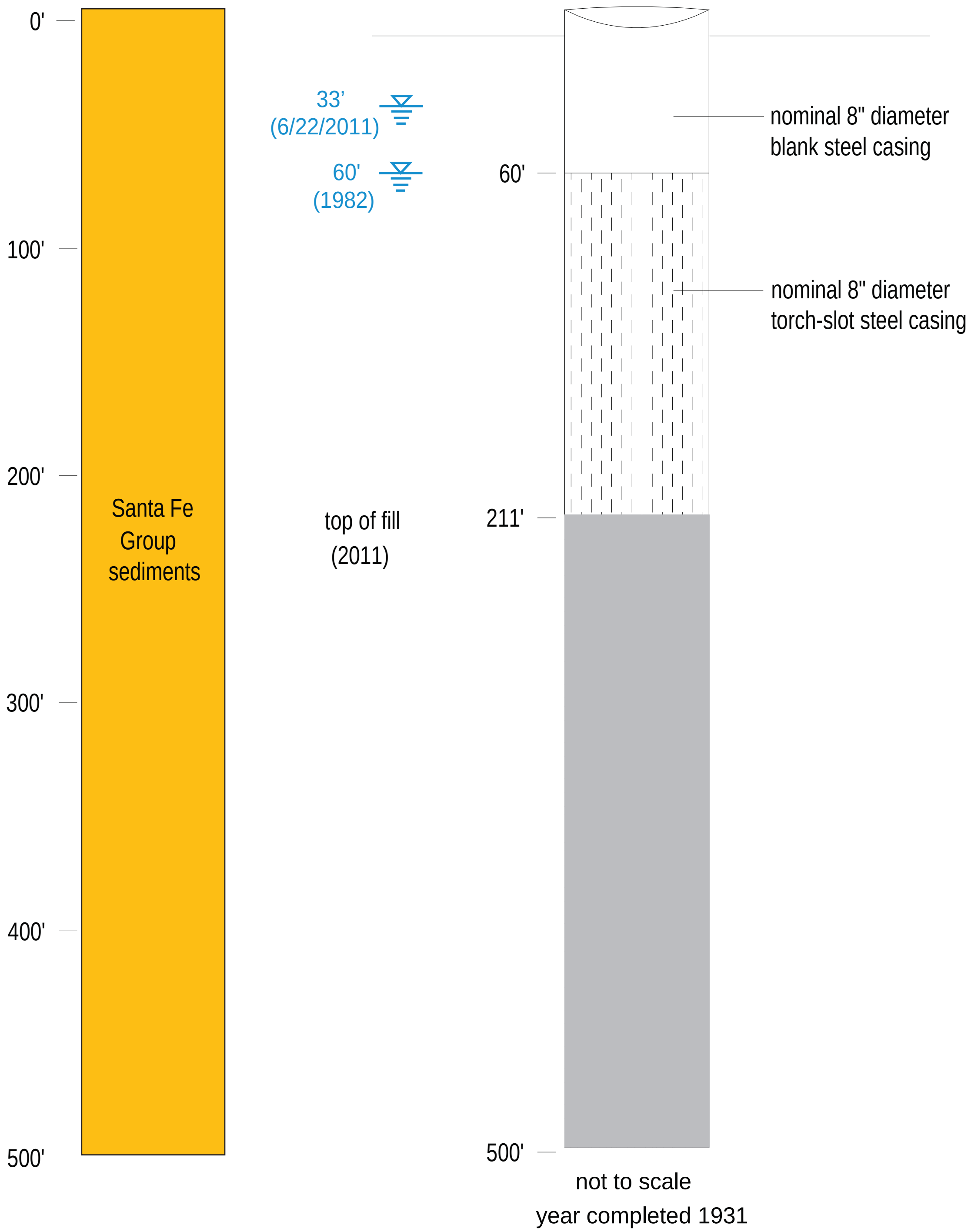


Figure B7. Well completion diagram for LRG-4652-S-6 (GWQ-2), Copper Flat Mine, Sierra County, New Mexico.

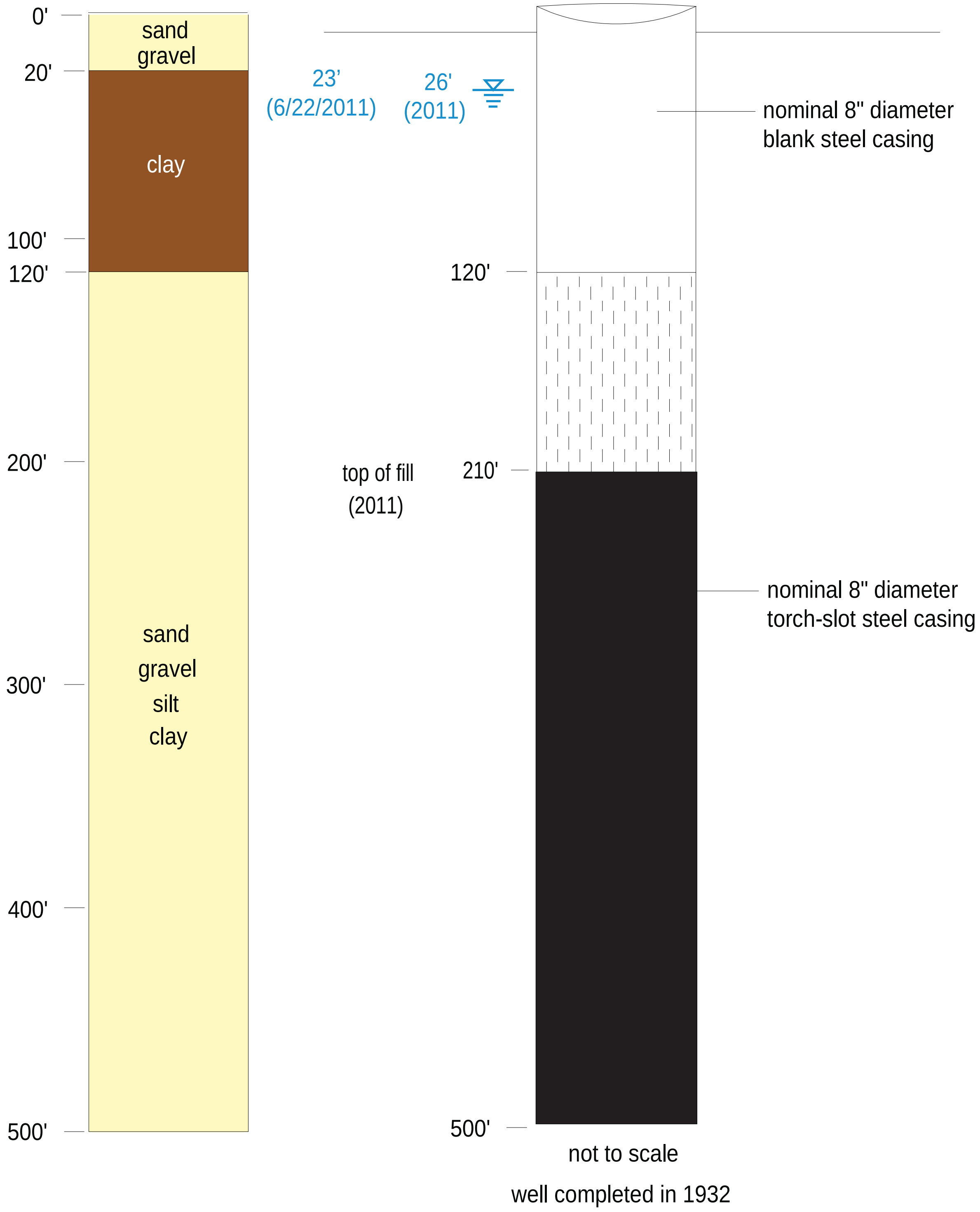


Figure B8. Well completion diagram for LRG-4652-S-7 (Irwin Well), Copper Flat Mine, Sierra County, New Mexico.

8-22-2013; DA/PW

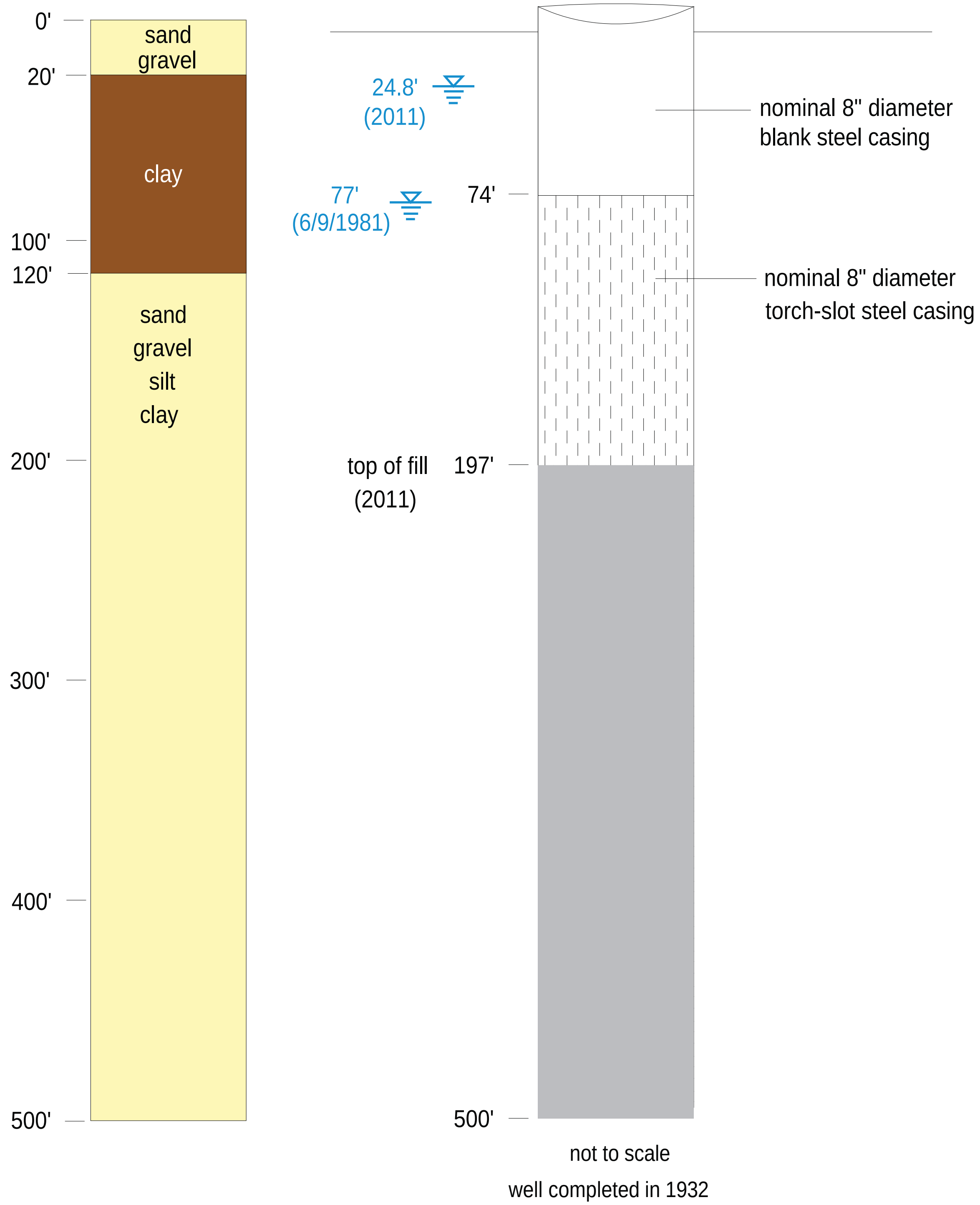


Figure B9. Well completion diagram for LRG-4652-S-8 (GWQ-7, Office Well), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

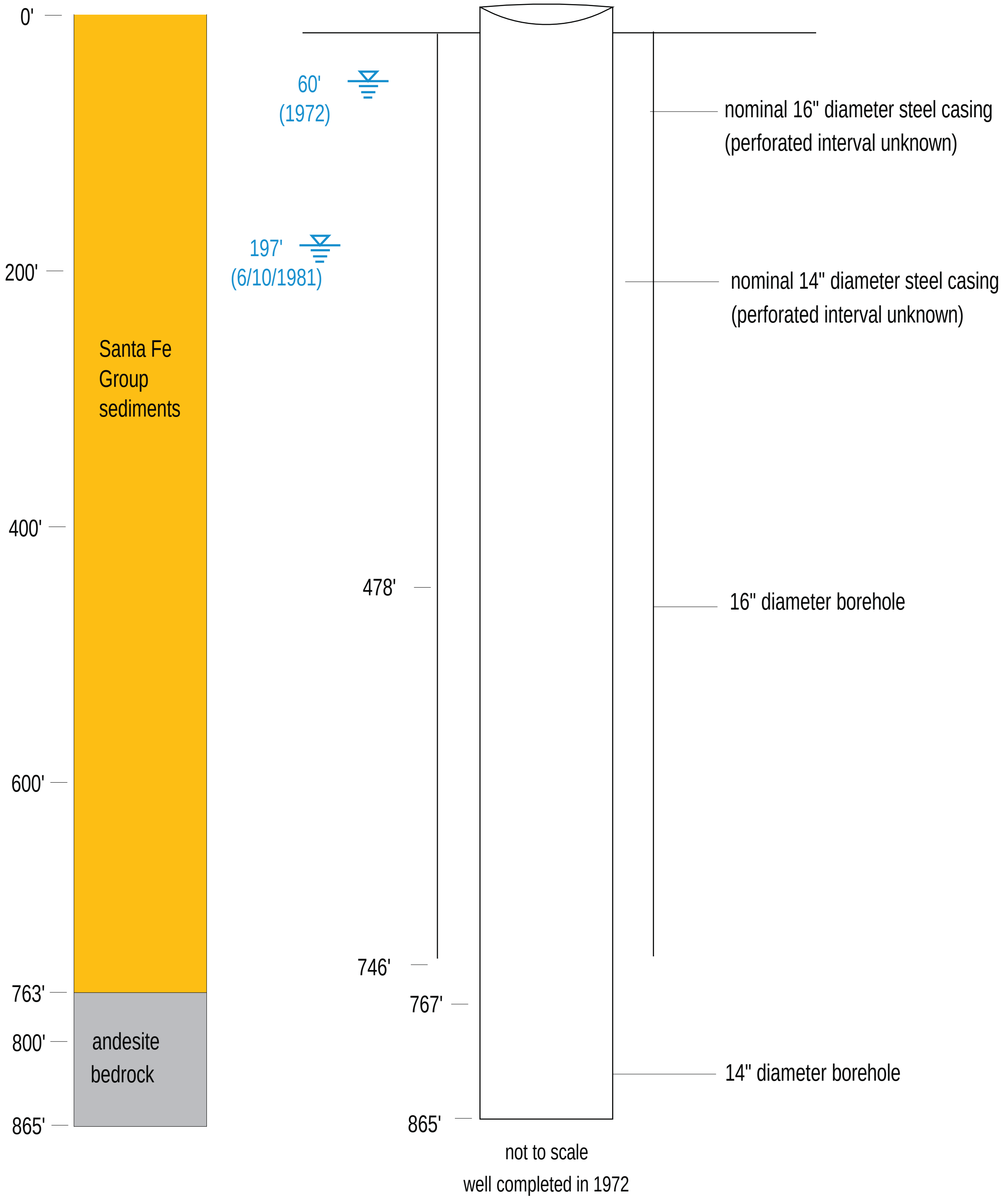


Figure B10. Well completion diagram for LRG-4652-S-9 (GWQ-9, South Inspiration, Well IDW-1), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

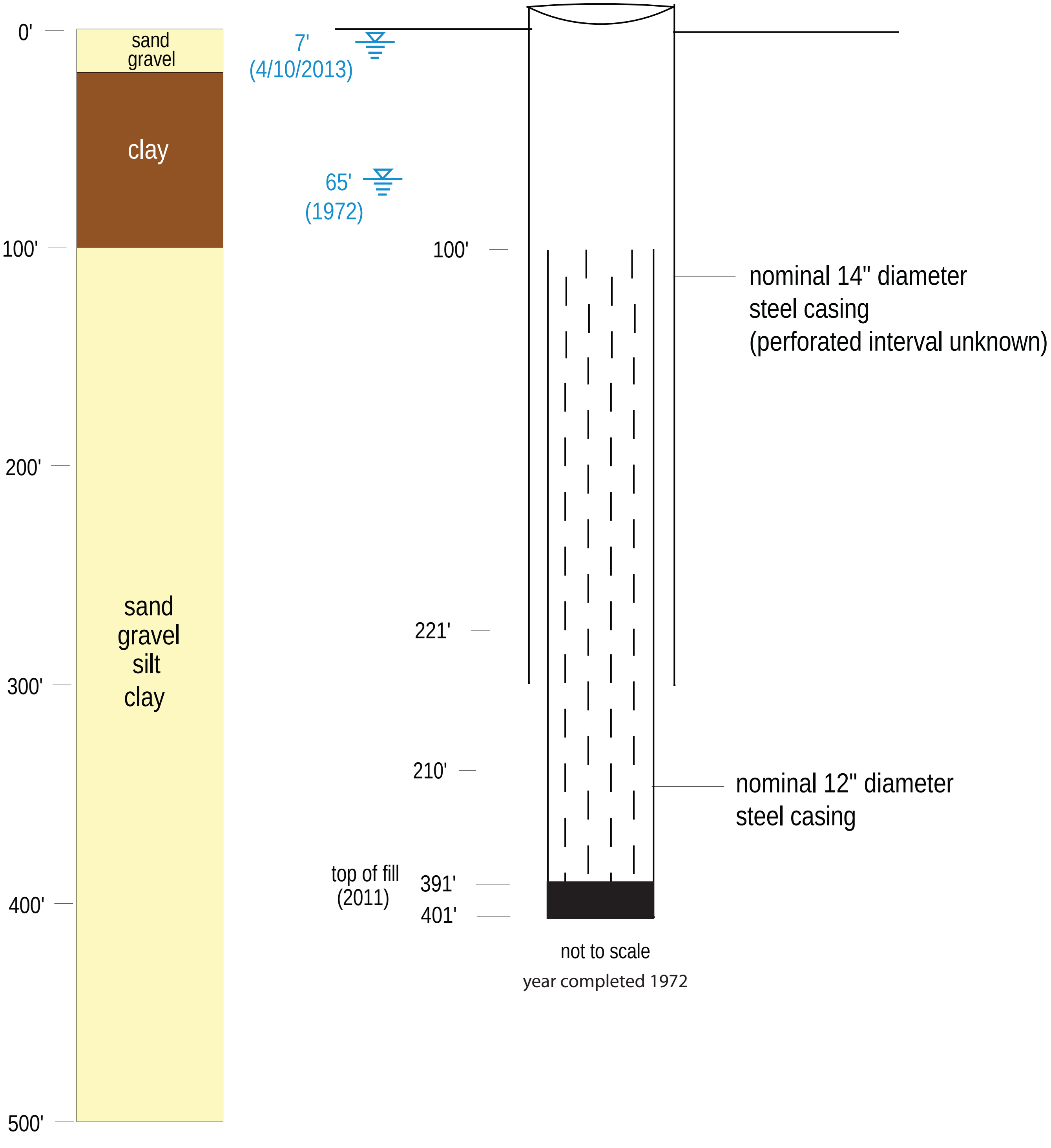


Figure B11. Well completion diagram for LRG-4652-S-10 (GWQ-1, North Inspiration, Well IDW-2, S-10), Copper Flat Mine, Sierra County, New Mexico.

8-22-2013; DA/PW

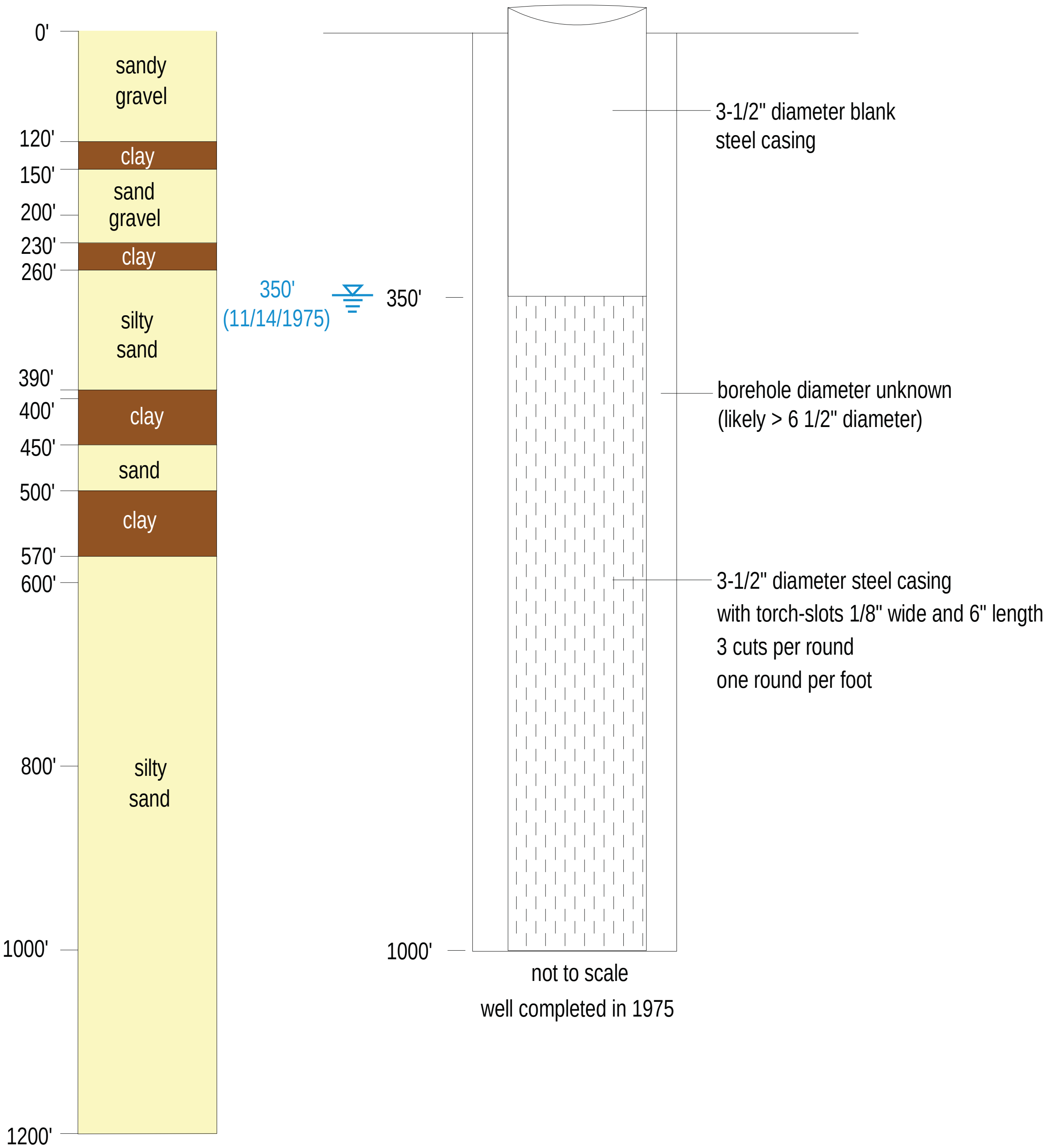


Figure B12. Well completion diagram for LRG-4652-S-11 (MW-1),
Copper Flat Mine, Sierra County, New Mexico.

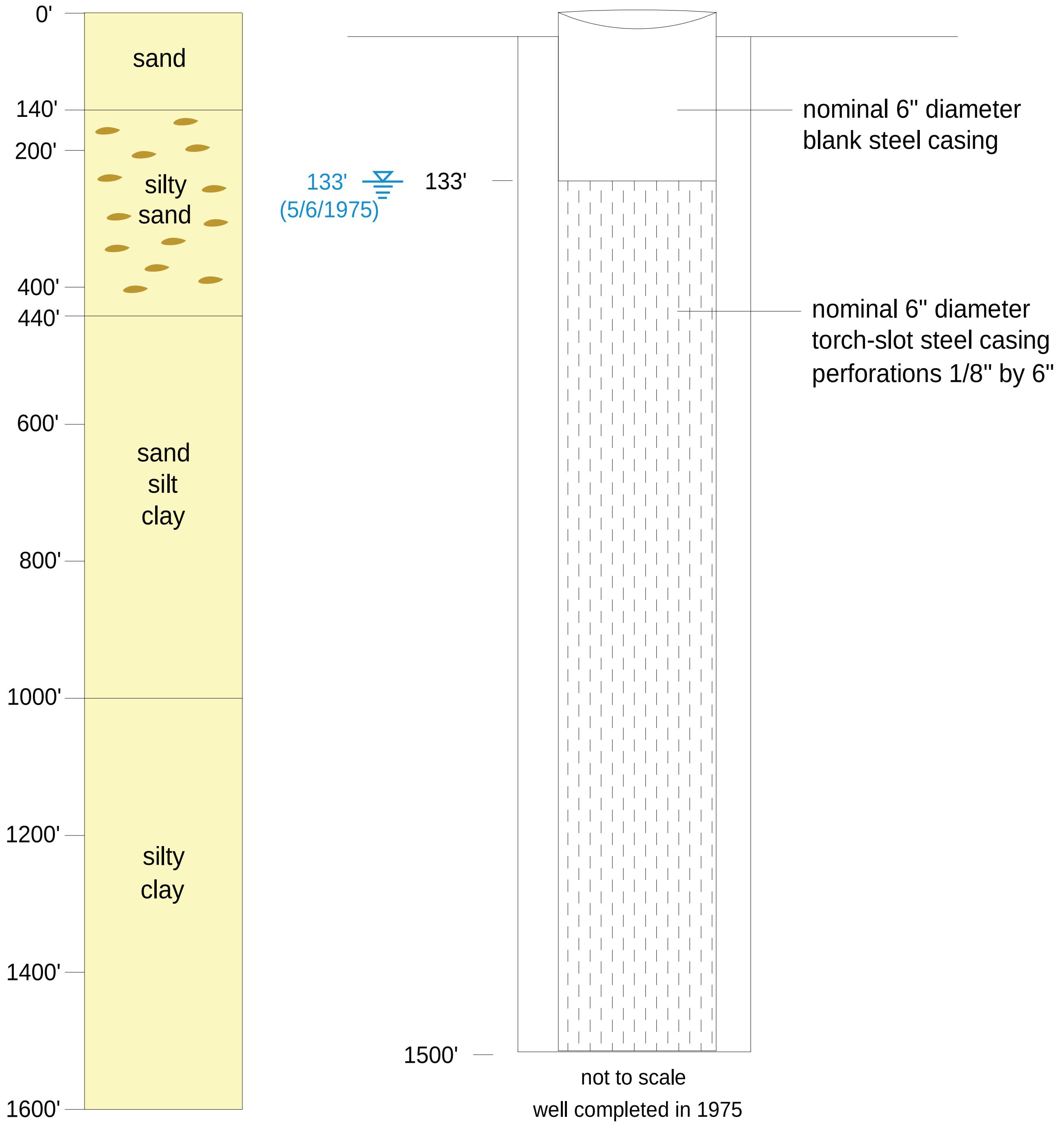


Figure B13. Well completion diagram for LRG-4652-S-12 (MW-2), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

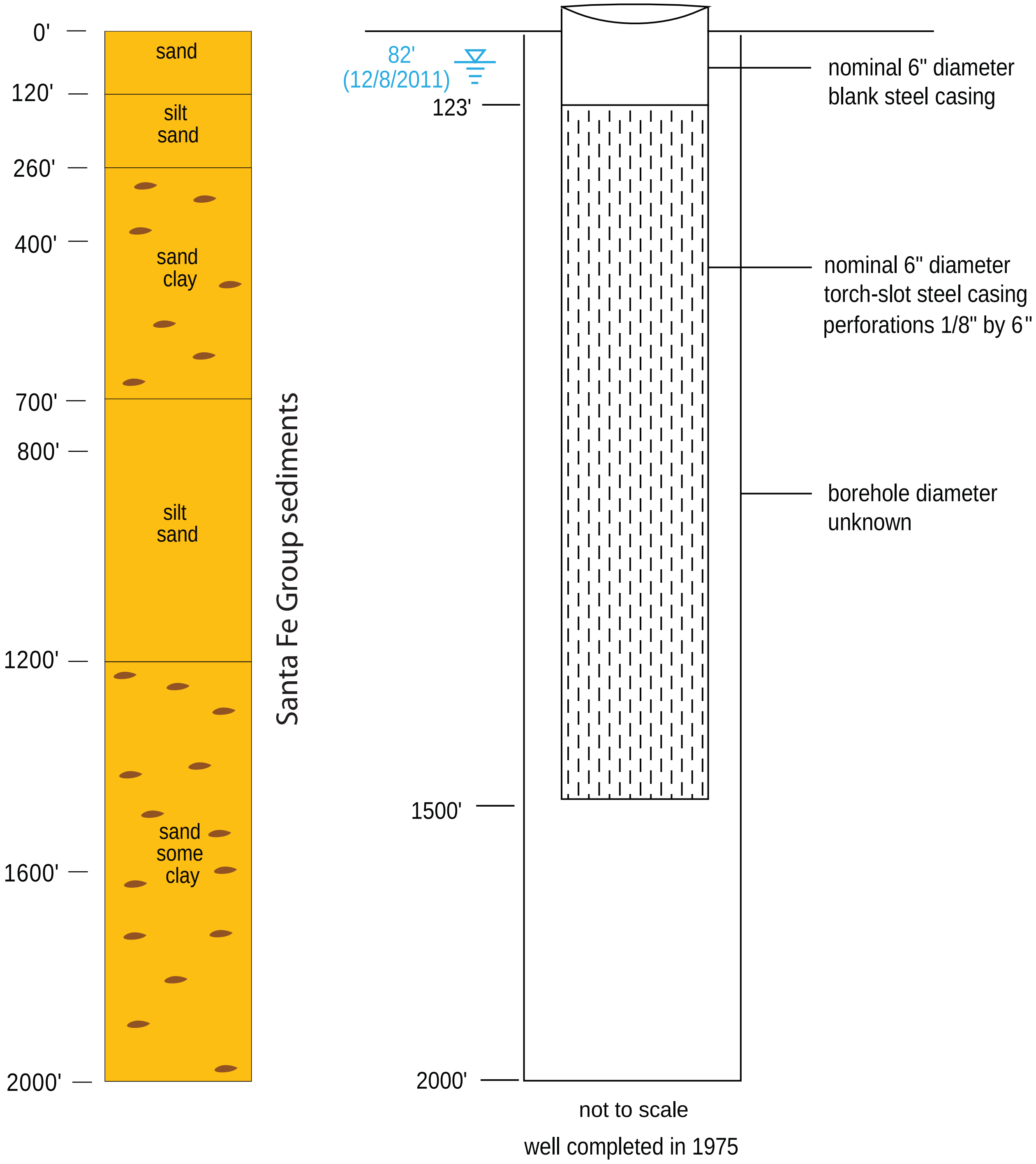


Figure B14. Well completion diagram for LRG-4652-S-13 (MW-4), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

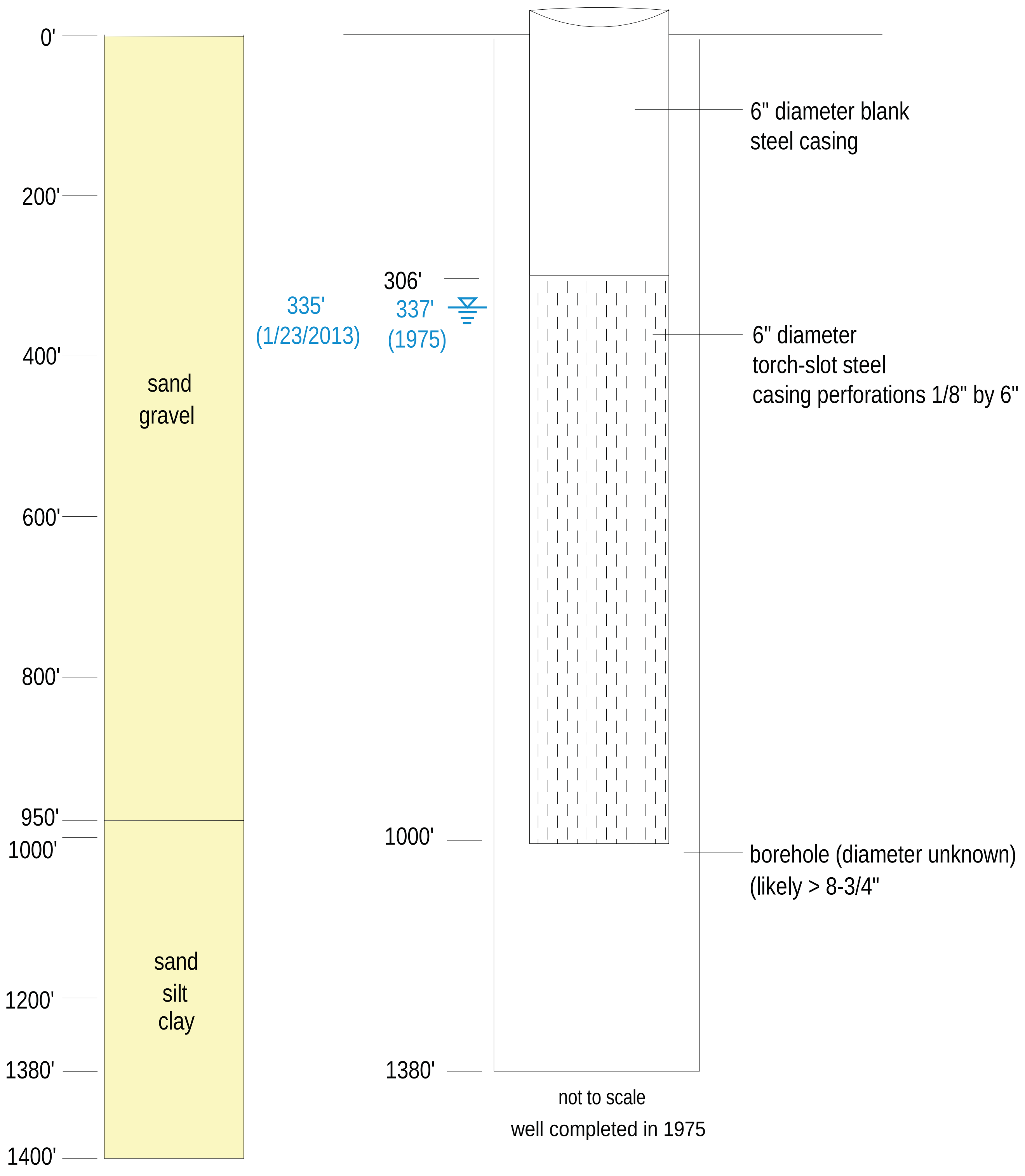


Figure B15. Well completion diagram for LRG-4652-S-14 (MW-5), Copper Flat Mine, Sierra County, New Mexico.

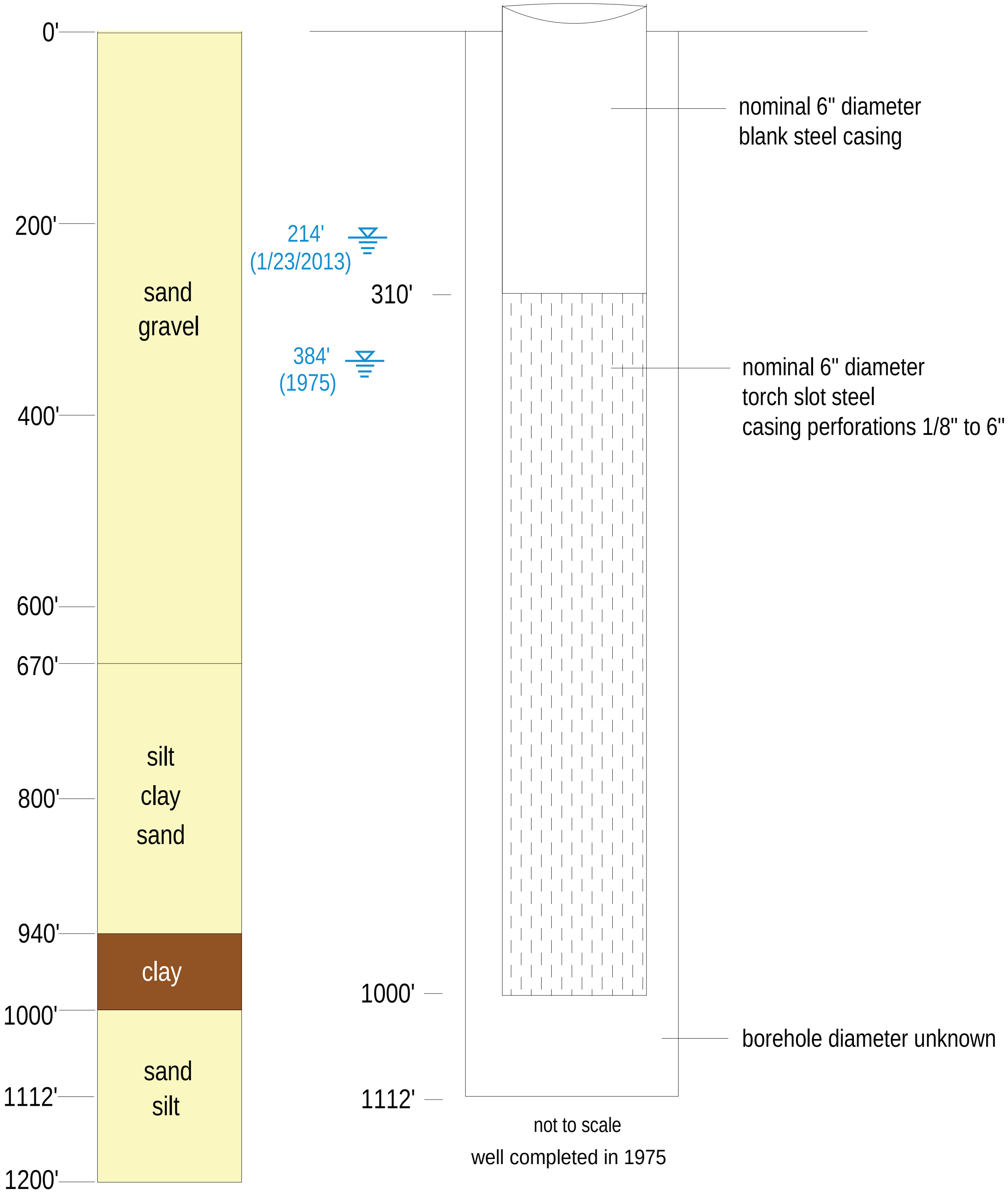


Figure B16. Well completion diagram for LRG-4652-S-15 (MW-6),
Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

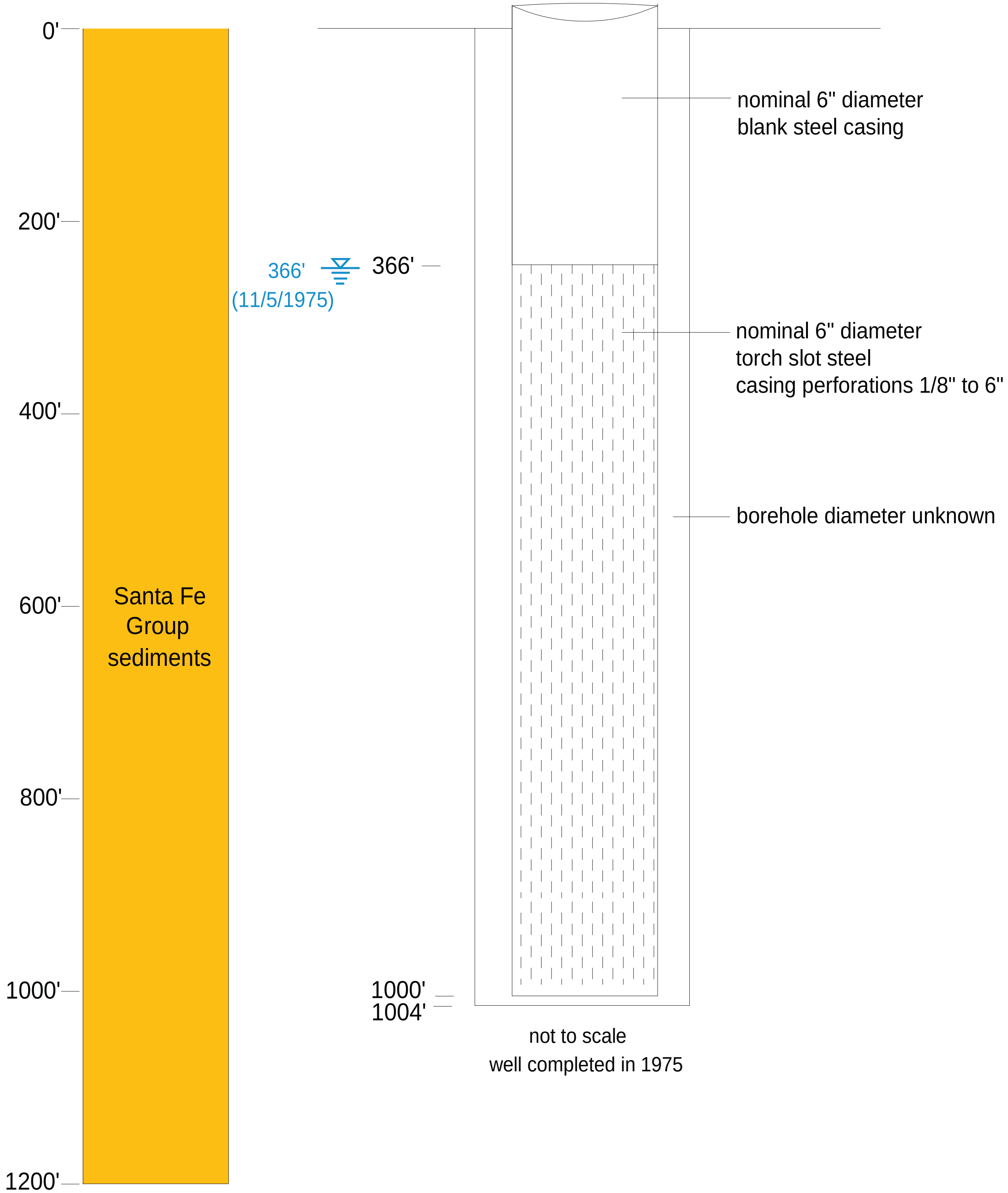


Figure B17. Well completion diagram for LRG-4652-S-16 (MW-8), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

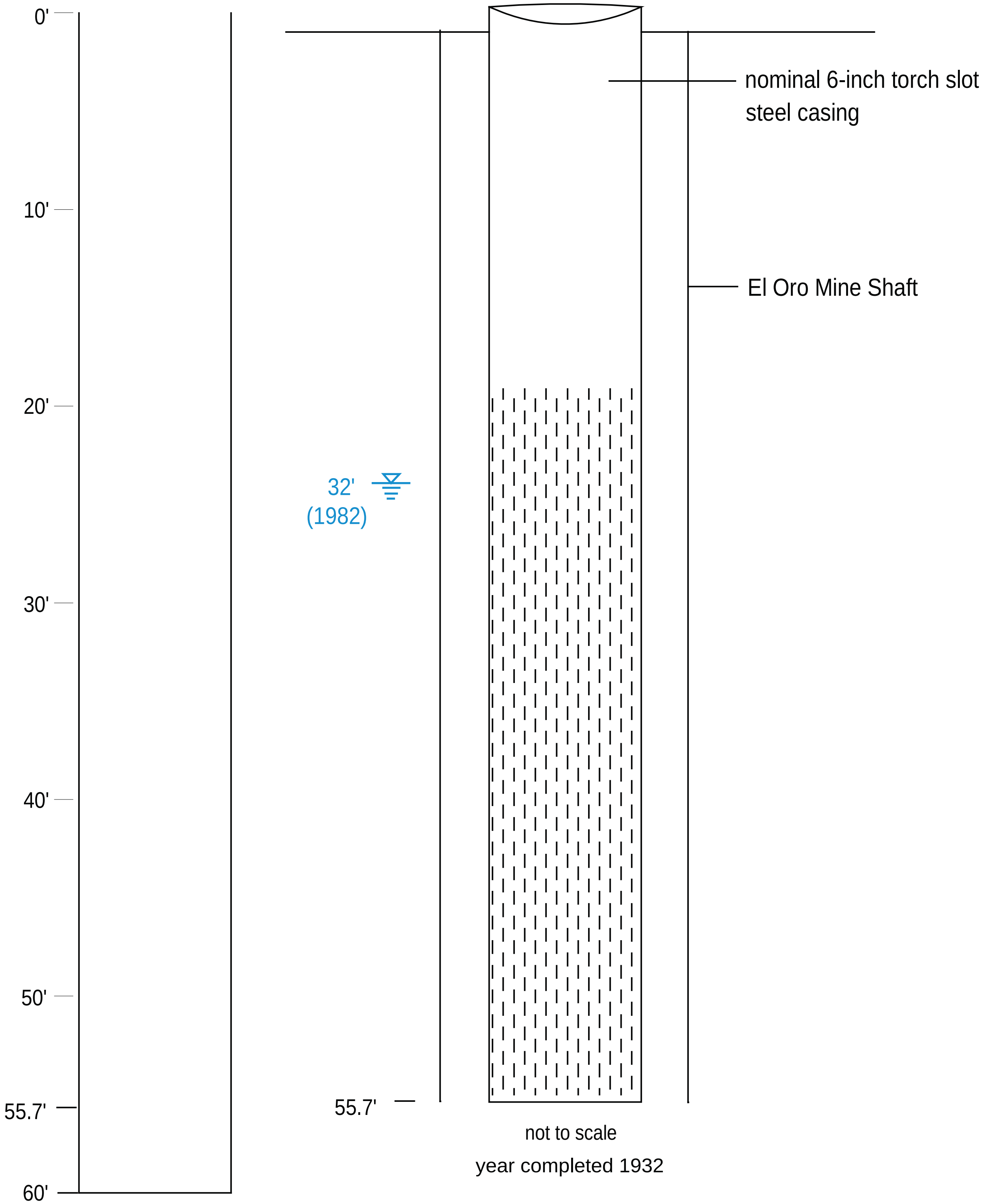


Figure B18. Well completion diagram for LRG-4654 (Old El Oro, Dolores), Copper Flat Mine, Sierra County, New Mexico.

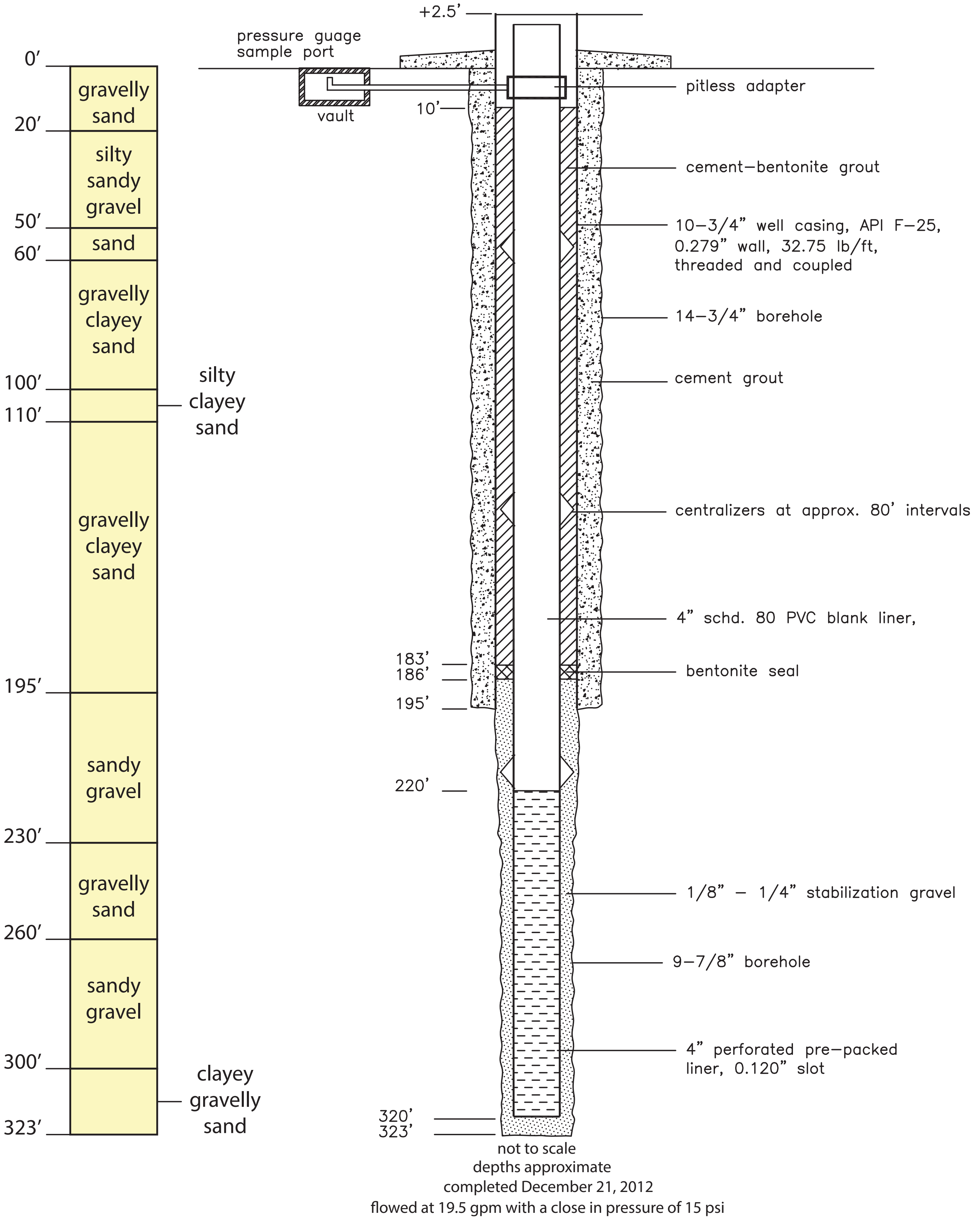
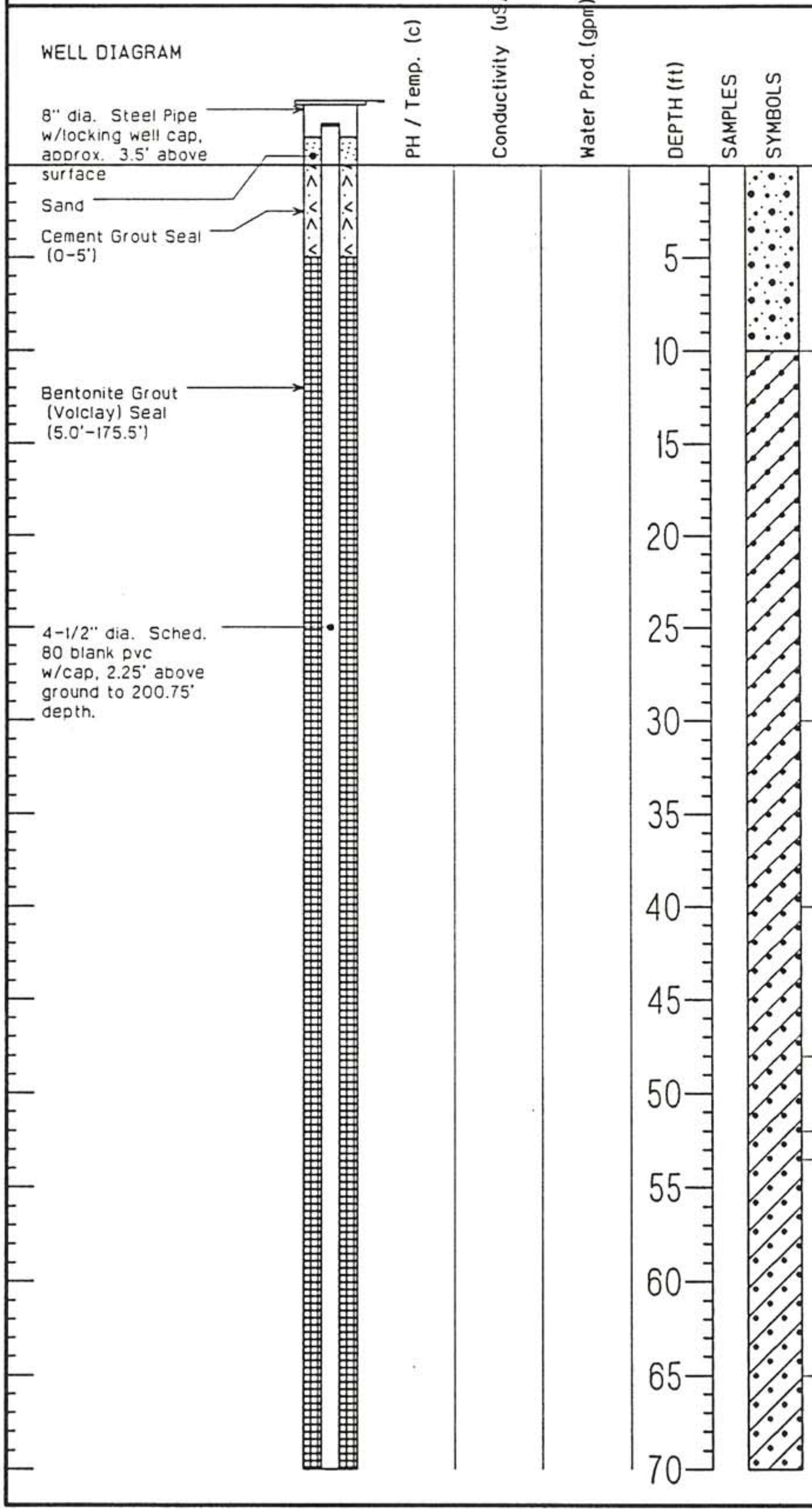


Figure B19. Well completion diagram for GWQ-11-27 (LA 00228 POD 1), Copper Flat Mine, Sierra County, New Mexico

Steffen Robertson and Kirsten
Engineering and Environmental Consultants

LOG OF MONITORING WELL MW-9

Page 1 of 4



MATERIALS DESCRIPTION

0-10', Soil/gravel, dark brown, w/abundant, silt, sand, cobbles/pebbles, wet @ 8'

7.75', ENCOUNTERED GROUNDWATER

10'-30', Alluvial gravels, varying amounts of silt/clay, sand & silt, abundant pebbles/cobbles very poorly sorted, Oxidized, wet

30'-40', Gravel, brown-slightly red brown, within clayey matrix very poorly sorted, min.-mod. sand, Oxidized, wet

40'-48', Gravel, as above with less clay/silt matrix.

48'-52', Gravel, brown-red brown within clay/silt matrix, min.-mod. sand very poorly sorted, wet.

52'-53.5', Gravel, as at 40'-48', relatively clean

53.5'-65', Gravel, brown-red brown, moderate-abundant clay/silt matrix, minor sand, very poorly sorted; wet

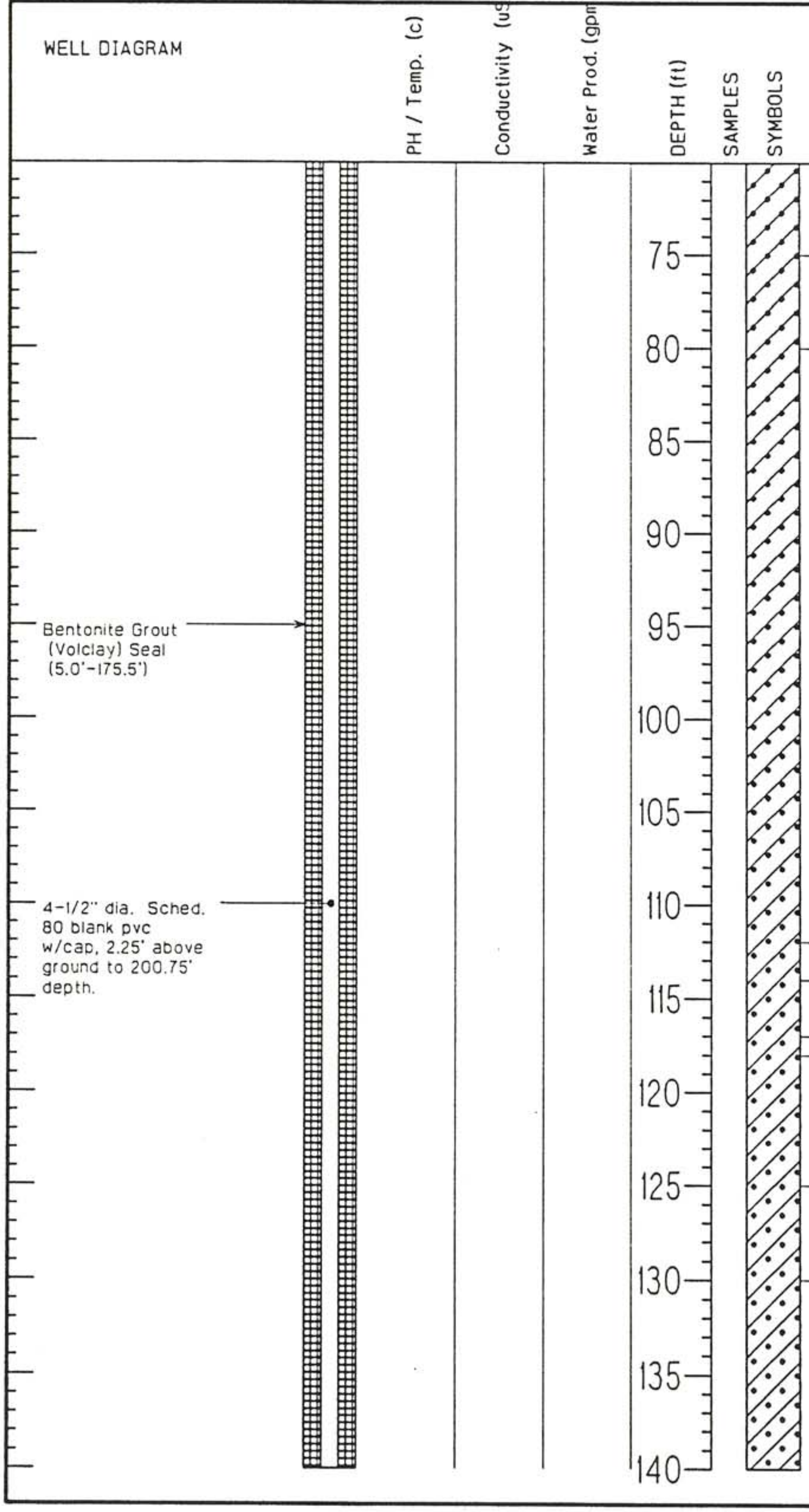
65'-75', clay, dark red-brown, w/min.-mod. sand & pebbles, no cobbles, moist-wet, very smooth drilling

PROJECT Copper Flat - Hillsboro, N.M.
LOCATION N713191.10, E603249.22 N.M. S.P.C.
JOB NUMBER 68607 (ref: 68607M9)
GEOLOGIST C.W.
DRILL RIG Air Rotary

DRILLING COMPANY Beylik Drilling
DATE DRILLED 09/20/94 - 09/26/94
SURFACE ELEVATION 4440.14
TOTAL DEPTH OF HOLE 252.50 Feet
WATER LEVEL Static, from TOC on 11/7/94: 71.05 Feet

Steffen Robertson and Kirsten
Engineering and Environmental Consultants

LOG OF MONITORING WELL MW-9



MATERIALS DESCRIPTION

75'-80', Gravel, very clayey/silty matrix, red-brown, trace-min. sand, very poorly sorted, wet

80'-112', Gravel, light-med brown-grey brown, min.-mod. dry/silt, min.-mod. sand, wet. Very clayey zone @ 80'-82'.

112'-114', Gravel, med. brown-red brown in clayey matrix, min.-mod. sand, wet.

114'-117', Gravel, dark brown-red brown, min.- mod. clay/silt, trace sand, wet.

117'-118', As at 114-117 with abundant clay/silt.

118'-125', Gravel, med. red brown, min.-mod. clay/silt matrix, trace-min. sand, Oxidized.

125'-130', Gravel, dark brown-red brown, abundant clay/silt matrix, min. sand, Oxidized

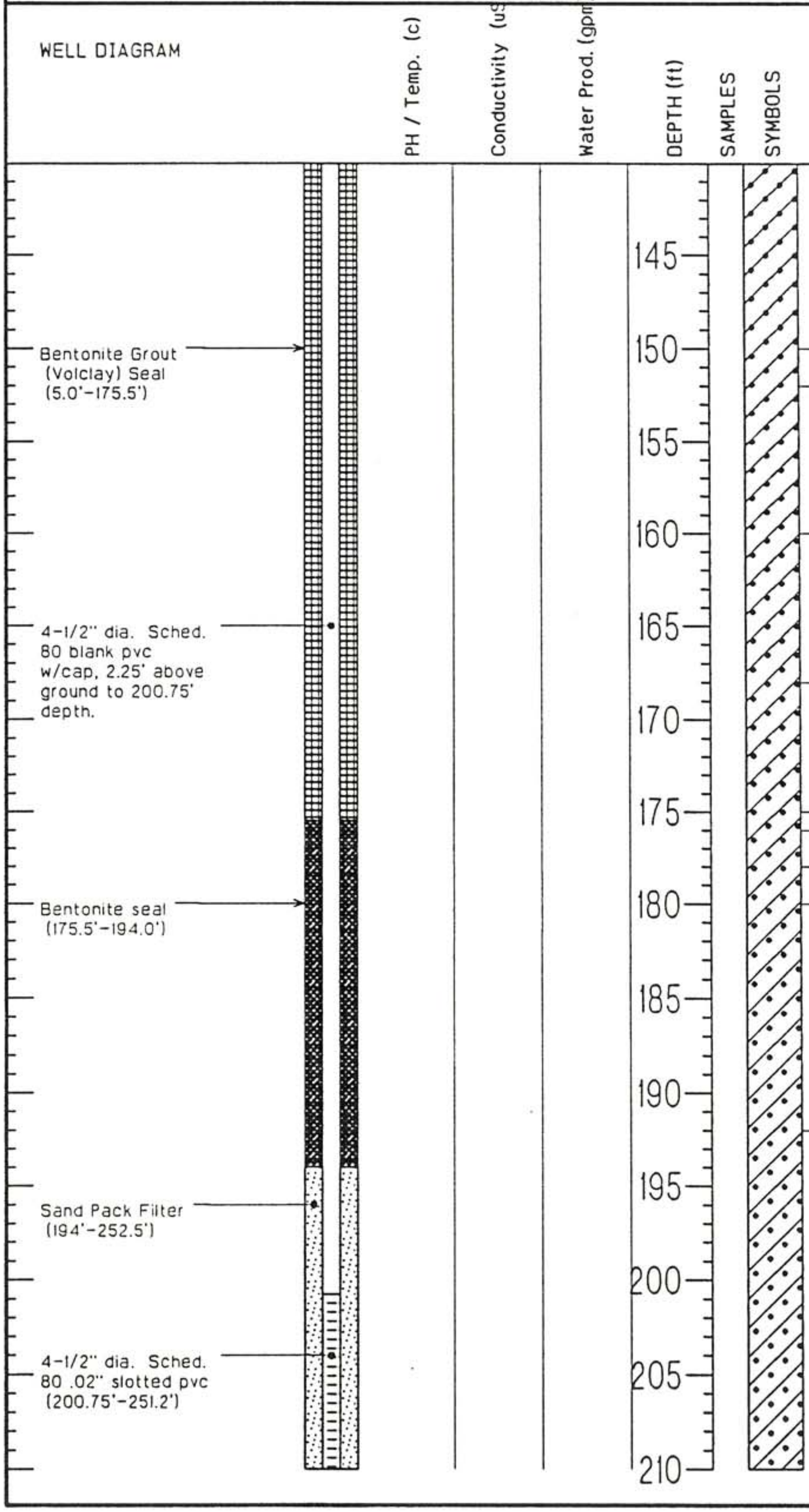
130'-150', Gravel, med. red brown, mod. silt/clay matrix, very poorly sorted, Oxidized.

PROJECT Copper Flat - Hillsboro, N.M.
LOCATION N713191.10, E603249.22 N.M. S.P.C.
JOB NUMBER 68607 (ref: 68607M9)
GEOLOGIST C.W.
DRILL RIG Air Rotary

DRILLING COMPANY Beylik Drilling
DATE DRILLED 09/20/94 - 09/26/94
SURFACE ELEVATION 4440.14
TOTAL DEPTH OF HOLE 252.50 Feet
WATER LEVEL Static, from TOC on 11/7/94: 71.05 Feet

Steffen Robertson and Kirsten
Engineering and Environmental Consultants

LOG OF MONITORING WELL MW-9



MATERIALS DESCRIPTION

130'-150', Gravel, med. red brown, mod. silt/clay matrix, very poorly sorted, Oxidized.

150'-152', Gravel as above w/abundant clay/silt matrix.

152'-160', Gravel, med. red brown, mod. clay/silt matrix material (less than @ 150-152)

160'-168', Gravel, dark red brown, abundant clay/silt matrix

168'-175', Gravel, medium brown-red brown, min.- mod. clay/silt matrix (most of matrix material washed out of cuttings)

175'-176', Sand in clay/silt matrix, med-very coarse, minor pebbles.

176'-178', Gravel, dark grey brown - red brown, w/min. - mod. clay/silt matrix, wet w/mod. sand.

178'-180', Gravel, brown-red brown, mod. sand, mod.-abundant clay/silt, Oxidized.

180'-192', Gravel, red brown, min.- mod. sand, min.- mod. clay/silt matrix, wet.

192'-202', Gravel, dark brown-red brown, mod.- abundant clay/silt matrix.

202'-253', Gravel, light-red brown, w/mod. sand, abundant pebbles/cobbles, min.- mod. clay/silt matrix, very poorly sorted, Oxidized, very uniform throughout zone, wet.

PROJECT	Copper Flat - Hillsboro, N.M.	DRILLING COMPANY	Beylik Drilling
LOCATION	N713191.10, E603249.22 N.M. S.P.C.	DATE DRILLED	09/20/94 - 09/26/94
JOB NUMBER	68607 (ref: 68607M9)	SURFACE ELEVATION	4440.14
GEOLOGIST	C.W.	TOTAL DEPTH OF HOLE	252.50 Feet
DRILL RIG	Air Rotary	WATER LEVEL	Static, from TOC on 11/7/94: 71.05 Feet

Steffen Robertson and Kirsten
Engineering and Environmental Consultants

LOG OF MONITORING WELL MW-9

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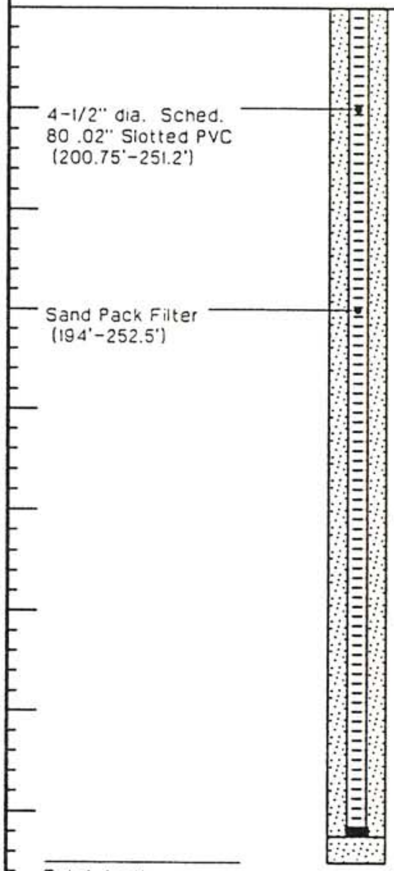
WELL DIAGRAM



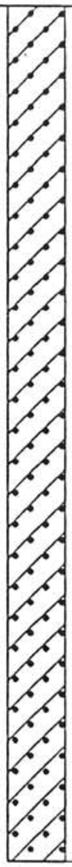
Total depth = 252.5'

PH / Temp. (c)	Conductivity (uS/m)	Water Prod. (gpm)
7.93 / 20	250	23
8.07 / 21	240	24
8.42 / 22	250	20
8.23 / 22	230	100
7.83 / 22	330	30 - 40

DEPTH (ft): 215, 220, 225, 230, 235, 240, 245, 250, 255, 260, 265, 270, 275, 280

SAMPLES

SYMBOLS



MATERIALS DESCRIPTION

202'-253', Gravel, light-red brown, w/mod. sand, abundant pebbles/cobbles, min.-mod. clay/silt matrix, very poorly sorted, Oxidized, very uniform throughout zone, wet.

Total depth = 252.5'

WELL DEVELOPMENT DATA

DATE: Oct. 6, 1994

FLOW: 50 gpm

TIME (hrs.): 1.5

PROJECT Cooper Flat - Hillsboro, N.M.

LOCATION N713191.10, E603249.22 N.M. S.P.C.

JOB NUMBER 68607 (ref: 68607M9)

GEOLOGIST C.W.

DRILL RIG Air Rotary

DRILLING COMPANY Beylik Drilling

DATE DRILLED 09/20/94 - 09/26/94

SURFACE ELEVATION 4440.14

TOTAL DEPTH OF HOLE 252.50 Feet

WATER LEVEL Static, from TOC on 11/7/94: 71.05 Feet

Steffen Robertson and Kirsten
Engineering and Environmental Consultants

LOG OF MONITORING WELL MW-10

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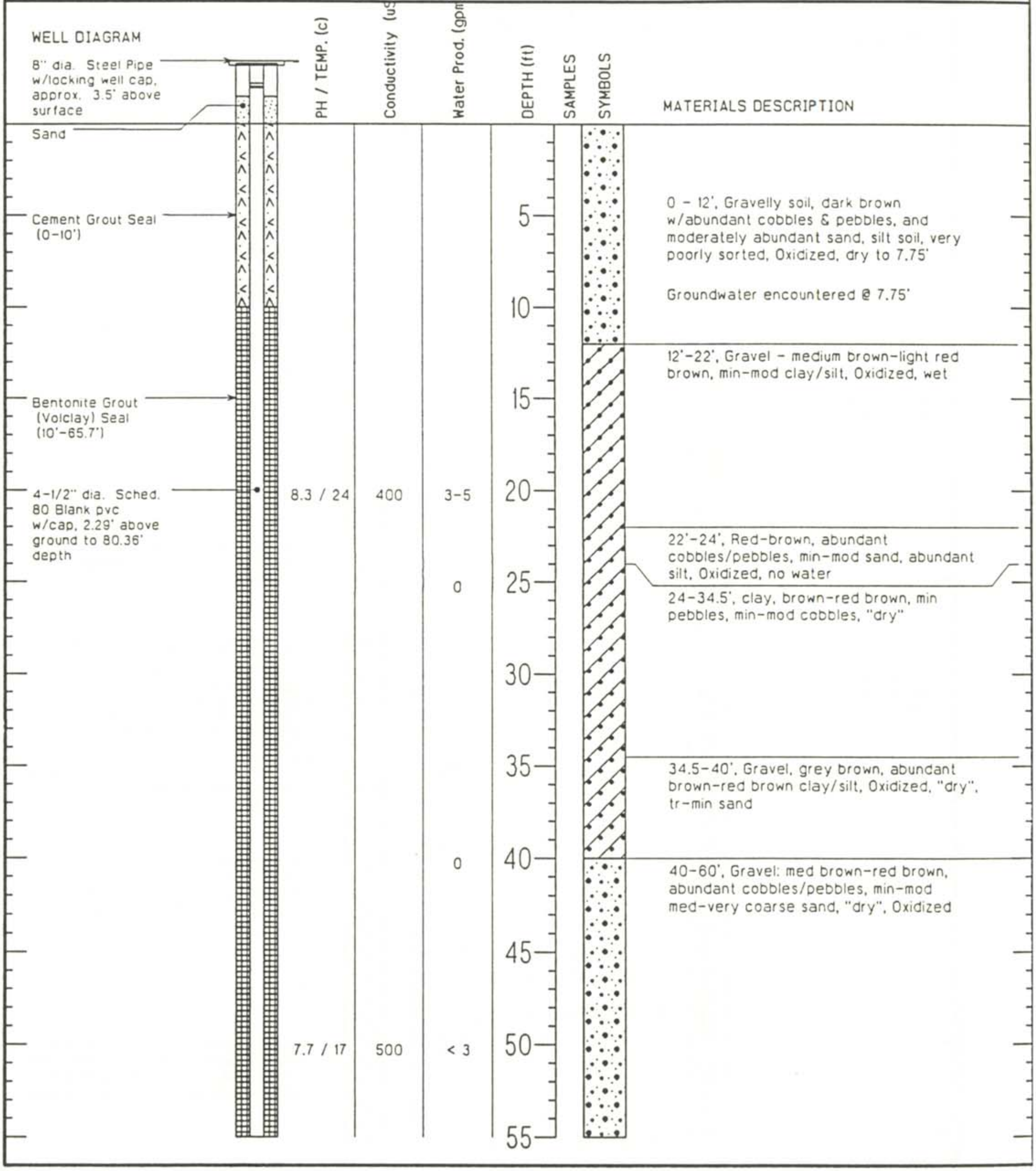


DEPTH (ft)	PH / TEMP. (c)	Conductivity (uS/m)	Water Prod. (gpm)
20	8.3 / 24	400	3-5
25			0
40			0
50	7.7 / 17	500	< 3

MATERIALS DESCRIPTION

0 - 12', Gravelly soil, dark brown w/abundant cobbles & pebbles, and moderately abundant sand, silt soil, very poorly sorted, Oxidized, dry to 7.75'

Groundwater encountered @ 7.75'

12'-22', Gravel - medium brown-light red brown, min-mod clay/silt, Oxidized, wet

22'-24', Red-brown, abundant cobbles/pebbles, min-mod sand, abundant silt, Oxidized, no water

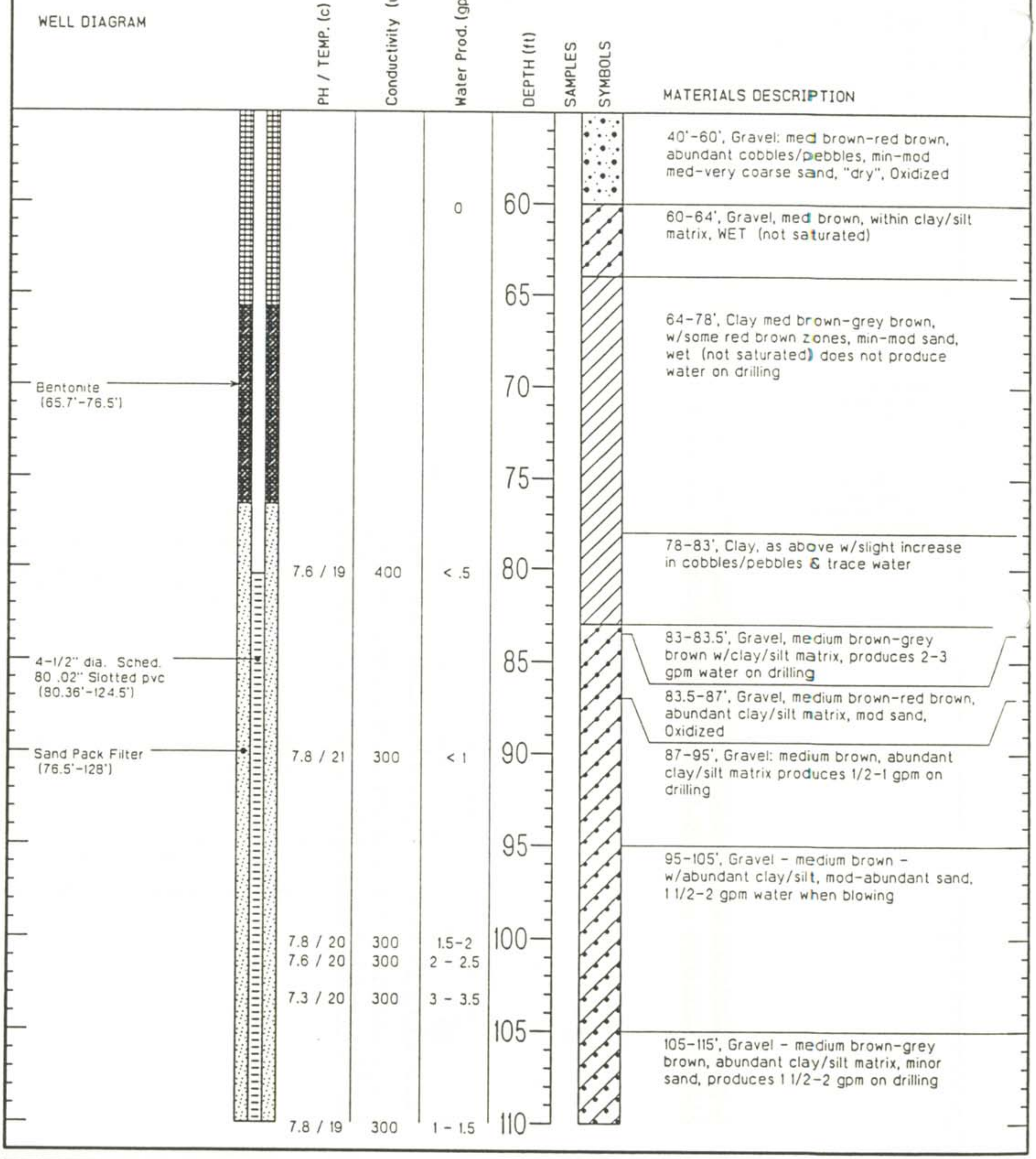
24-34.5', clay, brown-red brown, min pebbles, min-mod cobbles, "dry"

34.5-40', Gravel, grey brown, abundant brown-red brown clay/silt, Oxidized, "dry", tr-min sand

40-60', Gravel: med brown-red brown, abundant cobbles/pebbles, min-mod med-very coarse sand, "dry", Oxidized

PROJECT Copper Flat - Hillsboro, N.M.
LOCATION N719968.25, E636740.99 N.M. S.P.C.
JOB NUMBER 68607 (ref: 68607M10)
GEOLOGIST CW
DRILL RIG Air Rotary
DRILLING COMPANY Beylik Drilling
DATE DRILLED 10/94
SURFACE ELEVATION 4439.27
TOTAL DEPTH OF HOLE 128.0 Feet
WATER LEVEL Static, from TOC on 11/7/94: 70.625 Feet

LOG OF MONITORING WELL MW-10



DEPTH (ft)	PH / TEMP. (c)	Conductivity (uS/m)	Water Prod. (gpm)
60			0
80	7.6 / 19	400	< .5
90	7.8 / 21	300	< 1
100	7.8 / 20	300	1.5-2
	7.6 / 20	300	2 - 2.5
	7.3 / 20	300	3 - 3.5
110	7.8 / 19	300	1 - 1.5

MATERIALS DESCRIPTION

40'-60', Gravel: med brown-red brown, abundant cobbles/pebbles, min-mod med-very coarse sand, "dry", Oxidized

60-64', Gravel, med brown, within clay/silt matrix, WET (not saturated)

64-78', Clay med brown-grey brown, w/some red brown zones, min-mod sand, wet (not saturated) does not produce water on drilling

78-83', Clay, as above w/slight increase in cobbles/pebbles & trace water

83-83.5', Gravel, medium brown-grey brown w/clay/silt matrix, produces 2-3 gpm water on drilling

83.5-87', Gravel, medium brown-red brown, abundant clay/silt matrix, mod sand, Oxidized

87-95', Gravel: medium brown, abundant clay/silt matrix produces 1/2-1 gpm on drilling

95-105', Gravel - medium brown - w/abundant clay/silt, mod-abundant sand, 1 1/2-2 gpm water when blowing

105-115', Gravel - medium brown-grey brown, abundant clay/silt matrix, minor sand, produces 1 1/2-2 gpm on drilling

PROJECT Copper Flat - Hillsboro, N.M.
LOCATION N719968.25, E636740.99 N.M. S.P.C.
JOB NUMBER 68607 (ref: 68607M10)
GEOLOGIST CW
DRILL RIG Air Rotary
DRILLING COMPANY Beylik Drilling
DATE DRILLED 10/94
SURFACE ELEVATION 4439.27
TOTAL DEPTH OF HOLE 128.0 Feet
WATER LEVEL Static, from TOC on 11/7/94: 70.625 Feet

Steffen Robertson and Kirsten
Engineering and Environmental Consultants

LOG OF MONITORING WELL MW-10

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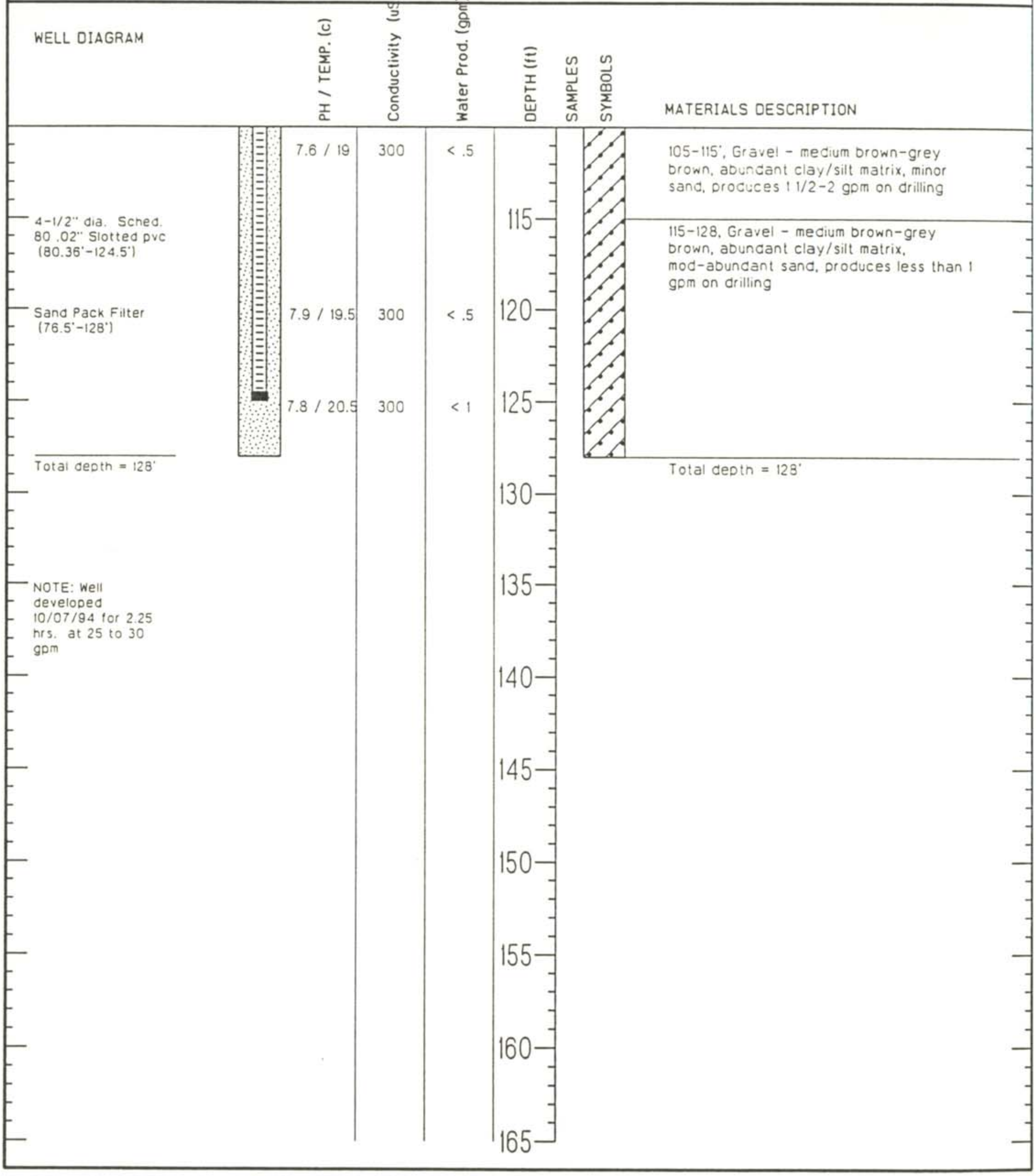

4-1/2" dia. Sched. 80 .02" Slotted pvc (80.36'-124.5')

Sand Pack Filter (76.5'-128')

Total depth = 128'

NOTE: Well developed 10/07/94 for 2.25 hrs. at 25 to 30 gpm

PH / TEMP. (c)	Conductivity (uS/m)	Water Prod. (gpm)
7.6 / 19	300	< .5
7.9 / 19.5	300	< .5
7.8 / 20.5	300	< 1

MATERIALS DESCRIPTION

105-115', Gravel - medium brown-grey brown, abundant clay/silt matrix, minor sand, produces 1 1/2-2 gpm on drilling

115-128, Gravel - medium brown-grey brown, abundant clay/silt matrix, mod-abundant sand, produces less than 1 gpm on drilling

Total depth = 128'

PROJECT Copper Flat - Hillsboro, N.M.
LOCATION N719968.25, E636740.99 N.M. S.P.C.
JOB NUMBER 68607 (ref: 68607M10)
GEOLOGIST CW
DRILL RIG Air Rotary
DRILLING COMPANY Beylik Drilling
DATE DRILLED 10/94
SURFACE ELEVATION 4439.27
TOTAL DEPTH OF HOLE 128.0 Feet
WATER LEVEL Static, from TOC on 11/7/94: 70.625 Feet

Steffen Robertson and Kirsten
Engineering and Environmental Consultants

LOG OF MONITORING WELL MW-11

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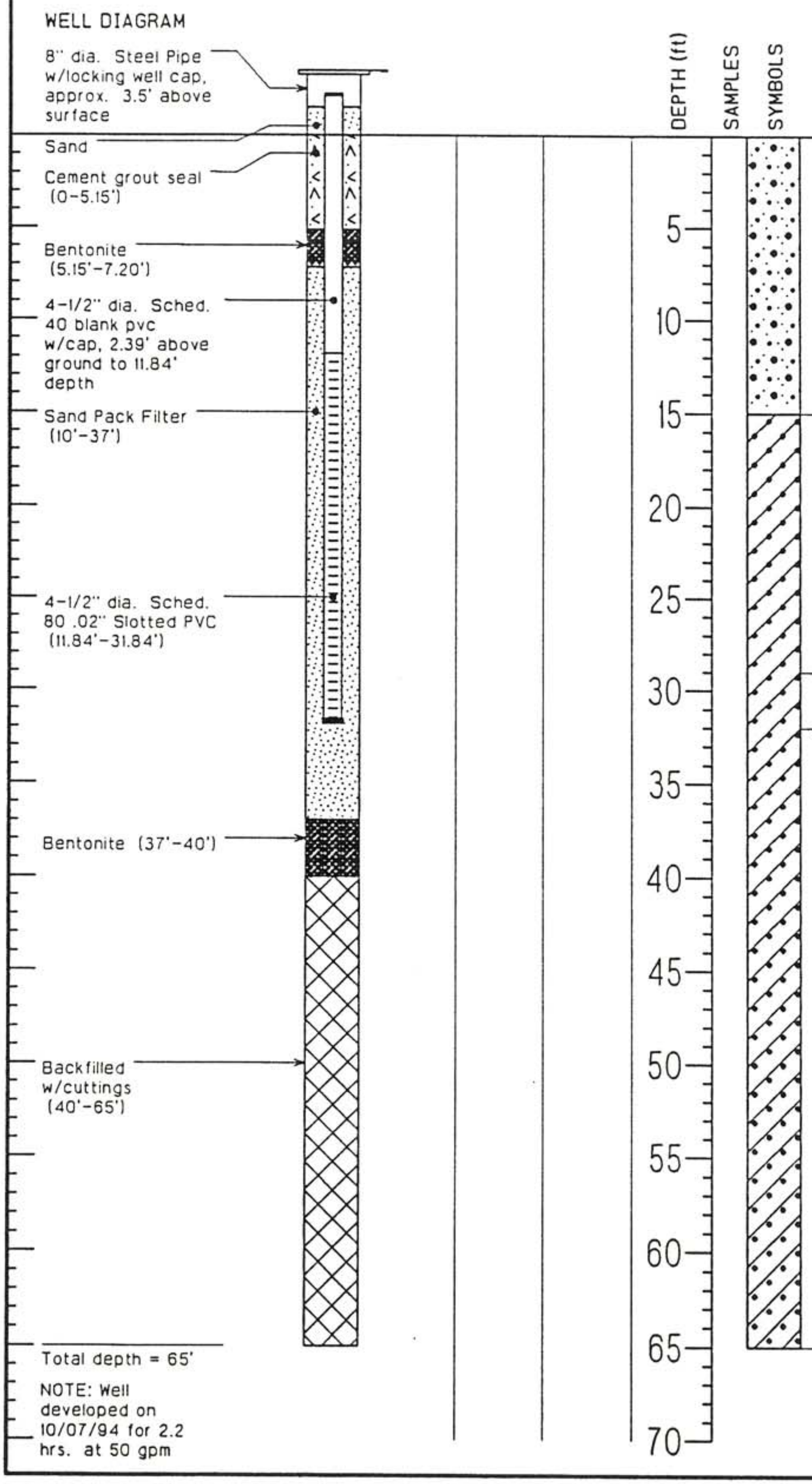


MATERIALS DESCRIPTION

0-15', Soil and gravel, dark brown, abundant cobbles, min.- mod. sand, wet @ 15'.

15'-29', Gravel: med. dark brown, silty soil matrix w/mod. clay, wet.

29'-32', Clay/silt, med. dark brown, moist - damp, (not saturated) abundant cobbles/pebbles, min.- mod. sand.

32'-65', Clay, as above but "dry"

Total depth = 65'

PROJECT	Copper Flat - Hillsboro, N.M.	DRILLING COMPANY	Beylik Drilling
LOCATION	N713751.31, E603378.24 N.M. S.P.C.	DATE DRILLED	10/11/94
JOB NUMBER	68607 (ref: 68607M11)	SURFACE ELEVATION	4439.48
GEOLOGIST	CW	TOTAL DEPTH OF HOLE	65 Feet
DRILL RIG	Air Rotary	WATER LEVEL	Static, from TOC on 11/7/94: 10.65 Feet

Appendix C1.

Initial PW- Well Pumping Tests, 1975-1980

BD - 1

P.G.D - 1

VB - 1

MHM - 1

Water Development Corporation
CONSULTANTS IN WATER RESOURCES

3938 Santa Barbara Avenue
TUCSON, ARIZONA 85711

Phone: 602-326-1133
Cable: WADEVCO, Tucson

RECEIVED
FEB 19 1976
QUINTANA

February 17, 1976

W. E. S.
FEB 20 1976

Mr. W. E. Saegart, President
Quintana Minerals Corporation
2475 North Jack Rabbit Avenue
Tucson, Arizona 85705

Dear Bill:

The purpose of this letter is to give a brief summary of the test results for the three production wells drilled for Quintana's Copper Flat Project.

Production Well No. 1 was tested for 70 hours at 1,500 gpm. Initial static water level was 331.8 feet. The final pumping water level was 381.6 feet giving a drawdown of 49.8 feet and a specific capacity of 30.1 gpm per foot of drawdown. Water levels were measured in MW-5 during the test on Production Well No. 1. At the end of 70 hours of pumping the decline in MW-5 amounted to 9.10 feet.

Production Well No. 2 was tested for 72 hours at a discharge rate of 2,020 gpm. Static water level at the beginning of the test was 310.4 feet and the final pumping water level was 413.7 feet giving a drawdown of 103.3 feet and a specific capacity of 19.6 gpm per foot of drawdown. During the test on Production Well No. 2 water levels were measured in MW-5 and Production Well No. 1. During the 72 hours of pumping the decline in MW-5 amounted to 3.82 feet and the decline in Production Well No. 1 amounted to 4.93 feet.

Production Well No. 3 was tested at a rate of 1,500 gpm for 72 hours Initial static water level was 350.8 feet and the final pumping water level was 454.2 feet. Drawdown amounted to 103.4 feet giving a specific capacity of 14.5 gpm per foot of drawdown. Water levels were measured in MW-5, MW-6, and Production Wells 1 and 2 during the test on Production Well No. 3. After 72 hours of pumping the declines were 2.07 feet in Production Well No. 1, 1.46 feet in Production Well No. 2, 2.04 feet in MW-5, and 0.51 feet in MW-6. Prior to and during the early stage of the test water levels were rising in MW-6. As MW-6 had recently been used to supply water for drilling the data for MW-6 are not considered valid.

In terms of specific capacity, Production Well No. 1 is the best well and we consider that this well could be operated at a discharge in the range of 1,800 to 2,000 gpm if necessary. We could not test it at this rate due to pump limitations and for the subsequent tests a larger pump was installed. Well No. 2 is the next best well. At a discharge rate of 2,020 gpm entrained air was beginning to appear in this well and we consider that a more reasonable pumping rate for this well would be in the range of 1,600 to 1,800 gpm. Well No. 3 was producing considerable entrained air at 1,500 gpm and we recommend that, unless necessary, this well not be pumped at a rate in excess of 1,000 to 1,200 gpm. During development this well had a specific capacity of about 20 gpm per foot of drawdown at 1,000 gpm.

The source of entrained air encountered in Production Wells 2 and 3 is from cascading water coming through the perforations and falling to the pumping water level. The deeper the pumping water level is below the top of the perforations the greater the amount of entrained air. We anticipated that this would be a problem in all of the production wells but due to the excellent specific capacity of Production Well No. 1 there was no entrained air at a discharge rate of 1,500 gpm. With a higher discharge rate it is considered likely that some air will appear in the discharge of this well.

The only guaranteed way to eliminate all entrained air from a well discharge is to install blank casing to a depth greater than the anticipated pumping water level. Due to the lenticular nature of the water bearing materials and the indication from the geophysical logs that some of the more productive materials were the shallower sediments, this would result in a substantial reduction in discharge and specific capacity. Thus, if maximum quantity of water is desired, it becomes necessary to produce some entrained air also. By going to deep pump settings a portion of the entrained air can be forced out of the water before it reaches the pump intake.

We are presently preparing a basic-data report on the production wells and an interpretive report related to the effect of operating the well field for a sustained period of time using aquifer coefficients as calculated from the test data. Based on raw data from the well tests we consider at the present time that the existing well field has the following range of capacity:

62, 4

Production Well No. 1	1,800 gpm to 2,000 gpm
Production Well No. 2	1,600 gpm to 1,800 gpm
Production Well No. 3	1,000 gpm to 1,200 gpm
Total	4,400 gpm to 5,000 gpm

Upon completion of our calculations related to well interference and long-term operation of the well field it may be necessary to modify the above figures. The modification, if necessary, is not considered likely to be substantial. Final selection of pumps and rates at which to operate each well should be delayed until reasonably accurate figures for mill water requirements are available.

Sincerely yours,

Don

Donald K. Greene

DKG/cm

GPM x 60 x 24 x 60% = GPD

$1 \text{ FT} = 43{,}560 \ \text{ft}^2/\text{ACRE} \times 7.5 \ \frac{\text{GAL}}{\text{FT}^3}$

2374

326,700 GAL/AC-FT.

~~6~~ 700 GPM x 60 x 24 x 60% x 3

2,112,912,000 GPY Allowed.

6467 AC-FT/YR.

5[illegible] [illegible] GPM – PW 1

PW 2

PW 3

WATER DEVELOPMENT CORPORATION

BASIC-DATA REPORT
QUINTANA MINERALS CORPORATION COPPER FLAT PROJECT PRODUCTION WELLS, HILLSBORO, NEW MEXICO

By

D. K. Greene and L. C. Halpenny

Tucson, Arizona
April 1976

CONTENTS

FIGURES

BASIC-DATA REPORT

QUINTANA MINERALS CORPORATION
COPPER FLAT PROJECT PRODUCTION WELLS
HILLSBORO, NEW MEXICO

By

D. K. Greene and L. C. Halpenny

GENERAL INFORMATION

A total of three production wells have been drilled to furnish the water supply for ore processing and other uses at the Copper Flat Project. Locations of the wells are shown on Figure 1 and legal descriptions are as follows:

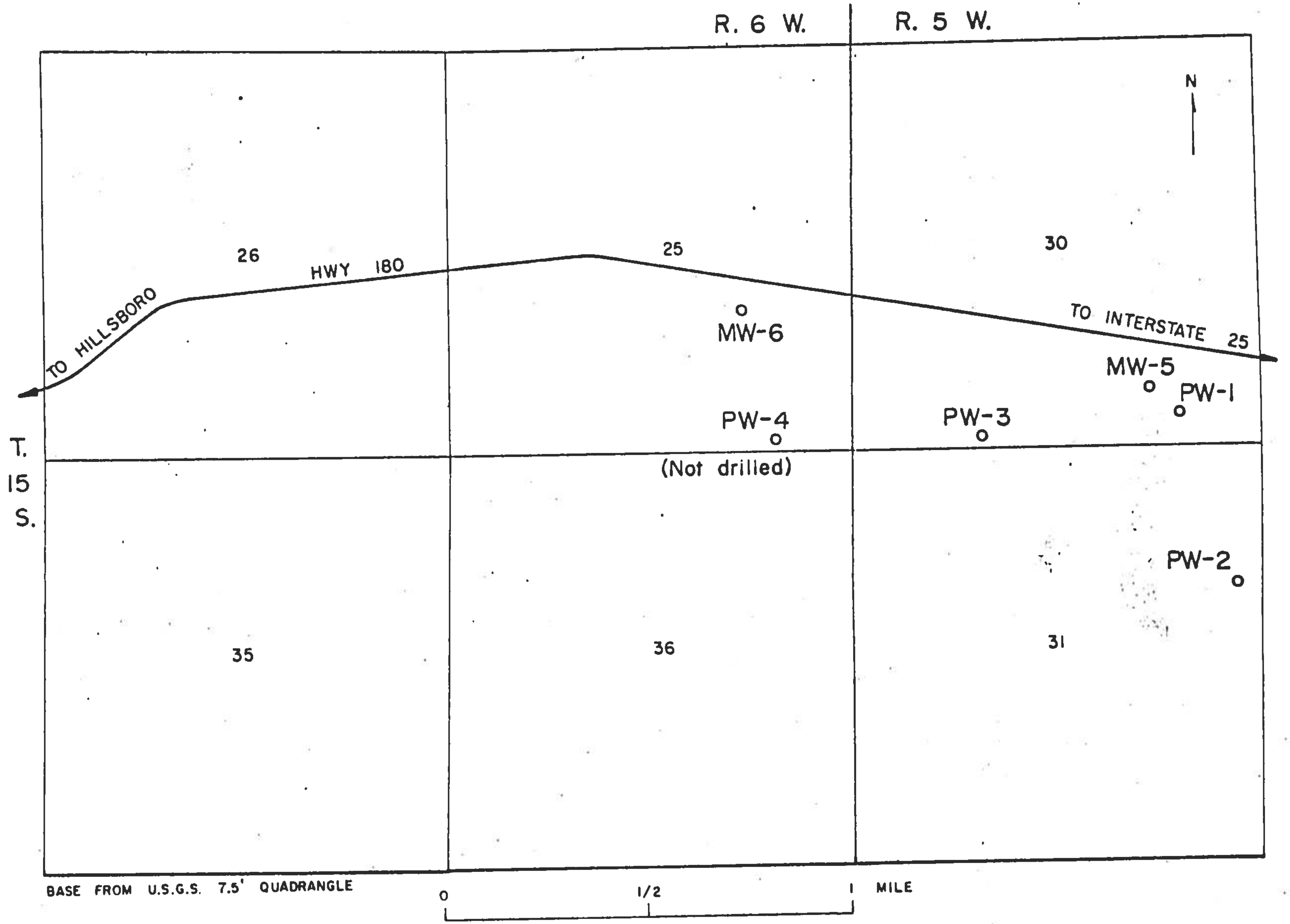


FIGURE 1.--MAP OF A PORTION OF TOWNSHIP 15 SOUTH, RANGES 5 AND 6 WEST, SIERRA COUNTY, NEW MEXICO, SHOWING LOCATIONS OF PRODUCTION WELLS AND MW-5 AND MW-6.

Production Well No. 1 (PW-1) SW$\frac{1}{4}$ SE$\frac{1}{4}$ SE$\frac{1}{4}$, Sec. 30, T. 15 S., R. 5 W.

Production Well No. 2 (PW-2) NE$\frac{1}{4}$ SE$\frac{1}{4}$ NE$\frac{1}{4}$, Sec. 31, T. 15 S., R. 5 W.

Production Well No. 3 (PW-3) SW$\frac{1}{4}$ SE$\frac{1}{4}$ SW$\frac{1}{4}$, Sec. 30, T. 15 S., R. 5 W.

The well field is located approximately 7.5 miles east of the proposed concentrator site and it will be necessary to pipe water this distance.

The wells were drilled by B. C. & M. Drilling, Inc. of Mesa, Arizona using reverse air rotary equipment, during the period December 1975-January 1976. Prior to start of drilling 30 feet of 30-inch diameter, 5/16-inch wall thickness, surface pipe was installed and cemented in at each site using an auger rig. During this phase of work a site for a fourth production well (PW-4) (see Figure 1) was prepared. This site was not drilled.

The general procedure in constructing the production wells was to drill a 26-inch diameter hole in one pass, install a 16-inch, 5/16-inch wall thickness, blank and perforated casing assembly with centering guides approximately every 100 feet, gravel pack the annular space with 1/8 to 3/8-inch gravel, and develop the well with the drilling rig by jetting and washing with the compressor. The perforations were vertical saw-cut slots 1/8-inch wide by 3-inches long with 36 cuts per round and two rounds per foot. Total open area amounted to about 27 square inches per foot.

Details on depth drilled, casing installed, etc., for each of the three production wells are as follows:

Production Well No. 1

Depth drilled	960 feet
Casing installed	
Blank	0 to 368 feet
Perforated	368 to 951 feet
Gravel installed	109 yards
Rig development time	33.5 hours
Gravel slippage during rig development	41 feet

Production Well No. 2

Depth drilled	1,005 feet
Casing installed	
Blank	0 to 376 feet
Perforated	376 to 995 feet
Gravel installed	116 yards
Rig development time	28 hours
Gravel slippage during rig development	43 feet

Production Well No. 3

Depth drilled	970 feet
Casing installed	
Blank	0 to 380 feet
Perforated	380 to 965 feet
Gravel installed	116 yards
Rig development time	35,5 hours
Gravel slippage during rig development	17 feet

Following completion of rig development each well was further developed and then tested with a diesel powered turbine pump supplied by Western Pump and Supply Company of Deming, New Mexico. Data obtained during this phase of the investigation are included in the following sections of this report along with logs and water analyses for each production well.

Quintana Minerals Corporation

2475 NORTH JACK RABBIT AVENUE
TUCSON, ARIZONA 85705
602/622-4801

Bob Donegan
Property Manager

FILE MEMORANDUM

TO: W. E. Saegart
P. G. Dunn
M. W. Hood

April 26, 1976

Hillsboro-Copper Flat
Water Wells

FROM: B. G. Donegan

Following are corrected elevations for the water wells given by Gordon McLain in telephone conversation today:

	PW 1	4693
	PW 2	4670
	PW 3	4717
(Proposed)	PW 4	4745
	MW 5	4700

The above are based on QMC elevation datum.

Bob Donegan

Bob Donegan

BD/ln

Hillsboro - Water
Extra file copies

Water Development Corporation

CONSULTANTS IN WATER RESOURCES

3938 Santa Barbara Avenue
Tucson Arizona 85711

Phone 602-326-1133
Cable WADEVCO Tucson

May 16, 1977

Mr. W. F. Saegart - President
Quintana Minerals Corporation
2475 North Jack Rabbit Avenue
Tucson, Arizona 85705

Re: Copper Flat Project, effect of pumping from wells

Dear Mr. Saegart:

In reply to your request for our opinion on the hydrology of the area of the Copper Flat Project water well field and the effect of pumping for 15 years from that well field, we submit the following information as an addendum to the opinions given in our April 1976 report entitled "Report on development of ground-water supply for Quintana Minerals Corporation Copper Flat Project, Hillsboro, New Mexico":

Extent of Cone of Depression

The aquifer characteristics of the Santa Fe Formation in the vicinity of the well field were developed from extended pumping of Production Wells 1, 2, and 3, and in our opinion are as follows:

Coefficient of transmissivity:	100,000 gal/day/ft
Long-term coefficient of storage:	0.10 dimensionless

The aquifer is less permeable westward toward the mountain front, based on data from test holes drilled during the exploration phase of the water well-field development program. The change toward finer-grained materials westward is gradual. No sharp barrier was found. The mathemathics of evaluating behavior of aquifers are amenable to analysis when a "negative barrier" of impermeable bedrock, or partially permeable materials occurs in one direction or more from a center of well pumping. However, for a gradational change in one or more directions it is necessary to assume the change is abrupt and is at a specified distance from the center of pumping. For this well field we have assumed that at a distance of one mile west of the center of pumping there is an abrupt change in the coefficient of transmissivity from 100,000 gpd/ft on the east side of a north-south line to 20,000 gpd/ft on the west side. The method for evaluating the effect upon water levels in an aquifer of a complete or partial line barrier is to assume the existence of an "image well" at a site on a line from the center of pumping perpendicular across the barrier, at a distance from the center of pumping equal to twice the distance from the center of pumping to the barrier.

We have made calculations of the drawdowns in water level in the Santa Fe aquifer along a north-south line through the center of pumping. These calculations are based on withdrawal of water from the well field during the first year at 6,000 gpm and for the next 14 years at 2,000 gpm. The calculations include the effect of the partial negative barrier westward. The results of the calculations are as follows:

Distance From the Center of Pumping (ft)	Decline of Water Levels in the Santa Fe Formation	
	After 1 Year (ft)	After 15 Years (ft)
5,000	13.6	18.5
10,000	5.4	13.7
20,000	.3	7.6
30,000	--	4.5
40,000	--	2.6
50,000	--	1.4
60,000	--	.6
70,000	--	.3
100,000	--	--

Decline of water levels eastward from the center of pumping would be less than the preceding tabulated figures because the effects of the assumed barrier decrease eastward.

Source of Recharge for Santa Fe Aquifer

The data given in our 1976 report include sea-level elevations of the water table (p. 18) and a discussion of the various factors affecting the water levels as determined (p. 19-21). The gradient of the water table as indicated by the water levels discussed in the report is clearly downward from west to east toward the Rio Grande, flattening eastward from about 200 feet per mile near the mountain front, decreasing to about 100 feet per mile and then to about 10 feet per mile in the vicinity of the well field. The eastward down-gradient direction of the water table indicates that ground water in the Santa Fe Formation is moving eastward, which in turn indicates that the sources of ground-water recharge are to the west. The north-south alignment of the water table contours indicates that the recharge is fairly uniform and is not concentrated in one place. In the western United States, hydrologic investigations during the past half century have indicated that ground-water recharge from rain falling directly on the desert floors is not great but that runoff in desert washes and mountain-front recharge are the major factors in replenishing the ground-water supply. In our opinion, the sources of recharge for the Santa Fe aquifer in the vicinity of the well field are infiltration of runoff from desert flood flows in Greyback Arroyo, Greenhorn Arroyo, Las Animas Creek, and Percha Creek plus mountain-front recharge.

Effect Upon Water Levels Along Animas Creek

Our April 1976 report discusses the fact that water levels in wells in the valley of Animas Creek are shallower than water levels in deep wells in the Santa Fe Formation by about 80 to 150 feet (p. 21-22). We consider that, although Las Animas Creek is a source of recharge to the Santa Fe Formation aquifer system, the low vertical permeability in the upper part of the Santa Fe Formation slows down the vertical percolation and permits existence of a perched shallow water table in the permeable younger sediments of the ancestral Las Animas Creek.

When water is moving vertically downward underground, the hydraulic head that is a component of that movement is 100 percent, one foot per foot. The factor that controls the downward rate of movement is the permeability of the materials through which the water is moving. If the upper portion of the Santa Fe Formation were highly permeable, all water in the younger alluvium along Las Animas Wash would readily sink, leaving the Las Animas Creek sediments dry and causing a higher water level in the underlying Santa Fe deposits.

Because of the existence of this blanket of finer-grained sediments between the coarse materials underlying Las Animas Creek and the permeable facies of the Santa Fe Formation from which the well field will produce, a water-level decline of about 13 feet in the Santa Fe Formation beneath the axis of Las Animas Creek after 15 years of pumping is not likely to lower water levels in shallow wells tapping the younger Las Animas Creek shoestring aquifer. The vertical gradient cannot increase above 100 percent and that is the gradient now, based on the data collected during the investigation in 1975-1976.

The chapter on quality of water in our 1976 report indicated a difference in chemical character exists between the shallow ground water along Las Animas Creek and the deeper ground water in the Santa Fe Formation (p. 24 and 27, Fig. 10 on p. 26). This confirms our opinion that there is not a direct connection between ground water in the two aquifer systems.

Subsurface Channels Within Santa Fe Formation

Geological field work during the course of our investigation in 1975-1976 indicated the existence of a coarser facies within the uppermost part of the Santa Fe Formation along an axis roughly from north-northwest to south-southeast visible in the canyon walls of Las Animas Creek and Lower Percha Creek. The Quintana well field is situated within this zone. The uppermost visible coarse-grained portion of the formation is underlain by a finer-grained zone which in turn is underlain by a coarser zone. The Quintana wells produce from the lower coarse zone. It is not known whether the trend of this lower coarse zone also is northwest-southeast. We have found no geological nor hydrological evidence of an "underground stream" trending in any direction. Instead the data indicate the well field is situated in a more permeable zone within the Santa Fe Formation, with ground water movement from west to east.

Were there to exist an underground stream along an axis from north-northwest to south-southeast, with recharge from a source somewhere to the north-northwest, pumping from the well field would not affect water levels upgradient beyond about 13 miles as shown in the tabulation set forth in a preceding part of this letter.

Respectfully submitted,
Water Development Corporation

By ______________________________
Leonard C. Halpenny, President

PRODUCTION WELL NO. 1
CUTTING LOG

(Prepared by B. Y. Kim, Geologist, Quintana Minerals Corporation)

Depth From (ft)	To	Pebble	Granule	Coarse Sand	Medium Sand	Fine Sand	Silt and Clay
30	50				30%	60%	10%
50	70	40%	50%	10%			
70	90	Minor	70%-80%	20%-30%	Minor	Minor	Minor
90	110	60%	30%	10%			
110	140	Minor	40%	40%	10%	5%	5%
140	160	60%	30%	10%			
160	180	20%	70%	10%			
180	200		Minor	20%	30%	30%	20%
200	220	10%	50%	40%			
220	240		Minor	20%	30%	20%	30%
240	250		60%	30%	Minor	5%	5%
250	270			Minor	10%-20%	40%	40%-50%
270	290	20%	40%	35%	Minor	Minor	5%
290	300		Minor	20%	30%	20%	30%
300	340		60%	30%	Minor	5%	5%
340	360		Minor	20%	20%	30%	30%
360	620	Minor	40%-70%	10%-30%	Minor	5%-15%	5%-15%
620	640		5%	5%	20%	30%	40%
640	660		40%	40%	Minor	10%	10%-20%
660	670	30%	40%	20%			10%
670	760	20%	40%	20%	Minor	5%	15%
760	770		5%	5%	20%	30%	40%
770	790	20%	40%	20%	Minor	5%	15%
790	800		Minor	10%	20%	40%	30%
800	960		40%-60%	10%-30%	5%	5%	20%

Well cuttings 360-620 feet generally uniform with coarse material (0.5mm) 60%-90%.

A few peanut-sized gravel at 880-890 feet with less amount of fine material; marked increase of fine material at 910-920 feet.

PRODUCTION WELL NO. 1
CUTTING LOG
(continued)

The following size ranges have been established from Wentworth Scale for classification of clastic sedimentary rock. The above log has been done by visual estimation according to the scale.

Pebble	Above 4 mm
Granule	2 mm - 4 mm
Coarse Sand	Very coarse - 1 mm - 2 mm Coarse - 0.5 mm - 1 mm (1/2 mm - 1 mm)
Medium Sand	0.25 mm - 0.5 mm (1/4 mm - 1/2 mm
Fine Sand	Fine - 0.125 mm - 0.25 mm (1/4 mm 1/8 mm) Very fine - 0.0625 mm - 0.125 mm (1/8 mm - 1/16 mm)
Silt and Clay	Less than 0.0625 mm (less than 1/16

PRODUCTION WELL NO. 1
DRILLERS LOG

Depth From (ft)	To	Sample Description
30	45	Fine silt.
45	50	Sand and silt.
50	55	Very hard rock.
55	90	Sand and rock.
90	105	Gravel and trace of clay.
105	115	Basalt, sand, little clay.
115	125	Basalt, sand.
125	135	Sand, clay, and some basalt.
135	155	Sand and rock.
155	165	Rock and some sand.
165	175	Small gravel and sand.
175	185	Clay with 5% sand.
185	195	Clay with 25% sand, some gravel.
195	206	Clay with gravel, 5% sand.
206	216	Gravel pediment with sand.
216	218	Clay.
218	222	Gravel pediment with 5% sand.
222	245	Clay.
245	255	Sand with cobbles, very hard.
255	265	Clay with 2% sand.
265	275	Sandy clay.
275	285	Sand and gravel.
285	295	Gravel and sand.
295	305	Sand and gravel with 80% clay.
305	315	Sand, gravel, and clay.
315	320	Gravel and clay.
320	325	Gravel, rock, and clay.
325	335	Basalt and rock.
335	340	Gravel and rock.
340	345	Clay and gravel.
345	355	Clay.
355	360	Clay and sand.
360	375	Sand and rock.
375	390	Sand, gravel, and clay.
390	406	Sand, rock, and clay.
406	415	Clay, sand, and gravel.
415	435	Sand and gravel.

PRODUCTION WELL NO. 1
DRILLERS LOG
(continued)

Depth From - To (ft)	Sample Description
435 - 445	Sand and some gravel.
445 - 469	Sand and little clay.
469 - 475	Sand and rock.
475 - 495	Pediment gravels, some sand.
495 - 505	Clay, 20% gravel.
505 - 525	Clay and gravel.
525 - 555	Sand and gravel.
555 - 565	Sand and 80% clay.
565 - 575	Sand, gravel, and some clay.
575 - 585	Sand and gravel.
585 - 590	Clay, sand, and gravel.
590 - 595	Sand and gravel.
595 - 605	Gravel and clay.
605 - 615	Clay, sand, and gravel.
615 - 620	Gravel and sand.
620 - 625	Sand.
625 - 630	Sand, gravel, 90% clay.
630 - 635	Clay.
635 - 645	Sand, 95% clay.
645 - 655	Sand, 35% clay.
655 - 665	Clay 50%, sand 50%.
665 - 675	Coarse sand 35%, gravel 35%, clay 30%.
675 - 685	Coarse sand, gravel.
685 - 709	Coarse sand 50%, gravel 20%, clay 30%.
709 - 715	Coarse sand 50%, gravel 10%, clay 40%.
715 - 725	Coarse sand 70%, gravel 20%, clay 10%
725 - 765	Gravel, clay, and sand.
765 - 785	Clay and gravel.
785 - 797	Sand, gravel, and clay.
797 - 805	Clay, sand, and gravel.
805 - 815	Sand 75%, gravel 10%, clay 15%.
815 - 835	Sand, gravel, and clay.
835 - 845	Sand 80%, gravel 15%, clay 5%.
845 - 850	Sand, clay, and gravel.
850 - 858	Sand and clay.
858 - 860	Clay and sand.
860 - 875	Sand.
875 - 888	Sand, some clay.

PRODUCTION WELL NO. 1
DRILLERS LOG
(continued)

Depth From (ft)	To	Sample Description
888	895	Sand, gravel, and clay.
895	905	Sand and clay.
905	917	Sand and gravel.
917	935	Clay 85%, gravel 5%, sand 10%.
935	947	Clay, gravel, and sand.
947	960	Clay, sand, and gravel.

PRODUCTION WELL NO. 1

DEVELOPMENT DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-18-75	09:48	329.3		Measuring with sounder. Measuring point top of 3/4-inch tube 1.65 feet above top of surface pipe. Surface pipe approximately 0.2 feet above land surface.
	10:00			Pump on. Eight-inch pump with bowls set at 550 feet. Discharge pipe 10-inch, orifice 6-inch.
	10:01	357.9		Decreasing RPM.
	10:02	348.9	370	Muddy, silty.
	10:03	345.3	395	
	10:04	344.4	370	Trace of sand.
	10:12	346.3	395	Clearing some.
	10:13			Increased RPM.
	10:14	350.0	500	
	10:15	350.6	500	Some mud, silt, trace of sand.
	10:20	352.1	500	
	10:27	352.4	500	
	10:44	353.1	500	Clearing.
	10:55			Surge.
	10:58			Lowering impellers.
	11:00			Pump on.
	11:05	350.3	500	Some color.
	11:12			Fairly clear, surge twice.
	11:18		760	Muddy, silty, no sand.
	11:19	358.8		
	11:25	360.8	760	Considerable color, silty.
	11:40	362.3	773	Clearing.
	11:45			T = 76° F, K = 350 micromhos.
	11:50	362.7	773	Fairly clear, surge twice.
	11:56			Silty.
	11:58		760	Clearing.
	12:00	356.9	760	

PRODUCTION WELL NO. 1

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-18-75	12:15	358.7	760	Fairly clear.
	12:22	359.0	760	T = 76° F, K = 340+ micromhos.
	12:23			Surge twice.
	12:30			Little mud and silt.
	12:33			Clearing.
	12:35	355.9	760	Fairly clear.
	12:40			Surge twice.
	12:47			Some color, no sand.
	12:50			Clearing.
	13:19	356.7	760	Surge twice.
	14:07	356 2	760	Clear, surge twice.
	14:15			Little color.
	14:18	353.1	760	Clear.
	14:20			Surge, change to 8-inch orifice.
	14:27			Pump on.
	14:29			Some color, no sand.
	14:30	358.4	1,040	
	14:35	361.6		
	14:52	363.7	1,060	Slight color.
	14:58	364.2	1,060	Surge.
	15:05			Fair amount of color, silt, no sand.
	15:08			Clearing.
	15:10	362.1	1,040	T = 76° F, K = 350 micromhos.
	15:30	363.8	1,050	Surge.
	15:35			Fair amount of color, silt.
	15:40			Clearing.
	15:58	361.8	1,030	Clear, surge twice.
	16:03			Some color, silt.
	16:28	363.5	1,060	Clear, surge twice.
	16:33			Some color, silt.
	16:37			Clearing.
	17:00	362.8	1,050	

PRODUCTION WELL NO. 1

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-18-75	17:05	378.6	1,500	Some color, no sand.
	17:10			Considerable color, silt.
	17:13	382.5	1,471	Lot of color, silt, <0.1 cc/l sand.
	17:19	382.2	1,438	
	17:28	382.6	1,421	
	17:38	382.5	1,404	Surge.
	17:45			Some color, silt.
	18:00	387.0	1,500	Surge twice.
	18:30		1,500	Surge.
	19:00		1,500	Surge.
	19:30		1,500	Surge.
	19:50	386.0	1,500	
	20:10			Surge twice.
	20:15		1,500	Some color.
	20:38	385.1	1,500	Clear, surge.
	21:07	383.6	1,493	Clear, surge twice.
	21:12			Some color, no sand.
	21:38	382.0	1,486	T = 76° F, K = 340 micromhos, clear, surge twice.
	21:45			Some color.
	22:20	381.2	1,493	Clear, surge twice.
	22:25			Some color.
	23:04	381.2	1,507	Clear, surge twice.
	23:10			Some color, silt.
	23:35	379.9	1,500	Clear, surge twice.
	23:40			Some color.
12-19-75	00:05	378.9	1,493	Clear, surge twice.
	00:10			Little color.
	00:30	378.4	1,493	Clear, surge twice.
	00:34	375.1	1,500	
	00:55	378.9	1,500	Clear, surge twice.
	01:05	375.7	1,500	Clear.
	01:40	378.6	1,500	Clear, surge twice.
	02:10	377.8	1,500	Clear, surge twice.

PRODUCTION WELL NO. 1

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-19-75	02:40	377.4	1,493	Clear, surge twice.
	03:10	377.0	1,500	Clear, surge twice.
	03:40	376.6	1,486	Clear, surge twice.
	04:10	376.3	1,493	Clear, surge twice.
	04:45	376.3	1,500	Clear, surge twice.
	05:15	375.7	1,493	Clear, surge twice.
	05:45	376.1	1.500	Clear, surge twice.
	06:15	376.6	1,500	Clear, surge twice.
	06:45	376.6	1,500	Clear, surge twice.
	07:00	377.0	1,500	Clear, surge twice.
	07:05			Very little color.
	07:30	376.0	1,493	Clear.
	07:35			T = 76° F, K = 340 micromhos.
	08:28	376.0	1,500	Clear.
	08:29			Increase RPM.
	08:30	380.9	1,641	
	08:32			Some color.
	08:33			Clearing.
	08:45	382.1	1,641	Clear, surge.
	08:50			Some color, then clear.
	09:00	381.5	1,634	Clear.
	09:15	381.9	1,634	Clear.
	09:18			T = 76° F, K = 340 micromhos.
	09:30	382.2	1,627	
	09:50	382.5	1,627	Clear.
	10:00			Pump off.
	10:01	338.4		
	10:02	338.1		
	10:03	339.8		
	10:04	339.3		
	10:05	338.6		
	10:06	338.3		
	10:07	337.8		

PRODUCTION WELL NO. 1

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-19-75	10:08	337.5		
	10:09	337.2		
	10:10	336.8		
	10:15	335.7		
	10:20	335.0		
	10:30	334.1		
	10:38	333.4		
	12:09	330.4		
	13:18	329.8		
	14:03	329.5		
	15:40	329.1		
	15:47	332.77		Measured with chain.

PRODUCTION WELL NO. 1

TEST DATA

cofpw1.wk1

time (min) C6..c98
WL d6..d98
MW-5 WL e6..e98

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-20-75	08:00	331.82		Measured with chain. Same measuring point as for development.
	09:22	331.82		Measured with chain.
	09:32	331.8		Set sounder at 331.8.
	11:00	331.8 -1.85= 330.0 GL		Pump on. Same setting as for development.
	11:01	360.8	1,500	
	11:02	363.5	1,500	
	11:03	365.9	1,500	
	11:04	367.2	1,500	
	11:05	367.9	1,500	
	11:06	368.5	1,500	Clear.
	11:07	369.2	1,500	
	11:08	369.7	1,500	
	11:09	370.1	1,500	
	11:10	370.2	1,500	
	11:12	370.8	1,500	
	11:14	371.1	1,500	
	11:16	371.4	1,500	
	11:18	371.8	1,500	
	11:20	372.0	1,500	
	11:25	372.6	1,500	
	11:30	373.3	1,500	
	11:35	373.7	1,500	
	11:40	374.1	1,500	
	11:50	374.7	1,500	
	12:00	375.0	1,500	
	12:15	375.5	1,500	
	12:30	376.0	1,500	
	12:45	376.3	1,500	
	13:00	376.7	1,500	
	13:30	377.4	1,500	
	14:00	377.6	1,500	
	15:00	378.2	1,500	

PRODUCTION WELL NO. 1

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-20-75	16:00	378.6	1,500	Clear.
	17:00	379.2	1,500	
	18:00	379.3	1,500	
	19:00	379.6	1,500	
	20:00	379.9	1,500	
	21:00	380.2	1,500	
	22:00	380.4	1,500 +	Decrease RPM.
	23:00	380.3	1,500	
	24:00	380.4	1,500	
12-21-75	01:00	380.4	1,500	
	01:50			T = 76° F, K = 340 micromhos.
	02:10	380.4	1,500	
	03:00	380.6	1,500	
	04:00	380.6	1,500	
	05:00	380.8	1,500	
	06:00	380.0	1,486	Increase RPM.
	06:50			T = 76° F, K = 340 micromhos.
	07:00	381.0	1,500	
	08:00	381.1	1,500	
	09:00	381.4	1,500	
	10:00	381.4	1,500 +	Decrease RPM.
	11:00	381.3	1,500	
	12:00	381.2	1,500	
	13:00	381.3	1,500	
	13:15			T = 76° F, K = 340 micromhos.
	14:20	381.3	1,500 -	Increase RPM.
	15:00	381.3	1,500	
	16:00	381.2	1,500	
	17:00	381.4	1,500	
	18:00	381.4	1,500	
	19:00	381.4	1,500	
	20:00	381.4	1,500	

PRODUCTION WELL NO. 1

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-21-75	21:00	381.5	1,500	
	22:00	381.7	1,500 +	Decrease RPM.
	23:00	381.4	1,500	
	24:00	381.4	1,500	
12-22-75	02:00	381.5	1,500	
	03:00	381.4	1,500	
	04:00	381.4	1,500	
	05:00	381.7	1,500	
	06:00	381.4	1,486	Increase RPM.
	07:00	381.0	1,500	
	08:00	381.3	1,500	
	09:00	381.4	1,500 +	Decrease RPM.
	10:00	381.4	1,500	
	11:00	381.4	1,500	
	12:00	380.7	1,500 -	Increase RPM.
	13:00	381.1	1,500	
	14:00	381.3	1,500	
	14:30	381.3	1,500	
	15:00	381.4	1,500	
	16:00	381.4	1,500	
	17:00	381.4	1,500	
	18:00	381.6	1,500	
	19:10	381.6	1,500	
	24:00	382.0	1,500	
12-23-75	03:00	381.7	1,500	
	07:00	381.6	1,500	
	08:45	381.6	1,500	T = 76°F, K = 340 micromhos. Collected water samples
	09:00			Pump off.
	09:01	340.9		
	09:02	342.7		
	09:03	342.2		
	09:04	341.6		
	09:05	341.3		
	09:06	341.1		
	09:07	340.2		
	09:18	338.8		
	09:30	337.5		

PRODUCTION WELL NO. 1

TEST DATA

(Observation Well MW-5 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
12-18-75	07:55	335.58	Measured with chain. Measuring point top of 6-inch casing approximately 1 foot above land surface.
	08:10	335.57	Measured with chain. Set sounder with tape mark at 335.57.
	10:00		PW-1 pump on for development.
	10:52	337.15	
	14:48	339.33	
12-19-75	07:40	344.03	
	09:12	344.54	
	10:00		PW-1 pump off.
	10:24	342.18	
	12:06	338.91	
	13:22	338.22	
	14:10	337.95	
	15:32	337.63	
12-20-75	07:43	336.73	Measured with chain. Set sounder with tape mark at 336.73.
	09:46	336.69	
	11:00	336-69	PW-1 pump on for test.
	11:01	336.73	
	11:02	336.90	
	11:03	337.14	
	11:04	337.32	
	11:05	337.52	
	11:06	337.61	
	11:07	337.81	
	11:08	337.89	
	11:09	338.05	
	11:10	338.19	
	11:11	338.31	
	11:12	338.47	
	11:13	338.51	
	11:14	338.62	

PRODUCTION WELL NO. 1

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-20-75	11:15	338.77	
	11:16	338.82	
	11:17	338.93	
	11:18	339.00	
	11:19	339.16	
	11:20	339.19	
	11:23	339.45	
	11:25	339.67	
	11:30	339.89	
	11:35	340.08	
	11:40	340.30	
	11:45	340.41	
	11:50	340.65	
	12:00	341.00	
	12:15	341.30	
	12:30	341.69	
	12:45	341.86	
	13:00	342.18	
	13:30	342.52	
	14:00	342.75	
	15:05	343.18	
	16:05	343.42	
	17:05	343.61	
	18:05	343.74	
	19:05	344.09	
	20:05	344.12	
	21:10	344.24	
	22:10	344.36	
	23:10	344.43	
12-21-75	00:10	344.51	
	01:30	344.54	
	02:00	344.68	
	03:05	344.75	
	04:05	344.81	

PRODUCTION WELL NO. 1

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-21-75	05:05	344.87	
	06:05	344.87	
	07:05	344.83	
	08:05	345.02	
	09:05	345.00	
	10:05	345.02	
	11:05	345.03	
	12:05	345.07	
	13:05	345.06	
	14:15	345.03	
	15:05	345.10	
	16:05	345.10	
	17:05	345.18	
	18:05	345.16	
	19:05	345.16	
	20:05	345.23	
	21:05	345.22	
	22:05	345.25	
	23:05	345.27	
12-22-75	00:05	345.31	
	01:25	345.21	
	02:00	345.52	
	03:05	345.44	
	04:05	345.39	
	06:05	345.37	
	07:05	345.32	
	08:05	345.38	
	09:05	345.52	
	10:05	345.54	
	11:05	345.58	
	13:10	345.54	
	14:10	345.54	
	15:05	345.61	
	16:05	345.57	

PRODUCTION WELL NO. 1

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-22-75	17:05	345.66	
	18:05	345.63	
	19:05	345.58	
12-23-75	00:10	345.70	
	03:10	345.78	
	07:10	345.71	
	08:50	345.79	
	09:00		PW-1 pump off.
	09:14	344.08	
	09:25	343.20	
	09:45	342.15	

BC
LABORATORIES Inc.
OIL - CORES - SOIL - WATER

3016 UNION AVENUE
BAKERSFIELD, CALIFORNIA 93305
Phone (805) 325-7475

J. J. EGLIN, Reg. Chem. Engr.

Submitted By: Water Development Corporation
3839 Santa Barbara Ave.
Tucson, Arizona 85711

Date Reported: 1/16/76
Date Received: 1/8/76
Laboratory No.: 9939

Marked: Quintana No. 1 12/23/75 08:45 T: 76° K: 340

WATER ANALYSIS

Sample Description:

pH	7.8
E.C. Micromhos/cm (K x 10^6) @ 25°C (salinity)	
Resistivity, Ohm M^2/M	

Constituents, P. P. M. (parts per million)

ron, (B)	
Calcium, (Ca)	22.
Magnesium, (Mg)	2.8
Sodium, (Na)	38.
Potassium, (K)	4.5
Carbonates, (CO_3)	0.
Bicarbonates, (HCO_3)	144.6
Chlorides, (Cl)	16.3
Sulphates, (SO_4)	10.
Nitrate, (NO_3)	3.53
Fluoride, (F)	0.46
Total Iron, (Fe)	
Copper, (Cu)	
Manganese, (Mn)	
Chromium, (Cr)	
Zinc, (Zn)	
Aluminum, (Al)	
Silica, (SiO_2)	
Lithium, (Li)	
Lead, (Pb)	
Phenol	
Sulfides as H_2S	
Total Hardness as $CaCO_3$	
Oil (chloroform extractable)	
tal Dissolved Solids	217. @ 180°F.
tal Suspended Solids	

B C LABORATORIES Inc.

By J. J. Eglin

PRODUCTION WELL NO. 2
CUTTING LOG

(Prepared by B.Y. Kim, Geologist, Quintana Minerals Corporation)

Depth From (ft)	To	Pebble	Granule	Coarse Sand	Medium Sand	Fine Sand	Silt and Clay
30	40			50%	20%	10%	20%
40	100	Minor	40%-60%	30%-50%			Minor
100	110		40%	10%	10%	20%	20%
110	150		40%	40%	5%	5%	10%
150	160		10%	20%	20%	25%	25%
160	210	Minor	50%-60%	40%-50%			Minor
210	250			10%	20%	30%	40%
250	260	Minor	60%	20%	5%	5%	10%
260	270			10%	20%	40%	30%
270	290	20%	60%	20%			Minor
290	300		10%	30%	20%	20%	20%
300	310	20%	70%	10%			Minor
310	330	Minor	30%	50%	5%	5%	10%
330	370		Minor	20%	20%	30%	30%
370	440		30%	40%	10%	10%	10%
440	450			Minor	30%	50%	20%
450	900	0%-20%	20%-40%	20%-30%	0%-10%	10%-20%	10%-20%
900	910		5%	15%	20%	20%	30%
910	920	20%	50%	Minor	Minor	10%	20%
920	960	Minor	20%-30%	30%-40%	10%	10%-20%	20%
960	970	Minor	50%	30%	Minor	Minor	20%
970	990		20%	20%	10%	20%	30%
990	1005			Minor	Minor	Minor	90%

No sample from 530-540 feet; 20% pebble at 610-620 feet.

Average for the above interval 450-900 feet:

10%	30%	30%	5%	10%	15%

PRODUCTION WELL NO. 2
CUTTING LOG
(continued)

The following size ranges have been established from Wentworth Scale for classification of clastic sedimentary rock. The above log has been done by visual estimation according to the scale.

Pebble	Above 4 mm
Granule	2 mm - 4 mm
Coarse Sand	Very coarse - 1 mm - 2 mm Coarse - 0.5 mm - 1 mm (1/2 mm - 1 mm)
Medium Sand	0.25 mm - 0.5 mm (1/4 mm - 1/2 mm)
Fine Sand	Fine - 0.125 mm - 0.25 mm (1/4 mm - 1/8 mm) Very fine - 0.0625 mm - 0.125 mm (1/8 mm - 1/16 mm)
Silt and Clay	Less than 0.0625 mm (less than 1/16 mm

PRODUCTION WELL NO. 2
DRILLERS LOG

Depth From (ft)	To	Sample Description
45	65	Sand, rock, and gravel.
65	105	Sand and gravel.
105	115	Clay and sand.
115	125	Sand and gravel.
125	135	Sand, gravel, and clay.
135	145	Sand and gravel.
145	155	Sand, gravel, and clay.
155	165	Clay and gravel.
165	215	Sand and gravel.
215	225	Clay and fine sand.
225	250	Clay and sand.
250	255	Clay and gravel.
255	265	Cobbles, gravel, and sand.
265	275	Clay with 10% rock.
275	285	Gravel and sand.
285	295	Sand and gravel.
295	305	Clay and sand.
305	315	Sand and gravel.
315	325	Sand, gravel, and 2% clay.
325	335	Sand, gravel, and 15% clay.
335	345	Clay.
345	355	Clay and 5% sand.
355	365	Clay, sand, and gravel.
365	375	Clay and fine sand.
375	385	Clay, sand, and gravel.
385	415	Sand, gravel, and clay.
415	435	Sand, gravel, and trace of clay.
435	445	Sand and clay.
445	455	Clay with sand.
455	465	Clay 50%, sand 50%.
465	475	Clay and sand.
475	485	Sand 60%, gravel 35%, clay 5%.
485	495	Sand 90%, clay 10%.
495	505	Sand, clay, and gravel.
505	515	Sandy clay with caliche, gravel.
515	525	Sandy clay with caliche, some gravel.

PRODUCTION WELL NO. 2
DRILLERS LOG
(continued)

Depth From (ft)	To	Sample Description
525	540	Sand and clay.
540	550	Gravel 90%, clay 10%.
550	553	Gravel 70%, clay 30%.
553	555	Gravel 80%, clay 20%.
555	560	Gravel and clay.
560	565	Gravel 60%, clay 40%.
565	575	Sand and gravel.
575	580	Sand 80%, clay 20%.
580	583	Gravel 70%, clay 30%.
583	585	Gravel 80%, clay 20%.
585	590	Clay 70%, sand 30%.
590	600	Rock, clay, and gravel.
600	605	Rock 50%, clay 50%.
605	610	Gravel.
610	613	Gravel 10%, clay.
613	620	Sand, 20% clay.
620	625	Clay and gravel, hard.
625	635	Gravel, 5% clay.
635	640	Rock, 10% clay, and sand.
640	643	Rock, basalt, hard.
643	645	Clay and some sand.
645	675	Gravel 50%, clay 50%
675	701	Clay, sand, and gravel.
701	705	Gravel 65%, clay 35%.
705	710	Gravel 50%, clay 50%.
710	720	Clay 55%, gravel 45%.
720	725	Gravel 60%, clay 40%.
725	735	Gravel 65%, clay 35%.
735	750	Gravel 70%, clay 30%.
750	765	Sand,80%, clay 20%.
765	775	Gravel 80%, clay 20%.
775	789	Gravel 90%, clay 10%.
789	795	Clay, sand, and gravel.
795	800	Sand and clay.
800	805	Clay and sand.
805	835	Sand and gravel, clay 65%.
835	855	Clay, sand, and gravel.

PRODUCTION WELL NO. 2
DRILLERS LOG
(continued)

Depth From (ft)	To	Sample Description
855	865	Gravel.
865	885	Gravel 85%, clay 15%.
885	905	Coarse sand,85%, clay 15%.
905	915	Clay 65%, coarse sand 35%.
915	925	Gravel, sand, and clay, equal amounts.
925	935	Clay 40%, gravel 30%, sand 30%.
935	945	Clay 75%, sand 25%.
945	955	Clay 90%, sand 10%.
955	965	Gravel, sand, clay stringers.
965	975	Gravel and sand, 10% clay.
975	985	Gravel 50%, clay 50%.
985	995	Sand 60%, clay 40%.
995	1005	Clay.

PRODUCTION WELL NO. 2

DEVELOPMENT DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-10-76	12:36	309.4		Measuring with sounder. Measuring point top of 3/4-inch tube 0.95 foot above top of surface pipe. Surface pipe approximately 0.5 foot above land surface.
	12:44	309.4		
	12:45			Pump on. Ten-inch pump with bowls set at 460 feet Discharge pipe 10-inch, orifice 6-inch.
	12:47	331.8	550	Dirty.
	12:48	331.3		
	12:50	331.7		Lot of color, 0.5 cc/l, fine sand, soapy.
	12:58	332.2	550	Color decreasing, 0.1 cc/l fine sand, soapy.
	13:08	333.3	568	Color decreasing, 0.1 cc/l fine sand,
	13:09			Pump off.
	13:11	284.3		
	13:12	305.7		
	13:13	309.7		
	13:14	310.5		
	13:15	310.8		
	13:19	310.6		
	13:20			Pump on.
	13:24	333.0	550	Lot of color, 0.3 cc/l fine sand.
	13:30	333.7	550	Clearing some, 0.1 cc/l fine sand.
	13:40	334.6	559	Muddy, silty.
	14:00		550	Fairly clear, surge once.
	14:07		550	Lot of color, 0.3 cc/l fine sand.

PRODUCTION WELL NO. 2

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-10-76	14:35	332.4	520	Fairly clear, surge once, change to 8" orifice.
	14:42	374.7	1,040	
	14:45			Lot of color, less than 0.1 cc/l sand.
	15:00	351.4	1,016	Fairly clear, surge once.
	15:05			Lot of color, silt, less than 0.1 cc/l fine sand.
	15:30	352.3	1,040	Fairly clear, surge twice.
	15:37			Lot of color, silt, 0.1 cc/l fine sand.
	16:00	351.4	1,040	Fairly clear, surge twice.
	16:08			Lot of color, silt, 0.2 cc/l fine sand.
	16:30	349.8	1,040	Fairly clear, surge twice.
	16:47			Lot of color, silt, 0.3 cc/l fine sand.
	17:00	349.2	1,016	Fairly clear, surge twice.
	17:10	365.9	1,500	Lot of color, silt, 0.1 cc/l fine sand.
	17:30	373.2	1,500	Fairly clear, surge twice.
	17:38			Lot of color, silt, 0.1 cc/l fine sand. T = 74^{o}F, K = 370 micromhos.
	18:00	372.1	1,486	Fairly clear, surge twice.
	18:07			Lot of color, silt.
	18:30	371.9	1,486	Fairly clear, surge twice.
	19:00	371.4	1,486	Surge twice.
	19:30	370.9	1,500	Surge twice.
	20:00	367.4	1,486	Surge twice.
	20:30	369.4	1,500	Fairly clear, surge twice.
	20:35			Less than 0.01 cc/l fine sand.
	21:00	369.1	1,486	Surge twice, straw color, clears quickly.
	21:30	369.0	1,486	Surge twice, slight color.

PRODUCTION WELL NO. 2

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-10-76	22:00	369.0	1,500	Surge twice, clear.
	22:30	369.0	1,486	Surge twice, straw color.
	23:00	368.4	1,486	Surge twice, clear.
	23:30	369.0	1,500	Surge twice, clear.
	24:00	368.4	1,486	Surge twice, straw color. Increase RPM.
01-11-76	00:30	394.6	1,940	Surge twice, some color.
	01:00	395.0	1,928	Surge twice, straw color, clears quickly. Entrained air showing in discharge.
	01:30	395.8	1,928	Surge twice, straw color.
	02:00	396.7	1,928	Surge twice, straw color.
	02:30	397.4	1,928	Surge twice, straw color.
	03:00	398.0	1,928	Surge twice, straw color.
	03:30	399.9	1,928	Surge twice, straw color.
	04:00	400.0	1,920	Surge twice, straw color, clears quickly.
	04:30	399.9	1,928	Surge twice, some color.
	05:00	399.8	1,928	Surge twice, some color.
	05:30	398.1	1,928	Surge twice, some color.
	06:00	397.4	1,928	Surge twice, straw color, clears quickly.
	06:30	400.0	1,970	Surge twice, some color.
	07:00	404.4	1,970	Surge twice, considerable color.
	07:30	400.9	1,940	Fairly clear, surge twice.
	07:37			Some color, silt.
	08:00	398.2	1,920	Clear, surge twice.
	08:06			Some color, clearing within 2 minutes.
	08:30	399.0	1,940	Clear, surge twice
	09:07			Some color, increase RPM.
	09:10		2,115	Clearing.
	09:15	412.0	2,212	More color showing, no sand.
	09:30	419.0	2,200	Clear, surge twice.

PRODUCTION WELL NO. 2

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-11-76	09:37			Some color, clearing in 2 minutes.
	10:00	419.0	2,200	Clear, surge twice.
	10:08			Some color, less than 0.1 cc/1 sand. Clearing in 2 minutes.
	10:30	418.7	2,212	Clear.
	10:37			Some color, clearing in 2 minutes, no sand.
	10:40			T = 76° F, K = 350 microm-hos.
	11:00	418.0	2,200	Clear, surge twice.
	11:07			Some color, clearing in 2 minutes, no sand.
	11:30	417.6	2,200	Clear, surge twice.
	11:37			Some color, clearing in 2 minutes, no sand.
	12:00	418.7	2,200	Clear, surge twice.
	12:07			Some color, clearing in 2 minutes, no sand.
	12:40	412.7	2,115	Clear.
	12:45			Pump off.
	12:46	321.9		
	12:47	326.5		
	12:48	330.6		
	12:49	330.0		
	12:50	328.9		
	12:51	328.0		
	12:52	327.3		
	12:53	326.5		
	12:54	325.8		
	12:55	325.2		
	13:00	322.8		
	13:05	321.3		
	13:10	320.2		
	13:15	319.3		
	13:51	316.1		
	16:06	312.8		

PRODUCTION WELL NO. 2

cufpw2.wk1

time = c6..c102
pwl = d6..d102

TEST DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-12-76	08:46	310.4 -1.45= 309.0 GL		Measuring with sounder. Same measuring point as for development.
	09:30			Pump on. Same setting as for development.
	09:31	366.4	2,020	Clear.
	09:32	370.4	2,020	
	09:33	373.9	2,020	
	09:34	376.2	2,020	
	09:35	378.0	2,020	
	09:36	379.6	2,020	
	09:37	380.7	2,020	
	09:38	381.7	2,020	
	09:39	382.6	2,020	
	09:40	383.3	2,020	
	09:45	386.6	2,020	
	09:50	388.8	2,020 +	Decrease RPM.
	09:55	390.3	2,020	
	10:00	391.7	2,020	Entrained air in discharge.
	10:10	393.5	2,020	
	10:20	395.7	2,020	
	10:30	396.3	2,020	
	10:40	397.8	2,020	
	10:50	398.4	2,020	
	11:00	399.1	2,020	
	11:17	400.1	2,020	
	11:30	400.3	2,020	
	11:45	401.1	2,020	
	12:00	401.4	2,020	
	12:15	402.3	2,040	Decrease RPM.
	12:30	401.3	2,020	
	12:45	401.3	2,020	
	13:00	401.3	2,020	
	13:17			T = 75^{o}F, K = 335 micromhos.

PRODUCTION WELL NO. 2

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-12-76	13:30	401.9	2,020	
	14:00	402.9	2,020	
	14:30	402.8	2,020 -	Increase RPM.
	15:00	402.9	2,020	
	16:00	403.7	2,020	
	17:00	404.3	2,020 -	Increase RPM.
	18:00	405.2	2,020	
	19:00	405.1	2,020	
	20:00	405.7	2,020	
	21:00	406.1	2,020	
	22:00	406.8	2,020	
	23:00	407.6	2,020	
	24:00	408.0	2,020	
01-13-76	01:00	408.9	2,020	
	02:00	409.1	2,020	
	03:00	409.2	2,020 +	Decrease RPM.
	04:00	408.5	2,020	
	05:00	409.1	2,020	
	06:00	408.1	2,020 -	Increase RPM.
	07:00	409.3	2,020	
	08:00	409.3	2,020	
	09:00	409.4	2,020	
	10:00	409.4	2,020	
	11:00	409.2	2,020	
	12:00	410.2	2,020	
	13:00	410.6	2,020	
	13:50		2,020 +	T = 76° F, K = 350 micromhos. Decrease RPM.
	14:00	410.0	2,020	
	15:00	410.0	2,020	
	16:00	410.1	2,020	
	17:00	410.2	2,020	
	18:00	411.3	2,020	
	19:00	411.2	2,020	
	20:00	410.1	2,020	

PRODUCTION WELL NO. 2

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-13-76	21:00	410.7	2,020	
	22:00	410.7	2,020	
	23:00	410.7	2,020	
	24:00	411.3	2,020	
01-14-76	01:00	411.4	2,020	
	02:00	411.7	2,020	
	03:00	411.7	2,020	
	04:00	411.5	2,020	
	05:00	411.7	2,020	
	06:00	411.5	2,020 -	Increase RPM.
	07:15	411.9	2,020	
	08:00	412.2	2,020	
	09:00	412.0	2,020	
	10:00	412.0	2,020	
	11:00	412.3	2,020	
	12:00	411.9	2,020	
	13:00	412.2	2,020	
	14:00	411.7	2,020	
	15:00	411.7	2,020	
	16:00	411.7	2,020	
	17:00	411.7	2,020	
	18:00	412.1	2,020	
	19:00	413.3	2,020 +	Decrease RPM.
	20:00	413.3	2,020 +	Decrease RPM.
	20:05			$T = 76^{\circ}$ F, K = 350 mhos.
	21:00	414.4	2,020	
	22:00	414.6	2,020	
	23:00	414.6	2,020 +	Decrease RPM.
	24:00	414.6	2,020	
01-15-76	01:00	414.0	2,020	
	02:00	414.1	2,020	
	03:00	413.8	2,020	
	04:00	412.8	2,020	
	05:00	412.6	2,020	

PRODUCTION WELL NO. 2

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-15-76	06:00	412.5	2,020	
	07:00	412.5	2,020	
	08:00	413.0	2,020	
	08:30			T = 76° F, K = 350 micromhos. Collected water samples.
	09:00	413.7	2,020	
	09:30			Pump off.
	09:31	325.0		
	09:32	329.9		
	09:33	333.8		
	09:34	333.3		
	09:35	331.9		
	09:36	331.2		
	09:37	330.3		
	09:38	329.6		
	09:39	328.8		
	09:40	328.3		
	09:45	326.2		
	09:50	324.7		
	09:55	323.5		
	10:00	322.6		
	10:10	321.3		
	10:20	320.3		
	10:30	319.5		
	10:45	318.7		
	11:00	318.0		
	11:15	317.4		
	11:30	317.0		
	12:00	316.5		
	12:30	315.9		
	13:00	315.6		
	13:30	315.2		
	14:00	314.8		
	15:00	314.6		

PRODUCTION WELL NO. 2

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-15-76	16:00	314.1		
	17:00	314.0		
	20:00	313.4		
	24:00	313.0		
01-16-76	04:00	312.8		
	08:00	312.5		
	09:45	312.2		
	09:50	312.42		Measured with chain.

PRODUCTION WELL NO. 2.

TEST DATA

(Observation Well PW-1 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-11-76	13:28	333.36	Measured with chain, spotty. Measuring point hole in plate 0.87 foot above top of surface pipe. Surface pipe approximately 0.2 foot above land surface.
	13:35	333.24	Measured with chain, spotty.
	16:00	332.04	Measured with chain. Water level is recovering from development of PW-2.
01-12-76	08:27	330.76	Measured with chain. Set sounder with tape mark at 330.76.
	09:11	330.66	
	09:30		PW-2 pump on for test.
	09:48	330.68	
	10:15	330.99	
	11:10	331.74	
	12:05	332.28	
	13:05	332.52	
	14:05	332.73	
	15:05	332.98	
	16:05	333.05	
	17:05	333.20	
	18:05	333.30	
	19:05	333.58	
	20:05	333.65	
	21:05	333.70	
	22:05	333.78	
	23:05	333.89	
01-13-76	00:05	334.05	
	01:00	333.97	
	02:05	333.96	
	03:05	334.03	
	04:05	334.06	
	05:05	334.10	
	06:08	334.17	
	07:05	334.25	

PRODUCTION WELL NO. 2

TEST DATA

(Observation Well PW-1 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-13-76	08:05	334.38	
	09:05	334.36	
	10:05	334.46	
	11:05	334.51	
	12:05	334.36	
	13:05	334.62	
	15:05	334.55	
	17:07	334.63	
	19:05	334.92	
	21:05	334.98	
	23:05	335.12	
01-14-76	01:05	335.19	
	03:05	335.23	
	05:05	335.27	
	07:20	335.18	
	08:05	335.21	
	09:05	335.24	
	11:05	335.29	
	13;05	335.30	
	15:05	335.29	
	17:05	335.32	
	19:05	335.39	
	21:05	335.44	
	23:05	335.53	
01-15-76	01:05	335.59	
	03:05	335.54	
	05:05	335.52	
	07:05	335.49	
	09:05	335.59	
	09:30		PW-2 pump off.
	10:03	335.39	
	10:33	334.94	
	11:05	334.50	
	11:35	334.25	

PRODUCTION WELL NO. 2

TEST DATA

(Observation Well PW-1 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-15-76	12:05	334.06	
	12:35	333.86	
	13:05	333.68	
	13:35	333:55	
	14:05	333.41	
	15:05	333.24	
	16:05	333.06	
	17:05	332.86	
	20:05	332.72	
01-16-76	00:05	332.44	
	04:05	332.36	
	08:05	332.25	
	10:04	332.01	

PRODUCTION WELL NO. 2

TEST DATA

(Observation Well MW-5 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-11-76	13:45	338.14	Measured with chain, Measuring point top of 6-inch casing approximately 1 foot above land surface.
	15:54	337.57	Measured with chain. Water level is recovering from development of PW-2.
01-12-76	08:00	336.52	Measured with chain. Set sounder with tape mark at 336.52.
	09:15	336.43	
	09:30		PW-2 pump on for test.
	09:52	336.44	
	10:17	336.52	
	11:14	337.02	
	12:07	337.28	
	13:07	337.44	
	14:07	337.60	
	15:07	337.74	
	16:07	337.85	
	17:07	337.98	
	18:07	338.06	
	19:07	338.14	
	20:07	338.23	
	21:07	338.31	
	22:08	338.42	
	23:07	338.47	
01-13-76	00:07	338.51	
	01:37	338.54	
	02:07	338.65	
	03:07	338.70	
	04:07	338.79	
	06:16	338.85	
	07:07	338.91	
	08:07	339.09	
	09:07	339.06	
	10:07	339.13	

PRODUCTION WELL NO. 2

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-13-76	11:07	339.22	
	12:07	339.22	
	13:07	339.23	
	15:07	339.21	
	17:09	339.31	
	19:07	339.45	
	21:07	339.54	
	23:07	339.62	
01-14-76	01:07	339.77	
	03:07	339.73	
	05:07	339.82	
	07:22	339.84	
	08:07	339.86	
	09:07	339.89	
	11:07	339.94	
	13:07	339.93	
	15:10	339.92	
	17:07	339.96	
	19:07	340.03	
	21:07	340.02	
	23:07	340.19	
01-15-76	01:07	340.18	
	03:07	340.21	
	05:07	340.11	
	07:07	340.18	
	09:07	340.25	
	09:30		PW-2 pump off.
	10:05	340.14	
	10:35	339.93	
	11:08	339.70	
	11:37	339.53	
	12:07	339.40	
	12:37	339.25	
	13:07	339.16	

PRODUCTION WELL NO. 2

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-15-76	13:37	338.99	
	14:07	338.94	
	15:07	338.86	
	16:07	338.80	
	17:07	338.55	
	20:05	338.20	
01-16-76	00:07	338.03	
	04:07	337.89	
	08:07	337.72	
	10:19	337.75	

BC

LABORATORIES Inc.

OIL - CORES - SOIL - WATER

3016 UNION AVENUE
BAKERSFIELD, CALIFORNIA 93305
Phone (805) 325-7475

J. J. EGLIN, Reg. Chem. Engr.

ubmitted By: Water Development Corp.
3938 Santa Barbara Ave.
Tucson, Arizona 85711

Date Reported: 2/16/76
Date Received: 2/3/76
Laboratory No.: 10752

larked: Quintana #2 1/15/76 08:30 T: 76°F. K: 350

WATER ANALYSIS

ample Description:

pH		8.1
.C. Micromhos/cm (K x 10^6) @ 25°C (salinity)		310.
esistivity, Ohm M^2/M		
tituents, P. P. M. (parts per million)		
B)		
alcium, (Ca)		21.
Magnesium, (Mg)		3.4
odium, (Na)		39.
otassium, (K)		4.3
Carbonates, (CO_3)		0.
Bicarbonates, (HCO_3)		153.1
Chlorides, (Cl)		17.0
ulphates, (SO_4)	(-)	5.
Nitrate, (NO_3)		3.53
Fluoride, (F)		0.66
Total Iron, (Fe)		
Copper, (Cu)		
Manganese, (Mn)		
Chromium, (Cr)		
Zinc, (Zn)		
Aluminum, (Al)		
Silica, (SiO_2)		
Lithium, (Li)		
Lead, (Pb)		
Phenol		
Sulfides as H_2S		
Total Hardness as $CaCO_3$		
Oil (chloroform extractable)		
Dissolved Solids		257. @ 180°F.
spended Solids		

BC LABORATORIES Inc.

By J. J. Eglin

PRODUCTION WELL NO. 3
CUTTING LOG

(Prepared by B. Y. Kim, Geologist, Quintana Minerals Corporation)

Depth From (ft)	To	Pebble	Granule	Coarse Sand	Medium Sand	Fine Sand	Silt and Clay
30 -	50		30%	50%	5%	5%	10%
50 -	60	90%	10%				
60 -	80	Minor	60%	20%	Minor	5%	15%
80 -	100	90%	10%				
100 -	180	10%-30%	50%-70%	5%-15%	Minor	5%	10%
180 -	190			Minor	20%	40%	40%
190 -	210	Minor	40%	30%	5%	5%	20%
210 -	220			10%	20%	40%	20%
220 -	240	Minor	50%	40%			10%
240 -	250			10%	20%	40%	30%
250 -	260		50%	40%	Minor		10%
260 -	270		10%	20%	10%	20%	20%
270 -	330	10%-20%	50%-60%	20%	Minor	Minor	10%
330 -	350		10%	30%-40%	0%-10%	20%	30%
350 -	380	0%-10%	40%-50%	30%-40%	Minor	Minor	0%-10%
380 -	390		10%	30%	10%	20%	20%
390 -	450		30%-40%	30%-40%	0%-10%	0%-10%	10%-20%
450 -	460			10%	30%	30%	30%
460 -	760	Minor	20%-40%	20%-30%	0%-10%	10%-20%	10%-30%
(Representative Sample:		Minor	30%	30%	5%	10%	20%)
760 -	830		10%-20%	30%-40%	0%-10%	10%-20%	20%
830 -	910		20%-30%	30%-40%	10%	20%	10%
910 -	970		10%-20%	20%-30%	10%-20%	10%-20%	20%

Peanut-size angular pebbles at 80-100 feet, probably broken pieces from larger boulder.

Sample 120-180 missing.

Pebble-containing samples:	670-680	(20%)
	710-720	(10%)
	610-620	(5%)

Toward the bottom of the hole, gradual decrease of coarse material (granule and coarse sand) has been noticed.

PRODUCTION WELL NO. 3
CUTTING LOG
(continued)

The following size ranges have been established from Wentworth Scale for classification of clastic sedimentary rock. The above log has been done by visual estimation according to the scale.

Pebble	Above 4 mm
Granule	2 mm - 4 mm
Coarse Sand	Very coarse - 1 mm - 2 mm Coarse - 0.5 mm - 1 mm (1/2 mm - 1 mm)
Medium Sand	0.25 mm - 0.5 mm (1/4 mm - 1/2 mm)
Fine Sand	Fine - 0.125 mm - 0.25 mm (1/4 mm - 1/8 mm) Very fine - 0.0625 mm - 0.125 mm (1/8 mm - 1/16 mm)
Silt and Clay	Less than 0.0625 mm (less than 1/16 mm)

PRODUCTION WELL NO. 3
DRILLERS LOG

Depth From (ft)	To	Sample Description
40	55	Sand 85%, gravel.
55	65	Gravel, 10% sand.
65	75	Gravel, 20% sand.
75	165	Sand and gravel.
165	185	Sand 70%, gravel 25%, clay 5%.
185	195	Clay.
195	200	Sand, 5% clay.
200	205	Clay.
205	215	Sand, 50%, gravel 45%, clay 5%.
215	225	Clay, 10% sand.
225	235	Sand 55%, gravel 40%, clay 5%.
235	250	Sand and gravel.
250	255	Sand, 80% clay.
255	265	Sand and gravel, 5% clay.
265	275	Sand, 70% clay.
275	339	Sand and gravel.
339	345	Clay 80%, sand 20%.
345	355	Clay 75%, sand 20%, gravel 5%.
355	369	Sand 90%, gravel 10%.
369	375	Clay 60%, gravel 30%, sand 10%.
375	385	Sand 65%, clay 25%, gravel 10%.
385	399	Clay 60%, sand 40%.
399	405	Sand 90%, clay 10%.
405	415	Sand 50%, gravel 50%.
415	425	Sand 50%, gravel 40%, clay 10%.
425	429	Sand, gravel, and clay.
429	435	Gravel 65%, sand 30%, clay 5%.
435	455	Sand, gravel, and clay.
455	465	Clay and little sand.
465	475	Clay, gravel, and sand.
475	495	Gravel 60%, sand 20%, clay 20%.
495	505	Sand and gravel.
505	525	Sand 50%, clay 50%.
525	535	Gravel 50%, sand 50%.
535	545	Sand 65%, clay 25%, gravel 10%.
545	555	Sand 50%, clay 50%.
555	565	Sand, 30% clay.

PRODUCTION WELL NO. 3
DRILLERS LOG
(continued)

Depth From	To	Sample Description
(ft)		
565	575	Sand and gravel.
575	590	Sand, gravel, and clay.
590	595	Sand and gravel, some clay.
595	605	Sand, gravel, and clay.
605	615	Sand and gravel, some clay.
615	625	Sand and gravel, 70% clay.
625	655	Sand and gravel.
655	665	Sand 70%, clay 30%.
665	675	Sand 85%, gravel 10%, clay 5%.
675	685	Gravel 60%, sand 20%, clay 20%.
685	699	Sand 50%, gravel 25%, clay 25%.
699	705	Sand 50%, gravel 48%, clay 2%.
705	715	Gravel 45%, coarse sand 45%, clay 10%.
715	728	Sand 80%, gravel 10%, clay 10%.
728	745	Sand, gravel, and clay.
745	756	Sand 85%, clay.
756	817	Sand, gravel, and clay.
817	835	Clay 80%, gravel 10%, sand 10%.
835	847	Sandy clay 98%, gravel 2%.
847	855	Sand 70%, gravel 30%.
855	865	Sand 80%, gravel 15%, clay 5%.
865	878	Clay 55%, gravel 35%, sand 10%.
878	895	Sand, gravel, and clay.
895	905	Sand and gravel.
905	945	Gravel 50%, sand 30%, clay 20%.
945	955	Clay 50%, sand 30%, gravel 20%.
955	965	Clay 95%, sand 5%.
965	970	Clay 90%, sand 10%.

PRODUCTION WELL NO. 3

DEVELOPMENT DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-22-76	12:54	350.6		Measuring with sounder. Measuring point top of 3/4-inch tube 0.95 feet above top of surface pipe. Surface pipe approximately 1 foot above land surface.
	13:00			Pump on. Ten-inch pump with bowls set at 500 feet. Discharge pipe 10-inch, orifice 6-inch.
	13:02	391.8	520	
	13:03	390.1		Dirty, lot of color.
	13:04	389.7	520	
	13:05	389.3		
	13:07	390.1	520	Lot of color, silt, 0.5 cc/l sand and silt.
	13:10	390.6		
	13:15	390.9	520	Clearing, less than 0.1 cc/l sand.
	13:20			Surge.
	13:25			Some color and silt, less than 0.1 cc/l fine sand.
	13:30	391.2	520	Clearing.
	13:36			Fairly clear, surge twice.
	13:44			Considerable color, 0.2 cc/l fine sand.
	13:47	386.4	520	
	13:55	388.6	520	Fairly clear, surge twice.
	14:05			Some color, silt.
	14:15	385.4	520	Fairly clear, surge twice.
	14:23			Some color, silt, less than 0.1 cc/l fine sand.
	14:30	383.3	520	Fairly clear, surge twice.
	14:37			Some color, silt, 0.1 cc/l fine sand.

PRODUCTION WELL NO. 3

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-22-76	14:45	382.0	520	Fairly clear, surge twice.
	14:58			Some color, silt, less than 0.1 cc/l fine sand.
	15:00	380.4	520	Fairly clear, silt, surge twice.
	15:08			Some color, no sand.
	15:15	379.4	520	Fairly clear, surge twice.
	15:30	378.4	520	Fairly clear, surge twice.
	15:45	377.9	520	Fairly clear, surge twice.
	16:00	377.7	520	Fairly clear, surge twice.
	16:15	377.6	520	Fairly clear, surge twice.
	16:30	377.4	520	Fairly clear, surge twice, change to 8-inch orifice.
	16:33			Pump on, increase RPM.
	16:35	402.7	1,000	Considerable color, 0.1 cc/l fine sand.
	16:40	403.0	1,000	
	16:45	403.8	1,000	Fairly clear, surge twice.
	16:53			Considerable color, silt, 0.1 cc/l fine sand.
	17:00	403.8	1,000	Fairly clear, surge twice.
	17:07			Considerable color, silt, 0.1 cc/l fine sand.
	17:10			T = 76^{o}F, K = 370 micromhos.
	17:15	403.1	1,000	Fairly clear, surge twice.
	17:22			Considerable color, silt, 0.1 cc/l fine sand.
	17:30	402.5	1,000	Fairly clear, surge twice.
	17:37			Considerable color, silt, 0.1 cc/l fine sand.
	17:45	401.4	1,000	Fairly clear, surge twice.
	17:52			Some color, silt, 0.15 cc/l fine sand.
	18:00	402.0	1,000	Fairly clear, surge twice.
	18:07			Some color, silt, 0.15 cc/l fin sand.

PRODUCTION WELL NO. 3

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-22-76	18:15 18:22	400.6	1,000	Fairly clear, surge twice. Some color, silt, 0.1 cc/l fine sand.
	18:30 18:37	399.7	1,000	Fairly clear, surge twice. Some color, silt, 0.1 cc/l fine sand.
	18:45 18:52	399.7	1,000	Fairly clear, surge twice. Some color, silt, less than 0.1 cc/l fine sand.
	19:00 19:08	399.4	1,000	Fairly clear, surge twice. Some color, silt, less than 0.1 cc/l fine sand.
	19:15 19:22	399.2	1,000	Fairly clear, surge twice. Some color, silt, 0.1 cc/l fine sand.
	19:30 19:37	398.3	1,000	Fairly clear, surge twice. Some color, silt, 0.1 cc/l fine sand.
	19:45 19:52	398.4	1,000	Fairly clear, surge twice. Some color, silt, less than 0.1 cc/l fine sand.
	20:00	398.6	1,000	Fairly clear, surge twice, increase RPM.
	20:07	428.5	1,500	Considerable color, 0.1 cc l fine sand.
	20:09	438.7		
	20:15	446.6	1,500	Dirty, 0.1 cc/l fine sand, considerable entrained air in discharge.
	20:30 20:37	447.0	1,486	Clearing, surge twice. Lot of color, silt, 0.2 cc/l fine sand.
	20:45 20:52	443.9	1,455	Fairly clear, surge twice. Lot of color, silt, 0.2 cc.1 fine sand.

PRODUCTION WELL NO. 3

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-22-76	21:00	446.1	1,500	Fairly clear, surge twice.
	21:07			Lot of color, silt, 0.1 cc/l fine sand.
	21:15	444.8	1,500	Fairly clear, surge twice.
	21:22			Lot of color, silt, less than 0.1 cc/l fine sand.
	21:30	444.1	1,500	Fairly clear, surge twice.
	21:37			Lot of color, silt.
	21:45	441.1	1,471	Fairly clear, surge twice.
	21:53			Considerable color, silt, less than 0.1 cc/l fine sand.
	22:00	442.0	1,486	Fairly clear, surge twice.
	22:30	446.6	1,500	Fairly clear, surge twice.
	23:00	446.5	1,500	Fairly clear, surge twice.
	23:30	446.9	1,486	Fairly clear, surge twice.
	23:38			Considerable color, silt, no sand.
	24:00	446.4	1,500	Fairly clear, surge twice.
01-23-76	00:07			Lot of color, silt, no sand.
	00:30	446.9	1,500	Fairly clear, surge twice.
	00:38			Lot of color, silt, no sand.
	01:00	447.0	1,500	Fairly clear, surge twice.
	01:07			Lot of color, silt.
	01:30			Engine stopped, broken throttle linkage.
	01:36			Throttle repaired, second surg
	01:40			Lot of color, silt, no sand.
	02:00	447.1	1,500	Fairly clear, surge twice.
	02:07			Lot of color, silt, no sand.
	02:30	447.2	1,500	Fairly clear, surge twice.
	03:00	447.8	1,500	Fairly clear, surge twice.
	03:37		1,500	
	04:00	448.0	1,500	Fairly clear, surge twice.
	04:07		1,500	
	04:30	447.4	1,500	Fairly clear, surge twice.

PRODUCTION WELL NO. 3

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-23-76	04:37		1,500	
	05:00	447.2	1,500	Fairly clear, surge twice.
	05:07		1,500	
	05:30	447.3	1,500	Fairly clear, surge twice.
	05:37		1,500	
	06:00	449.3	1,500	Fairly clear, surge twice.
	06:07		1,500	
	06:30	447.4	1,500	Fairly clear, surge twice.
	06:37		1,500	Considerable color, silt, no sand.
	07:00	447.4	1,500	Clear, surge twice, increase RPM.
	07:09	463.1	1,809	Fairly dirty, 0.3 cc/l fine sand.
	07:11	470.2	1,809	Fairly dirty, lot of entrained air.
	07:15			Ohmmeter fluctuating badly. Starts at 460 feet.
	07:31		1,641	Manometer ± 1 inch, well is not surging.
	07:33			Fairly clear, surge twice.
	08:30	454.7	1,669	Clear, Ohmmeter and Manometer fluctuating, surge twice.
	08:32			Some color, silt, no sand.
	09:00	452.1	1,543	Clear, surge twice.
	09:08			Some color, silt, no sand.
	09:10			Engine stopped, broken throttl linkage.
	09:15			Throttle repaired.
	09:30	453.1	1,613	Clear, surge twice, reduce RP
	10:02			Little color, silt, no sand.
	10:04		1,500	
	10:30	448.2	1,515	Clear, reduce RPM.
	11:00	448.0	1,500	

PRODUCTION WELL NO. 3

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-23-76	11:11			T = 76° F, K = 360 micromhos.
	11:30	448.0	1,500	Clear.
	11:58	448.4	1,500	Clear.
	12:00			Pump off.
	12:01	421.1		
	12:02	396.3		
	12:03	365.2		
	12:04	354.0		
	12:05	354.2		
	12:16	352.7		
	12:15	352.1		

PRODUCTION WELL NO. 3

TEST DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-24-76	07:46	350.8		Measuring with sounder. Same measuring point as for development.
	08:59	350.8 -1.95 = 348.9 GL		
	09:00			Pump on. Same setting as for development.
	09:01	421.4	1,500	
	09:02	424.6	1,500	Some color.
	09:03	428.2	1,500	
	09:04	431.1	1,500	
	09:05	432.6	1,500	Clear.
	09:06	433.5	1,500	
	09:07	434.5	1,500	
	09:08	435.6	1,500	
	09:09	436.2	1,500	
	09:10	436.9	1,500	
	09:11	437.6	1,500	
	09:12	437.8	1,500	
	09:13	438.0	1,500	
	09:14	438.5	1,500	
	09:15	439.0	1,500	
	09:16	440.0	1,515	Decrease RPM.
	09:17	439.6	1,500	
	09:18	439.6	1,500	
	09:19	439.8	1,500	
	09:20	440.0	1,500	
	09:25	441.0	1,500	
	09:30	441.6	1,500	
	09:35	441.9	1,500	
	09:40	442.0	1,500	
	09:50	443.4	1,500	
	10:00	443.5	1,500	
	10:15	444.5	1,500 -	Increase RPM.
	10:30	445.0	1,500	Considerable entrained air in discharge.
	10:45	445.9	1,500	

PRODUCTION WELL NO. 3

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-24-76	11:00	446.0	1,500 +	Decrease RPM.
	11:30	446.6	1,500	
	12:00	446.6	1,500	
	12:03			T = 76°, K = 360 micromhos.
	12:30	448.4	1,500	
	13:00	449.5	1,500	
	13:30	449.0	1,500 -	Increase RPM.
	14:00	449.1	1,500	
	15:00	448.7	1,500 +	Decrease RPM.
	16:00	448.9	1,500	
	17:00	449.8	1,515	Decrease RPM.
	18:00	448.4	1,486	Increase RPM.
	19:00	499.4	1,500	
	20:00	450.4	1,500	
	21:00	450.9	1,500	
	22:00	451.5	1,500	
	23:00	451.8	1,500	
	24:00	452.2	1,500	
01-25-76	01:00	452.2	1,500	
	02:00	452.2	1,500	
	03:00	452.4	1,500	
	04:00	452.4	1,500	
	05:00	452.7	1,500	
	06:00	453.0	1,500	
	07:00	453.7	1,500	
	08:00	452.3	1,500	
	09:00	451.7	1,486	Increase RPM.
	10:00	452.4	1,500	
	11:00	452.4	1,500	
	12:00	453.0	1,500 -	Increase RPM.
	12:25	453.2	1,500	
	12:36	453.2	1,500	Changed sounders.
	13:00	453.86	1,500	
	14:00	454.83	1,500 +	Decrease RPM.

PRODUCTION WELL NO. 3

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-25-76	14:40			T = 76°, K = 360 micromhos.
	15:00	452.50	1,500	
	16:00	452.59	1,500	
	17:00	453.81	1,500	
	18:00	454.26	1,500	
	19:00	453.73	1,500	
	20:00	454.16	1,500	
	21:00	455.38	1,500	
	22:00	456.12	1,500 +	Decrease RPM.
	23:00	456.36	1,500	
	24:00	456.46	1,500	
01-26-76	01:00	455.86	1,500	
	02:01	455.71	1,500	
	03:00	455.76	1,500	
	04:00	455.71	1,500	
	05:00	455.66	1,500	
	06:00	455.46	1,500	
	07:00	455.56	1,500 +	Decrease RPM.
	08:00	454.49	1,500	
	09:00	454.86	1,500	
	10:00	455.40	1,500	
	11:00	455.34	1,500	
	12:00	455.50	1,500	
	13:00	455.80	1,500	
	13:40		1,500 +	Decrease RPM.
	14:00	455.77	1,500	
	15:00	455.76	1,500	
	16:00	456.87	1,500	
	17:00	455.70	1,500	
	18:00	455.42	1,486	Increase RPM.
	19:00	456.19	1,500 -	Increase RPM.
	20:00	457.03	1,500	
	21:00	457.14	1,500	
	22:00	457.14	1,500	

PRODUCTION WELL NO. 3

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-26-76	23:00	457.31	1,500	
	24:00	457.0	1,500	
01-27-76	01:00	456.96	1,500	
	02:00	456.98	1,500	
	03:00	455.66	1,500	
	04:00	455.96	1,500	
	05:00	455.96	1,500	
	06:05	457.66	1,500	
	07:00	455.26	1,500	
	08:00	453.71	1,500	
	08:50			T = 76°, K = 360 micromhos. Collected water samples.
	08:55	454.16	1,500	
	09:00			Pump off.
	09:01	337.06		
	09:02	346.23		
	09:03	356.86		
	09:04	356.38		
	09:05	356.46		
	09:06	356.35		
	09:07	356.09		
	09:08	355.90		
	09:09	355.72		
	09:10	355.54		
	09:15	354.84		
	09:20	354.32		
	09:25	354.02		
	09:30	353.80		
	09:40	353.53		
	09:50	353.32		
	10:00	352.98		
	10:15	352.89		
	11:00	352.49		
	18:44	351.24		
01-28-76	07:42	350.66		

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well PW-1 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-22-76	11:49	330.91	Measured with chain, Measuring point hole in plate over casing 0.87 foot above top of surface pipe. Surface pipe approximately 0.2 foot above land surface.
	13:00		PW-3 pump on for development.
01-23-76	10:55	331.94	Measured with chain.
	12:00		PW-3 pump off.
01-24-76	08:13	330.77	Measured with chain. Set sounder with tape mark at 330.77.
	09:00		PW-3 pump on for test.
	09:10	330.77	
	09:30	330.87	
	09:45	330.96	
	10:00	330.98	
	10:15	331.10	
	10:35	331.10	
	11:05	331.22	
	11:55	331.33	
	13:12	331.42	
	14:15	331.45	
	15:15	331.51	
	16:15	331.55	
	17:18	331.62	
	18:23	331.67	
	20:13	331.77	
	22:13	331.85	
01-25-76	00:13	331.96	
	02:13	332.11	
	04:13	332.11	
	06:15	332.13	
	08:15	332.08	
	10:15	332.15	
	12:15	332.13	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well PW-1 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-25-76	14:15	332.11	
	16:12	332.15	
	18:15	332.21	
	20:15	332.27	
	22:50	332.36	
01-26-76	00:30	332.37	
	02:30	332.38	
	06:30	332.49	
	08:28	332.58	
	10:13	332.74	
	12:17	332.72	
	14:11	332.67	
	16:10	332.66	
	18:15	332.68	
	20:05	332.70	
01-27-76	00:10	332.74	
	02:15	332.76	
	05:55	332.78	
	08:20	332.84	
	09:00		PW-3 pump off.
	10:35	332.44	
	18:55	331.73	
01-28-76	08:06	331.47	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well PW-2 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-22-76	11:58	309.93	Measured with chain. Measuring point hole in plate above casing 0.7 foot above top of surface pipe. Surface pipe approximately 0.5 foot above land surface.
	13:00		PW-3 pump on for development.
01-23-76	10:45	310.31	Measured with chain.
	12:00		PW-3 pump off.
01-24-76	08:31	309.67	Measured with chain. Set sounder with tape mark at 309.67.
	09:00		PW-3 pump on for test.
	09:05	309.67	
	09:25	309.67	
	09:40	309.67	
	09:55	309.71	
	10:10	309.74	
	10:25	309.75	
	10:40	309.77	
	11:00	309.81	
	11:50	309.84	
	13:16	309.89	
	14:20	309.91	
	15:20	309.94	
	16:20	309.98	
	17:24	310.02	
	18:30	310.07	
	20:16	310.12	
	22:16	310.18	
01-25-76	00:16	310.22	
	02:16	310.27	
	04:18	310.31	
	06:20	310.40	
	08:20	310.42	
	10:20	310.46	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well PW-2 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-25-76	12:20	310.46	
	14:20	310.43	
	16:16	310.43	
	18:20	310.48	
	20:20	310.55	
	23:00	310.67	
01-26-76	00:35	310.65	
	02:35	310.72	
	06:35	310.83	
	08:33	310.90	
	10:17	311.01	
	12:23	311.00	
	14:15	310.92	
	16:15	310.96	
	18:20	310.99	
	20:10	311.01	
01-27-76	00:15	311.04	
	02:20	311.11	
	06:00	311.12	
	08:25	311.13	
	09:00		PW-3 pump off.
	10:40	311.04	
	19:00	310.65	
01-28-76	08:17	310.43	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well MW-5 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-22-76	11:41	336.67	Measured with chain. Measuring point top of 6-inch casing approximately 1 foot above land surface.
	13:00		PW-3 pump on for development.
01-23-76	11:03	337.68	Measured with chain.
	12:00		PW-3 pump off.
01-24-76	07:57	336.52	Measured with chain. Set sounder wit tape mark at 336.52.
	09:00		PW-3 pump on for test.
	09:13	336.52	
	09:34	336.64	
	09:50	336.70	
	10:04	336.71	
	10:24	336.77	
	10:36	336.83	
	11:07	336.91	
	11:57	337.01	
	13:10	337.07	
	14:12	337.11	
	15:12	337.14	
	16:12	337.24	
	17:15	337.29	
	18:20	337.33	
	20:08	337.42	
	22:08	337.49	
01-25-76	00:08	337.53	
	02:08	337.60	
	04:08	337.67	
	06:10	337.76	
	08:10	337.76	
	10:10	337.83	
	12:10	337.82	
	14:10	337.79	
	16:10	337.90	
	18:10	337.82	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-25-76	20:10	337.94	
	22:50	338.01	
01-26-76	00:25	338.03	
	02:25	338.06	
	06:25	338.17	
	08:25	338.26	
	10:10	338.28	
	12:12	338.29	
	14:09	338.28	
	16:08	338.30	
	18:10	338.34	
	20:00	338.39	
01-27-76	00:05	338.41	
	02:10	338.42	
	05:50	338.43	
	08:10	338.56	
	09:00		PW-3 pump off.
	10:30	338.18	
	18:50	337.41	
01-28-76	07:54	337.10	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well MW-6 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-22-76	12:22	386.84	Measuring with sounder. Inside of casing too wet to use chain. Measuring point top of 6-inch casing approximately 1 foot above land surface. MW-6 was used to supply drilling water for drilling production wells.
	13:00		PW-3 pump on for development.
01-23-76	10:14	386.67	
	12:00		PW-3 pump off.
01-24-76	07:34	386.41	
	09:00		PW-3 pump on for test.
	09:20	386.41	
	11:06	386.40	
	12:08	386.38	
	13:04	386.33	
	14:07	386.33	
	15:07	386.33	
	16:07	386.32	
	17:09	386.35	
	18:09	386.34	
	20:05	386.32	
	22:05	386.29	
01-25-76	00:05	386.32	
	02:05	386.35	
	04:05	386.39	
	06:05	386.43	
	08:05	386.49	
	10:05	386.53	
	12:05	386.50	
	14:05	386.47	
	16:05	386.41	
	18:05	386.46	
	20:05	386.54	
	22:24	386.63	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well MW-6 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-26-76	00:15	386.64	
	02:15	386.63	
	06:20	386.74	
	08:20	386.80	
	10:06	386.82	
	12:07	386.82	
	14:05	386.78	
	16:04	386.79	
	18:05	386.77	
	19:56	386.84	
	24:00	386.86	
01-27-76	02:05	386.87	
	05:45	386.88	
	08:05	386.92	
	09:00		PW-3 pump off.
	10:10	386.87	
	18:38	386.81	
01-28-76	07:29	386.77	

BC

LABORATORIES Inc.

OIL - CORES - SOIL - WATER

3016 UNION AVENUE
BAKERSFIELD, CALIFORNIA 93305
Phone (805) 325-7475

J. J. EGLIN, Reg. Chem. Engr.

Submitted By: Water Development Corp.
3938 Santa Barbara Ave.
Tucson, Arizona 85711

Date Reported: 2/16/76
Date Received: 2/3/76
Laboratory No.: 10753

Marked: Quintana #3 1/27/76 08:50 T: 76°F. K: 360

WATER ANALYSIS

Sample Description:

pH	8.0
E.C. Micromhos/cm (K x 10^6) @ $25^{\circ}C$ (salinity)	330.
Resistivity, Ohm M^2/M	

Constituents, P. P. M. (parts per million)

(B)	
Calcium, (Ca)	22.5
Magnesium, (Mg)	2.7
Sodium, (Na)	44.
Potassium, (K)	5.1
Carbonates, (CO_3)	0.
Bicarbonates, (HCO_3)	158.0
Chlorides, (Cl)	24.1
Sulphates, (SO_4)	(-) 5
Nitrate, (NO_3)	2.60
Fluoride, (F)	0.64
Total Iron, (Fe)	
Copper, (Cu)	
Manganese, (Mn)	
Chromium, (Cr)	
Zinc, (Zn)	
Aluminum, (Al)	
Silica, (SiO_2)	
Lithium, (Li)	
Lead, (Pb)	
Phenol	
Sulfides as H_2S	
Total Hardness as $CaCO_3$	
Oil (chloroform extractable)	
Dissolved Solids	243. @ 180°F.
Suspended Solids	

BC LABORATORIES Inc.

By J. J. Eglin

WATER DEVELOPMENT CORPORATION

BASIC-DATA REPORT
QUINTANA MINERALS CORPORATION
COPPER FLAT PROJECT
PRODUCTION WELL NO. 4,
HILLSBORO, NEW MEXICO

By
D. K. Greene and L. C. Halpenny

Tucson, Arizona
December 1980

BASIC-DATA REPORT

QUINTANA MINERALS CORPORATION
COPPER FLAT PROJECT PRODUCTION WELL NO. 4,
HILLSBORO, NEW MEXICO

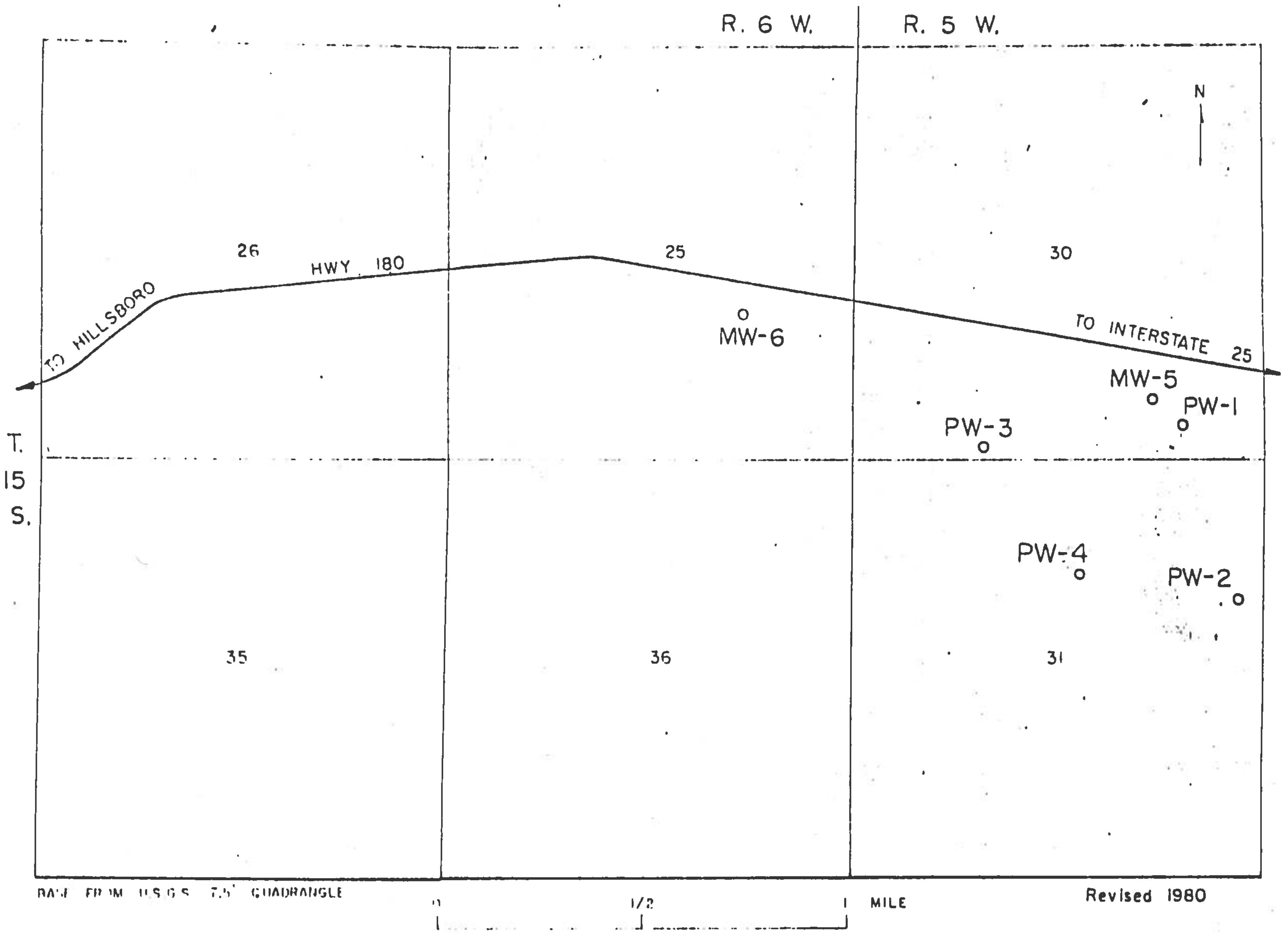
By

D. K. Greene and L. C. Halpenny

GENERAL INFORMATION

A fourth production well (PW-4) has been drilled to assist in furnishing the water supply for ore processing and other uses at the Copper Flat Project. Location of PW-4 along with PW-1, PW-2, and PW-3, is shown on Figure 1. The legal description of PW-4 is as follows:

NW$\frac{1}{4}$ SW$\frac{1}{4}$ NE$\frac{1}{4}$, Sec. 31, T. 15 S., R. 5 W.



BASE FROM U.S.G.S. 7.5' QUADRANGLE

Revised 1980

FIGURE 1.--MAP OF A PORTION OF TOWNSHIP 15 SOUTH, RANGES 5 AND 6 WEST, SIERRA COUNTY, NEW MEXICO, SHOWING LOCATIONS OF PRODUCTION WELLS AND MW-5 AND MW-6.

PW-4 was drilled by R. L. Guffey, Inc., Drilling Contractors of Las Cruces, New Mexico using rotary equipment and the conventional method of drilling. Considerable difficulty was encountered in drilling the upper 100 feet of hole due to boulders. A 12-inch pilot hole was drilled through this section and down to 400 feet. From 400 feet a 9-7/8-inch pilot hole was drilled to bottom depth of 957 feet. Following pilot hole drilling a 23-foot joint of 30-inch diameter surface pipe was set and cemented in place. The hole was then reamed to an ultimate diameter of 26 inches to a depth of 954 feet. An 18-inch pilot bit extended ahead of the 22-inch bit giving a hole diameter of 18-inches from 954 to 957 feet.

The hole was cased with 16-inch OD, 5/16-inch wall thickness, blank casing and 16-inch OD Johnson 100 slot Irrigator Screen. Open area in the Irrigator Screen amounts to 217 square inches per lineal foot. A 3-foot section of 16-inch OD, 5/16 inch wall thickness, blank casing was welded to the bottom of the Irrigator Screen.. This section of casing is tapered on the bottom end. The annular space was gravel packed with 1/8 to 3/8-inch gravel and the well was developed with the drilling rig by washing, jetting, and bailing.

Details on depth drilled, casing installed, etc., for PW-4 are as follows:

Depth drilled	957 feet
Casing installed	
Blank	0 to 354 feet
Screen	354 to 954 feet
Blank	954 to 957 feet
Gravel installed	110 yards
Rig development time	39 hours
Gravel slippage during rig development	55 feet

Upon completion of rig development the well was further developed and tested with a diesel powered turbine pump furnished by Western Pump and Supply Company of Deming, New Mexico. Data obtained during this phase of work are included in the following sections of this report along with logs for the well.

PRODUCTION WELL NO. 4
DRILLER'S LOG

(Prepared by R. L. Guffey, Inc. Drilling Contractors)

Depth From (ft)	To	Sample Description
0	23	Boulder gravel some clay
23	38	Hard black rock stks, clay
38	56	Stks. hard black rock gravel boulder some clay
56	73	Gravel some boulders and clay
73	96	Gravel and clay with boulders
96	156	Clay and gravel stks gravel
156	198	Gravel some sand with clay and clay stks.
198	233	Gravel and sand stks of red clay
233	275	Clay (red) stks gravel
275	281	Sand sandy clay
281	293	Clay stks gravel embedded in clay
293	309	Gravel some sand stks clay
309	407	Sand small gravel stks clay (sandy)
407	422	Clay stks gravel calcareous and sand
422	446	Clay some gravel embedded
446	532	Gravel and sand some clay stks
532	560	Gravel (larger) with clay
560	610	Gravel sand with some clay
610	764	Gravel some (clean) with clay stks, drilled tight
764	783	Gravel, gravel embedded in clay
783	805	Gravel some sand with clay
805	825	Gravel and clay (Bentonite)
825	835	Gravel clean with sand
835	877	Clay with gravel embedded
877	896	Gravel clean some clay lens
896	925	Gravel fine with sand (some clean)
925	957	Gravel embedded in clay

PRODUCTION WELL NO. 4

WADEVCO LOG

Depth (ft)		
From	To	Sample Description
0	20	Angular fragments of boulders which are exposed at land surface, 1/4" to 1/2" +.
20	30	Angular fragments of boulders, 1/4" to 1/2" +. Small amount of medium to coarse sand.
30	40	Angular fragments of boulders, 1/4" to 1/2" +.
40	50	Angular rock fragments, 1/8" to 1/4". Some silt and very fine sand.
50	70	Angular rock fragments, 1/4" to 1/2" +.
70	90	Angular rock fragments, 1/8" to 1/2" +. Some fine to medium sand.
90	100	Angular rock fragments, 1/8" to 1/2" +.
100	110	Angular rock fragments, 1/8" to 1/2" +. Some silt and clay.
110	120	Primarily angular rock fragments, 1/8" to 1/2". Few fragments are rounded.
120	130	Primarily angular rock fragments, 1/4" to 1/2". Several fragments of clay with embedded sand and gravel.
130	140	Angular rock fragments, ± 1/8". Some medium to very fine sand, silt, and clay.
140	160	Angular rock fragments, 1/8" to 1/4". Some medium to very fine sand, silt, and clay.
160	170	Angular rock fragments, 1/8" to 1/4". Some coarse to very fine sand.
170	180	Angular rock fragments, ± 1/8". Some coarse to very fine sand.
180	200	Medium to very coarse sand and gravel up to 1/8". Some silt.
200	220	Angular rock fragments, ± 1/8". Some coarse to very fine sand.
220	230	Angular rock fragments, 1/8" to 1/4". Some very coarse to fine sand.
230	240	Angular rock fragments, ± 1/8". Some very coarse to fine sand.
240	250	Angular rock fragments, 1/8" to 1/4". Some very coarse to fine sand.

PRODUCTION WELL NO. 4

WADEVCO LOG
(continued)

Depth From (ft)	To	Sample Description
250	260	Angular rock fragments, 1/8" to 1/4". Some very coarse to fine sand and silt. Several fragments of clay ± 1/8".
260	280	Angular rock fragments, ± 1/8". Some very coarse to fine sand.
280	300	Angular rock fragments, 1/8" to 1/4". Some very coarse to fine sand.
300	310	Angular rock fragments, 1/8" to 1/4". Some very coarse to fine sand. Several clay fragments ± 1/8".
310	330	Gravel up to ± 1/8" with fine to very coarse sand. Several rock fragments ± 1/4". Several clay fragments ± 1/8".
330	340	Medium to very coarse sand with gravel up to 1/8". Few angular rock fragments ± 1/4".
340	360	Fine to very coarse sand and gravel. Some silt.
360	390	Very coarse sand and gravel. Some fine to medium sand.
390	400	Very coarse sand and gravel. Some fine to medium sand. Few small fragments of clay.
400	420	Angular rock fragments 1/4" to 1/2". Some medium to very coarse sand and gravel.
420	450	Very coarse sand and gravel to ± 1/8". Few rock fragments ± 1/4". Some medium to coarse sand.
450	460	Very coarse sand and gravel to ± 1/8". Some medium to fine sand. Few fragments of clay. Some silt.
460	490	Very coarse sand and gravel to ± 1/8". Some medium to fine sand.
490	500	Very coarse sand and gravel to ± 1/8". Some medium to fine sand. Several fragments of black vesicular material with sand grains embedded in some vesicles.
500	530	Very coarse sand and gravel to ± 1/8". Some medium to fine sand.
530	560	Angular rock fragments, 1/8" to 1/2" with fine to very coarse sand. Some silt.

PRODUCTION WELL NO. 4

WADEVCO LOG
(continued)

Depth From (ft)	To	Sample Description
560	590	Very coarse sand and gravel to ± 1/8". Fair number of angular rock fragments in 1/4" to 1/2" range. Several fragments of clay up to 1/2". Some silt.
590	620	Very coarse sand and gravel up to ± 1/8". Some medium to very fine sand and silt.
620	700	Very coarse sand and gravel up to ± 1/8". Some medium to fine sand.
700	730	Medium to very coarse sand with some gravel up to ± 1/8". Some fine sand and silt.
730	740	Medium to very coarse sand with some gravel up to ± 1/8". Some fine sand, silt, and clay fragments.
740	750	Medium to very coarse sand with some gravel up to ± 1/8".
750	760	Coarse to very coarse sand with some gravel up to ± 1/8". Some fine to medium sand.
760	780	Coarse to very coarse sand with some gravel up to ± 1/8". Some fine to medium sand. Several fragments of clay.
780	800	Very coarse sand and gravel up to ± 1/8". Some medium to fine sand.
800	810	Coarse to very coarse sand with some gravel up to ± 1/8". Some fine to medium sand. Few fragments of clay.
810	820	Very coarse sand and gravel up to ± 1/8". Several angular rock fragments ± 1/4". Some fine to medium sand and silt.
820	840	Very coarse sand and gravel up to ± 1/8". Some fine to medium sand.
840	850	Medium to very coarse sand and gravel up to ± 1/8". Several rock fragments ± 1/4". Silt and numerous fragments of clay.
850	870	Very fine to medium sand and silt with fragments of clay. Some coarse to very coarse sand with gravel up to ± 1/8".

PRODUCTION WELL NO. 4

WADEVCO LOG
(continued)

Depth From (ft)	To	Sample Description
870	880	Coarse to very coarse sand and gravel up to ± 1/8". Some fine to medium sand.
880	900	Coarse to very coarse sand. Some fine to medium sand.
900	910	Very fine to coarse sand.
910	920	Very fine to medium sand with some coarse sand.
920	957	Samples missing. Refer to Driller's Log.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
11-30-80	16:15	290.82		Measured with chain. Measuring point top of 3/4-inch pipe 0.86 foot above top of surface pipe. Surface pipe approximately 0.5 foot above land surface.
12-01-80	07:35	290.87		Measured with chain.
	07:50	290.9		Measuring with sounder.
	09:50	290.9		
	10:15			Pump on. Ten-inch pump to 350-feet. Eight inch pump 350 to 550 feet. Top of 13.5 inch bowls set at 550 feet. Discharge pipe 10-inch. Orifice 7-inch.
	10:16	326.6		
	10:17	309.4	550	
	10:20	309.2		
	10:21	309.2	550	
	10:24		550	Lot of mud. 2.5 cc/l fine to very fine sand.
	10:25	309.5		
	10:28		550	Clearing some. 0.3 cc/l fine to very fine sand.
	10:30	309.4		
	10:38	309.4		
	10:40			Fairly clear. Slight mud color. < 0.1 cc/l very fine sand.
	10:44		550	Fairly clear. < 0.1 cc/l very fine sand.
	10:45	309.7		
	10:47			Surge once.
	10:52			Lot of mud. 1.5 cc/l medium to very fine sand.
	10:55			Lot of mud. 2.5 cc/l fine to very fine sand.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-01-80	10:56	310.6		
	11:05	310.7		Lot of mud. < 0.1 cc/l very fine sand.
	11:11		550	Clearing some. < 0.1 cc/l very fine sand.
	11:12	310.7		
	11:19			Fairly clear. < 0.1 cc/l very fine sand.
	11:20			Surge once.
	11:25		550	Lot of mud. 2.5 cc/l fine to very fine sand.
	11:27			Still lot of mud. 1.0 cc/l fine to very fine sand.
	11:29	310.5		
	11:32			Less mud. <0.1 cc/l very fine sand.
	11:38	310.6		
	11:40		550	Less mud. < 0.1 cc/l very fine sand.
	11:49			Fairly clear. Surge once.
	11:54		550	Lot of mud. 1.3 cc/l fine to very fine sand.
	11:56			Lot of mud. 0.9 cc/l fine to very fine sand.
	11:58			Lot of mud. 0.15 cc/l fine to very fine sand.
	12:00	310.9	550	
	12:11		550	Still muddy. < 0.1 cc/l very fine sand.
	12:15			Fairly clear. Surge once.
	12:19		812	Lot of mud. 1.5 cc/l medium to very fine sand.
	12:21			Lot of mud. 0.5 cc/l fine to very fine sand.
	12:23	324.1		
	12:27		812	Still muddy. < 0.1 cc/l fine to very fine sand.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-01-80	12:32	324.7		
	12:34			Fairly clear. Surge once.
	12:37			Lot of mud. 0.6 cc/l medium to very fine sand.
	12:38			Lot of mud. 1.2 cc/l fine to very fine sand.
	12:40		812	Lot of mud. 0.3 cc/l fine to very fine sand.
	12:34	324.0		
	12:52	324.4		
	12:53			Fairly clear. < 0.1 cc/l very fine sand.
	12:54			Surge twice.
	12:59			Lot of mud. 1.0 cc/l fine to very fine sand.
	13:00			Lot of mud. 0.6 cc/l fine to very fine sand.
	13:01		812	Lot of mud. 0.1 cc/l fine to very fine sand.
	13:03			Still muddy. 0.1 cc/l fine to very fine sand.
	13:12	323.8		
	13:15			Fairly clear. Surge twice.
	13:21			Lot of mud. 1.5 cc/l medium to very fine sand.
	13:23		812	Lot of mud. 0.1 cc/l fine to very fine sand.
	13:27			Still muddy. < 0.1 cc/l fine to very fine sand.
	13:29	323.1		
	13:31			Fairly clear. Surge twice.
	13:36			Lot of mud. 1.0 cc/l medium to fine sand.
	13:38			Lot of mud. 0.9 cc/l very fine sand and silt.
	13:47	322.5	812	Fairly clear. Surge twice.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-1-80	13:53		812	Lot of mud. 1.5 cc/l medium to very fine sand.
	13:55			Lot of mud. 0.15 cc/l fine to very fine sand.
	13:59		812	Still some mud. < 0.1 cc/l very fine sand.
	14:02	321.8		
	14:03			Fairly clear. Surge twice.
	14:08			Lot of mud. 0.5 cc/l medium to very fine sand.
	14:10		812	Lot of mud. 0.2 cc/l very fine sand and silt.
	14:18	321.2		
	14:20		812	Clearing some.
	14:22			Fairly clear. Surge twice.
	14:27		1,001	Lot of mud. 0.3 cc/l medium to very fine sand.
	14:28			Lot of mud. 0.3 cc/l medium to very fine sand.
	14:30			Still muddy. 0.1 cc/l very fine sand.
	14:32	329.0		
	14:40	329.8	1,001	
	14:41			Fairly clear. Surge twice.
	14:46			Lot of mud. 0.6 cc/l medium to very fine sand.
	14:48			Lot of mud. 0.1 cc/l very fine sand and silt.
	14:58	329.2	1,001	
	14:59			Fairly clear. Surge twice.
	15:04			Considerable mud and color. 0.5 cc/l medium to very fine sand.
	15:06		1,001	Considerable mud and color. 0.1 cc/l very fine sand.
	15:14	328.2	1,001	

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-01-80	15:15			Fairly clear. Surge twice.
	15:20			Considerable mud and color. 0.2 cc/l medium to fine sand.
	15:22		1,001	Considerable mud and color. 0.1 cc/l very fine sand.
	15:29	327.8	1,001	
	15:30			Fairly clear. Surge twice.
	15:35			Considerable mud and color. 0.2 cc/l fine to very fine sand.
	15:37			Considerable mud and color. < 0.1 cc/l very fine sand.
	15:44	327.2	1,001	
	15:45			Fairly clear. Surge twice.
	15:50			Considerable mud and silt. 0.2 cc/l medium to very fine sand.
	15:52			Considerable mud and silt. 0.1 cc/l very fine sand and silt.
	15:59	326.5	1,001	
	16:00			Fairly clear. Surge twice.
	16:05			Considerable mud and silt. 0.1 cc/l fine to very fine sand.
	16:07			Considerable mud and silt. 0.1 cc/l very fine sand and silt.
	16:14	326.2	1,001	
	16:15			Fairly clear. Surge twice.
	16:17			Considerable mud and silt. 0.2 cc/l fine to very fine sand.
	16:19			Considerable mud and silt. 0.1 cc/l very fine sand and silt.
	16:29	326.1	1,001	
	16:30			Fairly clear. Surge twice.
	16:35		1,251	Lot of mud and silt. 0.2 cc/l fine to very fine sand.
	16:44	335.9		
	16:45			Fairly clear. Surge twice.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-01-80	16:50			Lot of mud and color. 0.15 cc/l fine to very fine sand.
	16:52			Lot of mud and silt. < 0.1 cc/l very fine sand.
	16:59	335.9	1,251	
	17:00			Fairly clear. Surge twice.
	17:29	336.7	1,251	
	17:30			Fairly clear. Surge twice.
	17:35			Lot of color. 0.1 cc/l very fine sand.
	17:44	335.5	1,251	
	17:45			Fairly clear. Surge twice.
	17:59	335.4	1,251	Surge twice.
	18:00		1,404	Changed to 8-inch orifice.
	18:05	337.9	1,404	Fairly clear.
	19:00	341.2		Surge twice. Some color 0.1 cc/l very fine sand.
	19:15	339.9	1,370	Some color. 0.1 cc/l very fine sand.
	19:39	339.6	1,370	Surge twice. Some color.
	19:43		1,404	Some color. 0.2 cc/l very fine sand.
	20:00	339.9	1,387	Surge twice.
	20:05		1,404	Clear, then some color.
	20:30	339.5	1,370	Clearing.
	20:35		1,529	Clear, then some color.
	21:00	346.9	1,543	Some color. Surge twice.
	21:07			$T = 76^{o}F$; $K = 360$ micromhos. < 0.1 cc/l very fine sand.
	21:30	346.7	1,500	Clearing. Surge twice.
	21:37			Clear, then color. < 0.1 cc/l very fine sand.
	22:03	345.9	1,500	Clear. Surge twice.
	22:10		1,529	Clear, then some color. 0.1 cc/l very fine sand.
	22:30	345.2	1,529	Clearing. Very little color. Surge twice.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-01-80	23:07		1,613	Color, clearing fast. No sand.
12-02-80	01:00	348.3	1,585	Clear. Surge twice.
	01:07		1,613	Color, < 0.1 cc/l very fine sand.
	01:30	346.5	1,557	Clear. Surge twice.
	01:37		1,613	Some color. Clearing fast. < 0.1 cc/l very fine sand.
	02:00	345.0	1,529	Clear. Surge twice.
	02:05		1,613	Clear, then some color. < 0.1 cc/l very fine sand.
	02:35	350.2	1,627	Clear. Surge twice.
	02:40		1,697	Clear, then color. < 0.1 cc/l very fine sand.
	03:30	352.6	1,697	Clear. Surge twice.
	03:35			Color. Clearing. No sand. T = 76°F; K = 380 micromhos.
	04:00	352.7	1,711	Surge twice.
	04:07			Color. No sand.
	04:30	352.3	1,711	Surge twice.
	04:37		1,791	Clear, then some color. No sand.
	05:30	355.9	1,791	Clear. Surge twice.
	05:37		1,791	Some color. No sand.
	06:00	356.2	1,791	Clear. Surge twice.
	06:07		1,791	Color. No sand.
	06:30	356.9	1,795	
	07:10	356.2	1,791	Clear. Surge twice.
	07:15		1,865	Color. No sand.
	07:24	357.4	1,865	Clear. Surge twice.
	07:30			Color. No sand.
	07:31			Starting to clear.
	07:42	358.3	1,865	Clear. Surge twice.
	07:48			Color. No sand.
	07:52	357.2	1,865	Clear. Surge twice.
	07:57			Color. No sand.
	07:59			Clearing.
	08:05			Surge twice.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-02-80	08:11			Color. No sand.
	08:15	357.0	1,865	Surge twice.
	08:21		2,005	Color. No sand.
	08:23		1,975	Clear.
	08:25	359.2		
	08:28		1,975	Clear. Surge twice.
	08:31		1,975	Slight color.
	08:32			Clearing.
	08:34			Clear.
	08:35	359.0	1,975	
	08:36			Reduced rpm.
	08:39	355.7	1,809	Clear.
	08:48			T = 76^{o}F; K = 380 micromhos.
	08:53	356.8		
	09:23	357.6	1,823	Clear.
	09:40	357.5	1,809	Clear. No sand.
	09:55	357.6	1,809	Clear. No sand.
	10:05	357.7	1,808	Clear. No sand.
	10:15			Pump off.
	10:16	292.2		
	10:17	299.7		
	10:18	299.4		
	10:19	298.9		
	10:20	298.4		
	10:32	295.7		
	10:45	295.2		

PRODUCTION WELL NO. 4

TEST DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-03-80	07:25	291.75		Measured with chain. Same measuring point as for development.
	07:30	291.7 -1.36 = 290.3 GL		Measuring with sounder.
	07:45	291.7		
	08:00			Pump on. Same setting as for development.
	08:01	337.8	1,711	Some color.
	08:02	341.9		Some color. Trace of sand.
	08:03	343.4	1,711	Clearing. No sand.
	08:04	344.4		
	08:05	344.9	1,711	
	08:06	345.5		Slight mud color. Few grains of sand.
	08:07	345.9		
	08:08	346.3	1,711	
	08:09	346.5		Clear. No sand.
	08:10	346.7	1,711	
	08:11	346.9		
	08:12	347.2		
	08:13	347.6		
	08:14	347.6	1,711	
	08:15	347.6		
	08:16	347.6		
	08:17	348.0		
	08:18	348.2	1,711	Clear. No sand.
	08:19	348.3		
	08:20	348.3		
	08:21	348.4		
	08:22	348.5	1,711	
	08:24	348.8		
	08:26	348.9		
	08:28	348.9		
	08:30	349.0		
	08:32	349.0		
	08:34	349.2	1,711	

PRODUCTION WELL NO. 4

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-03-80	08:36	349.6		
	08:38	349.7		
	08:40	349.7		
	08:44	349.9		Clear. No sand.
	08:46	349.9	1,711	
	08:48	350.1		T = 76°F; K = 380 micromhos.
	08:50	350.3		
	08:52	350.3		
	08:54	350.4		
	08:56	350.5	1,711	
	08:58	350.7	1,711 +	Decreased rpm slightly.
	09:00	350.6		
	09:05	350.4		
	09:10	350.6		
	09:15	351.1	1,725	Decreased rpm slightly.
	09:20	351.0	1,711 +	Decreased rpm slightly.
	09:25	351.0		
	09:30	351.1		
	09:35	351.2	1,711 +	Decreased rpm slightly.
	09:40	351.2	1,711	
	09:50	351.3	1,711	
	10:00	351.5	1,711	
	10:10	351.5	1,711	
	10:20	351.8	1,711 +	Decreased rpm slightly.
	10:30	351.7	1,711 +	Decreased rpm slightly.
	10:40	351.7	1,711	
	10:50	351.9	1,711	
	11:00	351.8	1,711 -	Increased rpm slightly.
	11:20	351.9	1,711	
	11:30	352.3	1,711	
	11:45	352.3	1,711 +	Decreased rpm slightly.
	12:00	352.3	1,711	
	12:15	352.5	1,711 +	Decreased rpm slightly.
	12:30	352.4	1,711	
	13:00	352.7	1,711	

PRODUCTION WELL NO. 4

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-03-80	13:30	352.7	1,711	
	14:00	352.8	1,711	
	14:30	352.8	1,711	
	15:00	353.0	1,711	
	15:30	353.0	1,711	
	16:00	353.2	1,711	
	16:05			T = 76°F; K = 380 micromhos.
	16:30	353.3	1,711	
	17:00	353.4	1,711	
	17:30	353.4	1,711	
	18:00	353.5	1,711	
	18:30	353.4	1,711	
	19:00	353.4	1,711	
	19:30	353.4	1,711	
	20:00	353.9	1,711 +	Decreased rpm slightly.
	20:30	353.7	1,711	
	21:00	353.4	1,697	Increased rpm slightly.
	21:30	353.6	1,711	
	22:00	353.9	1,711	
	22:30	353.8	1,711	
	23:00	353.8	1,711	T = 76°F; K = 380 micromhos.
	23:30	354.1	1,711	
12-04-80	00:00	354.5	1,711	
	00:30	354.6	1,711	
	01:00	354.9	1,711	
	01:30	355.0	1,711 +	Decreased rpm slightly.
	02:00	355.3	1,711 +	Decreased rpm slightly.
	02:30	355.5	1,725	Decreased rpm slightly.
	03:00	354.5	1,711	
	03:30	354.5	1,711 +	Decreased rpm slightly.
	04:00	354.3	1,711	
	04:30	354.3	1,711	
	04:46			Engine stopped, wire to fuel pump solenoid broke.

PRODUCTION WELL NO. 4

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-04-80	04:50	298.9		
	04:51	298.7		
	04:52	298.3		
	04:53	298.1		
	04:54	297.9		
	04:55	297.7		
	04:56	297.6		Pump back on.
	05:00	348.7	1,711	
	05:22	352.8	1,711	
	05:30	353.1	1,711	
	06:00	353.7	1,711	
	06:30	354.0	1,711 +	Decreased rpm slightly.
	07:00	353.7	1,711	
	07:30	353.9	1,711	
	07:45			T = 76°F; K = 380 micromhos. Collected samples.
	07:55	353.4	1,711	
	08:00			Pump off.
	08:01	283.1		
	08:02	299.0		
	08:03	299.8		
	08:04	299.4		
	08:05	299.1		
	08:06	298.7		
	08:07	298.5		
	08:08	298.3		
	08:09	298.0		
	08:10	297.8		
	08:11	297.6		
	08:12	297.5		
	08:13	297.4		
	08:14	297.2		
	08:15	297.2		
	08:20	296.7		
	08:25	296.2		
	08:30	296.0		

PRODUCTION WELL NO. 4

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-04-80	08:35	295.8		
	08:40	295.5		
	08:45	295.5		
	08:50	295.2		
	08:55	295.1		
	09:00	295.0		
	09:10	294.9		
	09:20	294.6		
	09:30	294.5		
	09:40	294.4		
	09:50	294.3		
	10:00	294.2		
	10:15	294.0		
	10:30	293.8		
	10:45	293.8		
	11:00	293.7		
	11:30	293.5		

PRODUCTION WELL NO. 4

TEST DATA

(Observation Well PW-1 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
11-17-80	11:35	329.04	Measured with chain. Measuring point hole in plate over casing 0.87 foot above top of surface pipe. Surface pipe approximately 0.2 foot above land surface.
11-30-80	15:08	328.76	Measured with chain.
	15:28		Set wire with tape mark at 328.76.
12-01-80	08:09	328.68	
	10:15		PW-4 on for development.
	17:18	329.24	
12-02-80	02:15	330.21	
	09:07	330.70	
	10:15		PW-4 off.
12-03-80	07:25	329.44	
	08:00		PW-4 on for test.
	08:28	329.49	
	09:00	329.71	
	09:20	329.82	
	09:35	329.90	
	09:50	329.94	
	10:10	330.02	
	10:25	330.06	
	10:45	330.13	
	11:25	330.24	
	11:40	330.26	
	12:40	330.42	
	13:40	330.51	
	14:40	330.61	
	15:40	330.68	
	16:40	330.76	
	17:40	330.86	
	19:10	330.95	
	20:10	331.06	
	21:10	331.13	
	22:10	331.43	
	23:10	331.22	

PRODUCTION WELL NO. 4

TEST DATA

(Observation Well PW-1 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-04-80	00:10	331.24	
	01:10	331.25	
	02:10	331.30	
	03:10	331.33	
	04;10	331.34	
	05:10	331.29	
	06:10	331.32	
	07:10	331.39	
	08:00		PW-4 off.
	08:45	331.21	
	09:00	331.14	
	09:15	331.07	
	09:30	331.00	
	10:15	330.85	
	10:30	330.78	
	11:10	330.67	

PRODUCTION WELL NO. 4

TEST DATA

(Observation Well PW-2 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
11-17-80	11:50	307.46	Measured with chain. Measuring point hole in plate over casing 0.90 foot above top of surface pipe. Surface pipe approximately 0.5 foot above land surface.
11-30-80	15:40	307.29	Measured with chain.
	15:55		Set wire with tape mark at 307.29.
12-01-80	08:15	307.32	
	10:15		PW-4 on for development.
	17:22	307.97	
12-02-80	02:25	309.74	
	06:50	310.40	
	09:15	310.71	
	10:15		PW-4 off.
12-03-80	07:32	308.79	
	08:00		PW-4 on for test.
	08:33	308.94	
	09:05	309.10	
	09:25	309.18	
	09:40	309.23	
	09:55	309.31	
	10:15	309.42	
	10:30	309.49	
	10:50	309.57	
	11:30	309.71	
	11:45	309.77	
	12:45	310.01	
	13:45	310.13	
	14:45	310.35	
	15:45	310.52	
	16:45	310.73	
	17:45	310.92	
	19:15	311.17	
	20:15	311.30	
	21:15	311.46	

PRODUCTION WELL NO. 4

TEST DATA
(Observation Well PW-2 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-03-80	22:15	311.58	
	23:15	311.67	
12-04-80	00:15	311.76	
	01:15	311.83	
	02:15	311.91	
	03:15	311.98	
	04:15	312.07	
	05:15	312.04	
	06:15	312.17	
	07:15	312.22	
	08:00		PW-4 off.
	08:50	312.01	
	09:05	311.93	
	09:20	311.82	
	09:35	311.74	
	10:20	311.44	
	10:35	311.33	
	11:30	311.10	

PRODUCTION WELL NO. 4

TEST DATA

(Observation Well PW-3 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
11-17-80	11:10	353.22	Measured with chain. Measuring point hole in plate over casing 1.3 feet above surface pipe. Surface pipe approximately 1 foot above land surface.
11-30-80	14:23	352.92	Measured with chain.
	14:55		Set wire with tape at 352.92.
12-01-80	08:03	352.80	
	10:15		PW-4 on for development.
	17:13	353.18	
12-02-80	02:15	353.93	
	06:44	354.20	
	09:00	354.29	
	10:15		PW-4 off.
12-03-80	07:39	353.43	
	08:00		PW-4 on for test.
	08:23	353.47	
	08:55	353.64	
	09:30	353.77	
	09:45	353.79	
	10:00	353.83	
	10:20	353.86	
	10:35	353.91	
	11:20	353.98	
	11:35	354.01	
	12:35	354.06	
	13:35	354.12	
	14:35	354.16	
	15:35	354.24	
	16:35	354.28	
	17:35	354.34	
	19:05	354.41	
	20:05	354.48	
	21:05	354.57	
	22:05	354.59	
	23:05	354.65	

PRODUCTION WELL NO. 4

TEST DATA
(Observation Well PW-3 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-04-80	00:05	354.63	
	01:05	354.65	
	02:05	354.68	
	03:05	354.69	
	04:05	354.74	
	05:05	354.67	
	06:05	354.74	
	07:05	354.78	
	08:00		PW-4 off.
	08:55	354.60	
	09:10	354.55	
	09:25	354.51	
	10:10	354.40	
	10:25	354.37	
	10:45	354.31	

Appendix C2.

MW-9 Pumping Test, 1994

APPENDIX C

LAS ANIMAS CREEK PUMPING TEST

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September 12, 1996
Report 1356A/960912

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1. INTRODUCTION

Water supply for the Copper Flat project is to be drawn from Santa Fe Formation alluvium in the valley of the Rio Grande. Water is to be removed from four wells approximately one mile north of the Las Animas Creek valley. This valley contains a shallow aquifer and an intermittent stream, which supply water for a wide range of agricultural and water supply activities, as well as support a major stand of deciduous trees.

In order to evaluate the extent to which the stream flow and the water in the shallow aquifer may be affected by the drawdown from the nearby pumping wells, a major pumping test was designed and performed in Animas Creek. This test comprised the installation of a pumping well in the main Santa Fe aquifer, located some 200 feet below the ground surface in the valley. Water was pumped from this well to create a drawdown which would simulate the drawdown expected from the production pumping. The response to this pumping was monitored in one well completed at the top of the saturated section in the Santa Fe formation, at a depth of approximately 80 feet. In addition, the response of the overlying Las Animas Creek shallow aquifer was monitored by one specially completed shallow monitor well, as well as a total of seven other shallow private wells in the area. The pumping test was performed in October, 1994. This appendix presents the test approach, test results, and an interpretation of the results.

2. APPROACH

The pumping test was performed in the Las Animas Creek Valley at the point closest to the mine's water supply wells, as shown in Figure 1. The test location geology comprises 20-60 feet of reworked gravels which form a recent alluvium layer, overlying several thousand feet of Santa Fe Group gravels, sands, and silts.

A number of nearby private wells draw water from the Las Animas Creek alluvium, most are less than 100 feet deep, tapping the recent alluvium. Water levels in these wells are typically within a few feet of ground surface, and appear to be associated with stream levels (when the stream flows). This aquifer provides groundwater for domestic and stock watering wells in the area. Several wells are completed at approximately 100 feet or greater. These wells display a chemical signature distinct from the alluvial well water and a water level about 50 feet lower than the shallow wells.

Las Animas Creek is an intermittent stream. The stream was flowing when sampled in August 1994, but was not flowing at the time of the pumping test in October 1994. Water quality is generally good.

3. TEST ARRANGEMENT

Figure 2 shows the locations of the three wells which were installed for the test. Details of each well are provided in Attachment 1. The three wells were completed as follows:

1. Pumping well MW-9. The pumping well is MW-9. This well is drilled to a depth of 252.5 feet through the Las Animas Creek alluvium into the Santa Fe Formation. It is open to the formation from 194 feet to total depth. The well was screened with 4 ½ inch Schedule 80

slotted PVC, and cased with 4 ½ inch Schedule 80 blank PVC pipe. The well was fitted with a 100 gpm submersible pump.

2. <u>Monitor well MW-10.</u> MW-10 is located approximately 50 feet east of MW-9. It was drilled to a depth of 125 feet, and screened between 76.5 feet and total depth in the Santa Fe alluvium.
3. <u>Monitor well MW-11.</u> MW-11 is located approximately 50 feet southeast of MW-9. MW-11was initially drilled to a depth of 65 feet. After logging the hole, it was backfilled to a depth of 37 feet, sealed with bentonite, and screened from 7 to 37 feet BGS with a gravel pack.

Figure 3 shows the generalized geology of the three wells. The initial water levels are shown for reference.

In addition to these three wells, the test was monitored by measuring water levels in nearby domestic, irrigation, and water supply wells. The wells used were as follows:

Well Name	Location Relative to MW-9	Drilling method	Approx. Depth (ft)
Irwin House- "Birdie"	250 feet southwest	Hand dug	40
Irwin Yard- "Concrete"	150 feet due south	Hand dug	30
Exten	1250 feet west	Hand dug	25
Nicholson	1350 feet east	Hand dug	25
Cox	2200 feet east	Drilled	112
Darling	2700 feet east	Hand dug	25
PW-1	3400 feet south	Drilled	1000

4. TEST RESULTS

4.1 Pre-test activities

Prior to the test, all wells were measured daily for 17 days, to establish a trend for groundwater levels (if any).

4.2 Pumping Test Operation

The test was operated by starting the pump generator on October 13, 1994 at 12:30 p.m. Initially water was discharged to a location approximately 200 feet from the well. It was discovered that this location was too close to the monitor wells, as the water level began to rise slightly in MW-11. The test was temporarily shut down on October 14 from 13:32 to 16:30 to change the location of the discharge, with the new discharge point being located approximately one mile from the pumping well. During operating periods, the pumped flow rate averaged 90 gpm. Flows are shown on Figure 4. The test ended at 09:00 on October 17. Water levels were measured every day for 12 days following the test.

Water levels were monitored using water level sounders, which were calibrated against each other to the nearest one hundredth foot. Reading frequency depended on the changes in the levels; pre- and post-test levels were generally read daily, while test rates ranged from hourly to once per shift. Results of water level monitoring are presented in Attachment 2.

4.3 Rainfall event

On October 14, a nearby rain gauge measured 1 inch of rain in 2.5 hours in the Las Animas Creek drainage basin. The creek began to flow, and water levels in the wells changed in response to the rain and the flow.

5. RESULTS

5.1 Flows

Flows from the pumped well (MW-09) were recorded using a flow meter. The results are presented in Figure 4. The flow fluctuated somewhat, with an average flow rate of 90 gpm.

5.2 Heads

Heads were measured in all project wells, but were measured more frequently in the three main wells installed for the project. The results are as follows:

1. MW-09. The initial water level elevation in the pumping well was approximately 4,375 feet. The response of MW-9 to pumping is indicated in Figure 5. As can be seen, drawdown was rapid and reversible, and reached approximately 24 feet at the end of the test. Specific capacity of the well was 3.75 gpm/ft.
2. MW-10. The initial water level elevation in the deeper of the two monitor wells was 4,376 feet, about the same as the pumping well. The response to the pumping is indicated in Figure 6. A drawdown of approximately 1 foot was recorded at the well, although it is possible that this value was affected by the rainfall which occurred late in the test.
3. MW-11. The initial water elevation in the shallowest well, completed in the Las Animas Creek alluvium, was 4,435 feet, approximately 60 feet higher than the two deeper wells. The response of the level in MW-11 during the test is presented in Figure 7 (note very expanded vertical scale on this graph). The rise in water level after the start of the test on October 14 is due to the local discharge of water on the ground nearby. There is no evidence that pumping in MW-9 effected a head change in MW-11 at any time during the test; the level in the well was falling prior to the test, and continued to fall after it.

In addition to monitoring the three main wells, a total of seven other wells were monitored. All were relatively shallow, and all were near the pumping well. Figure 9 presents a magnified view of the pumping test wells' head responses. The general trend of these well results is as follows:

1. a small rise for the first few days after pumping began
2. a return to the previous rate of decrease after the rise.

Prior to the pumping test, the "Birdie" shallow aquifer well was falling at 0.02 ft/day. After the discharge incident, the rate of decline remained the same. There is no identifiable evidence of any impact on these wells of the drawdown created by MW-09.

5.3 PW-1 Response

To check if there was any effect of the drawdown in the extraction wells, pumping well PW-1 was monitored. This well is located 3500 feet to the south of MW-9. The water level elevation in this well was 4375 feet for the period during which the test was run. During the test, the water level in PW-1 did not change in any way attributable to MW-9.

6. ANALYSIS OF RESPONSES

6.1 MW-09 response

The hydraulic characteristics of the aquifer tapped by MW-09 have been estimated by a variety of non-equilibrium methods, using the Aqtesolve Package (Gerahty and Miller, 1995). Three approaches were used to analyze the first 24 hour drawdown period, with the following results (Figure 10, Figure 11, and Figure 12):

Method	**Cooper-Jacob**	**Theis**	**Hantush**	**Average**
Transmissivity (ft^2/min)	0.6086	0.5779	0.5666	0.5700
Storage Coefficient	$3.3x10^{-5}$	$6.1x10^{-5}$	$7.3x10^{-5}$	$5x10^{-5}$
Horizontal hydraulic conductivity (ft/yr)	6,400	6,075	5,960	6,000
Vertical hydraulic conductivity (ft/yr)	n/a	n/a	60	60

The Hantush analysis is particularly interesting, as the fit is good between the observed and the predicted behavior. In this analysis, it is assumed that there is leaky flow through an aquitard (on the bottom or top of the aquifer, or both). The vertical hydraulic conductivity of the leaky aquitards can be estimated from the response. The value obtained is 60 ft/yr. The vertical to horizontal anisotropy ratio obtained for the test is 100:1.

In summary, it would appear that MW-09 is located in a material with a hydraulic conductivity of approximately 6,000 ft/yr, with a storage coefficient of $5x10^{-5}$, and a ratio of horizontal hydraulic conductivity to vertical hydraulic conductivity of 100:1. These values are very similar to the calibrated values which have been used in the modeling (Appendix D).

6.2 Las Animas Creek aquitard conductivity

The conductivity of the aquitard below the Las Animas Creek alluvium can be estimated by consideration of the head difference in the aquifer. The vertical head gradient between MW-11 (completed in the Las Animas Creek alluvium) and MW-10 (completed in the Santa Fe Formation) can be computed as follows:

60'?

Head difference MW-10 to MW-11 = 23 feet

Thickness of low permeability layer = 50 feet

Head gradient = 23/50 = 0.46

This is a substantial vertical gradient. From modeling, it appears that there is approximately 13 miles of Las Animas Creek bottom land, with an average width of 2,000 feet. The total flow down the valley appears to be in the order of 2,000 gpm. If half of the water were to seep from the upper alluvium to the lower through the low permeability layer between the two wells above, then the hydraulic conductivity would have to be:

evidence?

but in the lower part, it seeps up!

$$K = Q/iA$$

where:
K = hydraulic conductivity (ft/yr)
Q = flow (1,000 gpm or 70×10^6 cuft/yr)
i = hydraulic gradient = 0.46
A = flow area (5 square miles or 150×10^6 square feet)

Applying the values produces a vertical hydraulic conductivity estimate of 1.0 ft/yr, or about 10^{-6} cm/sec. This is the vertical conductivity of a clayey material.

6.3 Water Chemistry

As a part of the evaluation, water chemistry was sampled from the test wells. The results are included in the data presented in Appendix E. The chemistry of the water is summarized below:

Parameter	Units	MW-9	MW-10	MW-11	PW-1
TDS	mg/L	190	310	314	217
HCO_3	mg/L	149	262	263	144
SO_4	mg/L	12	25	21	10
Ca	mg/L	12	59	63	22
Na	mg/L	54	29	23	38
Mg	mg/L	1	8	10	n/a

The chemistry of wells MW-10 and MW-11 are very similar, indicating that the water in the upper portion of the Santa Fe aquifer is provided by seepage from the overlying Las Animas Creek alluvium through a low permeability layer to the MW-10 level. Conversely, the chemistry of MW-9 differs from MW-10 and MW-11, and is very similar to PW-1. This suggests MW-9 comprises underflow beneath Las Animas Creek, not flow from it.

6.4 Conceptual Model

Based on the observations from the Las Animas Creek pump test a conceptual flow model of this system has been developed and quantified:

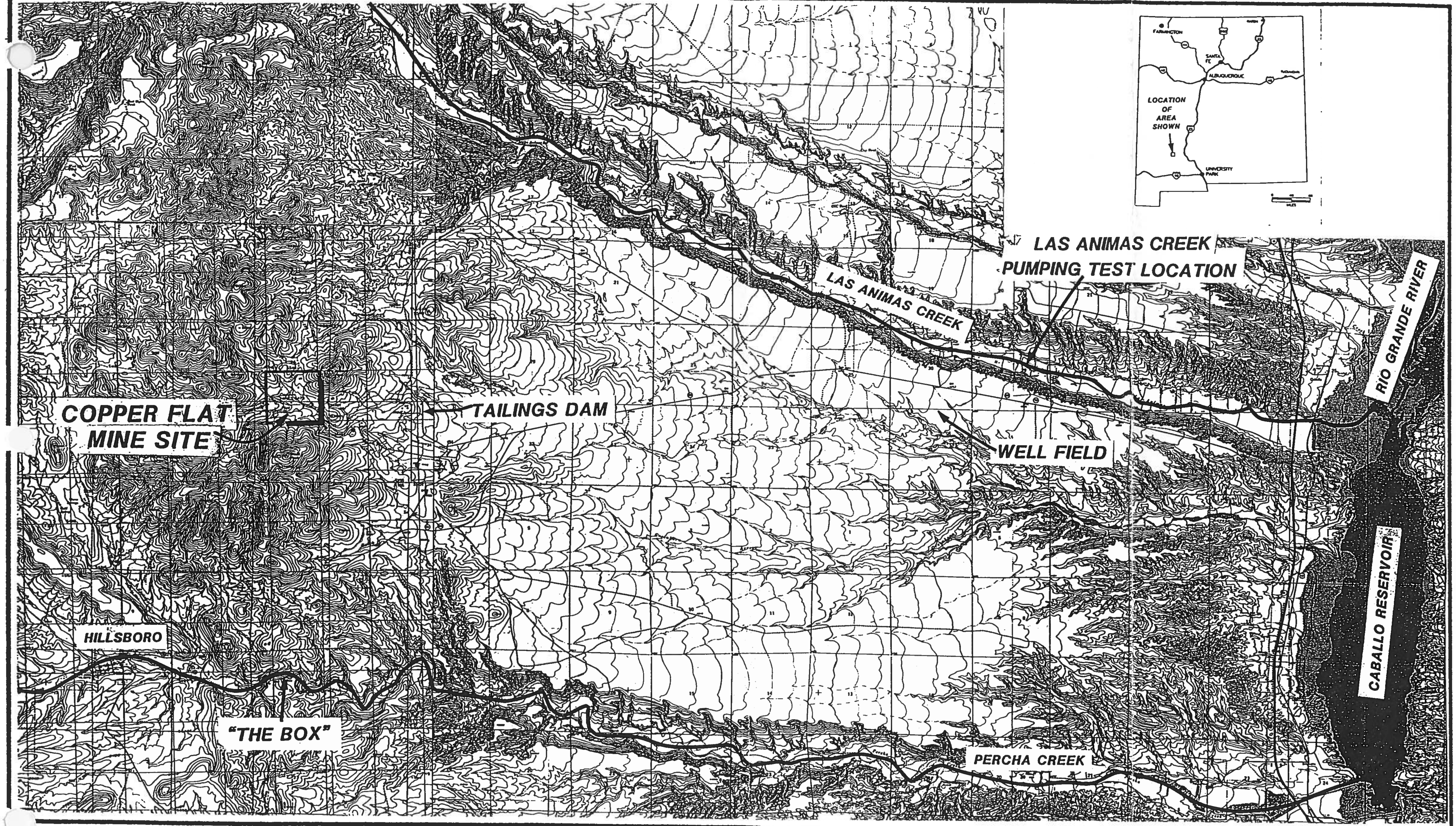
1. Water flows along Las Animas Creek, filling the associated alluvial aquifer.
2. Water leaks from the Las Animas Creek alluvial aquifer through the underlying clayey material. Analysis of this flow and the head gradient identified in the test produces a vertical hydraulic conductivity of 1 ft/yr.
3. This infiltrating water then meets with, and mixes with, water in the main Santa Fe aquifer. This aquifer is made up of relatively high permeability material, with a lateral hydraulic conductivity of about 6,000 ft/yr. The vertical permeability of this material is approximately 100 times less than its effective horizontal conductivity.

This system provides the explanation as to why the Las Animas alluvium remains saturated; the low conductivity of the underlying clayey material is sufficiently low to prevent water from leaving the alluvium, even under the strong vertical head which exists through the layer.

7. CONCLUSIONS

The Las Animas Creek alluvial system pump test has established that the creek and the associated alluvium is prevented from leaving the valley by a low permeability zone beneath the alluvial aquifer. This zone is estimated to have an hydraulic conductivity of no more than 1 ft/yr. The lower material in the Santa Fe aquifer is comprised of layers of high horizontal hydraulic conductivity materials (K = 6,000 ft/yr) and layers of low vertical conductivity aquitards (K = 60 ft/yr, or 1/100 of the horizontal conductivity).

While there is some evidence to suggest that the material between the Las Animas Creek alluvium is unsaturated (Attachment 1) the testing data does not provide a demonstration of a widespread unsaturated material beneath the creek bed.



ADRIAN BROWN CONSULTANTS, INC.

0 6000 12000

N

LOCATION MAP

Figure 1

Figure 2 Pump test location map

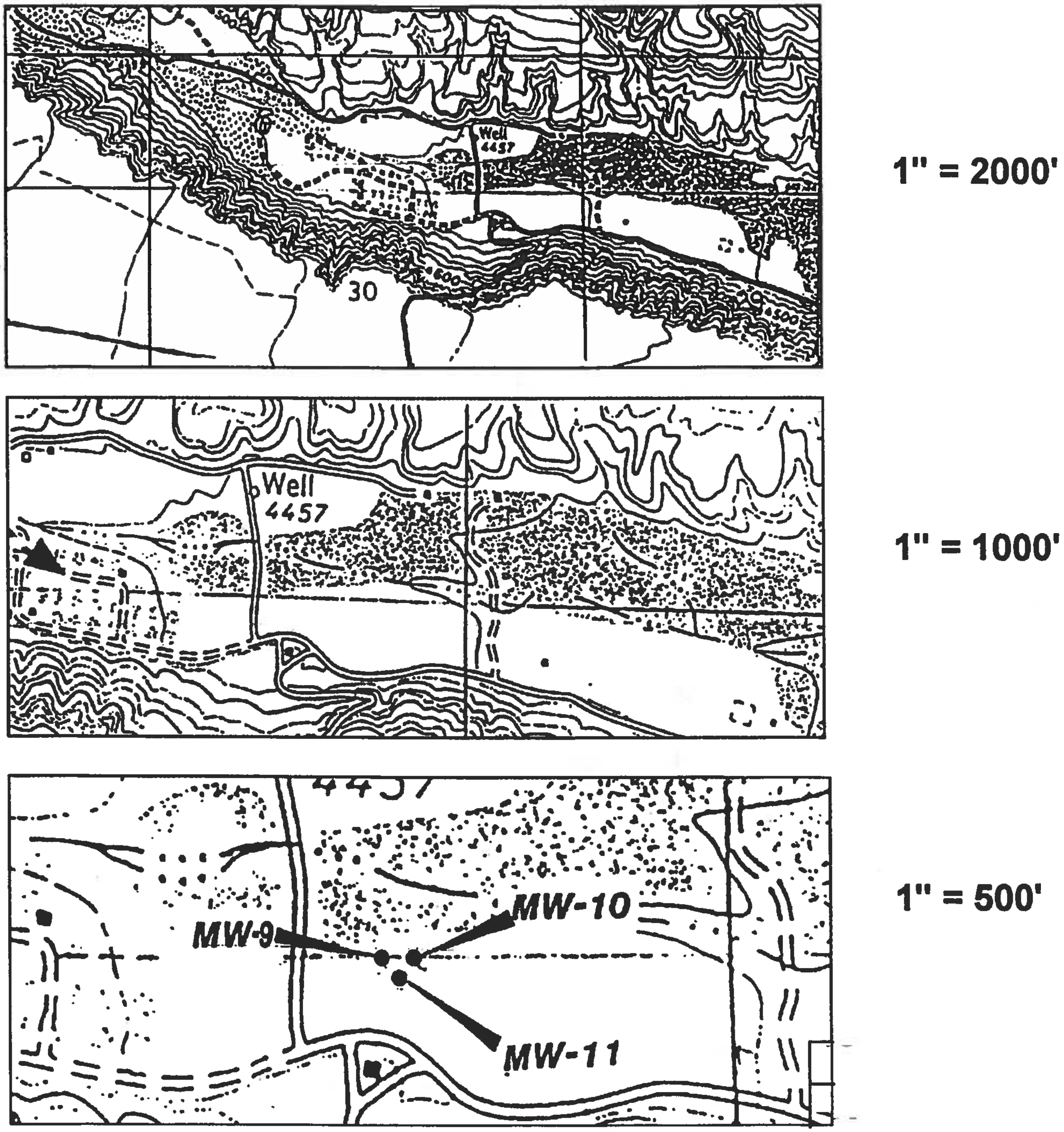


Figure 3 Generalized geology of pumping test wells

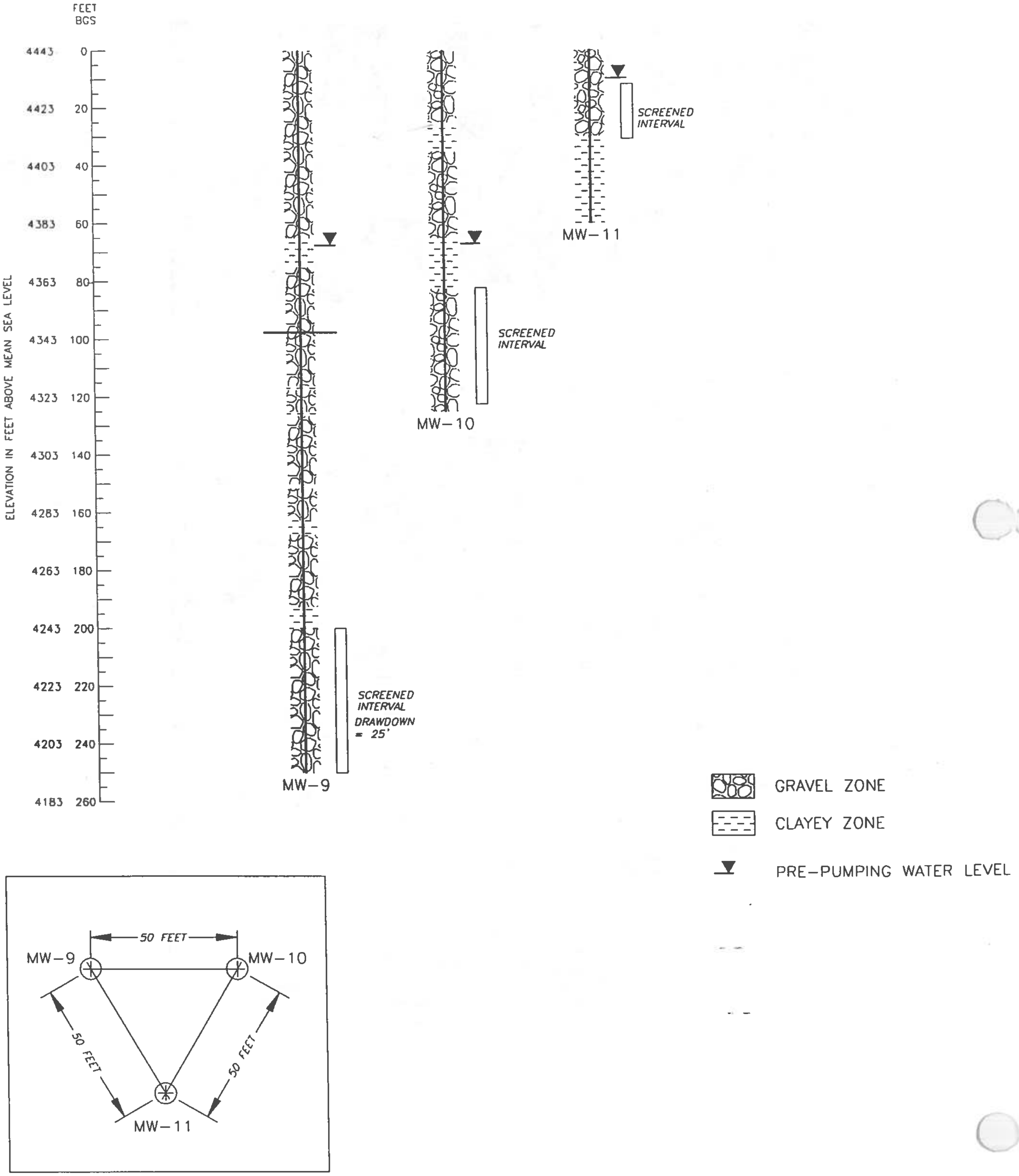


Figure 4 Flow from MW-9

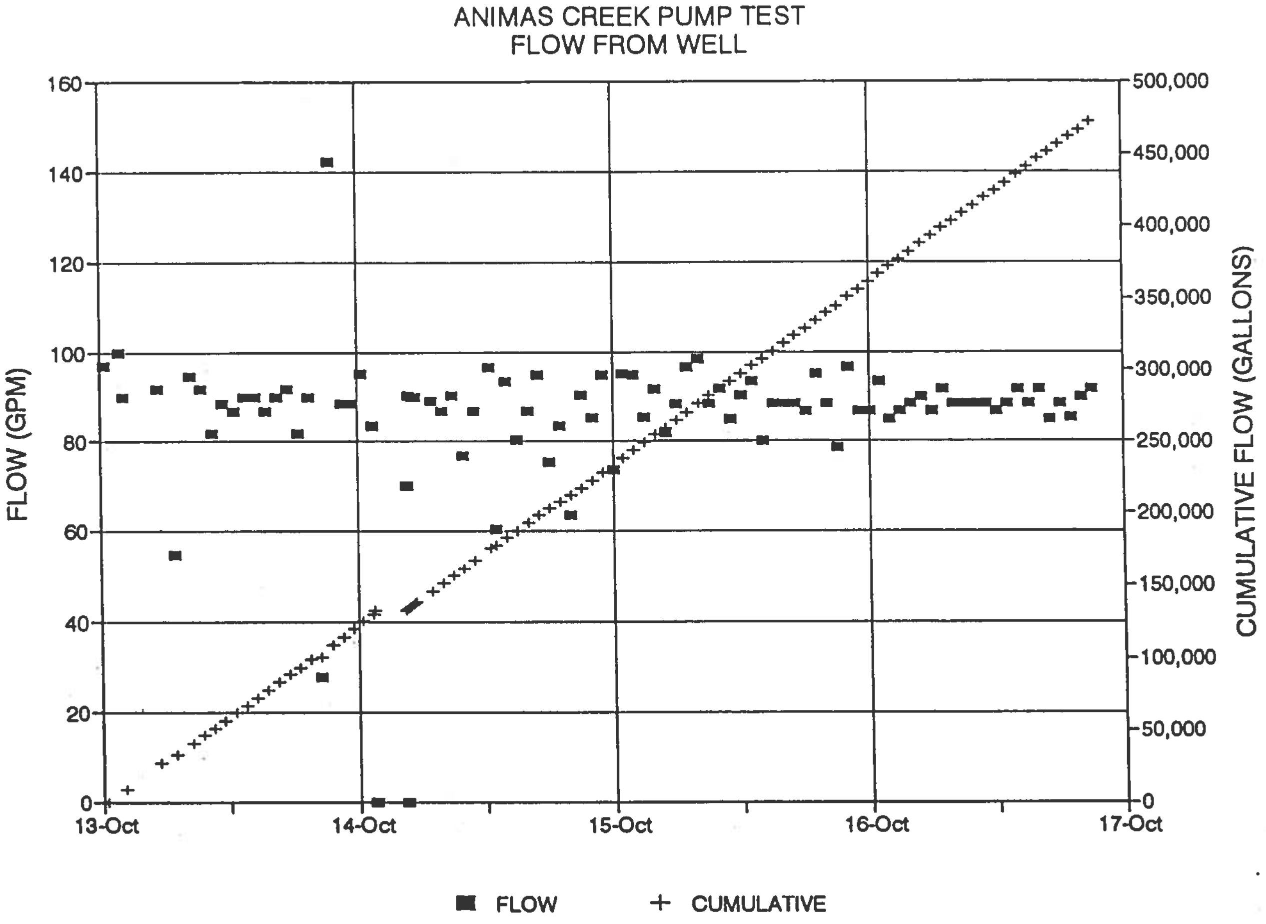


Figure 5 Drawdown in MW-9

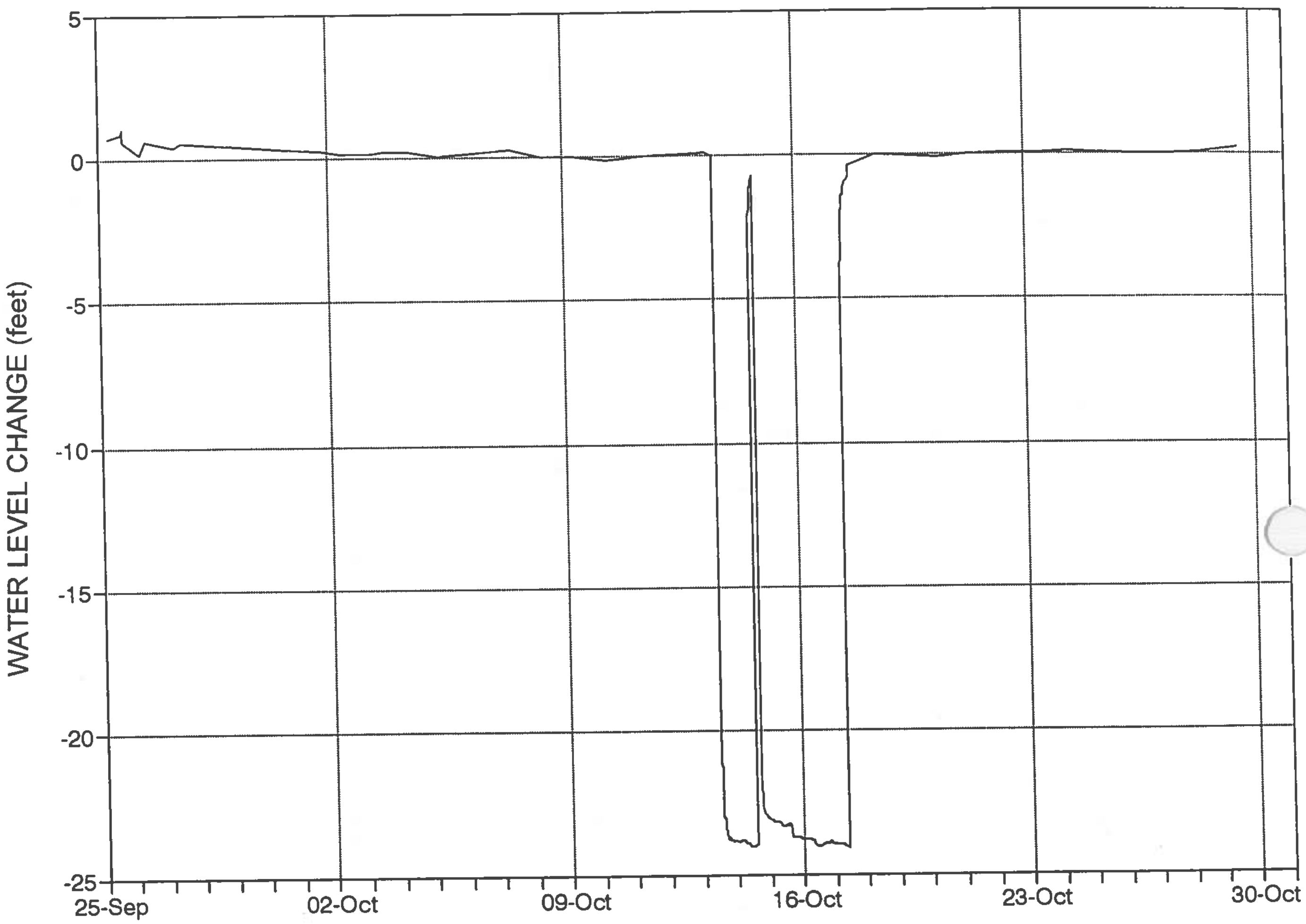


Figure 6 Drawdown in MW-10

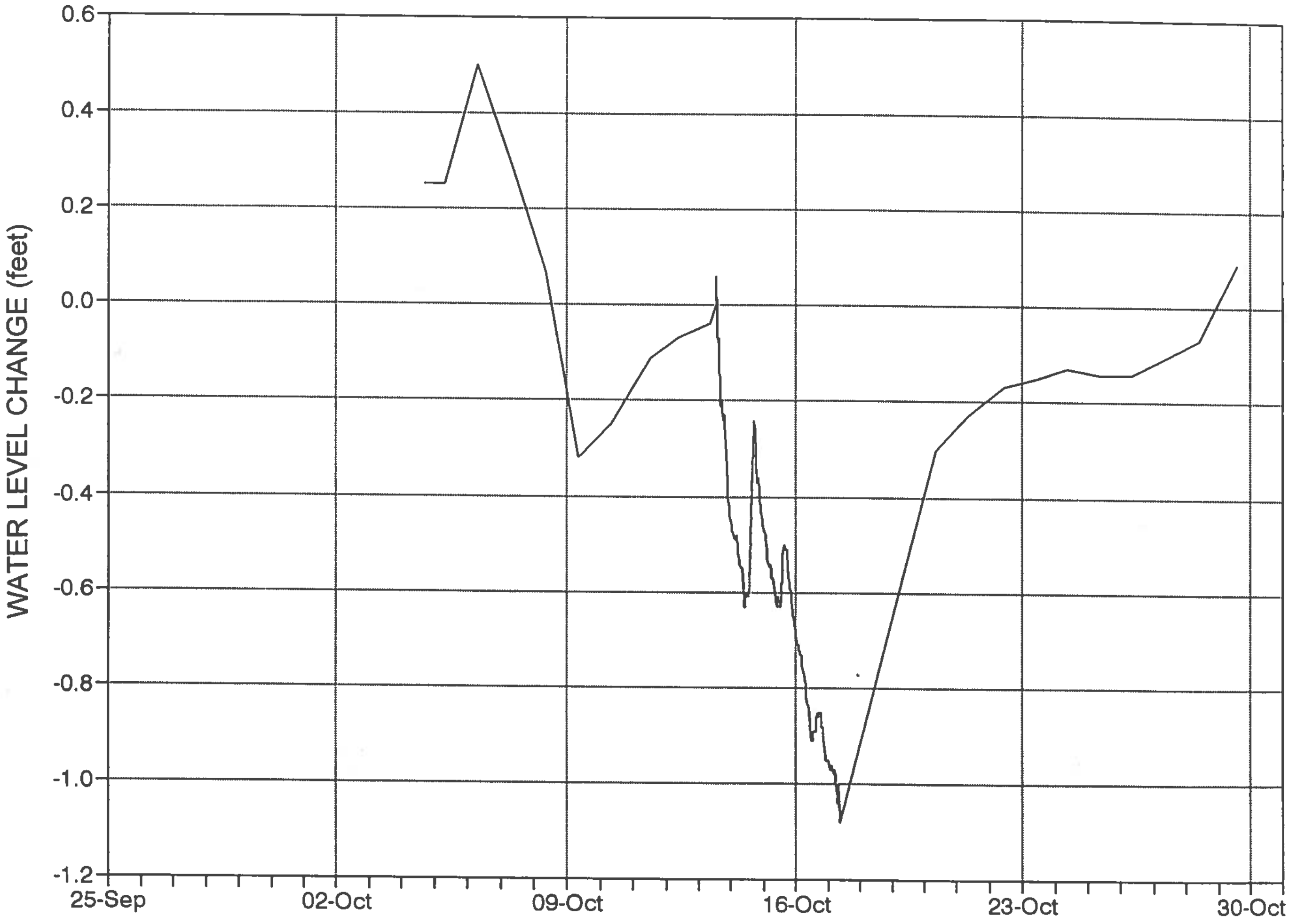


Figure 7 Drawdown in MW-11

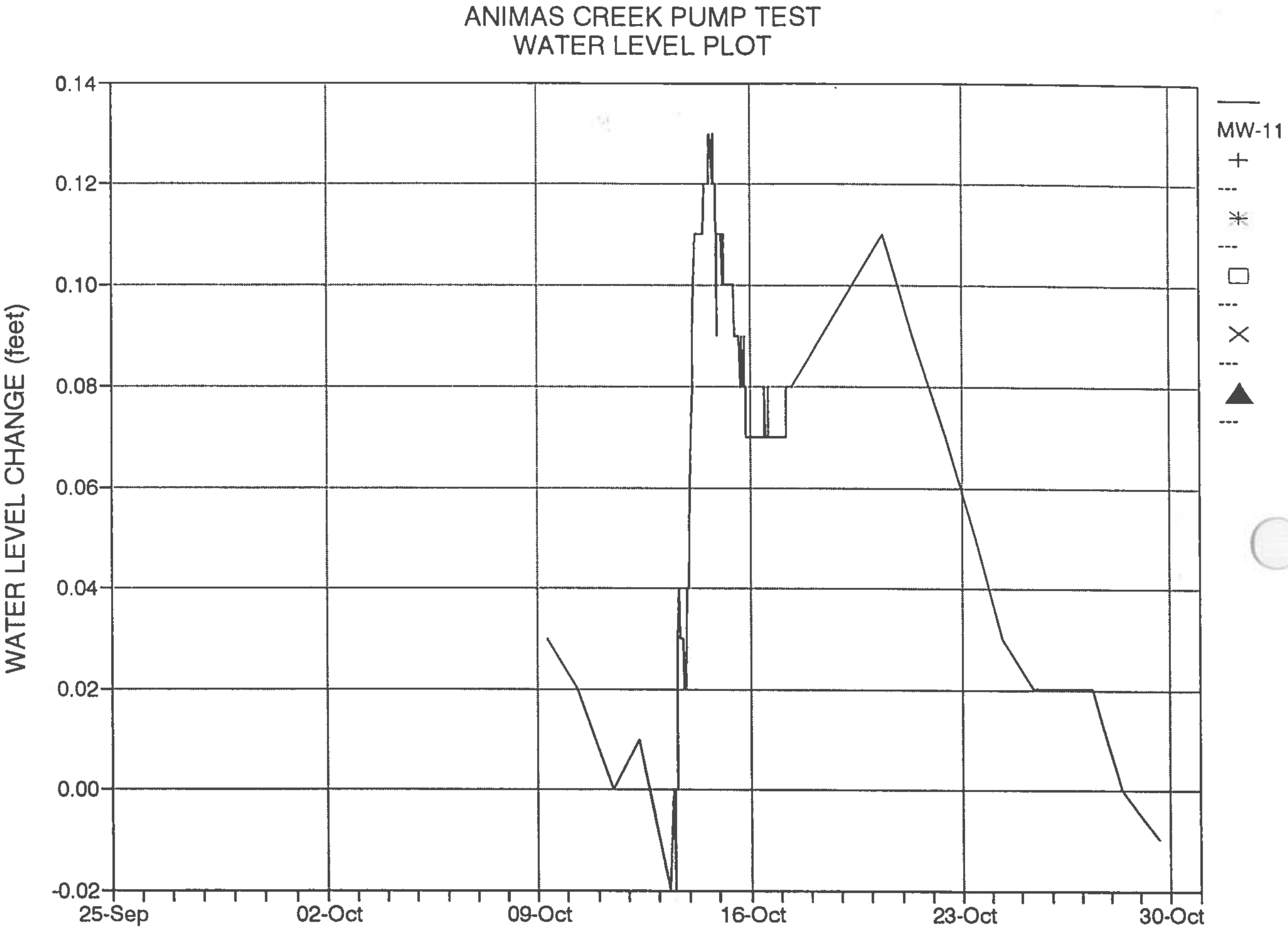
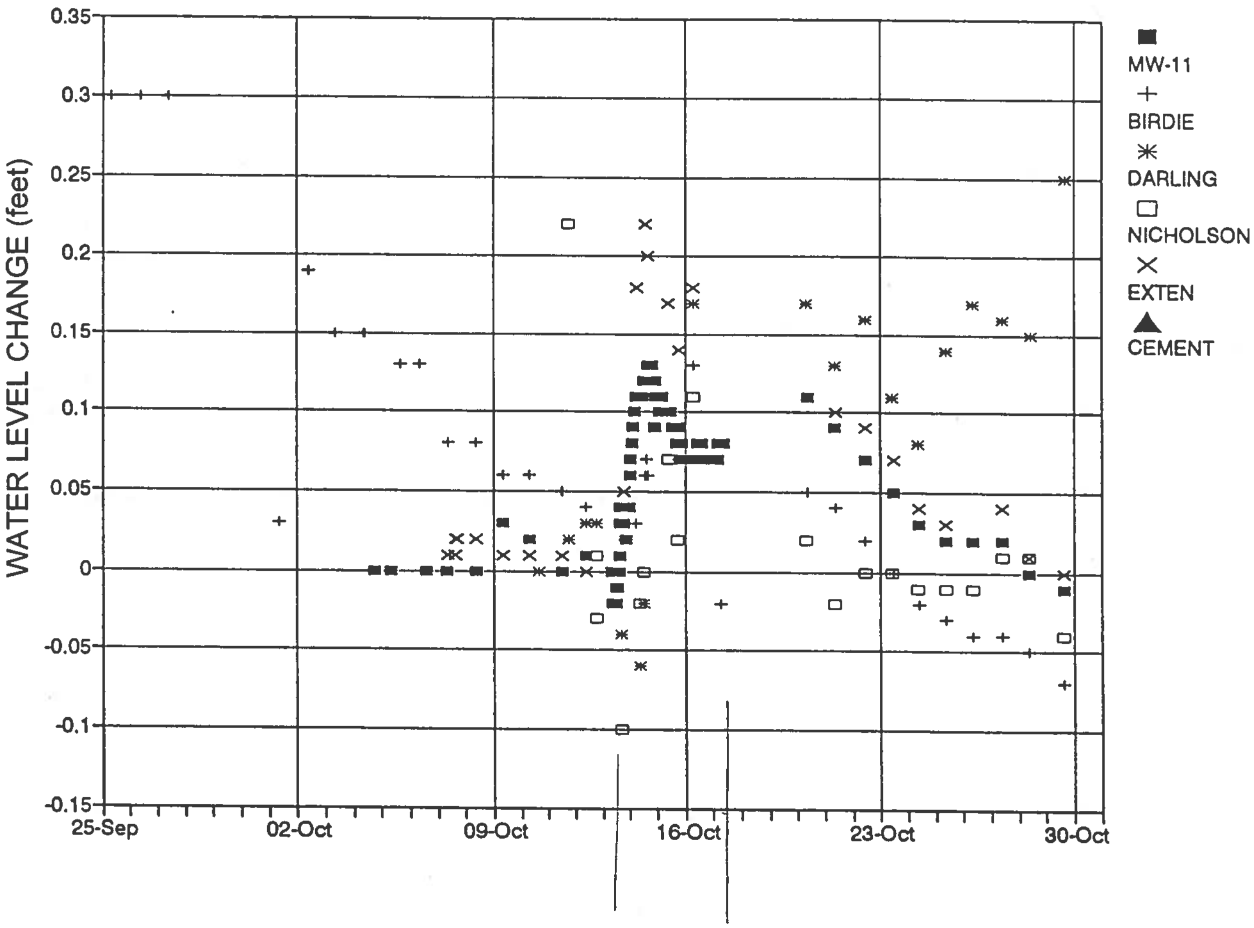


Figure 8 Water elevations in test wells



10-13-94
noon

10-17-94
09:00

Figure 9 Head changes for test wells

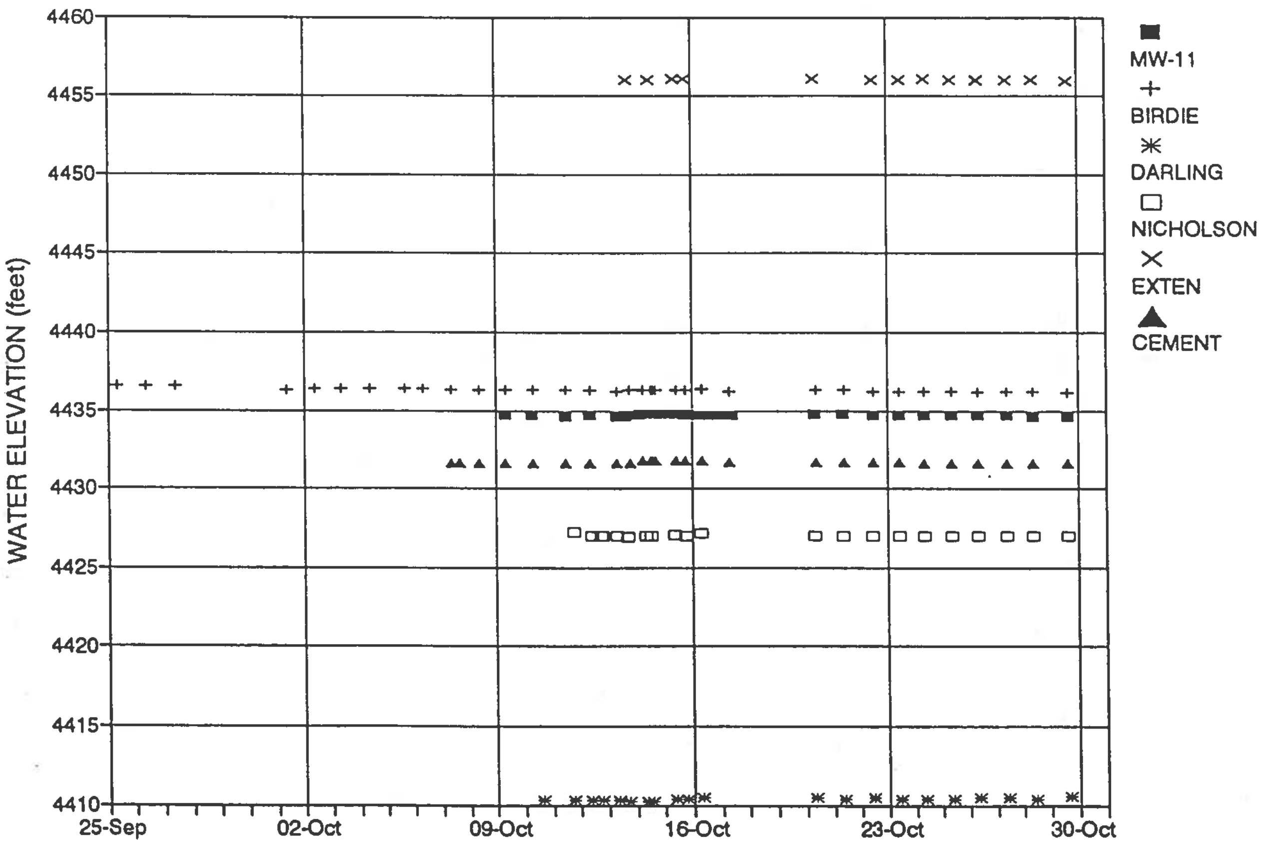
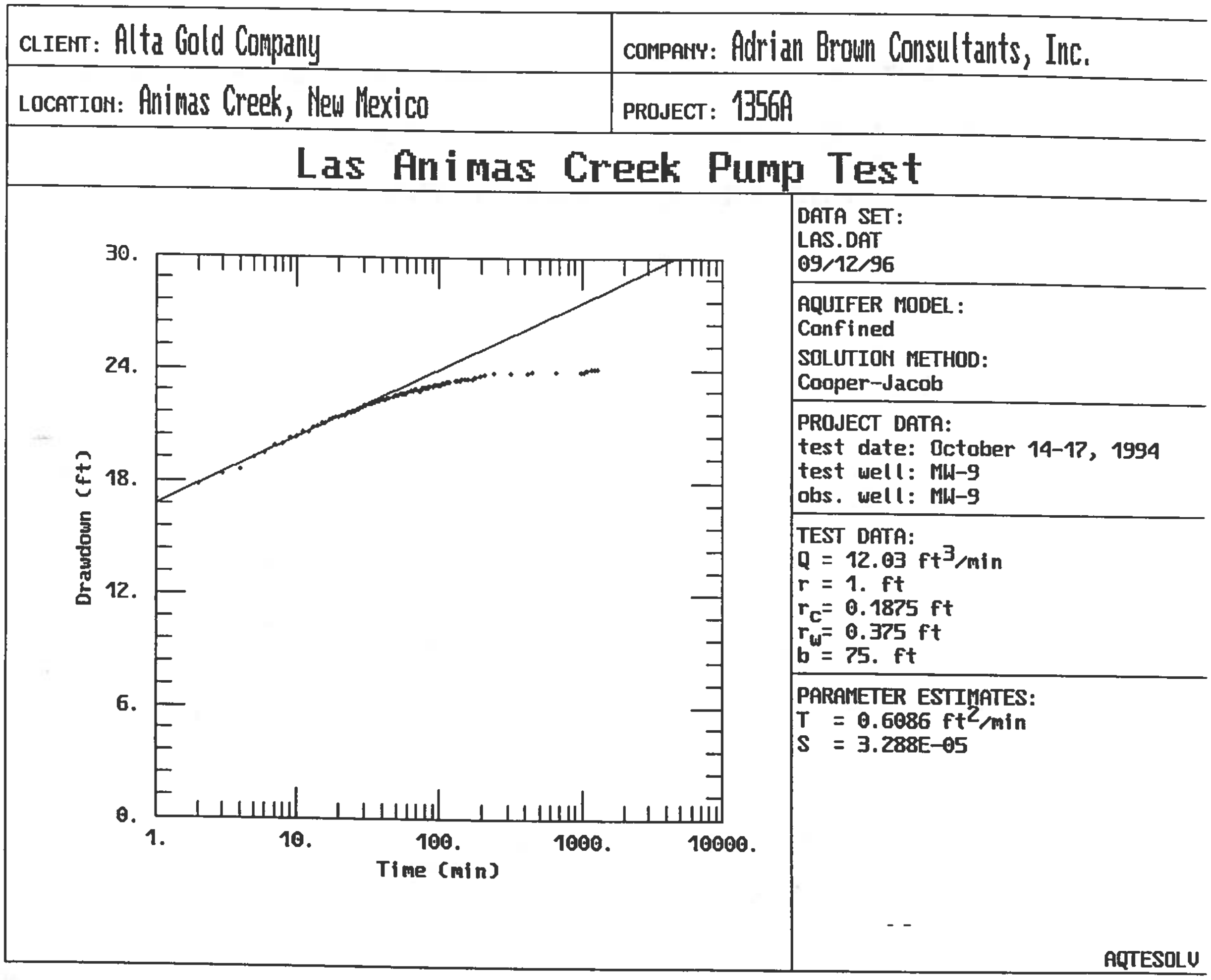


Figure 10 Cooper- Jacob drawdown analysis plot



CLIENT: Alta Gold Company

COMPANY: Adrian Brown Consultants, Inc.

LOCATION: Animas Creek, New Mexico

PROJECT: 1356A

Las Animas Creek Pump Test

DATA SET:
LAS.DAT
09/12/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper-Jacob

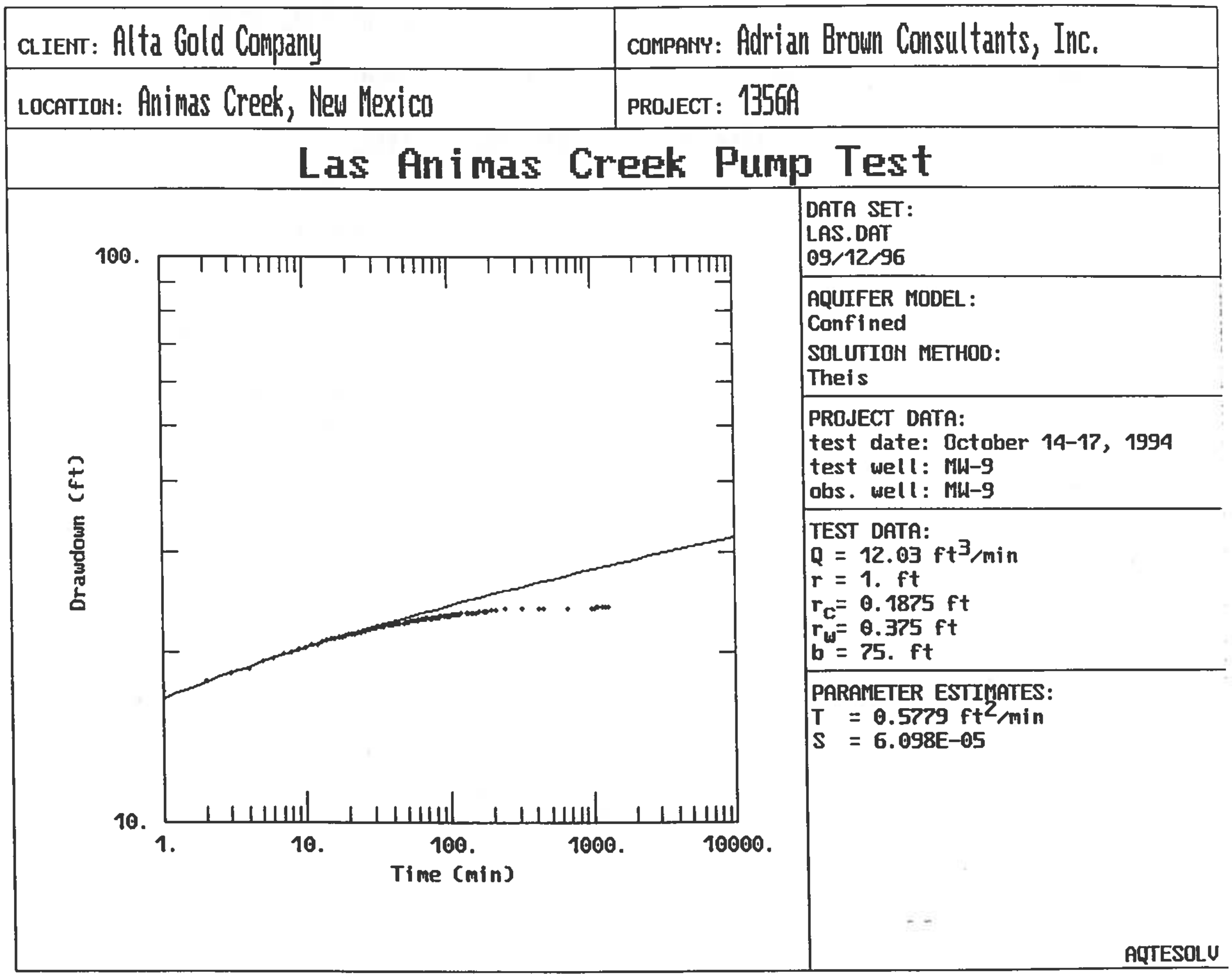
PROJECT DATA:
test date: October 14-17, 1994
test well: MW-9
obs. well: MW-9

TEST DATA:
$Q = 12.03\ ft^3/min$
$r = 1.\ ft$
$r_c = 0.1875\ ft$
$r_w = 0.375\ ft$
$b = 75.\ ft$

PARAMETER ESTIMATES:
$T = 0.6086\ ft^2/min$
$S = 3.288E-05$

AQTESOLV

Figure 11 Theis drawdown analysis plot



CLIENT: Alta Gold Company

COMPANY: Adrian Brown Consultants, Inc.

LOCATION: Animas Creek, New Mexico

PROJECT: 1356A

Las Animas Creek Pump Test

DATA SET:
LAS.DAT
09/12/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

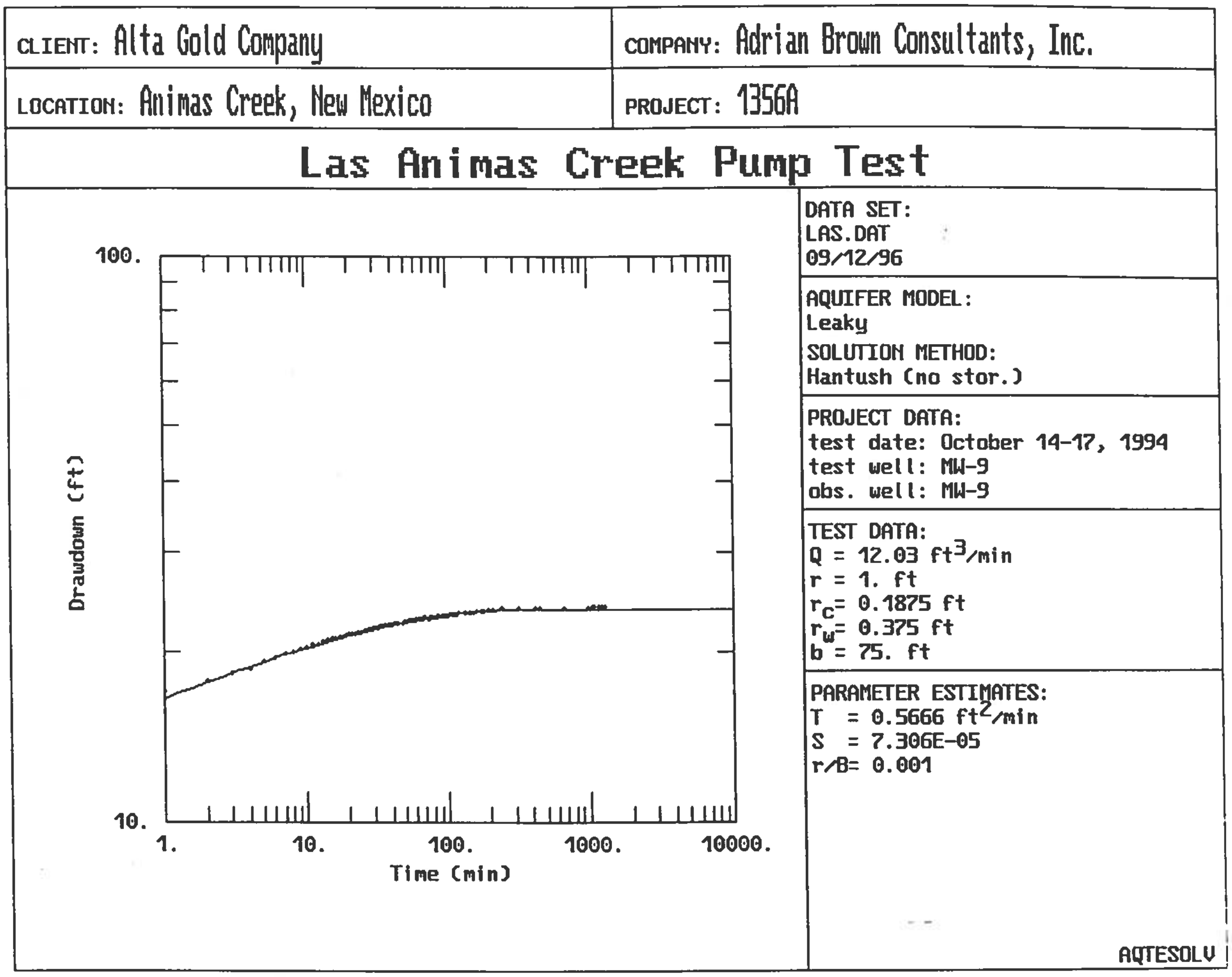
PROJECT DATA:
test date: October 14-17, 1994
test well: MW-9
obs. well: MW-9

TEST DATA:
Q = 12.03 ft^3/min
r = 1. ft
r_c= 0.1875 ft
r_w= 0.375 ft
b = 75. ft

PARAMETER ESTIMATES:
T = 0.5779 ft^2/min
S = 6.098E-05

AQTESOLV

Figure 12 Hantush leaky aquifer drawdown analysis plot


CLIENT: Alta Gold Company

COMPANY: Adrian Brown Consultants, Inc.

LOCATION: Animas Creek, New Mexico

PROJECT: 1356A

Las Animas Creek Pump Test

DATA SET:
LAS.DAT
09/12/96

AQUIFER MODEL:
Leaky

SOLUTION METHOD:
Hantush (no stor.)

PROJECT DATA:
test date: October 14-17, 1994
test well: MW-9
obs. well: MW-9

TEST DATA:
$Q = 12.03\ ft^3/min$
$r = 1.\ ft$
$r_c = 0.1875\ ft$
$r_w = 0.375\ ft$
$b = 75.\ ft$

PARAMETER ESTIMATES:
$T = 0.5666\ ft^2/min$
$S = 7.306E-05$
$r/B = 0.001$

AQTESOLV

Appendix C3.

TSF-Area Pumping Test, 1994

APPENDIX G
TAILINGS DAM AREA PUMPING TEST

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September 9, 1996
Project #1356A

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G.1 INTRODUCTION

A seven-day aquifer test was conducted in the vicinity of the tailings dam of the Copper Flat Mine, to determine the hydraulic characteristics of the aquifer(s) in this area. This section describes the pump test activities, and includes a discussion of the selection of the pumping well and observation wells, schedule of operations, operation of the test, water discharge and water quality issues. The aquifer test analysis is summarized in Section G.4 of this report.

An understanding of the site-specific geology is critical to the interpretation of the pumping test results. The deposits in the vicinity of the tailings dam are comprised of relatively recent sands and gravel contained within a clay/silt matrix, all of which overlie the Santa Fe Group sediments, which are similar in nature. A distinctive clay/silty clay unit is found at depths ranging from approximately 10 to 30 feet below ground surface and ranges in thickness from 25 to over 100 feet. This clay/silty clay unit, characterized by a distinctive red to red-brown color and dry to slightly moist with uniform composition and consistency, provides an effective hydrologic barrier between the upper alluvial sediments and those representing the Santa Fe Group.

Volcanic rocks (basalt and/or rhyolite) were commonly encountered above the clay unit during the drilling of the project boreholes. One borehole (GWQ94-16), however, encountered basalt beneath the clay. Unlike the clay observed in other boreholes, the clay/silty clay in GWQ94-16 was uncharacteristically thinner and was accompanied by significant amounts of gravel and moisture. Based on the gravelly nature of the clay, the relative superposition in the borehole, and the eastward dip of the sediments, the relatively shallow clay/silty clay located above the basalt in borehole GWQ94-16 may actually be reworked material from an upgradient clay source which was deposited over the basalt. The stratigraphy observed in all other boreholes clearly indicates that basalt and/or rhyolite was flowed out above the thick clay unit.

The alluvial units above and below the clay unit are similar in nature, although the gravel unit below the clay contains more matrix material. Because of the abundant matrix material, the lower unit is more poorly sorted and the lower aquifer has a lower permeability in those zones where clay or silty clay predominate.

G.2 WELL SELECTION

One pumping well and 13 observation wells were employed during the aquifer test. Figure G-1 shows the well locations and Table G-1 presents pertinent information for each of the wells used for data collection.

G.2.1 Pumping Well

Well GWQ94-17 was drilled and completed in October 1994. The borehole was drilled to a total depth of 158 feet and the well is screened from 120-150 feet below ground surface. Static water level in the well is on the order of 3 feet below ground surface. Well GWQ94-17 was chosen for pumping for the following reasons:

1. Central location relative to observation wells.
2. Casing diameter (4") was sufficient for pump installation.
3. Discharge water could be easily routed to discharge point.
4. Sulfate concentrations were low enough to pump without concern of immediately exceeding discharge standards.
5. Screened in a horizon of suitable water production.
6. Screen located beneath the red clay aquitard that separates the shallow aquifer from the underlying aquifer.

Discharge water from GWQ94-17 was piped through 600 feet of 3-inch layflat vinyl pipe that passed under the county road through a corrugated-steel culvert to a concrete sump. The sump is connected by an underground concrete culvert to a concrete-lined pit, located approximately 1500 feet southwest of the pumping well. Figure G-2 shows a schematic of the system.

G.2.2 Observation Wells

Observation wells were selected based on their proximity to the pumping well, their screened intervals, and their potential to exhibit a response in water levels during the pumping test.

The nearest observation well, GWQ94-13, is located 190 feet west-southwest of the pumping well, and is screened from 75 to 105 feet below ground surface. Observation well GWQ94-14, located 390 feet east-southeast of the pumping well, is screened from 127.5 to 157.5 feet. Observation well GWQ94-15 is 713 feet southeast of the pumping well, and is screened from 112 to 142 feet. Well GWQ94-16 is among the shallowest observation wells (screened from 25 to 45 feet below ground surface) and is located 423 feet southwest of pumping well GWQ94-17. The deepest observation well, GWQ94-20, is screened from 288 to 338 feet, and is located 264 feet northwest of the pumping well. Observation well GWQ94-21 has separate completions at

213-263 feet (A) and 285-315 feet (B), and is located 621 feet east of the pumping well.

Limited completion information was available for the six observation wells installed prior to the 1994 field program. Observation well GWQ-11 is located approximately 405 feet southwest of the pumping well and is completed to a depth of 76 feet. Observation wells NP-2 and NP-5 are located approximately 1130 and 735 feet south-southwest of the pumping well, and have total depths of 110 and 41 feet, respectively. Observation well IW-1 has a total depth of 67 feet and is located 239 feet west of the pumping well. Observation well IW-2, 248 feet northwest of the pumping well, is completed to 45 feet.

Water levels in wells GWQ94-18 and GWQ94-19 were not monitored during the pumping test since both wells were dry or nearly dry.

G.3 AQUIFER TEST

G.3.1 Aquifer Pumping Test Operations

Well GWQ94-17 was pumped for a total of 78.14 hours, starting at 10:50 on Tuesday, November 8, 1994 and ending at 16:58 on Friday, November 11, 1994. The average flow rate during the test was 23 gpm. The flowrate was not sufficient to activate the inline flowmeter at the wellhead, so flowrate was measured at the concrete sump discharge point approximately hourly using a bucket and stopwatch. The flowrate remained steady throughout the test until the pump was shut off.

G.3.2 Monitoring

Water level changes during the pumping portion of the aquifer test were monitored manually for wells GWQ94-17, GWQ-11, GWQ94-15, GWQ94-16, GWQ94-21A, GWQ94-21B, NP-2, NP-3, NP-5, IW-1, and IW-2 using an electronic water level sounder. The remaining wells (GWQ94-13, GWQ94-14, and GWQ94-20) were monitored automatically, during the pumping portion of the aquifer test, using pressure transducers attached to data logging units. Manual readings were collected every 5 to 10 minutes for about the first hour, every 15 to 20 minutes for the next 3 to 4 hours, and at least hourly for the remainder of the test. Automatic pressure transducer readings were collected every minute during the pumping period.

During the recovery portion of the test, water levels were measured at 5-minute intervals in wells GWQ94-14 and GWQ94-13 using pressure transducers. The pressure transducer that was set in GWQ94-20 during the pumping period of the test was transferred to GWQ94-21A for the recovery test. Water level recovery was also monitored in the pumping well at 5-minute intervals, using a pressure transducer. Recovery was monitored for 2.5 days, from 16:58 on Friday, November 11, 1994 to approximately 16:00 on Sunday, November 13.

A summary of these monitoring activities is presented in Figure G-3. The pre-pumping static water level data and aquifer test water level data are presented in the Attachments A-5 and G-2, respectively. A major storm event occurred, in which 6.5 inches of rain were gauged at the tailings dam from the morning of November 11, 1994 to the evening of November 12, 1994 (Irwin, personal communication). This recharge event may have affected the recovery of the water levels in the observation wells.

G.3.3 Observations

G.3.3.1 Pumping Well GWQ94-17

Well GWQ94-17 was pumped at a rate of 23 gpm for a total of 78.14 hours. The steady-state drawdown of 125 feet was acheived in 31 minutes of pumping. The plot of drawdown versus time, presented in Figure G-4, indicates that the pump operated continuously during the test.

G.3.3.2 Discharge

The well discharged a total of just under 108,000 gallons into the concrete-lined pit, located approximately 1500 feet south-southwest of the pumping well. Observation well NP-2, located approximately 50 feet from the northwest corner of the pit, was monitored during the test to determine whether the concrete pit was leaking and if so, how much effect it had on the local groundwater table. The water levels in NP-2 during the test period are shown in Figure G-5, and do not exhibit effects from leakage. However, the drop in water level in the concrete pit after the pump was shut off indicated that the pit leaked approximately 5000 gallons/day.

G.3.3.3 Water Quality

The quality of the discharge water was monitored periodically during the test. Sulfate ranged from a low of 180 mg/l to a high of 360 mg/l, with concentrations peaking eight hours into the test and decreasing as the test progressed. Temperature readings were affected by the sun incidence on the discharge pipe and were not representative of the groundwater temperature. The pH of the water stabilized at approximately 7.4 and the conductivity ranged from a low of 990 μS to a high of 1110 μS. Water quality parameters measured at the discharge pipe are summarized in Table G-2.

G.3.4 Test Results

G.3.4.1 Shallow Aquifer System

The shallow aquifer system hosts numerous wells, including the shallow (<80 feet) monitoring wells near the tailings dam.

None of the shallow observation wells monitored during the pumping test showed a response to pumping at GWQ94-17, indicating that in this area there is no hydraulic connection between the upper, shallow alluvial aquifer and the lower aquifer in the Santa Fe Group. The plots of drawdown in the observation wells versus time during the pumping test are presented in Attachment G-1. The shallow observation wells are IW-1, IW-2, NP-5, GWQ-11, and GWQ94-16.

G.3.4.2 Santa Fe Group Aquifer System

Two types of response were observed in the Santa Fe Group aquifer system due to stressing by pumping at GWQ94-17. Theis type responses were demonstrated at wells GWQ94-13, GWQ94-14, GWQ94-21A, GWQ94-21B and NP-3. An attenuated response was demonstrated at observation well GWQ94-15, in the form of a slower, flatter drawdown curve.

The response in observation well GWQ94-20 was influenced by recharge of the well following development on November 3, 1994. The well is completed in a low-permeability zone and is slow to equilibrate following pumping/development. Therefore, data collected from GWQ94-20 during the pumping test are considered invalid for analysis purposes. The water level plots versus time for all other monitoring wells observed during the aquifer test are shown in the Attachment G-1.

G.3.4.3 Bedrock Flow System

Although no deep bedrock wells were installed or monitored during this study, some knowledge of the deep bedrock system is discernible through investigation of the local geology of the area. Water that enters the various limestone beds of the upper Paleozoic rocks in the north-trending Animas Uplift moves downdip along bedding plane and solution openings until it reaches the zone of saturation, then moves laterally along the strike of permeable strata toward points of discharge in the principal stream valleys, which in this case are Las Animas Creek and Seco Creek (Davies and Spiegel, 1967).

G.4 ANALYSIS AND INTERPRETATION

The transmissivity of the aquifer appears to be approximately 1400 gpd/ft with a storage coefficient of 2.5 x 10^{-4}, based on a Theis analysis, and is representative of a confined aquifer of moderate permeability. Plots from the Theis evaluation are presented in Figures G-6 and G-7. The estimated efficieny of the pumping well, GWQ94-17, is approximately 25% based on the drawdown in the pumping well versus the water levels in the observation wells. This suggests that the aquifer is sufficiently tight to create large head losses in the formation as the groundwater flows radially into the wellbore. Additional well losses could be caused by the well design and completion.

The aquifer test did not positively identify any fixed-head or no-flow boundaries. The test did confirm that wells that penetrate the clay layer are hydraulically connected to the pumping well. Response of those observation wells were, in general, well-modeled by a Theis-type response. Wells that are completed above the confining clay layer (shallow aquifer) were not affected by the pumping activity at GWQ94-17.

Well GWQ94-14 displayed an unusually quick response and more rapid drawdown possibly indicating the presence of a higher permeability paleo-channel that connects GWQ94-14 to GWQ94-17.

In addition to performing an integrated, detailed Theis analysis on the suite of observation wells, data from individual observation wells were analyzed using the aquifer test analysis software package, AQTESOLV (Geraghty and Miller, Inc.). Table G-3 presents the transmissivity and storativity values derived using various methods, and the plots of drawdown versus time are included in Attachment G-1.

Table G-1 Observations Wells Used During the Tailings Dam Area Aquifer Test

WELL ID	TD (feet)	ELEV. (toc) QMC[3]	r (feet)	TOP OF SCREEN (feet bgs)	BOTTOM OF SCREEN (feet bgs)	SCREEN LENGTH (feet)	PIPE DIAM. (in.)	STATIC WATER LEVEL (feet btoc) 11/7/94
GWQ-11	76	5174.87	≈405	na	na	na	3	17.04
GWQ94-13	112	5179.05	190	75	105	30	4.5	8.02
GWQ94-14	158	5171.41	390	127.5	157.5	30	4.5	1.585
GWQ94-15	148	5161.64	713	112	142	30	4	0.63
GWQ94-16	48	5176.02	423	25	45	20	4	18.23
GWQ94-17[1]	158	5176.97	0	120	150	30	4	5.32
GWQ94-20	340	5181.97	264	288	338	50	4.5	20.315
GWQ94-21A	320	5171.28	621	213	263	50	2	4.58
GWQ94-21B	320	5170.79	621	285	315	30	2	3.945
NP-2	110	5171.38	≈1130	na	na	na	2	29.46
NP-3	79.3[2]	5178.42	≈239	na	na	na	2	7.07
NP-5	41.2[2]	5177.45	≈735	na	na	na	2	19.67
IW-1	67[2]	5177.68	239	na	na	na	4	20.55
IW-2	45	5186.54	438	na	na	na	4	33.585

[1] Pumping well
[2] Measured prior to groundwater sampling
[3] Elevations relative to project datum (Quintana Minerals Corp.)
TD = total depth of borehole
r = distance to the pumping well (feet)
bgs = below ground surface
toc = top of casing
btoc = below top of casing
na = information not available

Table G-2 Summary of Water Quality during Pumping of GWQ94-17

DATE	TIME	TEMPERATURE (deg-C)	pH	CONDUCTIVITY (um/cm)	SULFATE CONCENTRATION (mg/l)
11/8/94	12:14	21	7.4	1110	225
11/8/94	13:22	21	7.4	1050	180
11/8/94	15:15	19.5	7.4	1050	210
11/8/94	17:25	19	7.4	1030	350
11/8/94	18:10	18	7.4	1030	360
11/9/94	07:18	--	7.3	1050	300
11/9/94	12:24	--	7.3	1020	240
11/9/94	14:35	--	7.3	990	250
11/9/94	13:57	--	7.3	1010	240
11/10/94	12:40	--	7.4	1030	280
11/10/94	14:35	--	7.4	1000	220

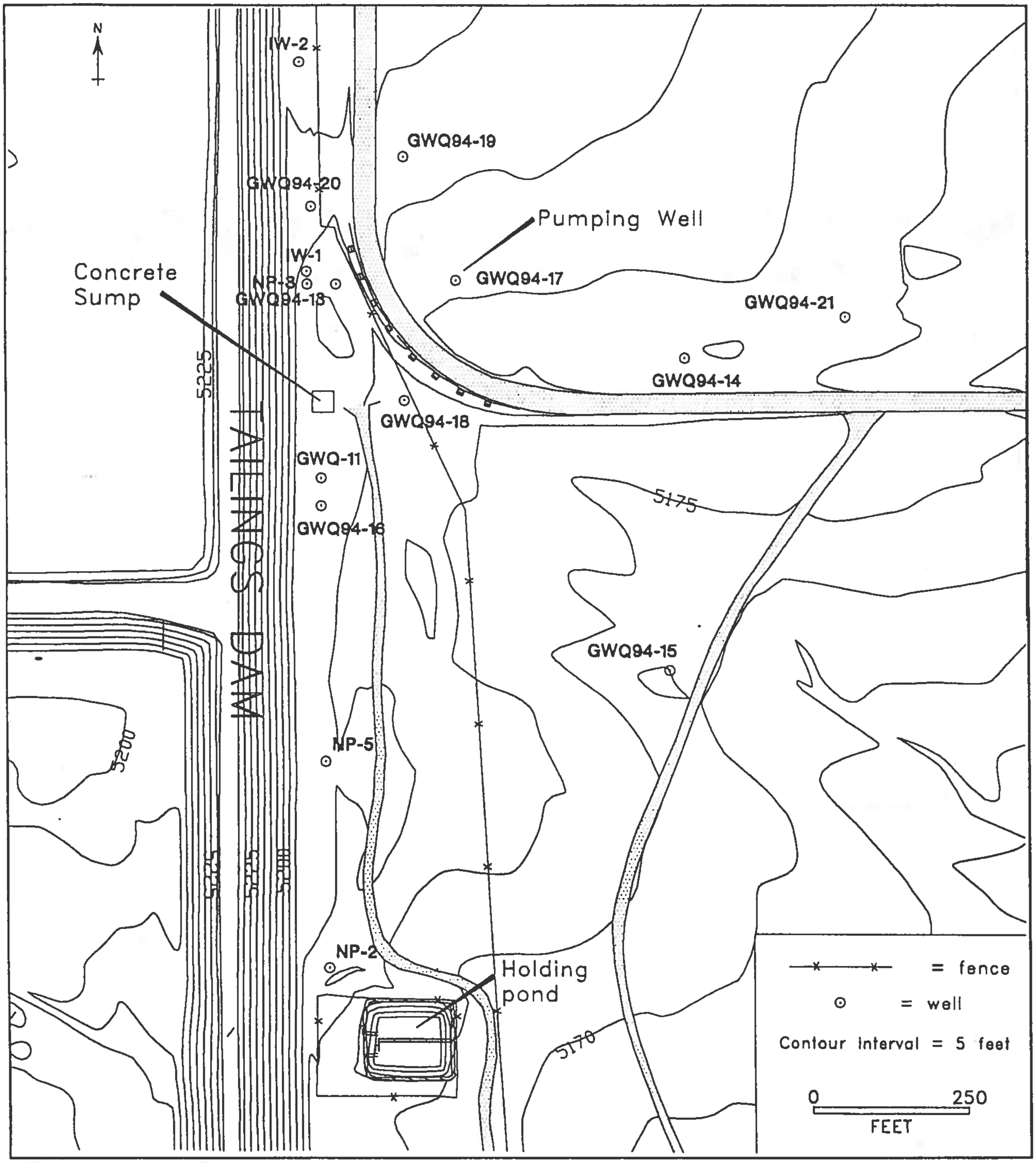


Figure G-1 Well location map for tailings dam area pumping test

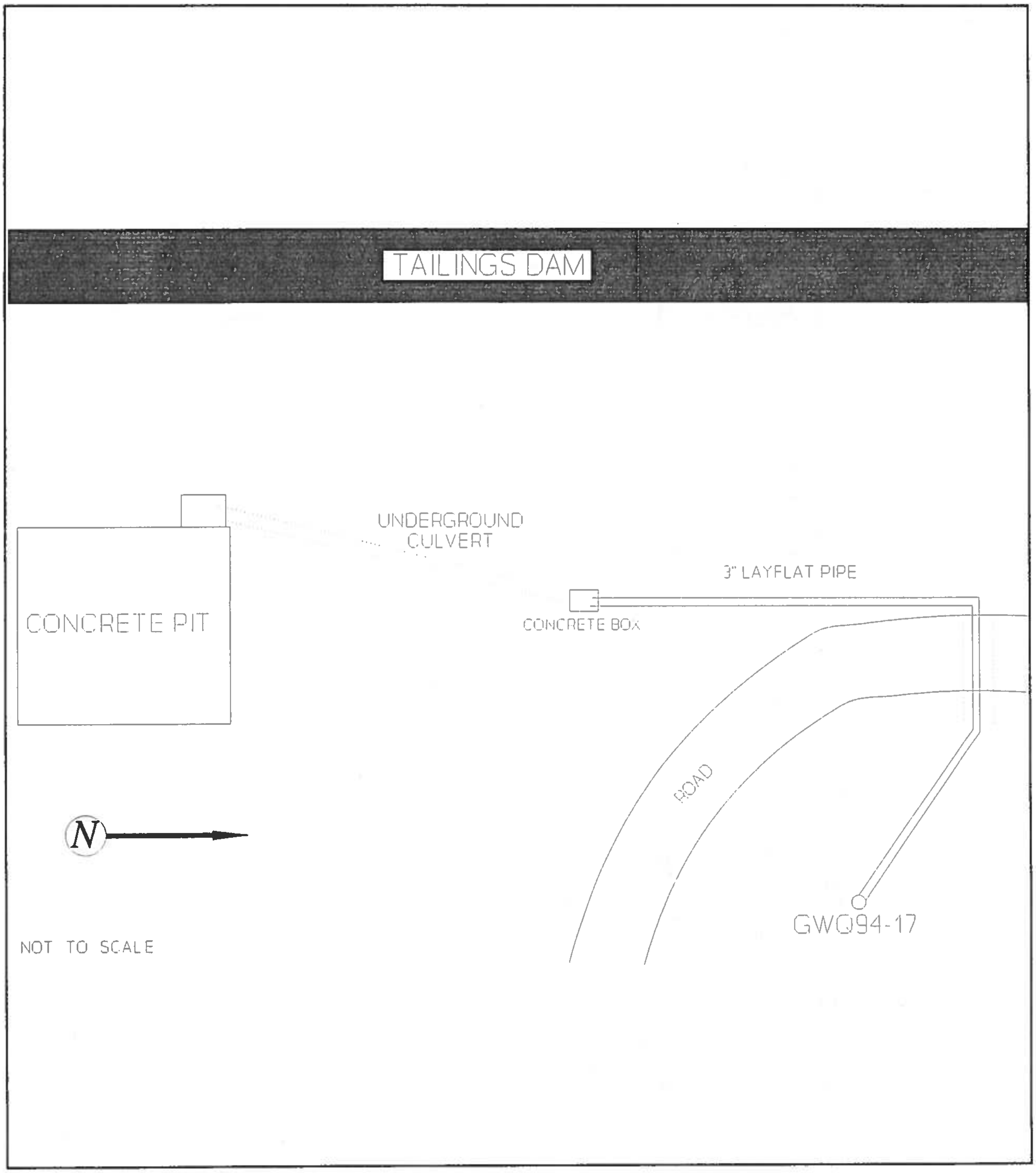


Figure G-2 Schematic of pumping test system

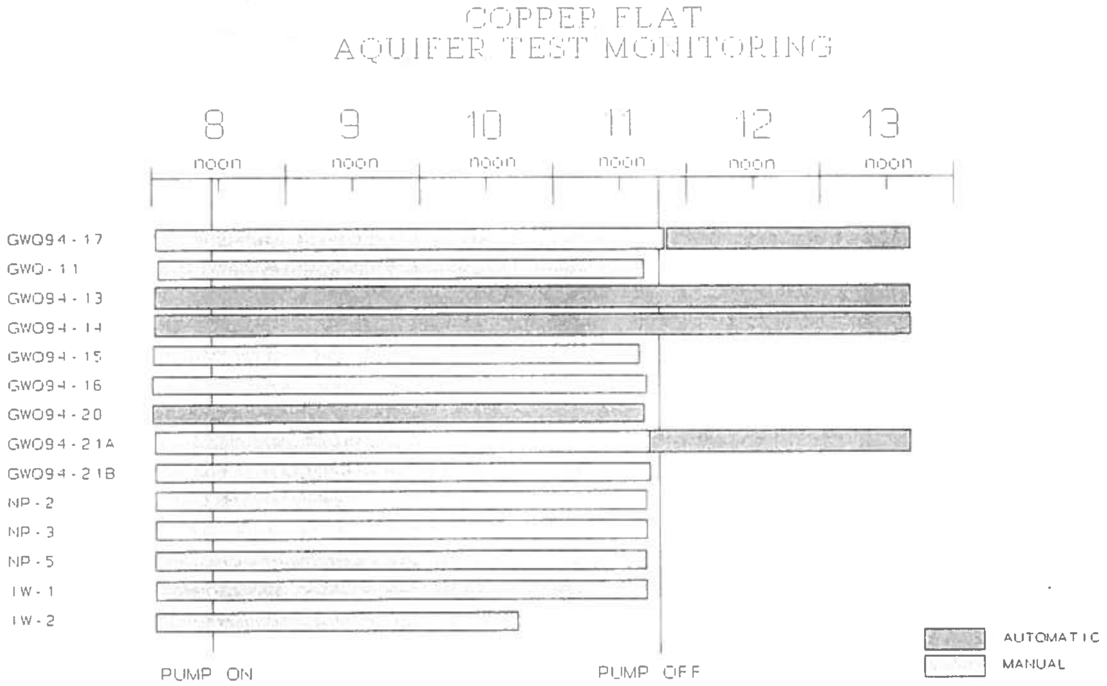
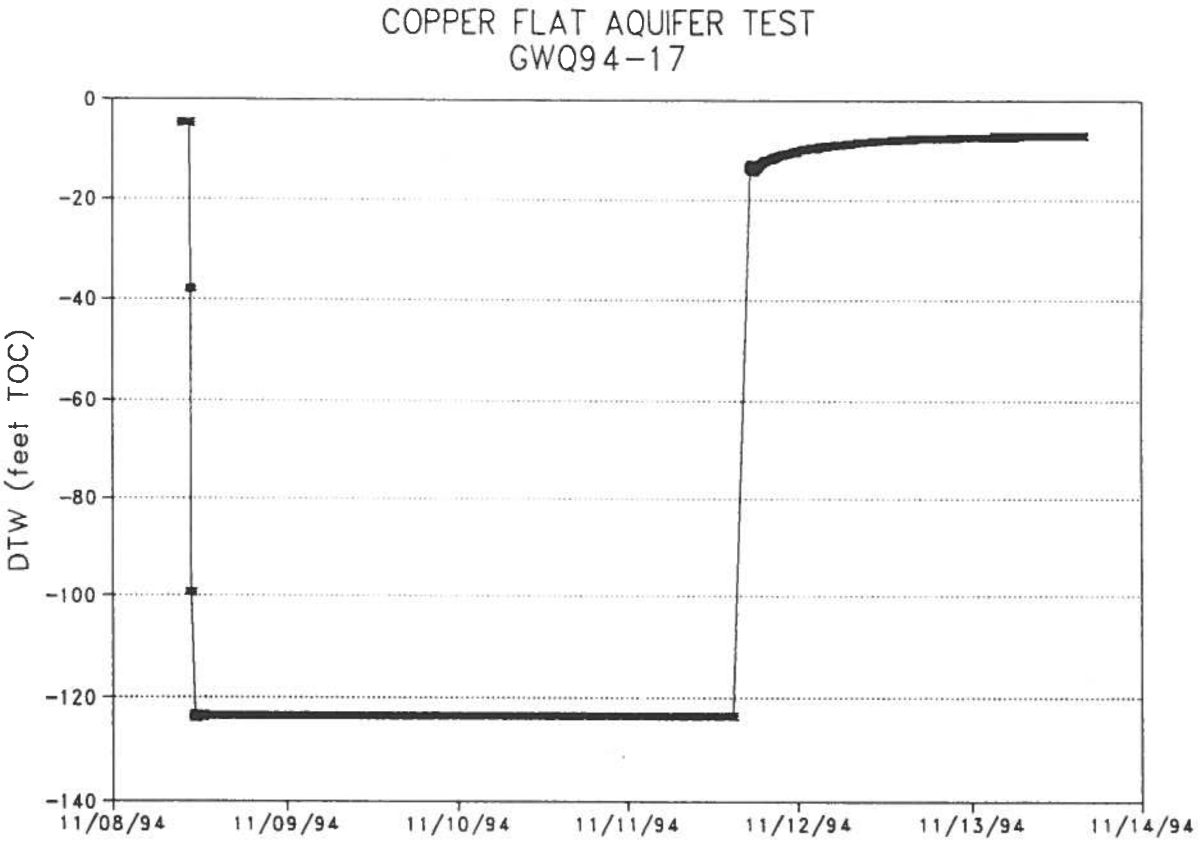


Figure G-3 Copper Flat tailings dam aquifer test monitoring


COPPER FLAT AQUIFER TEST
GWQ94-17
DTW (feet TOC)
0
-20
-40
-60
-80
-100
-120
-140
11/08/94
11/09/94
11/10/94
11/11/94
11/12/94
11/13/94
11/14/94

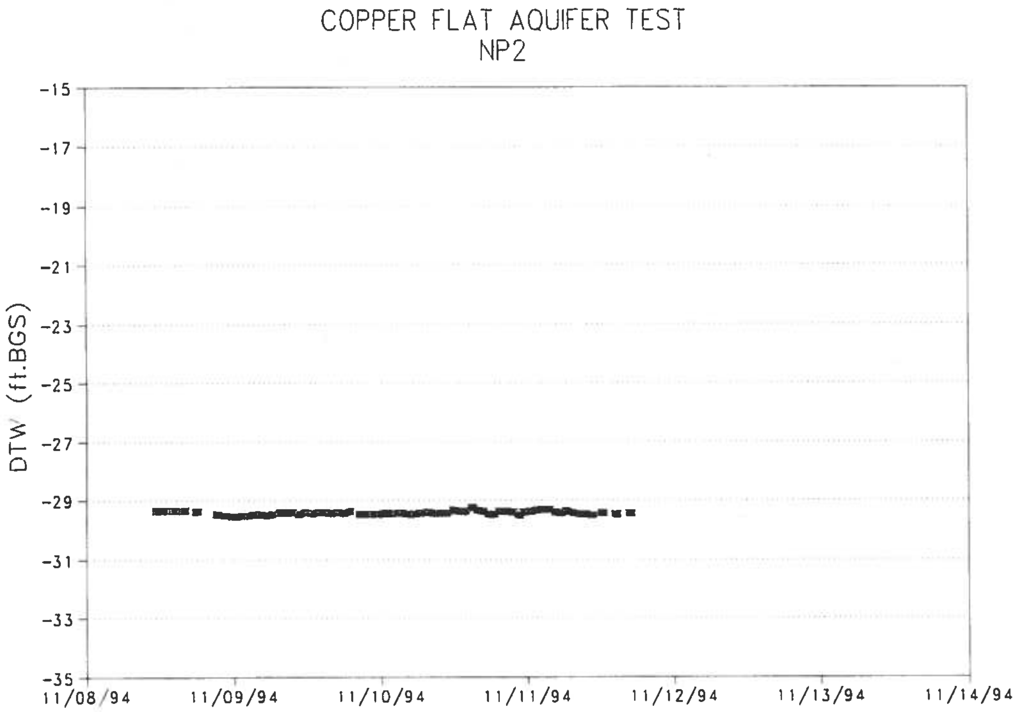


Figure G-5 Water levels in observation well NP-2

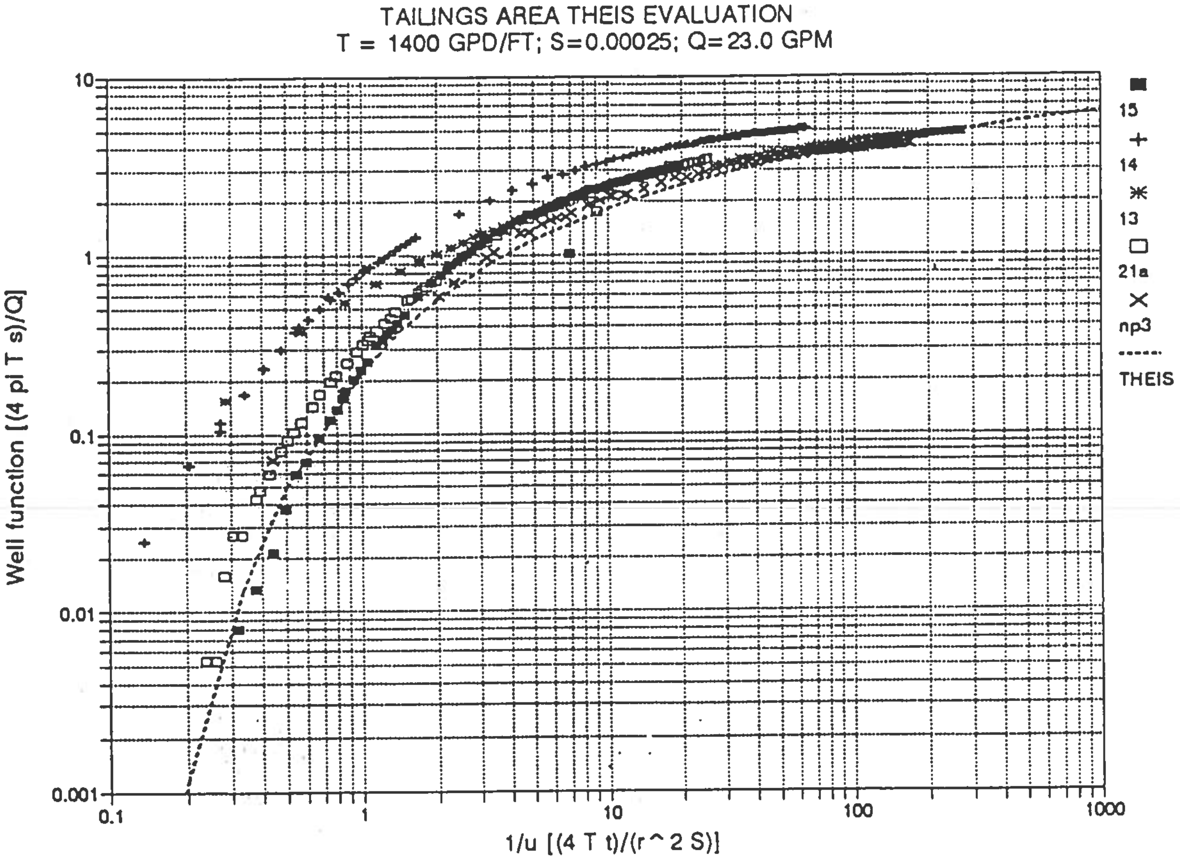


Figure G-6 Theis evaluation for tailings dam area pumping test, T=1400 gpd/ft

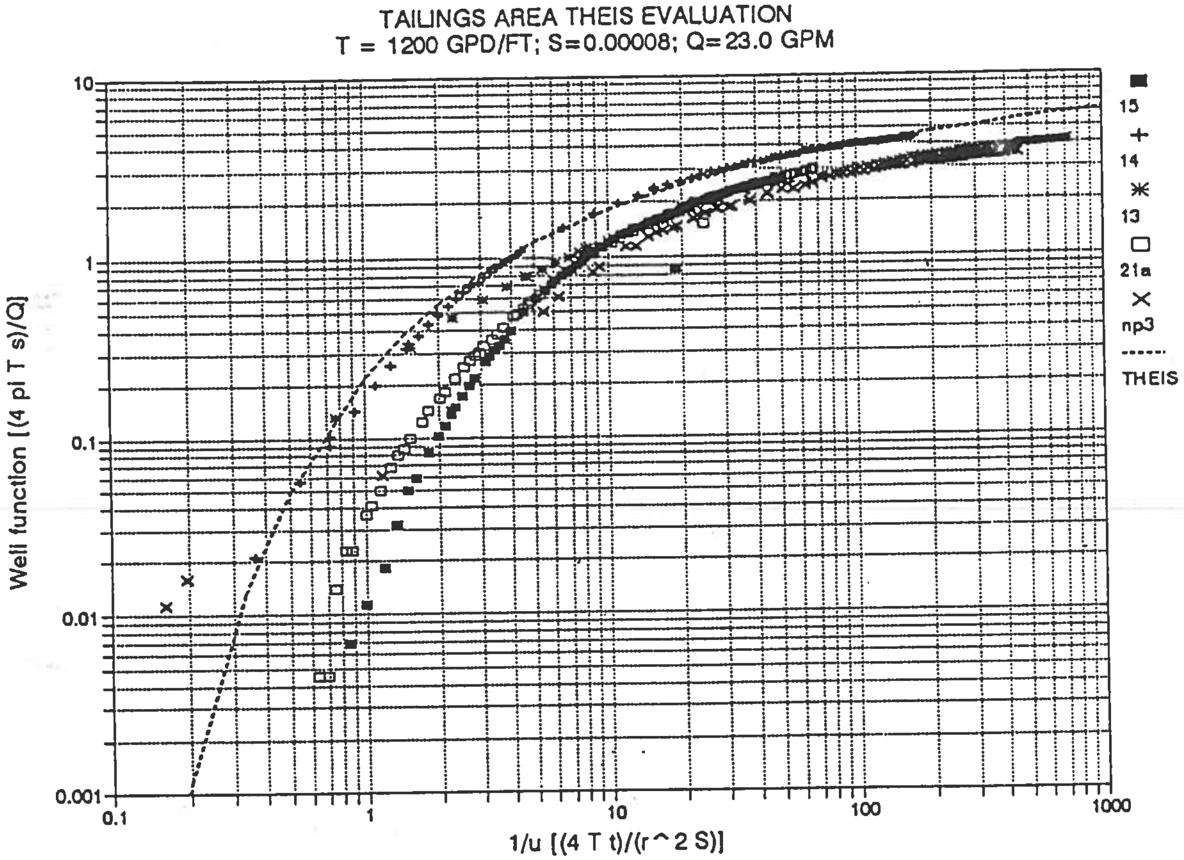


Figure G-7 Theis evaluation for tailings dam area pumping test, T=1200 gpd/ft

Table G-3 Aquifer Test Analysis Results

WELL ID	SOLUTION	TRANSMISSIVITY (gpd/ft)	STORATIVITY
GWQ94-13	Theis	1658	1.1×10^{-4}
	Jacob-Cooper straight-line	1540	1.2×10^{-4}
GWQ94-14	Theis	1148	8.1×10^{-5}
	Jacob-Cooper straight-line	1177	6.9×10^{-5}
GWQ94-15	Theis	1259	1.5×10^{-4}
	Hantush - leaky con. w/o storage	1168	1.7×10^{-4}
	Jacob-Cooper straight-line	1299	1.3×10^{-4}
GWQ94-21A	Theis	1147	1.7×10^{-4}
	Jacob-Cooper straight-line	1272	1.4×10^{-4}
GWQ94-21B	Theis	1068	2.8×10^{-4}
	Jacob-Cooper straight-line	1086	2.4×10^{-4}
Integrated Approach[1]	Theis	1400	2.5×10^{-4}

[1] See text and Figures B-6 and B-7

Appendix C4.

2012 Aquifer Test Results

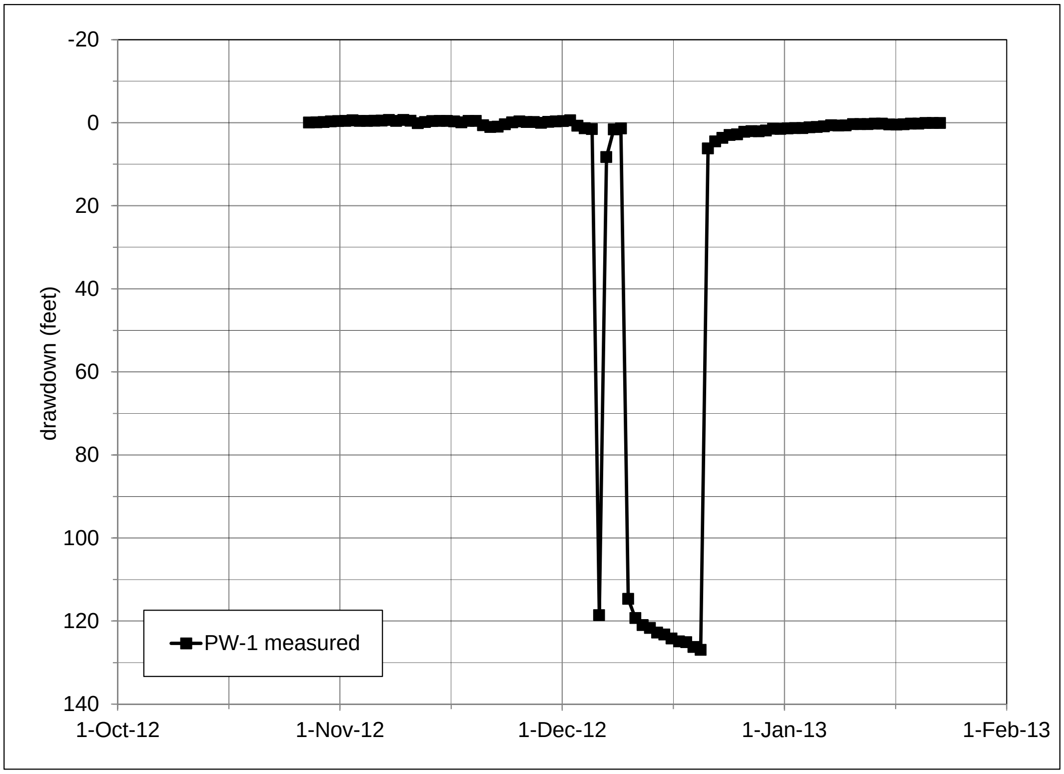


Figure C4-1. Aquifer test hydrograph PW-1.

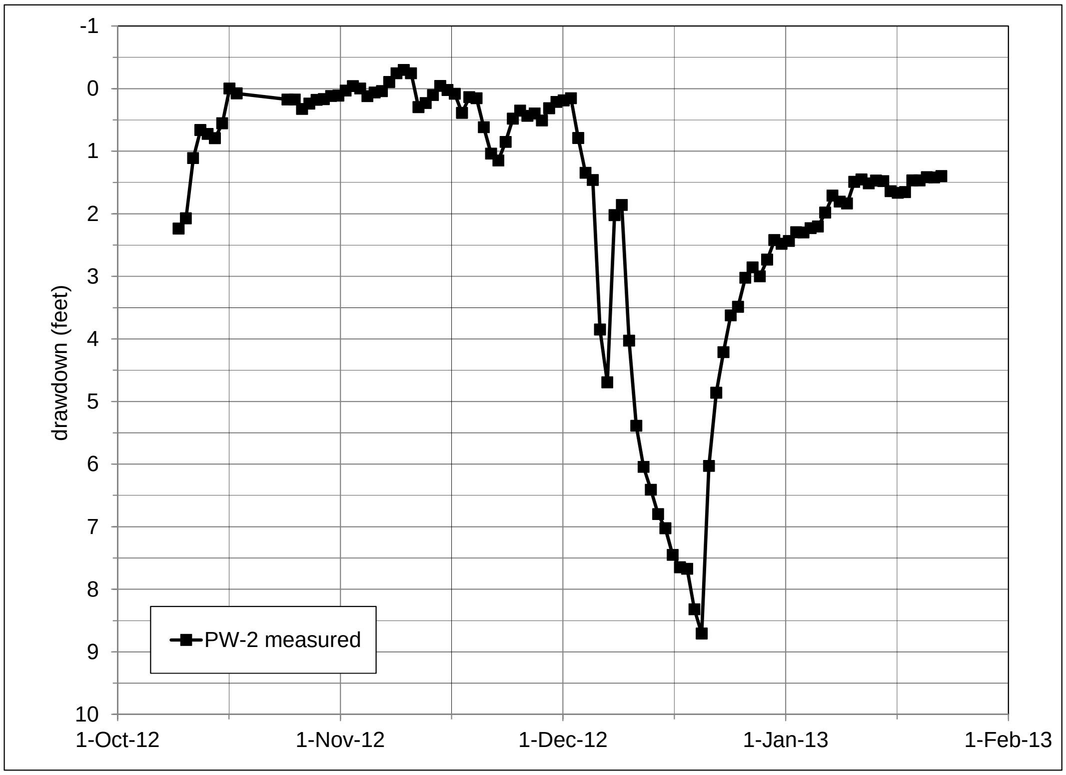


Figure C4-2. Aquifer test hydrograph PW-2.

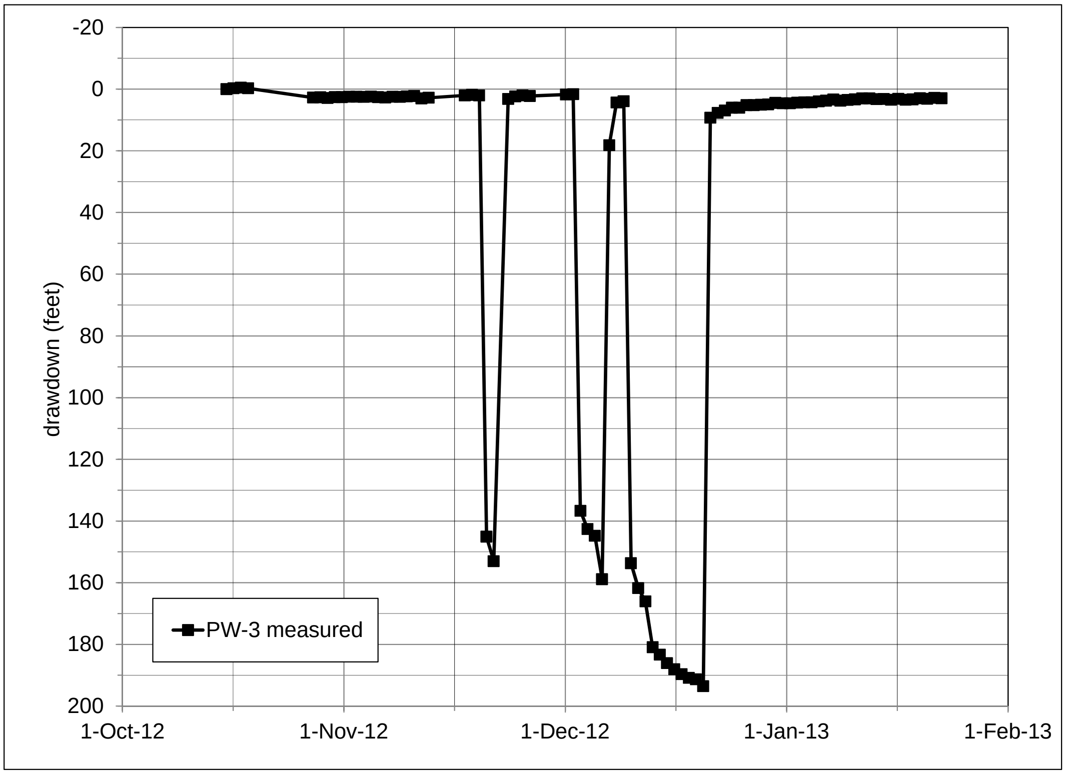


Figure C4-3. Aquifer test hydrograph PW-3.

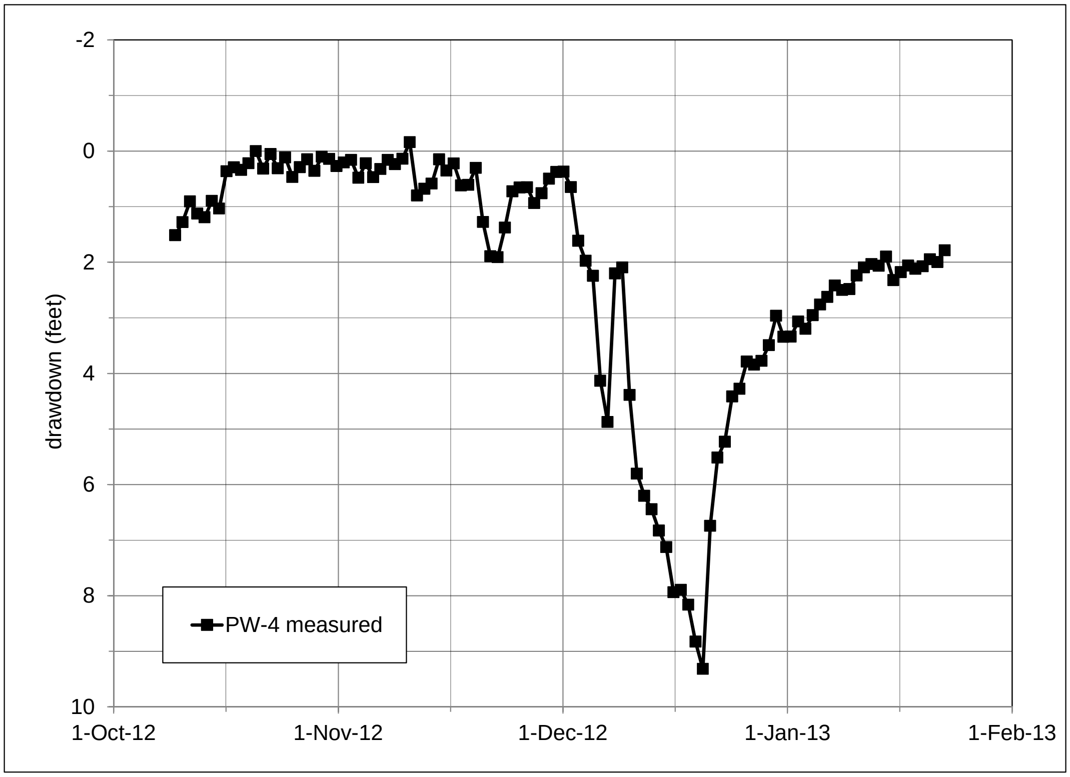


Figure C4-4. Aquifer test hydrograph PW-4.

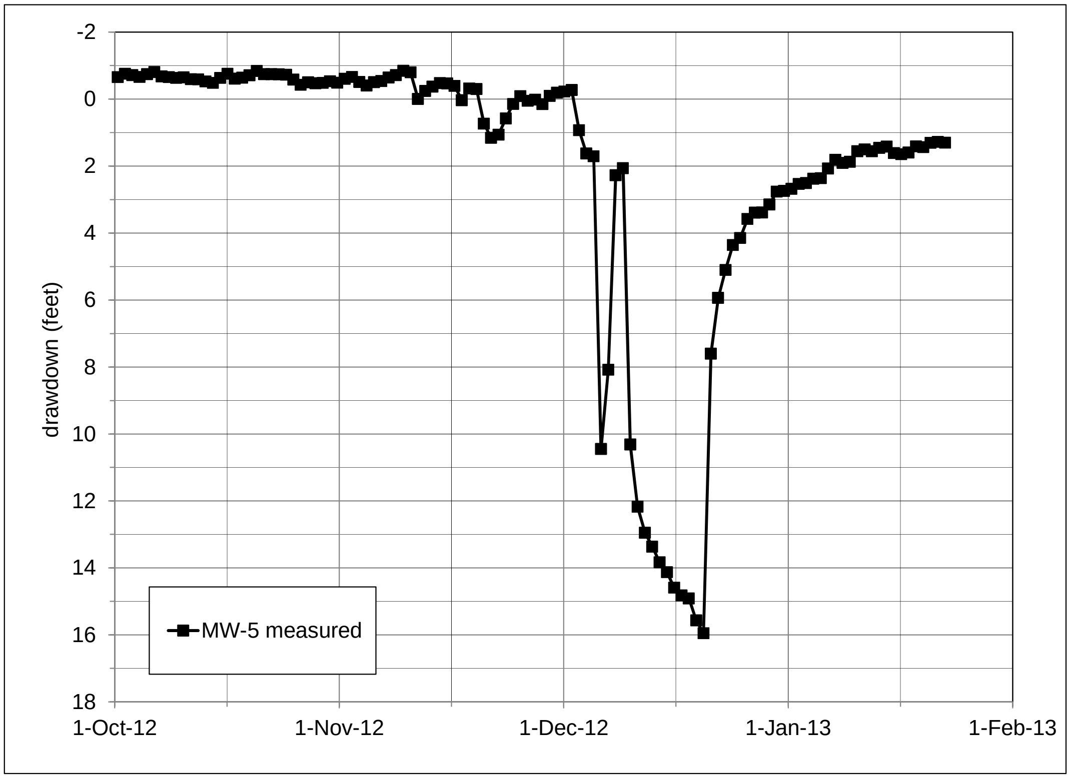


Figure C4-5. Aquifer test hydrograph MW-5.

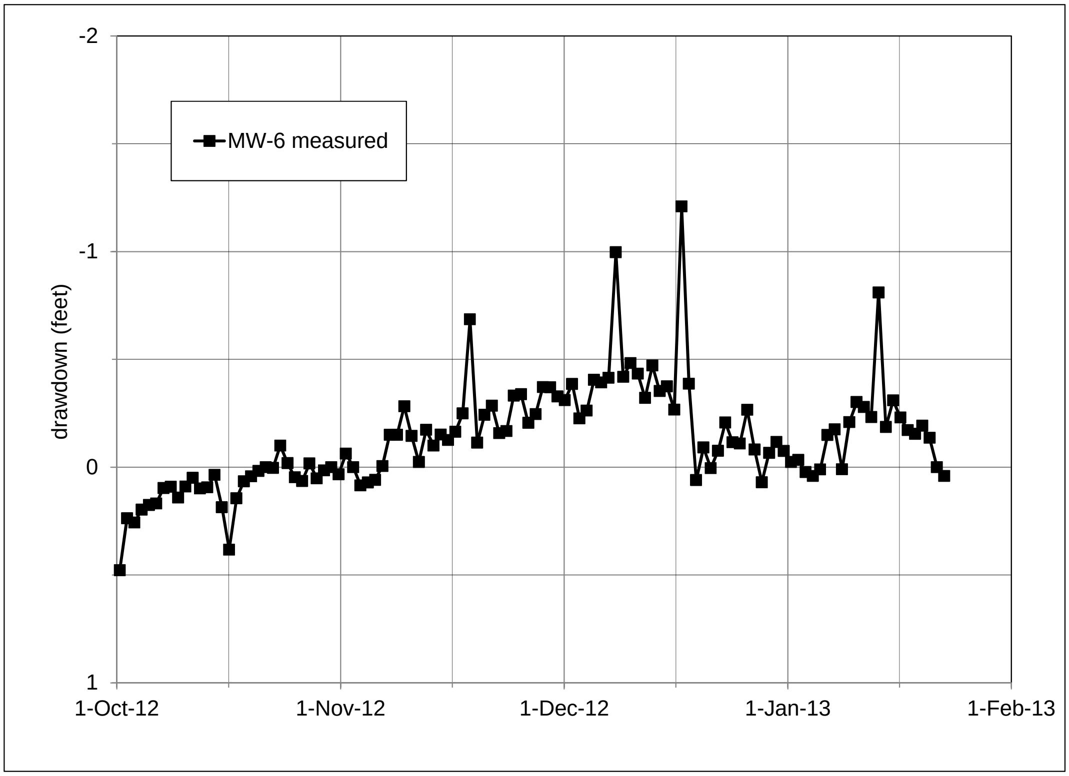


Figure C4-6. Aquifer test hydrograph MW-6.

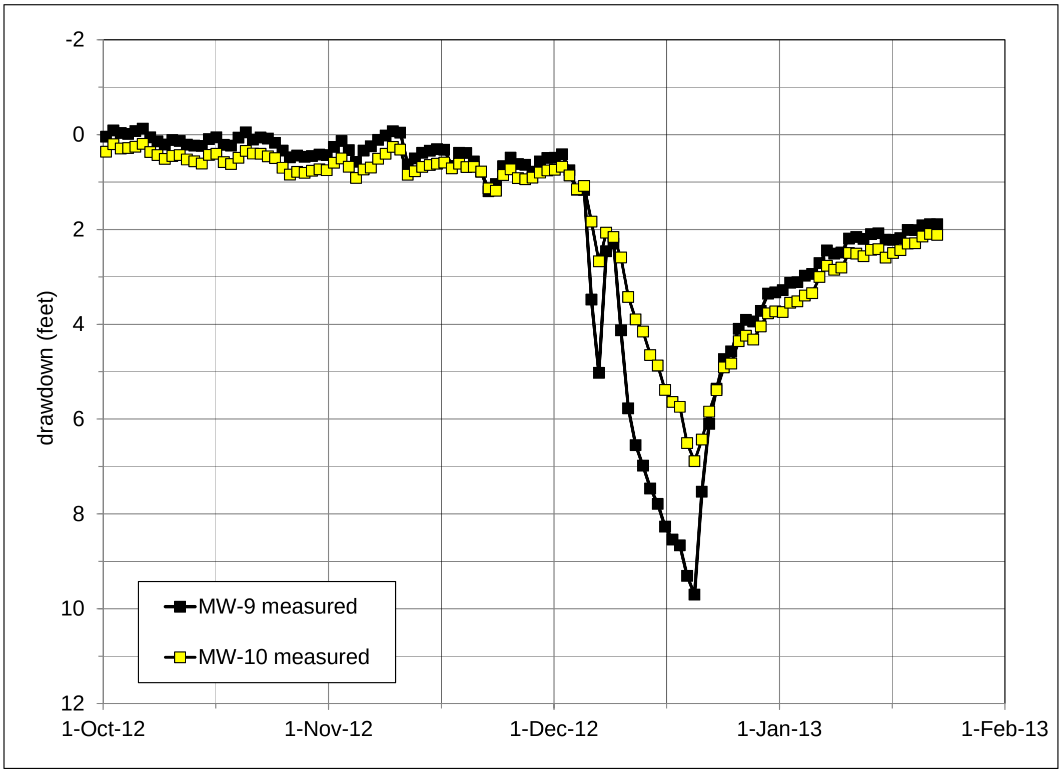


Figure C4-7. Aquifer test hydrograph MW-10.

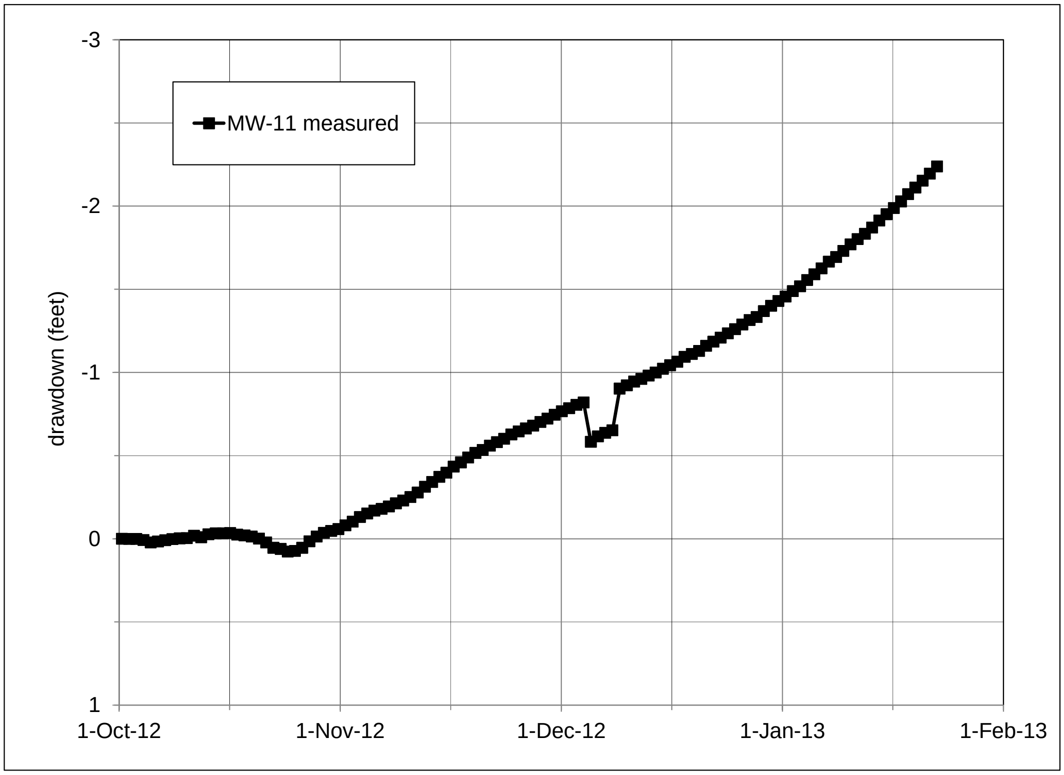


Figure C4-8. Aquifer test hydrograph MW-11.

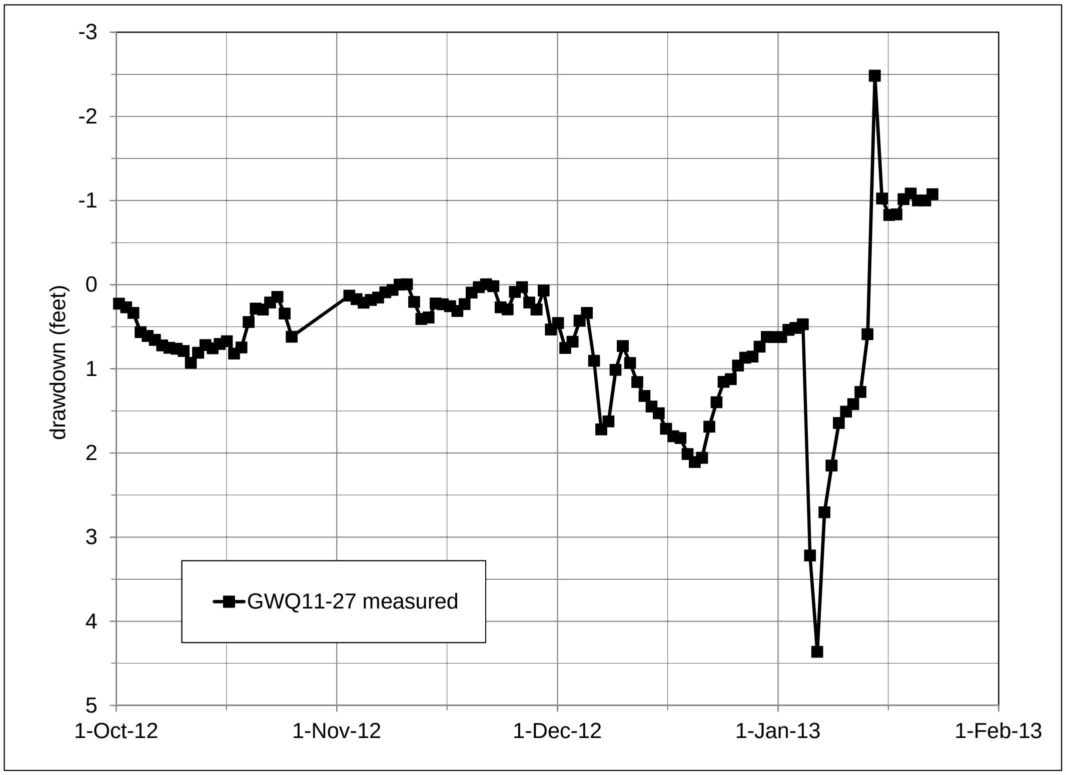


Figure C4-9. Aquifer test hydrograph GWQ11-27.

Appendix C5.

Pit Area Pressure-Injection Tests, September 2011

ESTIMATED HYDRAULIC CONDUCTIVITY OF PRESSURE-INJECTION TEST ZONES
BOREHOLES GWQ 5-R, GWQ 11-24, AND GWQ 11-25
COPPER FLAT MINE
SIERRA COUNTY, NEW MEXICO

by

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prepared for

New Mexico Copper Corporation
2425 San Pedro NE
Albuquerque, New Mexico 87110

September 2011

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September 2011

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TABLE

page

ILLUSTRATIONS

(follow text)

APPENDIX

(follow illustrations)

Basic data for pressure-injection tests

ESTIMATED HYDRAULIC CONDUCTIVITY OF PRESSURE-INJECTION TEST ZONES BOREHOLES GWQ 5-R, GWQ 11-24, AND GWQ 11-25 COPPER FLAT MINE, SIERRA COUNTY, NEW MEXICO

INTRODUCTION

Pressure-injection tests were conducted during drilling of three boreholes (later reamed and completed as monitor wells), New Mexico Copper GWQ 5-R, GWQ-11-24, and GWQ-11-25. One zone was tested in GWQ 5-R, and three zones were tested in each of the other two boreholes. The tests were carried out between July 27 and August 31, 2011. Test equipment was provided and operated by the drilling contractor, WDC Exploration. Jeffrey J. Kelsch of John Shomaker & Associates recorded the data. Figure 1 is a map showing the locations.

The locations, logs and descriptions of the three monitor wells may be found in other reports. Well GWQ 5-R is completed in Cretaceous-age andesite, in the SE/4 NE/4 NW/4, Sec. 36, T. 15 S., R. 7 W. GWQ 11-24 and GWQ 11-25 are completed in Cretaceous-age intrusive rocks, in the SE/4 NE/4 NW/4 of Sec. 35, and the SW/4 NE/4 SW/4 of Sec. 26, respectively, of T. 15 S., R. 7 W.

TEST METHOD AND INTERPRETATION

The tests were conducted using a variation on the standard Lugeon test (Lugeon, 1933; Houlsby, 1976), for estimating average hydraulic conductivity of rock masses. In each of the three vertical, 3-3/4-in. boreholes, one or more zones were isolated between the bottom of the hole as it was at the time of the test, and a packer run on 1-in. standard-pipe tubing. In all but one case (GWQ 5-R), the test zone was below the water table and the rock mass was saturated at the beginning of the test.

For most of the tests, a Moyno progressing-cavity pump, reportedly rated at 10 gpm maximum flow and 350 psi maximum pressure, was used to inject water. One test employed a centrifugal pump, which was then replaced by the Moyno pump. The lengths of the test zones ranged from 36 ft to 48 ft, as indicated in Table 1 below. The injection rate was metered as clear water was pumped through the tubing into the open interval of the borehole at constant pressure, in 10-minute steps, first at increasing pressure and then at decreasing pressure. Basic data from the tests are given in the Appendix. In most cases, three series of measurements, at the same injection-pressure steps, were taken.

Injection rate was measured with a new, calibrated meter. Pressure in the tubing was measured with a 4-1/2-in.-dial, 0-300 psi, NIST certified gauge with 10-psi increments. Data were recorded each minute during each 10-minute pumping step.

The standard Lugeon test method is based on a sequence of five, 10-minute measurements of injection rate, three at increasing pressure, followed by two at decreasing pressure. The procedure for this project differed from the standard method in that many more measurements were made, with smaller increments of pressure between them, as suggested by Quiñones-Rozo (2010). This variation provides data for a more complete interpretation. In all cases, the higher pressures in the sequence of steps exceeded the fracture-gradient pressure at the depth of the open interval of the borehole, and existing fractures were dilated as water was pumped into them, or new fractures were created.

For each step, total head above the pre-test water level in the borehole was calculated as the sum of the gauge pressure in the tubing, the height of the gauge above ground level, and the depth to the static water level in the borehole, less the friction loss in the tubing at the specific injection rate. The friction loss was calculated by the standard Hazen-Williams formula with a constant for steel pipe of 100.

Hydraulic conductivity was calculated using the Lugeon relationship, which is empirically defined as the conductivity required for maintenance of an injection rate of 1 liter per minute per meter of open interval in the borehole, under a reference water pressure of 10 bars. One Lugeon unit is equivalent to 1.3 x 10^{-5} cm/sec, 0.03685 ft/day (Fell et al., 2005). For convenience, the calculations were made in terms of total added head in pounds per square inch (psi), and injection rates in gallons per minute (gpm).

Plots of injection rate versus total head above the pre-test water level in the borehole, and of apparent hydraulic conductivity (permeability) against total head, are given in Figures 1 through 12 for the tests in which the pumping rate was measurable.

RESULTS AND CONCLUSIONS

GWQ 5-R

One injection zone, from the bottom of the packer at 64 ft to the bottom of the borehole at 100 ft, was tested. Although the hole was almost full of fluid at the time of the test, later water-level measurements indicate that the natural static water level is about 48 ft. No flow was measured until the total head above the water level at the beginning of the test (5.6 ft below land surface, probably more than 40 ft above the natural water level) had reached more than 200 ft of water (87 psi; see Fig. 1). The injection rate was small, but increased rapidly, above that pressure. In a pressure step at 120 psi gauge pressure, fluid began to move up the hole above the packer, and the well began to flow, indicating that the packer seal had failed. An attempt was made to complete the test, but only very small injection rates could be maintained and it is clear from Figure 1 that any measurable fluid injected was entering dilated fractures. The test interval took no more fluid at declining pressures after the total head fell below about 340 ft of water, at about 110 psi gauge pressure.

The apparent hydraulic conductivity (permeability) was calculated at zero for the steps up to a head of about 200 ft of water, and then rose rapidly at higher pressures (Fig. 2). All of the measured injection that did occur was undoubtedly into fractures dilated by the high test pressures, and the actual hydraulic conductivity (permeability) is extremely low. This conclusion is reinforced by the fact that, at the beginning of the test, the water level in the borehole was 5.6 ft below land surface, even though later measurements in the completed well indicate that the hole would have been dry to a depth of 48 ft. No attempt was made to replicate the test.

Table 1. Summary of hydraulic conductivity (permeability) estimates

borehole and zone	depth interval, ft	apparent permeability		
		Lugeon units	cm/sec	ft/day
GWQ 5-R, Zone 1	64-100	~0	~0	~0
GWQ 11-24, Zone 1	100-147	0.5	7×10^{-6}	0.02
GWQ 11-24, Zone 2	150-197	2.3	3.0×10^{-5}	0.085
GWQ 11-24, Zone 3	204-251	3.8	4.9×10^{-5}	0.14
GWQ 11-25, Zone 1	100-148	~0	~0	~0
GWQ 11-25, Zone 2	150-198	2.2	2.9×10^{-5}	0.081
GWQ 11-25, Zone 3	207-251	2.0	2.6×10^{-5}	0.074

GWQ 11-24, Zone 1

This zone extended from the packer, at 100 ft, to 147 ft. Three series of injection tests were conducted, the first two with a centrifugal pump and the third with the Moyno positive-displacement pump. Plots of injection rate against total head are shown on Figure 3. In Series 1, the injection rates at increasing pressure were close to a line passing through the origin of the graph (Fig. 1), indicating that dilation of fractures was not significant until total head exceeded 200 ft or more, and the apparent permeability (Fig. 2) was roughly constant at around 0.5 Lugeon units (7×10^{-6} cm/sec, or 0.02 ft/day). Late in the first series, above total heads of around 210 ft of water, with about 75 psi gauge pressure, the injection rates began to increase sharply (Fig. 3), and it is probable that dilation of fractures was occurring.

In the subsequent two series of injection measurements, the rates were successively higher at corresponding pressures, and apparent permeability was greater (Fig. 4). In the third series, at the highest injection rates, the decreasing trend of apparent permeability indicates that head loss due to turbulent flow, as water flowed to and entered discrete fractures, played a significant role. The value of around 0.5 Lugeon units (7×10^{-6} cm/sec, or 0.02 ft/day), based on the first series of measurements, is likely to be most nearly representative.

GWQ 11-24, Zone 2

The packer was set at 150 ft and the bottom of the hole was at 197 ft. The injection rates in the first series of measurements were high compared with the other tests (see Fig. 5), but the plot of injection rates against total head does not extrapolate back through the origin. This may be attributable to turbulent-flow losses, or to significant dilation of fractures that occurred, and flow into the rock mass begun, even as the hole was filling and before pressure began to show on the gauge. This seems improbable at such low total heads. Although not reflected in the field notes, a more probable explanation is that some leakage around the packer was occurring.

In the second series of measurements (Fig. 5), the injection rates were directly proportional to total head, and the increasing-pressure plot extrapolates back almost through the origin, suggesting that the packer was sealing properly. Injection rates were somewhat greater during the decreasing-pressure part of the series, which may be attributable to some fracture dilation that occurred at the highest pressures during the increasing-pressure part of the test, and persisted.

The plot of apparent permeability against total head (Fig. 6) shows a steep decline with increasing injection rate for the first series of measurements, which might be indicative of large and increasing influence of turbulent flow, but is more likely a consequence of leakage around the packer as mentioned above. In the second series, in contrast, the apparent permeability is nearly constant, representing nearly laminar-flow conditions, at about 2.3 Lugeon units for increasing pressures. The representative permeability is likely to be 2.3 Lugeon units (3.0 x 10^{-5} cm/sec, or 0.085 ft/day).

GWQ 11-24, Zone 3

In this zone, the packer was set at 204 ft and the bottom of the borehole was at 251 ft. For the first four steps at increasing pressure in the first series of measurements, for total head up to about 170 ft, the injection rates plot approximately on a line that extrapolates back through the origin (Fig. 7), indicating that no fracture-dilation occurred. The apparent-permeability plot, projected back to the value at zero head (Fig. 8) suggests a value of about 0.6 Lugeon units, and a small turbulent-flow effect.

After total head exceeded about 170 ft in the first series of measurement, the injection rate increased markedly (Fig. 7), indicating that a fracture or fractures had opened under the increasing pressure, or more probably in this case, that temporary clogging of a fracture or the skin effect of drilling-fluid solids had been overcome. The pattern of injection rates as the pressures continued to increase and then decrease in the first series of measurements, and the identical pattern in the second and third series of measurements (see Fig. 7), suggest that fracture(s) did not close as the pressure was reduced, and that the initial sharp rise in injection rates during the first series was attributable to clearing of clogging or skin effect.

The plots of injection rate against total head for points representing measurements after the original breakthrough do not, however, extrapolate back through the origin. A loss of about 1.6 gpm, equivalent to about 93 ft of head differential, is indicated. The water level in the well at the beginning of the test, however, compares closely with later measurements, and it is not likely that a difference between the natural head and the head at the beginning of the test would account for the discrepancy. The most likely explanation seems to be that some water leaked around the packer, perhaps through a fracture open at both ends of the packer element.

Figure 8 shows the calculated values of permeability versus total head. Discounting the earliest measurements in Series 1, and assuming that turbulent-flow conditions account for the negative slope of the plot, and also assuming that the leakage around the packer is actually proportional to the injection rate, leads to a projection at zero total head, where no turbulence or leakage would exist, of about 3.8 Lugeon units (4.9 x 10^{-5} cm/sec, or 0.14 ft/day).

GWQ 11-25, Zone 1

A zone from 100 to 148 ft was isolated between the packer and the bottom of the borehole. No water was measured as being injected into the test zone until the gauge pressure reached 150 psi, representing a total head above the water level in the hole at the beginning of the test of about 375 ft, equivalent to 163 psi. This pressure is far in excess of any probable fracture-gradient pressure at 100 ft, and it seems clear that the hydraulic conductivity of the rock was extremely low before fractures were induced or opened by the injection pressure. The remainder of the test was not considered valid for estimation of permeability.

GWQ 11-25, Zone 2

Zone 2 extended from the packer at 150 ft to the bottom of the hole at 198 ft. Injection rates during the first series of measurements were approximately proportional to total head, except for a relative rise in injection rate at heads above about 240 ft (Fig. 9). In the second and third series of measurements, injection rates increased and became directly proportional to total head, and the plot of injection rate against total head extrapolates back through the origin, with zero flow at zero additional head. Probably this sequence reflects some clearing of clogging by drilling-fluid solids.

The apparent permeability plot (Fig. 10) appears to reflect a decrease in turbulent-flow effects from Series 1 to Series 3. Projection of the apparent permeability for Series-3 measurements back to the value at zero additional head, where no turbulent-flow effect would be seen, suggests a representative permeability of about 2.2 Lugeon units (2.9 x 10^{-5} cm/sec or 0.081 ft/sec).

GWQ 11-25, Zone 3

This zone extended from the packer at 207 ft to the bottom of the hole at 251 ft. The injection rate was approximately proportional to total head at values of head up to about 180 ft during the first series of measurements (Fig. 11), but the plot appears to project back to a rate greater than zero at zero head, suggesting some leakage. At higher pressures, the injection rate increased very sharply, indicating dilation of fractures, and the injection rates at descending values of total head fell below the rates at corresponding heads during the increasing-pressure phase of the test, suggesting that some plugging of fractures had occurred. In the second and third series of measurements, the injection-rate versus total-head plots were very similar, and in each series they were similar for increasing and decreasing rates. The sharp rise in rate indicative of fracture dilation occurred at a higher total head, and projections of the plots pass nearly through the origin.

The apparent-permeability plot (Fig. 12) shows the influence of turbulent flow in all three series. Projection of the low total-head points back to a value at zero total head, suggests that a representative permeability may be about 2.0 Lugeon units (2.6 x 10^{-5} cm/sec or 0.074 ft/day).

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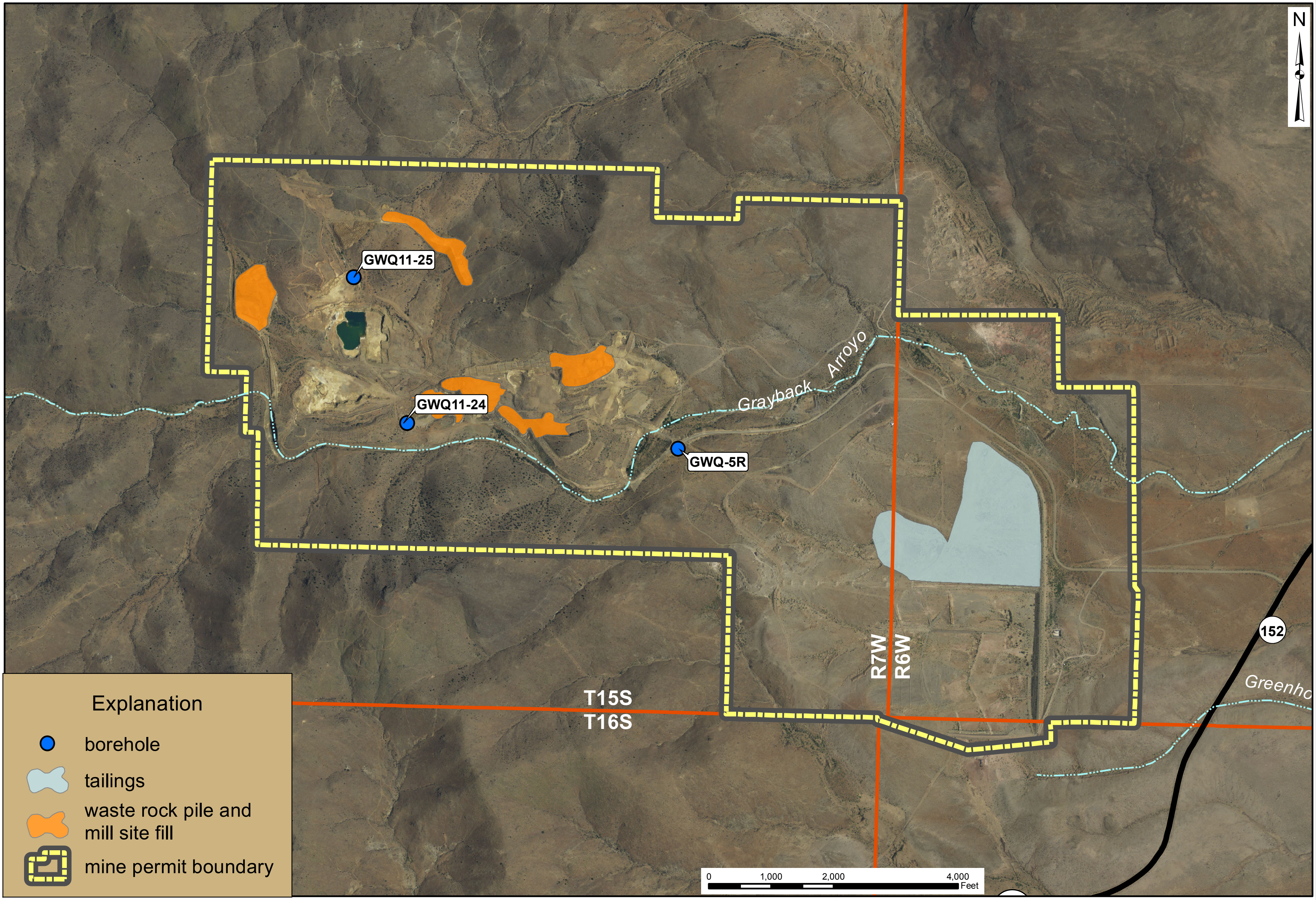
ILLUSTRATIONS



Aerial Photograph: NAIP 2011

July 26, 2013

Figure 1. Aerial photograph showing locations of three boreholes and facilities associated with the former Copper Flat Mine operated by Quintana Minerals, Sierra County, New Mexico.

JOHN SHOMAKER & ASSOCIATES, INC.
09396

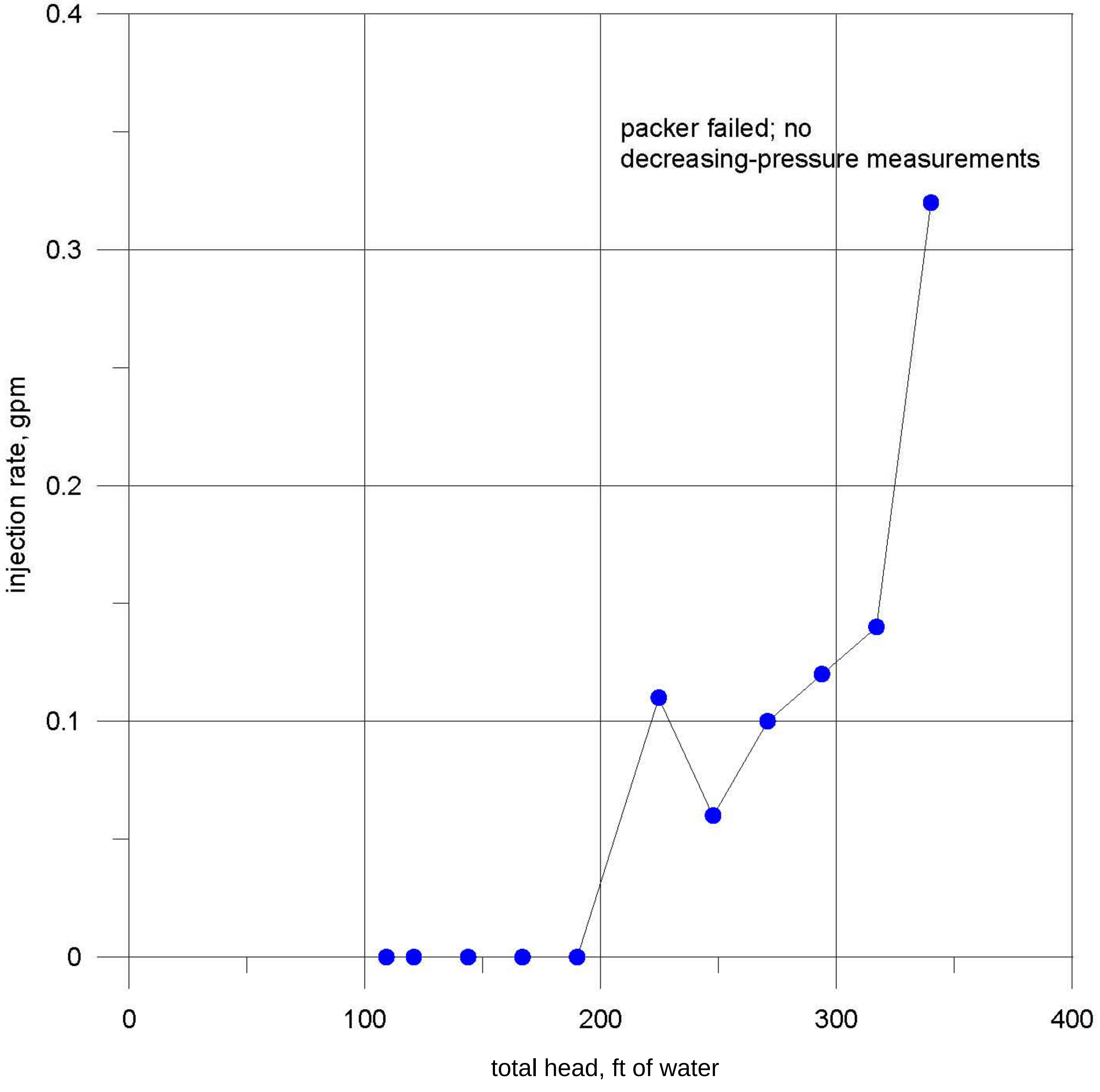


Figure 2. Pressure injection test, New Mexico Copper GWQ 5-R, Zone 1 (64-100 ft), Series 1, August 31, 2011.

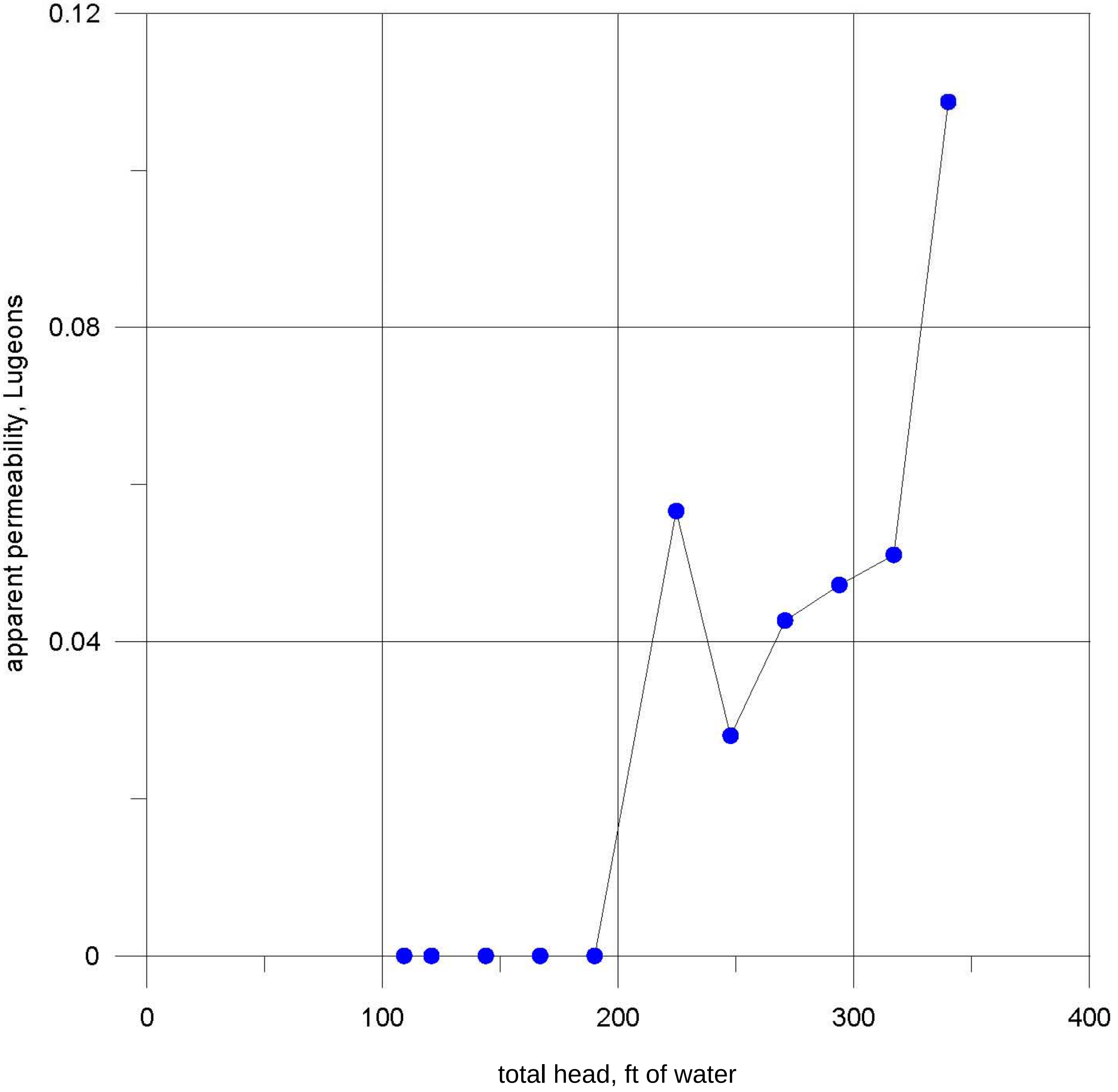


Figure 3. Apparent permeability from pressure injection test, New Mexico Copper GWQ 5-R, Zone 1 (64-100 ft), Series 1, August 31, 2011.

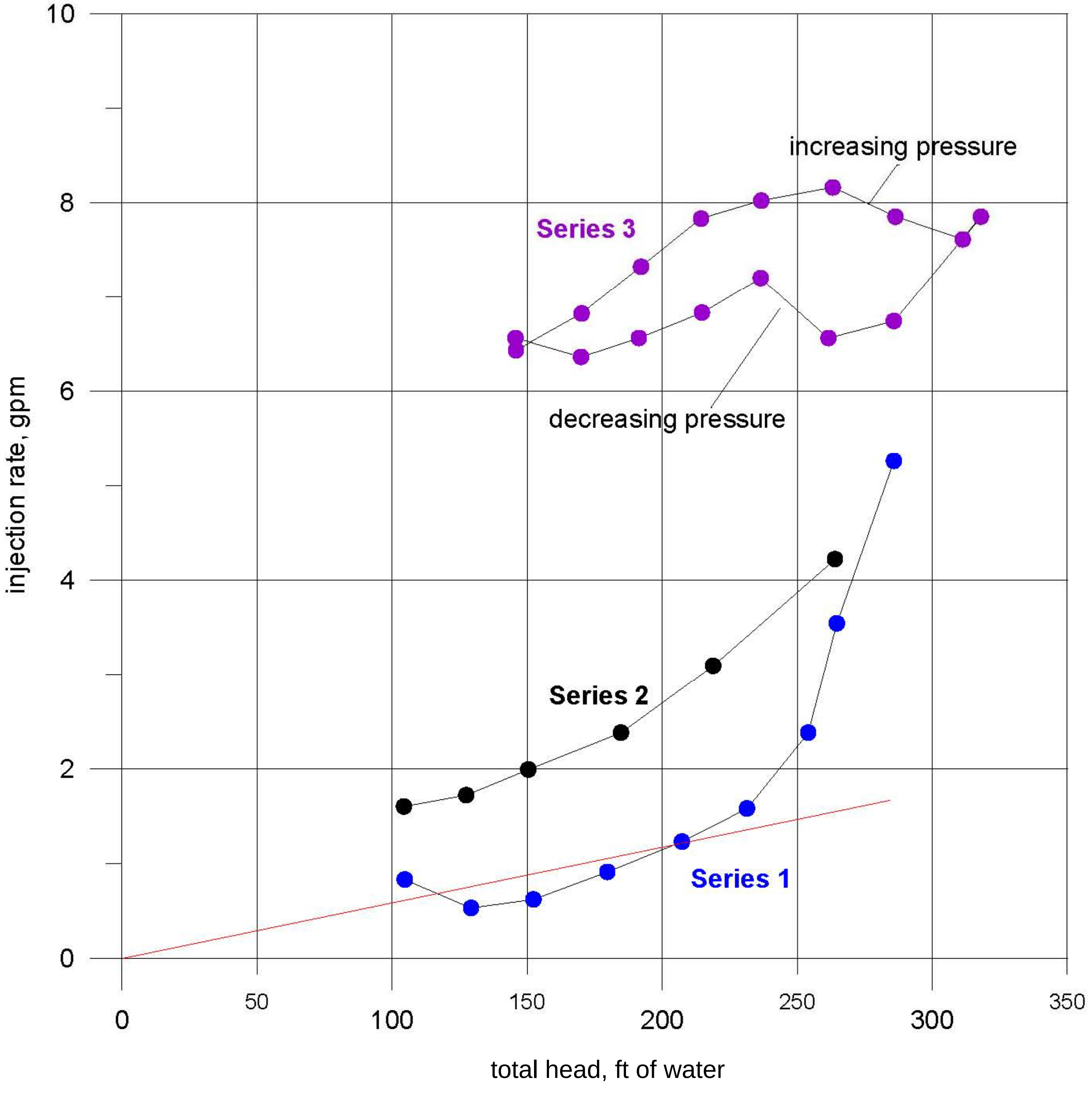


Figure 4. Pressure injection tests, New Mexico Copper GWQ 11-24, Zone 1 (100-147 ft), Series 1 and 2 (centrifugal pump), and Series 3 (positive displacement pump), July 27, 2011.

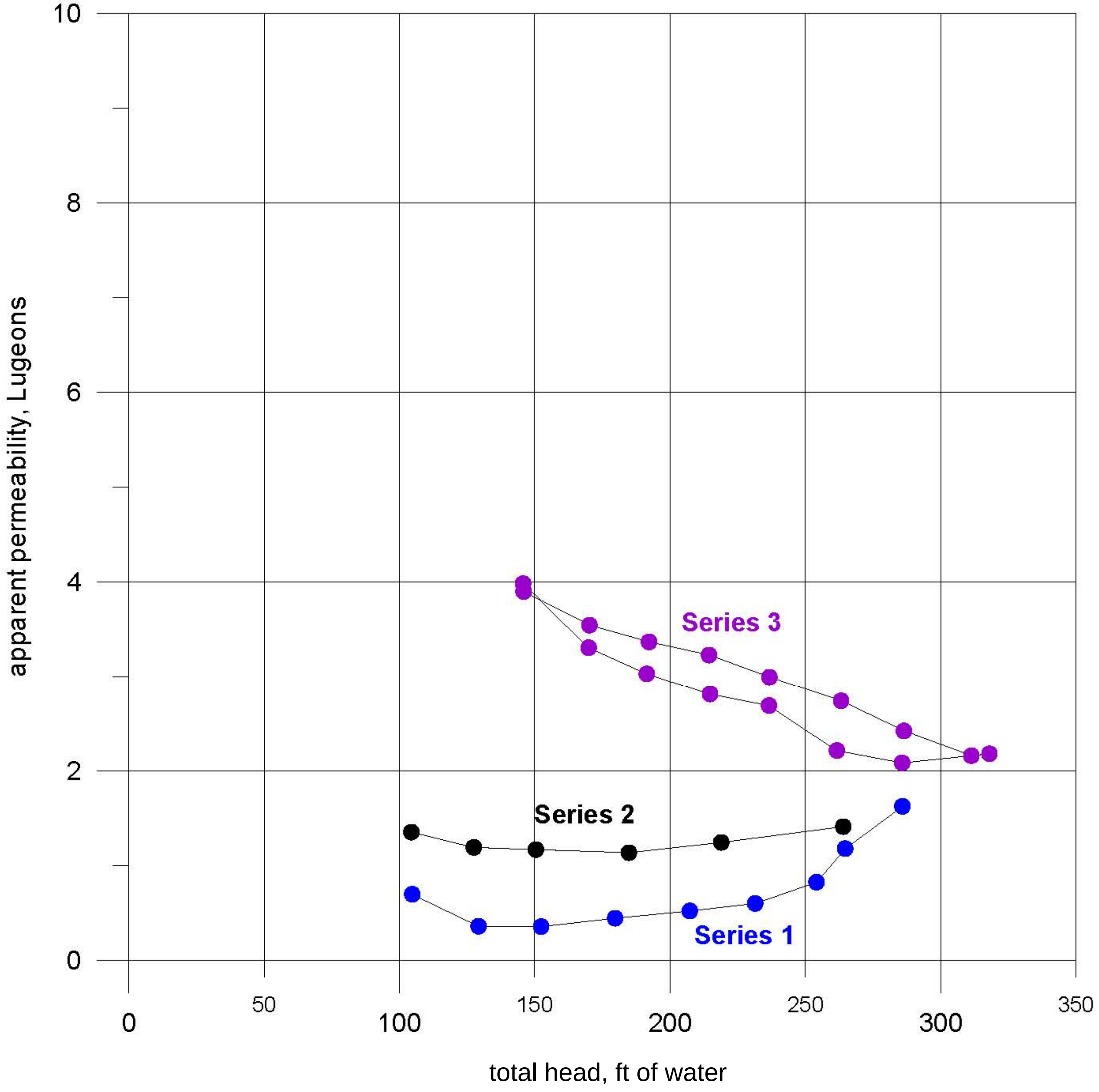


Figure 5. Apparent permeability from pressure injection tests, New Mexico Copper GWQ 11-24, Zone 1 (100-147 ft), Series 1 and 2 (centrifugal pump), and Series 3 (positive displacement pump), July 27, 2011.

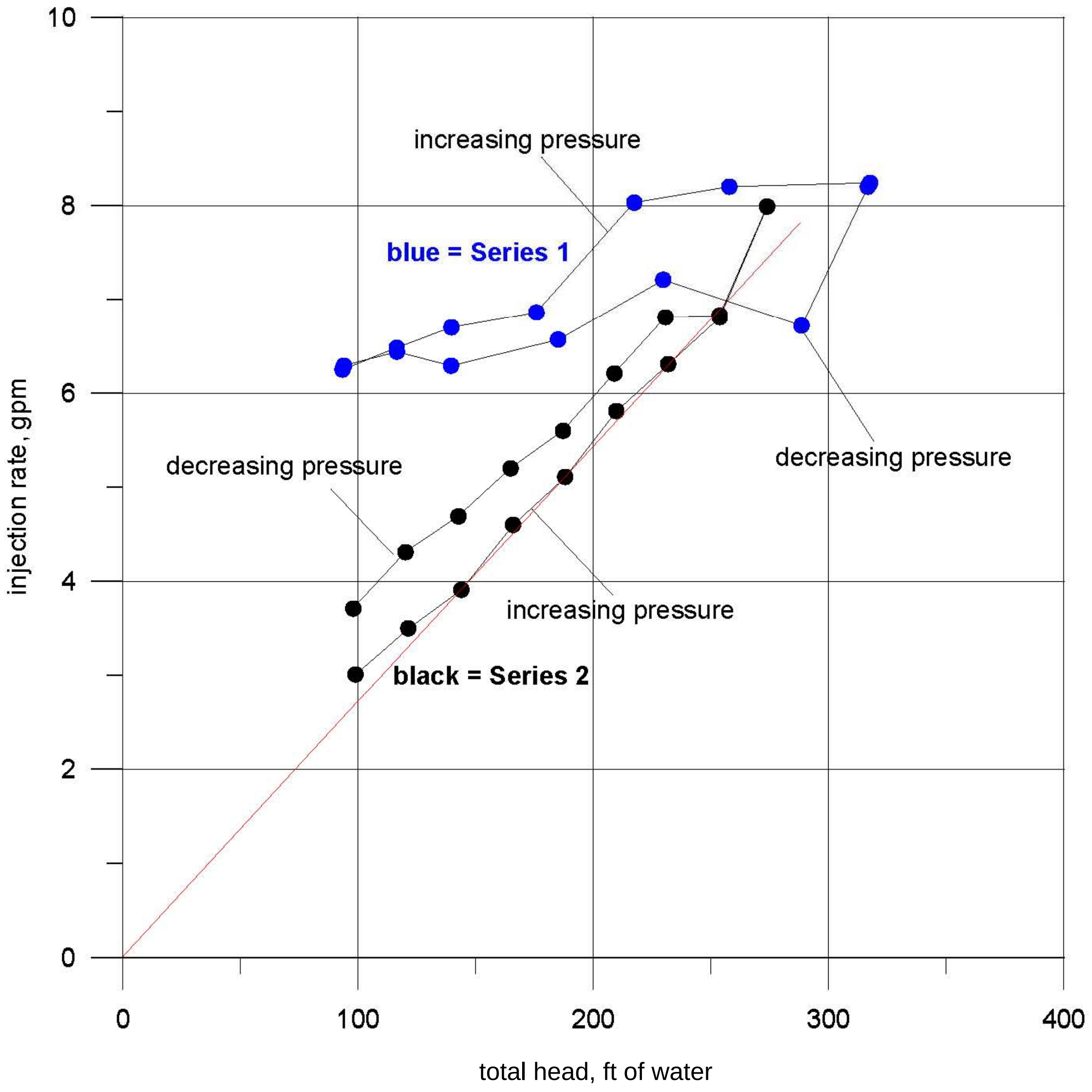


Figure 6. Pressure injection test, New Mexico Copper GWQ 11-24, Zone 2 (150-197 ft), Series 1 and 2, July 30, 2011.

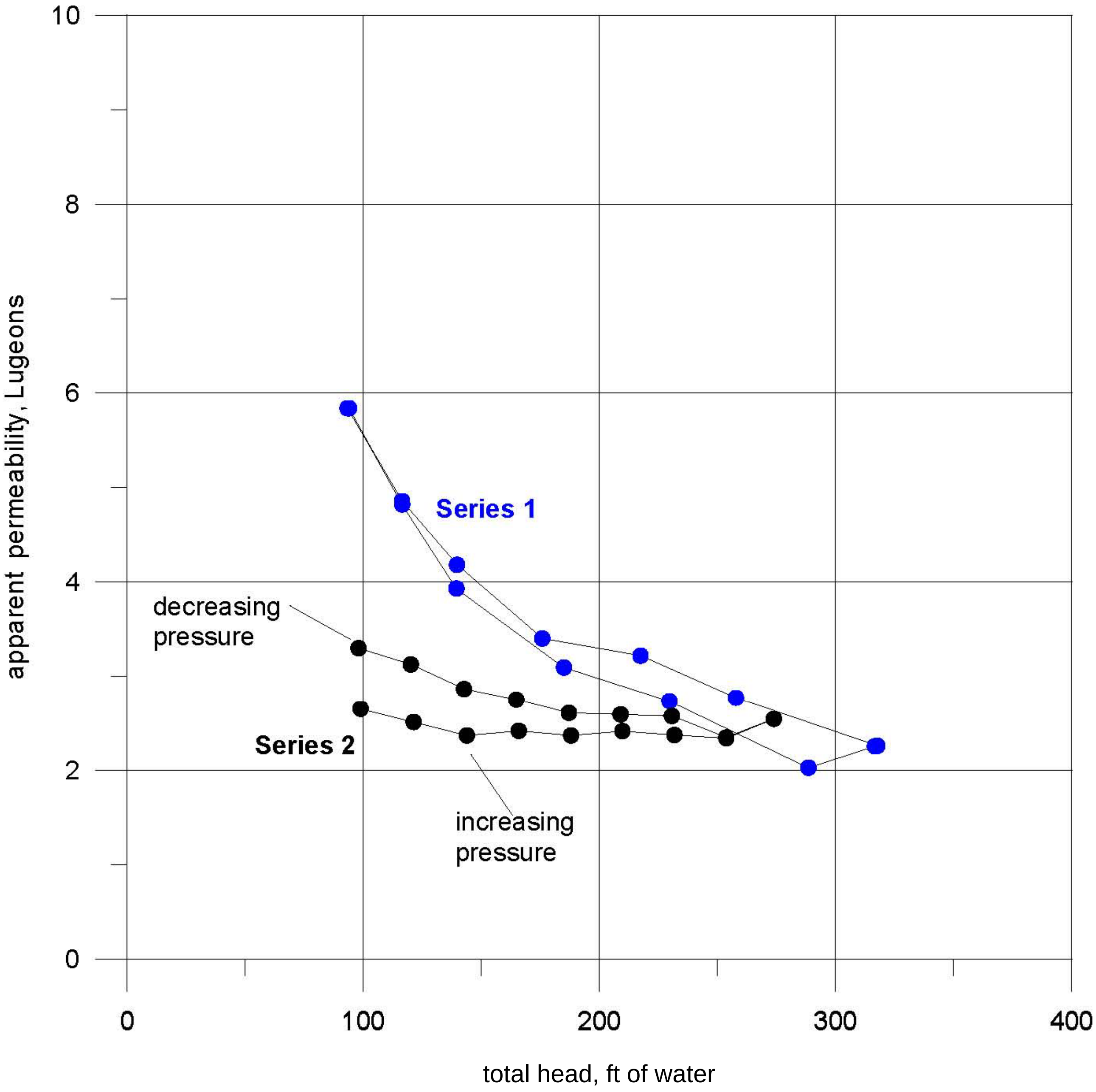


Figure 7. Apparent permeability from pressure injection test, New Mexico Copper GWQ 11-24, Zone 2 (150-197 ft), Series 1 and 2, July 30, 2011.

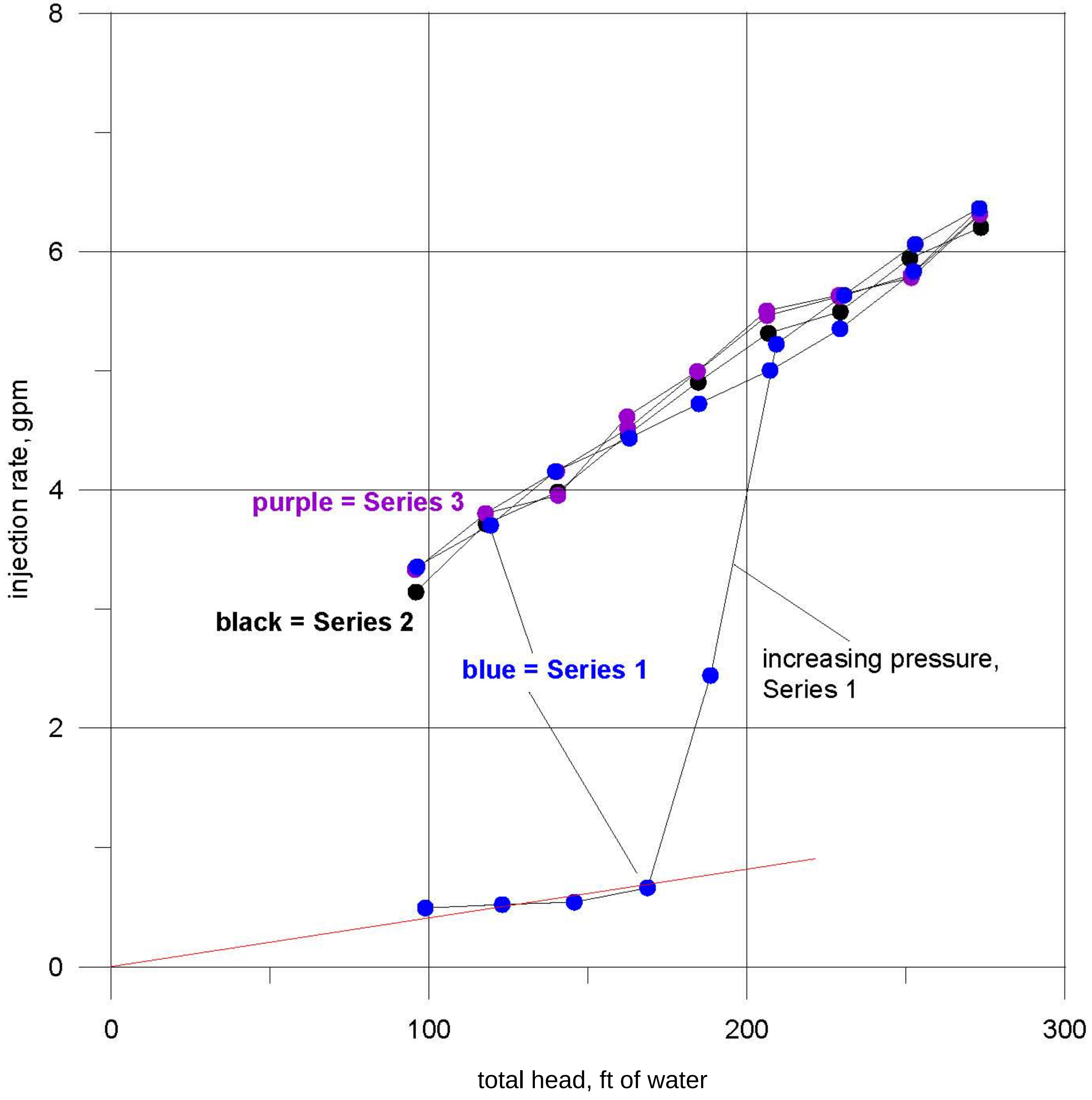


Figure 8. Pressure injection test, New Mexico Copper GWQ 11-24, Zone 3 (204-251 ft), Series 1, 2, and 3, August 1, 2011.

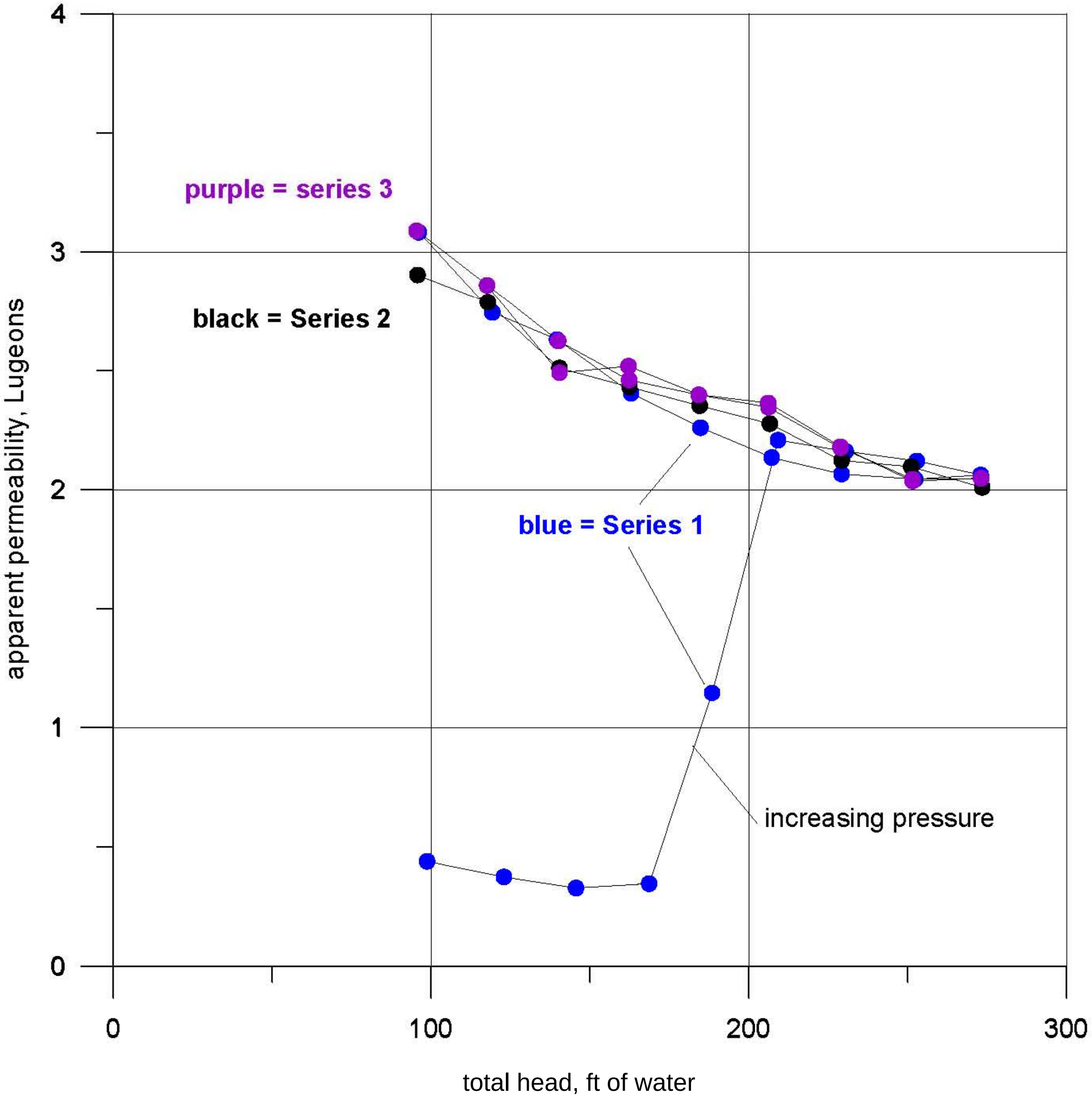


Figure 9. Apparent permeability from pressure injection test, New Mexico Copper GWQ 11-24, Zone 3 (204-251 ft), Series 1, 2, and 3, August 1, 2011.

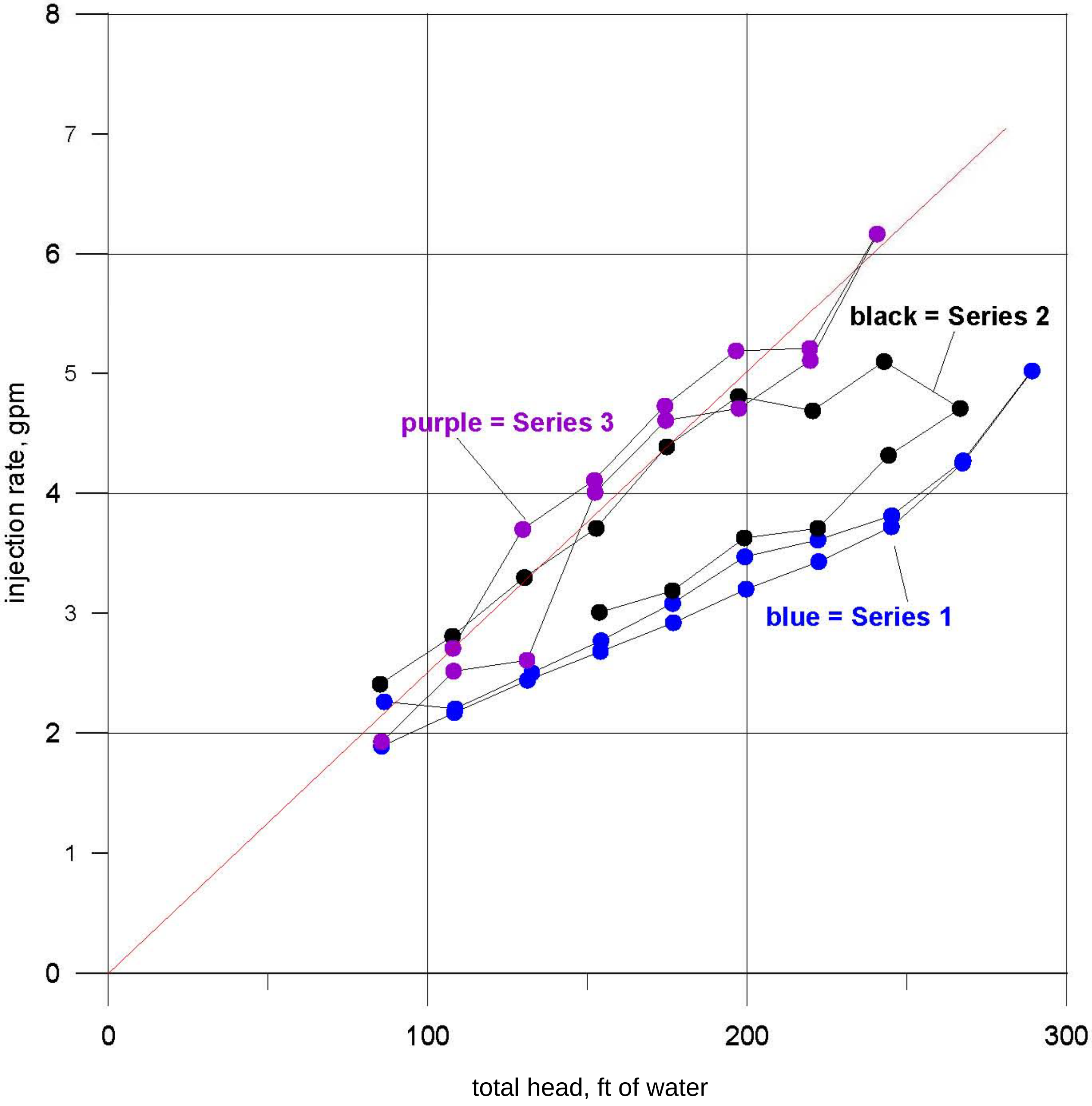


Figure 10. Pressure injection test, New Mexico Copper GWQ 11-25, Zone 2 (150-197.7 ft), Series 1, 2, and 3, August 16, 2011.

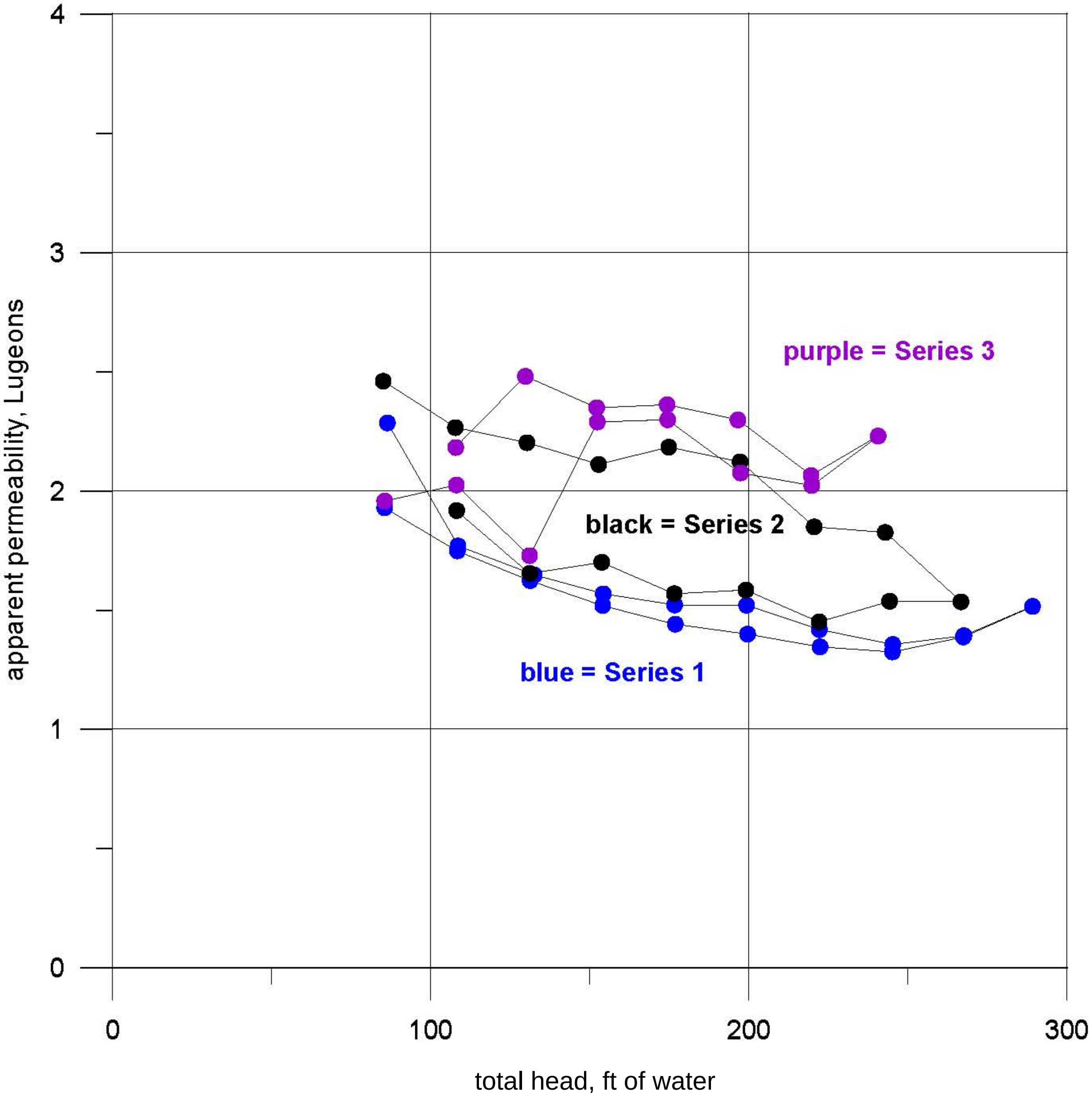


Figure 11. Apparent permeability from pressure injection test, New Mexico Copper GWQ 11-25, Zone 2 (150-197.7 ft), Series 1, 2, and 3, August 16, 2011.

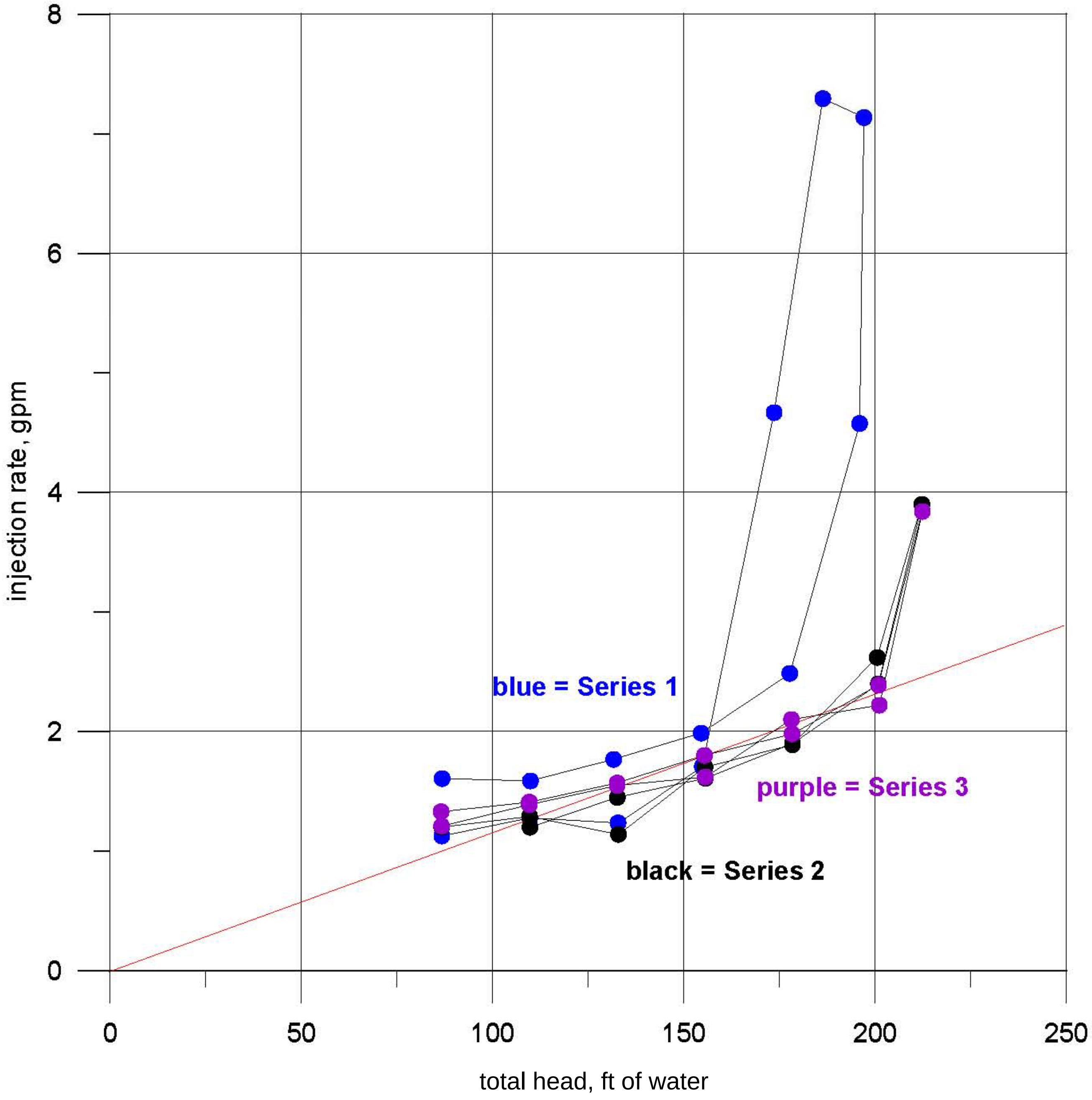


Figure 12. Pressure injection test, New Mexico Copper GWQ 11-25, Zone 3 (207-251 ft), Series 1, 2 and 3, August 24, 2011.

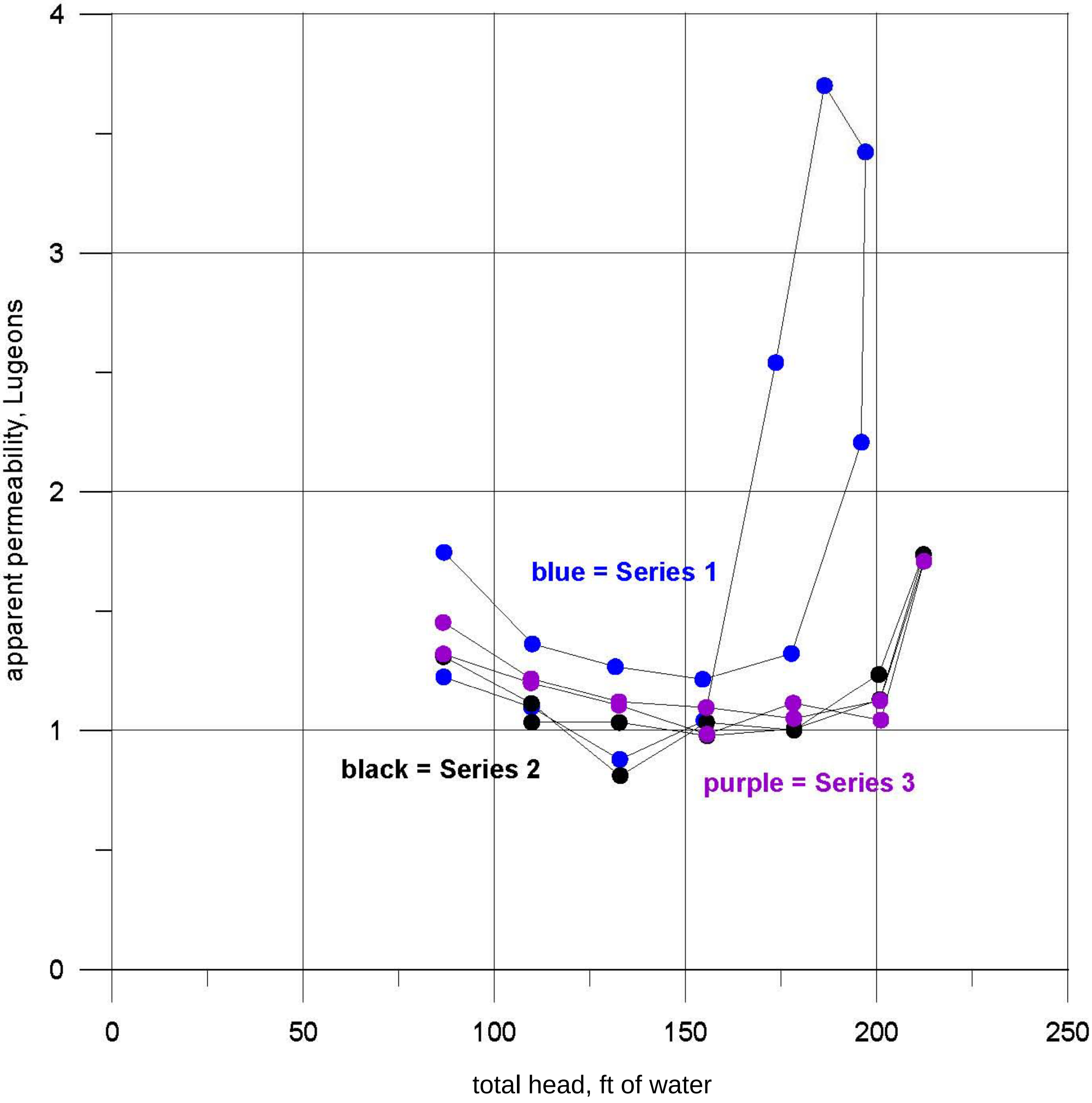


Figure 13. Apparent permeability from pressure injection test, New Mexico Copper GWQ 11-25, Zone 3 (207-251 ft), Series 1, 2, and 3, August 24, 2011.

APPENDIX

Appendix.

Basic data for pressure-injection tests

JOHN SHOMAKER & ASSOCIATES, INC.
WATER-RESOURCE AND ENVIRONMENTAL CONSULTANTS
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ALBUQUERQUE, NEW MEXICO 87107
(505) 345-3407, FAX (505) 345-9920
WWW.SHOMAKER.COM

Date 8/31/2011
Client New Mexico Copper Corp
Project Copper Flat
Well Name GWQ 5-R
Hydrologist JJK

later WLs indicate dry to 100 ft; use (64+100)/2

Starting Water Level (ft bgl) 5.6 (not representative of Static)
Elevation (ft GL)
Injection Interval (ft bgl) 64 to 100
Bore/Casing Depth (ft bgl) 100

Packer Dia 2 inch
Bore/Casing Dia 3-3/4 inch
Injection Pipe Dia 1 inch
Pressure gauge height above GL 4 ft

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
11:25	0		6000		10	0	Packer at 200 psi
11:26	1	1	6000	0.00	10	0	
11:27	2	2	6000	0.00	10	0	
11:28	3	3	6000	0.00	10	0	
11:29	4	4	6000	0.00	10	0	
11:30	5	5	6000	0.00	10	0	
11:31	6	1	6000	0.00	20	0	
11:32	7	2	6000	0.00	20	0	
11:33	8	3	6000	0.00	20	0	
11:34	9	4	6000	0.00	20	0	
11:35	10	5	6000	0.00	20	0	
11:36	11	1	6000	0.00	30	0	
11:37	12	2	6000	0.00	30	0	
11:38	13	3	6000	0.00	30	0	
11:39	14	4	6000	0.00	30	0	
11:40	15	5	6000	0.00	30	0	
11:41	16	1	6000	0.00	40	0	
11:42	17	2	6000	0.00	40	0	
11:43	18	3	6000	0.00	40	0	
11:44	19	4	6000	0.00	40	0	
11:45	20	5	6000	0.00	40	0	
11:46	21	1	6000	0.00	50	0	
11:47	22	2	6000	0.00	50	0	
11:48	23	3	6000	0.00	50	0	
11:49	24	4	6000	0.00	50	0	
11:50	25	5	6000	0.00	50	0	
11:51	26	1	6000	0.00	60	0	
11:52	27	2	6000	0.00	60	0	
11:53	28	3	6000.3	0.30	60	0.3	
11:54	29	4	6000.3	0.00	60	0.3	
11:55	30	5	6000.5	0.20	60	0.5	
11:56	31	1	6000.7	0.2	60	0.7	
11:57	32	2	6000.9	0.2	60	0.9	
11:58	33	3	6001	0.1	60	1	
11:59	34	4	6001.1	0.1	60	1.1	
12:00	35	5	6001.1	0	60	1.1	
12:01	36	1	6001.2	0.1	70	1.2	
12:02	37	2	6001.2	0	70	1.2	
12:03	38	3	6001.2	0	70	1.2	
12:04	39	4	6001.3	0.1	70	1.3	
12:05	40	5	6001.3	0	70	1.3	
12:06	41	6	6001.5	0.2	70	1.5	
12:07	42	7	6001.5	0	70	1.5	
12:08	43	8	6001.5	0	70	1.5	
12:09	44	9	6001.7	0.2	70	1.7	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
12:10	45	10	6001.7	0	70	1.7	
12:11	46	1	6001.9	0.2	80	1.9	
12:12	47	2	6002	0.1	80	2	
12:13	48	3	6002.1	0.1	80	2.1	
12:14	49	4	6002.1	0	80	2.1	
12:15	50	5	6002.1	0	80	2.1	
12:16	51	6	6002.4	0.3	80	2.4	
12:17	52	7	6002.4	0	80	2.4	
12:18	53	8	6002.5	0.1	80	2.5	
12:19	54	9	6002.7	0.2	80	2.7	
12:20	55	10	6002.7	0	80	2.7	
12:21	56	1	6002.8	0.1	90	2.8	
12:22	57	2	6003	0.2	90	3	
12:23	58	3	6003	0	90	3	
12:24	59	4	6003.2	0.2	90	3.2	
12:25	60	5	6003.2	0	90	3.2	
12:26	61	6	6003.3	0.1	90	3.3	
12:27	62	7	6003.4	0.1	90	3.4	
12:28	63	8	6003.6	0.2	90	3.6	
12:29	64	9	6003.7	0.1	90	3.7	
12:30	65	10	6003.9	0.2	90	3.9	
12:31	66	1	6004	0.10	100	4	
12:32	67	2	6004.2	0.20	100	4.2	
12:33	68	3	6004.2	0.00	100	4.2	
12:34	69	4	6004.5	0.30	100	4.5	
12:35	70	5	6004.7	0.20	100	4.7	
12:36	71	1	6004.7	0	100	4.7	
12:37	72	2	6004.9	0.2	100	4.9	
12:38	73	3	6005.1	0.2	100	5.1	
12:39	74	4	6005.1	0	100	5.1	
12:40	75	5	6005.3	0.2	100	5.3	
12:41	76	1	6005.7	0.4	110	5.7	
12:42	77	2	6006	0.3	110	6	
12:43	78	3	6006.4	0.4	110	6.4	
12:44	79	4	6006.6	0.2	110	6.6	
12:45	80	5	6006.9	0.3	110	6.9	
12:46	81	6	6007.3	0.4	110	7.3	
12:47	82	7	6007.7	0.4	110	7.7	
12:48	83	8	6007.9	0.2	110	7.9	
12:49	84	9	6008.2	0.3	110	8.2	
12:50	85	10	6008.5	0.3	110	8.5	
12:51	86	1	6011.2	2.7	120	11.2	Fluid moving up hole
12:52	87	2	6013.8	2.6	122	13.8	
12:53	88	3	6016.2	2.4	115	16.2	Fluid at top of conductor
12:54	89	4	6021.2	5	113	21.2	
12:55	90	5	6026.3	5.1	110	26.3	
12:56	91	6	6032	5.7	110	32	
12:57	92	7	6037.6	5.6	110	37.6	
12:58	93	8	6043.5	5.9	110	43.5	
12:59	94	9	6049.2	5.7	110	49.2	Approximatly 5 + gallons flowing at surface
13:00	95	10	6055	5.8	110	55	Stop pump
13:01	96		6055	0		NA	Packer pressure has dropped to 160
13:02	97		6055	0		NA	
13:03	98		6055	0		NA	
13:04	99		6055	0		NA	
13:05	100		6055	0		NA	
13:06	101		6055	0		NA	Attempt to reinflate packer and stabilize

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
13:07	102		6055	0		NA	
13:08	103		6055	0		NA	
13:09	104		6055	0		NA	
13:10	105		6055	0		NA	Unable to stabilize packer psi
13:11	106		6055	0		NA	
13:12	107		6055	0		NA	
13:13	108		6055	0		NA	
13:14	109		6055	0		NA	
13:15	110		6055	0		NA	
13:16	111		6055	0		NA	
13:17	112		6055	0		NA	
13:18	113		6055	0		NA	
13:19	114		6055	0		NA	
13:20	115		6055	0		NA	Pull and replace packer
13:21	116		6055	0		NA	
13:22	117		6055	0		NA	
13:23	118		6055	0		NA	
13:24	119		6055	0		NA	
13:25	120		6055	0		NA	
13:26	121		6055	0		NA	
13:27	122		6055	0		NA	
13:28	123		6055	0		NA	
13:29	124		6055	0		NA	
13:30	125		6055	0		NA	
13:31	126		6055	0		NA	
13:32	127		6055	0		NA	
13:33	128		6055	0		NA	
13:34	129		6055	0		NA	
13:35	130		6055	0		NA	
13:36	131		6055	0		NA	
13:37	132		6055	0		NA	
13:38	133		6055	0		NA	
13:39	134		6055	0		NA	
13:40	135		6055	0		NA	
13:41	136		6055	0		NA	
13:42	137		6055	0		NA	
13:43	138		6055	0		NA	
13:44	139		6055	0		NA	
13:45	140		6055	0		NA	
13:46	141		6055	0		NA	
13:47	142		6055	0		NA	
13:48	143		6055	0		NA	
13:49	144		6055	0		NA	
13:50	145		6055	0		NA	
13:51	146		6055	0		NA	
13:52	147		6055	0		NA	
13:53	148		6055	0		NA	
13:54	149		6055	0		NA	
13:55	150		6055	0		NA	
13:56	151		6055	0		NA	
13:57	152		6055	0		NA	
13:58	153		6055	0		NA	
13:59	154		6055	0		NA	New packer installed and inflated to 200 psi
14:00	155	1	6057	2	100	55	Filling hose and 1 inch
14:01	156	2	6057.4	0.4	110		
14:02	157	3	6057.5	0.1	110		
14:03	158	4	6057.5	0	125		
14:04	159	5	6057.5	0	123		

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
14:05	160	6	6057.5	0	120		
14:06	161	7	6057.5	0	120		Pump shear pin fails
14:07	162	8	6057.5	0	0		Stop to repair pump
14:08	163		6057.5	0	0		
14:09	164		6057.5	0	0		
14:10	165		6057.5	0	0		
14:11	166		6057.5	0	0		
14:12	167		6057.5	0	0		
14:13	168		6057.5	0	0		
14:14	169		6057.5	0	0		
14:15	170		6057.5	0	0		
14:16	171		6057.5	0	0		
14:17	172		6057.5	0	0		
14:18	173		6057.5	0	0		
14:19	174		6057.5	0	0		
14:20	175		6057.5	0	0		
14:21	176		6057.5	0	0		
14:22	177		6057.5	0	0		
14:23	178		6057.5	0	0		
14:24	179		6057.5	0	0		
14:25	180		6057.5	0	0		
14:26	181		6057.5	0	0		
14:27	182		6057.5	0	0		
14:28	183		6057.5	0	0		
14:29	184		6057.5	0	0		
14:30	185		6057.5	0	0		
14:31	186		6057.5	0	0		
14:32	187		6057.5	0	0		
14:33	188		6057.5	0	0		
14:34	189		6057.5	0	0		
14:35	190		6057.5	0	0		
14:36	191		6057.5	0	0		
14:37	192		6057.5	0	0		
14:38	193		6057.5	0	0		
14:39	194		6057.5	0	0		
14:40	195		6057.5	0	0		
14:41	196		6057.5	0	0		
14:42	197		6057.5	0	0		
14:43	198		6057.5	0	0		
14:44	199		6057.5	0	0		
14:45	200		6057.5	0	0		
14:46	201		6057.5	0	0		
14:47	202		6057.5	0	0		
14:48	203		6057.5	0	0		
14:49	204		6057.5	0	0		
14:50	205		6057.5	0	0		
14:51	206		6057.5	0	0		
14:52	207		6057.5	0	0		
14:53	208		6057.5	0	0		
14:54	209		6057.5	0	0		
14:55	210		6057.5	0	0		
14:56	211		6057.5	0	0		
14:57	212		6060	2.5	0		Test pump to ground
14:58	213		6067.5	7.5	0		
14:59	214		6075	7.5	0		
15:00	215		6082.5	7.5	0		
15:01	216		6082.5	0	0		
15:02	217		6082.5	0	0		

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
15:03	218		6082.5	0	0		
15:04	219		6082.5	0	0		
15:05	220		6082.5	0	0		
15:06	221		6082.5	0	0		
15:07	222		6082.5	0	0		
15:08	223		6082.5	0	0		
15:09	224		6082.5	0	0		
15:10	225		6082.5	0	0		
15:11	226	1	6082.7	0.2	120	55.2	
15:12	227	2	6082.9	0.2	120	55.4	
15:13	228	3	6083	0.1	120	55.5	
15:14	229	4	6083	0	120	55.5	
15:15	230	5	6083.2	0.2	120	55.7	
15:16	231	6	6083.3	0.1	120	55.8	
15:17	232	7	6083.3	0	120	55.8	
15:18	233	8	6083.3	0	120	55.8	
15:19	234	9	6083.3	0	120	55.8	
15:20	235	10	6083.3	0	120	55.8	
15:21	236	1	6083.3	0	130	28.3	
15:22	237	2	6083.3	0	130	28.3	
15:23	238	3	6083.4	0.1	130	28.4	
15:24	239	4	6083.4	0	130	28.4	
15:25	240	5	6083.4	0	130	28.4	
15:26	241	6	6083.4	0	130	28.4	
15:27	242	7	6083.4	0	130	28.4	
15:28	243	8	6083.4	0	130	28.4	
15:29	244	9	6083.5	0.1	130	28.5	
15:30	245	10	6083.5	0	130	28.5	
15:31	246	1	6083.5	0	150	28.5	
15:32	247	2	6083.5	0	150	28.5	
15:33	248	3	6083.6	0.1	150	28.6	1 inch injection pipe pushing up
15:34	249	4	6083.7	0.1	150	28.7	
15:35	250	5	6083.7	0	150	28.7	Packer pressure moving up 240
15:36	251	6	6083.7	0	150	28.7	
15:37	252	7	6083.7	0	150	28.7	Packer pressure moving up 260
15:38	253	8	6083.7	0	150	28.7	
15:39	254	9	6083.9	0.2	150	28.9	Packer pressure moving up 290
15:40	255	10	6084	0.1	150	29	
15:41	256	1	6084	0	130	29	
15:42	257	2	6084	0	130	29	
15:43	258	3	6084.2	0.2	130	29.2	
15:44	259	4	6084.2	0	130	29.2	
15:45	260	5	6084.2	0	130	29.2	Packer pressure down to 260
15:46	261	6	6084.2	0	130	29.2	
15:47	262	7	6084.3	0.1	130	29.3	
15:48	263	1	6084.3	0	120	29.3	
15:49	264	2	6084.3	0	120	29.3	
15:50	265	3	6084.3	0	120	29.3	
15:51	266	4	6084.3	0	120	29.3	
15:52	267	5	6084.3	0	120	29.3	
15:53	268	6	6084.3	0	120	29.3	
15:54	269	7	6084.3	0	120	29.3	
15:55	270	8	6084.3	0	120	29.3	
15:56	271	9	6084.3	0	120	29.3	
15:57	272	10	6084.4	0.1	120	29.4	
15:58	273	1	6084.4	0	110	29.4	
15:59	274	2	6084.4	0	110	29.4	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
16:00	275	3	6084.4	0	110	29.4	
16:01	276	4	6084.5	0.1	110	29.5	
16:02	277	5	6084.5	0	110	29.5	
16:03	278	1	6084.5	0	100	29.5	
16:04	279	2	6084.5	0	100	29.5	
16:05	280	3	6084.5	0	100	29.5	
16:06	281	4	6084.5	0	100	29.5	
16:07	282	5	6084.5	0	100	29.5	
16:08	283	1	6084.5	0	90	29.5	
16:09	284	2	6084.5	0	90	29.5	
16:10	285	3	6084.5	0	90	29.5	
16:11	286	4	6084.5	0	90	29.5	
16:12	287	5	6084.5	0	90	29.5	
16:13	288	1	6084.5	0	80	29.5	
16:14	289	2	6084.5	0	80	29.5	
16:15	290	3	6084.5	0	80	29.5	
16:16	291	4	6084.5	0	80	29.5	
16:17	292	5	6084.5	0	80	29.5	
16:18	293	1	6084.5	0	70	29.5	
16:19	294	2	6084.5	0	70	29.5	
16:20	295	3	6084.5	0	70	29.5	
16:21	296	4	6084.5	0	70	29.5	
16:22	297	5	6084.5	0	70	29.5	
16:23	298	1	6084.5	0	60	29.5	
16:24	299	2	6084.5	0	60	29.5	
16:25	300	3	6084.5	0	60	29.5	
16:26	301	4	6084.5	0	60	29.5	
16:27	302	5	6084.5	0	60	29.5	
16:28	303	1	6084.5	0	50	29.5	
16:29	304	2	6084.5	0	50	29.5	
16:30	305	3	6084.5	0	50	29.5	
16:31	306	4	6084.5	0	50	29.5	
16:32	307	5	6084.5	0	50	29.5	
16:33	308	1	6084.5	0	40	29.5	
16:34	309	2	6084.5	0	40	29.5	
16:35	310	3	6084.5	0	40	29.5	
16:36	311	4	6084.5	0	40	29.5	
16:37	312	5	6084.5	0	40	29.5	
16:38	313	1	6084.5	0	30	29.5	
16:39	314	2	6084.5	0	30	29.5	
16:40	315	3	6084.5	0	30	29.5	
16:41	316	4	6084.5	0	30	29.5	
16:42	317	5	6084.5	0	30	29.5	
16:43	318	6	6084.5	0	20	29.5	
16:44	319	7	6084.5	0	20	29.5	
16:45	320	8	6084.5	0	20	29.5	
16:46	321	9	6084.5	0	20	29.5	
16:47	322	10	6084.5	0	20	29.5	

Repeated steps summarized								
psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	
								No duplicat test performed

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Date 7/21/2011
Client New Mexico Copper Corp
Project Copper Flat
Well Name GWQ 11-24 Zone 1
Hydrologist JJK

Starting Water Level (ft bgl) 54.61
Elevation (ft GL)
Injection Interval (ft bgl) 100 to 147
Bore/Casing Depth (ft bgl) 147

Packer Dia 2 inch
Bore/Casing Dia 3-3/4 inch
Injection Pipe Dia 1 inch
Pressure gauge height above GL 4 ft

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
8:25	0		9		20	0	20 psi
8:26	1	1	9.8	0.80	20	0.8	
8:27	2	2	10.59	0.79	20	1.59	
8:28	3	3	11.4	0.81	20	2.4	
8:29	4	4	12.2	0.80	20	3.2	
8:30	5	5	13.1	0.90	20	4.1	
8:31	6	6	14	0.90	20	5	
8:32	7	7	14.8	0.80	20	5.8	
8:33	8	8	15.6	0.80	20	6.6	
8:34	9	9	16.5	0.90	20	7.5	
8:35	10	10	17.3	0.80	20	8.3	Average 0.83 gpm
8:36	11	1	17.8	0.5	30	8.8	30 psi
8:37	12	2	18.3	0.5	32	9.3	
8:38	13	3	18.9	0.6	30	9.9	
8:39	14	4	19.6	0.7	31	10.6	
8:40	15	5	20	0.4	30	11	
8:41	16	6	20.5	0.5	32	11.5	
8:42	17	7	21	0.5	31	12	
8:43	18	8	21.5	0.5	30	12.5	
8:44	19	9	22.1	0.6	30	13.1	
8:45	20	10	22.6	0.5	30	13.6	Average 0.53 gpm
8:46	21	1	23.22	0.62	40	14.22	Attempt 40 psi. Oscillating + - 5 psi
8:47	22	2	23.8	0.58	40	14.8	
8:48	23	3	24.4	0.6	40	15.4	
8:49	24	4	25	0.6	40	16	
8:50	25	5	25.6	0.6	40	16.6	
8:51	26	6	26.3	0.7	40	17.3	
8:52	27	7	26.9	0.6	40	17.9	
8:53	28	8	27.5	0.6	40	18.5	
8:54	29	9	28.1	0.6	42	19.1	
8:55	30	10	28.8	0.7	44	19.8	Average 0.62 gpm
8:56	31	1	29.7	0.9	50-55	20.7	Attempt 50 psi. Oscillating + - 5 psi
8:57	32	2	30.6	0.9	50-55	21.6	
8:58	33	3	31.5	0.9	50-55	22.5	
8:59	34	4	32.4	0.9	50-55	23.4	
9:00	35	5	33.3	0.9	50-55	24.3	
9:01	36	6	34.3	1	50-55	25.3	
9:02	37	7	35.2	0.9	50-55	26.2	
9:03	38	8	36.2	1	50-55	27.2	
9:04	39	9	37	0.8	50-55	28	
9:05	40	10	37.9	0.9	50-55	28.9	Average 0.91 gpm
9:06	41	1	39.1	1.2	60	30.1	Attempt 60 psi. Oscillating + - 8 psi
9:07	42	2	40.3	1.2	65	31.3	
9:08	43	3	41.5	1.2	65	32.5	
9:09	44	4	42.8	1.3	65	33.8	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
9:10	45	5	44	1.2	65	35	
9:11	46	6	45.3	1.3	65	36.3	
9:12	47	7	46.6	1.3	65	37.6	
9:13	48	8	47.8	1.2	65	38.8	
9:14	49	9	49	1.2	65	40	
9:15	50	10	50.2	1.2	65	41.2	Average 1.23 gpm
9:16	51	1	51.8	1.6	75	42.8	Attempt 70 psi Oscillating + - 10 to 12 psi
9:17	52	2	53.4	1.6	75	44.4	
9:18	53	3	55	1.6	75	46	
9:19	54	4	56.5	1.5	75	47.5	
9:20	55	5	58	1.5	75	49	
9:21	56	6	59.6	1.6	75	50.6	
9:22	57	7	61	1.4	75	52	
9:23	58	8	62.5	1.5	75	53.5	
9:24	59	9	64.1	1.6	75	55.1	
9:25	60	10	66	1.9	75	57	Average 1.58 gpm
9:26	61	1	68.4	2.4	85	59.4	Attempt 80 psi Oscillating + - 10 to 20 psi
9:27	62	2	70.7	2.3	85	61.7	
9:28	63	3	73	2.3	85	64	
9:29	64	4	75.5	2.5	85	66.5	
9:30	65	5	78	2.5	85	69	
9:31	66	6	80.3	2.3	85	71.3	
9:32	67	7	82.7	2.4	85	73.7	
9:33	68	8	85	2.3	85	76	
9:34	69	9	87.4	2.4	85	78.4	
9:35	70	10	89.8	2.4	85	80.8	Average 2.38 gpm
9:36	71	1	93.32	3.52	90	84.32	Attempt 90 psi Oscillating + - 20 to 30 psi
9:37	72	2	96.8	3.48	90	87.8	
9:38	73	3	100	3.2	90	91	
9:39	74	4	103.5	3.5	90	94.5	
9:40	75	5	107	3.5	90	98	
9:41	76	6	110.5	3.5	90	101.5	
9:42	77	7	114.2	3.7	90	105.2	
9:43	78	8	117.8	3.6	90	108.8	
9:44	79	9	121.4	3.6	90	112.4	
9:45	80	10	125.2	3.8	90	116.2	Average 3.54 gpm
9:46	81	1	130.4	5.2	100	121.4	Valve fully open readings on gauge 85 to 118
9:47	82	2	135.8	5.4	100	126.8	Test abandoned at 90 minutes due to excess
9:48	83	3	141	5.2	100	132	fluctuation in pressure gauge.
9:49	84	4	146.3	5.3	100	137.3	
9:50	85	5	151.5	5.2	100	142.5	
9:51	86	6	156.8	5.3	100	147.8	
9:52	87	7	162	5.2	100	153	
9:53	88	8	167.3	5.3	100	158.3	
9:54	89	9	172.5	5.2	100	163.5	
9:55	90	10	177.8	5.3	100	168.8	Average 5.26 gpm

Second attempt on 7-26-2011 with centrifugal pump

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
7:44	0		180				
7:45	1	1	181.6	3.8	20	1.6	
7:46	2	2	183.1	1.5	20	3.1	
7:47	3	3	184.7	1.6	20	4.7	
7:48	4	4	186.4	1.7	20	6.4	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
7:49	5	5	188	1.6	20	8	
7:50	6	6	189.7	1.7	20	9.7	
7:51	7	7	191.2	1.5	20	11.2	
7:52	8	8	192.8	1.6	20	12.8	
7:53	9	9	194.5	1.7	20	14.5	
7:54	10	10	196	1.5	20	16	Average 1.6 gpm
7:55	11	1	197.7	1.7	30	17.7	
7:56	12	2	199.5	1.8	30	19.5	
7:57	13	3	201.3	1.8	30	21.3	
7:58	14	4	203	1.7	30	23	
7:59	15	5	204.6	1.6	30	24.6	
8:00	16	6	206.4	1.8	30	26.4	
8:01	17	7	208	1.6	30	28	
8:02	18	8	209.7	1.7	30	29.7	
8:03	19	9	211.5	1.8	30	31.5	
8:04	20	10	213.2	1.7	30	33.2	Average 1.72 gpm
8:05	21	1	215.2	2	40	35.2	
8:06	22	2	217.3	2.1	40	37.3	
8:07	23	3	219.2	1.9	40	39.2	
8:08	24	4	221	1.8	40	41	
8:09	25	5	223	2	40	43	
8:10	26	6	225.1	2.1	40	45.1	
8:11	27	7	227.2	2.1	40	47.2	
8:12	28	8	229.3	2.1	40	49.3	
8:13	29	9	231.1	1.8	40	51.1	
8:14	30	10	233.1	2	40	53.1	Average 1.99 gpm
8:15	31	1	235.5	2.4	50 - 60	55.5	Gauge reading from 45 to 65 psi
8:16	32	2	237.9	2.4	50 - 60	57.9	
8:17	33	3	240	2.1	50 - 60	60	
8:18	34	4	242.4	2.4	50 - 60	62.4	
8:19	35	5	244.9	2.5	50 - 60	64.9	
8:20	36	6	247.2	2.3	50 - 60	67.2	
8:21	37	7	249.6	2.4	50 - 60	69.6	
8:22	38	8	252	2.4	50 - 60	72	
8:23	39	9	254.5	2.5	50 - 60	74.5	
8:24	40	10	256.9	2.4	50 - 60	76.9	Average 2.38 gpm
8:25	41	1	260	3.1	65 - 75	80	Gauge reading from 60 to 80 psi
8:26	42	2	263.1	3.1	65 - 75	83.1	
8:27	43	3	266.3	3.2	65 - 75	86.3	
8:28	44	4	269.3	3.1	65 - 75	89.3	
8:29	45	5	272.3	3	65 - 75	92.3	
8:30	46	6	275.4	3.1	65 - 75	95.4	
8:31	47	7	278.4	3	65 - 75	98.4	
8:32	48	8	281.5	3.1	65 - 75	101.5	
8:33	49	9	284.7	3.2	65 - 75	104.7	
8:34	50	10	287.8	3.1	65 - 75	107.8	Average 3.09 gpm
8:35	51	1	292	4.2	80 - 100	112	Gauge reading from 65 to 115
8:36	52	2	296.1	4.1	80 - 100	116.1	Test abandoned at 60 minutes due to excess
8:37	53	3	300	3.9	80 - 100	120	fluctuation in pressure gauge
8:38	54	4	304.2	4.2	80 - 100	124.2	
8:39	55	5	308.5	4.3	80 - 100	128.5	
8:40	56	6	312.9	4.4	80 - 100	132.9	
8:41	57	7	317.2	4.3	80 - 100	137.2	
8:42	58	8	321.5	4.3	80 - 100	141.5	
8:43	59	9	325.8	4.3	80 - 100	145.8	
8:44	60	10	330	4.2	80 - 100	150	Average 4.22 gpm

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
Third attempt on 7-27-2011 with screw pump							
Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
11:20	0	0	350		40	0	
11:21	1	1	356.2	6.2	40	6.2	
11:22	2	2	362.73	6.53	40	12.73	
11:23	3	3	369.3	6.57	40	19.3	
11:24	4	4	375.8	6.5	40	25.8	
11:25	5	5	382.3	6.5	40	32.3	
11:26	6	6	388.6	6.3	40	38.6	
11:27	7	7	395.1	6.5	40	45.1	
11:28	8	8	401.6	6.5	40	51.6	
11:29	9	9	408	6.4	40	58	
11:30	10	10	414.3	6.3	41	64.3	6.43 average gpm
11:31	11	1	421.1	6.8	50	71.1	Gauge oscillating + - 3 psi
11:32	12	2	427.9	6.8	50	77.9	
11:33	13	3	434.8	6.9	51	84.8	
11:34	14	4	441.7	6.9	51	91.7	
11:35	15	5	448.6	6.9	52	98.6	
11:36	16	6	455.4	6.8	50	105.4	
11:37	17	7	462.2	6.8	52	112.2	
11:38	18	8	469	6.8	51	119	
11:39	19	9	475.8	6.8	50	125.8	
11:40	20	10	482.5	6.7	52	132.5	6.82 average gpm
11:41	21	1	489.9	7.4	60	139.9	Gauge oscillating + - 3 psi
11:42	22	2	497.2	7.3	61	147.2	
11:43	23	3	504.4	7.2	61	154.4	
11:44	24	4	511.8	7.4	62	161.8	
11:45	25	5	519.2	7.4	62	169.2	
11:46	26	6	526.4	7.2	61	176.4	
11:47	27	7	533.7	7.3	60	183.7	
11:48	28	8	541	7.3	60	191	
11:49	29	9	548.3	7.3	60	198.3	
11:50	30	10	555.7	7.4	61	205.7	7.32 average gpm
11:51	31	1	563.6	7.9	70	213.6	Gauge oscillating + - 3 psi
11:52	32	2	571.4	7.8	71	221.4	
11:53	33	3	579.1	7.7	70	229.1	
11:54	34	4	587	7.9	70	237	
11:55	35	5	594.9	7.9	71	244.9	
11:56	36	6	602.9	8	72	252.9	
11:57	37	7	610.7	7.8	72	260.7	
11:58	38	8	618.5	7.8	70	268.5	
11:59	39	9	626.3	7.8	70	276.3	
12:00	40	10	634	7.7	72	284	7.83 average gpm
12:01	41	1	642	8	81	292	Gauge oscillating + - 3 psi
12:02	42	2	650.1	8.1	81	300.1	
12:03	43	3	658.2	8.1	80	308.2	
12:04	44	4	666	7.8	80	316	
12:05	45	5	674	8	80	324	
12:06	46	6	682.2	8.2	80	332.2	
12:07	47	7	690.3	8.1	81	340.3	
12:08	48	8	698.2	7.9	82	348.2	
12:09	49	9	706.1	7.9	80	356.1	
12:10	50	10	714.2	8.1	81	364.2	8.02 average gpm

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
12:11	51	1	722.4	8.2	90	372.4	Gauge oscillating + - 4 psi
12:12	52	2	730.5	8.1	92	380.5	
12:13	53	3	738.5	8	94	388.5	
12:14	54	4	746.8	8.3	95	396.8	
12:15	55	5	755	8.2	92	405	
12:16	56	6	763.1	8.1	92	413.1	
12:17	57	7	771.3	8.2	91	421.3	
12:18	58	8	779.3	8	92	429.3	
12:19	59	9	787.5	8.2	93	437.5	
12:20	60	10	795.8	8.3	91	445.8	8.16 average gpm
12:21	61	1	803.7	7.9	100	453.7	Gauge oscillating + - 5 psi
12:22	62	2	811.4	7.7	101	461.4	
12:23	63	3	819.2	7.8	102	469.2	
12:24	64	4	827	7.8	101	477	
12:25	65	5	834.9	7.9	103	484.9	
12:26	66	6	842.8	7.9	104	492.8	
12:27	67	7	850.9	8.1	102	500.9	
12:28	68	8	858.6	7.7	104	508.6	
12:29	69	9	866.5	7.9	102	516.5	
12:30	70	10	874.3	7.8	101	524.3	7.85 average gpm
12:31	71	1	881.9	7.6	110	531.9	Gauge oscillating + - 5 psi
12:32	72	2	889.3	7.4	112	539.3	
12:33	73	3	896.9	7.6	114	546.9	
12:34	74	4	904.7	7.8	112	554.7	
12:35	75	5	912.3	7.6	115	562.3	
12:36	76	6	919.9	7.6	112	569.9	
12:37	77	7	927.6	7.7	112	577.6	
12:38	78	8	935	7.4	112	585	
12:39	79	9	942.7	7.7	113	592.7	
12:40	80	10	950.4	7.7	114	600.4	7.61 average gpm
12:41	81	1	958.3	7.9	115	608.3	Gauge oscillating + - 5 psi
12:42	82	2	966	7.7	116	616	
12:43	83	3	973.9	7.9	115	623.9	
12:44	84	4	981.8	7.9	116	631.8	
12:45	85	5	989.6	7.8	117	639.6	
12:46	86	6	997.7	8.1	115	647.7	
12:47	87	7	1005.4	7.7	115	655.4	
12:48	88	8	1013.1	7.7	117	663.1	
12:49	89	9	1021	7.9	115	671	
12:50	90	10	1028.9	7.9	116	678.9	7.85 average gpm
12:51	91	1	1035.6	6.7	101	685.6	Gauge oscillating + - 5 psi
12:52	92	2	1042.4	6.8	100	692.4	
12:53	93	3	1049	6.6	102	699	
12:54	94	4	1055.8	6.8	101	705.8	
12:55	95	5	1062.6	6.8	100	712.6	
12:56	96	6	1069.4	6.8	102	719.4	
12:57	97	7	1076.2	6.8	100	726.2	
12:58	98	8	1083	6.8	101	733	
12:59	99	9	1089.7	6.7	102	739.7	
13:00	100	10	1096.3	6.6	100	746.3	6.74 average gpm
13:01	101	1	1102.9	6.6	90	752.9	Gauge oscillating + - 4 psi
13:02	102	2	1109.5	6.6	89	759.5	
13:03	103	3	1116	6.5	90	766	
13:04	104	4	1122.6	6.6	89	772.6	
13:05	105	5	1129	6.4	90	779	
13:06	106	6	1135.5	6.5	91	785.5	
13:07	107	7	1142	6.5	90	792	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
13:08	108	8	1148.6	6.6	92	798.6	
13:09	109	9	1155.2	6.6	91	805.2	
13:10	110	10	1161.9	6.7	91	811.9	6.56 average gpm
13:11	111	1	1169	7.1	80	819	Gauge oscillating + - 4 psi
13:12	112	2	1176.2	7.2	79	826.2	
13:13	113	3	1183.4	7.2	80	833.4	
13:14	114	4	1190.5	7.1	81	840.5	
13:15	115	5	1197.8	7.3	81	847.8	
13:16	116	6	1205	7.2	80	855	
13:17	117	7	1212.3	7.3	78	862.3	
13:18	118	8	1219.6	7.3	80	869.6	
13:19	119	9	1226.7	7.1	79	876.7	
13:20	120	10	1233.9	7.2	81	883.9	7.2 average gpm
13:21	121	1	1240.9	7	68	890.9	Gauge oscillating + - 3 psi
13:22	122	2	1247.8	6.9	69	897.8	
13:23	123	3	1254.6	6.8	70	904.6	
13:24	124	4	1261.3	6.7	71	911.3	
13:25	125	5	1268	6.7	70	918	
13:26	126	6	1274.9	6.9	71	924.9	
13:27	127	7	1281.9	7	70	931.9	
13:28	128	8	1288.7	6.8	70	938.7	
13:29	129	9	1295.5	6.8	71	945.5	
13:30	130	10	1302.2	6.7	72	952.2	6.86 average gpm
13:31	131	1	1308.9	6.7	60	958.9	Gauge oscillating + - 3 psi
13:32	132	2	1315.5	6.6	60	965.5	
13:33	133	3	1322	6.5	59	972	
13:34	134	4	1328.5	6.5	60	978.5	
13:35	135	5	1335.1	6.6	60	985.1	
13:36	136	6	1341.6	6.5	60	991.6	
13:37	137	7	1348	6.4	59	998	
13:38	138	8	1354.7	6.7	61	1004.7	
13:39	139	9	1361.2	6.5	60	1011.2	
13:40	140	10	1367.8	6.6	60	1017.8	6.56 average gpm
13:41	141	1	1374.2	6.4	50	1024.2	
13:42	142	2	1380.9	6.7	50	1030.9	
13:43	143	3	1387	6.1	50	1037	
13:44	144	4	1393.2	6.2	50	1043.2	
13:45	145	5	1399.6	6.4	51	1049.6	
13:46	146	6	1406	6.4	50	1056	
13:47	147	7	1412	6	50	1062	
13:48	148	8	1418.5	6.5	51	1068.5	
13:49	149	9	1424.9	6.4	52	1074.9	
13:50	150	10	1431.4	6.5	51	1081.4	6.36 average gpm
13:51	151	1	1438	6.6	40	1088	
13:52	152	2	1444.5	6.5	40	1094.5	
13:53	153	3	1451	6.5	40	1101	
13:54	154	4	1457.7	6.7	39	1107.7	
13:55	155	5	1464.2	6.5	40	1114.2	
13:56	156	6	1470.8	6.6	40	1120.8	
13:57	157	7	1477.3	6.5	41	1127.3	
13:58	158	8	1483.9	6.6	41	1133.9	
13:59	159	9	1490.4	6.5	40	1140.4	
14:00	160	10	1497	6.6	40	1147	6.56 average gpm

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Date 7/30/2011
Client New Mexico Copper Corp
Project Copper Flat
Well Name GWQ 11-24 Zone 2
Hydrologist JJK

Starting Water Level (ft bgl) 53.5
Elevation (ft GL)
Injection Interval (ft bgl) 150 to 197
Bore/Casing Depth (ft bgl) 197

Packer Dia 2 inch
Bore/Casing Dia 3-3/4 inch
Injection Pipe Dia 1 inch
Pressure gauge height above GL 1 ft

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
11:00	0		70				New meter
11:01	1	1	76.2	6.2	20	6.2	
11:02	2	2	82.3	6.1	20	12.3	
11:03	3	3	88.5	6.2	20	18.5	
11:04	4	4	94.7	6.2	20	24.7	
11:05	5	5	100.8	6.1	20	30.8	
11:06	6	6	107.2	6.4	20	37.2	
11:07	7	7	113.4	6.2	20	43.4	
11:08	8	8	119.6	6.2	20	49.6	
11:09	9	9	126	6.4	20	56	
11:10	10	10	132.5	6.5	20	62.5	6.25 gpm average for 20 psi
11:11	11	1	139	6.5	30	69	Up to approximately 30 psi
11:12	12	2	145.5	6.5	30	75.5	
11:13	13	3	152.1	6.6	30	82.1	
11:14	14	4	158.4	6.3	30	88.4	
11:15	15	5	164.9	6.5	30	94.9	
11:16	16	6	171.2	6.3	30	101.2	
11:17	17	7	177.7	6.5	30	107.7	
11:18	18	8	184	6.3	30	114	
11:19	19	9	190.5	6.5	32	120.5	
11:20	20	10	197.3	6.8	30	127.3	6.48 gpm average for 30 psi
11:21	21	1	204	6.70	40	134	Up to approximately 40 psi
11:22	22	2	210.6	6.60	40	140.6	
11:23	23	3	217.3	6.70	41	147.3	
11:24	24	4	224	6.70	40	154	
11:25	25	5	230.4	6.40	40	160.4	
11:26	26	6	237.1	6.70	41	167.1	
11:27	27	7	243.9	6.80	42	173.9	
11:28	28	8	250.6	6.70	41	180.6	
11:29	29	9	257.4	6.80	40	187.4	
11:30	30	10	264.3	6.90	40	194.3	6.70 gpm average for 40 psi
11:31	31	1	271.2	6.9	55	201.2	Up to approximately 55 psi
11:32	32	2	278.1	6.9	55	208.1	
11:33	33	3	285.0	6.9	55	215	
11:34	34	4	291.8	6.8	55	221.8	
11:35	35	5	298.5	6.7	56	228.5	
11:36	36	6	305.4	6.9	55	235.4	
11:37	37	7	312.4	7	56	242.4	
11:38	38	8	319.3	6.9	59	249.3	
11:39	39	9	326	6.7	59	256	
11:40	40	10	332.9	6.9	58	262.9	6.86 gpm average for 55 psi
11:41	41	1	340.4	7.5	70	270.4	Up to approximately 75 psi
11:42	42	2	348.5	8.1	75	278.5	
11:43	43	3	356.7	8.2	76	286.7	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
11:44	44	4	364.6	7.9	76	294.6	
11:45	45	5	372.8	8.2	76	302.8	
11:46	46	6	380.7	7.9	76	310.7	
11:47	47	7	388.9	8.2	76	318.9	
11:48	48	8	397	8.1	77	327	
11:49	49	9	405	8	77	335	
11:50	50	10	413.2	8.2	77	343.2	8.03 gpm average for 75 psi
11:51	51	1	421.5	8.3	90	351.5	Up to approximately 95 psi
11:52	52	2	429.8	8.3	90	359.8	
11:53	53	3	438	8.2	91	368	
11:54	54	4	446.1	8.1	93	376.1	
11:55	55	5	454.3	8.2	94	384.3	
11:56	56	6	462.6	8.3	95	392.6	
11:57	57	7	470.6	8	95	400.6	
11:58	58	8	478.8	8.2	96	408.8	
11:59	59	9	486.9	8.1	95	416.9	
12:00	60	10	495.2	8.3	94	425.2	8.2 gpm average for 95 psi
12:01	61	1	503.4	8.2	115	433.4	Up to approximately 120 psi
12:02	62	2	511.7	8.3	118	441.7	
12:03	63	3	520	8.3	120	450	
12:04	64	4	528.3	8.3	120	458.3	
12:05	65	5	536.7	8.4	120	466.7	
12:06	66	6	545	8.3	120	475	
12:07	67	7	553.2	8.2	120	483.2	
12:08	68	8	561.5	8.3	120	491.5	
12:09	69	9	569.5	8	120	499.5	
12:10	70	10	577.6	8.1	120	507.6	8.24 gpm average for 120 psi
12:11	71	1	585.8	8.2	120 to 123	515.8	Valve fully open.
12:12	72	2	594	8.2	120 to 123	524	
12:13	73	3	602.2	8.2	120 to 124	532.2	
12:14	74	4	610.4	8.2	120 to 122	540.4	
12:15	75	5	618.7	8.3	119 to 121	548.7	
12:16	76	6	626.8	8.1	119	556.8	
12:17	77	7	635	8.2	118	565	
12:18	78	8	643.2	8.2	118	573.2	
12:19	79	9	651.5	8.3	119	581.5	
12:20	80	10	659.6	8.1	120	589.6	8.2 gpm average for 120 psi
12:21	81	1	666.3	6.7	105	596.3	Down to approximately 100 psi
12:22	82	2	673.1	6.8	100 to 105	603.1	
12:23	83	3	679.8	6.7	100 to 105	609.8	
12:24	84	4	686.4	6.6	100 to 105	616.4	
12:25	85	5	693.2	6.8	100 to 105	623.2	
12:26	86	6	700	6.8	100 to 105	630	
12:27	87	7	706.7	6.7	100 to 105	636.7	
12:28	88	8	713.5	6.8	100 to 105	643.5	
12:29	89	9	720.1	6.6	100 to 105	650.1	
12:30	90	10	726.8	6.7	100 to 105	656.8	6.72 gpm average for 100 psi
12:31	91	1	734	7.2	80	664	Down to approximately 80 psi
12:32	92	2	741.2	7.2	80	671.2	
12:33	93	3	748.3	7.1	75 to 80	678.3	
12:34	94	4	755.6	7.3	75 to 80	685.6	
12:35	95	5	762.9	7.3	75 to 80	692.9	
12:36	96	6	770.1	7.2	75 to 80	700.1	
12:37	97	7	777.4	7.3	75 to 80	707.4	
12:38	98	8	784.6	7.2	75 to 80	714.6	
12:39	99	9	791.7	7.1	75 to 80	721.7	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
12:40	100	10	798.9	7.2	75 to 80	728.9	7.21 gpm average for 80 psi
12:41	101	1	805.5	6.6	60	735.5	Down to approximately 60 psi
12:42	102	2	812.1	6.6	55 to 60	742.1	
12:43	103	3	818.9	6.8	55 to 60	748.9	
12:44	104	4	825.3	6.4	55 to 60	755.3	
12:45	105	5	831.9	6.6	55 to 60	761.9	
12:46	106	6	838.4	6.5	55 to 60	768.4	
12:47	107	7	845	6.6	55 to 60	775	
12:48	108	8	851.5	6.5	55 to 60	781.5	
12:49	109	9	858.2	6.7	55 to 60	788.2	
12:50	110	10	864.6	6.4	55 to 60	794.6	6.57 gpm average for 60 psi
12:51	111	1	871	6.4	40	801	Down to approximately 40 psi
12:52	112	2	877.3	6.3	40	807.3	
12:53	113	3	883.6	6.3	40	813.6	
12:54	114	4	890	6.4	40	820	
12:55	115	5	896.3	6.3	40	826.3	
12:56	116	6	902.3	6	40	832.3	
12:57	117	7	908.5	6.2	40	838.5	
12:58	118	8	914.8	6.3	40	844.8	
12:59	119	9	921.1	6.3	40	851.1	
13:00	120	10	927.5	6.4	40	857.5	6.29 gpm average for 40 psi
13:01	121	1	933.92	6.42	30	863.92	Down to approximately 30 psi
13:02	122	2	940.4	6.48	30	870.4	
13:03	123	3	946.8	6.4	30	876.8	
13:04	124	4	953.2	6.4	31	883.2	
13:05	125	5	959.6	6.4	30	889.6	
13:06	126	6	966	6.4	30	896	
13:07	127	7	972.5	6.5	31	902.5	
13:08	128	8	979	6.5	30	909	
13:09	129	9	985.4	6.4	30	915.4	
13:10	130	10	991.9	6.5	30	921.9	6.44 gpm average for 30 psi
13:11	131	1	998.3	6.4	20	928.3	Down to approximately 20 psi
13:12	132	2	1004.6	6.3	20	934.6	
13:13	133	3	1010.9	6.3	20	940.9	
13:14	134	4	1017.3	6.4	21	947.3	
13:15	135	5	1023.5	6.2	22	953.5	
13:16	136	6	1029.8	6.3	20	959.8	
13:17	137	7	1036.1	6.3	20	966.1	
13:18	138	8	1042.3	6.2	20	972.3	
13:19	139	9	1048.5	6.2	20	978.5	
13:20	140	10	1054.8	6.3	20	984.8	6.29 gpm average for 20 psi

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	
3.00	20.0	6.82	90.0					Set pressure. Wait 1 minute
3.49	30.0	6.80	80.0					average over 2 minutes. Repeat
3.90	40.0	6.20	70.0					
4.59	50.0	5.59	60.0					
5.10	60.0	5.19	50.0					
5.80	70.0	4.68	40.0					
6.30	80.0	4.30	30.0					
6.80	90.0	3.70	20.0					
7.98	100.0							

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Date	8/1/2011
Client	New Mexico Copper Corp
Project	Copper Flat
Well Name	GWQ 11-24 Zone 3
Hydrologist	JJK

Starting Water Level (ft bgl)	51.42	**Packer Dia**	2 inch
Elevation (ft GL)		**Bore/Casing Dia**	3-3/4 inch
Injection Interval (ft bgl)	204 to 251	**Injection Pipe Dia**	1 inch
Bore/Casing Depth (ft bgl)	251	**Pressure gauge height above GL**	1 ft

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
11:50	0		2910		20	0	
11:51	1	1	2911	1.00	20	1	
11:52	2	2	2912.1	1.10	20	2.1	
11:53	3	3	2913	0.90	20	3	
11:54	4	4	2913.3	0.30	20	3.3	
11:55	5	5	2913.5	0.20	20	3.5	
11:56	6	6	2913.8	0.30	20	3.8	
11:57	7	7	2914.1	0.30	20	4.1	
11:58	8	8	2914.4	0.30	20	4.4	
11:59	9	9	2914.7	0.30	21	4.7	
12:00	10	10	2914.9	0.20	20	4.9	0.49 gpm average for 20 psi
12:01	11	1	2915.4	0.5	30	5.4	Up to approximately 30 psi
12:02	12	2	2915.9	0.5	31	5.9	
12:03	13	3	2916.4	0.5	30	6.4	
12:04	14	4	2917.1	0.7	31	7.1	
12:05	15	5	2917.6	0.5	31	7.6	
12:06	16	6	2918.1	0.5	31	8.1	
12:07	17	7	2918.7	0.6	31	8.7	
12:08	18	8	2919.2	0.5	30	9.2	
12:09	19	9	2919.6	0.4	31	9.6	
12:10	20	10	2920.1	0.5	30	10.1	0.52 gpm average for 30 psi
12:11	21	1	2920.8	0.7	38	10.8	Up to approximately 40 psi
12:12	22	2	2921.4	0.6	40	11.4	
12:13	23	3	2921.9	0.5	40	11.9	
12:14	24	4	2922.3	0.4	40	12.3	
12:15	25	5	2922.8	0.5	39	12.8	
12:16	26	6	2923.3	0.5	41	13.3	
12:17	27	7	2923.8	0.5	40	13.8	
12:18	28	8	2924.4	0.6	43	14.4	
12:19	29	9	2924.9	0.5	41	14.9	
12:20	30	10	2925.5	0.6	42	15.5	0.54 gpm average for 40 psi
12:21	31	1	2926.3	0.8	50	16.3	Up to approximately 50 psi
12:22	32	2	2927.2	0.9	51	17.2	
12:23	33	3	2928	0.8	52	18	
12:24	34	4	2928.6	0.6	50	18.6	
12:25	35	5	2929.2	0.6	50	19.2	
12:26	36	6	2929.8	0.6	50	19.8	
12:27	37	7	2930.4	0.6	50	20.4	
12:28	38	8	2931	0.6	50	21	
12:29	39	9	2931.5	0.5	51	21.5	
12:30	40	10	2932.1	0.6	50	22.1	0.66 gpm average for 50 psi
12:31	41	1	2932.6	0.5	59	22.6	
12:32	42	2	2933.4	0.8	60	23.4	
12:33	43	3	2934	0.6	60	24	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
12:34	44	4	2934.8	0.8	60 to 25	24.8	psi drops to 25
12:35	45	5	2935.5	0.7	25 to 60	25.5	adjust valves to maintain 60 psi
12:36	46	6	2940	4.5	60	30	
12:37	47	7	2943.5	3.5	50 to 60	33.5	adjust valves to maintain 60 psi
12:38	48	8	2947.2	3.7	50 to 60	37.2	adjust valves to maintain 60 psi
12:39	49	9	2952	4.8	60	42	
12:40	50	10	2956.5	4.5	59	46.5	2.44 gpm average for 60 psi
12:41	51	1	2961.5	5	70	51.5	
12:42	52	2	2968.8	7.3	71	58.8	
12:43	53	3	2971	2.2	72	61	
12:44	54	4	2973.9	2.9	70 to 60	63.9	psi drops to 60
12:45	55	5	2981.5	7.6	60 to 70	71.5	adjust valves to maintain 70 psi
12:46	56	6	2987	5.5	70	77	
12:47	57	7	2992.5	5.5	72	82.5	
12:48	58	8	2998	5.5	72	88	
12:49	59	9	3003.5	5.5	70	93.5	
12:50	60	10	3008.7	5.2	71	98.7	5.22 gpm average for 70 psi
12:51	61	1	3015	6.3	81	105	
12:52	62	2	3020.5	5.5	82	110.5	
12:53	63	3	3026	5.5	82	116	
12:54	64	4	3032	6	81	122	
12:55	65	5	3037.5	5.5	82	127.5	
12:56	66	6	3042.9	5.4	82	132.9	
12:57	67	7	3048.8	5.9	80	138.8	
12:58	68	8	3054	5.2	79	144	
12:59	69	9	3059.5	5.5	79	149.5	
13:00	70	10	3065	5.5	79	155	5.63 gpm average for 80 psi
13:01	71	1	3071	6	92	161	Gauge is oscillating + or - 3 psi
13:02	72	2	3077.5	6.5	90	167.5	
13:03	73	3	3083.6	6.1	92	173.6	
13:04	74	4	3090	6.4	92	180	
13:05	75	5	3095.9	5.9	92	185.9	
13:06	76	6	3102	6.1	90	192	
13:07	77	7	3108.7	6.7	90	198.7	
13:08	78	8	3113.8	5.1	90	203.8	
13:09	79	9	3119.9	6.1	90	209.9	
13:10	80	10	3125.6	5.7	91	215.6	6.06 gpm average for 90 psi
13:11	81	1	3132	6.4	100	222	Gauge is oscillating + or - 5 psi
13:12	82	2	3138.5	6.5	100	228.5	
13:13	83	3	3145	6.5	100	235	
13:14	84	4	3151.4	6.4	100	241.4	
13:15	85	5	3157.5	6.1	100	247.5	
13:16	86	6	3163.7	6.2	100	253.7	
13:17	87	7	3170.3	6.6	100	260.3	
13:18	88	8	3176.3	6	100	266.3	
13:19	89	9	3182.8	6.5	100	272.8	
13:20	90	10	3189.2	6.4	100	279.2	6.36 gpm average for 100 psi
13:21	91	1	3195	5.8	91	285	Gauge is oscillating + or - 3 psi
13:22	92	2	3201	6	90	291	
13:23	93	3	3206.6	5.6	90	296.6	
13:24	94	4	3212.5	5.9	91	302.5	
13:25	95	5	3218.5	6	89	308.5	
13:26	96	6	3224	5.5	90	314	
13:27	97	7	3229.8	5.8	91	319.8	
13:28	98	8	3235.5	5.7	91	325.5	
13:29	99	9	3241.4	5.9	91	331.4	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
13:30	100	10	3247.5	6.1	90	337.5	5.83 gpm average for 90 psi
13:31	101	1	3252.5	5	80	342.5	psi down to 80
13:32	102	2	3257.8	5.3	80	347.8	
13:33	103	3	3263	5.2	80	353	
13:34	104	4	3268.5	5.5	81	358.5	
13:35	105	5	3273.8	5.3	80	363.8	
13:36	106	6	3279.4	5.6	80	369.4	
13:37	107	7	3284.5	5.1	79	374.5	
13:38	108	8	3290	5.5	79	380	
13:39	109	9	3295.1	5.1	80	385.1	
13:40	110	10	3301	5.9	79	391	5.35 gpm average for 80 psi
13:41	111	1	3305.5	4.5	70	395.5	psi down to 70
13:42	112	2	3310.9	5.4	70	400.9	
13:43	113	3	3315.7	4.8	71	405.7	
13:44	114	4	3321	5.3	70	411	
13:45	115	5	3325.7	4.7	69	415.7	
13:46	116	6	3331	5.3	69	421	
13:47	117	7	3335.7	4.7	70	425.7	
13:48	118	8	3340.9	5.2	70	430.9	
13:49	119	9	3345.7	4.8	70	435.7	
13:50	120	10	3351	5.3	70	441	5.0 gpm average for 70 psi
13:51	121	1	3355.5	4.5	60	445.5	psi down to 60
13:52	122	2	3360.2	4.7	58	450.2	
13:53	123	3	3364.9	4.7	60	454.9	
13:54	124	4	3369.7	4.8	60	459.7	
13:55	125	5	3374.4	4.7	60	464.4	
13:56	126	6	3379.2	4.8	60	469.2	
13:57	127	7	3383.9	4.7	61	473.9	
13:58	128	8	3389	5.1	60	479	
13:59	129	9	3393.5	4.5	60	483.5	
14:00	130	10	3398.2	4.7	60	488.2	4.72 gpm average for 60 psi
14:01	131	1	3402.6	4.4	51 to 52	492.6	psi to 50
14:02	132	2	3407.5	4.9	52 to 50	497.5	
14:03	133	3	missed		52 to 50		
14:04	134	4	3416	4.25	50	506	
14:05	135	5	3420.7	4.7	50	510.7	
14:06	136	6	3425	4.3	50	515	
14:07	137	7	3429.4	4.4	48 to 50	519.4	
14:08	138	8	3433.7	4.3	51	523.7	
14:09	139	9	3438.2	4.5	50	528.2	
14:10	140	10	3442.5	4.3	50	532.5	4.43 gpm average for 50 psi
14:11	141	1	3447	4.5	40	537	psi to 40
14:12	142	2	3451.1	4.1	40	541.1	
14:13	143	3	3454.8	3.7	40	544.8	
14:14	144	4	3459	4.2	40	549	
14:15	145	5	3463	4	40	553	
14:16	146	6	3467.1	4.1	40	557.1	
14:17	147	7	3471.3	4.2	41	561.3	
14:18	148	8	3475.4	4.1	39	565.4	
14:19	149	9	3479.7	4.3	38	569.7	
14:20	150	10	3484	4.3	40	574	4.15 gpm average for 40 psi
14:21	151	1	3487.4	3.4	34	577.4	psi to 30
14:22	152	2	3491.2	3.8	30	581.2	
14:23	153	3	3494.8	3.6	30	584.8	
14:24	154	4	3498.7	3.9	29	588.7	
14:25	155	5	3502.3	3.6	30	592.3	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
14:26	156	6	3506	3.7	30	596	
14:27	157	7	3509.8	3.8	29	599.8	
14:28	158	8	3513.3	3.5	31	603.3	
14:29	159	9	3517	3.7	31	607	
14:30	160	10	3521	4	32	611	3.7 gpm average for 30 psi
14:31	161	1	3524.2	3.2	20	614.2	psi to 20
14:32	162	2	3527.6	3.4	20	617.6	
14:33	163	3	3531.1	3.5	21	621.1	
14:34	164	4	3534.3	3.2	21	624.3	
14:35	165	5	3538	3.7	20	628	
14:36	166	6	3541.4	3.4	20	631.4	
14:37	167	7	3544.6	3.2	20	634.6	
14:38	168	8	3548	3.4	20	638	
14:39	169	9	3551.4	3.4	20	641.4	
14:40	170	10	3554.5	3.1	21	644.5	3.35 gpm average for 20 psi

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	
3.14	20.0	3.14	20.0	3.80	30.0	5.78	90.0	Set pressure. Wait 1 minute
3.71	30.0	3.71	30.0	3.95	40.0	5.63	80.0	average over 2 minutes. Repeat
3.98	40.0	3.98	40.0	4.61	50.0	5.50	70.0	
4.46	50.0	4.46	50.0	4.99	60.0	4.99	60.0	
4.90	60.0	4.90	60.0	5.46	70.0	4.51	50.0	
5.31	70.0	5.31	70.0	5.62	80.0	4.15	40.0	
5.49	80.0	5.49	80.0	5.80	90.0	3.80	30.0	
5.94	90.0	5.94	90.0	6.31	100.0	3.33	20.0	
6.20	100.0	6.20	100.0					

same data as "increase" series

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Date 8/13/2011
Client New Mexico Copper Corp
Project Copper Flat
Well Name GWQ 11-25 Zone 1
Hydrologist JJK

Starting Water Level (ft bgl) 29.0 (not representative of Static)
Elevation (ft GL)
Injection Interval (ft bgl) 100 to 147.7
Bore/Casing Depth (ft bgl) 147.7

Packer Dia 2 inch
Bore/Casing Dia 3-3/4 inch
Injection Pipe Dia 1 inch
Pressure gauge height above GL 3 ft

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
15:00	0		4400		10	0	
15:01	1	1	4400	0.00	10	0	
15:02	2	2	4400	0.00	10	0	
15:03	3	3	4400	0.00	10	0	
15:04	4	4	4400	0.00	10	0	
15:05	5	5	4400	0.00	10	0	
15:06	6	6	4400	0.00	10	0	
15:07	7	7	4400	0.00	10	0	
15:08	8	8	4400	0.00	10	0	
15:09	9	9	4400	0.00	10	0	
15:10	10	10	4400	0.00	10	0	
15:11	11	1	4400	0.00	20	0	
15:12	12	2	4400	0.00	20	0	
15:13	13	3	4400	0.00	20	0	
15:14	14	4	4400	0.00	20	0	
15:15	15	5	4400	0.00	20	0	
15:16	16	6	4400	0.00	20	0	
15:17	17	7	4400	0.00	20	0	
15:18	18			0.00		0	Break out meter to verify operation of same
15:19	19			0.00		0	
15:20	20			0.00		0	Operating to spec
15:21	21	1	4410	0.00	30	0	
15:22	22	2	4410	0.00	30	0	
15:23	23	3	4410	0.00	30	0	
15:24	24	4	4410	0.00	30	0	
15:25	25	5	4410	0.00	30	0	
15:26	26	1	4410	0.00	40	0	
15:27	27	2	4410	0.00	40	0	
15:28	28	3	4410	0.00	40	0	
15:29	29	4	4410	0.00	40	0	
15:30	30	5	4410	0.00	40	0	
15:31	31	1	4410	0	50	0	
15:32	32	2	4410	0	50	0	
15:33	33	3	4410	0	50	0	
15:34	34	4	4410	0	50	0	
15:35	35	5	4410	0	50	0	
15:36	36	1	4410	0	60	0	
15:37	37	2	4410	0	60	0	
15:38	38	3	4410	0	60	0	
15:39	39	4	4410	0	60	0	
15:40	40	5	4410	0	60	0	
15:41	41	1	4410	0	70	0	
15:42	42	2	4410	0	70	0	
15:43	43	3	4410	0	70	0	
15:44	44	4	4410	0	70	0	
15:45	45	5	4410	0	70	0	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
15:46	46	1	4410	0	80	0	
15:47	47	2	4410	0	80	0	
15:48	48	3	4410	0	80	0	
15:49	49	4	4410	0	80	0	
15:50	50	5	4410	0	80	0	
15:51	51	1	4410	0	90	0	
15:52	52	2	4410	0	90	0	
15:53	53	3	4410	0	90	0	
15:54	54	4	4410	0	90	0	
15:55	55	5	4410	0	90	0	
15:56	56	1	4410	0	100	0	
15:57	57	2	4410	0	100	0	
15:58	58	3	4410	0	100	0	
15:59	59	4	4410	0	100	0	
16:00	60	5	4410	0	100	0	
16:01	61	1	4410	0	110	0	
16:02	62	2	4410	0	110	0	
16:03	63	3	4410	0	110	0	
16:04	64	4	4410	0	110	0	
16:05	65	5	4410	0	110	0	
16:06	66	6	4410	0.00	110	0	
16:07	67	7	4410	0.00	110	0	
16:08	68	8	4410	0.00	110	0	
16:09	69	9	4410	0.00	110	0	
16:10	70	10	4410	0.00	110	0	
16:11	71	1	4410	0	120	0	
16:12	72	2	4410	0	120	0	
16:13	73	3	4410	0	120	0	
16:14	74	4	4410	0	120	0	
16:15	75	5	4410	0	120	0	
16:16	76	6	4410	0	120	0	
16:17	77	7	4410	0	120	0	
16:18	78	8	4410	0	120	0	
16:19	79	9	4410	0	120	0	
16:20	80	10	4410	0	120	0	
16:21	81	1	4410	0	130	0	
16:22	82	2	4410	0	130	0	
16:23	83	3	4410	0	130	0	
16:24	84	4	4410	0	130	0	
16:25	85	5	4410	0	130	0	
16:26	86	6	4410	0	130	0	
16:27	87	7	4410	0	130	0	
16:28	88	8	4410	0	130	0	
16:29	89	9	4410	0	130	0	
16:30	90	10	4410	0	130	0	
16:31	91	1	4410	0	140	0	
16:32	92	2	4410	0	140	0	
16:33	93	3	4410	0	140	0	
16:34	94	4	4410	0	140	0	
16:35	95	5	4410	0	140	0	
16:36	96	6	4410	0	140	0	
16:37	97	7	4410	0	140	0	
16:38	98	8	4410	0	140	0	
16:39	99	9	4410	0	140	0	
16:40	100	10	4410	0	140	0	Lightning on site forces suspension of test
Resume test on 8-14-2011							
6:00	101	1	4420	0	0	0	Slow repeat of previous ramp up
6:01	102	2	4420	0	40	0	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
6:02	103	3	4420	0	40	0	
6:03	104	4	4420	0	40	0	
6:04	105	5	4420	0	40	0	
6:05	106	1	4420	0	50	0	
6:06	107	2	4420	0	50	0	
6:07	108	3	4420	0	50	0	
6:08	109	4	4420	0	50	0	
6:09	110	5	4420	0	50	0	
6:10	111	1	4420	0	60	0	
6:11	112	2	4420	0	60	0	
6:12	113	3	4420	0	60	0	
6:13	114	4	4420	0	60	0	
6:14	115	5	4420	0	60	0	
6:15	116	1	4420	0	70	0	
6:16	117	2	4420	0	70	0	
6:17	118	3	4420	0	70	0	
6:18	119	4	4420	0	70	0	
6:19	120	5	4420	0	70	0	
6:20	121	1	4420	0	80	0	
6:21	122	2	4420	0	80	0	
6:22	123	3	4420	0	80	0	
6:23	124	4	4420	0	80	0	
6:24	125	5	4420	0	80	0	
6:25	126	1	4420	0	90	0	
6:26	127	2	4420	0	90	0	
6:27	128	3	4420	0	90	0	
6:28	129	4	4420	0	90	0	
6:29	130	5	4420	0	90	0	
6:30	131	1	4420	0	100	0	
6:31	132	2	4420	0	100	0	
6:32	133	3	4420	0	100	0	
6:33	134	4	4420	0	100	0	
6:34	135	5	4420	0	100	0	
6:35	136	1	4420	0	110	0	
6:36	137	2	4420	0	110	0	
6:37	138	3	4420	0	110	0	
6:38	139	4	4420	0	110	0	
6:39	140	5	4420	0	110	0	
6:40	141	1	4420	0	120	0	
6:41	142	2	4420	0	120	0	
6:42	143	3	4420	0	120	0	
6:43	144	4	4420	0	120	0	
6:44	145	5	4420	0	120	0	
6:45	146	1	4420	0	130	0	
6:46	147	2	4420	0	130	0	
6:47	148	3	4420	0	130	0	
6:48	149	4	4420	0	130	0	
6:49	150	5	4420	0	130	0	
6:50	151	1	4420	0	140	0	
6:51	152	2	4420	0	140	0	
6:52	153	3	4420	0	140	0	
6:53	154	4	4420	0	140	0	
6:54	155	5	4420	0	140	0	
6:55	156	1	4420	0	150	0	
6:56	157	2	4420	0	150	0	
6:57	158	3	4420	0	146	0	First injection
6:58	159	4	4422.9	2.9	150	2.9	All 150 psi readings are approximate.
6:59	160	5	4425.9	3	150	5.9	Gauge oscillating from 140 to 158

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
7:00	161	6	4428.7	2.8	150	8.7	
7:01	162	7	4431.5	2.8	150	11.5	
7:02	163	8	4434.5	3	150	14.5	
7:03	164	9	4437.4	2.9	150	17.4	
7:04	165	10	4440.3	2.9	150	20.3	
7:05	166	11	4443.1	2.8	150	23.1	
7:06	167	12	4444	0.9	150	24	
7:07	168	13	4447.2	3.2	150	27.2	
7:08	169	14	4450.1	2.9	150	30.1	
7:09	170	15	4452.8	2.7	150	32.8	2.73 average for 150 psi
7:10	171	0	4457.1	4.3	130	37.1	Attempt to stabilize at 140 psi. abandon
7:11	172	1	4459.3	2.2	130	39.3	All 130 psi readings are approximate.
7:12	173	2	4461.2	1.9	130	41.2	Gauge oscillating from 125 to 137
7:13	174	3	4464.1	2.9	130	44.1	
7:14	175	4	4466.3	2.2	130	46.3	
7:15	176	5	4468.1	1.8	130	48.1	
7:16	177	6	4470.9	2.8	130	50.9	
7:17	178	7	4473.2	2.3	130	53.2	
7:18	179	8	4475.2	2	130	55.2	
7:19	180	9	4477.1	1.9	130	57.1	
7:20	181	10	4478.9	1.8	130	58.9	2.18 average for 130 psi
7:21	182	1	4480.9	2	100	60.9	
7:22	183	2	4482.7	1.8	100	62.7	
7:23	184	3	4484.6	1.9	100	64.6	
7:24	185	4	4486.4	1.8	100	66.4	
7:25	186	5	4488.2	1.8	100	68.2	
7:26	187	6	4490.1	1.9	100	70.1	
7:27	188	7	4491.9	1.8	100	71.9	
7:28	189	8	4493.9	2	100	73.9	
7:29	190	9	4495.7	1.8	100	75.7	
7:30	191	10	4497.6	1.9	100	77.6	1.87 average for 100 psi
7:31	192	1	4499.5	1.9	90	79.5	
7:32	193	2	4500.7	1.2	90	80.7	
7:33	194	3	4502.7	2	90	82.7	
7:34	195	4	4504.7	2	90	84.7	
7:35	196	5	4506.5	1.8	90	86.5	
7:36	197	6	4508.2	1.7	90	88.2	
7:37	198	7	4510	1.8	90	90	
7:38	199	8	4511.6	1.6	90	91.6	
7:39	200	9	4513.5	1.9	90	93.5	
7:40	201	10	4515.2	1.7	90	95.2	1.76 average for 90 psi
7:41	202	1	4516.6	1.4	80	96.6	
7:42	203	2	4518.2	1.6	80	98.2	
7:43	204	3	4519.9	1.7	80	99.9	
7:44	205	4	4521.3	1.4	80	101.3	
7:45	206	5	4523	1.7	80	103	
7:46	207	6	4524.7	1.7	80	104.7	
7:47	208	7	4526.4	1.7	80	106.4	
7:48	209	8	4528.2	1.8	80	108.2	
7:49	210	9	4530.1	1.9	80	110.1	
7:50	211	10	4531.9	1.8	80	111.9	1.67 average for 80 psi
7:51	212	1	4533.5	1.6	70	113.5	
7:52	213	2	4535.2	1.7	70	115.2	
7:53	214	3	4536.7	1.5	70	116.7	
7:54	215	4	4538.5	1.8	70	118.5	
7:55	216	5	4540.2	1.7	70	120.2	
7:56	217	6	4541.1	0.9	70	121.1	
7:57	218	7	4542.4	1.3	70	122.4	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
7:58	219	8	4544.3	1.9	70	124.3	
7:59	220	9	4545.9	1.6	70	125.9	
8:00	221	10	4547.5	1.6	70	127.5	1.56 average for 70 psi
8:01	222	1	4548.9	1.4	60	128.9	
8:02	223	2	4550.5	1.6	60	130.5	
8:03	224	3	4552.1	1.6	60	132.1	
8:04	225	4	4553.8	1.7	60	133.8	
8:05	226	5	4555.3	1.5	60	135.3	
8:06	227	6	4556.9	1.6	60	136.9	
8:07	228	7	4558.5	1.6	60	138.5	
8:08	229	8	4560	1.5	60	140	
8:09	230	9	4561.6	1.6	60	141.6	
8:10	231	10	4563.3	1.7	60	143.3	1.58 average for 60 psi
8:11	232	1	4564.7	1.4	50	144.7	
8:12	233	2	4566	1.3	50	146	
8:13	234	3	4567.3	1.3	50	147.3	
8:14	235	4	4568.6	1.3	50	148.6	
8:15	236	5	4570	1.4	50	150	
8:16	237	6	4571.4	1.4	50	151.4	
8:17	238	7	4572.8	1.4	50	152.8	
8:18	239	8	4574.2	1.4	50	154.2	
8:19	240	9	4575.3	1.1	50	155.3	
8:20	241	10	4576.5	1.2	50	156.5	1.32 average for 50 psi
8:21	242	1	4577.6	1.1	40	157.6	
8:22	243	2	4578.9	1.3	40	158.9	
8:23	244	3	4580.2	1.3	40	160.2	
8:24	245	4	4581.5	1.3	40	161.5	
8:25	246	5	4582.8	1.3	40	162.8	
8:26	247	6	4584.1	1.3	40	164.1	
8:27	248	7	4585.4	1.3	40	165.4	
8:28	249	8	4586.5	1.1	40	166.5	
8:29	250	9	4587.6	1.1	40	167.6	
8:30	251	10	4588.9	1.3	40	168.9	1.24 average for 40 psi
8:31	252	1	4590	1.1	30	170	
8:32	253	2	4591.2	1.2	30	171.2	
8:33	254	3	4592.3	1.1	30	172.3	
8:34	255	4	4593.2	0.9	30	173.2	
8:35	256	5	4594.6	1.4	30	174.6	
8:36	257	6	4595.7	1.1	30	175.7	
8:37	258	7	4596.8	1.1	30	176.8	
8:38	259	8	4597.9	1.1	30	177.9	
8:39	260	9	4599	1.1	30	179	
8:40	261	10	4600.1	1.1	30	180.1	1.12 average for 30 psi
8:41	262	1	4601.2	1.1	20	181.2	
8:42	263	2	4602.1	0.9	20	182.1	
8:43	264	3	4603.3	1.2	20	183.3	
8:44	265	4	4604.4	1.1	20	184.4	
8:45	266	5	4605.4	1	20	185.4	
8:46	267	6	4606.3	0.9	20	186.3	
8:47	268	7	4607.4	1.1	20	187.4	
8:48	269	8	4608.4	1	20	188.4	
8:49	270	9	4609.4	1	20	189.4	
8:50	271	10	4610.5	1.1	20	190.5	1.04 average for 20 psi
8:51	272	1	4611.4	0.9	10	191.4	
8:52	273	2	4612.4	1	10	192.4	
8:53	274	3	4613.3	0.9	10	193.3	
8:54	275	4	4614.2	0.9	10	194.2	
8:55	276	5	4615.1	0.9	10	195.1	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
8:56	277	6	4616	0.9	10	196	
8:57	278	7	4617	1	10	197	
8:58	279	8	4617.9	0.9	10	197.9	
8:59	280	9	4618.7	0.8	10	198.7	
9:00	281	10	4619.6	0.9	10	199.6	0.91 average for 10 psi

Repeated steps summarized								
psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	
0.98	10	2.31	130	1.02	10	2.45	130	Set pressure. Wait 1 minute
1.12	20	2.24	100	1.18	20	2.23	100	average over 2 minutes. Repeat
1.15	30	2.05	90	1.18	30	2.1	90	
1.26	40	1.8	80	1.29	40	1.82	80	
1.55	50	1.81	70	1.56	50	1.8	70	
1.78	60	1.78	60	1.8	60	1.83	60	
1.81	70	1.56	50	1.83	70	1.54	50	
1.81	80	1.31	40	1.82	80	1.33	40	
2.02	90	1.21	30	2.01	90	1.2	30	
2.20	100	1.13	20	2.19	100	1.14	20	
2.21	130	1	10	2.23	130	1.02	10	
2.98	150			3.12	150			
0.00	1	4	6084.5	0	60	1664.5		
0.00	2	5	6084.5	0	60	1664.5		
0.69	303	1	6084.5	0	50	1664.5		
0.69	304	2	6084.5	0	50	1664.5		
0.69	305	3	6084.5	0	50	1664.5		
0.69	306	4	6084.5	0	50	1664.5		
0.69	307	5	6084.5	0	50	1664.5		
0.69	308	1	6084.5	0	40	1664.5		
0.69	309	2	6084.5	0	40	1664.5		
0.69	310	3	6084.5	0	40	1664.5		
0.69	311	4	6084.5	0	40	1664.5		
0.69	312	5	6084.5	0	40	1664.5		
0.69	313	1	6084.5	0	30	1664.5		
0.69	314	2	6084.5	0	30	1664.5		
0.69	315	3	6084.5	0	30	1664.5		
0.70	316	4	6084.5	0	30	1664.5		
0.70	317	5	6084.5	0	30	1664.5		
0.70	318	6	6084.5	0	20	1664.5		
0.70	319	7	6084.5	0	20	1664.5		
0.70	320	8	6084.5	0	20	1664.5		
0.70	321	9	6084.5	0	20	1664.5		
0.70	322	10	6084.5	0	20	1664.5		

Repeated steps summarized								
psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	
								No duplicat test performed

JOHN SHOMAKER & ASSOCIATES, INC.
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Date 8/16/2011
Client New Mexico Copper Corp
Project Copper Flat
Well Name GWQ 11-25 Zone 2
Hydrologist JJK

Starting Water Level (ft bgl) 60.2
Elevation (ft GL)
Injection Interval (ft bgl) 150 to 197.7
Bore/Casing Depth (ft bgl) 197.7

Packer Dia 2 inch
Bore/Casing Dia 3-3/4 inch
Injection Pipe Dia 1 inch
Pressure gauge height above GL 3 ft

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
7:25	0		4700		10	0	
7:26	1	1	4704.5	4.50	12	4.5	
7:27	2	2	4707	2.50	10	7	
7:28	3	3	4709	2.00	10	9	
7:29	4	4	4711	2.00	12	11	
7:30	5	5	4712.9	1.90	10	12.9	
7:31	6	6	4714.9	2.00	10	14.9	
7:32	7	7	4717	2.10	11	17	
7:33	8	8	4718.8	1.80	10	18.8	
7:34	9	9	4720.7	1.90	10	20.7	
7:35	10	10	4722.6	1.90	10	22.6	2.26 gpm average for 10 psi
7:36	11	1	4724.8	2.2	20	24.8	
7:37	12	2	4727.1	2.3	20	27.1	
7:38	13	3	4729.2	2.1	21	29.2	
7:39	14	4	4731.4	2.2	20	31.4	
7:40	15	5	4733.6	2.2	19	33.6	
7:41	16	6	4735.8	2.2	20	35.8	
7:42	17	7	4738	2.2	20	38	
7:43	18	8	4740.2	2.2	21	40.2	
7:44	19	9	4742.4	2.2	20	42.4	
7:45	20	10	4744.6	2.2	20	44.6	2.20 gpm average for 20 psi
7:46	21	1	4747.1	2.5	30	47.1	
7:47	22	2	4749.6	2.5	31	49.6	
7:48	23	3	4752.3	2.7	31	52.3	
7:49	24	4	4754.8	2.5	32	54.8	
7:50	25	5	4757.2	2.4	31	57.2	
7:51	26	6	4759.7	2.5	30	59.7	
7:52	27	7	4762.3	2.6	30	62.3	
7:53	28	8	4764.7	2.4	31	64.7	
7:54	29	9	4767.2	2.5	30	67.2	
7:55	30	10	4769.6	2.4	30	69.6	2.50 gpm average for 30 psi
7:56	31	1	4772.4	2.8	38	72.4	
7:57	32	2	4775.3	2.9	40	75.3	
7:58	33	3	4778.2	2.9	41	78.2	
7:59	34	4	4781	2.8	40	81	
8:00	35	5	4783.8	2.8	40	83.8	
8:01	36	6	4786.4	2.6	40	86.4	
8:02	37	7	4789.1	2.7	40	89.1	
8:03	38	8	4791.9	2.8	41	91.9	
8:04	39	9	4794.2	2.3	40	94.2	
8:05	40	10	4797.3	3.1	41	97.3	2.77 gpm average for 40 psi
8:06	41	1	4800.5	3.2	50	100.5	Oscilating = or - 3 to 4 psi
8:07	42	2	4803.6	3.1	50	103.6	
8:08	43	3	4806.6	3	50	106.6	
8:09	44	4	4809.7	3.1	50	109.7	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
8:10	45	5	4812.8	3.1	50	112.8	
8:11	46	6	4815.8	3	50	115.8	
8:12	47	7	4818.9	3.1	50	118.9	
8:13	48	8	4822	3.1	50	122	
8:14	49	9	4825	3	50	125	
8:15	50	10	4828.1	3.1	50	128.1	3.08 gpm average for 50 psi
8:16	51	1	4831.6	3.5	60	131.6	Oscilating = or - 3 to 4 psi
8:17	52	2	4834.9	3.3	60	134.9	
8:18	53	3	4838	3.1	60	138	
8:19	54	4	4841.8	3.8	60	141.8	
8:20	55	5	4844.9	3.1	60	144.9	
8:21	56	6	4848.3	3.4	60	148.3	
8:22	57	7	4851.9	3.6	60	151.9	
8:23	58	8	4855.5	3.6	60	155.5	
8:24	59	9	4859.1	3.6	60	159.1	
8:25	60	10	4862.8	3.7	60	162.8	3.47 gpm average for 60 psi
8:26	61	1	4866.4	3.6	70	166.4	Oscilating = or - 3 to 4 psi
8:27	62	2	4870.2	3.8	70	170.2	
8:28	63	3	4874	3.8	70	174	
8:29	64	4	4877.5	3.5	70	177.5	
8:30	65	5	4881	3.5	70	181	
8:31	66	6	4884.6	3.6	70	184.6	
8:32	67	7	4888.1	3.5	70	188.1	
8:33	68	8	4891.7	3.6	70	191.7	
8:34	69	9	4895.5	3.8	70	195.5	
8:35	70	10	4898.9	3.4	70	198.9	3.61 gpm average for 70 psi
8:36	71	1	4903	4.1	80	203	Oscilating = or - 3 to 4 psi
8:37	72	2	4906.8	3.8	80	206.8	
8:38	73	3	4910.4	3.6	80	210.4	
8:39	74	4	4914.2	3.8	81	214.2	
8:40	75	5	4918	3.8	80	218	
8:41	76	6	4921.9	3.9	80	221.9	
8:42	77	7	4925.6	3.7	80	225.6	
8:43	78	8	4929.3	3.7	80	229.3	
8:44	79	9	4933.1	3.8	80	233.1	
8:45	80	10	4937	3.9	80	237	3.81 gpm average for 80 psi
8:46	81	1	4941.1	4.1	90	241.1	Oscilating = or - 5 psi
8:47	82	2	4945.4	4.3	90	245.4	
8:48	83	3	4949.6	4.2	90	249.6	
8:49	84	4	4954	4.4	91	254	
8:50	85	5	4958.1	4.1	90	258.1	
8:51	86	6	4962.3	4.2	90	262.3	
8:52	87	7	4966.6	4.3	90	266.6	
8:53	88	8	4971.2	4.6	90	271.2	
8:54	89	9	4975.3	4.1	90	275.3	
8:55	90	10	4979.7	4.4	90	279.7	4.27 gpm average for 90 psi
8:56	91	1	4984.8	5.1	100	284.8	Oscilating = or - 6 psi
8:57	92	2	4989.9	5.1	100	289.9	
8:58	93	3	4995	5.1	100	295	
8:59	94	4	5000	5	100	300	
9:00	95	5	5005.1	5.1	100	305.1	
9:01	96	6	5010	4.9	100	310	
9:02	97	7	5015.1	5.1	100	315.1	
9:03	98	8	5020	4.9	100	320	
9:04	99	9	5025	5	100	325	
9:05	100	10	5029.9	4.9	100	329.9	5.02 gpm average for 100 psi
9:06	101	1	5034	4.1	90	334	Oscilating = or - 5 psi

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
9:07	102	2	5038	4	90	338	
9:08	103	3	5042.1	4.1	90	342.1	
9:09	104	4	5046.5	4.4	90	346.5	
9:10	105	5	5050.7	4.2	90	350.7	
9:11	106	6	5055	4.3	90	355	
9:12	107	7	5059.2	4.2	90	359.2	
9:13	108	8	5063.4	4.2	90	363.4	
9:14	109	9	5067.7	4.3	90	367.7	
9:15	110	10	5072.4	4.7	90	372.4	4.25 gpm average for 90 psi
9:16	111	1	5076.2	3.8	80	376.2	Oscilating = or - 5 psi
9:17	112	2	5079.9	3.7	80	379.9	
9:18	113	3	5083.5	3.6	80	383.5	
9:19	114	4	5087.1	3.6	80	387.1	
9:20	115	5	5090.5	3.4	80	390.5	
9:21	116	6	5094.3	3.8	80	394.3	
9:22	117	7	5098	3.7	80	398	
9:23	118	8	5101.8	3.8	80	401.8	
9:24	119	9	5105.6	3.8	80	405.6	
9:25	120	10	5109.6	4	80	409.6	3.72 gpm average for 80 psi
9:26	121	1	5113	3.4	70	413	Oscilating = or - 3 to 4 psi
9:27	122	2	5116.2	3.2	70	416.2	
9:28	123	3	5119.8	3.6	70	419.8	
9:29	124	4	5123	3.2	70	423	
9:30	125	5	5126.5	3.5	70	426.5	
9:31	126	6	5130.2	3.7	70	430.2	
9:32	127	7	5133.7	3.5	70	433.7	
9:33	128	8	5137.2	3.5	70	437.2	
9:34	129	9	5140.4	3.2	70	440.4	
9:35	130	10	5143.9	3.5	70	443.9	3.43 gpm average for 70 psi
9:36	131	1	5147	3.1	60	447	Oscilating = or - 3 to 4 psi
9:37	132	2	5150.1	3.1	60	450.1	
9:38	133	3	5153.5	3.4	60	453.5	
9:39	134	4	5156.5	3	60	456.5	
9:40	135	5	5159.7	3.2	60	459.7	
9:41	136	6	5163	3.3	60	463	
9:42	137	7	5166.2	3.2	60	466.2	
9:43	138	8	5169.4	3.2	60	469.4	
9:44	139	9	5172.7	3.3	60	472.7	
9:45	140	10	5175.9	3.2	60	475.9	3.20 gpm average for 60 psi
9:46	141	1	5178.7	2.8	50	478.7	Oscilating = or - 3 to 4 psi
9:47	142	2	5181.6	2.9	50	481.6	
9:48	143	3	5184.7	3.1	50	484.7	
9:49	144	4	5187.5	2.8	50	487.5	
9:50	145	5	5190.3	2.8	50	490.3	
9:51	146	6	5193.3	3	50	493.3	
9:52	147	7	5196.1	2.8	50	496.1	
9:53	148	8	5199	2.9	50	499	
9:54	149	9	5202.1	3.1	50	502.1	
9:55	150	10	5205.1	3	50	505.1	2.92 gpm average for 50 psi
9:56	151	1	5207.8	2.7	40	507.8	
9:57	152	2	5210.1	2.3	40	510.1	
9:58	153	3	5212.8	2.7	40	512.8	
9:59	154	4	5215.6	2.8	40	515.6	
10:00	155	5	5218.1	2.5	40	518.1	
10:01	156	6	5221	2.9	40	521	
10:02	157	7	5223.8	2.8	40	523.8	
10:03	158	8	5226.4	2.6	40	526.4	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
10:04	159	9	5229	2.6	40	529	
10:05	160	10	5231.9	2.9	40	531.9	2.68 gpm average for 40 psi
10:06	161	1	5234.2	2.3	30	534.2	
10:07	162	2	5236.5	2.3	30	536.5	
10:08	163	3	5238.9	2.4	30	538.9	
10:09	164	4	5241.4	2.5	30	541.4	
10:10	165	5	5244	2.6	30	544	
10:11	166	6	5246.3	2.3	30	546.3	
10:12	167	7	5248.7	2.4	30	548.7	
10:13	168	8	5251.2	2.5	30	551.2	
10:14	169	9	5253.7	2.5	30	553.7	
10:15	170	10	5256.3	2.6	30	556.3	2.44 gpm average for 30 psi
10:16	171	1	5258.2	1.9	20	558.2	
10:17	172	2	5260.2	2	20	560.2	
10:18	173	3	5262.6	2.4	20	562.6	
10:19	174	4	5264.8	2.2	20	564.8	
10:20	175	5	5267	2.2	20	567	
10:21	176	6	5269.1	2.1	20	569.1	
10:22	177	7	5271.3	2.2	20	571.3	
10:23	178	8	5273.6	2.3	20	573.6	
10:24	179	9	5275.9	2.3	20	575.9	
10:25	180	10	5278	2.1	20	578	2.17 gpm average for 20 psi
10:26	181	1	5279.7	1.7	10	579.7	
10:27	182	2	5281.6	1.9	10	581.6	
10:28	183	3	5283.5	1.9	10	583.5	
10:29	184	4	5285.4	1.9	10	585.4	
10:30	185	5	5287.2	1.8	10	587.2	
10:31	186	6	5289.1	1.9	10	589.1	
10:32	187	7	5291	1.9	10	591	
10:33	188	8	5293	2	10	593	
10:34	189	9	5295	2	10	595	
10:35	190	10	5296.9	1.9	10	596.9	1.89 gpm average for 10 psi

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	
NA	10.0	(*)	90.0	2.70	20.0	(*)	90.0	Set pressure. Wait 1 minute
2.38	20.0	5.09	80.0	3.69	30.0	(*)	80.0	average over 2 minutes. Repeat
2.49	30.0	4.68	70.0	4.10	40.0	5.10	70.0	
3.00	40.0	4.80	60.0	4.72	50.0	4.70	60.0	
3.18	50.0	4.38	50.0	5.18	60.0	4.60	50.0	
3.62	60.0	3.70	40.0	5.20	70.0	4.00	40.0	
3.70	70.0	3.29	30.0	6.16	80.0	2.60	30.0	
4.31	80.0	2.80	20.0	(*)	90.0	2.51	20.0	
4.70	90.0	2.40	10.0	(*)	100.0	1.92	10.0	
(*)	100.0							
(*) unable to maintain pressure								

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Date	8/24/2011
Client	New Mexico Copper Corp
Project	Copper Flat
Well Name	GWQ 11-25, Zone 3
Hydrologist	JJK

Starting Water Level (ft bgl)	60.00	**Packer Dia**	2 inch
Elevation (ft GL)		**Bore/Casing Dia**	3-3/4 inch
Injection Interval (ft bgl)	207 to 251	**Injection Pipe Dia**	1 inch
Bore/Casing Depth (ft bgl)	251	**Pressure gauge height above GL**	4 ft

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
8:10	0		5463		11	0	
8:11	1	1	5465	2.00	10	2	
8:12	2	2	5465.7	0.70	11	2.7	
8:13	3	3	5468.3	2.60	11	5.3	
8:14	4	4	5470	1.70	10	7	
8:15	5	5	5471.4	1.40	10	8.4	
8:16	6	6	5472.8	1.40	10	9.8	
8:17	7	7	5474.4	1.60	10	11.4	
8:18	8	8	5475.9	1.50	10	12.9	
8:19	9	9	5477.4	1.50	10	14.4	
8:20	10	10	5479	1.60	10	16	1.6 gpm average for 10 psi
8:21	11	1	5480.5	1.5	20	17.5	
8:22	12	2	5482.2	1.7	20	19.2	
8:23	13	3	5483.5	1.3	20	20.5	
8:24	14	4	5485.2	1.7	20	22.2	
8:25	15	5	5486.7	1.5	21	23.7	
8:26	16	6	5488.4	1.7	20	25.4	
8:27	17	7	5490	1.6	20	27	
8:28	18	8	5491.6	0	20	28.6	
8:29	19	9	5493.1	1.5	20	30.1	
8:30	20	10	5494.8	1.7	21	31.8	1.58 gpm average for 20 psi
8:31	21	1	5496.5	1.7	30	33.5	
8:32	22	2	5498.1	1.6	29	35.1	
8:33	23	3	5499.9	1.8	30	36.9	
8:34	24	4	5501.5	1.6	30	38.5	
8:35	25	5	5503.1	1.6	30	40.1	
8:36	26	6	5505	1.9	30	42	
8:37	27	7	5506.6	1.6	30	43.6	
8:38	28	8	5508.6	2	30	45.6	
8:39	29	9	5510.4	1.8	29	47.4	
8:40	30	10	5512.4	2	29	49.4	1.76 gpm average for 30 psi
8:41	31	1	5514.3	1.9	40	51.3	
8:42	32	2	5516.2	1.9	40	53.2	
8:43	33	3	5518.3	2.1	40	55.3	
8:44	34	4	5520.4	2.1	40	57.4	
8:45	35	5	5522.3	1.9	40	59.3	
8:46	36	6	5524.3	2	40	61.3	
8:47	37	7	5526.3	2	40	63.3	
8:48	38	8	5528.2	1.9	39	65.2	
8:49	39	9	5530.2	2	39	67.2	
8:50	40	10	5532.2	2	39	69.2	1.98 gpm average for 40 psi
8:51	41	1	5534.4	2.2	50	71.4	All 50 psi readings are approximate
8:52	42	2	5536.6	2.2	50	73.6	pressure gauge is oscillating + - 3 to 4 psi
8:53	43	3	5539.1	2.5	50	76.1	
8:54	44	4	5541.6	2.5	50	78.6	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
8:55	45	5	5544.1	2.5	50	81.1	
8:56	46	6	5546.6	2.5	50	83.6	
8:57	47	7	5549.2	2.6	50	86.2	
8:58	48	8	5551.7	2.5	50	88.7	
8:59	49	9	5554.3	2.6	50	91.3	
9:00	50	10	5557	2.7	50	94	2.48 gpm average for 50 psi
9:01	51	1	0	-5557	60	-5463	All 60 psi readings are approximate
9:02	52	2	5565.1	5565.1	60	102.1	pressure gauge is oscillating + - 3 to 4 psi
9:03	53	3	5569.7	4.6	60	106.7	
9:04	54	4	5573.9	4.2	60	110.9	
9:05	55	5	5578.5	4.6	60	115.5	
9:06	56	6	5583.4	4.9	60	120.4	
9:07	57	7	5587.4	4	58	124.4	
9:08	58	8	5592.2	4.8	58	129.2	
9:09	59	9	5597.4	5.2	60	134.4	
9:10	60	10	5602.7	5.3	60	139.7	4.57 gpm average for 60 psi
9:11	61	1	5609	6.3	65	146	Valve fully open. Water moving past packer
9:12	62	2	5616.1	7.1	65	153.1	
9:13	63	3	5623.1	7	65	160.1	
9:14	64	4	5630.3	7.2	65	167.3	
9:15	65	5	5637.6	7.3	65	174.6	
9:16	66	6	5645.1	7.5	63	182.1	Water at surface
9:17	67	7	5652.3	7.2	62	189.3	
9:18	68	8	5659.8	7.5	62	196.8	
9:19	69	9	5666.9	7.1	60	203.9	
9:20	70	10	5674	7.1	60	211	7.13 gpm average for 65 psi
9:21	71	1	5681.4	7.4	60	218.4	
9:22	72	2	5688.6	7.2	60	225.6	
9:23	73	3	5696	7.4	59	233	
9:24	74	4	5703.2	7.2	59	240.2	
9:25	75	5	5710.6	7.4	58	247.6	
9:26	76	6	5717.8	7.2	58	254.8	
9:27	77	7	5725	7.2	58	262	
9:28	78	8	5732.3	7.3	58	269.3	
9:29	79	9	5739.5	7.2	59	276.5	
9:30	80	10	5746.9	7.4	59	283.9	7.29 gpm average for 60 psi
9:31	81	1	5752.3	5.4	50	289.3	Water now moving down casing
9:32	82	2	5757	4.7	50	294	
9:33	83	3	5761.3	4.3	50	298.3	
9:34	84	4	5766	4.7	50	303	
9:35	85	5	5770.5	4.5	50	307.5	
9:36	86	6	5775	4.5	50	312	
9:37	87	7	5779.7	4.7	50	316.7	
9:38	88	8	5784.3	4.6	50	321.3	
9:39	89	9	5788.8	4.5	50	325.8	
9:40	90	10	5793.5	4.7	50	330.5	4.66 average for 50 psi
9:41	91	1	5796.5	3	40	333.5	
9:42	92	2	5798	1.5	40	335	
9:43	93	3	5799.9	1.9	40	336.9	
9:44	94	4	5801.2	1.3	39	338.2	
9:45	95	5	5802.8	1.6	40	339.8	
9:46	96	6	5804.4	1.6	39	341.4	
9:47	97	7	5806	1.6	40	343	
9:48	98	8	5807.5	1.5	40	344.5	
9:49	99	9	5809.2	1.7	40	346.2	
9:50	100	10	5810.5	1.3	39	347.5	1.7 average for 40 psi
9:51	101	1	5812.1	1.6	30	0	

Time 24 hr	**Elapsed minutes**	**Injection period**	**Water meter reading, gals**	**Injection rate, gals**	**Injection pressure, psi**	**total water injected, gals**	**Remarks**
9:52	102	2	5813.4	1.3	30	1.3	
9:53	103	3	5814.8	1.4	30	2.7	
9:54	104	4	5816.3	1.5	30	4.2	
9:55	105	5	5817.6	1.3	30	5.5	
9:56	106	6	5818.9	1.3	30	6.8	
9:57	107	7	5820.3	1.4	30	8.2	
9:58	108	8	5821.8	1.5	30	9.7	
9:59	109	9	5823	1.2	30	10.9	
10:00	110	10	5824.4	1.4	30	12.3	1.39 average for 30 psi
10:01	111	1	5825.7	1.3	20	13.6	
10:02	112	2	5827	1.3	20	14.9	
10:03	113	3	5828.3	1.3	20	16.2	
10:04	114	4	5829.5	1.2	20	17.4	
10:05	115	5	5830.8	1.3	20	18.7	
10:06	116	6	5832.1	1.3	20	20	
10:07	117	7	5833.3	1.2	20	21.2	
10:08	118	8	5834.6	1.3	20	22.5	
10:09	119	9	5835.9	1.3	20	23.8	
10:10	120	10	5837.1	1.2	20	25	1.27 average for 20 psi
10:11	121	1	5838.2	1.1	10	26.1	
10:12	122	2	5839.3	1.1	10	27.2	
10:13	123	3	5840.3	1	10	28.2	
10:14	124	4	5841.8	1.5	10	29.7	
10:15	125	5	5842.7	0.9	10	30.6	
10:16	126	6	5843.8	1.1	10	31.7	
10:17	127	7	5845	1.2	10	32.9	
10:18	128	8	5846.1	1.1	10	34	
10:19	129	9	5847.2	1.1	10	35.1	
10:20	130	10	5848.3	1.1	10	36.2	1.12 average for 10 psi

Repeated steps summarized								
psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	
NA	10.0	NA	65.0	1.21	10.0	NA	65.0	Set pressure. Wait 1 minute
1.20	20.0	2.62	60.0	1.39	20.0	2.39	60.0	average over 2 minutes. Repeat
1.45	30.0	1.89	50.0	1.55	30.0	1.98	50.0	
1.61	40.0	1.70	40.0	1.62	40.0	1.80	40.0	
1.90	50.0	1.14	30.0	2.10	50.0	1.57	30.0	
2.40	60.0	1.29	20.0	2.22	60.0	1.41	20.0	
3.90	66.0	1.20	10.0	3.84	66.0	1.33	10.0	

Appendix D.

MODFLOW Code Documentation

DOCUMENTATION FOR MODFLOW CODE VERSION

The following report first presents general details and documentation for the MODFLOW version titled maj10_12mar10. Documentation for LAK2 is presented as an Appendix.

DOCUMENTATION FOR MODFLOW CODE VERSION

DOCUMENTATION FOR MODFLOW CODE VERSION

INTRODUCTION

This report documents a version of the US Geological Survey modular ground-water flow model, or MODFLOW (McDonald and Harbaugh, 1988). Major non-standard features include:

- Modifications to module BCF2 and other modules involving the treatment of perched aquifers, dry cells and cell rewetting. These modifications preserve continuity of the governing equations of flow and also preserve mass balance accounting.
- Module RIV2 (adapted from Miller, 1988). The original program has been revised to improve the surface water mass balance accounting, to improve I/O options and to accommodate the sub-module DIV1.
- RIV2 sub-module DIV1. This module simulates the diversion of surface water and the optional re-injection of diverted water into the groundwater system.
- Module LAK2. This module is used to simulate lakes, well bores and other open water bodies connected to groundwater systems.
- Module OUT1 manages output control.
- Module ZON1 computes and outputs zone-by-zone budgets

Minor features include:

- Additional options for the formatting of input arrays (from Zheng, 1989, Appendix B)
- The Drain Package, DRN1, has been modified to also perform the functions of the WEL module, in addition to the DRN function. In addition, a second copy of the DRN module has been implemented in the code. These modifications are useful in simulating complex, multi-component and highly variable pumping regimes.
- The Well Package, WEL1, has been modified to optionally transfer pumping to the next layer down when a pumping cell goes dry.
- The Output Control (OC1) sub-module of the Basic Package, BAS has been modified to include the output of hydrographs and to allow the output of volumetric budget terms to a separate file
- Addition of a repeating seasonal input option to the Evapotranspiration (EVT1) and Recharge (RCH1) modules.

GENERAL DOCUMENTATION

Modules

MODFLOW packages are invoked using the IUNIT array (McDonald and Harbaugh, 1988, ch. 4). This particular version contains the following selection of modules:

IUNIT#	PACKAGE	TYPE	
1	BCF2	G	Block-Centered Flow Package BCF2 (McDonald et al., 1991) modified
2	WEL	B	Well Package modified
3	DRN	B	Drain Package modified
4	RIV	B	River Package
5	EVT	B	Evapotranspiration Package, modified
6	RIV2	S	River Package 2 (adapted from Miller, 1988)
7	GHB	B	General Head Boundary Package
8	RCH	B	Recharge Package, modified
9	SIP	M	Strongly Implicit Procedure solver Package
10	PCG	M	Preconditioned Conjugate Gradient solver Package (Hill, 1990)
11	SOR1	M	Slice-successive OverRelaxation solver Package
12	OC	O	Output Control Option, modified
13	LAK2	S	Lake Package
14	DRN	B	Drain Package modified (second entry)
15	NCF1	G	Node-Centered Flow Package (Jones, 1997)
16	SOL1	M	ITPACK2C matrix solvers (Kincaid et al., 1992)
17	CHD1	B	Time-variant Constant HeaD Package (Leake and Prudic, 1988, Appendix C)
18	OUT1	O	Output Control Package
19	HFB	G	Horizontal Flow Barrier Package (Hsieh and Freckleton, 1992)
20	ZON1	O	Zone Budget Package
21	(unused)		
2	LKMT	O	Package creates interface files to MT3D, modified
23	LKMP1	O	Package creates interface files to MODPATH
24	(unused)		

Types
G: Groundwater flow domain / Aquifer properties
B: Boundary conditions to Groundwater domain
S: Surface water flow / Boundary conditions to Groundwater domain
O: Output control
M: Matrix inversion/ solution

Name file

MODFLOW has been modified to run from a single input file (the Name file) containing a list of input and output file names and unit numbers. The file is equivalent to the ".NAM" file of MODFLOW96 and later, though with different format. In addition to providing instructions to the program, the Name file serves to define the simulation and is a useful file for record keeping. File names needed include

the BAS input file (unit 1),
the main output file (unit 2),
all input file units specified in the IUNIT array,
all output units specified in individual input files (including modules OC1, OUT1, ZON1, LAK2, etc.)

When MODFLOW.EXE is run, the program first reads the console for the name of the Name file. The Name file consists of one line for each file to be used during the simulation, in the following format:

Input Records

RECORD1 : read once for each file to be opened during simulation.

variable:	**KUNIT**	**FNAME**	**UNFC**
format:	I5	A20	A1

Explanation of Variables

KUNIT : Unit number of file to be opened.
FNAME : Name of file to be opened.
UNFC : Format flag.
If UNFC = 'U' or 'u', the file is opened as unformatted.
Otherwise the file is opened as formatted.

Array Readers

Input instructions throughout MODFLOW refer to the input formats U2DREL , U1DREL , and U2DINT. These "formats" are utility package array reading subroutines. Options for the format of input arrays have been added to the original MODFLOW routines, following Zheng (1989). One option not in Zheng (1989) has also been added.

Options for the format of input arrays are characterized here by the value of an input variable, LOCAT (see below). The options available with 1988 MODFLOW are

LOCAT<0
LOCAT>0

The options added by (Zheng, 1989) are

LOCAT = 100
LOCAT = 101
LOCAT = 102
LOCAT = 103

one more option has been added:

LOCAT<-100

The file opening aspects of the (Zheng, 1989) subroutines have not been utilized.

Input Records

When called to read a data array from an input file, the array readers first read an array control record. The data array may then be read in various formats from the same file or from a different file, depending on specifications in the array control record

For the real array readers (U2DREL, U1DREL)
Array control record

variable:	**LOCAT**	**CNSTNT**	**FMTIN**	**IPRN**
format:	I10	F10.0	5A4	I10

For the integer array readers (U2DINT)
Array control record

variable:	**LOCAT**	**ICONST**	**FMTIN**	**IPRN**
format:	I10	F10.0	5A4	I10

The data array may or may not follow the input control record, depending on the value of LOCAT.

Explanation of Variables

LOCAT : Data location and format style.

if LOCAT<-100, the array is read from unit (-LOCAT-100) using format FMTIN. The array input unit is then rewound, so that the same array may be used later.

if -100<LOCAT<0, the array is read unformatted from unit -LOCAT.

if LOCAT=0, the array is set to the constant CNSTNT/ICONST.

if LOCAT>0, but LOCAT does not take the values 100, 101, 102 or 103, the array is read from unit LOCAT using format FMTIN.

if LOCAT=100, the array is read from the current unit (the file from which the array control record was read) using format FMTIN.

if LOCAT=101, the array is read from the current unit using a block format (Zheng, 1989).

if LOCAT=102, the array is read from the current unit using a zone format (Zheng, 1989).

if LOCAT=103, the array is read from the current unit using a list-directed or free format (Zheng, 1989).

CNSTNT/ICONST : constant.
if LOCAT=0, each element of the array is set to CNSTNT/ICONST**.**
if LOCAT≠0, each element of the array is multiplied by CNSTNT/ICONST.

FMTIN : Input format, enclosed in parenthesis.

IPRN : Printout flag and format.
If IPRN<0, the array is not printed.
Otherwise, the array is printed in the main output file, using a format determined by the value of IPRN:

IPRN	U1/2DREL	U2DINT
0	10G11.4	10I11
1	11G10.3	60I1
2	9G13.6	40I2
3	15F7.1	30I3
4	15F7.2	25I4
5	15F7.3	20I5
6	15F7.4	
7	20F5.0	
8	20F5.1	
9	20F5.2	
10	20F5.3	
11	20F5.4	
12	10G11.4	

OUTPUT CONTROL MODULES

The modifications and new modules described below perform output control functions and are not directly related to the numerical computations of water levels and flows. They are, however valuable for viewing, evaluating and presenting model results.

Modifications to module BAS1/OC1

The Basic Package has been modified from its original version (McDonald and Harbaugh, 1988). The Output Control Option has been modified to output hydrographs and to output volumetric budget information to a separate file. The modified option is referred to here as OC2. OC2 will not correctly read unmodified OC1 input files. OC2 capabilities are identical to those of OC1, with the following exceptions:

(1) OC2 allows the specification of a number of cells/nodes as observed head locations: For each time step the user may specify a list of cells/nodes whose hydraulic head will be printed to the file number JHEDUN.

(2) OC2 allows output of the volumetric budget to file number IBUD, as well as to the main output file.

To work correctly with the modified model, input files created for OC1 must be modified. To convert an older file, insert input record 1, with a value of zero, at the beginning of the file:

sample OC1 input file

```
4     4     81    82
0     1     1     0
0     0     1     0
```

modified input file

```
0
4     4     81    82
0     1     1     0
0     0     1     0
```

Input Records

Record 1 is read by module OC1AL and *is read once for a simulation*.

record 1: Maximum number of individual head values (observed heads) to be printed to unit JHEDUN in any one time step.

variable: MXHEADS
format: I10

Record 2 is read by module BAS1RP and *is read once for a simulation*.

record 2: Print formats for head and drawdown, unit numbers for head, drawdown, observed heads and volumetric budget.

variable:	IHEDFM	IDDNFM	IHEDUN	IDDNUN	JHEDUN	IBUD
format:	I10	I10	I10	I10	I10	I10

Records 3, 4 and 5 are read by module BAS1OC and *are read once for each time step*.

record 3: Flag for layer-by-layer head and drawdown output requests, flags for head/drawdown, volumetric budget and cell-by-cell or node-by-node flow components, number of observed heads for this time step.

variable:	INCODE	IHDDFL	IBUDFL	ICBCFL	NHEADS
format:	I10	I10	I10	I10	I10

record 4: Layer, row and column of observed heads. Read NHEADS times when NHEADS is greater than zero.

variable:	LAYER	ROW	COLUMN
format:	I10	I10	I10

record 5: Layer-by-layer output specifications for head and drawdown. Read zero, one or NLAY times, depending on the value of INCODE.

variable:	HDPR	DDPR	HDSV	DDSV
format:	I10	I10	I10	I10

Explanation of Variables

Record 1

MXHEADS : Maximum number of individual head values, or observed heads, to be written to unit JHEDUN in any one time step.

Record 2

IHEDFM : Format code for printing heads.
IDDNFM : Format code for printing drawdowns.

Format codes have the same meaning for head and drawdown. A positive entry indicates wrap format, a negative entry strip format. The absolute value of IDDNFM specifies the printout format as follows:

0 - 10G11.4
1 - 11G10.3
2 - 9G13.6
3 - 15F7.1
4 - 15F7.2
5 - 15F7.3
6 - 15F7.4
7 - 20F5.0
8 - 20F5.1
9 - 20F5.2
10 - 20F5.3
11 - 20F5.4
12 - 10G11.4

IHEDUN : Unit number to which heads are written, if they are saved.
IDDNUN : Unit number to which drawdowns are written, if they are saved.
JHEDUN : Unit number to which observed head values are to be written.
IBUD : Unit number to which volumetric budget is to be written when flag IBUDFL is set. A value of zero indicates the budget is written to the main output file.

Record 3

INCODE : Head/drawdown output code. Determines the number of times record 5 is read. If INCODE is:

< 0 : layer-by-layer specifications from last time step are used. Record 5 is not read.
= 0 : all layers are treated the same way. Record 5 is read once.
> 0 : Input record 5 is read for each layer.

IHDDFL : Head/drawdown output flag. If IHDDFL is nonzero, heads and drawdowns will be printed or saved according to the flags for each layer specified in input record 5.
IBUDFL : Budget print flag. If IBUDFL is nonzero, overall volumetric budget is printed. Exception: The budget is always printed at the end of a stress period.
ICBCFL : node-by-node flow-term flag. If ICBCFL is nonzero, node-by-node flow terms are printed or saved according to flags set in the individual packages.
NHEADS : Number of individual head values to be written to unit JHEDUN for current time step. If NHEADS<0, the list of individual heads from the previous time step is reused.

Record 4

LAYER, ROW, COLUMN : Layer, row, and column of individual head to be written to unit JHEDUN. (Read NHEADS times, when NHEADS>0).

Record 5

HDPR : Flag for head printing. Head is printed if HDPR is nonzero.
DDPR : Flag for drawdown printing. Drawdown is printed if DDPR is nonzero.
HDSV : Flag for head saving to disk. Head is saved if HDSV is nonzero.
DDSV : Flag for drawdown saving to disk. Drawdown is saved if DDSV is nonzero.

Changes to BAS1 Code

Changes to the BAS1 code are listed below by BAS1 module subroutine.

OC1AL

OC1AL is a new subroutine added to allocate array space for hydrograph output using the Output Control package.

BAS1RP

Subroutine BAS1RP has been modified to reserve values of IBOUND and to accommodate hydrograph and budget output. The parameters JHEDUN and IBUD, unit numbers for hydrograph and budget output, have been added. Special IBOUND values (currently 30000 and 99) are reserved in bold text following comment **C5a**. The call statement to subroutine SBAS1I is indicated in bold text following comment **C8**.

BAS1ST

BAS1ST has been modified to include the stress period length (variable PERLEN) as a subroutine argument. This makes this variable available for use by other subroutines.

SBAS1I

Subroutine SBAS1I has been modified to read unit numbers for hydrograph output (JHEDUN) and budget output (IBUD). The parameters JHEDUN and IBUD have been added. The unit numbers are read in the bold text following comment **C2**.

BAS1OC

Subroutine BAS1OC has been modified to read output hydrograph data. The parameters MXHEDS and NHEADS and the array XHEDMT have been added. Hydrograph cell locations are read from the output control input file in the bold text following comments **C3** and **C3a**.

BAS1OT

Subroutine BAS1OT has been modified to accommodate hydrograph and budget output. The parameters JHEDUN, IBUD, MXHEDS and NHEADS and the array XHEDMT have been added. The call statement to subroutine SBAS1H has been modified in the bold text following comment **C3**. A call statement to subroutine SBAS1B has been added in the bold text following comment **C4**.

SBAS1H

Subroutine SBAS1H has been modified to output hydrograph data. The parameters JHEDUN, MXHEDS and NHEADS and the array XHEDMT have been added. Hydrograph data are output in the bold text following comment **C0**.

SBAS1B

SBAS1B is a new subroutine added to print the volumetric budget to a separate output file.

DOCUMENTATION FOR OUT1

OUT1 is an output control package for MODFLOW that generates a user-specified set of output. OUT1 is activated in IUNIT(18) of the BAS input file in MODFLOW version **maj6x5**. Output is specified in a format similar to MODAFT. OUT1 performs the functions of MODAFT and STARTHED.

Input Records

Record 1 is read by module OUT1AL and *is read once for a simulation*.

variable:	KOUTOP	MXOTRC
format:	I10	I10

Record 2 is read by module OUT1OT and is read:

once for each time step when KOUTOP=0.
once for each stress period when KOUTOP>0.

variable:	ITMP
format:	I10

Records 3 and 4 are read by module OUT1OT a <u>combined</u> total of ITMP times when ITMP>0.

record 3 Read up to ITMP times when ITMP>0. Not read when ITMP≤0.

variable:	KCOM	KSUB	KNDX	KFRM	KFIL
format:	I10	I10	I10	I10	I10

record 4 Read KNDX times when KSUB=4. Not read otherwise.

variable:	KLAY	KROW	KCOL
format:	I10	I10	I10

Explanation of Variables

1. KOUTOP : Output control option.

   If KOUTOP=0, output control specifications are read for each time step.
   Output is generated for each time step.
   If KOUTOP=1, output control specifications are read for each stress period.
   Output is generated for each time step.
   If KOUTOP=2, output control specifications are read for each stress period.
   Output is generated for the last time step of each stress period.

   MOTRC: Maximum number of output control records. Must be greater than or equal to the largest value of ITMP (Record 2) within a simulation.

2. ITMP: Number of output control records.

   If ITMP <0, output control specifications from the previous time step or stress period are re-used.
   If ITMP>0, ITMP output control records (combined total of records 3 and 4) are read.
   If ITMP=0, no output is generated for the current time step or stress period.

3. KCOM: Component of output desired:

If KCOM =0, **hydraulic head** is output.
=1, “**storage**” flow is output.
=2, “**constant head**” flow is output.
=3, “**flow right face**” is output.
=4, “**flow front face**” is output.
=5, “**flow lower face**” is output.
=6, “**wells**” (WEL1) flow is output.
=7, “**drains**” flow (DRN1, copy 1, IUNIT 3) is output.
=8, “**recharge**” (RCH1) flow is output.
=9, “**ET**” (EVT1) flow is output.
=10, “**river leakage**” (RIV1 flow) is output.
=11, “**head dependent bounds**” (GHB) flow is output.
=12, “**river 2 leakage**” (RIV2 flow to groundwater) is output.
=13, “**lake seepage**” (LAK2 flow to groundwater) is output.
=14, “**drains**” flow (DRN1, copy 2, IUNIT 14) is output.
=15, “**river 2 downstream flow**” (RIV2 surface flow) is output.
=16, **hydraulic head** is output (same as KCOM=0).
=17, (inactive, reserved for NCF1 “diagonal flow”)
=18, “**river 2 reinjection**” (DIV1 injection of diverted surface flow) is output
=19, (inactive, reserved for “drawdown”)

KSUB: Subset of output desired:

If KSUB=0, the entire array is output
=1, a layer of the array is output
=2, a row of the array is output
=3, a column of the array is output
=4, a selection of points from the array is output

KNDX: Index number for KSUB:

If KSUB=0, KNDX is not used.
If KSUB=1, KNDX is the layer number output
If KSUB=2, KNDX is the row number output
If KSUB=3, KNDX is the column number output
If KSUB=4, KNDX is the number of points to be output (read in Record 4)

KFRM: format of output. KFRM is discussed below.

KFIL: Unit number for output file. Output described by KCOM, KSUB, KNDX and KFRM is output to unit KFIL.

4. KLAY KROW KCOL

The layer, row, column indices of specific points to be output.
Read KNDX times when KSUB=4.

Explanation of KFRM

KFRM is the format of output. Its meaning is dependent on the value of KSUB.

If KSUB=0 (entire array output):

If KFRM=0, the array is output as a list of records in the form of *layer, row, column, value*

=1, the array is output in UBUDSV format (3 dimensional unformatted output, used in MODFLOW for unformatted cell-by-cell flow output).

=2, the array is output in ULASAV format (layer by layer unformatted output, used in MODFLOW for unformatted head output). Use this format to generate starting head files.

=3, the array is output as a list of records in the form of *row, column, period, step, time, value*

If KSUB=1 (one layer output):

If KFRM=0, the layer is output as a list of records in the form of la*yer, row, column, value*

=1, the layer is output as a list of records in the form of *row, column, value*

=2, the layer is output in ULASAV format (layer by layer unformatted MODFLOW output).

=3, the layer is output as a list of records in the form of *row, column, period, step, time, value*

>11, the layer is output in wrap/strip format (ULAPRW and ULAPRS, used by mudflow to print heads). The format number used is determined by computing KFRM1=KFRM-24: If KFRM1<0, strip format (ULAPRS) is used, with format number –KFRM1. Otherwise, wrap format (ULAPRW) is used, with format number KFRM1:

KFRM1	U1/2DREL	U2DINT
0	10G11.4	10I11
1	11G10.3	60I1
2	9G13.6	40I2
3	15F7.1	30I3
4	15F7.2	25I4
5	15F7.3	20I5
6	15F7.4	
7	20F5.0	
8	20F5.1	
9	20F5.2	
10	20F5.3	
11	20F5.4	
12	10G11.4	

If KSUB=2 (one row output):

If KFRM=0, the row is output as a list of records in the form of *layer, row, column, value*

=1, the row is output as a list of records in the form of *layer, column, value*

=2, the row is output as a list of records in the form of *layer, column, period, step, value*

=3, the row is output as a list of records in the form of *layer, column, period, step, time, value*

=4, the row is output as a list of records in the form of *layer, column, time, value*

If KSUB=3 (one column output):

If KFRM=0, the column is output as a list of records in the form of *layer, row, column, value*

=1, the column is output as a list of records in the form of *layer, row, value*

=2, the column is output as a list of records in the form of *layer, row, time, value*

=3, the column is output as a list of records in the form of *layer, row, period, step, value*

=4, the column is output as a list of records in the form of *layer, row, period, step, time, value*

If KSUB=4 (list of points output):

If KFRM=0, output is generated in hydrograph format: Each line of the output file contains stress period and time step numbers and a value for each point. The header of the file contains the layer, row and column location of each point.

=1, output is generated in list format: Each line of the output file contains information in the form of *period, step, layer, row, column, value*

DOCUMENTATION FOR ZON1

ZON1 is an output control package for MODFLOW that generates zone budgets. ZON1 is activated in IUNIT(20) of the BAS input file in MODFLOW version **maj6x5**. ZON1 uses the memory allocated by OUT1 (IUNIT(18)), and will not run if OUT1 is not also activated.

Input Records

Record 1 is read by module ZON1AL and *is read once for a simulation*.

variable:	NZONES	KZONOP	KZONOT
format:	I10	I10	I10

Record 2 is read by module ZON1OT and *is read once for each layer*.

variable:	IZON (NCOL,NROW)
format:	(U2DINT)

Record 3 is read by module ZON1OT and *is read once for each stress period if KZONOP>0*,
once for each time step if KZONOP=0

variable:	ITMP
format:	(I10)

Record 4 is read by module ZON1OT when ITMP > 0

variable:	ICODES (NZONES)
format:	(50I2)

Explanation of Variables

1. NZONES: The number of zones in the model grid. Set NZONES equal to the highest number in the zone array, IZON.

   KZONOP: Options for zone budget output
   If KZONOP=0 Record 3 is read each time step. Output is generated each time step.
   =1 Record 3 is read each stress period. Output is generated each time step.
   =2 Record 3 is read each stress period. Output is generated on the last time step of each stress period.

   KZONOT: Unit number for zone budget output.

2. IZON: Zone designation for each cell. One array is read for each layer

3. ITMP: Flag for reading output specifications (Record 4)
   If ITMP>0 Record 4 is read. Output is generated based on flags set in Record 4.
   =0 Record 4 is not read. No output is generated.
   <0 Record 4 is not read. Output is generated based on the previous reading of Record 4.

4. ICODES: Output flag for each zone. If ICODES(K) is not zero, output is generated for zone K.

MODIFICATIONS TO LKMT

The LKMT package has been added to enable use of MT3D (Zheng, 1996). The LKMT package saves MODFLOW output in the format used for MT3D input.

Modifications

(a) the LKMT package has been made into a subroutine; (b) the LKMT package is distributed as an included block in the main MODFLOW program; (c) subroutine LKMT contains the code from the included block; (d) subroutines LAK2MT and RIV2MT have been added to the LKMT package to allow MT3D interfaces for the LAK2 and RIV2 packages.

DOCUMENTATION FOR LKMP1

The LKMP1 package has been added to facilitate the use of MODPATH (Pollock, 1994), a particle tracking program. The LKMP1 package saves MODFLOW output in the format used for MODPATH input. LKMP1 generates a MODPATH input file, the Composite Budget File (*.cbf),

LKMP1 is activated by setting IUNIT(23) in the .BAS file to a non-zero unit number, then listing a file (*.cbf) with the same unit number in the master input file (".NAM" file). The CBF file will be saved to the unit number (IUNIT[23]) and filename specified.

PERCHED WATER, DRY CELLS, AND REWETTING

This group of modifications to MODFLOW was inspired by conditions encountered along the Carlin Trend of Northern Nevada. A highly-transmissive carbonate rock aquifer (the carbonate aquifer) has been dewatered for mining. The carbonate aquifer is represented using multiple model layers, with some cells becoming dry during the course of dewatering. These cells are rewet during the simulation of post-mining water level recovery.

The Carlin Formation overlies the carbonate aquifer in parts of the model area. It is composed of Tertiary-aged alluvial deposits with much lower permeability than the carbonate aquifer. Over the course of dewatering the carbonate water level has dropped below the bottom of the Carlin Formation and created a perched Carlin water table overlying a zone of desaturated carbonate rock.

Water drains through the dewatered but highly transmissive carbonate rock. Components of recharge to the carbonate aquifer that pass through the dewatered part of the aquifer include:

a) Recharge from the Carlin formation. Water drains from the Carlin Formation downward, through the dewatered carbonate rock, to the carbonate water table below.

b) Recharge from stream networks. Stream channels including Brush Creek, Rodeo Creek, Boulder Creek, and Bell Creek directly recharge the carbonate in outcrop areas.

c) Areal recharge. Direct infiltration of precipitation occurs over carbonate outcrops.

In order to properly represent the above conditions, the following modifications were made to the MODFLOW code.

Vertical Leakage Transfer

The BCF2 package (McDonald et al., 1991) has been modified to (optionally) transmit vertical leakage from above a dry cell to a lower, active layer. Thus the Carlin formation in Layer 1, initially leaking water to the carbonate aquifer in Layer 2, will leak water to the carbonate in Layer 3 after Layer 2 is dry.

Without modifications, MODFLOW already simulates perched aquifer units: Under non-perched conditions, vertical flow between two layers is calculated based on the difference in head between the two layers. As water level in the lower layer drops below the bottom of the upper layer, MODFLOW switches to calculating a flow based on water head in the upper layer only, assuming gravity drainage through the unsaturated zone to the water table below in the lower layer.

A problem arises as the Layer 2 carbonate aquifer cells become dry. Without modification, MODFLOW stops simulating drainage from the perched Carlin Formation to the carbonate water table below. This discontinuity in the equations used to calculate flow produced unrealistic results in the simulated carbonate aquifer water balance and in the simulated Carlin Formation water level trends and water balance.

With the modification, water continues draining at the same rate it was before the Layer 2 carbonate aquifer cells became dry. This restores continuity to the equations used to simulate groundwater flow.

The transfer of vertical leakage is appropriate to apply to the situation along the Carlin Trend, where a lower permeability unit is perched above a higher permeability unit. In some cases, the use of the unmodified algorithm, in which drainage stops as Layer 2 becomes dry, would be more appropriate. In other cases, the use of an unsaturated flow algorithm to represent Layer 2 may be most appropriate.

Vertical Transfer of Recharge and River Leakage

The RCH1 package (McDonald and Harbaugh, 1988) was already equipped with an option (NRCHOP=3) to add areal recharge to the uppermost active layer; therefore, no modifications were necessary to simulate recharge to a lower layer when the uppermost carbonate layers are dry.

The RIV2 package was similarly equipped with a feature that adds stream infiltration to the uppermost active layer. Thus rivers initially recharging the carbonate aquifer in Layer 1 will recharge the Layer 2 carbonate when Layer 1 is dry (and Layer 3 when Layer 2 is dry).

Vertical Transfer of Pumping

Historical pumping rates are modeled as specified flows using the module WEL1. Without modifications, MODFLOW removes pumping from the model when a pumping cell becomes dry. The WEL1 package has been modified to (optionally) shift pumping to the next layer down when a pumping cell becomes dry. This option preserves specified pumping rates.

The approach can be appropriate for representing dewatering wells that are completed in multiple layers, or wells that are assumed to be replaced when pumping levels become too low, and it eliminates the need to re-partition pumping between layers and re-specify WEL package input every time a cell becomes dry.

Transfer of Residual Storage

In a model time step in which a cell becomes dry, MODFLOW normally ignores the water stored in the cell at the beginning of the time step. This volume of water is lost to the model mass balance accounting. In the carbonate aquifer, however, this volume of water would percolate to the water table below. The BCF2 package has been modified to (optionally) transfer the residual storage volume from a dry cell to a lower, active cell, thus preserving the mass-balance accounting of aquifer storage.

Cell Rewetting

A simplified rewetting method allows dry cells to be rewet with a zero rewetting threshold, resulting in smoother rewetting and better continuity of groundwater flow equations. Dry cells are rewet when head in an underlying or adjacent cell is above the bottom of a dry cell. Cells may be rewet with a zero saturated thickness and cells can remain wet with a small saturated thickness.

MODIFICATIONS TO MODULE BCF2

The BCF2 package (McDonald et al., 1991) has been modified from its original version for the purpose of simulating conditions of drawdown and recovery of a high-permeability formation underlying a low-permeability formation. The modifications allow the simulation of a perched leaky aquifer by allowing the vertical flow of water through inactive high-permeability cells to a water table in the underlying active cells.

Modifications

The modifications to BCF2 provide an option for vertical transfer of flow, including:

The transfer of vertical flow from an active cell, goes through the underlying inactive cells to the uppermost active cell below. The transfer of vertical flow allows the simulation of a perched water table.

The transfer of storage flow from of a cell, in the time step in which it goes dry, to the uppermost active cell below. The vertical transfer of storage improves computation of cumulative mass balance.

The input parameter IWETIT, previously not used for rewetting simulations with vertical transfer, now is a cutoff iteration for rewetting. When IWETIT is greater than zero, cells are not rewet after iteration IWETIT.

The vertical transfer option may be used with or without rewetting. Vertical transfer simulations use a simplified rewetting algorithm appropriate to high-permeability material: A dry cell is rewet at the beginning of any iteration in which the cell below has a head higher than the bottom of the dry cell. The initial head of the rewet cell is set equal to the cell bottom.

Input Records

Input records for the modified BCF2 are unchanged from the original BCF2. Explanations of input parameters are unchanged except for the following:

IWDFLG rewetting/flux transfer flag.
if IWDFLG=0, cell rewetting and transfer of BCF2 flux components are not enabled.
if IWDFLG>0, BCF2 cell rewetting is enabled.
if IWDFLG<0, vertical transfer of BCF2 flux components is enabled.
if IWDFLG=-2, cell rewetting and vertical transfer of BCF2 flux components are enabled.

WETDRY rewetting array.
When IWDFLG=0 or -1, WETDRY is not read.
When IWDFLG>0 WETDRY is the rewetting array as originally used in BCF2.
When IWDFLG<-1 WETDRY is a rewetting flag: A cell may be rewet if WETDRY for the cell is not equal to zero.

Changes to BCF2 Code

BCF2AL

Subroutine BCF2AL has been modified to reflect vertical transfer of flow. The vertical transfer option is identified in bold text following comment **C2a**. The condition for allocation of array WETDRY is changed in the bold text following comment **C7a**.

BCF2RP

Changes to subroutine BCF2RP accommodating the vertical transfer option are indicated in bold text following comment **C2H**.

SBCF2N

Changes to subroutine SBCF2N accommodating the vertical transfer option are indicated in bold text following comments **C4B1** and **C4B4**.

BCF2AD

Subroutine BCF2AD has been modified to initialize HOLD for inactive cells during simulations using vertical transfer. The parameters KPER and KSTP have been added. New code is indicated in bold text following comment **C1**. Modified code is indicated in bold text following comment **C1a**.

BCF2FM

Transfer of Flux Components

BCF2 has been modified to transfer storage from dry cells to lower layers. Storage is transferred in subroutine BCF2FM in the bold text following comments **C4a**, **C4b** and **C5d**. BCF2 has also been modified to transfer vertical leakage from above to a lower layer from cells that desaturate. Vertical leakage is transferred in subroutine BCF2FM in the bold text following comments **C6** and **C6a**.

Secondary Modifications

Transfer of storage and vertical leakage is invoked in subroutine BCF2FM by an IBOUND value of 99, set in SBCF2H. Cells with an IBOUND value of 99 are deactivated in subroutine BCF2FM in the bold text following comment **C8d**.

SBCF2H

Rewetting

In transient simulations, vertical transfer of flux components from dry cells maintains the head in dry cells at the layer bottom. Dry cells may be rewet with a zero saturated thickness by ending transfer of flux components and restoring vertical conductance values. No wetting threshold is required, allowing cells to remain wet with a small saturated thickness. Dry cells are rewet when head in the layer below is above the bottom of the dry cell. The rewetting criteria are therefore equivalent to the bottom wetting option in BCF2 (WETDRY<0) with a rewetting interval of 1 (IWETIT=1) and a zero wetting threshold (WETFCT=0 and WETDRY=0). Cells are rewet in the bold text following comment **C2c**.

Secondary Modifications

Transfer of storage and vertical leakage is invoked in subroutine BCF2FM by an IBOUND value of 99. SBCF2H sets the IBOUND value of dry cells to 99 when the flux transfer option is invoked. Head in dry cells is set at the layer bottom elevation to allow computation of storage in dry cells. Dry cells entering SBCF2H are assigned IBOUND values of 99 in the bold text following comment **C2b**. As in the unmodified BCF2, horizontal and vertical conductance terms are set to zero. Unlike unmodified BCF2, vertical conductance from above is not set to zero (bold text following comment **C2d**), enabling the transfer of vertical leakage to lower layers. IBOUND values and heads are assigned to cells that become dry in the bold text following comment **C6c**.

BCF1BD

Subroutine BCF1BD has been modified to recognize the vertical transfer of storage from dry cells to lower layers. Flag IWDFLG and array CVWD have been added to the subroutine parameters. Modifications are contained in bold text in the subroutine header and in bold text following comments **C6** and **C6aa** and in the call statement to subroutine SBCF1F

SBCF1F

Subroutine SBCF1F has been modified to recognize the transfer of vertical flow through dry cells during computation of constant head flows. Flag IWDFLG and array CVWD have been added to the subroutine parameters. Modifications are contained in bold text following comments **C6E1** and **C6F1**.

Verification of Changes Made to BCF2

The modifications to BCF2 were verified using the example problems described in the BCF2 Package documentation (McDonald, Harbaugh, Orr, and Ackerman, 1991). Following is a brief description of the example problems and a comparison of the model results using both BCF2 and modified BCF2:

Problem 1 A steady-state problem, referred to as Problem 1 in the BCF2 Package documentation, was run. First the original problem was duplicated employing the modified BCF2 Package, with IWDFLG>0. The problem was then run with the flux transfer/rewetting option (IWDFLG=-2). Results closely matched the published Problem 1 results, computing the same number and location of active cells and a maximum head difference between simulations of .02 feet.

Problem 2a A steady-state problem, referred to as Problem 2a in the BCF2 Package documentation, was run. First the original problem was run, with IWDFLG>0. Results were confirmed to be identical to the published BCF2 results.

In a second simulation the problem was modified by the specification of absolute values of .0001 for WETDRY and WETFCT. The small wetting values approximate the zero wetting values of the flux transfer/rewetting option (IWDFLG=-2). Results were close to the published 2A results, with 2 more active cells in Layer 2, 3 more active cells in Layer 5 and head differences of up to .1 feet.

In a third simulation the problem was run with the flux-transfer/rewetting option (IWDFLG=-2). Results were identical to those of the second simulation.

Problem 2d A transient problem, 2d, was run. First the original problem was run, with IWDFLG>0. Results were confirmed to be identical to the published BCF2 results.

Second the problem was modified by the specification of absolute values of .0001 for WETDRY and WETFCT. The small wetting values approximate the zero wetting values of the flux transfer/rewetting option (IWDFLG=-2). The results of changing WETDRY and WETFCT for problem 2d resembled the results of changing WETDRY and WETFCT for problem 2a, with several more active nodes and head differences of up to .1 feet.

Third the problem was run with the flux-transfer/rewetting option (IWDFLG=-2). Results were identical to those of the second simulation.

Fourth, the problem was modified to test the transfer of vertical leakage. The recharge package was turned off and replaced with an initially wet Layer 1. The flux transfer option without rewetting (IWDFLG=-1) was enabled. Layer 1 was specified as active, with an initial head of 70 feet and a bottom of 65 feet. The last row and the last column of Layer 1 were de-activated to avoid vertical transfer of flow directly into constant head cells. Layers 2-9 were specified as inactive, unable to be rewet. Layers 10-14 were specified as active, with an initial head of 25 feet. Layer 1 is thus separated from the rest of the grid by inactive layers. The problem was run for 50 1-day time steps. As a perched aquifer, Layer 1 should drain according to the equation

$$Sy\frac{\partial h}{\partial t} = Vc(h-b)\,,$$

where,

h is hydraulic head
Sy=0.2 is specific yield
Vc=0.05/dy is vertical conductance
b=65 ft is layer bottom,

with a solution of $h = 65\,ft + (5\,ft)e^{-t/4dy}$

A comparison of numerical and analytical solutions is shown on the figure below:

.

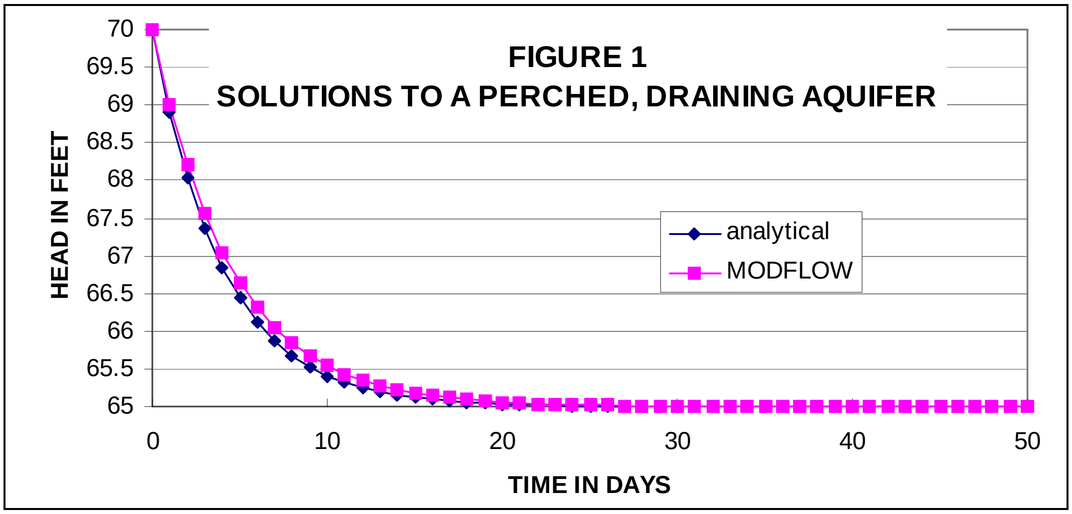

Figure 1 shows that the isolated layer drains as expected, with a reasonable match of the analytical solution. Furthermore, a 1-point implicit finite difference spreadsheet solution exactly matched the MODFLOW solution. Inspection of the mass balance table in the simulation output also shows that the water from Layer 1 enters aquifer storage or exits through constant heads in the active Layers 10-14.

Fifth, the problem was modified to test the transfer of storage. The bottom of Layer 1 is re-specified at 69.1 feet. The simulation is run for a 1 day time step, during which Layer 1 goes dry. Inspection of the mass balance table in the simulation output shows that the correct volume of storage flows from Layer 1:

$$(39 \text{ rows}) \times (39 \text{ columns}) \times (125 \text{ ft})^2 \times (0.9 \text{ ft}) \times (0.2) \;=\; 4.2778\times 10^6 \text{ft}^3$$

The Layer 1 storage entering the model exits the model as storage or constant head flow in the active Layers 10-14.

MODIFICATIONS TO BOUNDARY CONDITION MODULES

The following sections describe mostly minor modifications that are used to specify boundary conditions to a groundwater flow domain, including modules RCH1, EVT1, WEL1 and DRN1.

Modifications to Module WEL1

The original WEL package (McDonald and Harbaugh, 1988) has been modified to shift pumping down to the uppermost active layer when the assigned cell for a well is dry. This vertical flux transfer serves to maintain the total specified pumping flow for a simulated well that is completed in several layers. Prior to modification, MODFLOW removes pumping from the simulation when a cell goes dry; vertical flux transfer therefore eliminates the need to re-partition pumping between layers and re-specify WEL package input every time a cell goes dry. Vertical flux transfer is accomplished by means of an extra variable in the WELL array that serves as a flag indicating whether vertical transfer is to be used for a given well. Modifications to WEL1AL, WEL1RP, WEL1FM and WEL1BD are indicated in bold text.

Modifications

In subroutine WEL1AL the dimensioning of array WELL is 5* MXWEL instead of 4* MXWEL. Modified code is indicated by bold text in the line following comment **C4**. The new dimension of WELL is also indicated by bold text in the DIMENSION statements of WEL1RP, WEL1FM and WEL1BD.

In subroutine WEL1RP the READ statement in the fifth line following comment **C5** has been modified to also read a vertical transfer flag. Modified code is indicated by bold text.

In subroutine WEL1FM, vertical transfer is performed in the bold text following comment **C2aa**.

In subroutine WEL1BD, vertical transfer is performed in the bold text following comment **C5aa**.

Input Records

Record 1 is read by module WEL1AL and *is read once for a simulation*.

record 1	variable:	MXWEL	IWELCB			
	format:	I10	I10			

Records 2 and 3 are read by module WEL1RP and *are read once for each stress period*.

record 2	variable:	ITMP				
	format:	I10				
record 3	Read ITMP times when ITMP>0. Not read when ITMP≤0.					
	variable:	LAYER	ROW	COLUMN	RATE	IVTF
	format:	I10	I10	I10	F10.0	I10

Explanation of Variables

1. MXWEL : Maximum number of wells in any stress period.
   IWELCB : Flag and unit number for node-by-node WEL output.
      If IWELB>0, well flows are saved unformatted on unit number IWELCB whenever the flag ICBCFL from the OC Package is nonzero.
      If IWELCB<0, well flows are printed to the main output file. In the future they will be printed to unit number -IWELCB.
      If IWELCB=0, well flows are not printed or saved.
2. ITMP : If ITMP≥0, ITMP is the number of wells used in the current stress period.
      If ITMP<0, the well list from the previous stress period is reused.
3. LAYER : Layer of well cell/node.
   ROW : Row of well cell/node.
   COLUMN : Column of well cell/node.
   RATE : Pumping rate of well.
   IVTF : Vertical transfer flag for well.
      If IVTF is not equal to zero, vertical transfer is performed.
      If IVTF is equal to zero, vertical transfer is not used.

Modifications to Module DRN1

The Drain Package has been modified from its original version (McDonald and Harbaugh, 1988). The function of the Well Package has been incorporated into the Drain Package. The modification allows a convenient representation of pumping wells, in which a well may pump a specified rate or a head-dependent rate. Vertical flow transfer may be used with the Well package function of DRN.

Modifications

In subroutine DRN1AL a vertical transfer is read following comment **C2**. The dimension of array DRAI is 6* MXDRN instead of 5* MXDRN. Modified code is indicated by bold text in the line following comment **C4**. The new dimension of DRAI is also indicated by bold text in the DIMENSION statements of DRN1RP, DRN1FM and DRN1BD.

In subroutine DRN1RP the READ statement in the fifth line following comment **C7** has been modified to also read a pumping rate. Modified code is indicated by bold text.

In subroutine DRN1FM the function of the Well Package is performed in the bold text following comment **C3b**. Vertical transfer for the Well package function is performed in the bold text following comment **C3a**.

In subroutine DRN1BD the function of the Well Package is performed in the bold text following comment **C5c** and indicated by bold text in the lines following comments **C5a** and **C9**. Vertical transfer for the Well package function is performed in the bold text following comment **C5b**.

Input Records

Record 1 is read by module DRN1AL and *is read once for a simulation*.

record 1	variable:	MXDRN	IDRNCB	ID1VT		
	format:	I10	I10	I10		

Records 2 and 3 are read by module DRN1RP and *are read once for each stress period*.

record 2	variable:	ITMP					
	format:	I10					
record 3	Read ITMP times when ITMP>0. Not read when ITMP≤0.						
	variable:	LAYER	ROW	COLUMN	HEAD	COND	RATE
	format:	I10	I10	I10	(3F10.0)		

Explanation of Variables

1. MXDRN : Maximum number of drains in any stress period.

IDRNCB : flag and unit number for node-by-node DRN output.

If IDRNCB>0, drain flows are saved unformatted on unit number IDRNCB whenever the flag ICBCFL from the OC Package is nonzero.

If IDRNCB<0, drain flows are printed to the main output file. In the future they will be printed to unit number -IDRNCB.

If IDRNCB=0, drain flows are not printed or saved.

ID1VT : Vertical transfer flag. If ID1VT is not zero, vertical transfer is used for the well function part of DRN : Pumping (RATE in record 3) is placed in the uppermost active layer.

2. ITMP : If ITMP≥0, ITMP is the number of drains used in the current stress period.

If ITMP<0, the drain list from the previous stress period is reused.

3. LAYER : Layer of drain cell/node.

ROW : Row of drain cell/node.

COLUMN : Column of drain cell/node.

HEAD : Elevation of drain.

COND : Conductance of drain.

RATE : Pumping rate of well

Modifications to Module RCH1

The areal Recharge Package, version 1, RCH1 (McDonald and Harbaugh, 1988), has been modified to include a seasonal input option. When the seasonal option is invoked, the RCH1 input file is rewound and recharge data from the first stress period are used. The seasonal option may be seen in subroutine RCH1RP in the bold text following comment **C2**. Following are revised input instructions. The seasonal input option is described in Record 2 (INRECH).

Input Records

Record 1 is read by module RCH1AL and *is read once for a simulation.*

record 1.

variable:	NRCHOP	IRCHCB
format:	I10	I10

Records 2-4 are read by module RCH1RP and *are read once for each stress period.*

record 2.

variable:	INRECH	INIRCH
format:	I10	I10

record 3. Read if INRECH is greater than or equal to 0.

variable: RECH(NCOL,NROW)
format: U2DREL

record 4. Read if NRCHOP=2 and INIRCH is greater than or equal to 0.

variable: IRCH(NCOL,NROW)
format: U2DINT

Explanation of Variables

<u>record 1</u>

NRCHOP : RCH option.

If NRCHOP=1, recharge is specified for the top layer.

If NRCHOP=2, the user specifies the recharge layer at each horizontal location using array IRCH.

If NRCHOP=3, recharge is applied to the top-most active layer. If the top-most active layer at a given horizontal location is a constant head cell/node, recharge is not applied to that location.

IRCHCB : flag and unit number for node-by-node RCH output.

When IRCHCB>0, node-by-node terms are recorded on unit IRCHCB.

<u>record 2</u>

INRECH : recharge rate (RECH) read flag.

If INRECH is greater than or equal to 0, RECH is read.

If INRECH=-1, RECH from the previous stress period is used.

If INRECH<-1, the input file is rewound and RCH input for the first stress period is read.

INIRCH : Layer indicator (IRCH) read flag.

If NRCHOP=2 and INIRCH is greater than or equal to 0, IRCH is read. Otherwise (if NRCHOP=2), IRCH from the previous stress period is used.

<u>record 3</u>

RECH : recharge rate (L/t).

<u>record 4</u>

IRCH : Layer indicator array. Used if NRCHOP=2. At each horizontal location, IRCH indicates the layer to which recharge is applied.

Modifications to Module EVT1

The Evapotranspiration Package, version 1, EVT1 (McDonald and Harbaugh, 1988), has been modified to include a seasonal input option. When the seasonal option is invoked, the EVT1 input file is rewound and recharge data from the first stress period are used. The seasonal option may be seen in subroutine EVT1RP in the bold text following comment **C2**. Following are revised input instructions. The seasonal input option is described in Record 2 (INSURF).

Input Records

Record 1 is read by module EVT1AL and *is read once for a simulation.*

record 1.

variable:	NEVTOP	IEVTCB
format:	I10	I10

Records 2-6 are read by module EVT1RP and *are read once for each stress period.*

record 2.

variable:	INSURF	INEVTR	INEXDP	INIEVT
format:	I10	I10	I10	I10

record 3. Read if INSURF greater than or equal to 0.
variable: SURF(NCOL,NROW)
format: U2DREL

record 4. Read if INEVTR greater than or equal to 0.
variable: EVTR(NCOL,NROW)
format: U2DREL

record 5. Read if INEXDP greater than or equal to 0.
variable: EXDP(NCOL,NROW)
format: U2DREL

record 6. Read if NEVTOP=2 and INIEVT greater than or equal to 0.
variable: IEVT(NCOL,NROW)
format: U2DINT

Explanation of Variables:

record 1.

NEVTOP : ET option.
1 - ET is calculated for the top layer.
2 - the user specifies the ET layer at each horizontal location using array IEVT.

IEVTCB : flag and unit number for node-by-node EVT output.
When IEVTCB>0, node-by-node terms are recorded on unit IEVTCB.

record 2.

INSURF : ET surface (SURF) read flag.

If INSURF greater than or equal to 0, SURF is read.

If INSURF=-1, SURF from the previous stress period is used.

If INSURF<-1, the input file is rewound and EVT input for the first stress period is read and used.

INEVTR : Maximum ET rate (EVTR) read flag. If INEVTR is greater than or equal to 0, EVTR is read.

Otherwise, EVTR from the previous stress period is used.

INEXDP : Extinction depth (EXDP) read flag. If INEXDP is greater than or equal to 0, EXDP is read.

Otherwise, EXDP from the previous stress period is used.

INIEVT : Layer indicator (IEVT) read flag. If NEVTOP=2 and INIEVT greater than or equal to 0, IEVT is read. Otherwise (if NEVTOP=2), IEVT from the previous stress period is used.

record 3: SURF : ET surface elevation.

record 4: EVTR : Maximum ET rate.

record 5: EXDP : Extinction depth.

record 6: IEVT : Layer indicator array. Used if NEVTOP=2.

At each horizontal location, IEVT indicates the layer from which ET is taken.

DOCUMENTATION FOR RIV2

The River Package, version 2 (RIV2), developed by the USGS (Miller, 1988) is a FORTRAN package for the U.S. Geological Survey Modular Groundwater Flow Model, MODFLOW (McDonald and Harbaugh, 1988). RIV2 has been modified to allow unformatted output of streamflow, to include a seasonal input option, to allow input of new river reach data while repeating river node data and to allow input of new river node data while repeating river reach data. In addition, river recharge is now placed in the uppermost active layer. The capability to simulate diversion of river flow and optional transfer and re-injection of diverted flow to a new location has also been added. This diversion capability was added through a set of subroutines that all include the characters "DIV1" in their names. Input data for the diversion capability is in a file that is separate from the RIV2 input file.

RIV2 Narrative (from Miller, 1988)

The main features of RIV2 are:

1. The river system is divided into reaches and simulated river discharge is routed from one reach to another in a specified sequence. Within a reach, river discharge is routed from one node to the next.
2. Inflow (river discharge) entering the upstream end of a reach can be specified.
3. More than one river can be represented at one node and rivers can cross, as when representing a siphon.
4. The quantity of leakage to or from the aquifer at a given node is proportional to the hydraulic-head difference between that specified for the river and that calculated for the aquifer. Also, the quantity of leakage to the aquifer at any node can be limited by the user and, within this limit, the maximum leakage to the aquifer is the discharge available in the river. This feature allows for the simulation of intermittent rivers and drains that have no discharge routed to their upstream reaches.
5. An accounting of river discharge is maintained.

Neither stage-discharge relations nor storage in the river or river banks is simulated.

The modeling concepts necessary for the operation of RIV2 differ little from those for RIV1. The differences are largely due to features adapted from the modeling code of Posson et al. (1980) and Hearne (1982). The RIV2 code represents a number of nodes that simulate leakage from or to an overlying river. Certain features of a river that would be essential in a surface-water model, such as storage in the channel or banks, are not represented because RIV2, like RIV1, is considered to be a boundary condition in a ground-water model, not a surface-water model.

The rate of leakage at each node is directly proportional to the difference between the hydraulic head in the aquifer and the stage of the river, but is limited to the lesser of either a user-specified maximum or the intermittent and ephemeral rivers. Leakage from the aquifer to the river is not limited in RIV2.

The user needs to supply the hydraulic-connection coefficient, the limiting maximum rate of leakage to the aquifer, and the river stage for each node. It is possible for the user to re-specify the river characteristics (stage, hydraulic-connection coefficient, and limiting maximum rate of leakage to the aquifer and river stage) for each stress period. They hydraulic-connection coefficient, CRIV, may be defined as the conductance of the reach of the riverbed with units of length squared per unit time:

$$CRIV = K'\,A'/b$$

where K’ = vertical hydraulic conductivity of the riverbed material
A’ = area of the river channel; and
b = thickness of the riverbed material

The river discharge for a node is equal to the river discharge into the node minus the leakage to the aquifer or plus the leakage from the aquifer. The river stage, the wetted perimeter of the river channel, and the conductance of the riverbed material in a river vary with the discharge of the river. The constant values used in RIV2 limit its accuracy, but the error probably is not as great as it would be if the aquifer were allowed to gain more water from the river than the river contained.

The river-discharge-routing procedure in RIV2 uses a higher order structure that is not used in RIV1. A river, as represented in the framework of the model, consists of one or more reaches, and each reach consists of one or more nodes. (This definition of the term “reach” is distinctly different from that of RIV1.) A node may be part of more than one river reach. The river discharge at the upstream end of a reach consists of the river discharge from upstream reaches plus any user-specified tributary inflow. The river discharge from the downstream end of a reach may be routed to any downstream reach. The structure allows representation of tributaries.

RIV2, like RIV1, separates the leakage term into explicit and implicit parts. The explicit part of the leakage term is added to the variable RHS. (RHS is the right side of a finite-difference equation and is an accumulation of the terms that are independent of hydraulic head at the current time step. Terms in RHS are defined by various model packages.) The term added to RHS may have either of two forms. If the hydraulic head computed for the aquifer during the previous iteration was greater that the hydraulic head required to produce the limiting value of leakage to the aquifer, then the following FORTRAN assignment is made:

$$RHS = CRIV * HRIV$$

where, HRIV is the river stage, and other terms are as previously defined. If the hydraulic head computed for the aquifer during the previous iteration was less than or equal to the hydraulic head required to produce the limiting value of leakage to the aquifer, then the assignment is:

$$RHS = RHS - CRIV * (HRIV - HMIN)$$

where, HMIN is the hydraulic head required to produce the limiting value of leakage to the aquifer, and other terms are as previously defined.

The implicit part of the leakage term is added to the variable HCOF. (HCOF) is the coefficient of hydraulic head for the node (J, I, K) in the finite-difference equation.) The implicit term may, like the explicit term, have either of two forms. If the hydraulic head computed for the aquifer during the previous iteration was greater than the hydraulic head required to produce the limiting value of leakage to the aquifer, then the following FORTRAN assignment is made:

$$HCOF = HCOF - CRIV$$

where, all terms are as previously defined. The implicit term is zero when the hydraulic head computed for the aquifer during the previous iteration was less than or equal to the hydraulic head necessary to produce the limiting value of leakage to the aquifer. In this instance, the leakage term included in the solution algorithm is explicit.

Modifications

The following are modifications to the original RIV2 Package:

The River Package, version 2, RIV2, has been modified to allow unformatted output of streamflow. Streamflow for each river node is saved when the flag IDQ (record 1) is set.

RIV2 has been modified to include a seasonal input option. The RIV2 input file is rewound, and river data from the first stress period re-read, when the flag ITMP (record 3) is less than -1.

RIV2 has been modified to allow input of new river reach data while repeating river node data. River reach data will be read, and river node data repeated, when the flag IREAC (record 3) is set.

RIV2 has been modified to allow river leakage to be placed in the uppermost active model layer. The flux transfer option is invoked by the flag IR2VT in record 1 below.

DIV1**,** which is a subpackage to RIV2, has been developed to expand the capabilities of the River Package. DIV1 permits a portion of existing river flow to be diverted and routed to another location in the model. Streamflow is subtracted from a user specified river node. All or part of the flow is added directly to the RHS vector of a user specified model cell.

Input Records

Records 1 and 2 are read by module RIV2AL and are *read once for a simulation*:

<u>record 1</u>

Data:	MXRIVR	IRIVCB	IDQ	IDIV	IR2VT
Format:	I10	I10	I10	I10	I10

<u>record 2</u>

Data:	MXREAC
Format:	I10

Records 3, 4, 5 and 6 are read by module RIV2RP and are *read each stress period*.

<u>record 3</u>

Data:	ITMP	IREAC
Format:	I10	I10

<u>record 4</u>

Data:	NR
Format:	I10

<u>record 5</u> read NR times.

Data:	NREA	NNRE	RQIN	NADD
Format:	I10	I10	F1O.0	I10

(record 5 consists of one record for each river reach active during the current stress period. The reaches need to be specified in downstream order.)

<u>record 6</u> read ITMP times, when ITMP>0.

Data:	Layer	Row	Column	STAGE	COND	QMAX
Format:	I10	I10	I10	F10.0	F10.0	F10.0

(record 6 consists of one record for each river node active during the current stress period. The nodes need to be specified in downstream order, consistent with the specification of the river reaches.)

Explanation of Variables

record 1

MXRIVR is the maximum number of river nodes active at one time.

IRIVCB is a flag and a unit number.

If IRIVCB > 0, then node-by-node flow terms will be recorded on unit IRIVCB whenever ICBCFL (see Output Control) is set.

If IRIVCB = 0, then node-by-node flow terms will be neither printed nor recorded.

If IRIVCB < 0, then river leakage for each reach will be printed whenever ICBCFL is set.

IDQ is a flag indicating whether downstream flows are to be saved.

If IDQ ≠ 0, then streamflow for each river node will be recorded on unit IRIVCB whenever ICBCFL (see Output Control) is set.

If IDQ = 0, then streamflow will not be recorded.

IDIV is a flag and a unit number activating the DIV1 subpackage for river diversions.

If IDIV > 0 then DIVI is unit number from which DIV1 input is read (see input instructions below).

IR2VT is a flag for vertical transfer of river leakage.

If IR2VT=0, vertical transfer is not used: River leakage is placed in the specified layer, if active.

If IR2VT≠ 0, vertical transfer is used: River leakage is placed in the uppermost active layer.

record 2 MXREAC is the maximum number of river reaches active at one time.

record 3

ITMP is a flag and a counter.

If ITMP <-1, the input file is rewound. River node data and river reach data from the first stress period are used.

If ITMP =-1, then river node data from last stress period will be re-used.

If ITMP ≥ 0, ITMP is the number of river nodes active during the current stress period.

IREAC is a flag for reading river reach data when ITMP=-1.

If IREAC = 0 and ITMP=-1, river reach data and river node data from the previous stress period are re-used. Records 4, 5 and 6 are not read.

If IREAC ≠ 0 and ITMP=-1, river reach data is read, but river node data from the previous stress period are re-used. Records 4 and 5 are read, and record 6 is not read.

record 4 NR if NR<0, river reach data from the previous stress period are re-used.
if NR>0, NR is the number of river reaches active in the current stress period.

record 5 **river reach data**

NREA is the river-reach number.

NNRE is the number of river nodes in the reach.

RQIN is the river discharge added at the upstream end of the reach.

NADD is the number of the downstream reach (zero, if none).

record 6 **river node data**

LAYER is the layer number of the river node.

ROW is the row number of the river node.

COLUMN is the column number of the river node.

STAGE is the hydraulic head in the river.

COND is the riverbed hydraulic conductance.

QMAX is the maximum allowable leakage to the aquifer.

DOCUMENTATION FOR DIV1

DIV1 enables water to be diverted from a river channel and permits the optional transfer of the diverted water to another location within the model. This feature allows the simulation of processes such as the extraction of river water for application to agricultural lands, direct recharge of a reservoir or unspecified municipal/industrial use. Multiple diversions may be made, each being extracted from a single river node and re-injected into a single model cell. Each diversion is specified using the following variables:

NODE = RIV2 node from which water is to be diverted. $NODE \in (1, MXRIVR)$

Qd = maximum rate of water to be diverted. The actual flow diverted by DIV1 is the minimum of Qd and available river flow.

Qa = That portion of Qd assumed to be accounted for elsewhere, not to be re-injected by DIV1. Qa may represent water put into the model by other MODFLOW packages or water removed from the simulation. The amount of water diverted over Qa is re-injected.

ILAY, IROW, ICOL = The layer, row and column indices of the cell into which diverted water is re-injected.

For each RIV2 node (node number) to be diverted from, subroutine DIV1RP sets a flag in MXRIVR(7,NODE) to indicate the diversion. As subroutine RIV2FM is looping through river nodes it checks the flag for diversions. When diversions are found, RIV2FM calls subroutine DIV1FM to perform the diversion.

The amount of water diverted is computed as the minimum of Qd and available river flow:

$$Qdiverted = \min(Qd, Q(NODE))$$

where, Q(NODE) is the streamflow at the river node.

The amount of water re-injected is the difference between the amount diverted and Qa:

$$Qreinjected = \max(0, Qdiverted - Qa)$$

Input Records

Records 1 is read by module DIV1AL and is read *once for a simulation*:

record 1

Data:	MXDIV	IDIVOT
Format:	I10	I10

Records 2, and 3 are read by module RIV2RP and are read *each stress period*

record 2

Data:	ITMP
Format:	I10

record 3

Read ITMP times when ITMP ≥ 0

Data:	NODE	ILAY	IROW	ICOL	QD	QA
Format:	I10	I10	I10	I10	F10.0	F10.0

Explanation of Variables

record 1
MXDIV is the maximum number of river diversions occurring during the simulation.
IDIVOT is a flag and a unit number.
  If IDIVOT > 0, then node-by-node flow terms will be recorded on unit IDIVOT whenever ICBCFL (see Output Control) is set.
  If IDIVOT = 0, then node-by-node flow terms will be neither printed nor recorded.

record 2
ITMP is a flag and a counter.
  If ITMP <0, information from the previous stress period is repeated. River reach data from the first stress period is used.
  If ITMP ≥ 0, ITMP is the number of river nodes active during the current stress period.

record 3
NODE is the river node number as defined in RIV2 (from 1 to MXRIVR) from which water is to be diverted.
ILAY is the layer number of the location for the re-injection of diverted water
IROW is the row number of the location for the re-injection of diverted water
ICOL is the column number of the location for the re-injection of diverted water
QD is the volume of water diverted from the river
QA is the volume of water re-injected into the modeled system

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APPENDIX: DOCUMENTATION FOR MODULE LAK2

DOCUMENTATION OF LAK2: A COMPUTER PROGRAM TO SIMULATE THE PRESENCE OF LAKES AND OTHER OPEN WATER BODIES WITHIN A GROUNDWATER FLOW SYSTEM USING THE MODFLOW GROUNDWATER FLOW MODEL

ABSTRACT

LAK2 is a module for the U.S. Geological Survey Modular Groundwater Flow Model (MODFLOW) that simulates the interconnection between a groundwater system and an adjacent open water body such as a lake, an open pit or a well bore.

The module has been in use since 1998. Although other modules have subsequently been published (lake package, USGS OFR 00-4167 and Multi-Node Well Package, USGS OFR 02-293) that perform some of the same functions, these only provide stable and accurate solutions for a limited range of problems, and break down under strongly transient or nonlinear conditions, when aquifer water level and "lake" water level are each sensitive to the other.

The main difference between LAK2 and other modules is the method used to solve two parallel but interdependent (coupled) sets of equations governing (1) groundwater levels and flows and (2) "lake" water levels and flows. Other modules solve partially decoupled forms of the equations with good results for a limited range of problems, but with slow convergence, instability and mass balance errors for other applications. LAK2 solves the fully coupled system of equations and provides efficient, stable, convergent solutions without mass balance errors.

LAK2 was first reviewed and accepted for use in the state of Nevada for simulation of post-mining water level recovery in an open pit (BLM, 2000). LAK2 has since been applied to pit-filling simulations for sites in Nevada, New Mexico, Canada, Chile, and Tanzania. Other applications have involved modeling borehole hydraulics and wells intersecting multiple model cells. Further applications potentially include the representation of natural lakes, caverns or other open spaces linked to a groundwater system.

This report presents LAK2 documentation and selected applications including:

- Module documentation: Presentation of algorithm, input instructions and simple test case.
- Archimedes pit: Demonstration of the representation of lake (pit) geometry and water balance, projection of future water level and water balance.
- Ortiz pit: Calibration of a groundwater flow model to historical pit water levels, post-audit of water level projections.
- Belen municipal well: Representation of a well pumping from multiple layers, correcting the erratic numerical solution previously obtained.
- Fan Sediments aquifer test: Simulation of borehole water levels for analysis of aquifer test results and projection of future pumping water levels.

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DOCUMENTATION OF LAK2: A COMPUTER PROGRAM TO SIMULATE THE PRESENCE OF LAKES AND OTHER OPEN WATER BODIES WITHIN A GROUNDWATER FLOW SYSTEM USING THE MODFLOW GROUNDWATER FLOW MODEL

INTRODUCTION

This report describes a module that has been used since 1998 to solve the fully coupled system of equations describing groundwater flow and lake/water body mass balance. The module applies to both larger-scale water bodies such as open pits and smaller-scale bodies such as well bores.

Previous Work

Software for modeling of lakes in conjunction with surrounding groundwater systems, using the U.S. Geological Survey Modular Groundwater Flow Model (MODFLOW), dates back to at least 1993 (Cheng and Anderson, 1993). Other lake modules developed for MODFLOW include those by HSI Geotrans (Council, 1999) and most recently by USGS (Merritt and Konikow, 2000). Another module was developed to represent well bores intersecting multiple model cells (Halford and Hanson, 2002).

All of these modules utilize an algorithm that treats the mass balance equation governing lake stage as if it were decoupled from the equations governing the groundwater system. They have been successfully used to represent natural lakes with little change, or slow change, in water level and they work acceptably well for a range of applications where lake stage does not strongly influence groundwater heads and where simulation time steps are sufficiently small so that the lake stage does not change too much in a single time step.

The decoupling of equations is done as follows: MODFLOW iteratively solves the system of equations governing groundwater head. The equation governing lake stage is then solved, after the iterative process has finished. Because groundwater head and lake stage are mutually dependent variables, errors result in both groundwater and lake solutions.

The decoupled solution algorithms break down for strongly transient problems, such as recovery of water level in an open pit after mining has ceased, or for highly sensitive problems where lake stage strongly influences groundwater levels. Mass balance errors become large and stability or convergence limits require impractically short time step lengths with long model run times.

The module described here solves the fully coupled system of equations describing groundwater flow and lake mass balance. The equations governing lake stage are solved at each iterative step of the groundwater flow solution process, thus simultaneously solving for lake stage and groundwater head. The algorithm produces stable, efficient and convergent solutions without mass balance error.

Structure of Report

This report includes the following chapters:

1. Module documentation: Presentation of algorithm, input instructions and simple test case.
2. Application: Archimedes pit. Representation of lake (pit) geometry and water balance, projection of future water level and water balance.
3. Application: Ortiz pit. Calibration of a groundwater flow model to historical pit water levels, post-audit of water level projections.
4. Application: Belen municipal well. Representation of a well pumping from multiple layers, correcting the erratic numerical solution previously obtained.
5. Application: Fan Sediments aquifer test. Simulation of borehole water levels for analysis of aquifer test results and projection of future pumping water levels.

1.0 DOCUMENTATION

1.1 LAKE WATER BALANCE

Groundwater flow systems can be influenced by stationary surface water features (lakes) including natural lakes, constructed reservoirs, retired mine pits and wetlands. Lakes can function as hydraulic sinks with groundwater inflow, as hydraulic sources of groundwater recharge or as flow-through lakes with both groundwater inflow and groundwater outflow. A lake may serve to connect distinct parts of a groundwater flow system.

Lake water balance components are illustrated on Figure 1.1 and can include:

- direct precipitation and runoff from surface catchment
- evaporation of water from lake surface
- groundwater inflow
- inflow from surface streams
- groundwater outflow
- surface water outflow

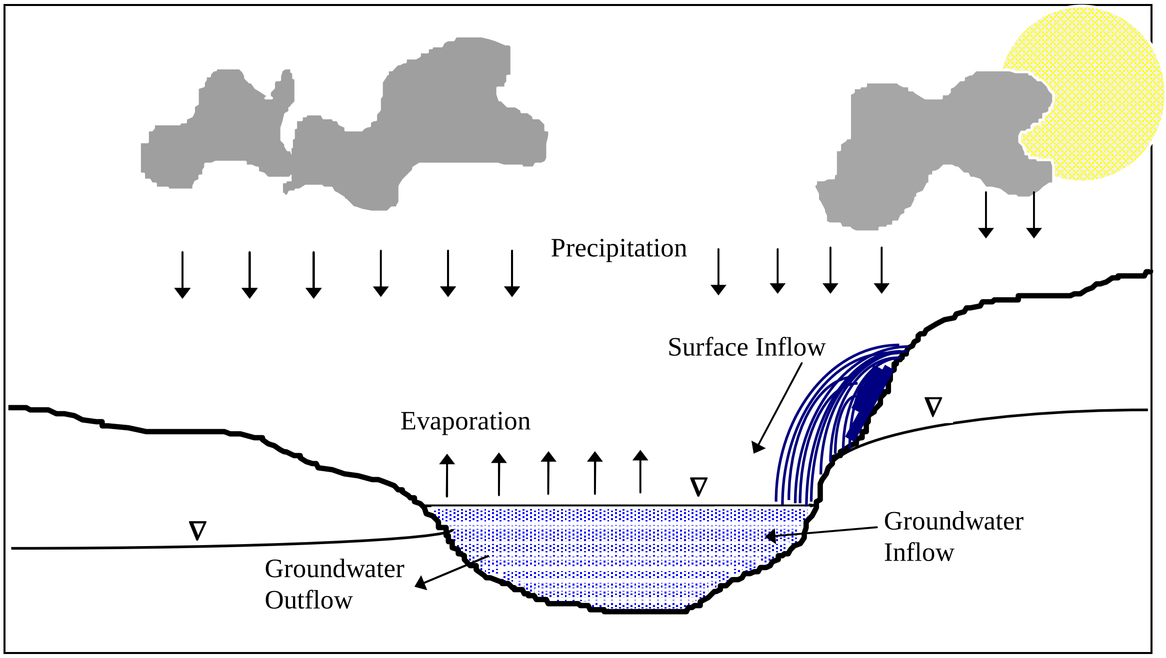


Figure 1.1 Components of lake water balance.

The governing equation for lake stage used by LAK2 is

$$\frac{\partial H_{LAKE}}{\partial t} = \frac{1}{A_{LAKE}}\{Q_{str\ in} - Q_{str\ out} + P - E + Q_{gw} - W\} \tag{1}$$

where:

H_{LAKE} is the lake water surface elevation (L).

A_{LAKE} is the water surface area of the lake at stage HLAKE (L^2).

Q_{strin} is the rate of streamflow into the lake (L^3/t).

Q_{strout} is the rate of streamflow out of the lake (L^3/t).

P is the rate of precipitation inflow to the lake (L^3/t).

E is the rate of evaporation from the lake (L^3/t).

Q_{gw} is the net rate of groundwater flow to the lake (L^3/t).

W is the rate of pumping or other diversion out of or into the lake (L^3/t).

1.1.1 Geometric Representation of Lake

A lake is defined by a list of cells (lake cells) in the groundwater flow domain that are connected to the lake. A conceptual view is shown on Figure 1.2, indicating lake cells (groundwater cells connected to the lake) and inactive cells (not part of the groundwater domain).

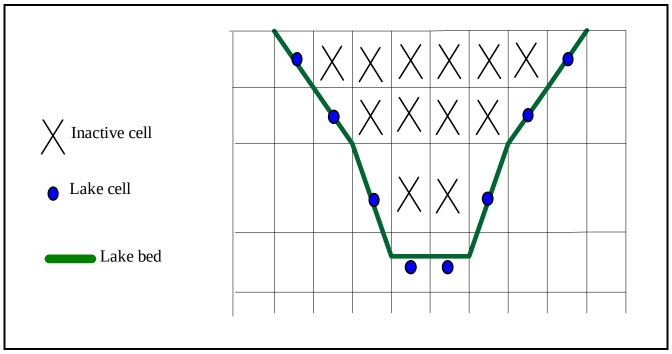


Figure 1.2. Cross-sectional view of a lake in a MODFLOW grid.

Each lake cell is specified with a lakebed minimum elevation, lakebed maximum elevation and maximum water surface area.

Water surface area of the lake is computed by summing the contribution of each cell to the total water surface. The contribution for a cell is equal to zero when lake water level is at or below the lakebed minimum elevation, increasing linearly with lake water level to the maximum water surface area when lake water level is at or above the lakebed maximum elevation.

The bottom of a lake is the lowest lakebed minimum elevation among the lake nodes. Two options exist for representation of the lake bottom:

1. A flat bottom lake is defined when the lakebed minimum elevation is equal to lakebed maximum elevation for the lowermost cell(s) of the lake.
2. A non-flat bottom lake is defined when the lakebed minimum elevation is lower than the lakebed maximum elevation for the lowermost cell(s) of the lake.

The two types of lake bottom have different implications for Equation (1) above when water level is near the lake bottom elevation. For a non-flat bottom, the water surface area A_{LAKE} approaches zero as water level approaches bottom elevation. For a flat bottom, the water surface area A_{LAKE} approaches a nonzero constant as water level approaches bottom elevation. For both types, A_{LAKE} is zero when the lake is dry (water level equal to bottom elevation) and Equation (1) is undefined. Lake bottom type is considered in the computation of the components of Equation (1) and in the handling and rewetting of dry lakes.

1.1.2 Stream Connections

LAK2 is configured to recognize surface water inflows and outflows simulated using the streamflow routing package RIV2 (Miller, 1988, Jones, 2010). RIV2 has been developed to provide the streamflow routing function in an efficient and simple way without surface water mass balance errors. Other streamflow routing modules for Modflow could readily be utilized by LAK2 with minor code changes.

A list of RIV2 reaches may be specified to flow into a LAK2 lake. The simulated streamflow at the bottom node of each inflowing reach is added to Q_{strin} in Equation (1).

A single RIV2 reach may be specified to flow out of a lake at a specified spill elevation. Spill from the lake, Q_{strout} in Equation (1), is computed by setting water level equal to spill elevation and then computing the resulting water surplus. The simulated inflow at the top node of the outflowing reach is set equal to spill from the lake.

Note: Other lake modules including (Merritt and Konikow, 2000) have used a Manning equation to estimate a spill rating curve and thus compute spill as a function of water level above spill elevation. To date, the models to which LAK2 has been applied have not been concerned with the small margin of water level above spill elevation. A Manning equation-based spill computation could be readily implemented into LAK2 with minor code changes.

1.1.3 Precipitation

Total precipitation inflow to a lake consists of direct precipitation on the water surface as well as runoff from the surface catchment above the lake water level. A runoff coefficient for each lake cell is specified to define the portion of precipitation that runs off to the lake from areas above the lake water level.

Total precipitation inflow to the lake is computed as precipitation multiplied by water surface area, plus precipitation multiplied by runoff coefficient multiplied by catchment area above the lake water level, or

$$P=p[\ \alpha\ A_{MAX} + (1-\ \alpha)\ A_{LAKE}] \qquad (2)$$

where

p is precipitation rate over the lake (L/t).
α is runoff coefficient for the lake cell.
A_{MAX} is the maximum water surface area of the lake cell (L^2).
A_{LAKE} is the actual water surface area of the lake cell (L^2).

Note that the right-hand side of equation (2) represents a summation over the individual lake cells defining a lake, each cell having its own α, A_{MAX} and contribution to A_{LAKE}.

1.1.4 Evaporation

Lake evaporation is computed as

$$E = eA_{LAKE} \qquad (3)$$

where

e is evaporation rate over the lake (L/t).

<u>Evaporation/Evapotranspiration from ephemeral, flat-bottom lakes</u>

If groundwater level is close to a flat lake bottom, groundwater evapotranspiration (ET) may occur when the lake is dry. LAK2 recognizes this condition and adds boundary conditions to each lake cell on a dry lake bottom equivalent to those added by the EVT1 module (McDonald and Harbaugh, 1988). An extinction depth is specified for each flat bottom lake to define the reduction of ET with depth. ET is zero if the lake is not dry. ET rate is equal to e when groundwater head is at the lakebed elevation, decreasing linearly to zero when groundwater head drops to extinction depth below the lake bottom. Simulated ET is included as part of the “groundwater inflow” and “evaporation” components of the lake water balance.

Other considerations arise in the computation of evaporation over a discrete time step in which a flat bottom lake is dry or becomes dry. Evaporation in this case is reduced from the maximum rate by limiting evaporation to lake inflow, reflecting the evaporation of all available water in only part of the time step. If, in addition, groundwater levels are close to the lake bottom, maximum ET rate is specified such that the sum of lake evaporation and maximum ET rate is equal to the evaporation rate e, reflecting evaporation for one part of the time step and ET for the other part.

1.1.5 Groundwater Flow

Groundwater flow into and out of the lake is computed based on the difference between lake water level and groundwater head at each lake cell, multiplied by lake cell conductance. The conductance of each lake cell is specified as described in Numerical Implementation below.

Conductance for each lake cell is adjusted based on water levels. Conductance is equal to the specified (maximum) conductance when either lake water level or groundwater level is above the lakebed maximum elevation. Conductance is equal to zero when water level is below the lakebed minimum elevation. Conductance decreases linearly for water levels between the lakebed maximum and lakebed minimum elevations.

Groundwater flow to or from lake cell n is computed as

$$Q_n = -C_n(\max[H_{LAKE}, BOTLK_n] - \max[H_n, BOTLK_n])$$

where

Q_n is the groundwater flux into the lake at lake cell n (L3/t).
C_n is the conductance of lake cell n (L2/t).
H_n is the groundwater head in lake cell n (L).
$BOTLK_n$ is the lakebed minimum elevation in lake cell n (L): If HLAKE > $BOTLK_n$, the lake is wet at lake cell n. If HLAKE < $BOTLK_n$, the lake is dry at lake cell n.

Total groundwater inflow and outflow to the lake are equal to the respective sum of inflows and outflows from each lake cell. Net rate of groundwater flow to the lake is computed as $Q_{gw} = \sum_n Q_n$.

1.2 NUMERICAL IMPLEMENTATION

1.2.1 Discrete Equation

The discrete equation for lake stage used by LAK2 for a MODFLOW time step may be written as

$$\frac{\Delta S}{\Delta t} = P - E + Q_{gw} + Q_{strin} - Q_{strout} \tag{1}$$

where

$\Delta S = \int_{t0}^{t0+\Delta t} A_{LAKE} \frac{\partial H_{LAKE}}{\partial t} dt$ is the change in lake storage during the time step
t_0 is the beginning of the time step
Δt is the length of the time step

1.2.2 Change in Lake Storage

Change in lake storage is computed as

$$\Delta S = \sum_{n=1}^{N} \left[\int_{h1_n}^{h2_n} A_n dh \right]$$

where

$Hnew_{LAKE}$ is lake stage at the end of the time step
$Hold_{LAKE}$ is lake stage at the beginning of the time step

$h1_n = \max[Hold_{LAKE}, BOTLK_n]$

$h2_n = \max[Hnew_{LAKE}, BOTLK_n$

The above equation can be written in the form

(2)
$$\Delta S = D_0 + D_1 Hnew_{LAKE} + D_2\ Hold_{LAKE}$$

where

$$D_0 = \sum_{\{n \in [1,N] | Hnew_{LAKE} < BOTLK_n\}} A_n BOTLK_n - \sum_{\{n \in [1,N] | Hold_{LAKE} < BOTLK_n\}} A_n BOTLK_n$$

$$D_1 = \sum_{\{n \in [1,N] | Hnew_{LAKE} > BOTLK_n\}} A_n$$

$$D_2 = -\sum_{\{n \in [1,N] | Hold_{LAKE} > BOTLK_n\}} A_n$$

1.2.3 Precipitation

As above, lake precipitation is computed as

(3)
$$P = p \alpha A_{MAX} + p(1-\alpha) A_{LAKE}$$

1.2.4 Evaporation

As above, lake evaporation is computed as

(4)
$$E = eA_{LAKE}$$

1.2.5 Groundwater Flow

Groundwater flow to a lake is defined to be the sum of groundwater flow to each lake node:

(i)
$$Q_{gw} = \sum_{n=1}^{N} Q_n$$

where

Q_n is the groundwater flux to lake node n (L^3/t).

(ii)
$$Q_n = -C_n(\max[H_{LAKE}, BOTLK_n] - \max[H_n, BOTLK_n])$$

where

H_n is the groundwater head in lake node n

C_n is the lake bed conductance at lake node n (L^2/t).

Equation (ii) may be written in the form

(iv)
$$Q_n = R_n + \gamma_n H_{LAKE} + \beta_n H_n$$

where

βn	=Cn	if	Hn>BOTLKn
	=0	if	Hn<BOTLKn
γn	= -Cn	if	HLAKE>BOTLKn
	=0	if	HLAKE<BOTLKn
Rn	=CnBOTLKn	if	Hn<BOTLKn and HLAKE>BOTLKn
	= -CnBOTLKn	if	Hn>BOTLKn and HLAKE<BOTLKn
	=0	if	Hn,HLAKE<BOTLKn or $H_n, H_{LAKE} > BOTLK_n$

Combining equations (i) and (iv) yields an equation of the form

$$Q_{gw} = \alpha + \beta_0 \mathrm{H}_{\mathrm{LAKE}} + \sum_{n=1}^{N} \beta_{\mathrm{n}} \mathrm{H}_{\mathrm{n}} \tag{5}$$

where

$$\beta_0 = \sum_{n=1}^{N} \gamma_{\mathrm{n}}$$

$$\alpha = \sum_{n=1}^{N} R_{\mathrm{n}}$$

1.2.6 Lakebed Conductance

Lakebed conductance is specified by the LAK2 user. Conductance may be computed externally to the simulation as

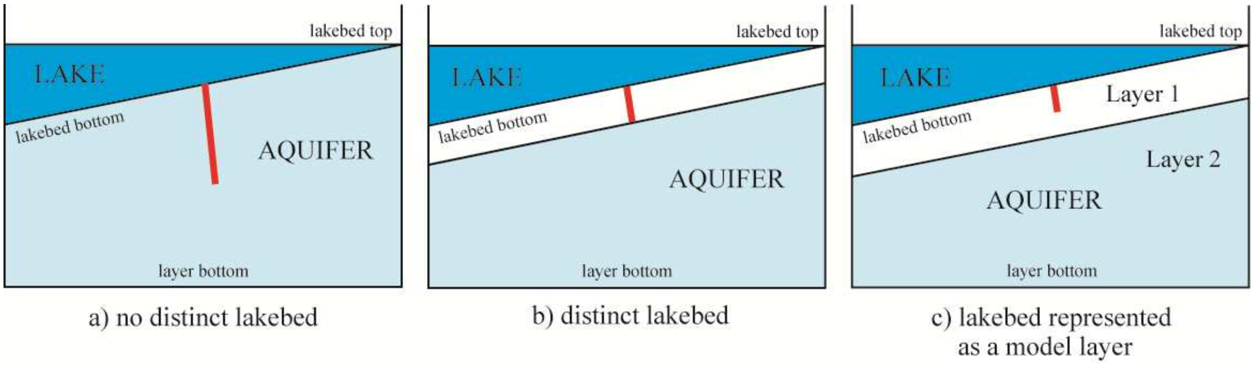
C_n = (lakebed area)x(hydraulic conductivity)/(bed thickness).

Three models of lakebed conductance are shown on Figures 1.3a, b and c.

Lakebed area: If the lakebed is horizontal, then lakebed area is equal to lake cell surface area. Lakebed area may also be computed as lake cell surface area divided by the cosine of the average angle of lakebed inclination.

Hydraulic conductivity: Effective hydraulic conductivity for the zone crossed by the bold line in Figures 1.3a, b or c may be specified to compute conductance. If the lakebed is horizontal, a vertical hydraulic conductivity should be used. If the lakebed is vertical, a horizontal hydraulic conductivity should be used.

Bed thickness: Bed thickness for each of the three conductance models is indicated by the bold line in Figures 1.3a, b and c.



a) no distinct lakebed b) distinct lakebed c) lakebed represented as a model layer

Figure 1.3. Models of lakebed conductance.

LAK2 adjusts conductance for each node to reflect partial saturation:

Let X= max (H_n,H_{LAKE}). Let $TOPLK_n$ = lakebed max elevation in lake cell n

1. If X≥$TOPLK_n$, C_n is set to the user-specified conductance.
2. If $BOTLK_n$< X<$TOPLK_n$, C_n is set equal to the user-specified conductance times the factor

$$\left[\frac{\mathrm{X} - \mathrm{BOTLK}_{\mathrm{n}}}{\mathrm{TOPLK}_{\mathrm{n}} - \mathrm{BOTLK}_{\mathrm{n}}}\right]$$

3. If X≤$BOTLK_n$, C_n is set equal to zero

1.2.7 Interpolation of HLAKE

The lake stage used for computing Qgw in equations (3), (4) and (5) is defined by

(6) $$\mathrm{H}_{\mathrm{LAKE}} = \theta Hnew_{LAKE} + (1-\theta)Hold_{LAKE} ,$$

where

θ is a specified explicit/implicit parameter, with 0≤θ≤1.

θ=0 is the explicit formulation of lake stage,
θ =1 is the implicit formulation of lake stage and
0<θ<1 is an intermediate formulation of lake stage.

In the explicit formulation, lake stage at the beginning of a time step is used to compute flow between the lake and the aquifer. Lake stage is updated at the end of each time step. The explicit formulation converges most easily, but is unstable for large time steps.

In the implicit formulation, lake stage at the end of a time step is used to compute flow between the lake and the aquifer. Lake stage is updated at the end of each iteration of the groundwater flow equation.

In an intermediate formulation, an intermediate stage is used to compute flow between the lake and the aquifer. Lake stage is updated at the end of each iteration of the groundwater flow equation.

The implicit formulation is used for all of the applications presented here, matching the implicit formulation of groundwater flow equations used by the Modflow module BCF.

1.2.8 Numerical Equation

The LAK2 code substitutes equations (2), (3), (4), (5) and (6) into equation (1) to get an equation for lake stage in the following form:

$$\alpha_0 Hnew_{LAKE} + \sum_{n=1}^{N} \beta_n H_n = RHS_{LAKE}$$

(7)

where

$$\alpha_0 = \frac{D_1}{\Delta t} + \theta\beta_0$$

$$RHS_{LAKE} = \frac{D_0}{\Delta t} + \frac{D_2}{\Delta t} Hold_{LAKE} + P - E + Q_{strin} - Q_{strout} + \alpha + (1-\theta)\beta_0 Hold_{LAKE}$$

equation (7) may be solved as

$$Hnew_{LAKE} = \frac{1}{\alpha_0}\{RHS_{LAKE} - \sum_{n=1}^{N} \beta_n H_n\}.$$

Because the equations for lake stage are nonlinear, equation (7) is formulated iteratively. Equation (7) is formulated and solved until computed lake stage in successive iterations changes by less than a specified tolerance, or until the specified maximum number of iterations are performed.

After completing iteration of equation (7), LAK2 modifies the groundwater flow equation for each lake node to reflect flow between aquifer and lake. Inserting equation (6) into equation (iv) above yields a modified form of equation (iv):

(iv’)

$$Q_n = R'_n + \gamma'_n Hnew_{LAKE} + \beta_n H_n$$

where

$\gamma'_n = \gamma_n\theta$

$R'_n = R_n + \gamma_n(1-\theta)Hold_{LAKE}$

LAK2 modifies the MODFLOW equation for each lake node according to equation (iv’) by adding boundary conditions to the HCOF and RHS arrays of the MODFLOW equation:

β_n is added to the HCOF entry for lake node n.

The term $R'_n + \gamma'_n Hnew_{LAKE}$ is added to the RHS array entry for lake node n.

On the subsequent iteration of the main MODFLOW equation, the iterative formulation and solution of lake stage is repeated and the MODFLOW equation is again modified.

1.3 Input Instructions

Input consists of parameters for the entire simulation, parameters for each lake, parameters for each lake and stress period and parameters for each lake node.

Parameters for the entire simulation include the following:

1. Total number of lake cells.
2. Number of lakes.
3. Unit number for main lake output file.
4. Unit number for cell by cell output.
5. Unit number for lakebed zone budget output.
6. Explicit/implicit parameter THETA.
7. Head change convergence criteria used in lake stage computation.
8. Maximum number of iterations allowed in lake stage computation.
9. Flow change convergence criteria, used when lake stage is at spill elevation.
10. Total number of river reaches flowing into lakes

Parameters for each lake include the following:

1. Number of lake cells
2. Initial water stage
3. Listing of inflowing river reaches, if any
4. Identification of outflowing river reach, if any
5. Spill elevation (lakes with outflowing river reaches only)
6. ET extinction depth (flat bottomed lakes only).

Parameters for each lake and stress period include the following:

1. Precipitation (L),
2. Evaporation (L) and
3. Pumping to/from the lake(L^3/t)

The following are input for each lake cell:

1. Lakebed maximum elevation (L),
2. Lakebed minimum elevation (L),
3. Water surface area (L^2),
4. Conductance (L^2/t)
5. Runoff coefficient ()
6. Zone number, for groundwater zone budgets. Groundwater flow to and from lake nodes may be broken down by zones. This allows, for example, computation of pit lake chemical balances based on groundwater flow from different rock types. Each lake node is assigned a zone number. Flow totals into and out of each zone are computed.

1.3.1 Input Records

For Each Simulation:
Record 1.

variable:	MXLKND	NLAKES	ILKC1	ILKC2	ILKC3	THETA	TOL	MXITER	TOL2	MXRIVIN
format:	I10	I10	I10	I10	I10	F10.0	F10.0	I10	F10.0	I10

For Each Lake:
Record 2. Read NLAKES times.

variable:	NODES	STAGE0	NRVIN	KRVOT	XSPIL	EXDP
format:	I10	F10.0	I10	I10	F10.0	F10.0

Record 3: Read when NRVIN > 0.

variable:	IRI(NRVIN)
format:	*

For Each Lake Node:
Record 4. Read MXLKND times.

variable:	ILAY	IROW	ICOL	COND	BOT	TOP	XAREA	IBZON	RUNCOF
format:	I10	I10	I10	F10.0	F10.0	F10.0	F10.0	I10	

For Each Stress Period:
Record 5.

variable:	ITMP
format:	I10

Record 6. Read NLAKES times.

variable:	XEVAP	XPREC	Q
format:	F10.0	F10.0	F10.0

1.3.2 Explanation of Variables

Record 1. Read once for a simulation/
MXLKND: total number of lake nodes.
NLAKES: number of lakes.
ILKC1: unit number for main lake output file.
ILKC2: flag and unit number for cell by cell output.
ILKC3: flag and unit number for lakebed zone budget output.
THETA: explicit/implicit parameter.
TOL: head change convergence criteria used in lake stage computation.
MXITER: maximum number of iterations allowed in lake stage computation.
TOL2: flow change convergence criteria, used when lake stage equals spill elevation.
MXRIVIN: total number of river reaches flowing into lakes

Record 2. Read NLAKES times.
NODES: number of nodes representing lake.
STAGE0: initial lake stage.
NRVIN: number of RIV2 reaches flowing into lake.
KRVOT: reach number of RIV2 reach flowing out of lake.
XSPIL: spill elevation for lake (L).
EXDP: extinction depth for playa surface.

Record 3. Read when NRVIN > 0.
IRI(NRVIN): reach numbers of RIV2 reaches flowing into lake.

Record 4. Read MXLKND times.
ILAY: layer of lake node.
IROW: row of lake node.
ICOL: column of lake node.
COND: maximum conductance of lake node (L2/t)
BOT: lowest lake bed elevation within lake node.
TOP: highest lake bed elevation within lake node.
XAREA: maximum area of horizontal water surface for node.
IBZON: zone number of lake node, used in computation of lakebed zone budget.
RUNCOF: runoff coefficient for lake node, defined to be the fraction of precipitation falling draining directly to lake ().

Record 5. Read once for each stress period.
ITMP: flag for reading evaporation rate, precipitation rate, and spill elevatiion.
If ITMP>0, record 7 is read.
If ITMP<0, values from the previous stress period are used.

Record 6. Read NLAKES times when ITMP>0.
EVAP: lake evaporation rate for stress period (L/t)
PRECIP: lake precipitation rate for stress period (L/t)
Q: pumping/withdrawal rate from lake (L3/t). A negative value signifies addition of water to the lake.

1.4 CODE VERIFICATION

1.4.1 Example 0: Large-diameter well recovery

The LAK2 stage computation is tested using a pair of MODFLOW simulations. Water level recovery in a large diameter well is simulated in two different ways, with and without LAK2. Results are then compared to confirm the basic functioning of the code.

1.4.2 Example 0a: Without LAK2

A sample grid is constructed with 100 rows, 100 columns and 2 layers. Each column and row has a width of 1000 units. A confined layer type (type 0) is specified. Initial head is specified as 0, except for a group of four layer 1 cells in the center of the grid (Fig. 1.4). The initial head at these cells is specified as -100. Storage coefficient is specified as 1 at the four cells and .001 everywhere else, Transmissivity for each layer is specified everywhere as .001 square units per second. Vertical conductance is specified as 10-9 /second. A 100 year recovery is simulated. By symmetry, head in each of the group of four cells is the same.

1.4.3 Example 0b: With LAK2

The model grid and aquifer parameters from the large diameter well recovery are retained. The four cells are specified as inactive cells. A lake is specified using twelve LAK2 cells as shown in Figure 1.4. An implicit lake stage computation is selected. Initial lake stage is specified as -100. Lake evaporation and precipitation are specified as 0. The four lake cells in the center are placed in layer 2 and are considered to lie underneath a horizontal lake bed. The eight cells on the perimeter are placed in layer 1 and are considered to lie next to a vertical lake bed.

Area of each of the four lake cells in the center is specified as row width times column width, or 10^6 square units. Area of the eight remaining lake cells is specified as zero.

Conductance of each of the four lake cells in the center is specified as vertical conductance times cell area, or 10^{-3} square units per second. Conductance of the eight lake cells on the perimeter is specified as transmissivity times row width divided by column width, also 10^{-3} square units per second. Lakebed minimum and maximum for each lake cell are specified at a level below initial stage, leading to constant conductance for each lake cell throughout the simulation.

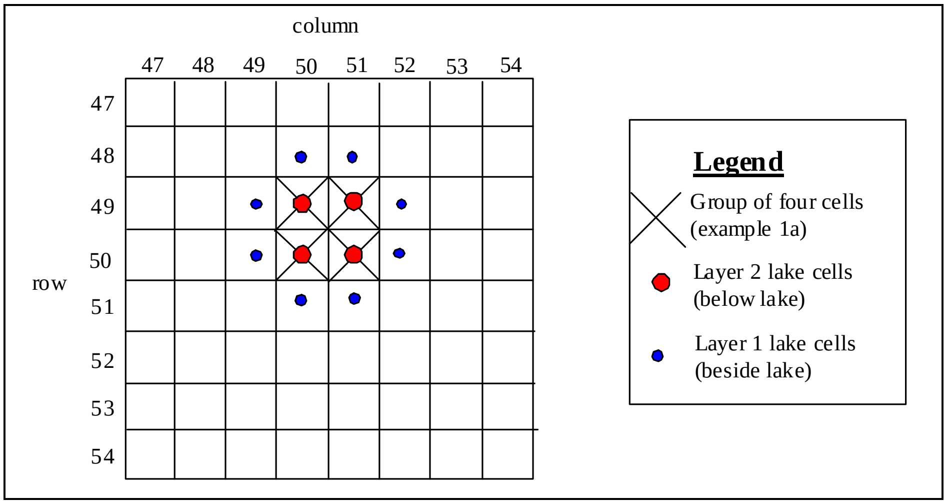


Figure 1.4. Layout of examples 0a and 0b.

1.4.4 Comparison of Results

The results of example 0a and example 0b are expected to be identical because

1. The specified area of the lake cells in example 0b matches the specified area of the group of four cells in example 0a. The storage coefficient of the group of four cells is specified as 1. The storage capacity of the lake is therefore identical to that of the group of four cells.
2. The specified conductances of the lake nodes match the specified horizontal and vertical conductances of Example 0a. In addition the lake node conductances are constant because lakebed elevations are specified below lake stage. Water is therefore transmitted to the lake at the same rate as to the group of four cells.
3. Heads in the group of four cells in example 0a are symmetric. The group of four cells is therefore represented by a single head, analogous to lake stage.
4. An implicit lake stage computation is used in example 0b. Example 0a, like most MODFLOW simulations, uses an implicit computation.

Head in the group of four cells of example 0a and stage in the lake of example 0b, both shown on Figure 1.5, are identical. Further inspection confirms that budget terms for the two simulations are also identical.

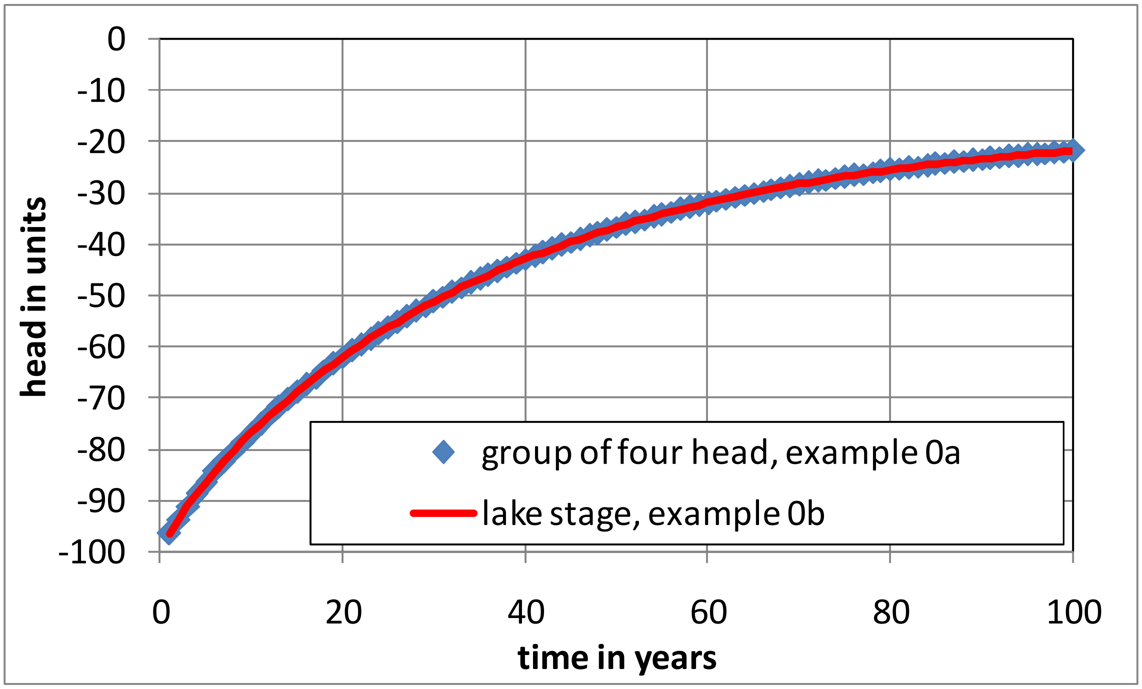


Figure 1.5. Comparison of water levels in examples 1a and 1b.

2.0 APPLICATION: ARCHIMEDES PIT

LAK2 was used to project the post-mining recovery of water level in the Archimedes pit near Eureka, Nevada. The pit bottom topography and pit surface catchment area are shown on Figure 2.1.

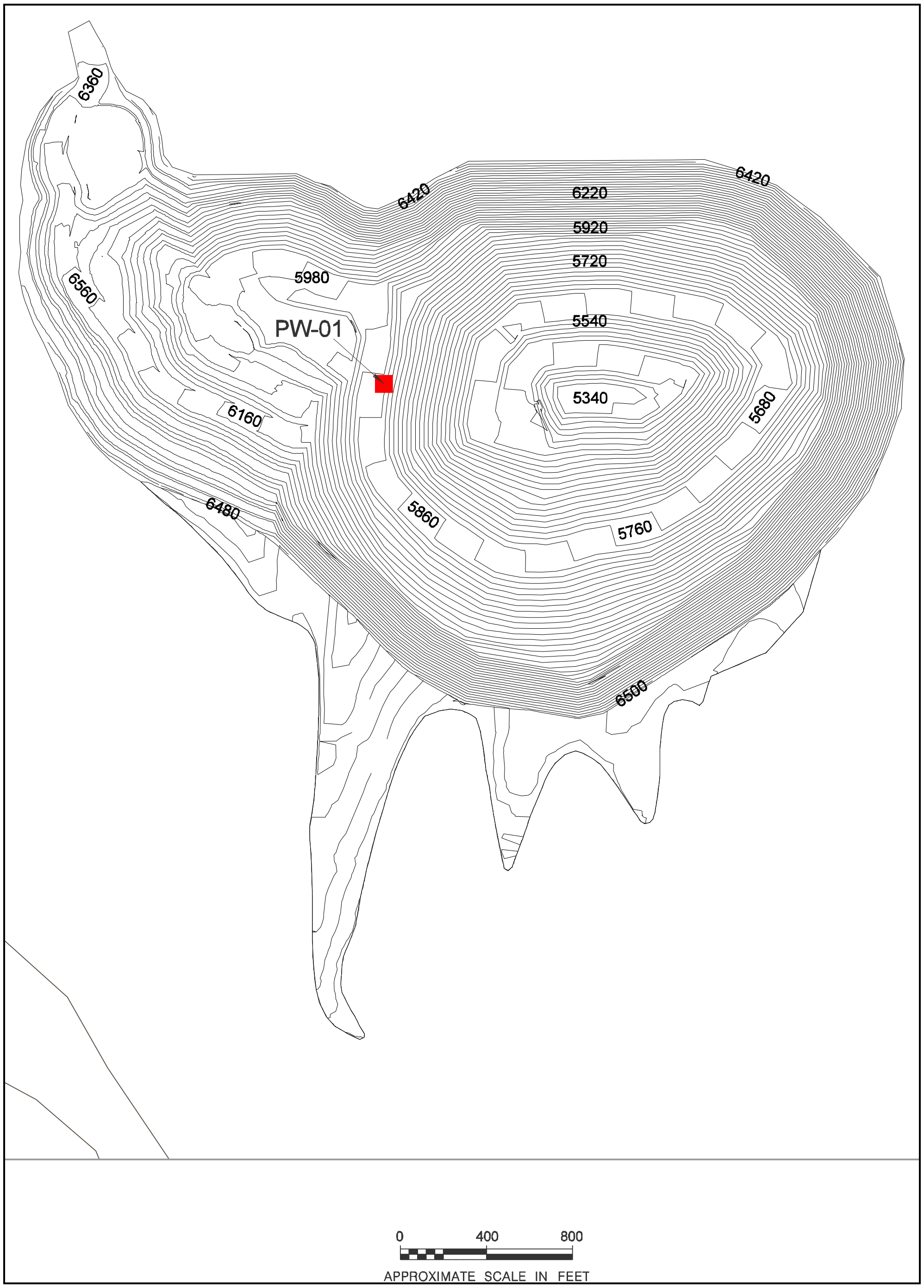


Figure 2.1. Ultimate pit contours.

The pit geometry was represented using LAK2 as described in Section 1 above, as a list of model cell locations. For each cell location, the following geometric parameters are spedified:

- Lowest pit bottom elevation within cell
- Highest pit bottom elevation within cell
- Maximum water surface area of each cell

The contribution of each cell to total open water surface area increases linearly from zero at the lowest pit bottom elevation, to the maximum area at the highest pit bottom elevation. Total water surface is computed as the sum of the area contributed by each cell.

The lowest and highest pit bottom elevations were initially assigned based on the contour map. Maximum open water surface was initially assigned to be the plan area of the MODFLOW finite difference grid cell.

The geometric parameters were then calibrated. The simulated lake bed elevations were adjusted to best reflect the actual increase of area with elevation for the portion of pit bottom within each cell. The measured and modeled pit stage-area-volume relationship is shown on Figure 2.2.

In addition to the pit geometry, the following inputs were required to simulate pit filling:

- Annual precipitation was estimated at 11.72 inches, based on records from the Eureka weather station (Western Regional Climate Center, 2004).
- A runoff coefficient of 0.15 was assumed for the pit catchment of about 210 acres.
- Annual lake evaporation was estimated at 45 inches (NOAA, 2004).

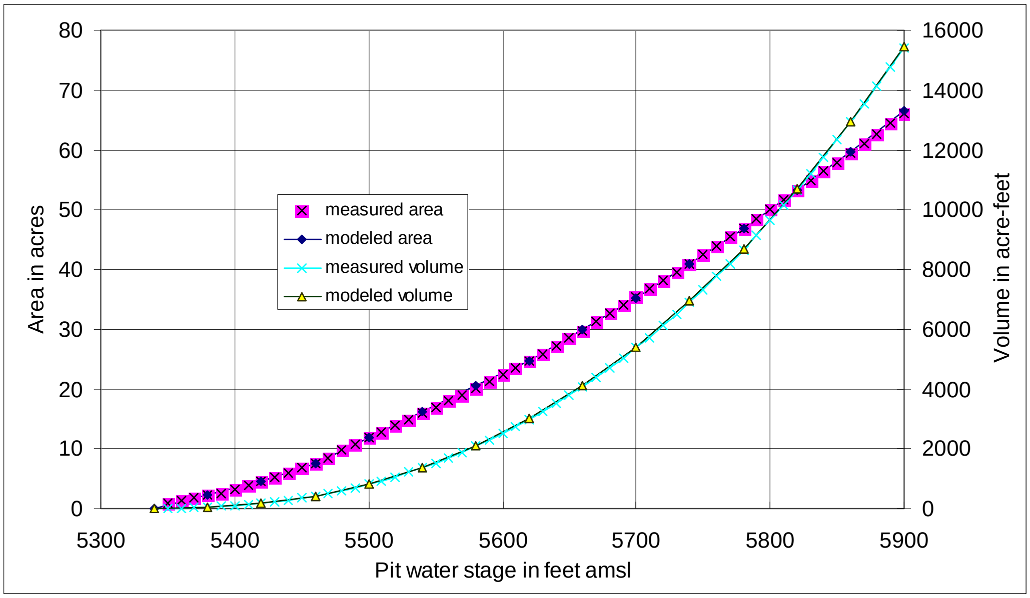


Figure 2.2. Measured and modeled pit stage-area-volume.

2.1 Changes to Original Groundwater Flow Model

Changes were also made to the specifications of aquifer geometry in MODFLOW module BCF, to reflect the presence of the pit: The layer top elevation, at which water level the layer becomes confined, was set equal to the mean of the low and high pit bottom elevations for each LAK2 cell.

2.2 Pit Filling

Recovery of water level after the end of active dewatering was simulated as described above. The projected pit water level is presented on Figure 2.3. The final equilibrium pit elevation is predicted to be 5861 feet amsl. The pit is projected to fill to 95% of recovery (elevation 5835 feet amsl) about 39 years after the end of active dewatering.

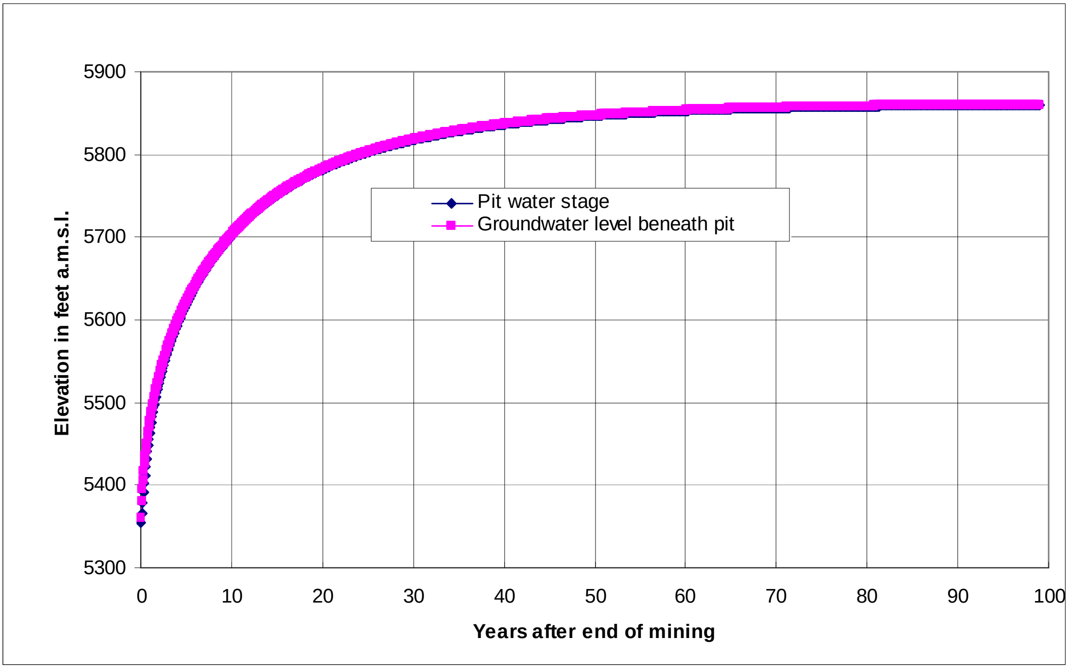


Figure 2.3. Projected pit water stage.

The projected pit water surface area and volume are presented on Figure 2.4. The final pit water surface area is predicted to be 60 acres. The final pit water volume is predicted to be 13,000 acre-feet.

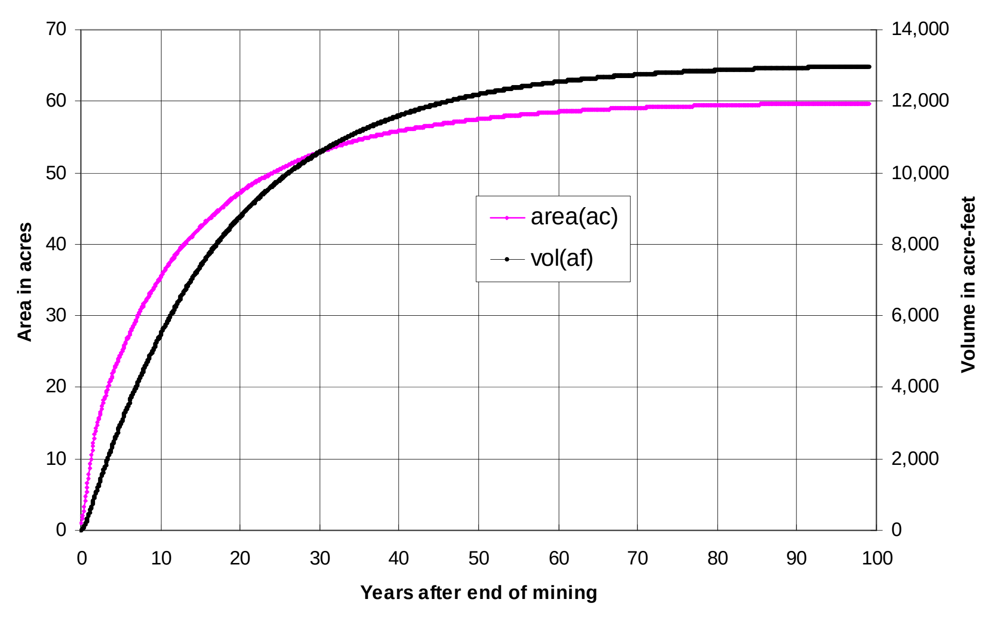


Figure 2.4. Projected pit water surface area and volume.

The projected pit water budget components are presented on Figure 2.5. The final average annual pit evaporation is predicted to be about 140 gpm. Groundwater outflow is predicted to be zero.

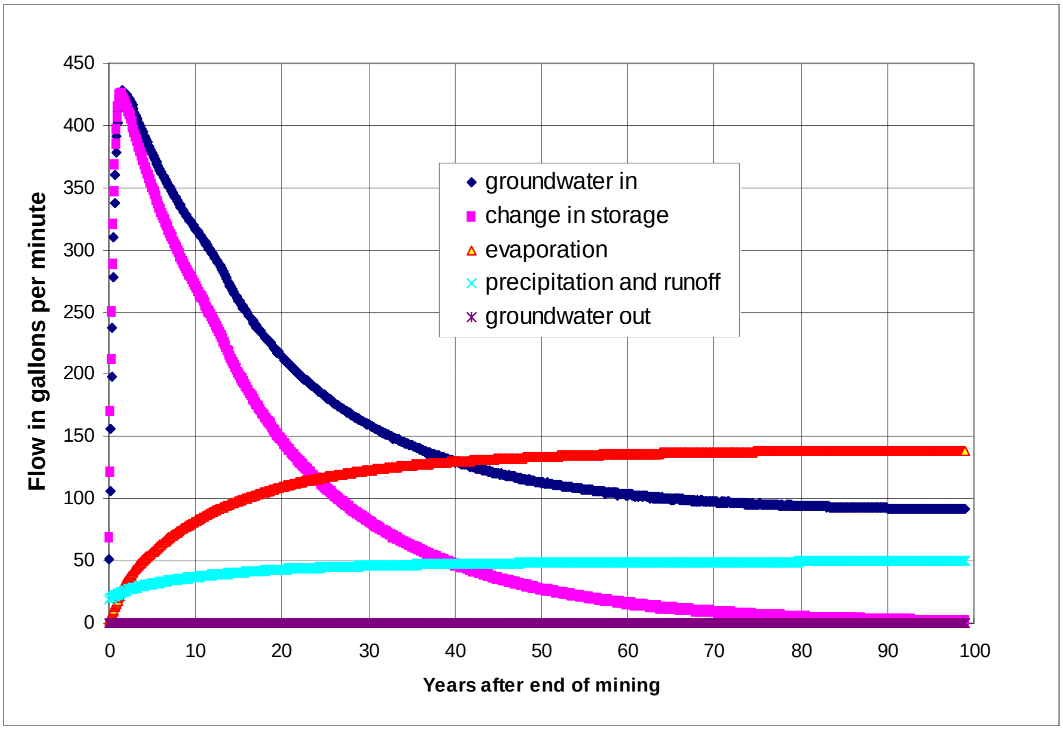


Figure 2.5. Projected pit water budget.

A map of the geochemical types exposed in the pit was provided. The units include:

- Oxide limestone (OgO)
- Oxide intrusive (KgO)
- Sulfide limestone (OgS)
- Sulfide intrusive (KgS)
- Alluvium (Qtal)
- Volcanic Tuff

The map of geochemical types was used to estimate the portions of pit inflow attributable to each unit, for use in projections of pit water chemistry. Groundwater inflow from each geochemical type is shown on Figure 2.6. Inflow from direct precipitation and from runoff over each geochemical type is shown on Figure 2.7.

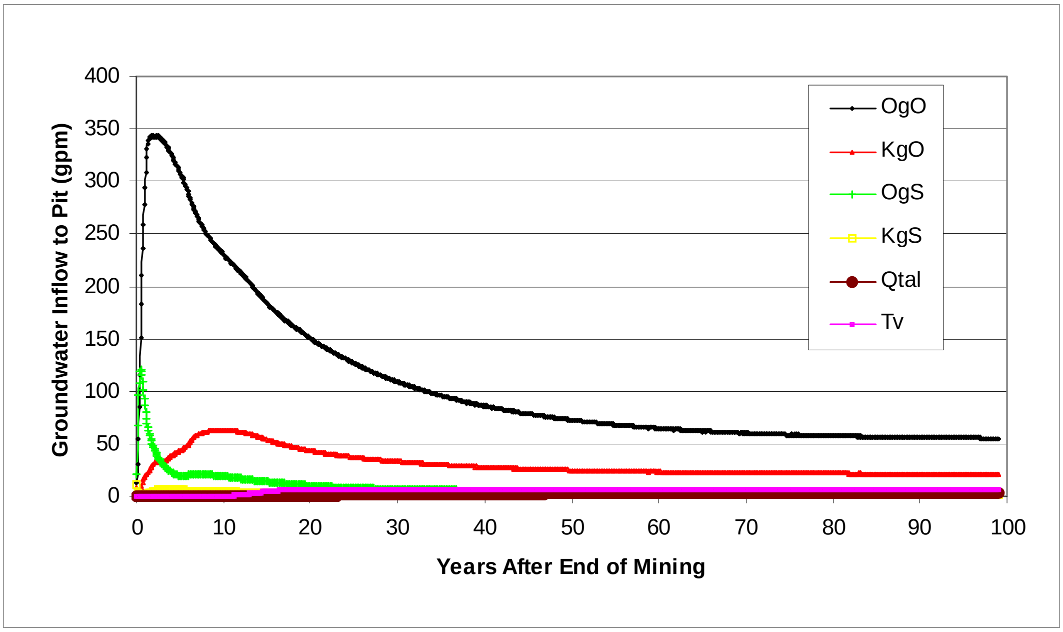


Figure 2.6. Groundwater inflow to pit by geochemical type.

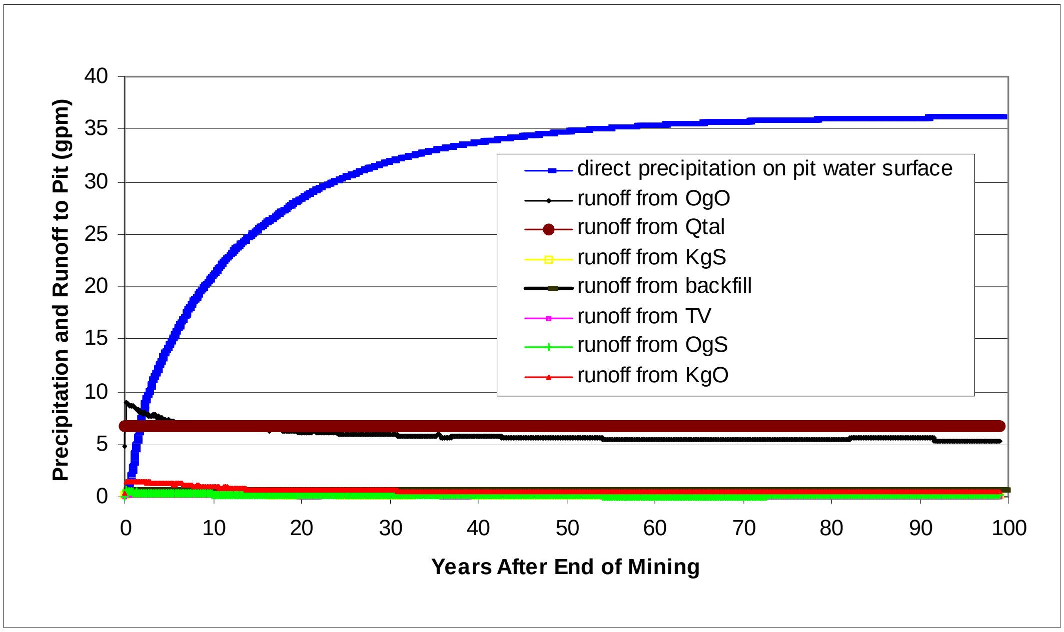


Figure 2.7. Precipitation and runoff to pit by geochemical type.

3.0 APPLICATION: ORTIZ PIT

LAK2 was used to calibrate a groundwater flow model to the measured history of mine dewatering and post-mining water level recovery in the Ortiz pit, near Cerrillos, New Mexico. Measured and simulated groundwater levels during mine dewatering, and measured and simulated post-mining pit water levels, are shown on Figure 3.1.

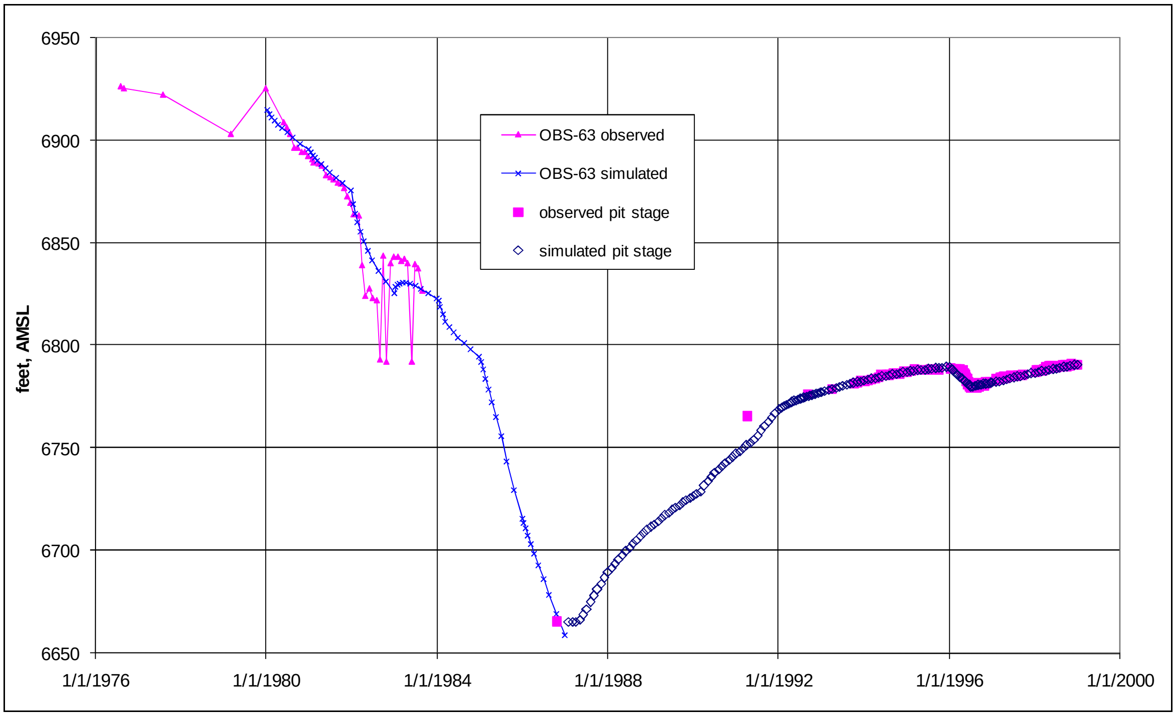


Figure 3.1. Measured and simulated historical water levels (JSAI, 1999).

The model was then used to project long-term water levels and the effect of diverting runoff from the up-gradient watershed into the pit, in order to submerge the acid seeps on the pit wall, which were adversely impacting pit water quality. Runoff from the watershed was estimated using the SCS curve number method. A series of projections of water level was developed, including, “normal”, “wet” and “dry” scenarios

4.0 APPLICATION: BELEN MUNICIPAL WELL

This section describes a problem that occurred with an application of the Middle Rio Grande Administrative (MRGA) model (Barroll, 2001), used to administer water rights in the Middle Rio Grande basin of New Mexico. The problem and its cause are analyzed and a solution is presented that utilizes LAK2 to more accurately represent pumping from a well.

4.1 The Problem

The Middle Rio Grande Administrative model (Barroll, 2001) has been employed in an attempt to evaluate the depletion effects of an additional 325 afy of groundwater pumping from the Belen municipal wells.

The results of the exercise are shown on Figure 4.1 which presents the simulated depletion, computed as the sum of the differences in total streamflow gain, streamflow loss and evapotranspiration between the base case model simulation and a simulation including the additional 325 afy of groundwater pumping. Also shown on Figure 4.1 is the portion of the additional pumping supplied by groundwater storage, rather than by depletion.

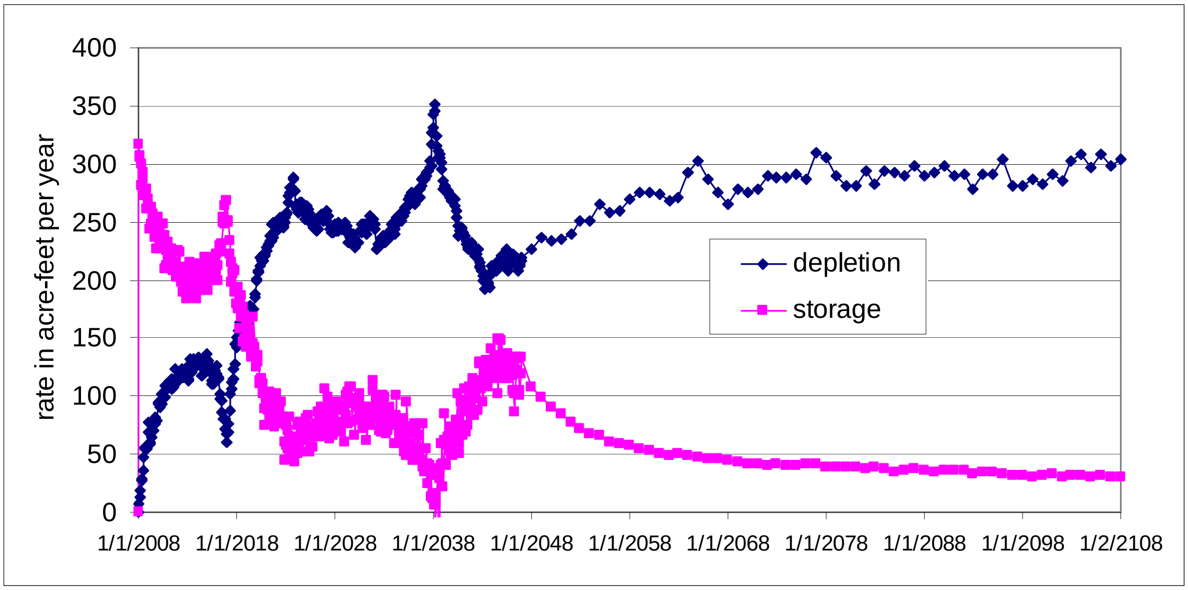


Figure 4.1. Model simulated depletion resulting from 325 afy additional pumping from belen municipal wells.

As can be seen in Figure 4.1, the results are suspicious. Instead of a steady increase in depletion from zero to 325 afy, with a corresponding decrease in the storage component from 325 afy to zero, the graph includes periods of increasing and decreasing depletion, with minima and maxima in between.

4.2 The Cause

The unexpected features of the graph shown on Figure 4.2 are the result of a dry cell in layer 2, row 100, column 37 of the model grid (corresponding to City of Belen Well 1). The cell becomes dry in both the base case simulation, in April 2038, and in the simulation with 325 afy additional pumping, in January 2017.

Simulated water levels for the cell that becomes dry, and for the cells immediately above and below, are presented for the base case ("without") and for the simulation with additional pumping ("with") in Figure 4.2.

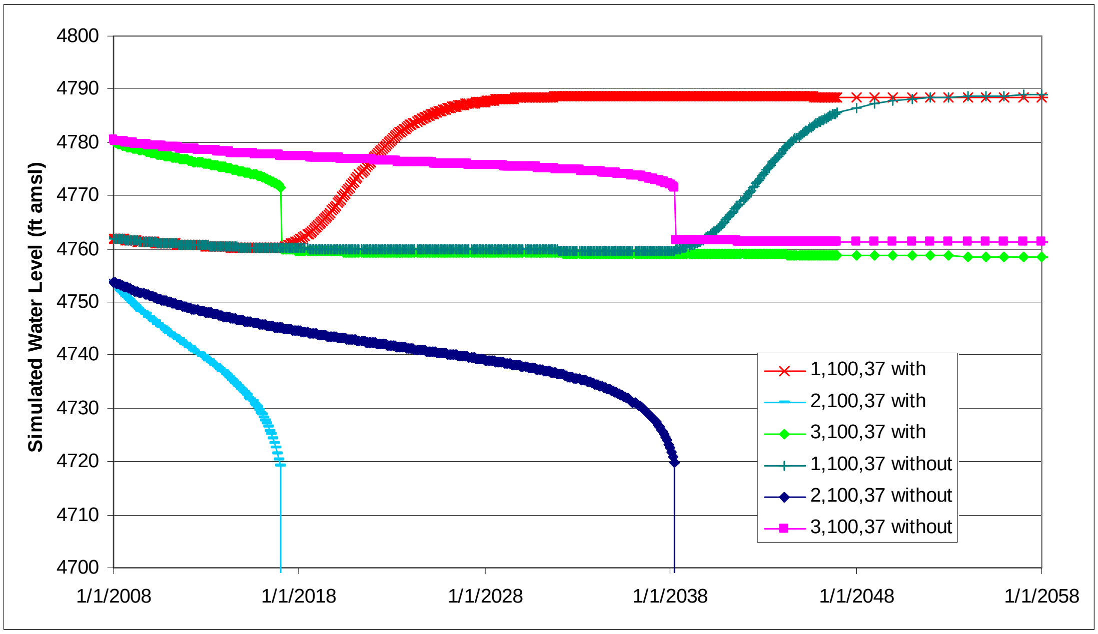


Figure 4.2. Simulated water levels in model cells in row 100, column 37.

In order to preserve simulated pumping rates, the convention adopted with the MRGA model is to shift pumping down a layer whenever a cell becomes dry (Barroll, 2001). Consequently a sharp drop in the layer 3 water level is shown on Figure 2 at the point when layer 2 becomes dry. In addition, the removal of the connection to layer 2 causes water level in layer 1 to begin to rise at the same time.

The correlation between the simulated depletion curve on Figure 4.1 and the simulated water levels on Figure 4.2 is shown graphically on Figure 4.3. Essentially, the dry cell causes discontinuities in the equations used to describe the groundwater flow system. The discontinuities occur at different times in the two simulations, impacting the depletion calculation (the difference between the two simulations) at both times.

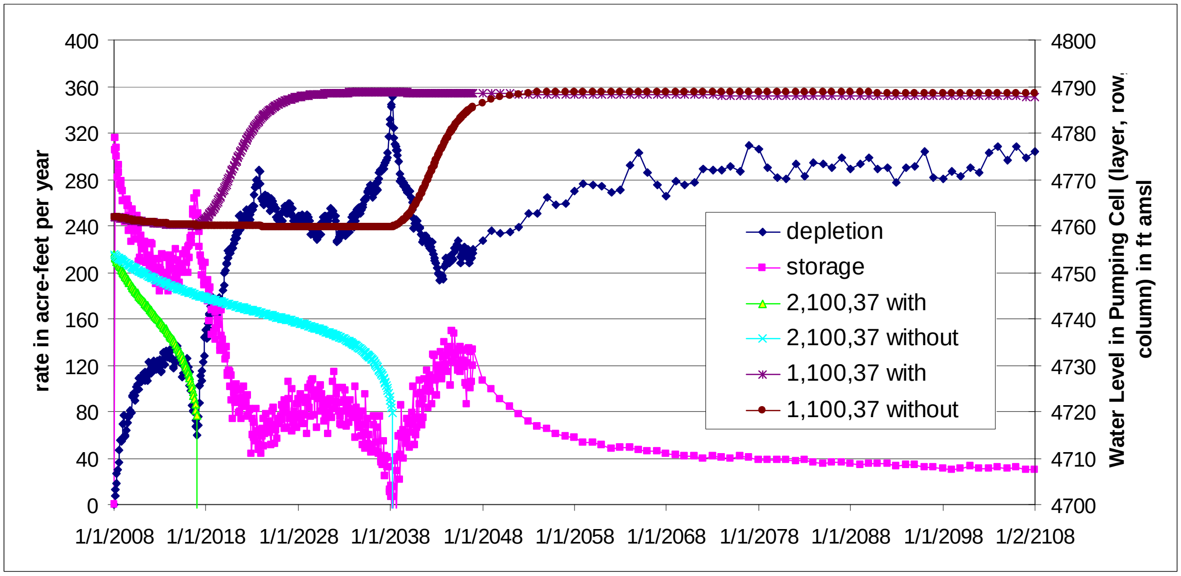


Figure 4.3. Simulated depletion and water levels.

4.3 A Solution

The problem can be addressed by restoring continuity to the equations describing the groundwater flow system. One way to do this is to represent the pumping in both layers 2 and 3. A difficulty with this approach is that results can be sensitive to the division of pumping between the layers. Proper division of pumping should be proportional to the conductivity of each layer, to the saturated screened interval and, if pumping water level is above the bottom of the screened interval, the difference between groundwater level in each cell and water level in the well bore.

The two model simulations were repeated representing the pumping in both layer 2 and layer 3. In order to properly partition the pumping, the well bore was explicitly represented in the model using LAK2 as a generic tool to represent open spaces, including well bores, connecting multiple model cells. Flows between model cells and the well are computed based on conductance terms, groundwater level in the cell, water level in the open space and elevation of the interface between the cell and the open space. The mass balance equation for the well considers the geometry of the space (a function of bore radius) and source/sink terms (pumping rate).

Results are presented in Figure 4.4.

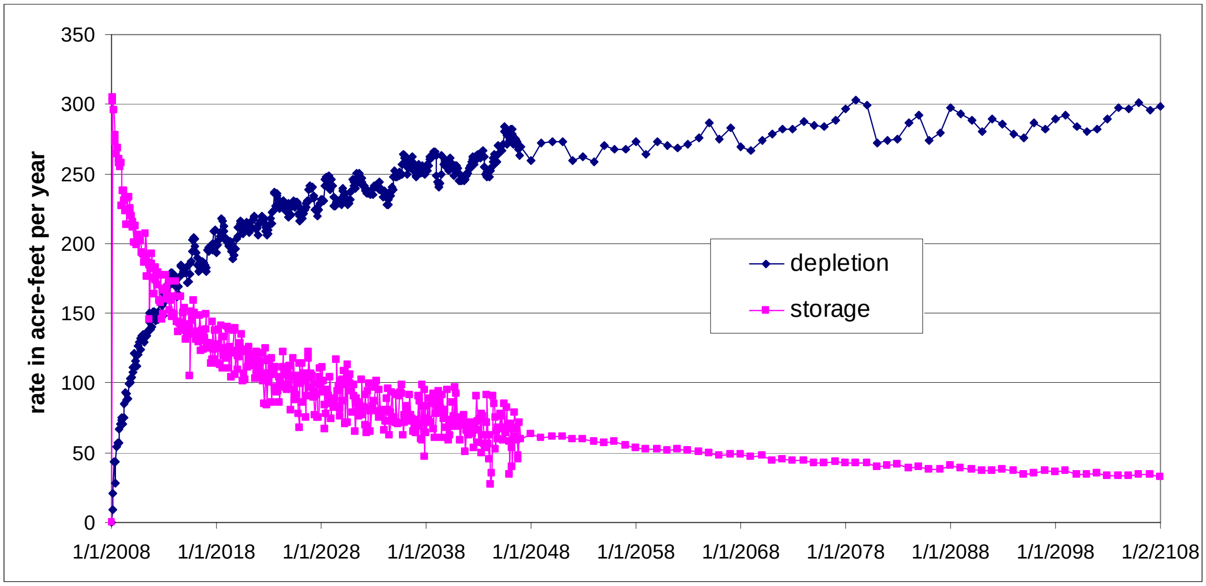


Figure 4.4. Model simulated depletion resulting from 325 afy additional pumping from Belen municipal wells, with pumping from two layers.

The oscillations remaining in the simulated depletion curve are a result of the small mass balance errors in the underlying groundwater flow simulation. These can be reduced through tighter convergence criteria, more iterations and longer run times.

5.0 APPLICATION: FAN SEDIMENTS AQUIFER TEST

LAK2 was used to simulate in-bore water levels in the analysis of aquifer test results. A numerical model was prepared to characterize the “Fan Sediments” colluvial aquifer .

A 21-day aquifer test was conducted. Three production bores, FSWW004-PB, FSWW013-PB, and FSWW020-PB, were pumped simultaneously at an average rate of about 35 liters per second each. Drawdown and recovery were measured in a total of 24 bores including:

- three pumping bores
- an observation bore located near each pumping bore, completed at a similar depth
- an observation bore located near each pumping bore, completed at a shallow depth
- a shallow observation bore located about 1 km from each pumping bore, in the area of the infiltration of pumped water
- regional observation bores, with deeper completions

A numerical model was developed to analyze the aquifer test in detail, considering saturated units above and below the production zone and responses measured in shallow, intermediate, and deep piezometers.

An observation bore is located near each pumping bore, within the same model cell, completed at a similar depth as the pumping bore. The drawdown at each model cell with a pumping bore was calibrated to match drawdown at the nearby observation bore.

In addition, water level in the pumping bore was represented directly using LAK2, in order to characterize the bore efficiency component of drawdown and to characterize the potential range of in-bore head losses that may be encountered in future production bores. The conductivity of each bore skin (the resistance to flow between aquifer and bore hole) was calibrated to match the measured pumping bore drawdown.

The water levels in observation bores FSWW012-MB and FSWW022-MB were also represented with the LAK2 module. Response in both bores to aquifer test pumping was found to be impacted by borehole problems, the first with an apparently blocked annulus and the second with apparent borehole leakage from a deeper formation. The LAK2 results help to confirm the explanation of borehole processes as the cause of each bore’s anomalous response.

Measured and simulated drawdown in pumping bore FSWW004-PB and in nearby monitoring bore FSWW003-MB are shown in Figures 5.1 and 5.2.

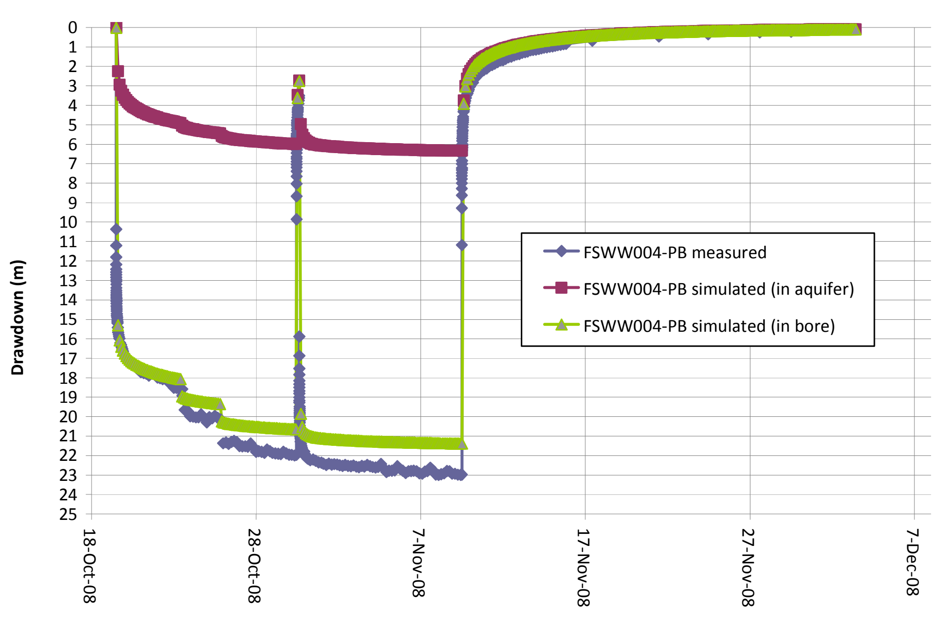


Figure 5.1. Measured and simulated aquifer test drawdown, FSWW004-PB.

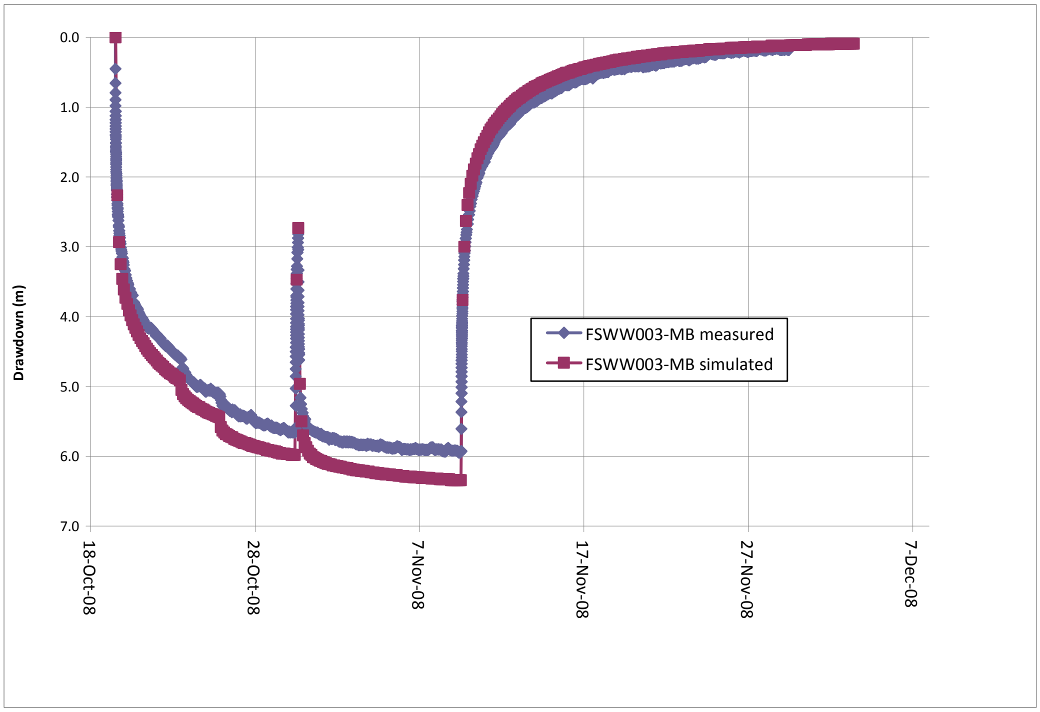


Figure 5.2. Measured and simulated aquifer test drawdown, FSWW003-MB.

Measured and simulated drawdown in pumping bore FSWW013-PB and in nearby monitoring bore FSWW010-MB are shown in Figures 5.3 and 5.4.

Measured and simulated drawdown in shallow observation bore FSWW022-MB is shown in Figure 5.5. The rapid and sharp response is characteristic of borehole leakage rather than water table drawdown. The apparent vertical connection observed in FSWW022-PB is likely a local borehole phenomenon. This was verified using LAK2 to simulate a bore in hydraulic communication with both Layers 1 and 2, resulting in a reasonably close reproduction of measured water levels.

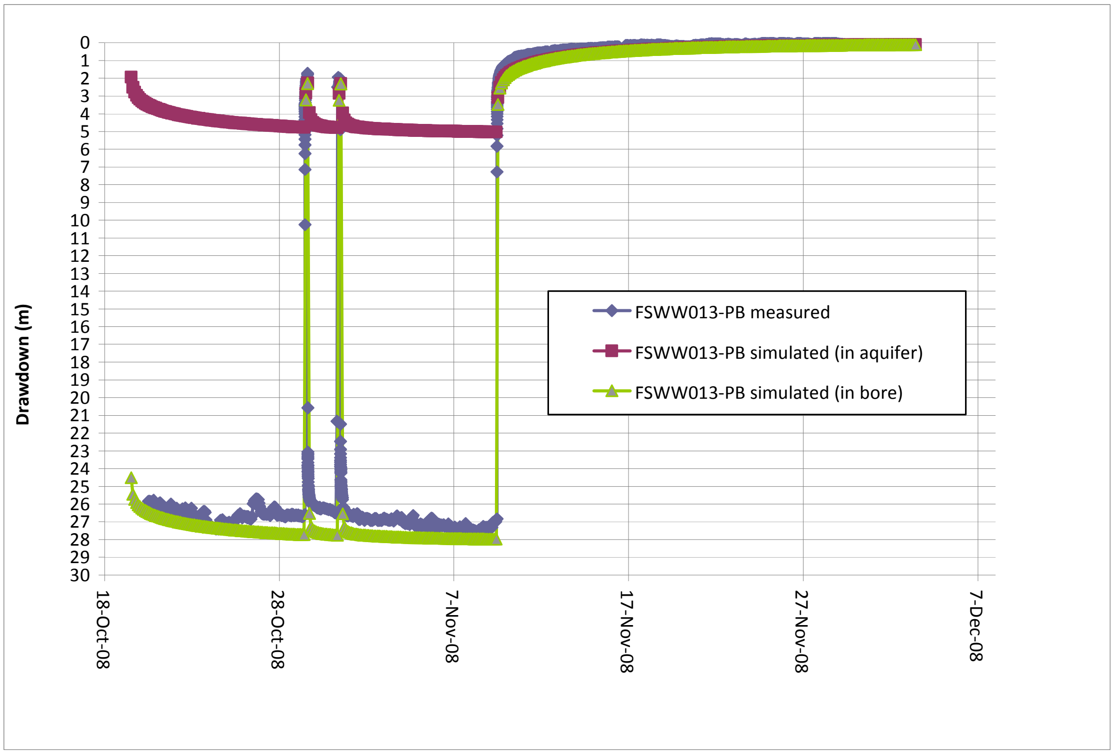


Figure 5.3. Measured and simulated aquifer test drawdown, FSWW013-PB.

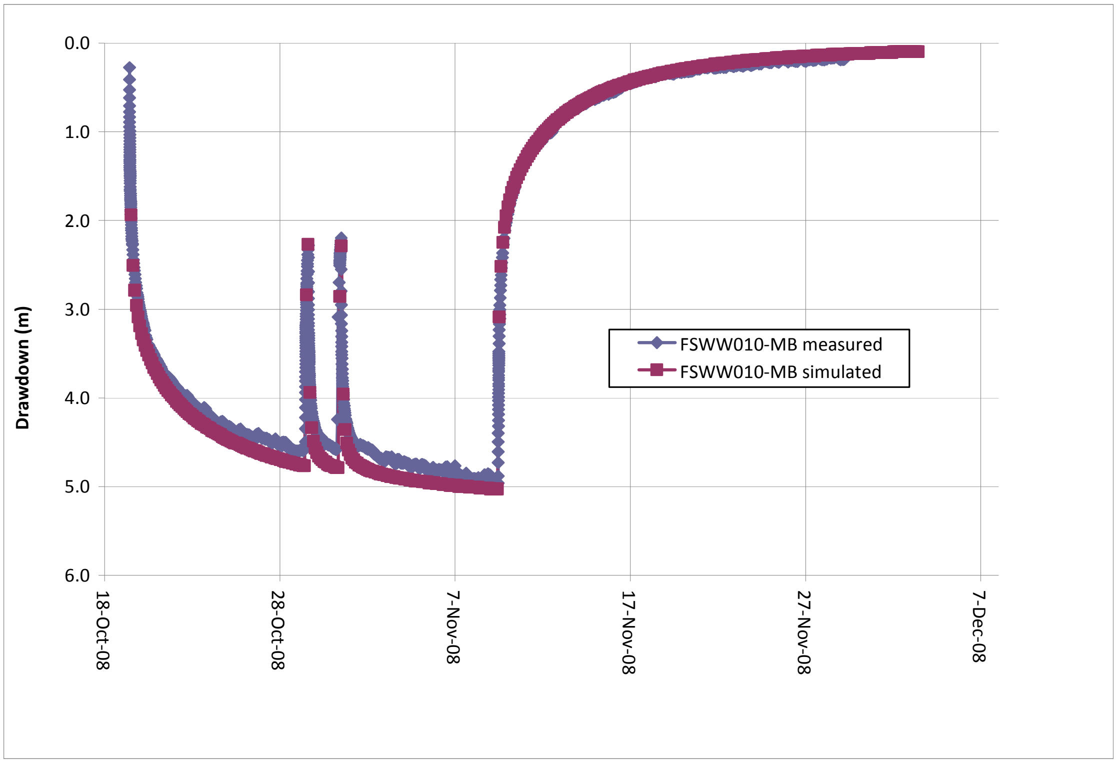


Figure 5.4. Measured and simulated aquifer test drawdown, FSWW010-MB.

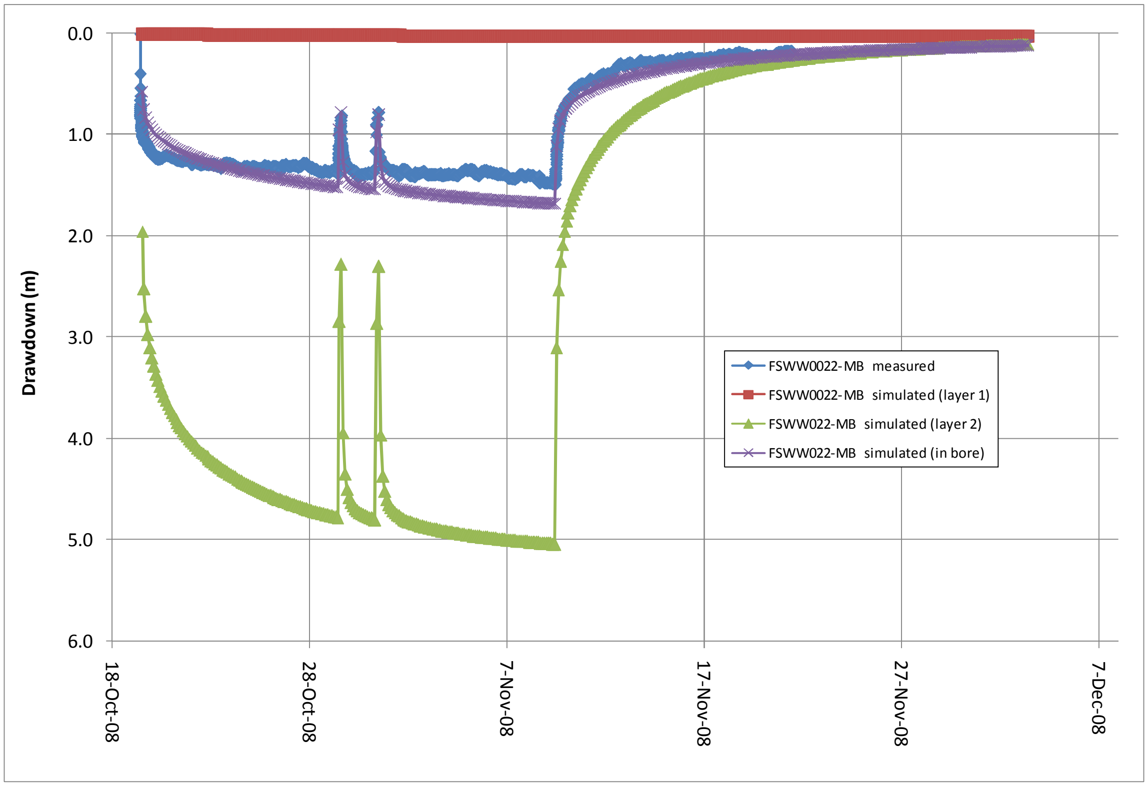


Figure 5.5. Measured and simulated aquifer test drawdown, FSWW022-MB.

Measured and simulated drawdown in pumping bore FSWW020-PB and in nearby monitoring bore FSWW018-MB are shown in Figures 5.6 and 5.7.

Farther away, water level in FSWW012-MB did not respond to pumping, as would be expected from the aquifer parameters indicated by the other observation bore responses. It was concluded, based on drilling results , that FSWW012-MB is isolated from the neighboring aquifer due to difficulties encountered during well construction and development. The lack of response at FSWW012-MB was simulated using the LAK2 module to represent an inefficient bore. Measured and simulated aquifer test drawdown at FSWW012-MB is shown on Figure 5.8.

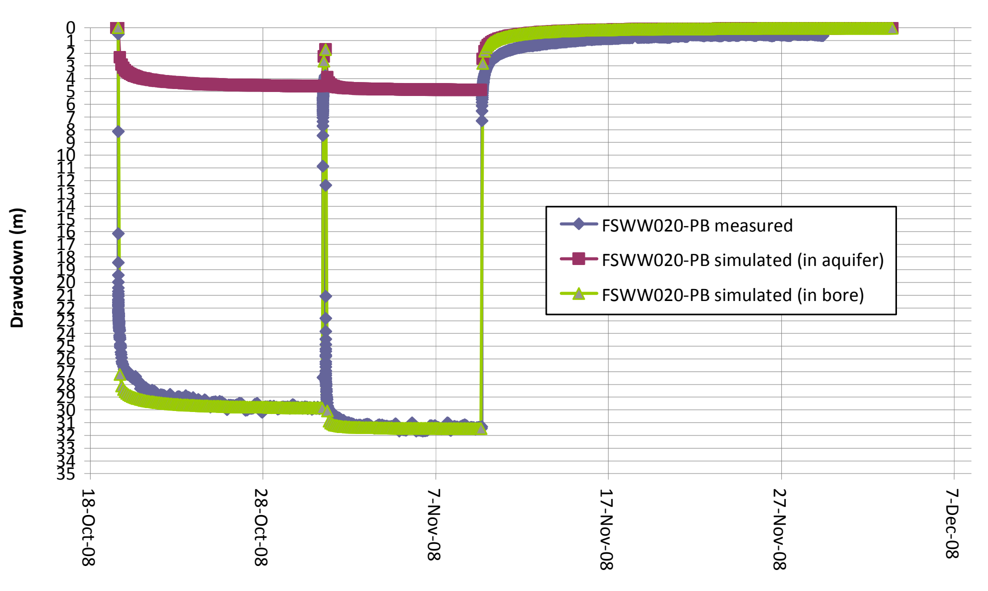


Figure 5.6. Measured and simulated aquifer test drawdown, FSWW020-PB.

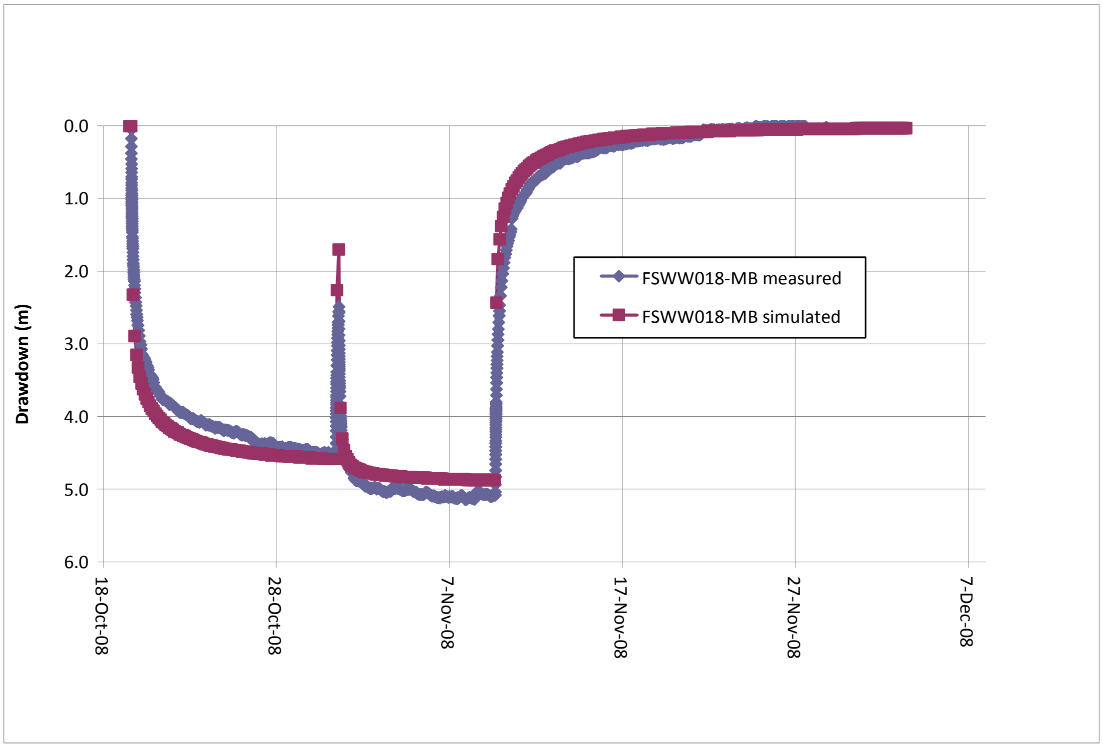


Figure 5.7. Measured and simulated aquifer test drawdown, FSWW018-MB.

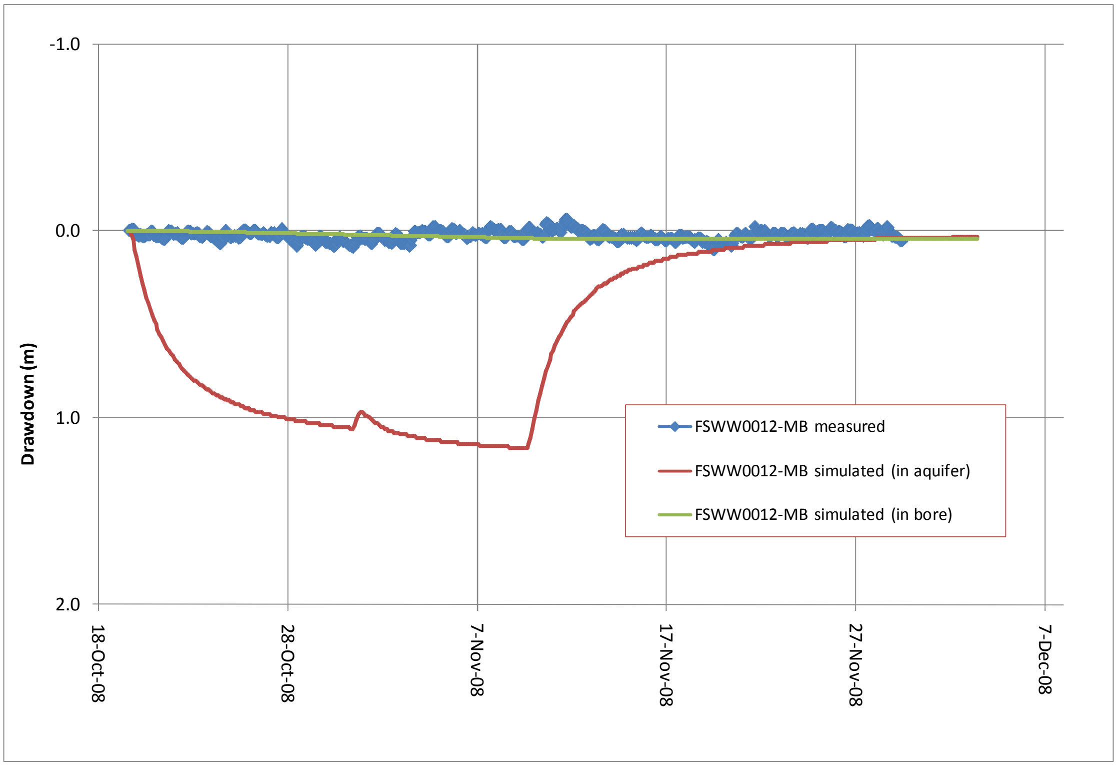


Figure 5.8. Measured and simulated aquifer test drawdown, FSWW012-MB.

6.0 REFERENCES

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THEMAC
RESOURCES

February 25, 2014

Brad Reid and Kurt Vollbrecht
New Mexico Environment Department
Groundwater Quality Bureau
Harold Runnels Building, Room N2250
1190 St. Francis Drive
Santa Fe, NM 87505

GROUND WATER
FEB 26 2014
BUREAU

RE: Model of Groundwater Flow in the Animas Uplift and Palomas Basin, Copper Flat Project, Sierra County, New Mexico

Dear Messrs. Reid and Vollbrecht,

This letter transmits the revised groundwater model report for the Copper Flat Project, noted above. Included with this transmittal:

- One bound hard copy of the full report
- CD with pdf of full report & complete model files

The report and CD was prepared by John Shomaker and Associates, Inc. Please contact me or Jeff Smith with any questions. Please email me to confirm receipt of the report and disk. My email address is kemmer@themacresourcesgroup.com.

Sincerely,
Katie Emmer

Katie Emmer
Permitting & Environmental Compliance Manager

cc: Chris Eustice, Mining and Minerals Division
Douglas Haywood, Bureau of Land Management
David Henney, Mangi Environmental Group
Kevin Myers, Office of the State Engineer
Lee Wilson, Lee Wilson & Associates Inc.

THEMAC
RESOURCES

February 25, 2014

Brad Reid and Kurt Vollbrecht
New Mexico Environment Department
Groundwater Quality Bureau
Harold Runnels Building, Room N2250
1190 St. Francis Drive
Santa Fe, NM 87505

GROUND WATER
FEB 26 2014
BUREAU

RE: Humidity Cell Termination Report for the Copper Flat Project, New Mexico, and SRK's External Memorandum: Copper Flat PFS and DFS Gap Analysis

Dear Messrs. Reid and Vollbrecht,

This letter transmits the geochemistry reports for Copper Flat referenced above. Included with this transmittal:

- A bound hard copy of the Humidity Cell Termination Report for the Copper Flat Project, New Mexico
- A hard copy of SRK's External Memorandum: Copper Flat PFS and DFS Gap Analysis
- Two CDs: one with both reports, another with only the Humidity Cell Termination Report (included in the report binder)

The reports and CDs were prepared by SRK Consulting. Please contact me or Jeff Smith with any questions. Please email me to confirm receipt of the report and disk. My email address is kemmer@themacresourcesgroup.com.

Sincerely,

Katie Emmer

Katie Emmer
Permitting & Environmental Compliance Manager

cc: Chris Eustice, Mining and Minerals Division
Douglas Haywood, Bureau of Land Management
David Henney, Mangi Environmental Group
Mark Nelson, CDM Smith

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5th Floor Churchill House
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Fax: + 44 (0) 2920 348 199

External Memorandum

To:	Steve Raugust	**From:**	Rob Bowell, Ruth Warrender, Amy Prestia
Company:	THEMAC Resources Group Ltd.	**Project Number:**	191000.03/UK3939
File Ref:	*P:\U3939 Copper Flat Scoping Study\Project\Reps\PFS DFS Comparison memo*	**Project Title:**	Copper Flat
		Date:	February 13, 2014
Subject:	**Copper Flat PFS and DFS Gap Analysis**		

Introduction

SRK Consulting, Inc. (SRK) has undertaken a geochemical characterization study to assess the Acid Rock Drainage and Metal Leaching (ARDML) potential of waste rock, tailings and ore at the Copper Flat project, New Mexico. This assessment has included static and kinetic geochemical characterization testing of representative materials and the development of numerical predictions to assess potential future water quality associated with the mine facilities (waste rock dumps, tailings facility and pit lake). The results of the characterization program and subsequent numerical predictions are provided in the *Geochemical Characterization Report for the Copper Flat Project* (SRK, 2013a) and *Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico* (SRK, 2013b) report, prepared by SRK Consulting, Inc. and submitted in May and September 2013, respectively.

The characterization program and subsequent numerical predictions were designed around the Pre-Feasibility Study (PFS) mine plan. However, subsequent changes to the mine plan have been made as part of the Definitive Feasibility Study (DFS). THEMAC Copper Resources Group Ltd. has requested that SRK review and compare the relevant information contained with both the PFS and DFS reports and undertake a gap analysis to determine whether additional work is warranted based on the revised mine plan and new information provided in the DFS. The findings of the data review and gap analysis are presented herein.

Data Review and Gap Analysis

A comparison of the relevant design criteria for the PFS and DFS are provided in Table 1 along with implications for the geochemical characterization study. This comparison demonstrates that in most cases there have only been minor changes to the design criteria and the implication of these changes on the results of the geochemical characterization work are not significant. In instances where there has been a more substantial change between the PFS and DFS (for example the change in waste rock tonnage and the removal of the low grade ore stockpile), the predictions provided by SRK as part of the PFS reflect a more conservative scenario and therefore no additional work is considered necessary for the purpose of the DFS. Figure 1 presents the DFS mine plan and Figure 2 shows the layout of the DFS Waste Rock Disposal Facilities. The PFS facility layout as originally presented in SRK 2013a is shown in Figure 3 and 4. A comparison of Figures 1 through 4 shows the general configuration of the DFS mine plan is similar to the PFS mine plan.

Table 1: Summary of PFS and DFS Design Criteria Pertinent to Geochemical Characterization Program

Parameter	Pre-Feasibility Study Design Criteria	Definitive Feasibility Study Design Criteria	Implications for Geochemical Characterization Study
Cu cut-off grade (wt%)	0.164	WRDF1 – 0.168 WRDF2 – 0.131 WRDF3 < 0.131	Minor. Based on the October 2013 revisions to the DFS, the low-low grade and high-low grade stockpiles will not be processed and the material in these stockpiles will become uneconomic waste rock. The DFS states that there will be three WRDFs with different cut-off grades; higher grade material will be deposited in WRDF1 and will have a cut-off grade of 0.168 wt% Cu (comparable to the PFS cut-off grade of 0.164 wt%); WRDF2 will have a lower cut-off grade of 0.131 wt%, and WRDF3 will receive material less than 0.131 wt%, which is likely to result in a reduced amount of sulfide-bearing waste in WRDF2 and WRDF3. The numerical predictions undertaken for the WRDF as part of the PFS are based the higher cut-off grade and therefore represent a conservative estimate of future water quality.
Waste rock (ktons)	60,725	44,682	None. The tonnage of waste rock has decreased for the DFS. The numerical predictions are based the higher (PFS) waste rock tonnage and therefore represent a conservative estimate of future water quality.
Waste rock proportions	Andesite 1.1%; biotite breccia 1.2%; quartz feldspar breccia 4.6%, quartz monzonite 78.2%, coarse crystalline porphyry 14.9%	Andesite 3.3%; biotite breccia 4.3%; quartz monzonite 77.5%, coarse crystalline porphyry 14.9%	Minor. The difference between the PFS and DFS waste rock proportions is negligible. There has been a small increase in the proportion of andesite intersected by the DFS pit (see Figure 5 and 6). However, this will not have significant implications for the numerical predictions, as the unoxidized andesite is predicted to be NAF with low levels of metal leaching. In addition, the DFS block model groups the biotite breccia and quartz feldspar breccia units together, which will have no effect on the geochemical characterization program.
Mill ore (ktons)	95,248	113,084	Not applicable. Mill ore was not considered.
Low grade stockpile ore (ktons)	2,870	There will be no separate LGO stockpile, but material deposited in WRDF1 and WRDF2 will be higher grade and the facilities are planned so that they could be re-mined for a future processing opportunity or reclaimed in their current configuration.	None. No geochemical predictions were undertaken for the LGO stockpile as part of the PFS. In addition, the cut-off grade for the higher grade material that will be deposited in WRDF1 (0.168 wt% Cu) is comparable to the waste rock cut-off grade used for the PFS (0.164 wt% Cu). Therefore no change to the waste rock characteristics is anticipated.

Parameter	Pre-Feasibility Study Design Criteria	Definitive Feasibility Study Design Criteria	Implications for Geochemical Characterization Study
WRDF design and closure	One WRDF. Closure of the facility will include placement of a 3-ft thick cover of growth media and native fill material.	Three WRDFs. Material in WRDF1 and WRDF2 will be higher grade and potentially re-mined. Closure of the facilities will include regrading, placement of a 3-ft thick cover and re-vegetation.	Minor. Although WRDF1 is not included in the PFS, this facility is located within the open pit surface drainage area and only requires that surface water contact with the material to be minimized. In addition, the total tonnage of waste rock has decreased for the DFS. Therefore, the numerical predictions conducted as part of the PFS represents a conservative estimate of future water quality.
TSF surface area (acres)	530	536	None. The planned surface area of the TSF has only increased by 1.1% between PFS and DFS, which will have minimal implications on the numerical model results.
TSF capacity	100 Mt	112 Mt	Minor. The tonnage of tailings has increased by 12% between the PFS and DFS. This is not expected to significantly increase solute loading from the TSF.
TSF design and closure	Underlain by a geomembrane liner (80-mil HDPE placed on 6 - 12 inch thick liner bedding fill layer) and tailings drainage collection system. Closure of the facility will include placement of a 36-inch reclamation cover.	Underlain by a geomembrane liner (80-mil HDPE placed on 12 inch thick liner bedding fill layer) and tailings drainage collection system. Closure of the facility will include placement of a minimum 36-inch reclamation cover.	None. The design and closure plans for the TSF have not changed between the PFS and DFS.
Pit wall final exposed lithologies	Andesite 1.2%; biotite breccia 4.0%; quartz feldspar breccia 6.3%, quartz monzonite 74.5%, coarse crystalline porphyry13.3%	Andesite 2.6%; biotite breccia 15.3%; quartz monzonite 68.6%, coarse crystalline porphyry 13.5%	None. The difference between the proportions of each lithology exposed in the final PFS and DFS pit walls is minor. There has been a small increase in the proportion of andesite, however, this will not have significant implications for the numerical predictions as the unoxidized andesite is predicted to be NAF with low levels of metal leaching. In addition, the DFS block model groups the biotite breccia and quartz feldspar breccia units together, which will have no effect on the pit lake model results as the geochemical properties remain unchanged.
Pit water balance	Disturbance area 156 acres; pit highwall area 143 acres; pit watershed area 230 acres; final water level 4900 ft amsl; final water surface area 18.6 acres; final pit water balance 100 acre-feet per year.	Disturbance area 161 acres; pit highwall area 129 acres; pit watershed area 230 acres; final water level 4860 ft amsl; final water surface area 18.6 acres; final pit water balance 101 acre-feet per year.	None. The final pit water balance has only changed by 1 acre-foot per year between PFS and DFS. Although there is a slight increase in the pit disturbance area (3%), the pit highwall area that will represent the greatest contribution to solute loading from run-off has reduced from 143 acres to 129 acres. The numerical predictions conducted for the PFS therefore represent a slightly more conservative estimate of future pit lake water quality.

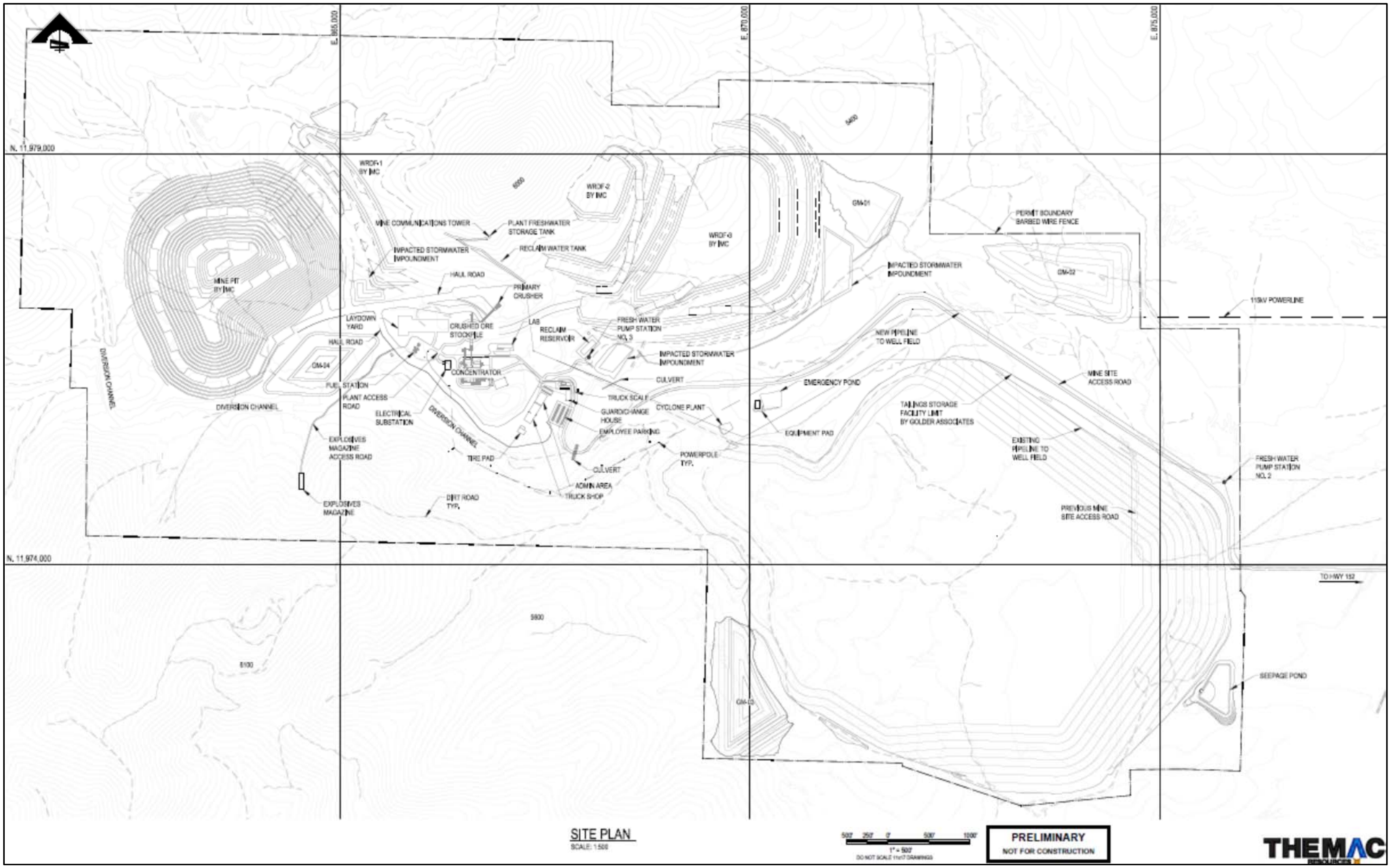

Figure 1: Definitive Feasibility Study Facility Layout

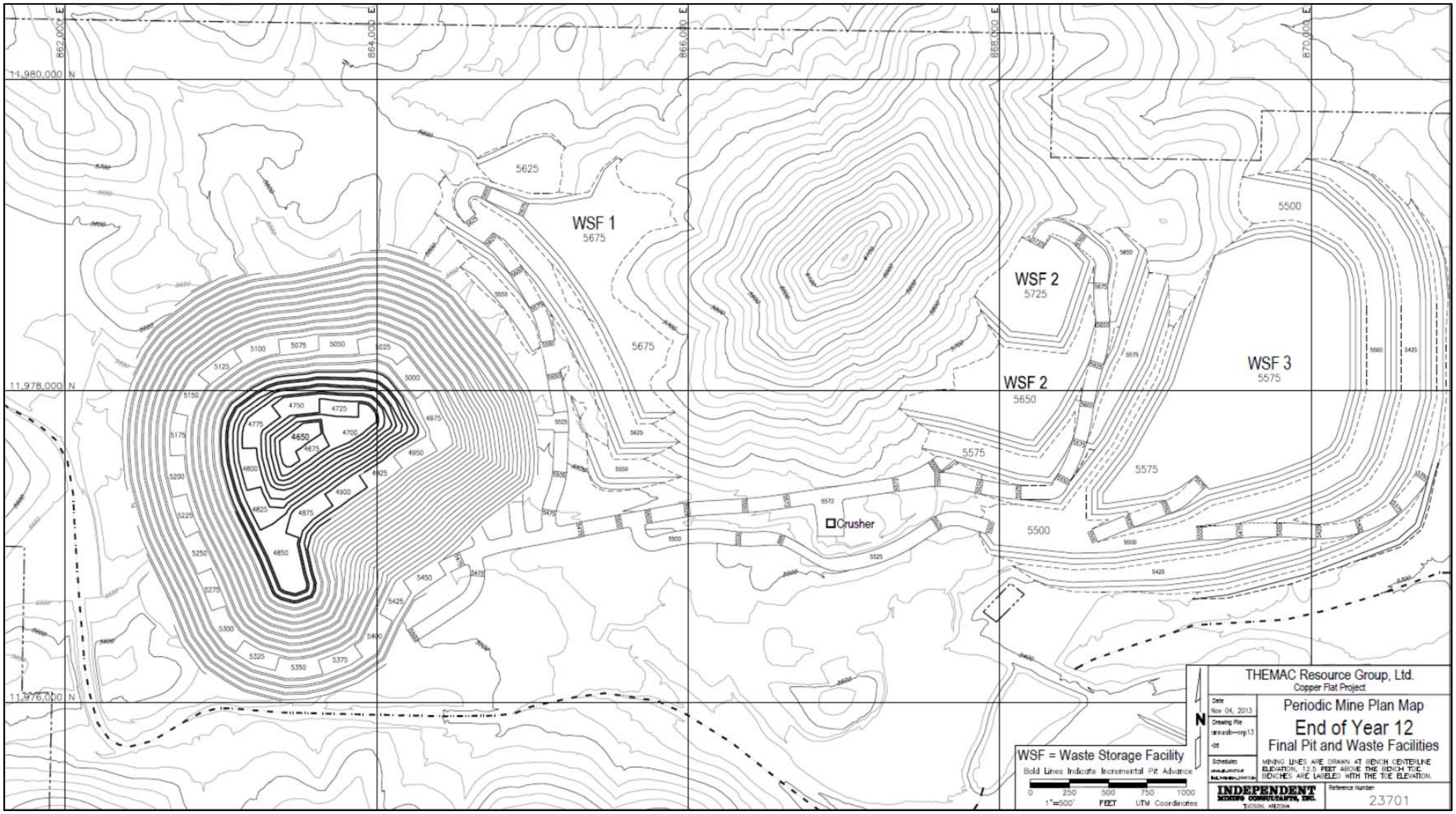

Figure 2: Definitive Feasibility Study Facility Layout Waste Rock Disposal Facility Detail

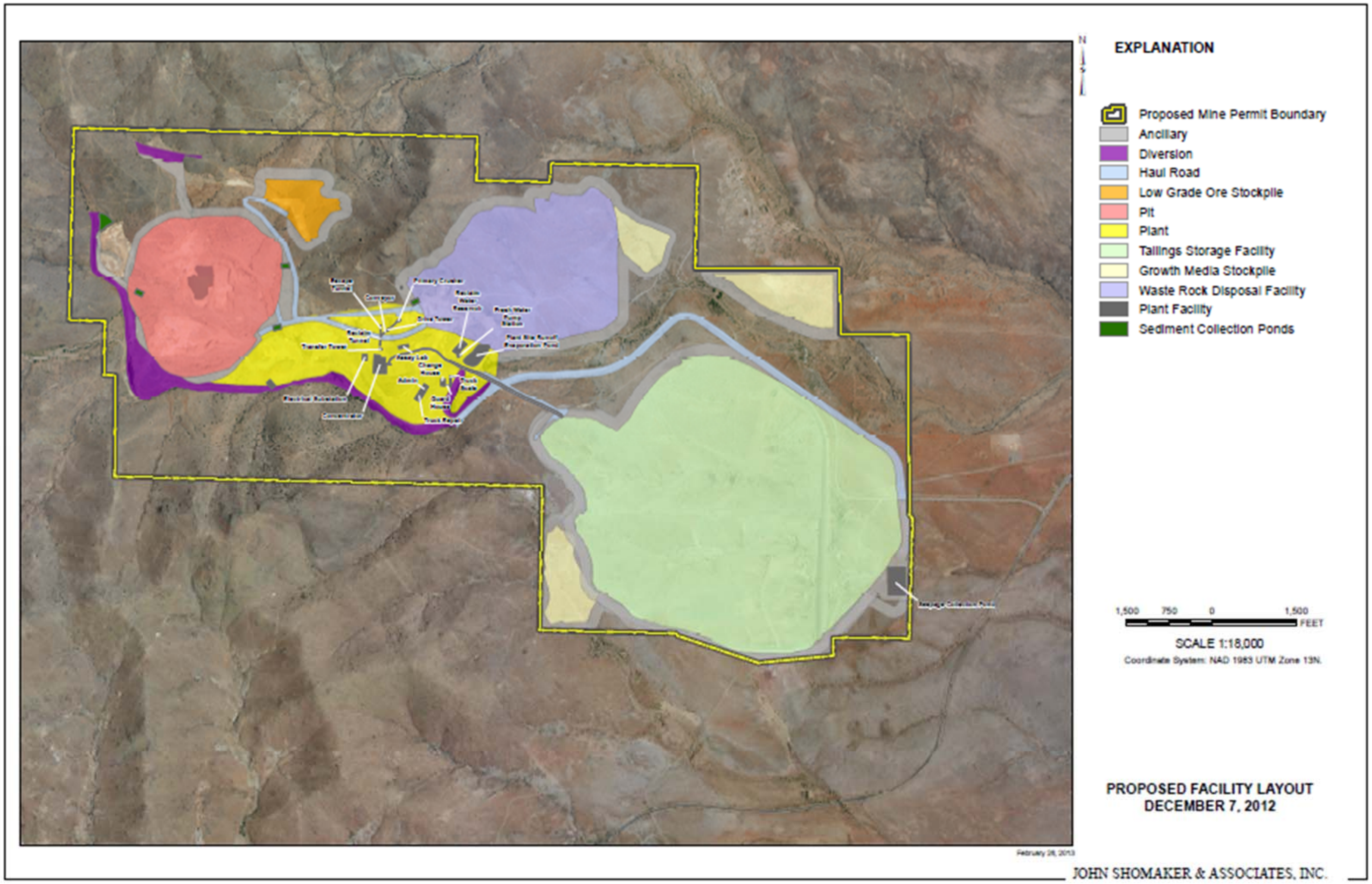

Figure 3: Pre-Feasibility Study Facility Layout

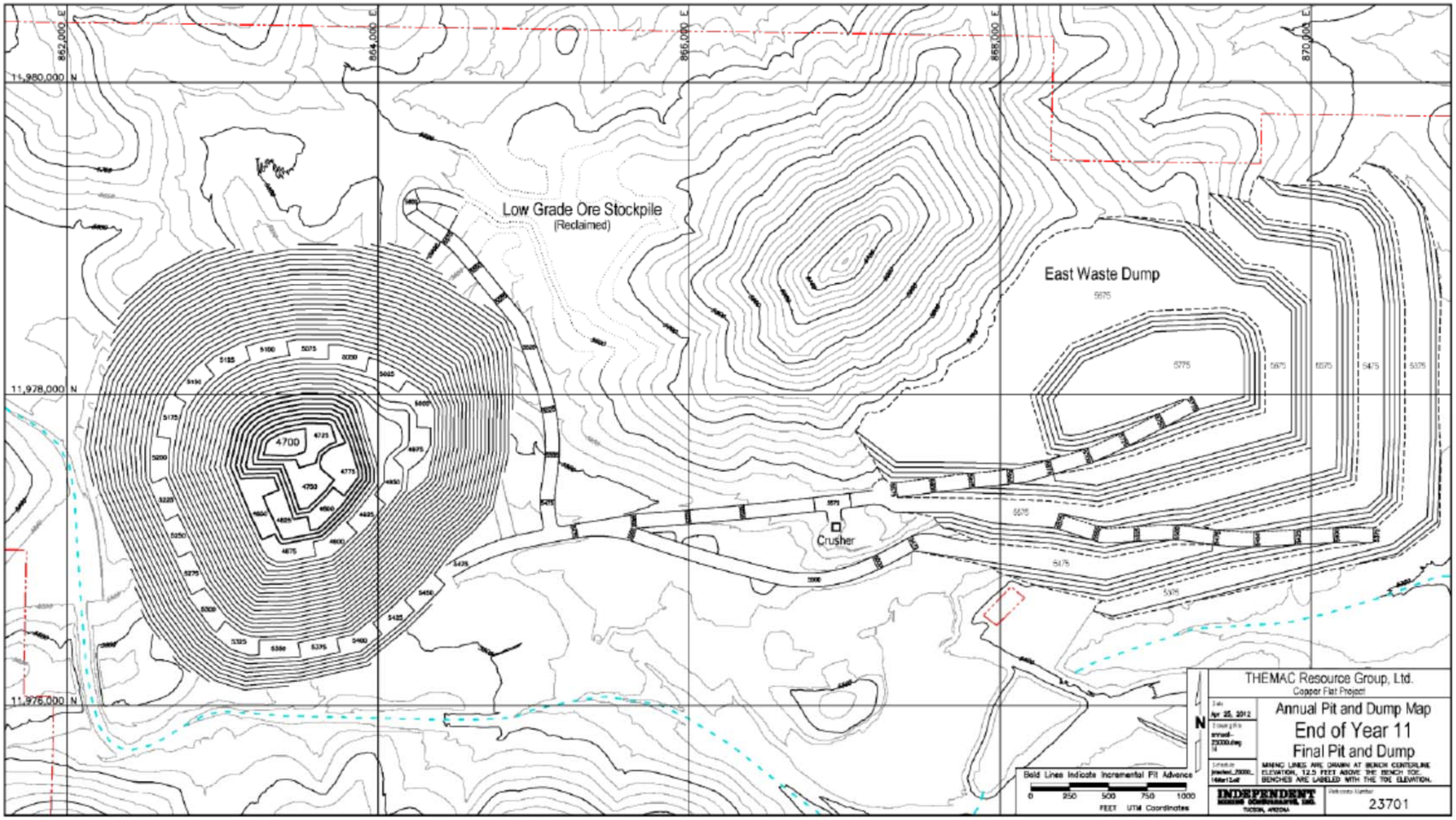

Figure 4: Pre-Feasibility Study Waste Rock Disposal Facility Detail

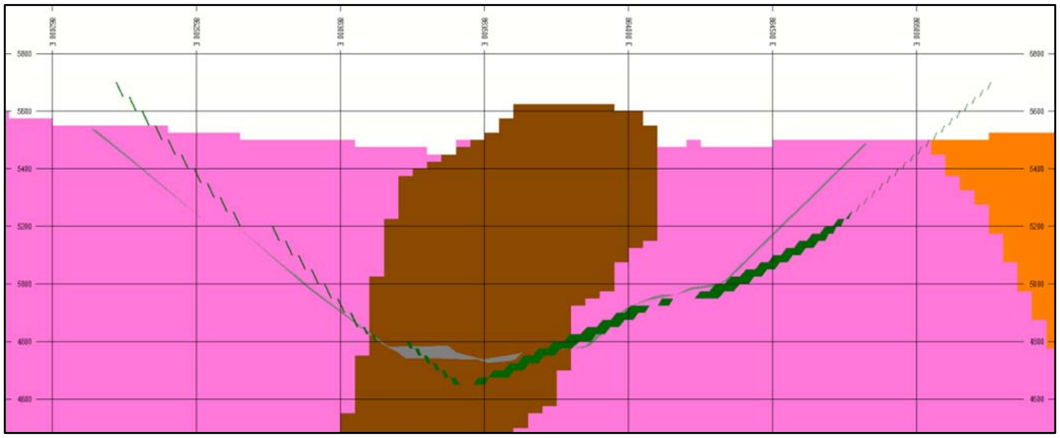

Figure 5: Cross section showing comparison between PFS pit shell (in grey) and DFS pit shell (in green). *[Pink = quartz monzonite; brown = biotite breccia; orange = andesite]*

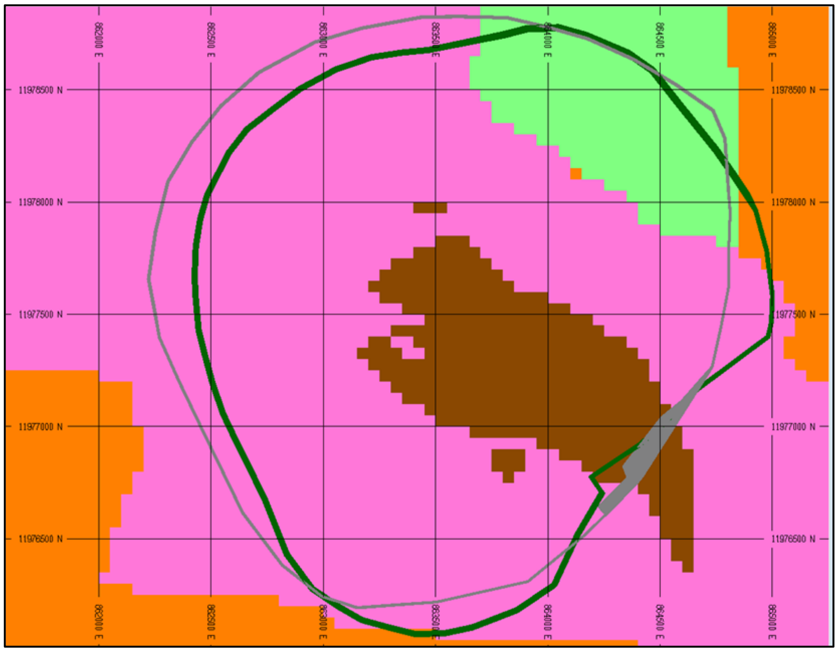

Figure 6: Plan view showing comparison between PFS pit shell (in grey) and DFS pit shell (in green). *[Pink = quartz monzonite; brown = biotite breccia; orange = andesite]*

Conclusions

Based on the findings presented herein, the previous geochemical characterization work remains valid and revisions to the geochemical characterization and modeling will not be required as part of the DFS. In most cases, the predictions provided by SRK as part of the PFS reflect a more conservative scenario and therefore no additional work is considered necessary for the purpose of the DFS.

State of New Mexico
Energy, Minerals and Natural Resources Department

Susana Martinez
Governor

David F. Martin
Cabinet Secretary - Designate

Brett F. Woods, Ph.D.
Deputy Cabinet Secretary

Fernando Martinez, Director
Mining and Minerals Division

March 18, 2014

Ms. Katie Emmer
New Mexico Copper Corporation
2424 Louisiana Blvd., N.E., Suite 301
Albuquerque, NM 87110

RE: Baseline Data Report for Proposed Copper Flat Mine, Permit No. SI027RN

Ms. Emmer:

The New Mexico Mining and Minerals Division ("MMD") received a permit application package ("PAP") to mine from New Mexico Copper Corporation ("NMCC") dated July 17, 2012 that included the required Baseline Data Report ("BDR"). Upon technical review of the BDR, and soliciting and receiving state agency comments, MMD provided NMCC with technical comments (including agency comments) in a correspondence dated February 18, 2013. This correspondence is a summary of the documents related to the BDR and describes MMD's assessment of the BDR to date.

On July 19, 2013 MMD received two reports from NMCC considered as additions to the BDR:

1. *Copper Flat Mine Baseline Data Report Addendum,* which presents responses to MMD's February 18, 2013 correspondence and additional data to support the BDR.
2. *Geochemical Characterization Report for the Copper Flat Project New Mexico.*

These two reports are collectively referred to as "BDR Addendum" and are considered a part of the BDR and/or permit application package as submitted by NMCC for the proposed Copper Flat Mine. MMD has solicited and received technical comments (enclosed) on the BDR Addendum from the state agencies and have reviewed the same internally.

On October 2, 2013, the MMD received two more reports from NMCC that are also considered additions to the BDR for the Copper Flat Mine PAP. The titles of the reports are:

1. *Predictive Modeling of Pit Lake Water Quality at the Copper Flat Project;*
2. *Model of Ground Water Flow in the Animas Uplift and Palomas Basin, Copper Flat Project*

Together these two subject reports are collectively referred to as "BDR Addendum 2" and both are considered to be part of the BDR and the developing PAP. The MMD has solicited and received the technical comments enclosed from NMED and Office of State Engineer on the BDR Addendum 2

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and MMD is currently reviewing these documents with respect to the *probable hydrologic consequences* ("PHC").

On March 3, 2014, the MMD received three additional reports from NMCC that are considered additions to the BDR's in so far as they provide data necessary to characterize the PHC for the proposed Copper Flat Mine. The titles of those reports provided by NMCC are:

1. *Humidity Cell Termination Report for the Copper Flat Project, New Mexico*;
2. *Copper Flat PFS and DFS Gap Analysis*;
3. *Model of Ground Water Flow in the Animas Uplift and Palomas Basin, Copper Flat Project* , which is an update to the submission of July 19, 2013 and includes responses to Office of State Engineer's and the Bureau of Land Management's ("BLM") comments and suggestions.

MMD will review the three documents identified above, under the context of characterizing the PHC and the developing mining operations and reclamation plan ("MORP"). Additionally, MMD will solicit review and comments from the state agencies within that same context upon submittal of an updated MORP.

Subsequently, the MMD now acknowledges that NMCC has fulfilled the requirements of 19.10.6.602.D(13) with the exception of characterizing and determining what the PHC of the proposed mining operation would be as required by 19.10.6.602.D(13)(g)(v). The MMD recognizes that characterizing the PHC of the proposed mining operation is not possible to do at this time, given the fact the MORP and the predictive groundwater modeling for the pit and the production wells are still being developed.

If you have any questions, please contact me at (505) 476-3438.

Sincerely,

Chris Eustice, Permit Lead
Mining Act Reclamation Program (MARP)

Enclosures

Cc: Fernando Martinez, Director, MMD
Holland Shepherd, Program Manager, MARP
Kurt Vollbrecht, NMED
Joseph Navarro, BLM-Las Cruces
Mine File SI025EM

Cooperating Agencies - NMCC Meeting Notes
18 March 2014 14:00 MST

Attendee	Company	Initial	Present
Doug Haywood (via phone)	BLM	D.Haywood	X
Rachel Jankowitz	NM G&F	RJ	X
Patrick Longmire	NMED	PL	X
Brad Reid	NMED	BR	Not present
Kurt Vollbrecht	NMED	KV	X
Kevin Myers	NMOSE	KM	Not present
Dave Henney (via phone)	Mangi	D.Henney	Not present
DJ Ennis	MMD	DJE	X
Chris Eustice	MMD	CE	X
Holland Shepherd	MMD	HS	X
Katie Emmer	THEMAC	KE	X

Action Items for 18 March 2014 Meeting

- Upcoming Meetings/Calls
    - Patrick Longmire and Brad Reid to meet NMCC & JSAI for site visit at Copper Flat: 20 March
    - NMED, MMD, Mangi, BLM to conduct call regarding geochemistry 28 March. NMCC will not participate to allow free discussion of review per MMD's request.
    - Bud Brock from OSE Dam Safety will visit Copper Flat, meet with Steve Raugust: 25 March
    - NMCC will contact NMED to set up a meeting likely in early April to deliver/discuss Stage I report regarding 2013 characterization work
    - NMED recommends another meeting with James Hogan of the Surface Water Quality Bureau to discuss plans for the pit. NMCC will look for a good time to schedule.
    - A call with NMED, MMD, Mangi, NMCC and SRK to discuss Patrick Longmire and Mark Nelson's review of geochemistry is anticipated, TBD after review is complete.
- Geochemistry
    - Patrick Longmire is preparing informal written comments regarding additional geochemistry reports, to be ready around 22 April.
- NMCC Upcoming Deliverables
    - Stage I Abatement Report on 2013 characterization work: early April

1. **Geochemistry Reports status** : Submitted to MMD, NMED, BLM & Mangi via FEDEX 27-Feb2014
Discussion: Mangi to rely on NMED for geochemistry review, Mark Nelson to do a cursory review of geochemistry.
PL: I have reviewed groundwater geochemistry for Copper Flat, we had a call with SRK on 13 January, discussed informal written comments and we thought that call went pretty well. I received HCT Termination report last Friday (14 March). I am planning to visit Copper Flat 20 March with Brad Reid. I have other things I am working on but expect to get to the Pit Lake report and review it over the next 30 days.
KV: The agencies should have a conversation about the geochemistry review/timeline.
D. Haywood: I have forwarded the geochemistry reports to Corey Durr, they are on his desk. He is a hydrologist.

KV: Perhaps next week would work for an agency call. I met with James Hogan and discussed the pit with him; we note that the Pit Lake Report does not talk to warm water aquatics standards. This will need to be addressed in the not too distant future. James and I are poking at Nevada to see if we can talk to them about how they handle these things.
KE: It is our understanding, based on the meeting we had with James Hogan over a year ago, I believe Kurt you were there, that we will pursue Use Attainability Analysis to get the warm water aquatics standards removed.
KV: We see four standards: warm water aquatics, primary contact, livestock, and wildlife. We assumed you would approach warm water aquatics with an UAA and we can see how you could eliminate primary contact and livestock by controlling the site; it's wildlife that will be more problematic.
KE: We are working with JSAI and Mark Logston to address these concerns. We are aware the Pit Lake Report predicts some concerns for the pit in the future, however that report did not take into account any source controls or reclamation. JSAI is working on a document that will look at reclamation plans and we had envisioned this as a potential appendix to the MORP because it deals with reclamation, we hope to show that with reclamation the water in the pit lake will meet wildlife standards. We are happy with the work SRK did and we believe the model work is good. We want to build on that document to address these concerns through reclamation.
RJ: I would like to see the geochemistry reports.
CE: You can access them on the MMD website.
RJ: Ok, I'll look for them there. I will let you know if I need anything else.

2. **Groundwater model**: Revised report submitted to MMD, NMED, NMOSE, BLM, Mangi, FEDEX 27Feb-14
CE: We understand this document captured comments from BLM and OSE.
KE: Yes, and the report came with executable final model files, it was intended to be everything except projections. On 26 February, NMCC received word from Dave Henney that LWA does have comments regarding the groundwater model that came up during their review and work to provide model results to NEPA analysts. JSAI, NMCC, BLM and LWA met in Socorro on 10 March to discuss LWA's concerns, Dave Henney was on the phone for that meeting. The main good news is that LWA agrees that we have a functioning, useful model. At this point we are working with LWA to make some requested tweaks to the model to address specific EIS scoping comments. We do not anticipate significant changes to the model based on these comments, but we would like to get this resolved before we generate for the state a report regarding probable hydrologic consequences of the proposed mine. LWA has indicated they are not completely done with their review of the model, they may have more comments. We are working with LWA and BLM to be as responsive as possible and to resolve comments as quickly as possible.
D. Haywood: It does appear there are no major concerns with the model; we are working to get public comments addressed.

3. EIS status
D. Haywood: I am working on reviewing EIS draft Chapter 2, hope to be done in the next day or two, then will pass it on to the other BLM staff for their review. I have received comments from our minerals guy in Santa Fe. As you know, the time we had blocked to do this work has come and gone, we have to fit it in where we can.

4. Overall permit timeline shifts
KE: NMCC is still working to make internal decisions regarding state permit schedules, and the concerns of the EIS have taken a great deal of our time and attention. We do not have a current schedule for when NMCC will be submitting outstanding state permit documents, however we would like to be working to respond to questions and comments about existing submitted documents as quickly as possible.

KE: NMCC has heard from BLM that they cannot commit to any schedule for the EIS, Doug Haywood has communicated that since the EIS is over a year behind schedule a number of BLM analysts and experts have their time assigned to other concerns. I hope that as the year progresses and the schedule becomes more firm BLM may be able to get NMCC back into their schedule for work as the current EIS timeline calls for work to be ongoing into 2015.

5. Permit Application Package Status

KE: NMCC received a letter from MMD this morning stating all baseline data has been received with the exception of probable hydrologic consequences. NMCC appreciates MMD's response. The letter indicates that additional agency comments were "enclosed" with the letter, I haven't yet seen them.
CE: We just emailed those as well; they would have gone through in the last hour or two.
KE: We appreciate MMD's correspondence for the administrative record, this will be useful. We remain focused on achieving a Technically Approvable status, if possible in 2014. We understand these steps remain:

a) Receiving and resolving all comments on these components of the baseline data including the geochemistry reports,
b) Preparing and submitting the "probable hydrologic consequences" (projections)
c) Preparing and submitting the revised MORP
d) Receiving and resolving all comments on the groundwater projections and the MORP

CE: That sounds about right to me.
-Concurrence from MMD members. Discussion: there is no schedule yet for a revised MORP but NMCC is working on this piece and it's a priority. There is a hope to get a revised MORP to the agencies in the next 3-4 months.-
KE: As we've discussed, a revised Discharge Permit Application and resolution of comments on that will also be key to advancing the state permitting process, however this is with NMED.

6. Stage I Abatement Plan status

KE: I am reviewing a draft Stage I Abatement Report this week and have been pushing JSAI to have something to NMED by the end of March. Things are running a bit behind; it may be early April before we have something to submit. We will be in touch with Brad and Kurt and anticipate it will be useful to schedule a meeting to deliver the report and discuss its findings. I will be in touch.

7. Revised Discharge Permit Status

KE: NMCC is still working to get internal decisions made regarding a revised MORP plan and the revised DP permit application together. We have not yet set a schedule for this.

8. **OSE Dam Permit:** Bud Brock and Steve Raugust have been in contact. Bud and Steve have a site visit planned for the 25th of March.

9. **HS Question Re: Foundations:** What is the status of the foundations at the mine site? Has that been released with BLM?

KE: A portion has been released, the 3809, which has to do with the areas that were recovered and reclaimed- the administration building, the truck shop, the concentrate load out, the top of the primary crusher – Joe Navarro was happy with that dirt work and reclamation and that has been released, there was a small financial assurance released, I believe about $30,000. The other foundations are under a 3600 permit and that has not yet been released. Joe was planning to look at the stipulations on that and get back to us on if they'd like additional dirt work or vegetation.

CE: What areas are part of the 3600?
KE: It’s the foundations that have been exposed; the concentrator is the main one, also the assay lab. I have a map, just not with me.
CE: Will those be re-covered?
KE: No, that material was purchased from the BLM. We anticipate possibly doing addition dirt work to make things stable around the foundations and may have some vegetation work per BLM’s request, but we do not plan to re-cover those foundations. We hope to get this closed out this summer, depending on what Joe Navarro would like to see.

10. **Next meeting date:** 22 April is selected.

-KE departs-

11. **Geochemistry Conversation without NMCC present:** MMD, NMED, NMOSE, BLM, Mangi

New Mexico Environment Department
Ground Water Quality Bureau

Inspection Report

Inspection Date: 03/20/14

DP #: 1

Facility Name: Copper Flat Mine

Facility Contact Information – Scheduling Inspection

☑ **Scheduled Inspection - provide contact information** ☐ **Unannounced Inspection**

Person Contacted:
Katie Emmer,
Project Scientist

Phone Number:
505.400.7925

Facility Description

Waste Type: Other

Directions to Facility: 6 miles NE of Hillsboro along Hwy 152

Inspection Information

Start Time: 10:45 am **End Time:** 2:30 pm

NMED Inspector(s): Brad Reid, Patrick Longmire

Verify that NMED identification was presented: ☑ Yes ☐ No

Facility Representative(s) present during the Inspection/Discussion: Katie Emmer and Steve Raugust (NMCC); Steve Finch, (Shoemaker and Associates);

Reason for Inspection: other

Discussion, Observations and Information Obtained

NMED staff met Katie Emmer from NMCC and Steve Finch from John Shoemaker and Associates for a tour of the mine site. Following are relevant observations from the inspection.

1) NMED staff spent most of the inspection in and around the pit lake looking at the precipitates rimming the edge of the pit lake (see attached photos).
2) NMED also observed the acid impacted fractures, seeps and rocks around the pit lake.
3) Discussed approximate pit lake water balance = ~11 gpm going in and ~15 gpm going out.
4) NMCC retrieved one water sample from pit lake since the heavy September 2013 rain event. NMCC stated that the pit neutralized fairly quickly after this rain event.
5) NMED took a look at MW GWQ11-25A&B – the MW that is showing substantial impacts in ground water quality and located north of the open pit.
6) Discussed the red clay shown on the cross sections down near the former tailings impoundment.

Inspection Report

Photographic Documentation

Photos Taken? 19 ☑ Yes - see attached ☐ No

Sample Information

Samples Collected? ☐ Yes ☑ No

Samples Collected by: N/A

Sample Id #s and locations:

Were samples split between permittee and NMED? ☐ Yes ☐ No ☑ N/A

Did the Facility Representative request copies of NMED's sampling results? ☐ Yes ☐ No ☑ N/A

Monitoring Well Camera Inspection

Monitoring well camera inspection conducted? ☐ Yes - see attached report(s) ☑ No

Initials of Report Preparer: ____________


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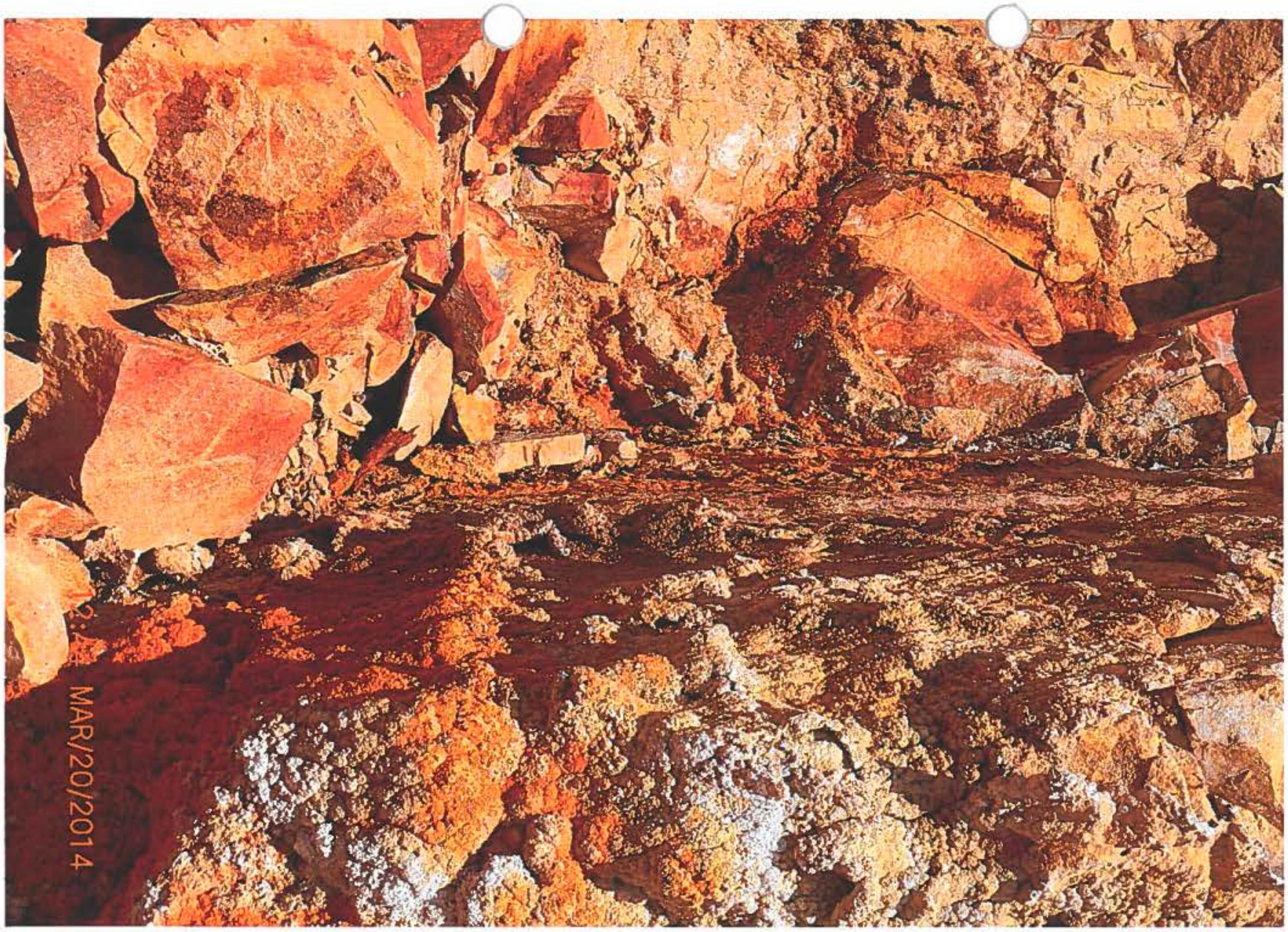
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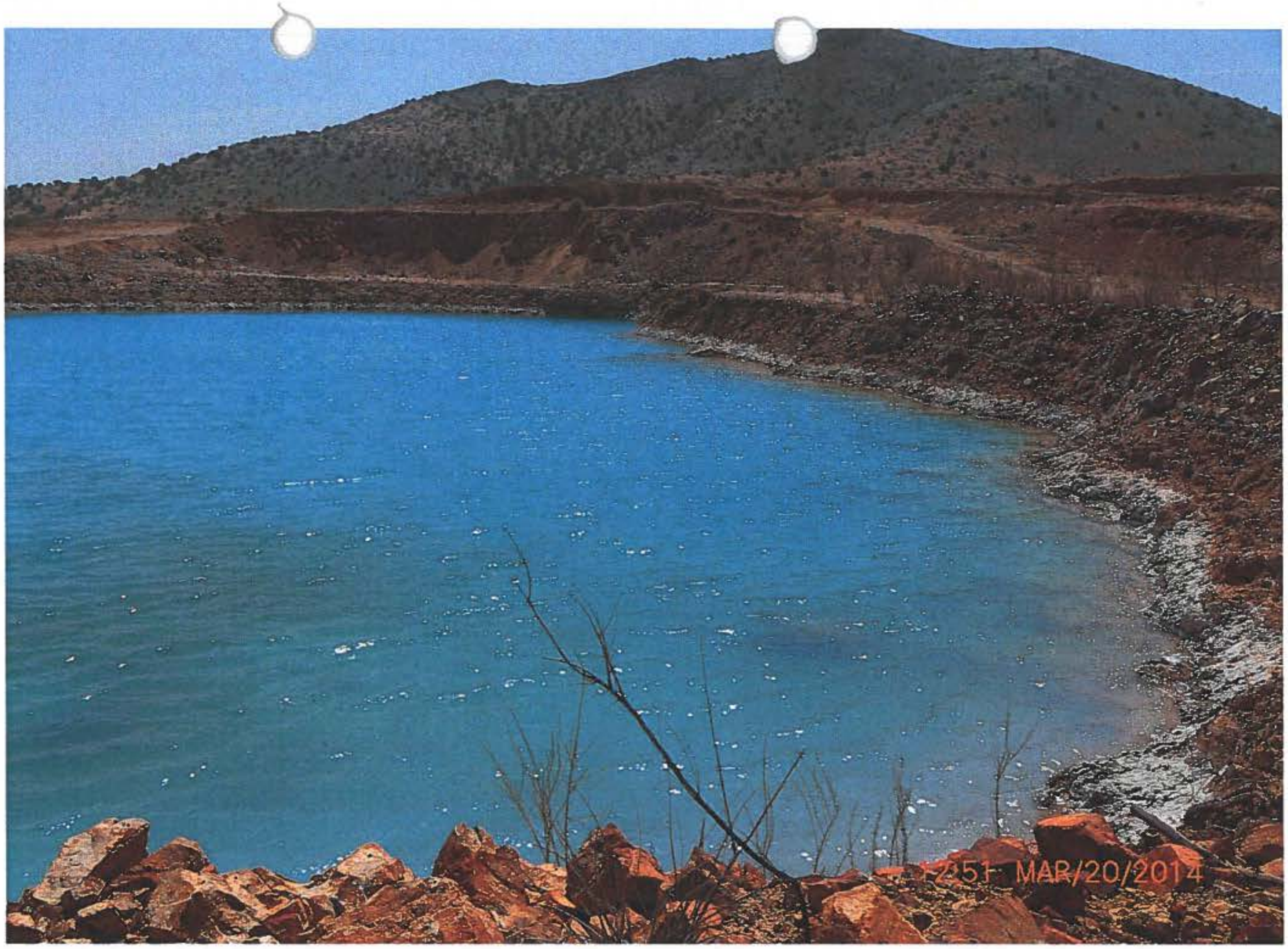
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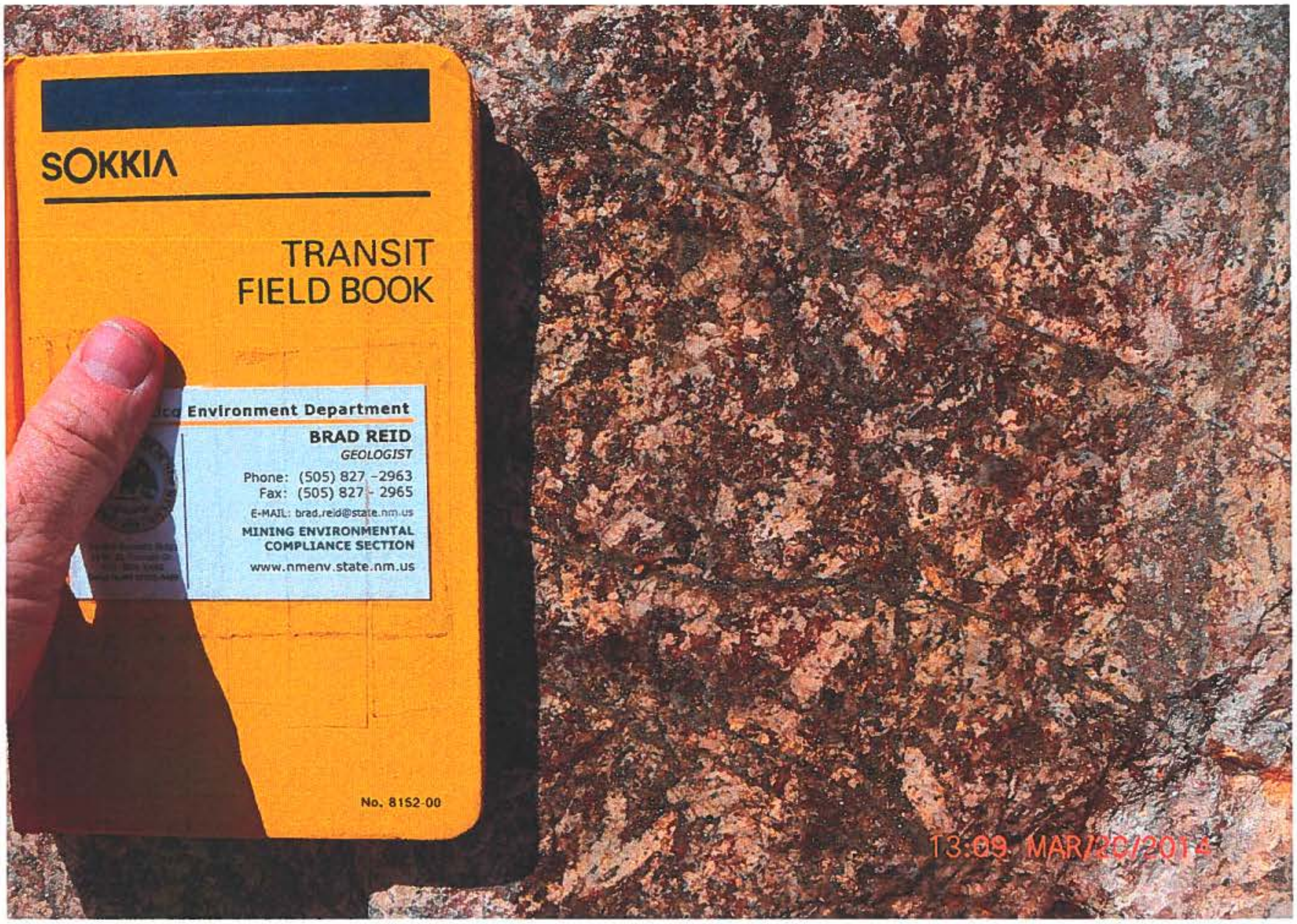

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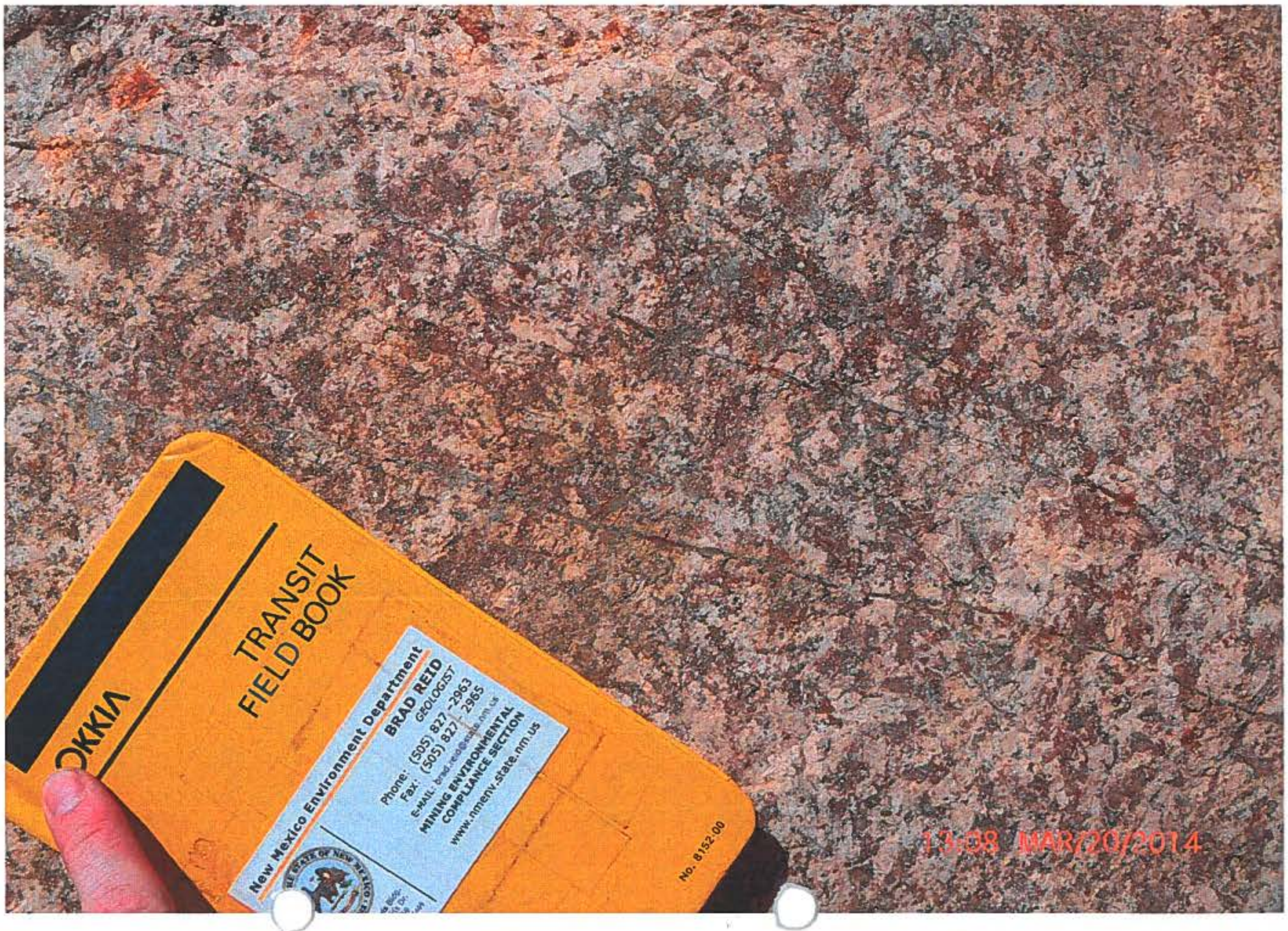

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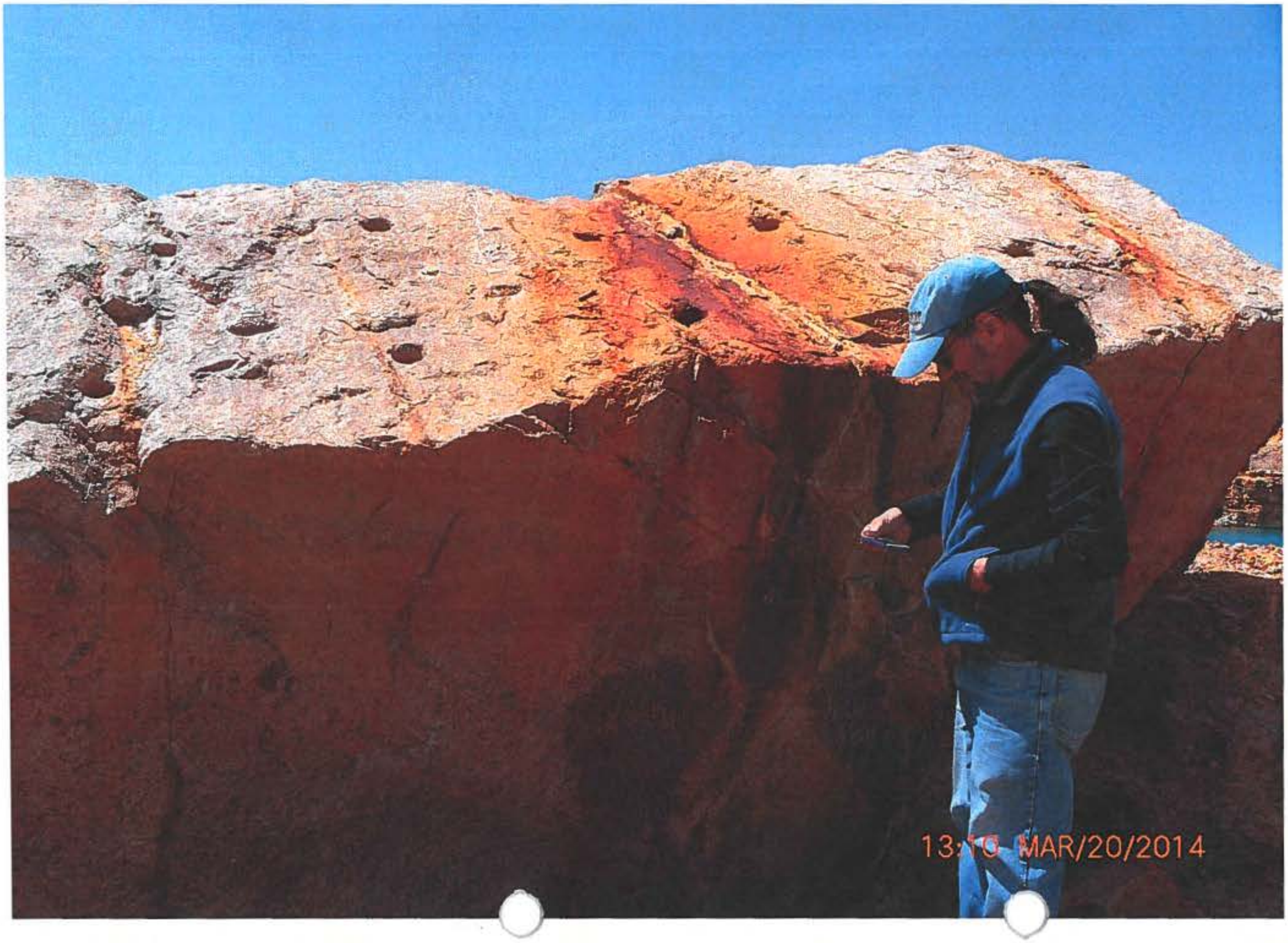
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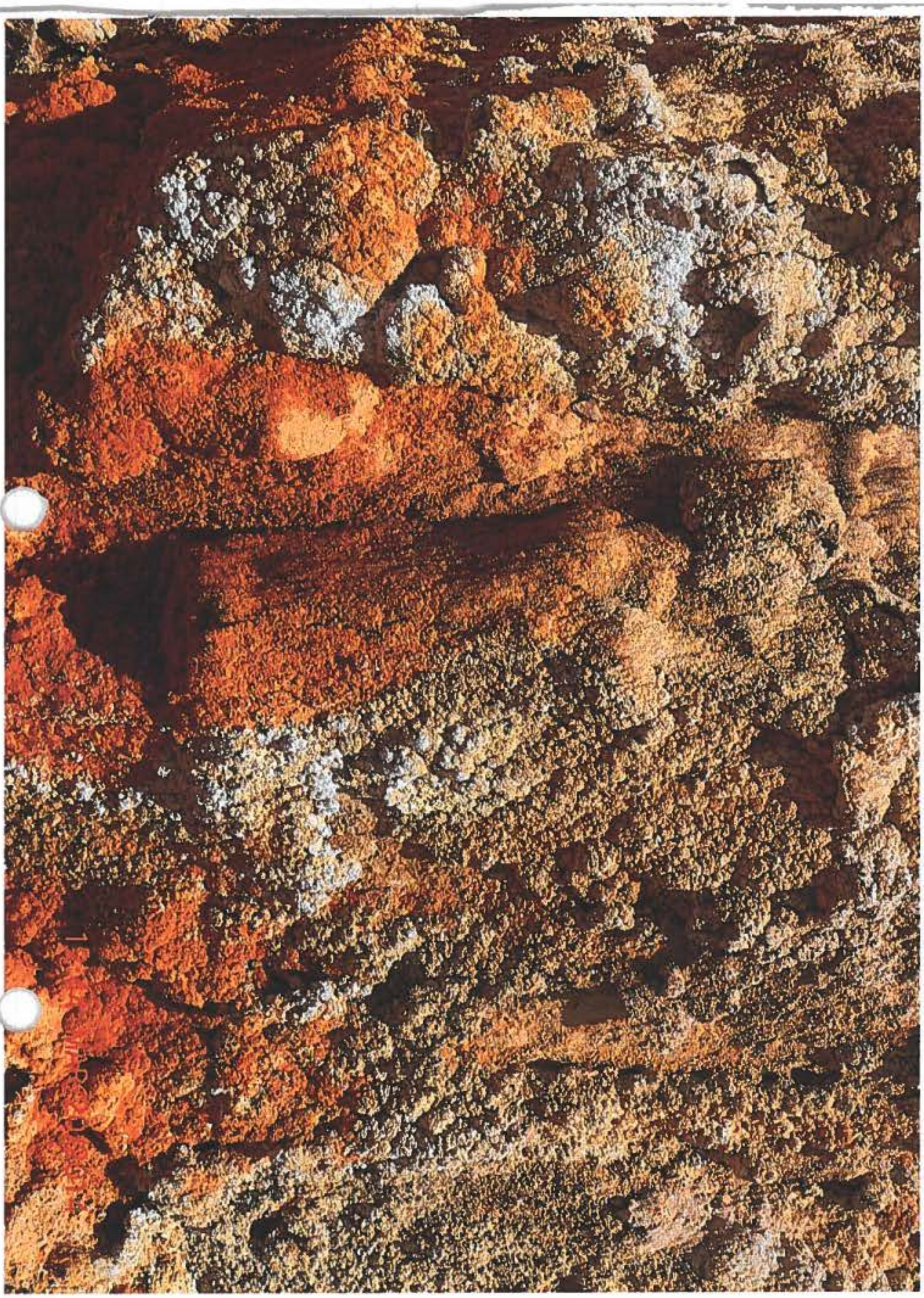

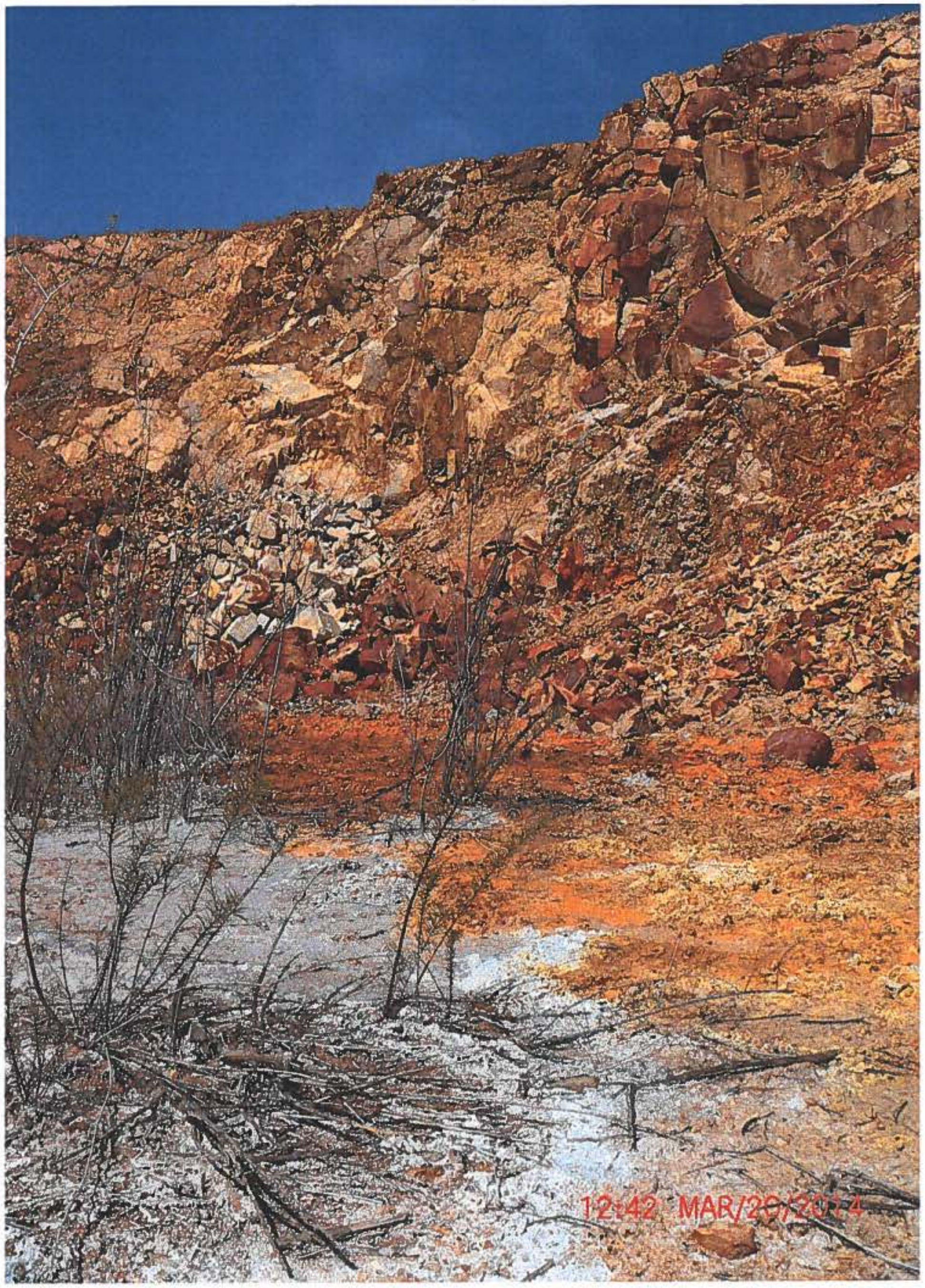

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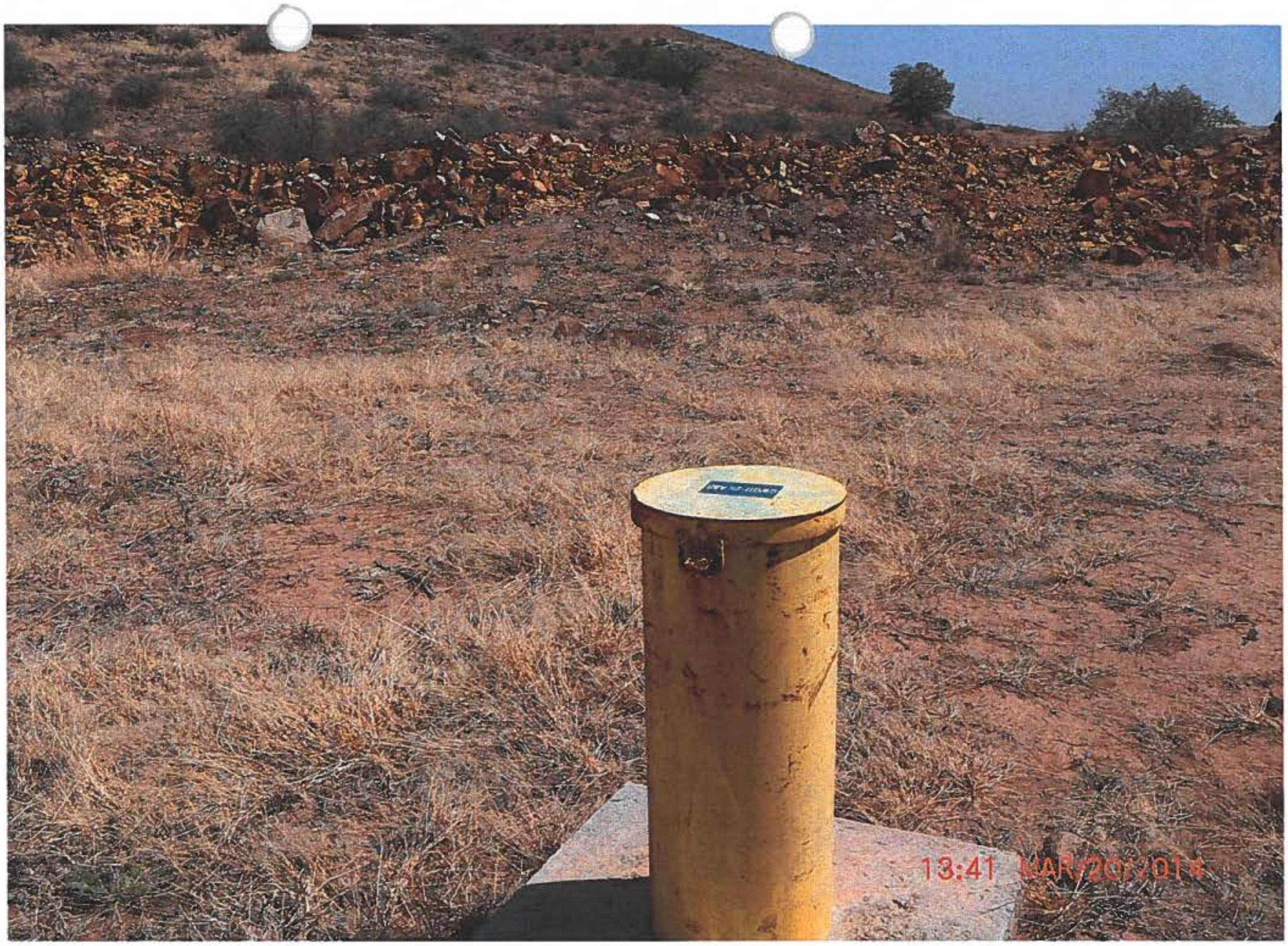
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From:	Longmire, Patrick, NMENV
Sent:	Monday, March 31, 2014 2:08 PM
To:	Vollbrecht, Kurt, NMENV; Reid, Brad, NMENV; Longmire, Patrick, NMENV; plongmire@lanl.gov; longmire@cybermesa.com
Subject:	Copper Flat Pit Lake Chemistry
Attachments:	copper Flat Pit Lake GC(03-31-14).pdf

Kurt and Brad,

Plots of the Copper Flat pit lake are attached, showing the effects of evaporation in a well-mixed lake. This shallow lake is likely be better mixed than the proposed 180 ft pit lake.

Pat

Patrick Longmire, Ph.D.
Aqueous Geochemist

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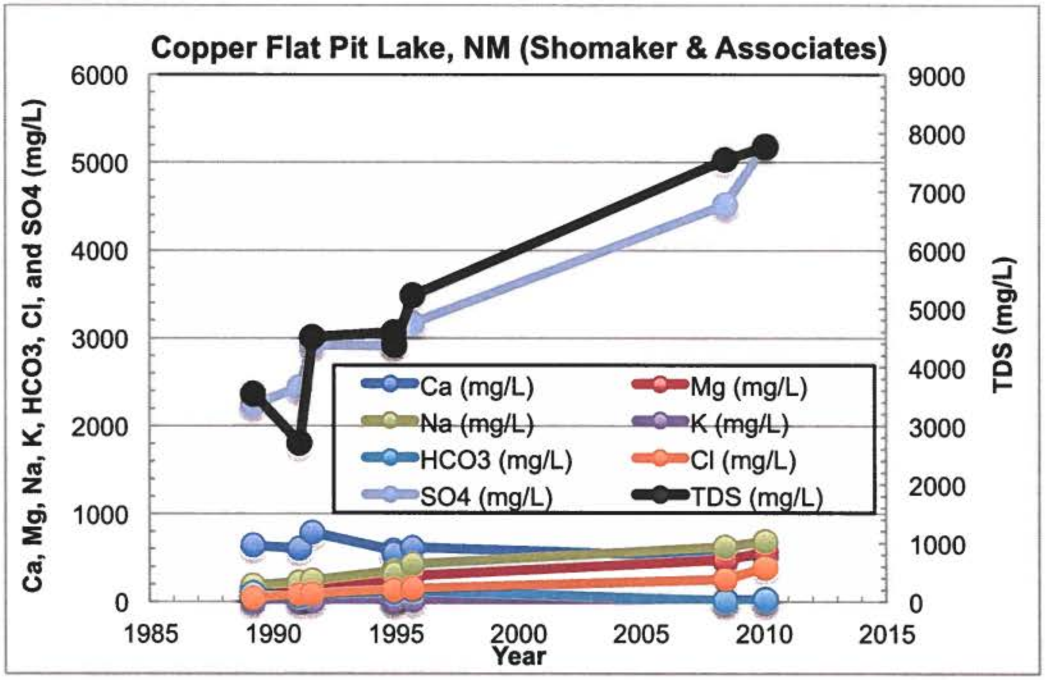
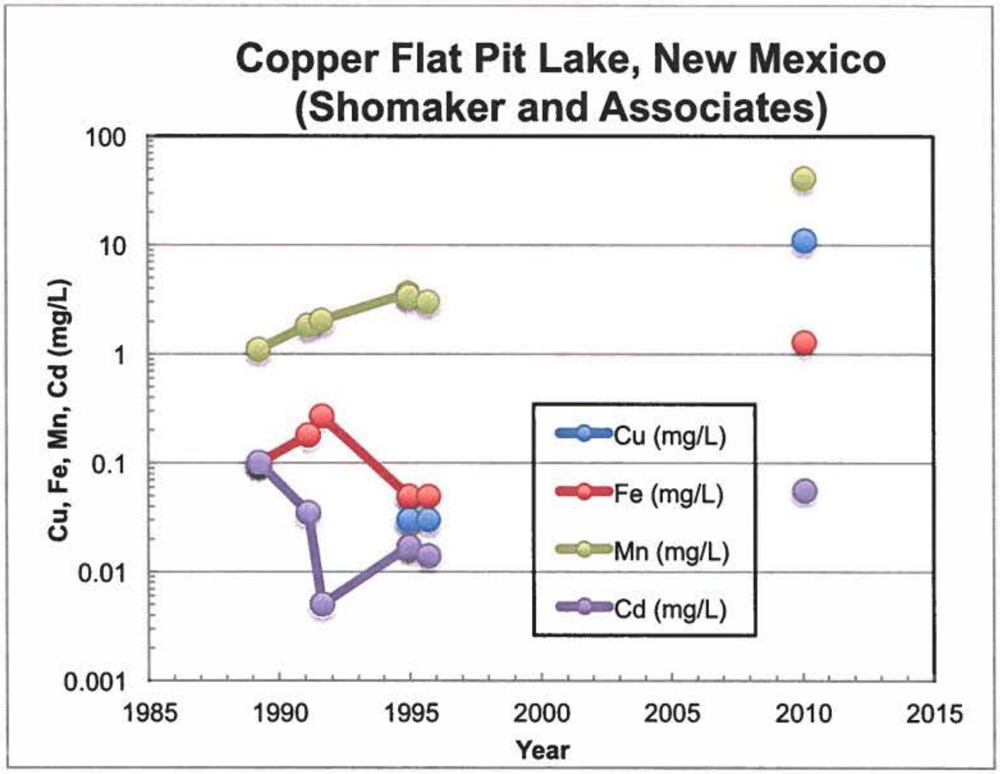
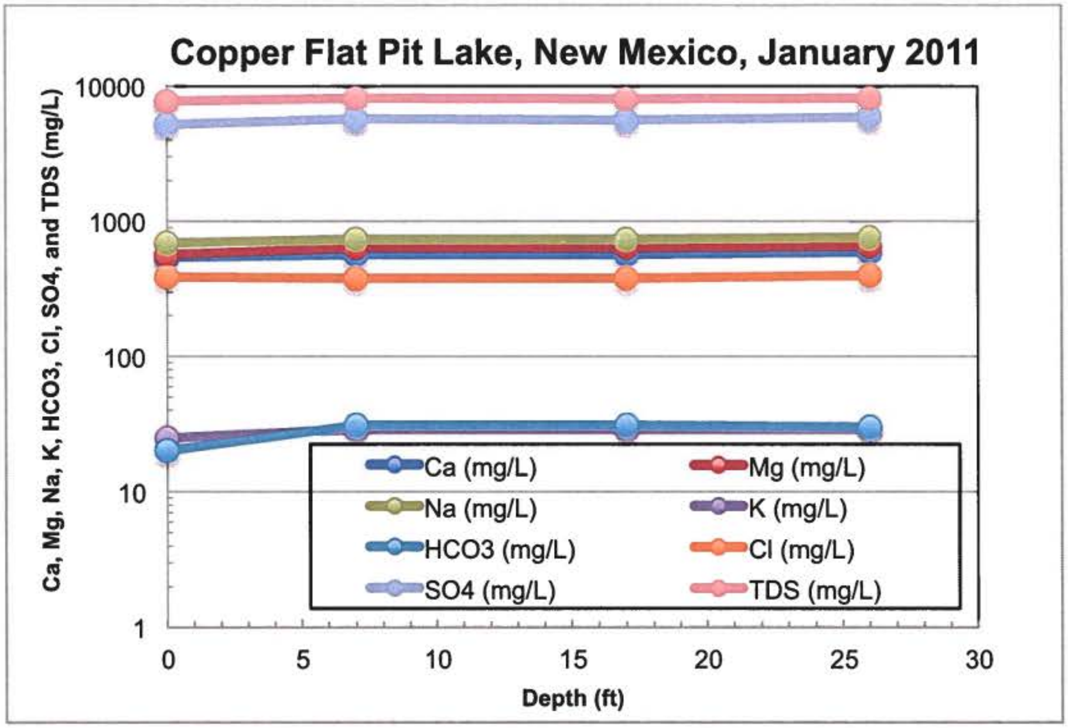
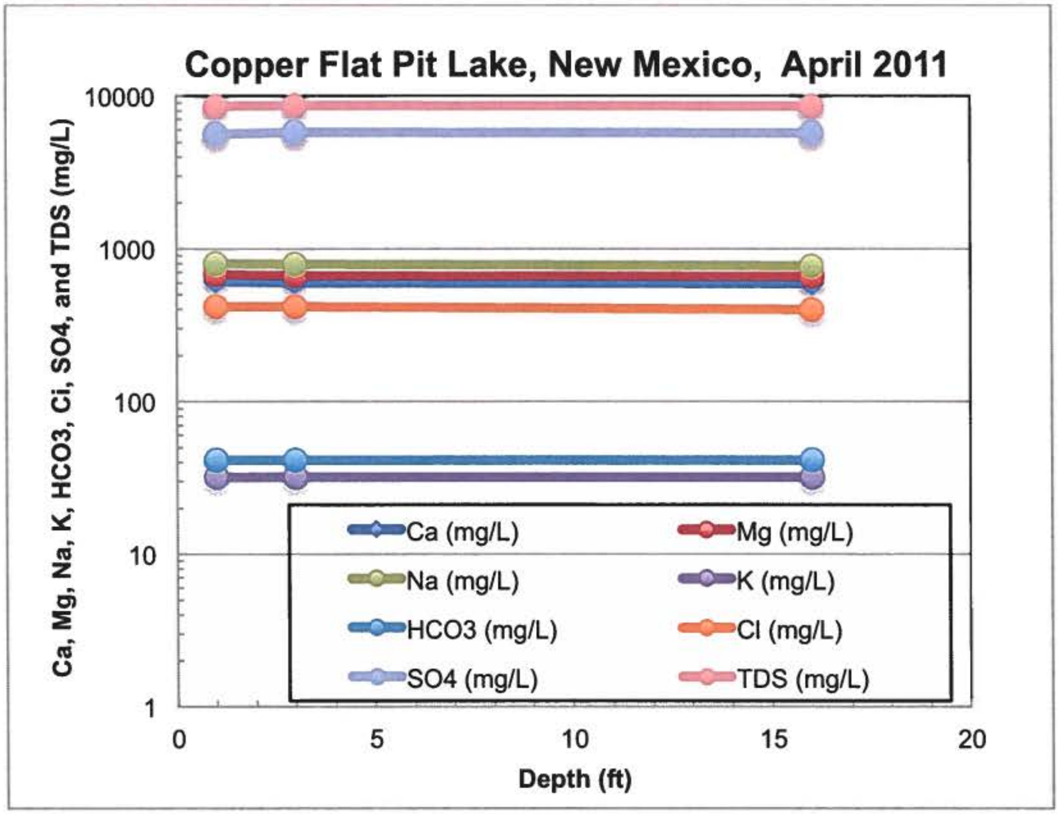

Copper Flat Pit Lake, NM (Shomaker & Associates)
Ca, Mg, Na, K, HCO3, Cl, and SO4 (mg/L)
6000
5000
4000
3000
2000
1000
0
TDS (mg/L)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1985
1990
1995
2000
2005
2010
2015
Year
Ca (mg/L)
Mg (mg/L)
Na (mg/L)
K (mg/L)
HCO3 (mg/L)
Cl (mg/L)
SO4 (mg/L)
TDS (mg/L)


Copper Flat Pit Lake, New Mexico (Shomaker and Associates)
Cu, Fe, Mn, Cd (mg/L)
100
10
1
0.1
0.01
0.001
1985
1990
1995
2000
2005
2010
2015
Year
Cu (mg/L)
Fe (mg/L)
Mn (mg/L)
Cd (mg/L)


Copper Flat Pit Lake, New Mexico, January 2011
Ca, Mg, Na, K, HCO3, Cl, SO4, and TDS (mg/L)
10000
1000
100
10
1
0
5
10
15
20
25
30
Depth (ft)
Ca (mg/L)
Mg (mg/L)
Na (mg/L)
K (mg/L)
HCO3 (mg/L)
Cl (mg/L)
SO4 (mg/L)
TDS (mg/L)


Copper Flat Pit Lake, New Mexico, April 2011
Ca, Mg, Na, K, HCO3, Ci, SO4, and TDS (mg/L)
10000
1000
100
10
1
0
5
10
15
20
Depth (ft)
Ca (mg/L)
Mg (mg/L)
Na (mg/L)
K (mg/L)
HCO3 (mg/L)
Cl (mg/L)
SO4 (mg/L)
TDS (mg/L)

Reid, Brad, NMENV

From:	Reid, Brad, NMENV
Sent:	Tuesday, April 22, 2014 11:35 AM
To:	'Prestia, Amy'; 'Katie Emmer'; 'Steve Raugust'; 'Warrender, Ruth'; 'Bowell, Rob'; Vollbrecht, Kurt, NMENV; Eustice, Chris, EMNRD; Ennis, David, EMNRD; Shepherd, Holland, EMNRD; Longmire, Patrick, NMENV; NelsonMR@cdmsmith.com; Dail, Bryan, NMENV; Hogan, James, NMENV
Subject:	RE: Draft Comments on PHREEQC Modeling of Pit Lake, Copper Flat
Attachments:	Draft Comments on PHREEQC SimulationsCF(04-22-14).pdf

In advance of Thursday's 9:00 am (MST) conference call concerning the Pit Lake modeling report, NMED attaches draft comments from Patrick Longmire.

As for the conference call, for those of you that will be joining us at the Runnels Building, the meeting location has changed to N2303 (GWQB Conference Room). Thanks, Brad

Brad Reid, Geologist
Mining Environmental Compliance Section
Ground Water Quality Bureau
New Mexico Environment Department
P.O. Box 5469
Santa Fe, NM 87502
Phone: 505.827.2963; Fax: 505.827.2965
E-mail: brad.reid@state.nm.us

From: Longmire, Patrick, NMENV
Sent: Tuesday, April 22, 2014 10:58 AM
To: Reid, Brad, NMENV; Vollbrecht, Kurt, NMENV; plongmire@lanl.gov; longmire@cybermesa.com; Longmire, Patrick, NMENV; Yanicak, Steve
Subject: Draft Comments on PHREEQC Modeling of Pit Lake, Copper Flat

Hi Brad,

My draft comments on PHREEQC modeling of the pit lake at Copper Flat is attached for your use. Please distribute to interested parties.

Merci,

Pat

Patrick Longmire, Ph.D.
Aqueous Geochemist

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Draft Comments on Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico

Prepared by

Patrick Longmire, Ph.D.
DOE Oversight Bureau
1183 Diamond Drive Suite B
New Mexico Environment Department
Los Alamos, NM 87544

April 22, 2014

The purpose of this communication is to provide draft comments for discussion on the report entitled "Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico" prepared by SRK in 2013. This report was prepared for THEMAC Resources Group Ltd. Geochemical, mineralogical, and hydrological data and information are presented in this report that serve as input to the computer code PHREEQC, assuming batch equilibrium conditions. The purpose of the PHREEQC simulations is to reasonably predict solute concentrations in the pit lake up to 100 years post mine closure at Copper Flat, New Mexico.

Complex and interrelated climatological, hydrological, mineralogical, and geochemical processes significantly influence present and future pit lake water quality at the site. The quality, relevance, and meaningfulness of model output depend on identifying and bounding uncertainties associated with all model input parameters using site-specific data and information. This report, in part, provides elaborate input PHREEQC files to attempt to quantify pit lake water chemistry under present and future conditions.

It is recognized that such modeling efforts require meaningful geochemical conceptual models, detailed site characterization data, accurate climatological data, and experimental data to produce a technically defensible understanding and forecasting of complex interactions anticipated to occur in the future in the pit lake. The NMED appreciates the level of detail presented in the report and the authors' recognition of limitations imposed on such a modeling effort.

Executive Summary (Page vi)

SRK Consulting, Inc. (SRK) should provide more detail on why the predicted exceedance of mercury (Hg) does not represent a true ecological risk to wildlife at the Copper Flat project area. Geochemical simulations using PHREEQC show that predicted concentrations of Hg exceed the NMAC 20.6.4900 surface water standard (wildlife) of 0.00077 mg/L (0.77 μg/L) at concentrations ranging from 0.001 to 0.003 mg/L between 25 and 100 years post mine closure, respectively.

Results of simulations using PHREEQC also show that predicted concentrations of selenium (Se) also exceed the NMAC 20.6.4900 surface water standard (wildlife) of 0.005 mg/L (5 μg/L) at concentrations generally ranging from 0.07 to 0.28 mg/L between 0.5 and 100 years post mine closure, respectively. Results of PHREEQC simulations relevant to Se (adsorption and mineral precipitation) should be summarized in the Executive Summary.

Predicted concentrations of vanadium (V) using PHREEQC are equal to or exceed the NMAC 20.6.4900 surface water standard (Livestock) of 0.1 mg/L (100 μg/L), at concentrations generally ranging from 0.10 to 0.14 mg/L between 75 and 100 years post closure, respectively. Vanadium, in the form of oxyanions stable in the IV and V oxidation states may potentially adsorb onto hydrous ferric oxide (HFO) and can be rigorously modeled using PHREEQC to further understand the fate and transport of this transition metal in the pit lake. Results of surface complexation simulations involving V should be summarized in the Executive Summary.

3.2.2 Calculation of Pit Wall Rock Available for Leaching (Page 19)

Have site-specific studies been conducted on fractures exposed on the pit walls at Copper Flat? Such studies will provide a basis for precise calibration and validation of pit wall surface area and geochemical reactivity, which serve as input parameters for PHREEQC simulations. More detail should be provided on the validity of assuming an average fracture density of 10 percent based on Siskind and Fumanti (1974). In addition, more detail on the humidity cell tests (HCT) previously conducted by SRK regarding water infiltration and products of reactivity up to 0.04 feet into rock fragments also should be presented. This includes the assumption of having a reaction rim thickness of 0.04 feet in the pit walls at Copper Flat.

3.3 Hydrologic Model (Page 20)

Details of the water balance performed by JSAI, including all assumptions and site-specific hydrological data and information, relevant to the pit lake at Copper Flat should be provided. Hydrological processes included in the water balance calculations are important input requirements for the PHREEQC simulations with respect to evapoconcentration, which is considered to be the major control on increasing solute concentrations. Was a sensitivity analysis performed as part of the water balance, in which input parameters were varied and uncertainty in each parameter measurement evaluated? The accuracy and precision of the water balance significantly influences predicted dissolved solute concentrations using PHREEQC.

The depth of the future pit lake is anticipated to be 180 feet at the end of mining at Copper Flat. Chemical and density stratification within the pit lake are likely to occur within 100 years after cessation of mining operations at the site. Chemical heterogeneity as a function of depth within the current pit lake is controlled by the thermocline shown by INTERA (2012). Temperature and chemical data, including dissolved oxygen (DO), oxidation-reduction potential (ORP) and specific conductance (SC), presented by INTERA (2012) show chemical stratification of these parameters occurring within the existing pit lake. This pit lake presently has a maximum depth of 30 feet. The field parameters were measured during September 2010, April 2011, July 2011, and January 2011 (INTERA, 2012). Variations in field parameters and chemical species (suspended and dissolved) are expected to occur as a function of depth within the future pit lake after mining operations have been terminated. During this period of time, any residual mass of sulfide minerals (pyrite, chalcopyrite, molybdenite, and bornite) will most likely undergo oxidation forming gypsum, Fe oxyhydroxides, and other sulfate phases within the pit lake.

3.4 Solution Inputs (Page 23)

3.4.1 Groundwater Chemistry

Range (minimum and maximum) of groundwater compositions (field parameters, major ions, and trace elements) should be included as input to the PHREEQC simulations to quantify and decrease uncertainty in solute chemistry. These results can be compared to the simulations using average groundwater-solute concentrations.

3.5 Mineral and Gas Phase Equilibrium

A detailed discussion is warranted on why kinetic modeling of sulfide oxidation of residual pyrite, chalcopyrite, molybdenite, and bornite and other nonreactive sulfate and silicate phases was not considered for the PHREEQC simulations. Some of the important parameters for kinetic modeling of pyrite, chalcopyrite, molybdenite, and bornite include Fe(II, III) concentrations, concentrations of catalysts (pH, Eh, and DO), surface area, rate constants, and crystal morphology. Equilibrium modeling of pyrite, chalcopyrite, alunite, jarosite, and other phases may not provide realistic and meaningful PHREEQC simulations at Copper Flat. These minerals are not reactive and precipitation/dissolution of these phases occurs under nonequilibrium or kinetic conditions.

A table should be provided that identifies and quantifies precipitating and dissolving minerals as part of mass transfer calculations (in units of moles or millimoles of solid phases per kg water) for equilibrium and nonequilibrium conditions.

Table 3.5: Equilibrium Phases Included in the Pit Lake Geochemical Model (Page 28)

SRK has provided informative and detailed mineralogical characterization of several rock types present at Copper Flat (Humidity Cell Termination Report for the Copper Flat Project, New Mexico; Geochemical Characterization Report for the Copper Flat project, New Mexico, Appendix D). SRK should provide a revised comprehensive list of minerals observed in the various rock types that are exposed in the existing pit lake. This list should also include hypothetical phases used in the PHREEQC simulations that reach saturation with pit lake water. The observed minerals should be used as input for the PHREEQC simulations for calibration purposes. Residual sulfide minerals (pyrite, chalcopyrite, bornite, and molybdenite) occur within the existing pit and these phases should be included in additional PHREEQC simulations. Nonreactive silicate minerals and metal hydroxides including zeolites and clay minerals such as illite, kaolinite, smectite, witherite, and amorphous $Al(OH)_3$ were not included in the PHREEQC simulations. Other potentially important phases including jarosite ($KFe_3(SO_4)_2(OH)_6$) and schwertmannite ($Fe_8O_8(OH)_6(SO_4)\cdot nH_2O$) should be considered in additional PHREEQC simulations. Mineral data gaps should be discussed that influence the accuracy and representativeness of the PHREEQC simulations. Various uranium minerals listed in Table 3.5, which are used as input to PHREEQC simulations, need to be addressed and discussed in terms of their importance in controlling dissolved U concentrations in the pit lake.

3.6 Adsorption

SRK should account for the existing mass of HFO, amorphous $Fe(OH)_3$, or ferrihydrite to more accurately model adsorption-surface complexation using PHREEQC. This should provide a better fit between simulated and observed trace solute chemistries in the existing pit lake. Adsorption processes most likely control concentrations of As, Se, Hg, V, and other trace elements present in pit lake water under oxidizing conditions with respect to Fe(III). Results of surface complexation simulations should be provided to further understand adsorbate affinity for adsorption sites (strong and weak) present on HFO, competing adsorbates, and complexing ligands such as sulfate and carbonate. Quantifying speciation of As(III, V) and Se(IV, VI) is essential in understanding adsorption of these two trace elements onto HFO and placing constraints on ecological risk.

3.8 Model Logic and Coding

Ranges in solute concentrations (major ions and trace elements) and field parameter measurements should be used as input for the PHREEQC simulations to capture uncertainties in model input and output.

Uncertainties associated with the HCT analytical results and predicted pit lake water chemistries, simulated for up to 100 years after mining operations have been terminated, should be thoroughly evaluated and presented in a revised report. Ranges in solute concentrations associated with the HCT experiments should be included in the PHREEQC simulations to bound uncertainties in model input and output under current and future conditions.

INTERA (2012) report that concentrations of DO range from approximately 6.4 to 8.5 mg/L in the existing pit lake, therefore, the assumed pe = 12 – pH is probably too low for certain periods of time and seasonal variations in redox are expected to occur. This parameter could be as high as pe = 20 – pH under oxygenated conditions within some depth intervals during summer months, based on data provided by INTERA (2012). Varying redox conditions or heterogeneities occurring within the future pit lake should be considered in additional PHREEQC simulations (up to 100 years post closure of mining operations). Redox conditions within the future pit lake (180 feet depth) may be bounded by the range of pe = 12 – pH and pe = 20 – pH.

Simulated solute concentrations calculated by PHREEQC for nine time steps (0.5, 1, 2, 5, 10, 25, 50, 75, and 100 years after cessation of mining operations) are presented by SRK. A detailed discussion on selecting the specific time steps as a function of evaporation of pit lake water needs to be presented so that the reader will understand the rational behind this component of the PHREEQC simulations. Uncertainties in input parameters associated with evaporation quantified by the site-wide water balance at specific time steps should be presented.

Spreadsheets (selected output) for each time step detailing PHREEQC results for key field parameters (pH, pe or Eh, DO), selected solute concentrations, adsorption results, and mass transfer of precipitating and dissolving solid phases should be provided.

3.9 Geochemical Modeling Assumptions (Page 31)

Uncertainties and sensitivity analyses of input parameters used for the PHREEQC simulations under current and future conditions should be conducted and results presented in detail in a revised or updated report. A detailed discussion on assumptions regarding the following topics should be expanded on in the revised report regarding the pit lake under existing and future conditions:

- Accuracy of the water balance and the influence of climate change in controlling evaporation and surface water and groundwater flow into the pit lake,
- Steady-state versus transient geochemical and hydrological conditions,
- Technical defensibility of geochemical conceptual models considered for modeling various geochemical processes,
- Heterogeneities in pH, Eh, and solute concentrations as functions of season, depth interval, and location,

- Using relevant reactive minerals observed or anticipated to occur at Copper Flat,
- Kinetic versus thermodynamic modeling, and
- Limitations of thermodynamic databases (speciation, solid phase solubility products, surface complexation parameters).

Sensitivity analyses and uncertainties in parameters used in the PHREEQC simulations should be conducted and discussed for the different categories listed in Table 3.6 of the SRK report. This includes site-specific data and information that were estimated and measured as part of the water balance calculations; average versus ranges in groundwater chemistry compositions; average versus ranges in analytical concentrations measured from HCT experiments; calculated versus measured surface areas and fracture densities of pit wall rock; mass of pit wall rock available for reaction based on calculated oxidized rind and fracture zone (1 foot thickness with 10 percent fractures); and site-specific versus hypothetical mineral phases selected for the PHREEQC simulations.

3.12 Existing Pit Lake Calculations (Page 34)

Uncertainties associated with input parameters used in the water balance provided to SRK by JSAI should be included in the revised report.

Uncertainties and site-specific applicability or representativeness of the study conducted by Siskind and Fumasnti (1974) to the pit walls that will be exposed in the future at Copper Flat need to be presented. Uncertainties in oxygen infiltration, fracture depth, and density calculations for pit wall material also need to be presented in the final report. Details and applicability of investigations conducted by Atchison (1968) need to be expanded on for estimating fracturing in pit wall material.

Figure 3-12 Predicted Versus Measured Pit Lake Chemistry for the Existing Pit Lake (Page 37) and

Table 3-9: Predicted Versus Measured Pit Lake Chemistry for the Existing Pit Lake (Page 38)

Figure 3-12 should be revised to include measured and simulated concentrations of dissolved Al, Fe, and Mo. Predicted dissolved concentrations exceed measured dissolved concentrations of B, K, Ni, Se, Na, and U. Conversely, measured dissolved concentrations exceed predicted dissolved concentrations of Al, As, Ba, Ca, Cl, Cr, Cu, F, Fe, Mg, Mn, SO_4, Zn, and TDS by up to factors of 1255 (Al). The measured dissolved concentrations of Fe and Cu exceed predicted dissolved concentrations by factors of 400 and 20, respectively. Observed and predicted concentrations of Cd and Co are in close agreement, suggesting that the PHREEQC simulation is well calibrated for the two trace elements.

Minerals selected for controlling dissolved concentrations of Al and Fe do not accurately represent field or site conditions. Dissolved concentrations of As measured in the pit lake exceed predicted concentrations by a factor of 30. A discussion should be provided that addresses this discrepancy, which may result from existing uncertainties and errors associated with As(III, V) adsorption onto HFO including solution composition dominated by competing sulfate. Mineral precipitation and/or adsorption processes for Al, As, Cu, and Fe are not well quantified with the PHREEQC simulations for existing conditions in the pit lake. These discrepancies place uncertainty on the simulated results and show a less than desirable model calibration under current pit lake conditions. These errors are carried through other PHREEQC simulations involving future pit lake compositions. The same suite of minerals was generally used for both current and future conditions within the pit lake.

There are errors in the reported concentrations of alkalinity as $CaCO_3$ and/or HCO_3 provided in Table 3-9, based on the fact that the concentration of total carbonate alkalinity as $CaCO_3$ is 1.22 times less than HCO_3 concentrations as shown below:

$CaCO_3 + H_2O + CO_2(g) \rightarrow Ca(HCO_3)_2^0$,

Molecular weight of $CaCO_3$ = 100 g/mol, and

Molecular weight of HCO_3^- = 61 g/mol.

Each mole of $Ca(HCO_3)_2^0$ corresponds to one mol of $CaCO_3$ (100 g) and contains 2 x 61 g = 122 g of HCO_3^-. (122 g/mol/100 g/mol = 1.22)

Bicarbonate alkalinity as HCO_3^- (mg/L) = 1.22 x HCO_3^- alkalinity as mg$CaCO_3$/L.

Concentrations of alkalinity as $CaCO_3$ and HCO_3 provided in Table 3-9 are 74.8 and 34.2 mg/L, respectively. This error needs to be corrected.

3.13 Future Pit Lake Results (Page 39)

Equilibrium conditions were assumed for the PHREEQC simulations with mineral dissolution/precipitation and adsorption controlling solute concentrations in the pit lake under future conditions. Kinetics were not considered in the simulations, which influence rates of dissolution of any potential residual pyrite, chalcopyrite, molybdenite, and bornite along with rates of precipitation of oxidation products including alunite, amorphous $Al(OH)_3$, jarosite, schwertmannite, and other non-reactive phases. Precipitation and dissolution of gypsum and calcite, however, are known to occur under equilibrium conditions in aquatic systems. A more detailed discussion should be presented that focuses on limitations of modeling systems by not considering kinetics of nonreactive solid phases. The discussion should address uncertainty associated with the PHREEQC simulations under future conditions.

Groundwater inflow has remained fairly constant from January 1980 to January 2014 (see Figure 3-11). Predicted future contributions on groundwater flow into the pit lake are also fairly constant, as shown in Figure 3-6. The sentence "Over time, the groundwater contribution will decrease as the pit lake is established" needs to be revised.

Systematic modeling errors and inaccuracies are present for selected chemicals whose measured concentrations in the existing pit lake are greater than predicted concentrations calculated by PHREEQC. The predicted values for future concentrations are bias low for this condition, including Al, As, Ba, Ca, Cr, Cu, F, Mg, Mn, Na, Zn, SO_4, and TDS. Under this condition, future concentrations of chemicals calculated by PHREEQC are predicted to be less than those measured in the existing pit lake. Chemicals with predicted concentrations exceeding existing concentrations are bias high, including B, Cd, K, Mo, Na, Ni, Se, U, and V. Predicted future concentrations of these chemicals are also probably bias high, depending on the extent of mineral precipitation/ dissolution and adsorption/desorption processes. A detailed discussion should be presented on this topic, focusing on model uncertainties and inaccuracies and understanding geochemical processes controlling the fate of these chemicals under existing and future conditions.

Simulations were conducted with PHREEQC by allowing sodium concentrations to vary to achieve charge balance of the various solutions (average groundwater chemistry, andesite oxide material, biotite breccia, quartz feldspar breccia, quartz monzonite oxide/transitional, coarse crystalline porphyry, andesite sulfide, and quartz monzonite sulfide). A statement needs to be made addressing the positive bias of sodium enhancing precipitation of sodium carbonate and sodium sulfate (mirabilite) phases predicted to precipitate in the pit lake.

Spreadsheets need to be provided showing the molal concentrations of each mineral precipitating or dissolving at the various time steps stipulated in the PHREEQC input files. Spreadsheets should also be provided for each time step detailing results of surface complexation modeling involving trace elements potentially binding onto both strong and weak sites present on HFO surfaces.

A detailed discussion on pit wall interaction mix calculator used in the PHREEQC input file should be provided. Compositions of the pit wall runoff vary for each of the nine time steps. The rational and uncertainty in the varying amounts of runoff based on HCT results need to be presented.

Concentrations of dissolved Cd increased from <0.005 mg/L in 1991 to 0.053 mg/L in 2011 (SRK, 2013) within the existing pit lake. Predicted concentrations of Cd increase from 0.0003 to 0.001 mg/L during the time interval of 0.5 to 50 years post closure, and remain constant at 0.001 mg/L from 50 to 100 years. The NMAC surface water standard (livestock) for Cd is 0.05 mg/L. A discussion should be provided that addresses the fate of Cd in the pit lake, including a sensitivity analysis, under future conditions. It is likely that evapoconcentration and desorption/dissolution processes result in an increase in predicted Cd concentrations under existing conditions and are likely to continue in the future 100 years post closure.

Concentrations of Hg are less than analytical detection (<0.002 mg/L) in the existing pit lake. Predicted concentrations of Hg increase from 0.0007 to 0.003 mg/L during the time interval of 0.5 to 100 years post closure. The NMAC surface water standard (wildlife) for Hg is 0.00077 mg/L. Using appropriate analytical methods such as cold vapor atomic absorption spectroscopy is necessary to achieve sample detection and reporting (quantitation) limits for Hg that are less than the NMAC surface water standard for wildlife (0.77 μg/L). A discussion should be provided that addresses the fate of Hg in the pit lake under future conditions, including a sensitivity analysis. It is possible that evapoconcentration and desorption/dissolution processes will result in an increase in Hg concentrations under future conditions provided that the PHREEQC simulations are accurate.

The average concentration of Se is 0.035 mg/L in the existing pit lake. Predicted concentrations of Se generally increase from 0.05 to 0.28 mg/L during the time interval of 0.5 to 100 years post mine closure. The NMAC surface water standard (wildlife) for Se is 0.005 mg/L. A discussion needs to be provided that addresses the fate of Se in the pit lake under future conditions. A sensitivity analysis should be included that quantifies the fate of Se(IV, VI) in the pit lake under existing and future conditions. It is likely that evapoconcentration and desorption/dissolution processes will result in an increase in Se concentrations under future conditions provided that the PHREEQC simulations are accurate.

Concentrations of V are less than analytical detection (<0.05 mg/L) in the existing pit lake. Predicted concentrations of V generally increase from 0.04 to 0.14 mg/L during the time interval of 0.5 to 100 years post closure. The NMAC surface water standard (livestock) for V is 0.1 mg/L. A discussion needs to be provided that addresses the fate of V in the pit lake, including a sensitivity analysis, under future conditions. It is likely that evapoconcentration and desorption/dissolution processes have resulted in an increase in predicted V concentrations under existing conditions and are likely to continue in the future 100 years post closure.

3.14 Model Limitations (Page 47)

In this section, SRK provides a discussion on PHREEQC model limitations, which is appreciated and well presented. Model results are compared to NMAC surface water standards (livestock and wildlife), with the wildlife standard being more stringent.

Average pH values and analytical results for major ions and trace elements for both groundwater samples and leachates produced from HCT experiments were used as input for the PHREEQC simulations. Redox conditions were assumed to be constant (pe = 4, Eh = 237 mV at 25°C) for PHREEQC modeling, however, Eh is most likely to vary within the pit lake under future conditions. Average analytical results used as input to the PHREEQC simulations do not bound the range of possible geochemical conditions that are likely to occur at the site. Homogeneous conditions are assumed to occur in the pit lake under existing and future conditions, whereas data provided by INTERA (2012) show that the existing pit lake is heterogeneous at depth with respect to DO, temperature, ORP, and specific conductance (SC). Variations in SC support the concept that there are variations in TDS, and most likely the same holds true for solute concentrations of major ions and trace metals.

Many of the selected mineral phases presented in the report are not entirely reactive and precipitation/dissolution of the phases are controlled by kinetics rather than by equilibrium. These most likely include alunite, Ag_2Se, $Ba_3(AsO_4)_2$, carnotite, Cr_2O_3, chrysotile, gummite, HgSe, $Ni_3(AsO_4)_2{\cdot}8H_2O$, $NiCO_3$, pyromorphite, rutherfordine, sepiolite, tenorite, U_3O_8, and $\beta\text{–}UO_2(OH)_2$. Calcite, gypsum, barite, and ferrihydrite, however, are reactive minerals, precipitating and dissolving at the same rate under equilibrium conditions, and these phases are important components to the PHREEQC simulations. Jarosite and schwertmannite, which are known oxidation products of pyrite were not included in the PHREEQC simulations. No consideration was given to oxidation of residual sulfide minerals (pyrite, chalcopyrite, molybdenite, and bornite) potentially present in rocks exposed to water within the pit lake. It is recommended that additional simulations be run to evaluate the reactivity of residual sulfides under equilibrium and nonequilibrium conditions.

4 Summary and Recommendations (Page 48)

A summary of the PHREEQC geochemical modeling conducted on the pit lake at Copper Flat is presented in this section of the report. Metals of concern mainly include Cd, Cu, Hg, Se and V that are either observed or are predicted to exceed the NMAC surface water standards for wildlife and/or livestock. Recommendations, however, are not presented in this section. Specific recommendations developed from the review of this report are provided below.

Additional PHREEQC modeling simulations should be conducted using the range of values for pH, Eh, major ions and trace elements measured in groundwater and in leachates produced from the HCT experiments. Model output results should be compared to the previous simulations that used average chemical concentrations and average pH values. This approach should bound the range of geochemical conditions that currently occur and are anticipated to occur in the future in the pit lake. This approach should also reduce uncertainties in model input and output.

The presence of a thermocline in the existing pit lake strongly suggests that the future pit lake having a depth of 180 feet will be heterogeneous with respect to temperature, pH, Eh, DO, and solute chemistry. Additional simulations using PHREEQC should be conducted to quantify observed and future heterogeneous conditions within the pit lake.

The potential for colloids possibly consisting of $Al(OH)_3$, Al_2O_3, $Fe(OH)_3$, and Fe_2O_3 should be considered in the PHREEQC simulations by evaluating suspended material present in the pit lake. A comparison of filtered (for example, 0.05, 0.2, and 0.45 micrometer membranes) and nonfiltered pit lake water samples is anticipated to provided useful information to evaluate this component of trace element geochemistry and transport.

Sensitivity analyses should be conducted on all input parameters (physical and chemical) used in the PHREEQC simulations. This includes the water balance study, estimated fracture density and surface area of pit wall rock, nonuniform redox conditions, solute chemistry, observed and predicted reactive minerals, and equilibrium versus nonequilibrium (kinetics) conditions.

Simulations should be performed using only observed and hypothesized relevant reactive minerals likely to precipitate from solution. More discussion on adsorption processes using PHREEQC should be presented, detailing which adsorbates are predicted to bind onto strong and weak sites present on HFO. The extent of adsorption may change over time in response to changes in aqueous speciation, for example increasing sulfate concentrations competing with other oxyanions for adsorption sites present on HFO.

Spreadsheets of selected output from the PHREEQC simulations need to be provided for the nine time steps detailing solute concentrations and speciation, concentrations of precipitating and dissolving reactive solids, and mass of trace elements potentially adsorbing onto HFO.

The revised report should present a detailed discussion on how simulated evaporation of pit lake water over time is related to the future time steps used in model input. A discussion on the changing chemical composition of surface water (leachate results from HCT experiments) flowing over the different rock units near and on exposed pit walls should be presented so that the reader completely understands PHREEQC output with respect to this input parameter.

From: Nelson, Mark <NelsonMR@cdmsmith.com>
Sent: Tuesday, April 22, 2014 9:41 AM
To: Longmire, Patrick, NMENV
Cc: Vollbrecht, Kurt, NMENV; Reid, Brad, NMENV
Subject: RE: Review of Geochemical Modeling of Pit Lake at Copper Flats: P. Longmire

Hello-

Overall, very good comments Pat. Here are a few thoughts to consider:

1. SRK's conceptual model assumes that precipitation and runoff would infiltrate only one foot into the highwalls (with assumed 10% fracture density), and that the reactive rim on fracture surfaces within this one foot zone would only be 0.04 feet thick. They also assumed that groundwater flowing into the pit lake would have the background groundwater chemistry with slight modification as it flows through the thin reactive zone. However, it seems to me that sulfide mineral oxidation would occur within unsaturated, natural fractures that are located within the entire cone of depression formed by dewatering the open pit, and that the products of this sulfide mineral oxidation would be transported towards the pit lake as the water table recovers. The SRK conceptual model does not account for this additional contaminant load, which would occur over the period of water table recovery (~100 years). It would be helpful to understand the sensitivity of the model to variations in the volume of rock that is assumed to oxidize and contribute contaminants to the pit lake.

2. The comments currently address variability in redox-conditions and other chemical parameters in the pit lake, but the discussion of potential thermal and chemical stratification in the pit lake could be strengthened. SRK's conceptual model assumes that the lake is well mixed, which provides for adsorption of dissolved metals to ferrihydrite particles, settling of these particles to the base of the lake, and permanent sequestration of the adsorbed metals in the lake sediments. This is an important geochemical mechanism for removal of dissolved metals from the water column. Many pit lakes are seasonally stratified, with the lower layer (the hypolimnium) exhibiting more reduced conditions. In this case, metals that are removed from the water column in the upper layer (the epilimnium) through adsorption to ferrihydrite may not be permanently sequestered in the sediments, because the ferrihyrdrite may dissolve in the hypolimnium releasing the adsorbed metals. When seasonal mixing occurs, these redissolved metals would be redistributed in the water column. Therefore, the SRK conceptual model may underestimate the trace metal concentrations in the pit lake, by assuming that the lake is well-mixed. SRK did not provide much analysis or rationalization to support their assumption of a well-mixed lake other than a statement that baseline data shows that the current lake is not chemically stratified. However, the new pit lake will be deeper than the existing lake and will be located in the base of a larger pit where the mixing effect of wind will be reduced as compared to current conditions. It would be helpful to better understand potential stratification of the lake and the effects it could have on water quality.

3. The SRK pit lake model report does not say much regarding scaling of humidity cell data other than to say that they did scale the data. The humidity cell data are used to estimate the primary source of contaminant loading to the pit lake, which is rinsing of products of sulfide oxidation from the pit highwalls. Therefore, the pit lake model is likely sensitive to the scaling factor. Appendix I of the May 2013 Geochem Report provides a discussion of scaling of humidity cell data. In that appendix, SRK says that the humidity cell data were scaled by a factor of 10 (i.e. the contaminant load released from the humidity cells was reduced by an order of magnitude prior to input in a model). However, it is unclear if the scaling assumptions in Appendix I of the geochemical characterization report apply to the pit lake model. It would be helpful to better understand the scaling assumption used in the pit lake model, and the sensitivity of the model results to variations in the assumed scaling factor.

Thanks

Mark

Mark Nelson, PG
Geologist
CDM Smith|12445 Misty Meadows Rd.|Nemo, SD|T: 605.578.9739|Cell: 605.390.9042
nelsonmr@cdmsmith.com

From: Longmire, Patrick, NMENV [mailto:Patrick.Longmire@state.nm.us]
Sent: Monday, April 21, 2014 7:04 AM
To: Vollbrecht, Kurt, NMENV; Eustice, Chris, EMNRD; Ennis, David, EMNRD; Reid, Brad, NMENV; Shepherd, Holland, EMNRD; Nelson, Mark; plongmire@lanl.gov; longmire@cybermesa.com; Longmire, Patrick, NMENV
Subject: RE: Review of Geochemical Modeling of Pit Lake at Copper Flats: P. Longmire

All,

A revised draft copy of my comments on the PHREEQC modeling of the pit lake system at Coper Flat is attached for your review. I corrected several typos in this version. Sorry about the inconvenience.

Pat

Patrick Longmire, Ph.D.
Aqueous Geochemist

DOE Oversight Bureau-New Mexico Environment Department
1183 Diamond Drive, Suite B
Los Alamos, New Mexico 87544
Office: 505-661-2681

From: Longmire, Patrick, NMENV
Sent: Thursday, April 17, 2014 10:09 AM
To: Vollbrecht, Kurt, NMENV; Eustice, Chris, EMNRD; Ennis, David, EMNRD; Reid, Brad, NMENV; Shepherd, Holland, EMNRD; plongmire@lanl.gov; longmire@cybermesa.com; Longmire, Patrick, NMENV
Subject: Review of Geochemical Modeling of Pit Lake at Copper Flats: P. Longmire

All,

A copy of my draft comments on the geochemical modeling of pit lake water at Copper Flat is attached for your review. If you have any comments or revisions, please let me know by 5:00 pm on Monday, April 21, 2014. After the revisions are addressed, I will send the revised comments to Kurt to forward to SRK, THEMAC Resources Group, and other interested groups by noon on Tuesday, April 22 (Earth Day), 2014.

Pat

Patrick Longmire, Ph.D.
Aqueous Geochemist

DOE Oversight Bureau-New Mexico Environment Department
1183 Diamond Drive, Suite B

Cooperating Agencies - NMCC Meeting Notes
22 April 2014   14:00 MST

Attendee	Company	Initial	Present
Doug Haywood (via phone)	BLM	D.Haywood	X
Rachel Jankowitz	NM G&F	RJ	Not present
Patrick Longmire	NMED	PL	Not present
Brad Reid	NMED	BR	X
Kurt Vollbrecht	NMED	KV	Not present
Kevin Myers	NMOSE	KM	X
Dave Henney (via phone)	Mangi	D.Henney	Not present
DJ Ennis	MMD	DJE	X
Chris Eustice	MMD	CE	X
Holland Shepherd	MMD	HS	Not present
Steve Finch	JSAI	SF	X
Katie Emmer	THEMAC	KE	X

Action Items for 22 April Meeting

Upcoming Meetings/Calls

- Call to discuss Patrick Longmire comments on Geochemistry Pit Lake report, including NMED, SRK, NMCC, MMD, OSE, BLM, Mangi, and Mangi's sub-consultant Mark Nelson: 24 April

NMCC Upcoming Deliverables

- Stage I Abatement Report on 2013 characterization work

Next Meeting date: 3 June, 14:00

Discussion

1. **EIS status**

D. Haywood: BLM is waiting on Mangi, looks like Ch2 will be delivered next week for BLM review. LWA is in a hearing in Az through May 5 resulting in a delay on when they can run the water model. Based on a quick look Lee believes they can work with the model as they received it from JSAI, but he won't know until he generates outputs.

2. **GW Model Status**

KE: We have had some back and forth with LWA and are working to resolve their comments. LWA has created their own "clone" version of the JSAI model in a different version of the same software. NMCC would like to get LWA's comments resolved and to make sure everyone is happy with the model before we turn in Probable Hydrologic Effects for the mine to the state. It appears LWA's model is very similar to the JSAI version. JSAI has made some requested changes to the model and sent them to LWA on 11 April. If LWA is satisfied with the model with those changes, they or NMCC will send it to OSE for their review.
KM: We had something similar with Roca Honda. We had some concern about the time step and calibration runs but we documented everything. In this case, it would be our intention to try to use LWA's model; we will look at the mass balance and other details. Hopefully OSE can say the two models are sufficiently the same.

3. Geochemistry Report review status

KE: There is a call scheduled with SRK this week to allow informal discussion of Patrick Longmire's latest comments. Mark Nelson from Mangi will be on the call.
BR: A lot of P. Longmire's last comments were resolved in the next reports NMCC submitted to NMED.
KM: I would like to participate in the geochemistry call.
KE: Ok I can send you the call information.

4. Pit water standards discussions with SWQB and GWQB update

CE: You might want to include SWQB in the cooperating agency meetings, it might be beneficial for them to come occasionally.
KE: Ok, we'll probably mention that to them. NMCC and our consultant, Steve Finch with John Shomaker & Associates (JSAI) are just coming from a meeting with the SWQB and GWQB, DJ Ennis also attended this meeting – to discuss how we might be able to navigate the permitting process for the water in the pit, especially at the end of mine life.
Discussion: We have established that both the existing pit and the future pit are sinks, with the Copper Rule, the pit would not be subject to groundwater standards but to surface water standards. NMCC is looking at doing a Use Attainability Analysis (UAA) for designated uses primary contact and warmwater aquatic life.
SF: The Pit Lake report that has been submitted for review doesn't have source controls or reclamation; it's presenting the raw outcome. We are looking at potential reclamation plans to meet wildlife habitat and livestock watering through source controls.
KE: We are working with JSAI on the reclamation plans, and will either submit them before the MORP, or as an appendix to the MORP, depending on timing.

5. Overall permit timeline shifts

KE: We are continuing to press on as many fronts as possible. The timeline continues to shift as we address comments. Nothing definitive or new to report at this time.

6. Permit Application Package Status

- BDR submissions: Probable Hydrologic Effects will be developed after the groundwater model is settled to all reviewers' satisfaction.
- Revised MORP: NMCC is selecting a contractor for this work, we anticipate this may be ready for MMD this fall. We will let you know before we turn something in.

7. Stage I Abatement Plan status

SF:JSAI has prepared the report and received comments from NMCC, which have been addressed. When Brad was out at the site in March he asked a few questions and pointed out a few things that we are addressing. We will be in contact with NMED before we submit the report.

8. Revised Discharge Permit Status

KE: We know NMED is waiting on us, we will prepared a revised DP once we can focus on it, right now a lot of effort has gone to the EIS and finding a path forward with the MORP.

9. Next meeting date: 3 June 2014 at 14:00

10. **Geochemistry Conversation without NMCC present:** CE indicated this is cancelled this week as there is a geochemistry call on 24 April.

Cooperating Agencies - NMCC Meeting Notes
3 June 2014 14:00 MST

Attendee	Company	Initial	Present
Doug Haywood (via phone)	BLM	D.Haywood	Not present
Rachel Jankowitz	NM G&F	RJ	Not present
Patrick Longmire	NMED	PL	Not present
Brad Reid	NMED	BR	Not present
Kurt Vollbrecht	NMED	KV	Not present
Keith Ehlert	NMED	K.Ehlert	X
Kevin Myers	NMOSE	KM	X
Dave Henney (via phone)	Solv (formerly Mangi)	D.Henney	X
DJ Ennis	MMD	DJE	X
Chris Eustice	MMD	CE	X
Holland Shepherd	MMD	HS	X
Katie Emmer	THEMAC	KE	X

Name change to note: Mangi Environmental (the 3rd Party EIS contractor) is now doing business as Solv

Action Items for 3 June Meeting

Upcoming Meetings/Calls

- NMCC to meet with NMED at their convenience regarding 15 May submitted Stage I report- TBD

NMCC Upcoming Deliverables

- Informal responses to informal comments on the geochemistry pit lake report are being prepared by JSAI & SRK and will be submitted to agencies for discussion in July 2014.
- Revised MORP: NMCC is working toward submission to MMD by November 2014.
- Probable Hydrologic Effects: will be submitted to MMD once the groundwater model has met the expectations of all parties and is settled.
- NMCC continues to work with LWA, sub-consultant to Solv to provided requested information, groundwater model runs, etc.
- Once LWA has indicated they are happy with the groundwater model, the LWA version of the JSAI model will be submitted to OSE for review and validation, ideally by LWA or Solv.
- Revised Discharge Permit Application is needed, no sure timeline set for this yet.

Other Action Items

- NMCC will invite SWQB to join future Cooperating Agency Meetings
- NMCC will contact ACOE regarding a jurisdictional determination for the pit water body
- Solv will discuss with BLM MMD’s request to see the Ch2 draft, or perhaps MMD may have a presentation by Solv covering the contents of the draft Ch2.

Next Meeting date: Tuesday, July 8 at 14:00, MMD office in Santa Fe

Discussion

1. **Geochemistry Report review status**

KE: We had a 24 April call to discuss added informal comments from PL, participants included: NMED, MMD, OSE, BLM, Mangi (now Solv), CDM, NMCC, and SRK. NMCC later had a very informal meeting with NMED on 15 May to discuss potential response pathways.

KE cont.: NMCC is working with SRK and JSAI to create informal responses to Patrick's informal comments. We hope to pivot our dialogue about the pit to the context of planned reclamation of the pit. The geochemistry pit report prepared by SRK did not include reclamation and so it presents a sort of worst case scenario. We understand that Patrick Longmire needs to be comfortable with the model and we want to address all necessary comments. We believe reclamation and source control plans will allow us to show that the future pit water will meet surface water standards for wildlife habitat and livestock. We are hoping to get a written response to informal comments to NMED in July. We will include everyone in this discussion.

CE: Will one of the things you are doing characterize uncertainties?
KE: PL requested some sensitivity analyses and we are open to doing that if we can get reasonable parameters to work within. SRK's work was based on assumptions they have given reasoning for, additional sensitivity analyses need to be based on something.
HS: Were DJ Ennis' comments included in what was conveyed to NMCC?
DJE: Yes, my comments were included in PL's comments.

2. **Pit water standards discussions with SWQB and GWQB update**

KE: We are pursuing work for UAA for warmwater aquatic life standard, primary contact: submitted UAA workplan for SWQB review during our 22 April meeting & understand SWQB has a letter with suggestions and guidance in the works – word from Kris Pintado is that should come this week.

KE Cont: In our conversation with SWQB, James Hogan indicated he would not be comfortable issuing a standard change for a pit water body that does not exist yet. The current thought is that we will work on an UAA for the current pit and if that goes forward successfully, we have some basis for how we think a future UAA could work for the future pit.

CE: So you don't have this letter from SWQB?
Discussion: SWQB sent a letter dated 2 June 2014 via email while KE was driving up to Santa Fe, other agencies already copied on it. KE will review and follow up on this after the meeting.

KE: Other path forward plans:

- We are working to hire biologist to do survey at pit for warmwater aquatic life. The Baseline Data Report looked at migratory birds, reptiles, and mammals but did not discuss insects at the pit water body.
- We will be contacting the Army Corps of Engineers to ask for a determination on the pit water body – hopefully may show the USACOE agrees it is not a water of the US.
- We will extend an invitation to SWQB to attend these meetings if they believe it would be useful in the future.

Discussion: Contact at the USACOE suggested by KM: Deanna Cummings

3. GW Model Status

KE: Mangi (now Solv) has indicated LWA is basically fine with the groundwater model as it stands. We received requests from LWA on 22 May re: sensitivity analyses and running the model long enough to reach a steady state at the pit to show if the mine operation would impact Hillsboro or Percha box. We have responded to most comments and are preparing a map to send separately. We expect to get the follow up maps to LWA this week and are waiting for further direction from LWA on requested sensitivity runs.

DHenney: LWA is currently focused on output to check against the JSAI model. We have some sections dependent on groundwater model outputs.

4. EIS status

D. Henney: Chapter 2 is nearly complete, we have the objective to get the document to Doug Haywood by the time he returns from vacation on 9 June.

CE: What about Ch2? MMD might want to review Ch 2, I've spoken with Doug Haywood about this, we don't want the EIS to get too far along and then find out we have a problem with it.

DHenney: I believe the plan currently calls for getting the state agencies the Draft EIS prior to publication but there are not plans to get Ch2 to the state agencies.

CE: What is Ch 2 covering?

KE: It's a description of the proposed action and the alternatives, it does not contain analyses on the impacts of the proposed mine plan.

HS: If we get a draft of Ch2 and then get an IPRA request, we will have to give the document to the public. I know this has been a concern for BLM in the past. If however, we got a presentation on the contents of Ch2 we could listen and give input.

KE: Now might be the time to do that as the BLM analysts will be providing comments on Ch2 after Doug distributes them.

DHenney: I will talk about this with Doug. It would be up to the BLM.

5. Permit Application Package Status

KE:

- BDR submissions: Probable Hydrologic Effects will be developed after the groundwater model is settled to all reviewers' satisfaction.
- Revised MORP: Contractor for MORP revision selected, aiming to have revision to MMD in late October or early November

6. Stage I Abatement Plan status

KE: We submitted a report on the 4Q of characterization work conducted in 2013 to NMED on 15 May. We plan to schedule a meeting to discuss this report and results at NMED's convenience.

7. Revised Discharge Permit Status

KE: We know NMED is waiting on us, still no target date yet for the submission of this document.

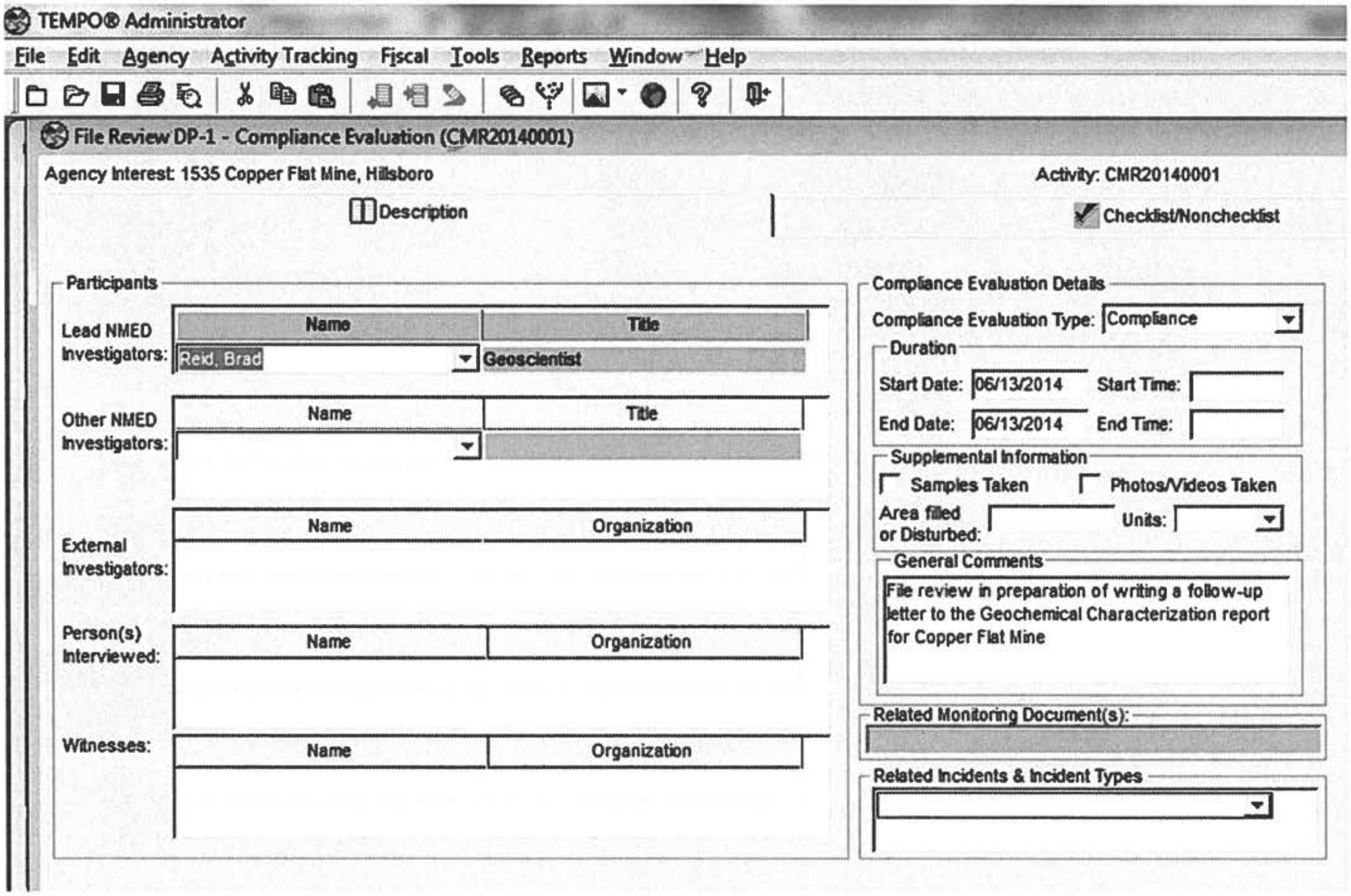
8. Next meeting date: 8 July 2014, 14:00, MMD Conference Room

9. Geochemistry Conversation without NMCC present: Agencies concluded this would not be necessary.

Other discussion-

HS: We would like to see Pit Reclamation Discussion on the next agenda. We need to talk about what NMCC is proposing. NMCC will not get a waiver for the pit.

KE: Sure, we can do that. No one is proposing not to reclaim the pit.



File Review DP-1 - Compliance Evaluation (CMR20140001)

Agency Interest: 1535 Copper Flat Mine, Hillsboro

Activity: CMR20140001

Description

☑ Checklist/Nonchecklist

Participants

Lead NMED Investigators:

Name	Title
Reid, Brad	Geoscientist

Other NMED Investigators:

Name	Title

External Investigators:

Name	Organization

Person(s) Interviewed:

Name	Organization

Witnesses:

Name	Organization

Compliance Evaluation Details

Compliance Evaluation Type: Compliance

Duration

Start Date: 06/13/2014 Start Time:

End Date: 06/13/2014 End Time:

Supplemental Information

☐ Samples Taken ☐ Photos/Videos Taken

Area filled or Disturbed: Units:

General Comments

File review in preparation of writing a follow-up letter to the Geochemical Characterization report for Copper Flat Mine

Related Monitoring Document(s):

Related Incidents & Incident Types

JOHN SHOMAKER & ASSOCIATES, INC.
WATER-RESOURCE AND ENVIRONMENTAL CONSULTANTS
2611 BROADBENT PARKWAY NE
ALBUQUERQUE, NEW MEXICO 87107
(505) 345-3407, FAX (505) 345-9920
www.shomaker.com

GROUND WATER
JUN 19 2014
BUREAU

usps

TRANSMITTAL LETTER

Date: March 18, 2014

To: Brad Reid, Geologist
Mining Environmental Compliance Section
Ground Water Quality Bureau – NMED
P.O. Box 5469
Santa Fe, NM 87502

From: Katie Jubb, Office Coordinator
John Shomaker & Associates, Inc.

☐ urgent ☐ for review ☐ please comment ☐ please reply

Subject: New Mexico Copper Stage 1 Abatement

Message:

Please find enclosed a CD containing the PDF of the complete report:

"Results From First Year of Stage 1 Abatement Investigation at the Copper Flat Mine Site Near Hillsboro, New Mexico"

Thank you

KJ:kj

Enc: one CD
cc + enc: Steve Raugust, NMCC (one CD)

RESULTS FROM FIRST YEAR OF STAGE 1 ABATEMENT INVESTIGATION AT THE COPPER FLAT MINE SITE NEAR HILLSBORO, NEW MEXICO

prepared by

Steven T. Finch, Jr., CPG

JOHN SHOMAKER & ASSOCIATES, INC.
Water-Resource and Environmental Consultants
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prepared for

New Mexico Copper Corporation
a wholly owned subsidiary of THEMAC Resources Group, Ltd.
2424 Louisiana Blvd NE, Suite 301
Albuquerque, New Mexico 87110

May 2014

RESULTS FROM FIRST YEAR OF STAGE 1 ABATEMENT INVESTIGATION AT THE COPPER FLAT MINE SITE NEAR HILLSBORO, NEW MEXICO

prepared by

Steven T. Finch, Jr., CPG

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May 2014

RESULTS FROM FIRST YEAR OF
STAGE 1 ABATEMENT INVESTIGATION AT THE
COPPER FLAT MINE SITE, NEAR HILLSBORO, NEW MEXICO

EXECUTIVE SUMMARY

New Mexico Copper Corporation (NMCC) contracted John Shomaker & Associates, Inc. (JSAI) to implement the approved Stage 1 Abatement Plan (Plan) for the Copper Flat Mine. The Plan calls for four quarters of monitoring and investigation of the Copper Flat Mine facilities created by the Quintana Minerals operations in 1982, which include 1) open pit area, 2) waste rock/mill site area, and 3) tailings storage facility (TSF) area (Fig. 1). The purpose of the Stage 1 Abatement Plan is to define the extent and nature of contamination associated with the Copper Flat Mine facilities, and to design and conduct a site investigation that will adequately define site conditions, and provide the data necessary to select and design an effective abatement option(s).

Open Pit Area

The open pit is a hydraulic sink, as indicated by precipitation of salts around the water line and evapo-concentration of dissolved constituents in pit water. Groundwater inflow to the open pit is alkaline, but the rate is controlled by the low-permeability andesite rocks encompassing the Copper Flat ore body (Fig. 4). During drought periods the outflow by evaporation can exceed inflow, and during above average precipitation conditions the inflow can be greater than outflow. Both conditions will change open pit water storage and water level, but the pit is low enough in elevation to remain as a hydraulic sink.

The four nested piezometers around the open pit characterize the horizontal and vertical extent of potential contaminants; however, it is the ore body mineralization and its contact with oxygenated water that defines the extent of potential contaminants. Low pH groundwater with high mineral acidity and dissolved metal concentrations at GWQ11-24(A) and GWQ11-25(A), and at the acid wall seeps (AWS) are a result of localized sulfide masses that have been in contact with oxygenated meteoric water. Elevated dissolved constituents at near neutral pH most likely represent background conditions within the sulfide bearing ore body.

The pit water chemistry has been influenced by the effects of evapo-concentration. Salts are precipitating along the edge of the pit water surface, but, under neutral pH conditions, concentrations of sulfate continue to increase along with chloride, sodium, and magnesium (Fig. 12). Evapo-concentration has caused only selenium concentrations to slightly exceed NMWQCC standards for stock and wildlife during the 3rd Quarter 2013 (Table 15). Past AWS events have been the primary source for acidity and dissolved metal in the pit water. The pit water pH has varied as a result of episodes of AWS input and subsequent neutralization (Fig. 14). Dissolved copper concentrations in the pit water increased during AWS events, and then decreased with the subsequent increase in pH (Fig. 15). After AWS events, the pit water acidity and dissolved metal load appears to be neutralized by inflow of alkaline groundwater.

Waste Rock/Mill Site Area

The waste rock/mill site area includes about 115 acres between Animas Peak and Grayback Arroyo (Fig. 2). The area is underlain by andesite rock with some alluvial cover. The primary drown-gradient monitoring points are SWQ-2, SWQ-3, and GWQ-3 (Fig. 2). Between the waste rock/mill site area and GWQ-3, groundwater from the low-permeability andesite discharges to the alluvium along Grayback Arroyo as cross-formational groundwater flow, however the alluvial system is dominated by storm-water runoff. Upstream of GWQ-3, storm-water infiltrates and recharges the alluvial cover in the watershed which drains into Grayback Arroyo, and becomes surface-water flow where the arroyo is underlain by andesite. The low-permeability andesite acts as a natural liner that conveys all potential discharges from the waste rock/mill site area to Grayback Arroyo. Downstream of GWQ-3, storm water readily infiltrates along the arroyo channel and recharges the alluvium and the underlying Santa Fe Group sediments in the vicinity of GWQ-8 and GWQ-1.

Results from GWQ-3 and GWQ-8 provide evidence that a sulfate-TDS plume exists in the alluvium and Santa Fe Group sediments below the waste rock/mill site area along Grayback Arroyo. Time-series sulfate concentrations for these three wells and historical data from SWQ-1 through -3 are shown on Figure 16. The 2013 sulfate concentrations in GWQ-3 decreased, but they are still elevated well above the concentrations observed in the early 1980s. Sulfate concentrations from GWQ-8 have been slowly increasing during 2013. The source of the sulfate-TDS plume appears to be from storm-water runoff containing leachate from the waste rock/mill site area, as indicated by results from sample points SWQ-2 and SWQ-3 that are located directly down-gradient of the watershed area containing the waste rock piles and mill site.

Tailings Storage Facility (TSF) Area

The hydrogeologic setting of the TSF area is highly complicated, but can be easily divided into two systems: 1) shallow alluvial aquifer, and 2) Santa Fe Group sediments aquifer. TSF discharges occurred to the shallow alluvial aquifer during Quintana 1982 operations. Since 1984, a sulfate and TDS plume has been identified directly east of the TSF in the shallow alluvial aquifer and underlying Santa Fe Group sediments. The sulfate and TDS plume has significantly reduced in size over time, and the current extent is shown on Figures 9, 10, 18, and 19. The alluvial system is limited to the upper reach of Hunkidori Gulch; located about the center point of the TSF Dam (Fig. 18). Monitoring data from wells in the alluvium have shown that the alluvial aquifer system has drained off and potentially evaporated. Boreholes drilled in 2013 down-gradient of the existing monitoring system were dry.

The Santa Fe Group sediments dip to the east, and were dragged down by the movement along the East Animas Fault. Discharges to the TSF during Quintana operations caused hydraulic loading of the eastward dipping high-permeability beds of the Santa Fe Group sediments up-gradient of the TSF dam. The upper red clay unit on the west side of the fault acts as a hydraulic barrier, and has confined discharges (Fig. 9). The hydrogeologic conditions in the TSF area have provided a natural containment for discharges to groundwater. Monitoring points (GWQ13-28, MW-4) east of the fault show no indication of water-quality effects from TSF discharges.

Abatement Options

It is recommended to continue monitoring pH and pit water quality and perform temporary pH mitigation measures, as needed, until abatement options are implemented. The most logical abatement option is to permit the NMCC mining plans, so the pit can be dewatered and mined out. The new open pit would be reclaimed at closure to meet water-quality standards for post closure uses.

The constituents of concern down-gradient of the waste rock/mill site area are limited to elevated sulfate and TDS concentrations. The most logical abatement options may include source controls and natural attenuation. Permitting a new mining operation would be the best option for reclaiming the waste rock/mill site area. As part of the new mining operation, the waste rock piles within the proposed mining footprint will be removed and handled appropriately during mining construction and development, and the area would be rebuilt with storm-water management structures for source controls. A new mine permit would also include BLM access needed to install groundwater monitoring and protection measures.

The nature and extent of contamination in the TSF area have been defined and is limited to a small zone in the Santa Fe Group sediments. NMCC pumping from GWQ-7 and GWQ-9 has caused drawdown and capture of the residual TDS plume below the TSF (JSAI, 2013). These supply wells are located in the Santa Fe Group aquifer below the dam, and directly north and south of the TSF TDS plume. Continued use of these supply wells is the preferred abatement option. Building the new lined TSF will remove and abate any potential source from the existing TSF.

CONTENTS

page

TABLES

ILLUSTRATIONS

(follow text)

ILLUSTRATIONS

(follow text)

APPENDICES

(follow illustrations)

Appendix A. Well completion diagrams for Copper Flat Mine area

Appendix B. Laboratory reports for 3rd and 4th Quarter 2013 sampling

Appendix C. NMCC Stage 1 water-quality database

Appendix D. Well completion report for GWQ13-28 and geotechnical drilling below TSF

Appendix E. Hydrographs (pit, pit area wells, waste rock/mill site area wells, and TSF wells)

RESULTS FROM FIRST YEAR OF STAGE 1 ABATEMENT INVESTIGATION AT THE COPPER FLAT MINE SITE, NEAR HILLSBORO, NEW MEXICO

New Mexico Copper Corporation (NMCC) contracted John Shomaker & Associates, Inc. (JSAI) to implement the approved Stage 1 Abatement Plan (Plan) for the Copper Flat Mine (as amended by JSAI, 2011). The Plan calls for four quarters of monitoring and investigation of the Copper Flat Mine facilities created by the Quintana Minerals operations in 1982. The facilities include 1) open pit area, 2) waste rock and mill site area, and 3) tailings storage facility (TSF) area (Fig. 1). This report presents the first year of Stage 1 Abatement quarterly monitoring and investigation.

1.0 BACKGROUND

The Copper Flat area has been actively mined for over a century, including but not limited to, placer mining, underground mining, and open pit mining (Harley, 1934). Numerous geologic studies have been conducted to assess the potential mineral resources at Copper Flat (Harley, 1934; Hedlund 1975; Dunn 1982; and McLemore, 2001).

1.1 Site History

SHB (1981) submitted a geohydrologic evaluation in support of discharge plan (DP-1) for the Quintana Minerals mining operations. Quintana Minerals operations occurred between March and June 1982, and remnants of the mining operations include an open pit, waste rock piles, and tailings impoundment facility (Fig. 1). The mill was dismantled in 1986 and the site stabilized. Approximately 60 percent of the Copper Flat area has been disturbed by operations prior to 2014, which include historical underground and open pit mining operations, and placer operations down-gradient of the waste rock piles in Grayback watershed (INTERA, 2012).

An assessment of post-Quintana mining water-quality impacts was performed by Newcomer and Finch (1993). Water-quality data were collected from the monitoring network, and water-quality impacts were assessed for Grayback Arroyo, pit area, acid rock drainage, and tailings dam area.

Several studies were performed during the late 1990s in preparation of re-opening the mine by Alta Gold, primarily related to the Environmental Impact Statement (EIS) required for permits from the BLM (SRK, 1997). More recently, in preparation for permitting, the Copper Flat Project, New Mexico Copper Corporation (NMCC) has submitted a Sampling and Analysis Plan (INTERA, 2010), baseline data report (INTERA, 2012), proposed monitoring network for discharge plan (JSAI, 2013), and other studies related to permitting Copper Flat Mine.

The Stage 1 Abatement plan was submitted by INTERA (2011) and amended by JSAI (2011). Modifications were made to the monitoring plan after the first quarter revealed several shallow wells below the TSF were dry. Additional monitoring wells were added to the monitoring program so the extent of the TSF sulfate plume could be better defined. Details on the monitoring program modifications can be referenced from THEMAC, 2013.

1.2 Purpose

The first task of the Stage 1 Abatement Plan is to define the extent and nature of contamination associated with the Copper Flat Mine facilities shown on Figure 1. As described in NMAC 20.6.2.4106.C, “the purpose of Stage 1 of the abatement plan shall be to design and conduct a site investigation that will adequately define site conditions, and provide the data necessary to select and design an effective abatement option.” Components of the Stage 1 investigation are summarized in Table 1.

Table 1. Required components for completion of Stage 1 Investigation

component of investigation	facility		
	pit	WRP	TSF
constituents of concern	✓	✓	✓
vertical and horizontal extent of groundwater contamination	✓	?	✓
aquifer properties: • transmissivity • hydraulic conductivity • storativity • rate of groundwater flow	✓	✓	✓
wells within 1 mile of each facility	✓	✓	✓
characteristics of seasonal surface-water flow	✓	✓	✓
characteristics of surface-water and groundwater interactions	✓	✓	✓
extent of surface-water impacts	✓	?	✓
extent of impacted stream sediments	✓	?	✓

✓ completed as part of Stage 1 investigation
? not fully identified and characterized

WRP - waste rock pile
TSF - tailings storage facility

2.0 DATA COLLECTION METHODS

Stage 1 monitoring points are listed in Table 2. In addition to those listed in Table 2 are the pit wall seep, and storm-water sampling locations SWQ-1, SWQ-2, and SWQ-3 (Figs. 1 and 2). The pit wall seep and storm-water sampling locations were dry for the 1st and 2nd Quarters of 2013; however, samples were collected during the 3rd and 4th Quarters. Well completion diagrams for the wells listed in Table 2 can be referenced from Appendix A.

2.1 Water-Level Elevation Measurements

Water levels were measured with a calibrated wire-line sounder or steel tape prior to well purging and sampling. Measuring points were established and surveyed prior to Stage 1 water-level measurements; measuring-point elevations are listed in Table 1.

2.2 Well Purging

Monitoring wells were purged using disposable bailers, or a redi-flo submersible pump. Purged volumes are listed in Tables 2 and 3. Several wells pumped dry after the first well volume, and under those conditions, the sample is collected after the well has recovered enough for collection of a sample. Wells GWQ-1, GWQ-3, and GWQ-8 were sampled using micropurging methods (low flow pumping from the top of the screen interval). Pit samples were collected by using a disposable bailer to collect a grab sample approximately 6 ft from shore line on the south end of the pit water surface.

2.3 Field Parameters

Field parameters included temperature, specific conductance, and pH. Instruments were calibrated prior to collection of measurements. Results from 1st through 4th Quarter sampling can be referenced from Tables 3 through 6.

2.4 Laboratory Analyses

Based on the approved amended Stage 1 Abatement Plan, two constituent lists for laboratory analysis included 1) List A for the pit area, and 2) List B for the waste rock/mill site area, and TSF area. A summary of List A and List B constituents for laboratory analysis can be referenced from Table 7. Copies of laboratory reports for 3rd and 4th Quarters are in Appendix B.

Table 2. Summary of wells and well data for the Stage 1 Abatement Plan monitoring, Copper Flat Mine, Sierra County, New Mexico

well name	well type	facility area	year drilled	casing diameter (inches)	total depth (ft bgl)	screen interval (ft bgl)	measuring-point elevation (ft amsl)	geologic unit	depth to water measurement date	depth to water (ft bmp)	water-level elevation (ft amsl)
GWQ96-22A	monitoring	pit	1996	2	244	174 to 244	5,596.17	andesite	4/8/2013	55.45	5,540.72
GWQ96-22B	monitoring	pit	1996	2	380	340 to 380	5,595.95	andesite	4/8/2013	55.28	5,540.67
GWQ96-23A	monitoring	pit	1996	2	101	50 to 100	5,489.84	quartz monzonite	4/8/2013	41.09	5,448.75
GWQ96-23B	monitoring	pit	1996	2	251	150 to 250	5,489.70	quartz monzonite	4/8/2013	41.37	5,448.33
GWQ11-24A	monitoring	pit	2011	2	90	60 to 90	5,517.37	quartz monzonite	4/8/2013	58.44	5,458.93
GWQ11-24B	monitoring	pit	2011	2	250	230 to 250	5,517.26	quartz monzonite	4/8/2013	61.44	5,455.82
GWQ11-25A	monitoring	pit	2011	2	100	70 to 100	5,533.60	quartz monzonite	4/8/2013	73.25	5,460.35
GWQ11-25B	monitoring	pit	2011	2	242	222 to 242	5,533.41	quartz monzonite	4/8/2013	73.66	5,459.75
GWQ11-26	monitoring	pit	2011	4	43	23 to 43	5,539.75	alluvium	4/9/2013	41.42	5,498.33
open pit	monitoring	pit	1982	-	-	-	5,430.00	quartz monzonite	4/8/2013	-8.60	5,438.60
GWQ-1	supply	waste rock/mill site	1972	14/12	391	100 to 391	5,195.59	Santa Fe Group	4/10/2013	7.46	5,188.13
GWQ-3	supply	waste rock/mill site	1932	40 x 43	33	10 to 33	5,252.60	alluvium/andesite	4/11/2013	24.55	5,228.05
GWQ-5R	monitoring	waste rock/mill site	2011	4	120	80 to 120	5,412.80	andesite	4/9/2013	48.25	5,364.55
GWQ-8	supply	waste rock/mill site	1931	8	148	81 to 148	5,216.94	Santa Fe Group	4/9/2013	27.53	5,189.41
GWQ-11	monitoring	tailings storage facility (TSF)	1981	3	70	40 to 65	5,196.44	alluvium/Santa Fe Group	4/10/2013	21.38	5,175.06
GWQ-12	monitoring	tailings storage facility (TSF)	1981	3	110	80 to 105	5,237.28	Santa Fe Group	4/10/2013	82.75	5,154.53
GWQ94-13	monitoring	tailings storage facility (TSF)	1994	5	106	74 to 104.5	5,200.47	Santa Fe Group	4/10/2013	16.22	5,184.25
GWQ94-14	monitoring	tailings storage facility (TSF)	1994	5	159	127.5 to 157.5	5,192.69	Santa Fe Group	4/10/2013	9.6	5,183.09
GWQ94-16	monitoring	tailings storage facility (TSF)	1994	5	46	25 to 45	5,197.41	alluvium	4/10/2013	22.62	5,174.79
GWQ94-18	monitoring	tailings storage facility (TSF)	1994	4	51	10 to 50	5,194.83	alluvium	4/10/2013	dry	<5,143.83
GWQ94-19	monitoring	tailings storage facility (TSF)	1994	4	53	10 to 50	5,203.36	alluvium	4/10/2013	dry	<5,150.36
GWQ13-28	monitoring	tailings storage facility (TSF)	2013	4	198	150 to 190	5,178.16	Santa Fe Group	10/23/2014	156.20	5,021.96
IW-1	monitoring	tailings storage facility (TSF)	1982	4	49	na	5,198.99	alluvium	4/10/2013	dry	<5,149.99
IW-2	monitoring	tailings storage facility (TSF)	1982	4	46	na	5,208.01	alluvium	4/10/2013	dry	<5,162.01
IW-3	monitoring	tailings storage facility (TSF)	1982	4	45	na	5,213.17	alluvium	4/10/2013	dry	<5,168.17
NP-2	monitoring	tailings storage facility (TSF)	1981	2	110	90 to 105	5,192.54	Santa Fe Group	4/10/2013	35.55	5,156.99
NP-3	monitoring	tailings storage facility (TSF)	1981	2	90	70 to 85	5,199.73	Santa Fe Group	4/10/2013	15.25	5,184.48
MW-4	supply	tailings storage facility (TSF)	1975	6	1,500	123 to 1,500	5,146.12	Santa Fe Group	12/8/2011	82.2	5,063.92

ft bgl - feet below ground level
ft amsl - feet above mean sea level
ft bmp - feet below measuring point
na - not available

Table 3. Summary of 1st Quarter 2013 field data and sample collection methods

monitoring point	sample list	casing diameter (in.)	date sampled	temp. (°C)	pH	conductivity (µS/cm)	depth to water (ft)	volume purged (gal)	comments
pit area									
GWQ96-22A	A	2	1/9/2013	15.5	7.41	679	54.31	17	pumped off, micropurge sample in screen
GWQ96-22B	A	2	1/9/2013	19.1	6.85	1,038	53.96	6	pumped off, sampled w/ bailer after recovered
GWQ96-23A	A	2	1/11/2013	17.1	7.46	878	41.14	5	pumped off, sampled w/ bailer after recovered
GWQ96-23B	A	2	1/11/2013	16.2	7.16	737	41.16	13	pumped off, sampled w/ sample pump after recovered
GWQ11-24A	A	2	1/8/2013	18.0	4.08	2,807	57.62	20	
GWQ11-24B	A	2	1/9/2013	18.0	6.72	1,904	61.30	30	parameters stable- sampled after 1 well vol.
GWQ11-25A	A	2	1/9/2013	16.5	3.63	6,410	70.00	8	pumped off, sampled w/ bailer after recovered
GWQ11-25B	A	2	1/9/2013	19.8	6.28	2,390	72.06	84	
GWQ11-26	A	4	1/8/2013	17.4	6.81	735	41.30	8	
pit water	A	-	1/9/2013	4.3	7.32	10,510	surface water	grab sample	
pit wall seep	A	-	1/9/2013	-	-	-	-	-	no seep observed

µS/cm - microSiemens per centimeter

Table 3. Summary of 1st Quarter 2013 field data and sample collection methods (concluded)

monitoring point	sample list	casing diameter (in.)	date sampled	temp. (°C)	pH	conductivity (µS/cm)	depth to water (ft)	volume purged (gal)	comments
waste rock/mill site area									
GWQ-1	B	12	1/10/2013	19.6	7.20	659	7.26	305	parameters stable-sampled after 1 well vol.
GWQ-3	B	40 x 43	-	-	-	-	-	-	no access 1/2013
GWQ-5R	B	4	1/10/2013	16.4	7.21	624	47.78	33	pumped off, sampled w/ sample pump after recovered
GWQ-8	B	8	1/10/2013	19.1	6.77	1,358	27.35	450	parameters stable-sampled after 1 well vol.
tailings storage facility (TSF) area									
GWQ94-13	B	5	1/10/2013	19.3	6.90	1,638	15.90	145	parameters stable, sampled after 1.5 well vol.
GWQ94-14	B	5	1/11/2013	20.7	6.97	743	9.2	210	parameters stable-sampled after 2 well vol.
GWQ94-16	B	5	1/10/2013	18.6	7.59	1,477	22.57	27	purged 3 wells vol. and sampled
GWQ94-18	B	4	-	-	-	-	dry	-	dry 1/10/2013
GWQ94-19	B	4	-	-	-	-	dry	-	dry 1/10/2013
IW-1	B	4	-	-	-	-	dry	-	dry 1/10/2013
IW-2	B	4	1/10/2013	18.8	7.19	3,050	42.20	-	purged dry; still dry 1/11/2013
IW-3	B	4	-	-	-	-	dry	-	dry 1/10/2013
NP-3	B	4	1/10/2013	19.5	6.36	1,605	14.80	6	pumped off, sampled w/ sample pump after recovered
MW-4	B	6	-	-	-	-	NA		no access due to frozen 1/2013

µS/cm - microSiemens per centimeter

Table 4. Summary of 2nd 2013 Quarter field data and sample collection methods

monitoring point	sample list	casing diameter (in.)	date sampled	temp. (°C)	pH	conductivity (µS/cm)	depth to water (ft)	volume purged (gal)	comments
pit area									
GWQ96-22A	-	2	4/8/2013	-	-	-	55.45	-	water level only
GWQ96-22B	-	2	4/8/2013	-	-	-	55.28	-	water level only
GWQ96-23A	-	2	4/8/2013	-	-	-	41.09	-	water level only
GWQ96-23B	-	2	4/8/2013	-	-	-	41.37	-	water level only
GWQ11-24A	A	2	4/11/2013	18.6	4.48	3,662	61.44	14	bailed 3 vols., sampled, cloudy yellow color
GWQ11-24B	A	2	4/8/2013	20.1	6.18	2,470	58.44	30	parameters stable-sampled after 1 well vol. (very slow pumping)
GWQ11-25A	A	2	4/9/2013	14.4	3.30	10,120	73.25	22.5	purged 3 times, then sampled, water gray color, low pH
GWQ11-25B	A	2	4/8/2013	21.0	6.54	2,722	73.66	80	purged 3 volumes and sampled, water was clear
GWQ11-26	A	4	4/9/2013	18.5	7.05	891	41.42	5	purged 3 volumes, then sampled, water was clear
pit water	A	-	4/8/2013	17.6	7.07	10,610	8.6	grab	surface sample from NW corner of ramp
pit wall seep	A	-	4/8/2013	-	-	-	-	-	no seep observed

µS/cm - microSiemens per centimeter

Table 4. Summary of 2nd Quarter 2013 field data and sample collection methods (concluded)

monitoring points	sample list	casing diameter (in.)	date sampled	temp. (°C)	pH	conductivity (µS/cm)	depth to water (ft)	volume purged (gal)	comments
waste rock/mill site area									
GWQ-1	B	12	4/10/2013	20.0	7.33	723	7.46	350	pump set middle of screen, micropurged and sampled ~1 vol.
GWQ-3	B	40 x 43	4/11/2013	17.5	7.50	2,782	24.55	957	sampled after parameters stable and 1.5 well volumes
GWQ-5R	B	4	4/9/2013	19.0	7.12	771	48.25	30	sampled after parameters stable and 1 well volume
GWQ-8	B	8	4/9/2013	19.6	7.16	1,564	27.53	575	parameters stable-sampled after 1.5 well volumes
tailings storage facility (TSF) area									
GWQ-11	B	3	4/10/2013	19.8	6.73	1,351	21.38	57	purged 3 vol. & sampled; water clear
GWQ-12	B	3	4/10/2013	20.1	7.19	553	82.75	55	purged 3 vol. & sampled; water clear
GWQ94-13	B	5	4/10/2013	19.4	7.16	1,711	16.22	310	purged 3 vol. & sampled; water clear
GWQ94-14	B	5	4/10/2013	19.7	7.21	721	9.60	300	purged 3 vol. & sampled; water clear
GWQ94-16	B	4	4/10/2013	19.0	7.36	1,576	22.62	45	purged 3 vol. & sampled; water clear
GWQ94-18	B	4	-	-	-	-	dry	-	dry 4/10/2013
GWQ94-19	B	4	-	-	-	-	dry	-	dry 4/10/2013
IW-1	B	4	-	-	-	-	dry	-	dry 4/10/2013
IW-2	B	4	-	-	-	-	dry	-	dry 4/10/2013
IW-3	B	4	-	-	-	-	dry	-	dry 4/10/2013
NP-2	B	2	4/10/2013	19.1	7.38	1,364	35.55	30	bailed 3 volumes and sampled; cloudy to reddish-brown
NP-3	B	2	4/10/2013	18.9	6.95	2,134	15.25	7.5	pumped off, sampled w/ bailer after it recovered
MW-4	B	6	4/12/2013	19.4	8.29	427		approx. 30	stock well; sampled from tank after approx. 30 gallons pumped

µS/cm - microSiemens per centimeter

Table 5. Summary of 3rd Quarter 2013 field data and sample collection methods

monitoring point	sample list	casing diameter (in.)	date sampled	temp. (°C)	pH	conductivity (µS/cm)	depth to water (ft)	volume purged (gal)	comments
pit area									
GWQ96-22A	A	2	7/9/2013	23.6	6.97	888	56.48	42	purged dry, sampled after recovery
GWQ96-22B	A	2	7/9/2013	24.9	7.07	1,039	56.24	12.5	purged dry, sampled after recovery
GWQ96-23A	A	2	7/9/2013	24.0	7.23	1,084	41.52	30	purged 3 volumes and sampled; water was clear
GWQ96-23B	A	2	7/9/2013	22.9	7.14	923	41.63	54	purged dry at 1.5 well volumes, sampled after recovery
GWQ11-24A	A	2	7/9/2013	20.9	3.72	3,677	60.04	15	bailed 3 volumes and sampled; cloudy yellow color
GWQ11-24B	A	2	7/9/2013	23.0	6.29	2,409	61.96	40	parameters stable-sampled after 1 well vol. micro purge
GWQ11-25A	A	2	7/10/2013	19.6	2.12	12,210	75.85	12	bailed 3 volumes and sampled; cloudy gray color
GWQ11-25B	A	2	7/10/2013	21.4	6.25	2,647	75.34	82	purged 3 volumes and sampled; water clear
GWQ11-26	A	4	7/9/2013	19.4	6.94	910	41.58	7	purged 3 volumes and sampled; water slightly cloudy
pit water	A	-	7/10/2013	26.3	7.36	12,600	6.92	grab	surface sample from NW corner of ramp
pit wall seep	A	-	7/10/2013	-	-	-	-	-	no seep, Q3

µS/cm - microSiemens per centimeter

Table 5. Summary of 3rd Quarter 2013 field data and sample collection methods (concluded)

monitoring points	sample list	casing diameter (in.)	date sampled	temp. (°C)	pH	conductivity (µS/cm)	depth to water (ft)	volume purged (gal)	comments
waste rock/mill site area									
GWQ-1	B	12	7/10/2013	21.7	7.49	692	7.80	385	micropurge in screen, sampled after parameters stabilized
GWQ-3	B	40 x 43	7/10/2013	21.5	7.44	3112	28.20	780	purged 3 well volumes and sampled, water was clear
GWQ-5R	B	4	7/9/2013	22.9	6.89	781	48.54	35	purged dry, sampled after recovery
GWQ-8	B	8	7/10/2013	22.0	7.11	1,611	28.05	500	parameters stable-sampled after 1.5 well volumes
tailings storage facility (TSF) area									
GWQ-11	B	3	7/11/2011	20.8	8.20	1,260	21.82	60	purged 3 volumes, sampled; clear
GWQ-12	B	3	7/11/2013	21.7	7.24	518	82.55	61.5	purged 3 volumes, sampled; clear
GWQ94-13	B	5	7/11/2013	21.3	7.33	1,898	16.53	175	purged 3 volumes, sampled; clear
GWQ94-14	B	5	7/11/2013	21.8	7.12	832	9.95	275	purged 3 volumes, sampled; clear
GWQ94-16	B	4	7/11/2013	21.2	7.28	1,456	22.98	51	purged 3 volumes, sampled; clear
GWQ94-18	B	4	-	-	-	-	dry	-	dry 7/10/2013
GWQ94-19	B	4	-	-	-	-	dry	-	dry 7/10/2013
IW-1	B	4	7/11/2013	-	-	-	46.50	-	2.5 ft water column below screen
IW-2	B	4	-	-	-	-	dry	-	dry 7/10/2013
IW-3	B	4	-	-	-	-	dry	-	dry 7/10/2013
NP-2	B	2	7/11/2013	19.1	8.79	1,307	35.96	16	purged dry, sampled after recovery
NP-3	B	2	7/11/2013	22.4	7.57	2,077	15.43	12	purged dry, sampled after recovery
MW-4	B	6	7/11/2013	29.7	8.80	713	93.11	approx. 5,000	stock well; ~5000-gallon tank recently filled, sampled from tank

µS/cm - microSiemens per centimeter

Table 6. Summary of 4th Quarter 2013 field data and sample collection methods

monitoring point	sample list	casing diameter (in.)	date sampled	temp. (°C)	pH	conductivity (µS/cm)	depth to water (ft)	volume purged (gal)	comments
pit area									
GWQ96-22A	-	2	10/22/2013	-	-	-	46.51	-	water level only; not sampled
GWQ96-22B	-	2	10/22/2013	-	-	-	46.32	-	water level only; not sampled
GWQ96-23A	-	2	10/22/2013	-	-	-	41.64	-	water level only; not sampled
GWQ96-23B	-	2	10/22/2013	-	-	-	41.82	-	water level only; not sampled
GWQ11-24A	A	2	10/22/2013	18.8	4.21	3,700	54.73	18	bailed 3 volumes, sampled; cloudy yellow color.
GWQ11-24B	A	2	10/22/2013	22.3	6.55	2,770	57.14	28	parameters stable-sampled after 1 well vol. micro purge
GWQ11-25A	A	2	10/22/2013	19.3	2.53	11,510	19.00	10	purged dry, sampled after recovery
GWQ11-25B	A	2	10/22/2013	20.1	6.74	2,810	41.31	55	parameters stable-sampled after 1.5 well vol. micro purge
GWQ11-26	A	4	10/22/2013	18.5	7.45	1,013	25.55	34	purged 3 volumes, sampled; water was slightly cloudy
pit water	A	-	10/22/2013	16.7	7.94	7,980	9.35	grab	surface sample from NW corner of ramp
pit wall seep	A	-	10/23/2013	23.8	2.43	6,600	surface sample	grab	sample collected from AWS flowing on bench

µS/cm - microSiemens per centimeter
AWS - acid wall seeps

Table 6. Summary of 4th Quarter 2013 field data and sample collection methods (concluded)

monitoring points	sample list	casing diameter (in.)	date sampled	temp. (°C)	pH	conductivity (µS/cm)	depth to water (ft)	volume purged (gal)	comments
waste rock/mill site area									
GWQ-1	B	12	10/23/2013	20.6	7.88	491	7.50	35	micropurged top of screen, sampled after parameters stabilized
GWQ-3	B	40 x 43	10/23/2013	20.7	7.30	2,700	12.60	1,640	purged 1 well volume, sampled, water was clear
GWQ-5R	B	4	10/23/2013	20.7	7.39	669	48.55	35	purged dry, sampled after recovery
GWQ-8	B	8	10/23/2013	20.2	7.27	1,410	27.78	40	micropurged top of screen, sampled after parameters stabilized
tailings storage facility (TSF) area									
GWQ-11	B	3	10/24/2013	20.0	7.44	1,185	21.18	55	purged 3 volumes, sampled; clear
GWQ-12	B	3	10/23/2013	21.1	7.62	477	82.9	28	purged dry, sampled after recovery
GWQ94-13	B	5	10/24/2013	20.2	7.38	1,644	16.64	175	purged 3 volumes, sampled; clear
GWQ94-14	B	5	10/22/2013	21.3	7.72	734	10.00	295	purged 3 volumes, sampled; clear
GWQ94-16	B	4	10/24/2013	20.0	7.44	1,652	22.40	47	purged 3 volumes, sampled; clear
GWQ94-18	B	4	10/24/2013	-	-	-	dry	-	dry
GWQ94-19	B	4	10/24/2013	-	-	-	dry	-	dry
GWQ13-28	B	4	10/23/2013	21.5	7.62	783	156.20	85	purged 3 volumes, sampled; cloudy
IW-1	B	4	10/23/2013	-	-	-	46.50	-	2.5 ft water column 7/10/2013
IW-2	B	4	10/24/2013	-	-	-	dry	-	dry 7/10/2013
IW-3	B	4	10/24/2013	-	-	-	dry	-	dry 7/10/2013
NP-2	B	2	10/23/2013	20.7	7.10	1,154	36.31	8	purged dry, sampled after recovery
NP-3	B	2	10/24/2013	19.2	7.31	1,749	15.32	8.5	purged dry, sampled after recovery
MW-4	B	6	10/22/2013	18.8	7.85	647	100.28 (pumping)	approx. 5,000	stock well; ~5,000-gallon tank recently filled, sampled from tank

µS/cm - microSiemens per centimeter

Table 7. Summary of Copper Flat Mine Stage 1 Abatement Plan constituent lists for lab analysis

List A*	**List B****
pit area	**waste rock/mill site and tailings storage facility (TSF) areas**
aluminum	total dissolved solids (TDS)
cadmium	sulfate
cobalt	chloride
copper	alkalinity
manganese	calcium
selenium	magnesium
zinc	sodium
calcium	potassium
magnesium	-
sodium	-
potassium	-
alkalinity	-
total acidity	-
chloride	-
fluoride	-
sulfate	-
total dissolved solids (TDS)	-

* List A metals are for dissolved metals (filtered)

** List B metals are for total metals (NOT filtered)

2.5 Field Reconnaissance

Field reconnaissance has been performed by several investigators over the years (SHB, 1981; Newcomer and Finch, 1993; Munroe, 1999; Raugust, 2003; and INTERA, 2012). Site conditions have not significantly changed over the last two decades.

SHB (1981) performed an inventory of wells and groundwater reconnaissance prior to the start up of Quintana mining operations. Water-levels and water-quality data were collected from approximately 19 wells in the Copper Flat Mine area to determine baseline conditions. Historical water-quality data have been added to the NMCC Stage 1 database (Appendix C). Gravity surveys performed by SHB (1981), as part of the groundwater investigation for the tailings dam area, indicated an anomaly just east of the tailings dam, suggesting a fault.

Newcomer and Finch (1993) collected and evaluated water-quality data from the open pit, waste rock/mill site, and the tailings impoundment areas. Field reconnaissance was performed across the entire mine permit area to locate existing wells, seeps, and springs. After above normal precipitation, acid rock drainage seeps were observed in the western pit wall, and below the waste rock pile/mill site on the southeast side.

Munroe (1999) assessed the mobility of metals from waste rock, placer workings, and stream sediments down-gradient of the Copper Flat waste rock/mill site area. Raugust (2003) field checked seeps, springs acid wall seeps (AWS), and acid rock drainage (ARD) locations reported by previous investigators and found that most are ephemeral and only occur after above average precipitation.

The NMCC Copper Flat Project Baseline Data Report (INTERA, 2012) contains a detailed reconnaissance and assessment of current conditions at and around the mine site. Wells were located and surveyed, and samples collected. Wells located within a 1-mile radius of each facility are shown on Figure 3. JSAI field reconnaissance during Stage 1 sampling activities included visual inspection of conditions around the open pit, and along Grayback Arroyo up stream of the open pit and downstream of the waste rock pile/mill site area. Two significant observations included AWS seeps along the northwestern wall of the open pit during 4th Quarter 2013 sampling, and arroyo channel disturbances from placer mining operations along Grayback Arroyo near GWQ-3.

3.0 HYDROGEOLOGIC INVESTIGATION

The results focus on the three areas of primary concern: 1) pit area, 2) Grayback Arroyo down-gradient of the waste rock/mill site area, and 3) TDS and sulfate plume observed below the TSF. Surface-water characteristics are limited to the Copper Flat Mine pit, and the ephemeral Grayback Arroyo (Fig. 2), the primary drainage through the mine area. Surficial geology is shown on Figure 4.

3.1 Surface-Water Characteristics

Surface-water characteristics of Grayback Arroyo have been investigated for the last three decades. Figure 5 is a map showing Grayback Arroyo, watershed areas, and surface water sampling points. Quintana constructed the diversion channel around the Copper Flat open pit and the TSF dam in 1981. As a result, three watershed areas were created: 1) Grayback Arroyo, 2) open pit, and 3) TSF (Fig. 5).

Seasonal surface-water flow in Grayback Arroyo is dependent on storm events. Daily storm events greater than 1.5 inches of precipitation typically generate runoff in Grayback Arroyo. Grayback Arroyo through the Copper Flat area is an ephemeral stream during average and below average precipitation conditions. During above normal precipitation, Grayback Arroyo below the waste rock/mill site can temporarily behave as an intermittent stream (gaining from groundwater). During spring of 1993, residue streamflow was observed in Grayback Arroyo after a preceding wet fall and winter (Table 8).

Table 8. Summary of measured surface-water flow rates and selected water-quality parameters in Grayback Arroyo during 1993 (from Newcomer and Finch, 1993)

location	date	measured flow (gpm)	pH	TDS (mg/L)
SWQ-1	4/1/1993	1 to 2	7.4	782
SWQ-1	5/7/1993	dry	---	---
SWQ-2	3/31/1993	less than 1	7.7	2,720
SWQ-3	3/31/1993	12.5	8.1	2,950

gpm - gallons per minute
mg/L - milligrams per liter
TDS - total dissolved solids

Surface-water quality in Grayback Arroyo changes as it passes through the Copper Flat area. SHB (1981) reported pre-Quintana mining (1977) water-quality data for Grayback Arroyo at a sampling location near or at SWQ-3 (Table 9). The total dissolved solids (TDS) content significantly increased from January to July 1977.

Table 9. Summary of pre-Quintana mining operations Grayback Arroyo surface-water-quality data for SWQ-3 (SHB, 1981)

parameter	unit	sample date		
		January 1977	March 1977	July 1977
TDS	mg/L	806	1,133	3,200
total alkalinity	mg/L as $CaCO_3$	287	226	-
total nitrogen	mg/L	5.7	3.5	-
fluoride	mg/L	0.45	0.42	-
copper	mg/L	0.04	0.005	0.005
iron	mg/L	0.25	0.12	0.14
manganese	mg/L	0.01	0.01	0.07
potassium	mg/L	3.1	2.9	8.9

TDS - total dissolved solids
mg/L - milligrams per liter

As supported by historical data (Tables 8 and 9), it is suspected the short-duration higher surface-water flow have lower TDS concentrations, and the prolonged flows have higher TDS concentrations from longer contact time with naturally occurring minerals in the stream alluvium and waste rock piles from historical mining.

3.1.1 Data Collected

The analyses of water-quality data include historical data and data collected during the 3rd and 4th Quarter Stage 1 sampling events. Drought conditions have prevented the collection of storm-water runoff samples from SWQ-1, SWQ-2, and SWQ-3 during the 1st and 2nd Quarters.

Existing autosamplers for SWQ-1, SWQ-2, and SWQ-3 were repaired and put back into service on April 23 and 24, 2013 during the 2nd Quarter sampling activities. On July 11, 2013, NMCC security staff reported that all of the drainages with autosamplers flowed overnight. SWQ-1 flowed overnight on July 10th but storm-water flow was not observed on July 11. Storm-water flow (<0.5 cubic ft per second; cfs) was observed at SWQ-2 and SWQ-3 on July 11. Samples were collected from SWQ-1, SWQ-2, and SWQ-3 for the 3rd Quarter.

During the 4th Quarter sampling, NMCC representatives collected samples from SWQ-2 and SWQ-3 on September 20, 2013 following the unprecedented precipitation event that occurred between September 7 and 14, 2013. Record flooding was reported for the region during September 2013. SWQ-1 had evidence of flooding (debris dam piled up on autosampler fence and intake full of mud), and no sample from SWQ-1 was collected for 4th Quarter due to damage caused by flooding. A sample from SWQ-2 was collected by JSAI on October 21, 2013; arroyo channel had residual flow from September 2013 precipitation event. A sample was collected by JSAI from SWQ-3 on October 10, 2013.

Table 10. Summary of surface-water monitoring points water-quality data

location	sample date	pH	sulfate (mg/L)	TDS (mg/L)	comments
SWQ-1	7/10/2013	7.20	6	620	overnight flash flood
SWQ-2	7/11/2013	7.19	21	540	overnight flash flood
	9/20/2013	----	1,300	2,470	precipitation event*
	10/21/2013	8.22	1,840	3,180	precipitation event*
SWQ-3	7/11/2013	7.55	455	1,080	overnight flash flood
	9/20/2013	----	1,700	3,030	precipitation event*
	10/9/2013	8.26	2,020	3,720	precipitation event*

* unprecedented precipitation event that occurred between September 7 and 14, 2013
TDS - total dissolved solids
mg/L - milligrams per liter

3.1.2 Stream Sediments

The impact to stream sediments is difficult to discern, due to decades of disturbances from gold panning operations along the stream channel and the fact that sediments have been naturally eroded from the Copper Flat ore deposit into Grayback Arroyo. Placer gold in stream alluvium obviously came from the Copper Flat ore body. Munroe (1999) concluded that the mineralogy and metal concentrations were similar between waste rock piles from historical mining and stream sediment samples collected from Grayback Arroyo downstream from Copper Flat.

There are no sulfide minerals or secondary minerals in the stream sediments that would create acidic streamflow conditions, as indicated by the mineralogical study by Munroe (1999) and the above neutral pH surface-water observed in Grayback Arroyo (Table 10).

3.1.3 Surface-Water Impacts

The increase in TDS in Grayback Arroyo surface-water downstream of Copper Flat appears to be occurring prior to Quintana operations. Evidence is provided in the baseline data collected by SHB (1981) and summarized in Table 9. Furthermore, pH and alkalinity significantly increase in surface-water downstream of Copper Flat, indicating the TDS is controlled by dissolution of sulfate and carbonate salts rather than oxidation of sulfide minerals. Surface-water impacts to Grayback Arroyo are limited to elevated TDS and sulfate.

3.2 Aquifer Characteristics

One task described in the amended Stage 1 Abatement Plan was to use data collected from the proposed monitoring to refine the hydrogeologic conceptual model for each facility. Rate of potential transport is defined in the conceptual models (Section 4.0). The Stage 1 data collection and investigation have focused on hydrogeologic conditions along Grayback Arroyo down-gradient of the waste rock/mill site area and the barrier boundary fault east of the TSF. Open pit water geochemistry has been investigated by SRK (2013, 2013a). A revised geologic map of the area of investigation is presented as Figure 4, and summary of aquifer units for each facility can be referenced from Table 11. Additional details on the regional geologic setting can be referenced from JSAI (2014).

Table 11. Summary of aquifer units found at each facility, Copper Flat Mine

facility	aquifer unit	general description
open pit	• andesite • quartz monzonite • biotite breccia	• fine-grained igneous volcanic rock • course-grained mineralized intrusive rock • sulfide-ore mineralized breccia pipe
waste rock piles and mill site	• alluvium • andesite • Santa Fe Group sediments	• unconsolidated sand and gravel • fine-grained igneous volcanic rock • bedded sand, silt, and clay
tailings storage facility (TSF)	• alluvium • Santa Fe Group sediments	• unconsolidated sand and gravel • bedded sand, silt, and clay

Sources of aquifer test data come from 1) pumping and specific-capacity tests performed on supply and monitoring wells, 2) injection and slug tests performed on Copper Flat Mine open pit piezometers, and 3) pumping test performed by Adrian-Brown Consultants (1994) on monitoring wells below the tailings dam.

3.2.1 Open Pit

The open pit is a hydraulic sink, as indicated by precipitation of salts around the water line and evapo-concentration of dissolved constituents in pit water. Groundwater inflow to the open pit is controlled by the andesite rocks encompassing the Copper Flat ore body (Fig. 4). Testing and well yield provide evidence that the andesite rocks have extremely low permeability. Faults and fractures in the andesite rocks have been mineralized and do not significantly contribute to the secondary permeability of the groundwater system. Hydrogeologic cross-sections through the open pit illustrating distribution of geologic units and monitoring wells are presented as Figures 6 and 7.

The Copper Flat porphyry deposit is a hypogene sulfide deposit, with chalcopyrite as the primary ore mineral. Sulfide mineralization is restricted almost entirely to the quartz monzonite, with an abrupt drop in sulfide content at the andesite contact (Dunn, 1982). The biotite breccia contains the highest concentration of chalcopyrite ore, particularly in the northwest part of the quartz monzonite intrusion. The breccias matrix contains quartz, biotite, potash feldspar, pyrite, chalcopyrite, magnetite, molybdenite, fluorite, calcite, and apatite (Dunn, 1982). Sulfide content by weight ranges from 1 to 5 percent in the quartz monzonite, and locally up to 20 percent in the biotite breccias. Quartz and carbonate veins are associated with sericite alteration. Calcite is commonly observed as the mineral in joint sets logged from exploration cores in the quartz monzonite.

Hydraulic conductivity values were derived from slug tests performed on wells GWQ96-22 and GWQ96-23 (SRK, 1997). JSAI evaluated injection tests performed on GWQ-5R, GWQ11-24, and GWQ11-25 as part of developing and calibrating a groundwater-flow model for the NMCC Copper Flat Project (JSAI, 2014). A summary of the hydraulic conductivity estimates for the pit area is presented as Table 11. The model calibrated average hydraulic conductivity for the rock surrounding the open pit is 0.002 ft/day (JSAI, 2014). The calibrated JSAI model has the horizontal hydraulic conductivity decreasing with respect to depth, from 0.002 to 0.001 ft/day. Model calibrated specific yield equals 0.01 (1 percent).

Table 12. Summary of hydraulic conductivity (permeability) estimates from wells in the vicinity of the pit and waste rock piles

borehole and zone	depth interval (ft)	geologic unit	apparent permeability	
			(cm/sec)	(ft/day)
GWQ96-22	170-386	andesite	6×10^{-9}	0.00003
GWQ96-23	420-491	andesite	9.5×10^{-7}	0.0027
GWQ-5R, Zone 1	64-100	andesite	~0	~0
GWQ11-24, Zone 1	100-147	monzonite	7×10^{-6}	0.02
GWQ11-24, Zone 2	150-197	monzonite	3.0×10^{-5}	0.085
GWQ11-24, Zone 3	204-251	monzonite	4.9×10^{-5}	0.14
GWQ11-25, Zone 1	100-148	monzonite	~0	~0
GWQ11-25, Zone 2	150-198	monzonite	2.9×10^{-5}	0.081
GWQ11-25, Zone 3	207-251	monzonite	2.6×10^{-5}	0.074

cm/sec - centimeters per second

The pit water balance, representative of current average conditions, was determined from the JSAI model calibration (JSAI, 2014). Groundwater inflow accounts for approximately 25 percent of the water budget, and all outflow is by evaporation. During drought periods, the outflow by evaporation can exceed inflow, and during above average precipitation conditions, the inflow can be greater than outflow. Both conditions will change open pit water storage and water level.

Table 13. Model-derived water budget for Copper Flat open pit

component	rate (gpm)
INFLOW	
direct precipitation	3.5
storm-water runoff	7.9
groundwater	4.1
OUTFLOW	
evaporation	15.5

gpm - gallons per minute

3.2.2 Waste Rock/Mill Site Area

The waste rock/mill site area includes about 115 acres between Animas Peak and Grayback Arroyo (Fig. 2). The area is underlain by andesite rock with some alluvial cover. The primary drown-gradient monitoring points are SWQ-2, SWQ-3, and GWQ-3 (Fig. 2). Prior to the development of the mill site area and placement of waste rock piles by Quintana, the area was heavily mined for placer and underground workings. In addition to the waste rock piles left by Quintana, numerous small waste rock piles from historical mining exist up-gradient of monitoring points SWQ-2 and SWQ-3.

Geologic mapping and well drilling data were used to construct the hydrogeologic cross-section down-gradient of the waste rock/mill site area along Grayback Arroyo (Fig. 8). Between the waste rock/mill site area and GWQ-3, groundwater from the low-permeability andesite likely discharges to the alluvium along Grayback Arroyo as cross-formational groundwater flow; however, the alluvial system is dominated by storm-water runoff. Upstream of GWQ-3, storm-water infiltrates and recharges the alluvial cover, which drains into Grayback Arroyo and becomes surface-water flow where the arroyo is underlain by andesite. The low-permeability andesite acts as a natural liner that conveys all potential discharges from the waste rock/mill site area to Grayback Arroyo. Downstream of GWQ-3, storm water readily infiltrates along the arroyo channel and recharges the alluvium and the underlying Santa Fe Group sediments in the vicinity of GWQ-8 and GWQ-1.

Hydraulic conductivity of the alluvium is unknown, because the alluvium is only saturated after storm-water runoff events, and as a result there are no wells constructed solely in the alluvium. GWQ-3 is a hand-dug rock-lined gallery that is completed in fractured andesite with some overlying stream alluvium. During sampling, GWQ-3 was pumping at a rate of 19.5 gallons per minute (gpm) and had a specific capacity of 2.4 gpm/ft of drawdown. Using a rewritten form of the Theis equation by Walton (1970), the corresponding transmissivity is 200 ft^2/day, and hydraulic conductivity is 17 ft/day. Specific yield of sand and gravel deposits typically range from 0.2 to 0.3 (Fetter, 1993).

3.2.3 Tailings Storage Facility (TSF) Area

The groundwater conditions below the TSF area has been extensively studied (SHB, 1981; Newcomer and Finch, 1993; JSAI, 2011; etc.). The shallow subsurface geology is complicated by varying degrees of alluvial thickness intertwined with basalt flows. The Santa Fe Group Sediments underlies the alluvium, and is the primary aquifer unit. Alternating low and moderate permeability beds of the Santa Fe Group Sediments dip to the east (see Fig. 9).

Tailings were only added to the northern TSF cell during the Quintana operations. Discharges to groundwater occurred to the shallow alluvium below the dam, and up-gradient of the dam to beds of the Santa Fe Group sediments with relatively moderate permeability. A prominent, mappable, red clay unit of the Santa Fe Group sediments acts as a confining layer to the underlying beds of the Santa Fe Group sediments with moderate permeability (Fig. 9).

A fault offsetting the beds of the Santa Fe Group sediments exists east of the TSF dam (Figs. 4 and 9). This south to north trending fault east of the TSF is referred to as part of the East Animas Fault Trend that forms the boundary between Animas Uplift and Palomas Basin. The fault is downthrown on the east side. The East Animas Fault Trend is either composed of several parallel faults or one fault mapped in slightly different longitude by SHB (1981), Seager et al. (1982), Harrison et al. (1993), Beaumont (2012), and Hawley (2012). As determined from lithologic logs (GWQ94-13, GWQ94-14, and GWQ94-21), the beds of the Santa Fe Group west of the fault appear to be dragged down with increasing degree of dip toward the fault. Beds of the Santa Fe Group east of the fault appear to be down dropped. The longitude of the fault has been further defined by analysis of logs from GWQ94-21(B) and GWQ13-28.

Monitoring well GWQ13-28 was drilled and completed down-gradient of the existing TSF monitoring network (Fig. 2) during the 4th Quarter 2013. A report on GWQ13-28 is presented in Appendix D. Red clay observed in the upper section of the Santa Fe Group sediments at GWQ94-13, GWQ94-14, GWQ94-17, and GWQ94-21(B) was not found at GWQ13-28, providing evidence that the fault is west of GWQ13-28. The fault mapped by Beaumont (2012) is a barrier boundary to groundwater flow and is supported by hydraulic response in monitoring wells east of the TSF, and results from GWQ13-28. There is a 150-ft drop in water-level elevation from west to east across the north-south trending barrier fault (Fig. 9).

Pumping and specific capacity tests were performed on mine-supply wells MW-4 (Water Development Corporation, 1975), GWQ-1 (Water Development Corporation, 1980), GWQ-7 (W.K. Summers & Associates, 1981), and GWQ-9 (Water Development Corporation, 1980), GWQ94-16 and GWQ94-17 (Adrian Brown Consultants, 1996), and GWQ13-28 (Appendix D, this report). All of these wells are in the vicinity of the tailings facility (Fig. 2). A summary of the hydraulic properties derived from the wells tested in the tailings impoundment area is listed in Table 13.

Table 14. Summary of hydraulic properties estimated from wells in the vicinity of the tailings impoundment

well	pumping rate (gpm)	specific capacity (gpm/ft)	aquifer thickness tested (ft)	transmissivity (ft^2/day)	horizontal hydraulic conductivity (ft/day)
MW-4	60	0.24	1,377	80	0.06
GWQ-1	119	1.57	328	1,540	4.7
GWQ-7	21	2.33	423	440	1.0
GWQ-9	60	0.44	700	1,710	2.4
GWQ94-16	2	0.5	23	87	3.8
GWQ94-17	23	0.19	146	200	1.4
GWQ13-28	2	1.0	45	187	4.2

gpm - gallons per minute gpm/ft - gallons per minute per foot of drawdown

Adrian Brown Consultants (1994) performed a 76-hour constant-rate pumping test on GWQ94-17 located below the tailings impoundment (Fig. 2). Neighboring monitoring wells were used as observation wells during the pumping test. The pumping well, GWQ94-17, was pumped at a rate of 23 gpm. The water levels in the pumping and observation wells never fully recovered to the pre-pumping level, indicating boundary effects from dewatering the groundwater mound observed beneath the tailings dam. Furthermore, the pumping test data confirmed the clay zones observed in the upper Santa Fe Group sediments (see Figs. 9 and 10) act as vertical barriers to groundwater flow.

There are no pumping test data from monitoring wells completed in the alluvium below the TSF dam. GWQ94-16 is the only monitoring well reportedly completed in alluvium and containing groundwater during the Stage 1 2013 sampling. Specific capacity was determined from water-level measurements during pumping for sample collection (Table 14).

3.3 Water-Level Elevation

Four quarters of water-level data were collected as part of the Stage 1 investigation. In addition, historical water-level data were compiled, combined with Stage 1 data, and used to make the hydrographs presented in Appendix E. The 4th Quarter water-level data were used to develop a groundwater-elevation contour map (Fig. 11). The groundwater-elevation contours are also based on regional contouring presented in the Baseline Data Report (INTERA, 2012).

No significant changes in water levels were observed, except between the 3rd and 4th Quarters at a few selected wells. A summary of depth to water data collected during 2013 is presented as Table 15. The second week of September 2013 had record precipitation, in which water-level rises were observed at wells affects by storm-water infiltration (GWQ11-26, GWQ96-22(A,B), GWQ11-24(A,B), GWQ11-25(A,B), and GWQ-3). The alluvial aquifer at GWQ11-26 experienced a significant water-level rise resulting from infiltration of ponded storm water during September 2013. The excessive water-level rises observed at GWQ11-25(A,B) are indicative of storm-water recharge to a fracture system with limited storage capacity. During 4th Quarter sampling, Grayback Arroyo had residual flow at GWQ-3, and the water-level elevation was near equal to the arroyo channel.

3.3.1 Pit Capture Zone

Groundwater-elevation data from wells in the pit area show the pit is a hydraulic sink. The pit capture zone encompasses the pit excavation area, including wells GWQ11-24 and GWQ11-25. A hydrograph for the pit is presented in Appendix E as Figure E1. The pit hydrograph consists of water levels collected from historical documents, Baseline Data Report, and Stage 1 Abatement; all data points were referenced to NMCC 2011 land surface survey. The pit filled to its maximum height in the late 1980s as a result of the corresponding period of elevated precipitation and storm-water runoff. Between 1990 and 2010, the pit level dropped 14 ft, and in the last 2 years prior to September 2013 the pit level has dropped 5.8 ft. The pit water surface rose 2.4 ft during the September 2013 precipitation event; however down-gradient monitoring point GWQ96-22 (A) remained 10 ft higher in elevation than the pit water surface even though water levels at GWQ96-22 (A) remained unchanged (Table 15; Fig. E2). Monitoring wells in the pit area have maintained water levels higher in elevation than the pit water-level elevation (Figs. 11 and E2), demonstrating the pit is a hydraulic sink.

Table 15. Summary of 2013 Stage 1 Copper Flat water-level data

well name	facility area	geologic unit	measuring-point elevation (ft amsl)	1st QTR (Jan 2013) depth to water (ft bmp)	1st QTR (Jan 2013) water-level elevation (ft amsl)	2nd QTR (Apr 2013) depth to water (ft bmp)	2nd QTR (Apr 2013) water-level elevation (ft amsl)	3rd QTR (Jul 2013) depth to water (ft bmp)	3rd QTR (Jul 2013) water-level elevation (ft amsl)	4th QTR (Oct 2013) depth to water (ft bmp)	4th QTR (Oct 2013) water-level elevation (ft amsl)	4th QTR - 3rd QTR (ft)
GWQ96-22A	pit	andesite	5,596.17	54.31	5,541.86	55.45	5,540.72	56.48	5,539.69	46.51	5,549.66	10.0
GWQ96-22B	pit	andesite	5,595.95	53.96	5,541.99	55.28	5,540.67	56.24	5,539.71	46.32	5,549.63	9.9
GWQ96-23A	pit	quartz monzonite	5,489.84	41.14	5,448.70	41.09	5,448.75	41.52	5,448.32	41.64	5,448.20	-0.1
GWQ96-23B	pit	quartz monzonite	5,489.70	41.16	5,448.54	41.37	5,448.33	41.63	5,448.07	41.82	5,447.88	-0.2
GWQ11-24A	pit	quartz monzonite	5,517.37	57.62	5,459.75	58.44	5,458.93	60.04	5,457.33	54.73	5,462.64	5.3
GWQ11-24B	pit	quartz monzonite	5,517.26	61.30	5,455.96	61.44	5,455.82	61.96	5,455.30	57.14	5,460.12	4.8
GWQ11-25A	pit	quartz monzonite	5,533.60	70.00	5,463.60	73.25	5,460.35	75.85	5,457.75	19.00	5,514.60	56.9
GWQ11-25B	pit	quartz monzonite	5,533.41	72.06	5,461.35	73.66	5,459.75	75.34	5,458.07	41.31	5,492.10	34.0
GWQ11-26	pit	alluvium	5,539.75	41.30	5,498.45	41.42	5,498.33	41.58	5,498.17	25.55	5,514.20	16.0
open pit	pit	quartz monzonite	5,430.00	-		-8.6	5,438.60	-6.92	5,436.92	-9.35	5,439.35	2.4
GWQ-1	WR/MS	Santa Fe Group	5,195.59	7.26	5,188.33	7.46	5,188.13	7.80	5,187.79	7.50	5,188.09	0.3
GWQ-3	WR/MS	alluvium/andesite	5,252.60	no access		24.55	5,228.05	28.20	5,224.40	12.60	5,240.00	15.6
GWQ-5R	WR/MS	andesite	5,412.80	47.78	5,365.02	48.25	5,364.55	48.54	5,364.26	48.55	5,364.25	0.0
GWQ-8	WR/MS	Santa Fe Group	5,216.94	27.35	5,189.59	27.53	5,189.41	28.05	5,188.89	27.78	5,189.16	0.3
GWQ-11	TSF	alluvium/Santa Fe Group	5,196.44	-	-	21.38	5,175.06	21.82	5,174.62	21.18	5,175.26	0.6
GWQ-12	TSF	Santa Fe Group	5,237.28	-	-	82.75	5,154.53	82.55	5,154.73	82.9	5,154.38	-0.3
GWQ94-13	TSF	Santa Fe Group	5,200.47	15.90	5,184.57	16.22	5,184.25	16.53	5,183.94	16.64	5,183.83	-0.1
GWQ94-14	TSF	Santa Fe Group	5,192.69	9.20	5,183.49	9.6	5,183.09	9.95	5,182.74	10.00	5,182.69	-0.1
GWQ94-16	TSF	alluvium	5,197.41	22.57	5,174.84	22.62	5,174.79	22.98	5,174.43	22.40	5,175.01	0.6
GWQ94-18	TSF	alluvium	5,194.83	dry	-	dry	-	dry	-	dry	-	-
GWQ94-19	TSF	alluvium	5,203.36	dry	-	dry	-	dry	-	dry	-	-
GWQ13-28	TSF	Santa Fe Group	5,178.16	-	-	-	-	-	-	156.20	5,021.96	-
IW-1	TSF	alluvium	5,198.99	dry	-	dry	-	46.5	5,152.49	dry	-	-
IW-2	TSF	alluvium	5,208.01	42.20	5,165.81	dry	-	dry	-	dry	-	-
IW-3	TSF	alluvium	5,213.17	dry	-	dry	-	dry	-	dry	-	-
NP-2	TSF	Santa Fe Group	5,192.54	-	-	35.55	5,156.99	35.96	5,156.58	36.31	5,156.23	-0.4
NP-3	TSF	Santa Fe Group	5,199.73	14.80	5,184.93	15.25	5,184.48	15.43	5,184.30	15.32	5,184.41	0.1
MW-4	TSF	Santa Fe Group	5,146.12	-	-	82.2	5,063.92	93.11	5,053.01	100.28	5,045.84	-7.2

WR/MS - waste rock/mill site
TSF - tailings storage facility

ft amsl - feet above mean sea level
ft bmp - feet below measuring point

3.3.2 Waste Rock/Mill Site Area

In the vicinity of GWQ-5R, the groundwater elevation in the andesite is slightly higher than the bottom elevation of the alluvium in Grayback Arroyo, and the alluvium is gaining groundwater from the andesite (Figs. 8 and 11). Groundwater inflow from the andesite to the alluvium is not enough to create streamflow in Grayback Arroyo down-gradient of SWQ-2. Between SWQ-2 and GWQ-3, storm-water flow in Grayback Arroyo will typically continue for days after a significant precipitation. The source of surface-water flow days after a precipitation event is believed to be from storm water that has infiltrated alluvial cover, flowed as perched groundwater at the alluvium-andesite contact, and discharged to Grayback Arroyo. Therefore, the potential discharges from the waste rock/mill site area will report to Grayback Arroyo.

After the September precipitation event the water-level rose over 15 ft in GWQ-3, but no significant water-level rises were observed in down-gradient wells GWQ-1 and GWQ-8 (Table 15) due to the capacity of the alluvium and Santa Fe Group to transmit infiltrated storm water.

The hydraulic gradient flattens down-gradient of GWQ-3 where the alluvium recharges the underlying Santa Fe Group sediments. The direction of groundwater flow is west to east, but preferentially along Grayback Arroyo where the alluvium acts as a hydraulic drain (Fig. 11). Down-gradient of GWQ-1 the hydraulic gradient steepens as a result of the barrier boundary effect of the East Animas Fault Trend mapped by Beaumont (2012). Based on the revised conceptual model for the area down-gradient of the waste rock pile, discharges from the mill site area would report to Grayback Arroyo.

3.3.3 Tailings Storage Facility (TSF)

In the TSF vicinity, regional groundwater flow is also from west to east (Fig. 11). In the Santa Fe Group sediments groundwater flow and changes in the hydraulic gradient are controlled by recharge to the high permeability beds, confinement by the overlying low permeability red clay unit, and the East Animas Fault Trend barrier boundary (Figs. 9 and 11). Discharges to the TSF during Quintana operations caused hydraulic loading of the eastward dipping high-permeability beds of the Santa Fe Group sediments. Wells at the lowest land-surface elevation that tapped by these beds (GWQ-1, McCravey-Grayback) began to flow soon after operations began, and ceased to flow around the mid-1990s (Quintana files; Newcomer and Finch, 1993).

Below the TSF, there are several monitoring wells (GWQ94-18, GWQ94-19, IW-1, IW-2, and IW-3) completed in the alluvial channel running east to west through the TSF. All of these wells have been dry during the 2013 Stage 1 sampling events (Tables 3 through 6). This alluvial channel is also referred to as Hunkidori Gulch (Fig. 11). During 2013 NMCC contracted Golder Associates to perform a geotechnical investigation down-gradient of the TSF dam. JSAI was instructed to check each boring for the presence of groundwater before the boring was plugged and abandoned. Over 28 geotechnical holes were drilled through the alluvium, four of the deeper holes were checked by JSAI and confirmed dry, and the remaining holes were reported dry by Golder Associates. Borings ranged from 15 to 52 ft in depth. Boring logs and results are presented in Appendix D.

Hydrographs for TSF monitoring wells are presented as Figure E10 through E18 in Appendix E. TSF monitoring wells screened across the hydraulically loaded high-permeability beds of the Santa Fe Group sediments include GWQ94-13, GWQ94-14, GWQ94-17, and GWQ94-21(A, B); hydrographs are only available for GWQ94-13 (Fig. E12) and GWQ94-14 (Fig. E13). In general, deeper wells have higher head than the shallower wells. Water levels below the TSF dam have declined over the last several years.

3.4 Horizontal and Vertical Extent of Contaminants

The proposed monitoring wells for the Stage 1 Abatement plan investigation were selected based on the known horizontal and vertical extent of contaminants at the Copper Flat Mine defined by NMCC Copper Flat Baseline data (JSAI, 2011). Four quarters of data were collected during 2013 from the proposed monitoring network; in addition, several monitoring points were added below the TSF and GWQ13-28 was drilled, constructed, and sampled. Results from the first two quarters of Stage 1 data were presented and discussed in a status report prepared by JSAI (2013).

Stage 1 2013 surface-water-quality results are summarized in Table 16, and the historical data can be referenced from Appendix C. Surface-water-quality results from pit water, SWQ-1, SWQ-2, and SWQ-3 are compared to New Mexico Water Quality Control Commission (NMWQCC) livestock and wildlife standards. SWQ-1 represents surface-water quality up-gradient of the Copper Flat Mine. Pit water is affected by evaporation and AWS from localized sulfide masses in the open pit walls. SWQ-2 and SWQ-3 are potentially affected by discharges from the waste rock/mill site area.

Table 16. Summary of Copper Flat Stage 1 2013 surface-water-quality data

sample ID	date	pH	total dissolved solids (TDS)	total alkalinity	bicarbonate	carbonate	sulfate	chloride	fluoride	calcium	magnesium	sodium	potassium	aluminum	cadmium	cobalt	copper	manganese	selenium	zinc
		standard units	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
NMWQCC standard*		6.6 to 9													0.05	1.0	0.5		0.05	25
pit water	1/9/2013	7.73	11,100	112	112	< 2	6,800	577	18.70	500	958	1,170	44.4	0.08	0.037	0.086	0.059		0.008	0.78
pit water	4/12/2013	7.07	11,700	122	122	<2	6,750	670	22.10	494	929	1,320	49.1	0.11	0.039	0.069	0.058	31.90	0.013	0.86
pit water	7/10/2013	7.36	14,800	111	111	<2	8,690	714	24.60	539	1,120	1,400	60.6	0.21	0.038	0.049	0.047	29.50	**0.059**	0.88
pit water	10/22/2013	7.94	8,740	<20	<20	<2	5,610	340	29.80	455	522	604	23.7	82.60	**0.062**	0.486	**26.50**	28.10	< 0.05	7.36
SWQ-1	7/9/2013	7.20	620	64	64	<2	6	3	<0.50	27	8	5	8.5	17.10	<0.002	0.015	0.036	1.32	< 0.01	0.08
SWQ-2	7/11/2013	7.19	540	34	34	<2	21	<2.5	<0.5	22	7	4	7.1	54.70	<0.002	0.011	0.099	0.83	< 0.01	0.09
SWQ-2	9/20/2013	nm	2,470	150	150	<2	1,300	33	0.9	380	88	180	6.8	<0.02	<0.002	<0.006	0.080	0.04	**0.051**	0.15
SWQ-2	10/21/2013	8.22	3,120	245	245	<2	1,840	30	0.7	510	113	222	5.7	<0.02	<0.002	<0.006	0.035	0.02	0.013	0.02
SWQ-3	7/11/2013	7.55	1,080	45	45	<2	455	16	<0.5	100	26	67	7.6	1.83	<0.002	<0.006	0.084	0.35	0.022	0.03
SWQ-3	9/20/2013	nm	3,030	180	180	<2	1,700	61	1.3	440	110	250	6.2	<0.02	<0.002	<0.006	0.110	0.06	**0.050**	0.14
SWQ-3	10/9/2013	8.26	3,720	241	241	<2	2,020	62	1.0	490	133	283	5.3	<0.02	<0.002	<0.006	0.05	0.02	0.016	<0.01

* livestock and wildlife only; applicable standards are yet to be determined
NMWQCC – New Mexico Water Quality Control Commission
bold above NMWQCC standard

nm not measured
mg/L – milligrams per liter

3.4.1 Pit Area

Monitoring wells GWQ11-26 and GWQ96-22(A, B) represent up-gradient water-quality conditions. Monitoring wells GWQ96-22(A, B) and GWQ96-23(A, B) are completed in the andesite rocks, which exhibit low TDS and sulfate, but relatively high alkalinity. Monitoring wells GWQ11-24 (A, B) and GWQ11-25(A, B) are completed in the ore body within the quartz monzonite (Fig. 4). A summary of pit area groundwater-quality results is presented as Table 17. The four nested piezometers around the open pit characterize the horizontal and vertical extent of potential contaminants; however, it is the ore body mineralization and its contact with oxygenated water that defines the extent of potential contaminants. Within the Copper Flat quartz monzonite ore body at GWQ11-24(B) and GWQ11-25(B), piezometers with near neutral pH exhibit elevated TDS, sulfate, fluoride, and manganese (Table 17). Elevated dissolved constituents at near neutral pH most likely represent background conditions within the sulfide bearing ore body.

Low pH groundwater with high mineral acidity and dissolved metal concentrations at GWQ11-24(A) and GWQ11-25(A), and at the AWS are a result of localized sulfide masses that have been in contact with oxygenated meteoric water. Low pH groundwater from GWQ11-24(A) is suspected to be an artifact of well development; airlifting the screen interval which is in a localized fracture zone containing chalcopyrite and pyrite. This would explain the anomalous elevated concentrations of dissolved copper (Table 17).

Water quality from GWQ11-25(A) is completely different than all other samples from the pit area, but somewhat similar to the pit wall seepage (Table 17). GWQ11-25(A) is completed in a localized zone of sulfide mineralization (see completion diagram in Appendix A), and it is suspected that the source of water supplying GWQ11-25(A) is from localized infiltration of oxygenated meteoric water into vertical sulfide-bearing fractures on the bench that are connected to the shallow piezometer. The 50^+ ft water-level rise after the September precipitation event (see Table 15) is evidence for hydraulic loading of a vertical fracture zone with limited storage. The A piezometer purged dry after one well volume indicating low horizontal hydraulic conductivity and fracture volume, so vertical infiltration appears very plausible.

Table 17. Summary of 2013 pit area groundwater-quality data

sample ID	date	pH	total dissolved solids (TDS)	total alkalinity	bicarbonate	total acidity	sulfate	chloride	fluoride	calcium	magnesium	sodium	potassium	aluminum	cadmium	cobalt	copper	manganese	selenium	zinc
		standard units	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
NMWQCC standard*		6 to 9	1,000				600	250	1.6					5.00	0.01	0.05	1.0	0.2	0.05	10
pit wall seepage	10/23/2013	**2.43**	**18,500**	<20	<20	9,590	**11,300**	20	**75.1**	462	174	99	<50	**789.00**	**0.187**	**2.05**	**95.30**	**30.8**	**<0.20**	**16.30**
GWQ96-22A	1/9/2013	7.85	521	301	301	-	39	61	**3.07**	41	3	147	2.34	0.02	< 0.002	< 0.006	< 0.001	-	< 0.001	< 0.01
GWQ96-22B	1/9/2013	7.52	722	477	477	-	6	101	**3.32**	70	6	193	3.66	0.04	< 0.002	< 0.006	0.003	-	< 0.001	0.05
GWQ96-23A	1/11/2013	8.07	693	627	627	-	6	12	**2.00**	129	38	71	1.37	0.03	< 0.002	< 0.006	0.001	-	< 0.001	< 0.01
GWQ96-23B	1/11/2013	8.03	571	502	502	-	< 5.0	15	**2.05**	77	21	98	1.57	< 0.02	< 0.002	< 0.006	< 0.001	-	< 0.001	0.01
GWQ11-24A	1/8/2013	**4.53**	**4,180**	<20	<20	-	**2,550**	30	**17.40**	464	108	129	6.98	**38.00**	**0.181**	**0.256**	**104.00**	-	0.029	5.72
GWQ11-24A	4/12/2013	**4.48**	**4,320**	<20	<20	-	**2,730**	30	**22.90**	468	110	126	<10	**46.00**	**0.206**	**0.290**	**126.00**	**11.40**	0.035	6.32
GWQ11-24A	7/9/2013	**3.72**	**4,400**	<20	<20	665	**2,720**	30	**24.40**	415	110	121	7.1	**53.90**	**0.199**	**0.302**	**129.00**	**12.60**	**0.057**	8.18
GWQ11-24A	10/22/2013	**4.21**	**4,280**	<20	<20	673	**2,570**	28	**23.70**	540	142	160	<50	**56.60**	**0.256**	**0.439**	**137.00**	**13.70**	<0.050	8.65
GWQ11-24B	1/9/2013	7.07	**2,280**	219	219	-	**1,280**	27	**3.39**	417	76	96	6.23	<0.02	< 0.002	0.011	< 0.001	-	< 0.001	0.05
GWQ11-24B	4/12/2013	6.18	**2,440**	189	189	-	**1,510**	28	**3.99**	469	78	91	5.81	<0.02	< 0.002	0.019	< 0.006	**3.54**	<0.005	0.23
GWQ11-24B	7/9/2013	6.29	**2,350**	181	181	79	**1,360**	28	**4.28**	393	75	91	6.37	0.022	<0.002	0.017	<0.006	**3.30**	0.004	0.22
GWQ11-24B	10/22/2013	6.55	**2,690**	176	176	96	**1,480**	26	**3.57**	490	88	98	6.30	<0.02	<0.002	0.002	<0.006	**3.58**	<0.005	0.23
GWQ11-25A	1/9/2013	**3.98**	**11,300**	<20	<20	-	**7,900**	21	**124.00**	419	149	647	< 100	**414.00**	**0.385**	**1.720**	**12.60**	-	**0.087**	**14.90**
GWQ11-25A	4/12/2013	**3.30**	**23,800**	<20	<20	-	**17,400**	11	**324.00**	556	<500	<500	<500	**1,730.00**	**0.656**	**3.910**	**63.90**	**77.50**	<0.500	**42.10**
GWQ11-25A	7/10/2013	**2.12**	**27,700**	<20	<20	14,800	**17,900**	10	**221.00**	<500	<500	<500	<500	**1,600.00**	**<1.00**	**4.67**	**78.30**	**60.40**	<0.500	**41.40**
GWQ11-25A	10/22/2013	**2.53**	**23,500**	<20	<20	14,100	**15,200**	11	**311.00**	<500	<500	<500	<500	**1,460.00**	**0.399**	**3.12**	**48.60**	**61.90**	<0.500	**30.30**
GWQ11-25B	1/9/2013	6.94	**2,540**	343	343	-	**1,400**	27	**8.03**	493	76	139	3.9	0.34	< 0.002	< 0.006	0.002	-	0.002	0.02
GWQ11-25B	4/12/2013	6.54	**2,530**	339	339	-	**1,470**	27	**8.10**	465	81	128	4.35	0.38	< 0.002	< 0.006	< 0.006	**3.30**	0.002	0.02
GWQ11-25B	7/10/2013	6.25	**2,510**	342	342	76	**1,350**	27	**8.82**	441	68	125	3.77	0.36	<0.002	<0.006	<0.006	**3.00**	0.0053	0.03
GWQ11-25B	10/22/2013	6.74	**2,580**	376	376	105	**1,260**	27	**6.78**	524	76	133	4.15	0.15	<0.002	0.008	<0.006	**3.46**	<0.005	0.03
GWQ11-26	1/8/2013	7.76	654	361	361	-	97	14	< 1.00	96	22	72	1.34	0.03	<0.002	<0.006	0.003	-	0.001	< 0.01
GWQ11-26	4/12/2013	7.05	582	354	354	-	98	16	0.39	93	23	68	1.73	<0.02	<0.002	<0.006	<0.006	0.02	0.002	< 0.01
GWQ11-26	7/9/2013	6.94	317	361	361	12	98	16	0.47	97	21	72	1.69	0.15	<0.002	<0.006	<0.006	0.04	0.003	0.01
GWQ11-26	10/22/2013	7.45	905	330	330	10	179	32	0.39	121	27	86	1.46	0.13	<0.002	<0.006	<0.006	0.02	0.006	<0.01

* may not apply to pit and pit capture area
** conformation sample
bold above NMWQCC standard

NMWQCC – New Mexico Water Quality Control Commission
mg/L – milligrams per liter

Poor quality groundwater observed in GWQ11-24(A) and GWQ11-25(A) is localized to the area around the wells or shallow fracture, and not indicative of a plume of acidic groundwater. All other pit area monitoring points yield neutral pH groundwater with healthy concentrations of alkalinity.

As discussed in the Stage 1 Abatement Plan amendment (JSAI, 2011), the pit chemistry has been influenced by the effects of evapo-concentration. Salts are precipitating along the edge of the pit water surface, but, under neutral pH conditions, concentrations of sulfate continue to increase along with chloride, sodium, and magnesium. Time-series pit water-quality data are presented as Figure 12. The pit water chemistry is obviously not in equilibrium with gypsum, otherwise sulfate concentrations would be maintained at about 1,600 mg/L (Hounslow, 1995). Evapo-concentration is controlling sulfate concentrations, as indicated by the direct correlation of increasing sulfate concentrations with increasing chloride concentrations (Fig. 13). Evapo-concentration has caused only selenium concentrations to slightly exceed NMWQCC standards for stock and wildlife during the 3rd Quarter 2013 (Table 15).

Past AWS events have been the primary source for acidity and dissolved metal in the pit water. The pit water pH has varied as a result of episodes of AWS input and subsequent neutralization (Fig. 14). Unfortunately, there is a data gap between 1998 and 2007; however, there are two events with pH measurements where the pit water turned acidic during 1993 and in 2008, and then rebounded to near neutral pH (Fig. 14). Dissolved copper concentrations in the pit water increased during both events, and then decreased with the subsequent increase in pH (Fig. 15). After AWS events, the pit water acidity and dissolved metal load appears to be neutralized by inflow of alkaline groundwater.

3.4.2 Waste Rock/Mill Site Area

A summary of Stage 1 2013 water-quality data from monitoring wells down-gradient and off-gradient of the waste rock/mill site area can be referenced from Table 18. Monitoring well GWQ-5R represents up-gradient groundwater-quality conditions in the andesite rocks; low TDS and sulfate, but relatively high alkalinity (Table 18). Surface-water and groundwater samples in Grayback Arroyo have neutral pH, alkalinity, and low to non-detectable metal concentrations, but elevated TDS and sulfate concentrations (Fig. 2; Table 18).

Table 18. Summary of Stage 1 2013 groundwater-quality data for monitoring points down-gradient of the waste rock/mill site area

sample location	analysis date	pH	total dissolved solids (TDS)	bicarbonate	sulfate	chloride	calcium	magnesium	sodium	potassium
		standard units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
NMWQCC standard		6 to 9	1,000		600	250				
GWQ-1	1/10/2013	7.87	487	164	152	38	63.2	17.7	65.1	2.11
GWQ-1	4/12/2013	7.33	465	195	120	30	57.0	13.5	60.0	2.00
GWQ-1	7/10/2013	7.49	448	194	120	26	61.2	14.1	61.1	2.20
GWQ-1	10/23/2013	7.88	380	177	72	20	39.2	12.8	63.9	2.08
GWQ-3	4/12/2013	7.50	**3,060**	188	**1,750**	75	477.0	111.0	253.0	3.99
GWQ-3	7/10/2013	7.44	**2,980**	201	**1,690**	69	446.0	96.4	235.0	4.31
GWQ-3	10/23/2013	7.30	**2,410**	237	**1,210**	63	345.0	76.1	199.0	2.85
GWQ-5R	1/10/2013	7.79	504	293	97	17	96.9	22.7	34.0	5.15
GWQ-5R	4/12/2013	7.12	500	285	101	17	87.1	20.3	30.6	4.63
GWQ-5R	7/9/2013	6.89	496	281	97	18	98.9	12.9	31.8	4.76
GWQ-5R	10/23/2013	7.39	518	282	102	18	96.2	22.9	34.0	4.32
GWQ-8	1/10/2013	7.60	**1,200**	213	498	89	202.0	33.8	107.0	2.43
GWQ-8	4/12/2013	7.16	**1,190**	214	447	85	214.0	35.6	113.0	2.73
GWQ-8	7/10/2013	7.11	**1,230**	209	537	84	208.0	32.3	108.0	2.62
GWQ-8	10/23/2013	7.27	**1,250**	201	586	91	195.0	36.0	113.0	2.36

NMWQCC – New Mexico Water Quality Control Commission mg/L – milligrams per liter
bold above NMWQCC standard

Results from GWQ-3 and GWQ-8 provide evidence that a sulfate-TDS plume exists in the alluvium and Santa Fe Group sediments below the waste rock/mill site area along Grayback Arroyo (Table 18). Time-series sulfate concentrations for these three wells and historical data from SWQ-1 through -3 are shown on Figure 16. The 2013 sulfate concentrations in GWQ-3 decreased, but they are still elevated well above the concentrations observed in the early 1980s. Sulfate concentrations from GWQ-8 have been slowly increasing during 2013.

The down-gradient extent of the sulfate-TDS plume appears to occur between GWQ-8 and GWQ-1; however GWQ-1 may not be fully representative of water table conditions. Both GWQ-1 and GWQ-8 were sampled at the top of the screen interval using micro-purging methods. GWQ-8 is plugged at 148 ft, where GWQ-1 screen extends to a depth of 391 ft. It is possible that GWQ-1 has a component of upward flow from confined units in the Santa Fe Group sediments. Nevertheless, results from GWQ-8 appear to define the down-gradient extent of the sulfate and TDS plume in Grayback Arroyo.

The source of the sulfate-TDS plume is likely leachate from the waste rock/mill site area (Fig. 1) that has comingled with storm-water runoff and infiltrated in the alluvium along Grayback Arroyo (Figs. 4, 8, and 16). GWQ-3 sulfate and TDS concentrations would have not increased over time if elevated TDS and sulfate in storm water at SWQ-2 and SWQ-3 were a result of background conditions.

The extent of TDS and sulfate in groundwater below the waste rock/mill site area is limited to Grayback Arroyo (Figs. 18 and 19), particularly where Grayback Arroyo and associated alluvium is underlain by low permeability andesite rock, and gaining groundwater from the andesite rock (prevents downward leakage).

3.4.3 Tailings Storage Facility (TSF)

A summary of 2013 water-quality data for the TSF area monitoring points can be referenced from Table 19. Monitoring well GWQ-5R represents up-gradient groundwater quality conditions in the andesite rocks, and GWQ-12 represents off-gradient groundwater quality conditions in the Santa Fe Group sediments (Fig. 4; Table 19). Groundwater up-gradient and off-gradient of the TSF exhibit low TDS and sulfate, but relatively high alkalinity (Table 19).

Table 19. Summary of Stage 1 2013 groundwater-quality data for monitoring points in the TSF area

sample location	analysis date	pH	total dissolved solids (TDS)	Bicarbonate	sulfate	chloride	calcium	magnesium	sodium	potassium
		standard units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
NMWQCC standard		6 to 9	1,000		600	250				
GWQ-11	4/12/2013	6.73	952	163	359	142	155.0	43.0	68.6	3.34
GWQ-11	7/11/2013	8.20	993	163	350	130	164.0	43.2	65.7	3.43
GWQ-11	10/24/2013	7.44	942	165	323	131	149.0	43.6	71.7	3.09
GWQ-12	4/12/2013	7.19	360	179	47	27	50.0	16.1	26.9	2.66
GWQ-12	7/11/2013	7.24	361	181	47	28	56.5	17.6	27.9	3.29
GWQ-12	10/23/2013	7.62	426	194	38	23	54.0	18.8	31.5	3.58
GWQ94-13	1/10/2013	7.63	**1,460**	126	543	184	246.0	49.9	106.0	3.22
GWQ94-13	4/10/2013	7.16	**1,410**	124	517	177	231.0	44.2	90.7	2.73
GWQ94-13	7/11/2013	7.33	**1,450**	125	**611**	210	246.0	47.4	98.6	3.45
GWQ94-13	10/24/2013	7.38	**1,440**	126	**607**	211	233.0	49.7	107.0	3.02
GWQ94-14	1/11/2013	7.78	583	218	140	44	90.2	24.5	45.8	1.62
GWQ94-14	4/10/2013	7.36	553	213	141	44	94.8	25.8	48.7	1.71
GWQ94-14	7/11/2013	7.12	565	314	138	43	94.2	24.2	45.8	1.64
GWQ94-14	10/22/2013	7.72	592	217	140	44	85.9	24.8	48.0	1.67
GWQ94-16	1/10/2013	7.76	**1,170**	173	407	192	188.0	47.7	75.7	3.33
GWQ94-16	4/12/2013	7.36	**1,070**	171	421	191	281.0	50.7	65.0	4.78
GWQ94-16	7/11/2013	7.28	**1,160**	170	386	177	193.0	46.4	73.4	3.23
GWQ94-16	10/24/2013	7.44	**1,430**	178	598	194	225.0	59.9	110.0	3.42
GWQ13-28	10/23/2013	7.62	629	185	167	52	98.4	17.0	66.6	2.91
NP-2	4/12/2013	7.38	872	167	299	170	147.0	40.7	68.9	4.24
NP-2	7/11/2013	8.79	840	149	292	166	148.0	44.4	74.0	4.03
NP-2	10/23/2013	7.10	**1,270**	153	280	158	208.0	61.4	71.7	6.36
NP-3	1/10/2013	7.24	**1,390**	54.2	557	190	218.0	49.5	107.0	3.23
NP-3	4/12/2013	6.95	**1,340**	71.4	561	191	219.0	47.5	97.9	3.41
NP-3	7/11/2013	7.57	**1,560**	124	**686**	239	290.0	60.1	108.0	5.03
NP-3	10/24/2013	7.31	**1,550**	118	**685**	238	252.0	59.4	109.0	4.56
MW-4	4/12/2013	8.29	267	87	92	21	23.2	7.3	48.1	2.27
MW-4	7/11/2013	8.80	469	200	124	20	70.3	15.0	52.2	2.65
MW-4	10/22/2013	7.85	495	202	115	18	64.7	15.9	57.1	2.62

NMWQCC - New Mexico Water Quality Control Commission
bold above NMWQCC standard
mg/L - milligrams per liter

Shallow monitoring wells (IW-1, IW-2, IW-3, GWQ94-16, GWQ94-18, and GWQ94-19) in the alluvium below the TSF Dam had saturated conditions after the Quintana operations and then slowly went dry by 2013 (see Figs. E16 and E17). It is possible that the lack of recharge and potential for evapotranspiration from mesquite shrubs dewatered the alluvial system below the TSF dam. During 2013, boreholes drilled to 50 feet below ground surface in the alluvium down-gradient of the TSF monitoring well network were also dry.

GWQ94-13, GWQ94-16, and NP-3 are the only remaining monitoring wells below the TSF Dam with elevated sulfate and TDS concentrations. TDS concentrations in GWQ94-13 are decreasing over time while TDS concentrations in GWQ94-16 and NP-3 have remained about the same (Fig. 17). Water levels also show declining trends in these wells (Fig. E18). TDS concentrations above the NMWQCC standard of 1,000 mg/L are common in these monitoring points with accompanying sulfate concentration below the NMWQCC standard of 600 mg/L. A charge balance analysis of the 4th Quarter sample from NP-2 suggests the laboratory analysis of TDS (1270 mg/L) is higher than the sum of ions (938 mg/L). All other samples from the TSF area follow the correlation of sulfate equals 0.497(TDS) – 131.6, where 1,000 mg/L TDS contains 365 mg/L sulfate concentration (36.5 percent). Typically groundwater impacted from sulfide-ore mine discharges contains sulfate concentrations equal to 60 percent of the TDS content (JSAI, 2014). The horizontal extent of TDS and sulfate concentrations above the NMWQCC standards are presented on Figures 18 and 19. Vertical extent is shown on Figures 9 and 10.

3.5 Surface-Water and Groundwater Interactions

Surface-water and groundwater interactions are limited to two areas 1) open pit, and 2) Grayback Arroyo, as discussed in previous sections. Both areas depend on precipitation events large enough to create significant storm-water runoff, which occur infrequently and at times several years apart. The length in which runoff occurs downstream in Grayback Arroyo is controlled by the magnitude of the event. Additional data down-gradient of GWQ-8 are needed to understand the potential surface-water and groundwater interactions, and extent of the sulfate plume in shallow groundwater.

4.0 CONCEPTUAL SITE MODELS

4.1 Pit Area

The additional Stage 1 water-level data from wells in the pit area demonstrate the pit is a hydraulic sink, and the capture zone includes the mineralized quartz monzonite rocks. The pit chemistry maintains neutral pH during drought conditions, and significant precipitation of sulfate salts have been occurring around the water-surface perimeter.

Pit water balance during the last 2 years has been dominated by evaporation. Evaporation exceeds groundwater inflow for pit level to drop. With no significant precipitation events and surface-water-runoff inflow, the evaporation rate for a 5-acre water surface is significantly greater than groundwater inflow. The pit water balance (Table 13) indicates that groundwater inflow is only 26 percent of the average total inflow.

The nature and extent of contaminants in groundwater and surface water at the Copper Flat open pit are controlled by the ability of storm water to infiltrate and oxidize localized sulfide masses in fractures of the quartz monzonite. The September 2013 precipitation event significantly lowered the pit water TDS and sulfate concentrations (Table 17), and also created AWS on the northwestern pit wall. During the 4th Quarter sampling (October 2013), AWS was seeping into the pit water, and has likely created temporary acidic conditions in the pit. Historical data would suggest the pit water acidity will be neutralized by inflow of alkaline groundwater (Fig. 14).

4.2 Waste Rock/Mill Site Area

Stage 1 data from monitoring points for the waste rock/mill site area have provided a better understanding of water-quality conditions in the down-gradient reach of Grayback Arroyo. Only GWQ-3 exceeded NMWQCC standards for both sulfate and TDS (Table 18). Potential discharges at SWQ-2 and SWQ-3 are characterized by water with elevated TDS and sulfate with high alkalinity (Table 17). The increases in TDS and sulfate at GWQ-3 since the 1980s suggest discharges from the waste rock/mill site created by Quintana operations are impacting Grayback Arroyo.

Meteoric precipitation appears to be infiltrating the waste rock/mill site area, generating leachate elevated in TDS and sulfate, and comingling with storm-water runoff to Grayback Arroyo. Furthermore, based on the delayed surface-water yield from the watershed area upstream of GWQ-3, storm water laden with leachate infiltrates alluvium and drains to Grayback Arroyo. Water in the alluvium does not drain into the underlying andesite rocks because the permeability of the andesite is too low and groundwater in the andesite already inflows to the alluvium at Grayback Arroyo. These mechanisms confine and contain discharges to Grayback Arroyo. The potential rate of groundwater flow in the alluvium along Grayback Arroyo can be estimated using Darcy's Law (Fetter, 1993):

$$Q = KIA$$

$$V_x = Q/[n_e A]$$

where,

Q = average discharge (ft^3/day)

K = horizontal hydraulic conductivity of alluvium (17 ft/day)

I = hydraulic gradient of 0.0273 ft/ft from SWQ-2 to GWQ-8 (Fig. 11)

A = saturated alluvium cross sectional area of 500 ft^2 (10 ft thick * 50 ft wide)

n_e = effective porosity of 0.20 (same as estimated specific yield)

V_x = average linear velocity (ft/day)

Solving for Q (average discharge) results in 232 ft^3/day or 1.2 gpm, and solving for V_x (average linear velocity) resulting in 2.3 ft/day. The hydraulic gradient downstream of GWQ-8 significantly flattens (<0.01 ft/ft) and reduces the average linear groundwater velocity to less than 0.85 ft/day. These calculations would suggest the sulfate-TDS plume has traveled farther east than GWQ-8. Additional monitoring points in Grayback Arroyo east of GWQ-8 would be needed to further define down-gradient hydrogeologic conditions and water quality.

The revised conceptual model and Stage 1 sampling results for the waste rock/mill site area help clarify the source for elevated sulfate and TDS, transport mechanisms, and extent of the sulfate and TDS plume. Figures 18 and 19 are maps showing the distribution of groundwater sulfate and TDS concentrations in Grayback Arroyo. Sulfate and TDS are the only contaminants of concern in Grayback Arroyo down-gradient of the waste rock/mill site area.

4.3 TSF Area

The hydrogeologic setting of the TSF area is highly complicated, but can be easily divided into two systems: 1) shallow alluvial aquifer, and 2) Santa Fe Group sediments aquifer. TSF discharges occurred to the shallow alluvial aquifer during Quintana 1982 operations. The alluvial system is limited to the upper reach of Hunkidori Gulch; located about the center point of the TSF Dam (Fig. 18). Monitoring data from wells in the alluvium have shown that the alluvial aquifer system has drained off and potentially evaporated. Boreholes drilled in 2013 down-gradient of the existing monitoring system were dry.

The Santa Fe Group sediments dip to the east, and were dragged down by the movement along the East Animas Fault. Discharges to the TSF during Quintana operations caused hydraulic loading of the eastward dipping high-permeability beds of the Santa Fe Group sediments up-gradient of the TSF dam. The upper red clay unit on the west side of the fault acts as a hydraulic barrier, and has confined discharges.

Background concentrations of TDS may be elevated above the NMWQCC standard of 1,000 mg/L; therefore sulfate is a better indicator of the extent of contamination beneath the TSF area. Analysis of the 2013 Stage 1 sampling data demonstrates the residual plume from the Quintana operations is limited to the sulfate concentrations slightly above NMWQCC standard of 600 mg/L in the Santa Fe Group Sediments at NP-3 and GWQ94-13 (Figs. 9, 10, 18, and 19).

The hydrogeologic conditions in the TSF area have provided a natural containment for discharges to groundwater. Monitoring points (GWQ13-28, MW-4) east of the fault show no indication of water-quality effects from TSF discharges.

5.0 ABATEMENT OPTIONS

5.1 Open Pit

It is recommended to continue monitoring pH and pit water quality until abatement options are implemented. Temporary mitigation measures may be needed to neutralize acidity and dissolved metal load from AWS or dewater the open pit. Such measures to neutralize acidity include addition of lime or bicarbonate-rich groundwater. The addition of bicarbonate groundwater is the more effective of the two measures, because it dilutes solute load, precipitates metals, and adds long-term buffering capacity. Temporary dewatering can be achieved by installing a forced evaporation system.

The most logical abatement option is to permit the NMCC mining plans, so the pit can be dewatered and mine out. The new open pit would be reclaimed at closure to meet water-quality standards for post closure uses.

5.2 Waste Rock/Mill Site Area

Additional characterization is needed down-gradient of GWQ-3 to better define the lateral and vertical extent of the sulfate and TDS plume in the alluvium and underlying Santa Fe Group Sediments. The proposed monitoring network for the NMCC mining operations would provide the needed data for characterization.

The constituents of concern down-gradient of the waste rock/mill site area are limited to elevated sulfate and TDS concentrations. The most logical abatement options may include source controls and natural attenuation.

Here again, permitting a new mining operation would be the best option for reclaiming the waste rock/mill site area. As part of the new mining operation, the waste rock piles within the proposed mining footprint will be removed and handled appropriately during mining construction and development, and the area would be rebuilt with storm-water management structures for source controls. A new mine permit would also include BLM access needed to install groundwater monitoring and protection measures.

5.3 TSF Area

The nature and extent of contamination in the TSF area have been defined and is limited to a small zone in the Santa Fe Group sediments. NMCC pumping from GWQ-7 and GWQ-9 has caused drawdown and capture of the residual TDS plume below the TSF (JSAI, 2013). These supply wells are located in the Santa Fe Group aquifer below the dam, and directly north and south of the TSF TDS plume. More than 6 ac-ft has been pumped from GWQ-7 and GWQ-9 in the last 24 months, which has resulted in observed drawdown and sulfate plume reduction (JSAI, 2013). Continued use of these supply wells is the preferred abatement option. Building the new lined TSF will remove and abate any potential source from the existing TSF.

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ILLUSTRATIONS

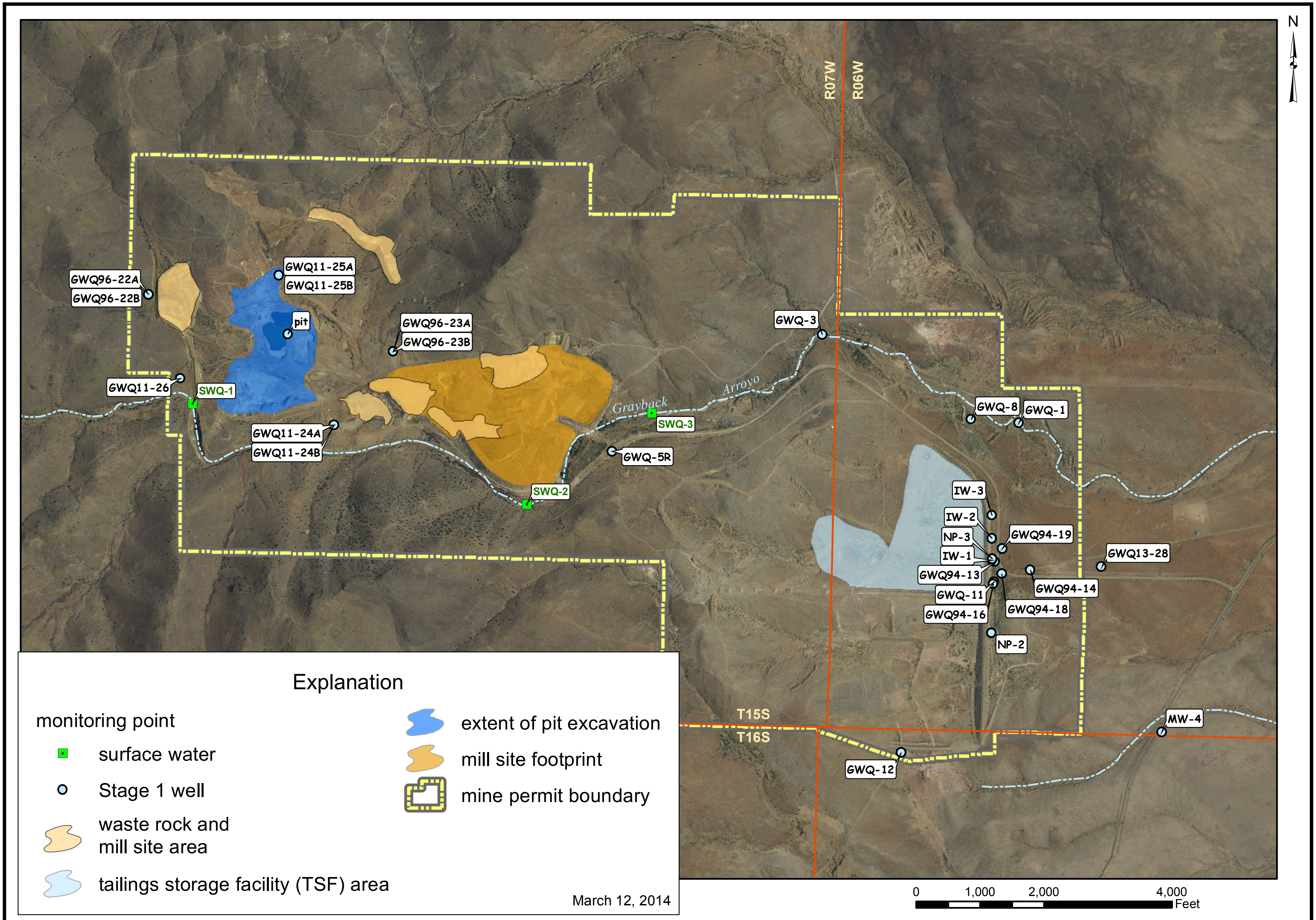

Figure 1. Aerial photograph showing locations of facilities associated with the former Copper Flat Mine operated by Quintana Minerals, Sierra County, New Mexico.

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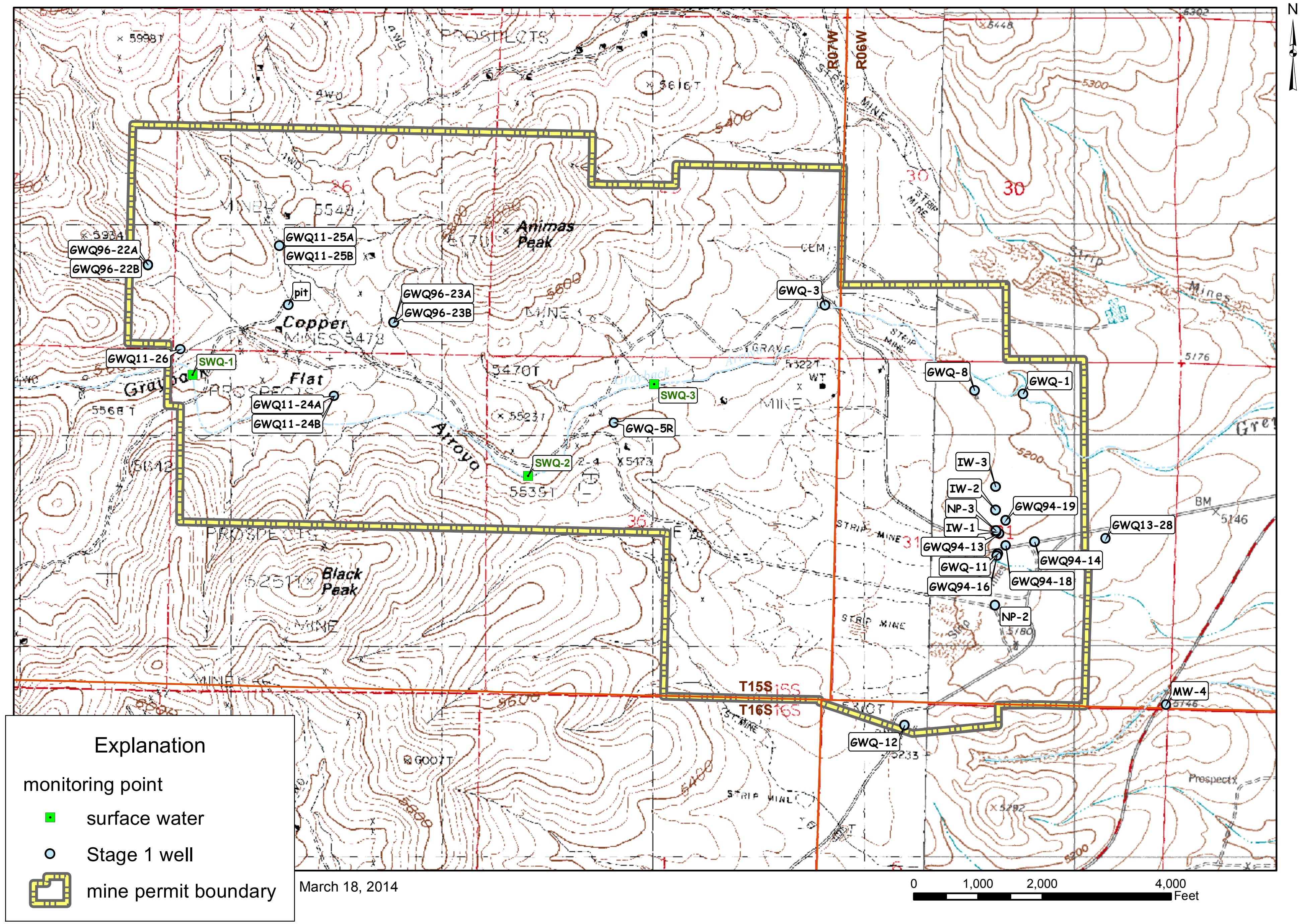

Figure 2. Topographic map showing locations of Stage 1 Abatement Plan monitoring points, Copper Flat Mine, Sierra County, New Mexico.

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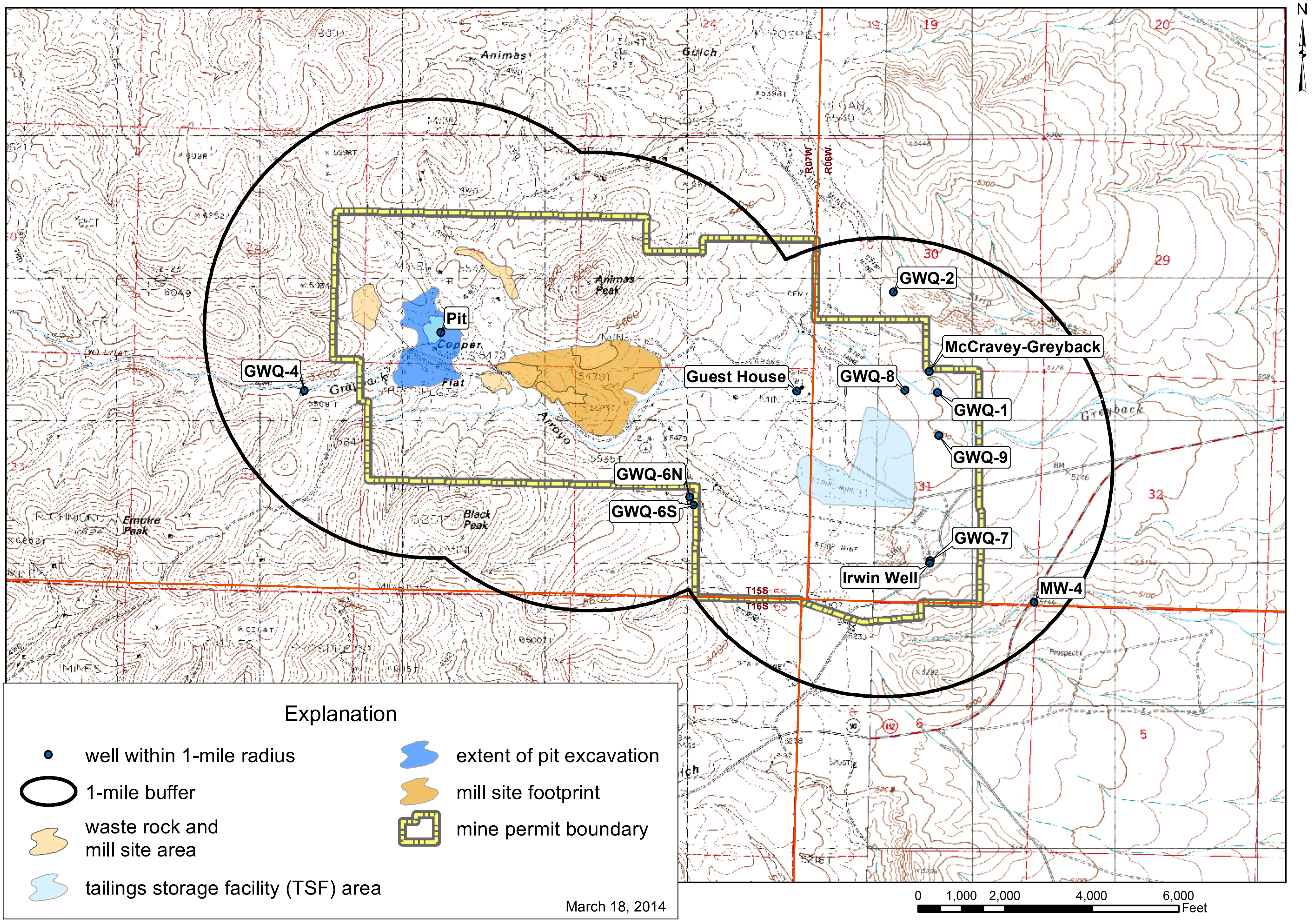
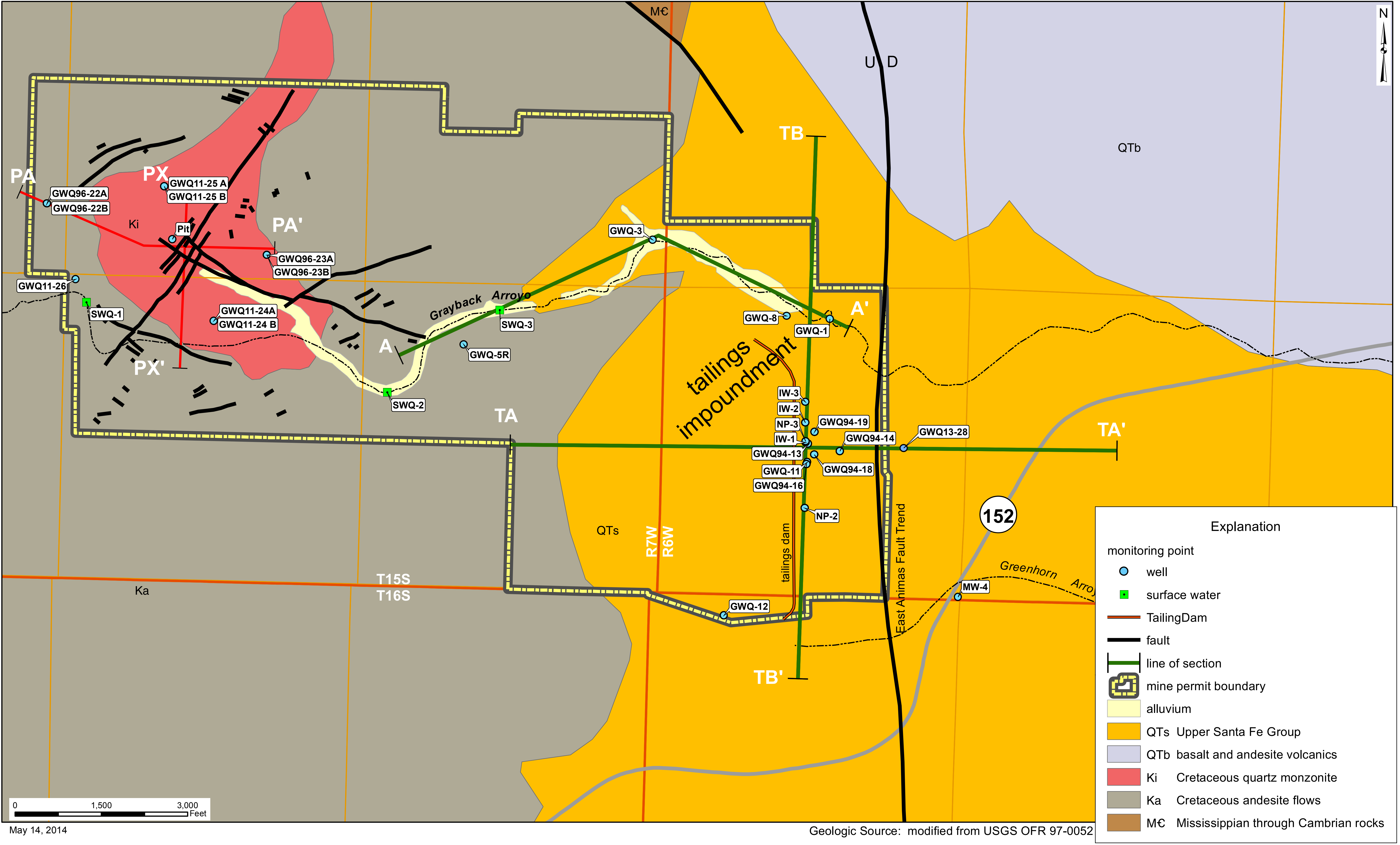


Figure 3. Topographic map showing locations of wells within 1-mile of each facility, Copper Flat Mine, Sierra County, New Mexico.



May 14, 2014

Geologic Source: modified from USGS OFR 97-0052

Figure 4. Geologic map of Stage 1 Abatement Plan area, Copper Flat Mine, Sierra County, New Mexico.

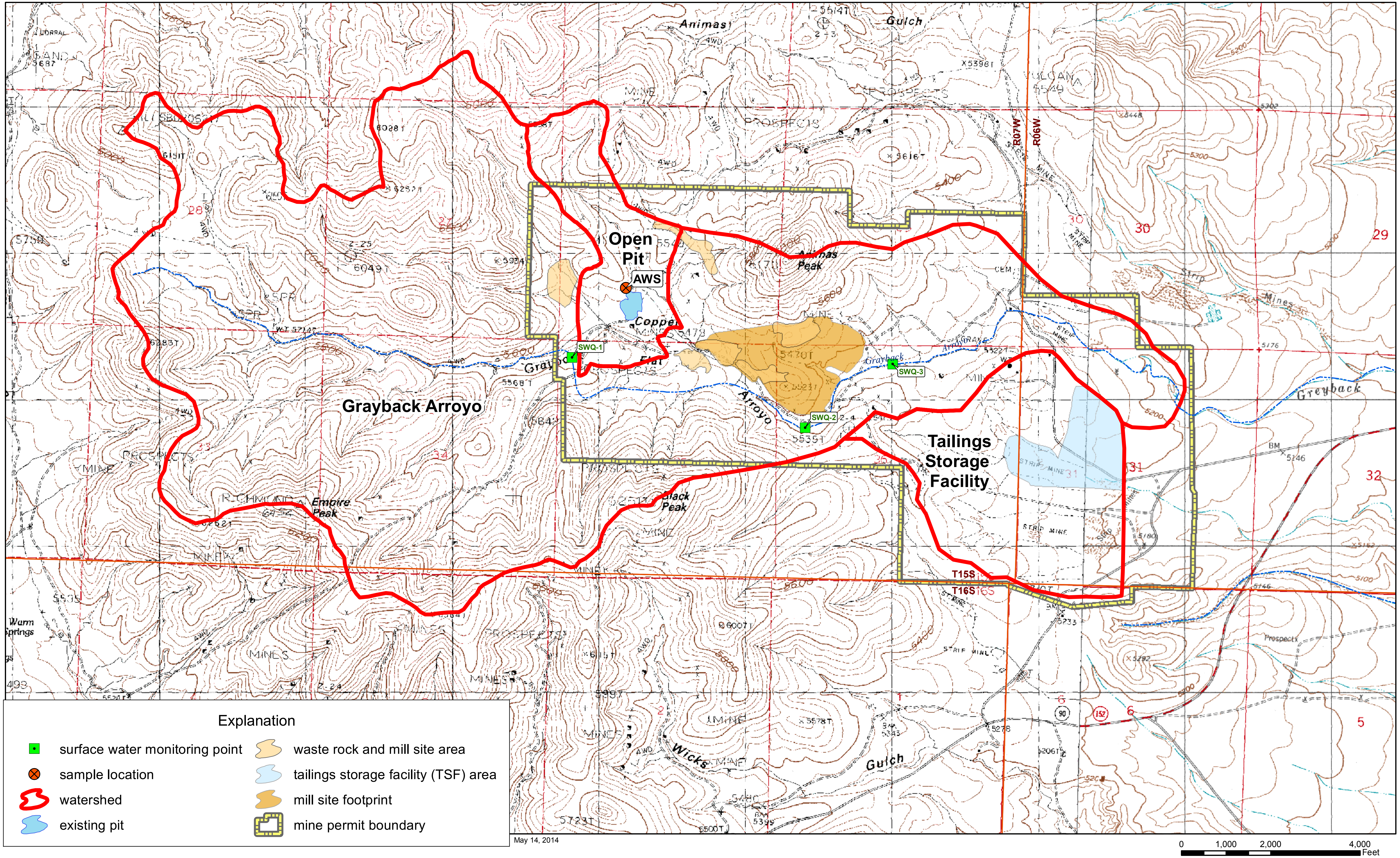


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Figure 5. Topographic map showing watersheds and sampling points, Copper Flat Mine, Sierra County, New Mexico.

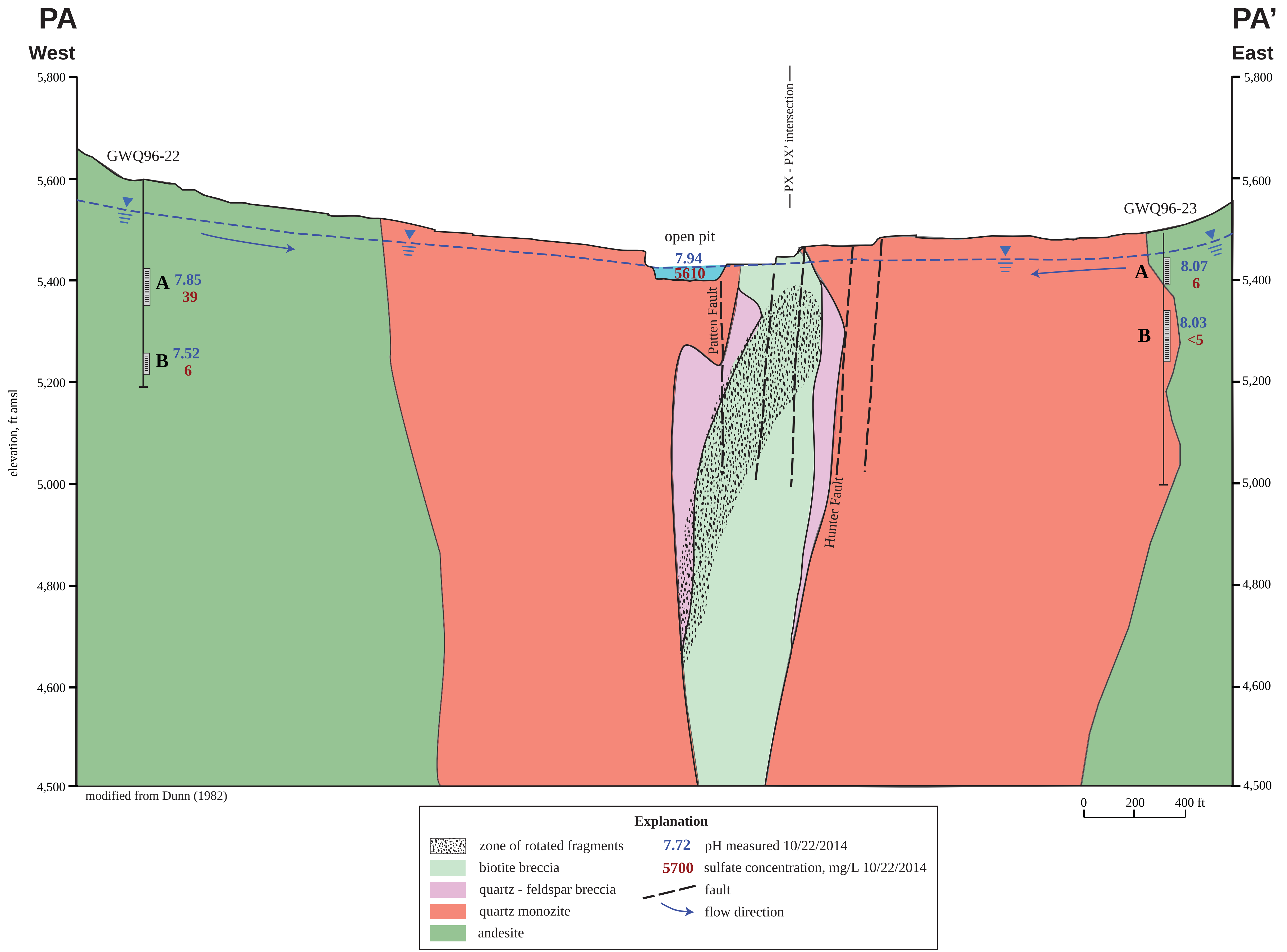

Figure 6. Hydrogeologic cross-section PA-PA’ through open pit area, Copper Flat Mine, Sierra County, New Mexico.

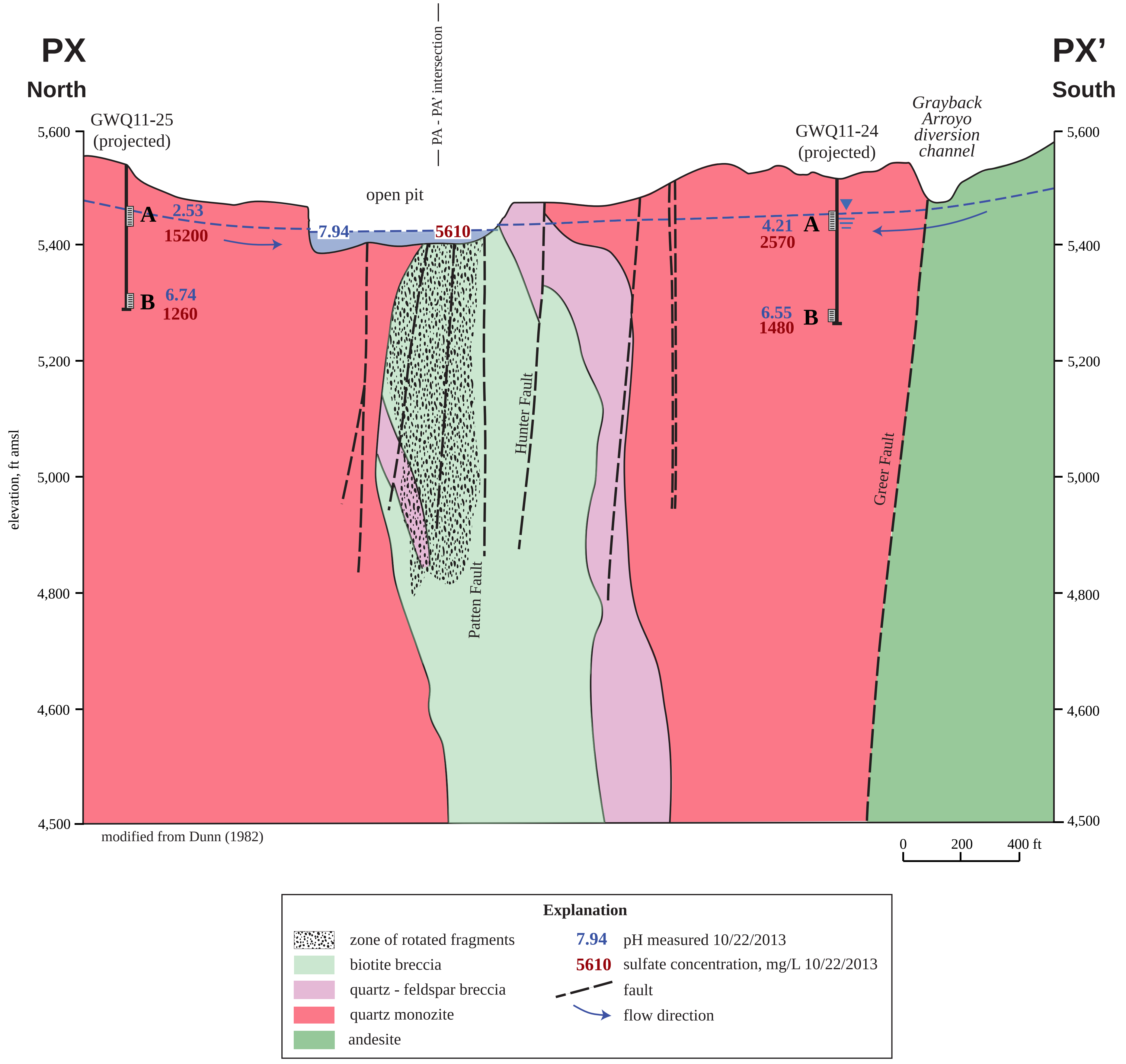

Figure 7. Hydrogeologic cross-section PX-PX' through open pit area, Copper Flat Mine, Sierra County, New Mexico.

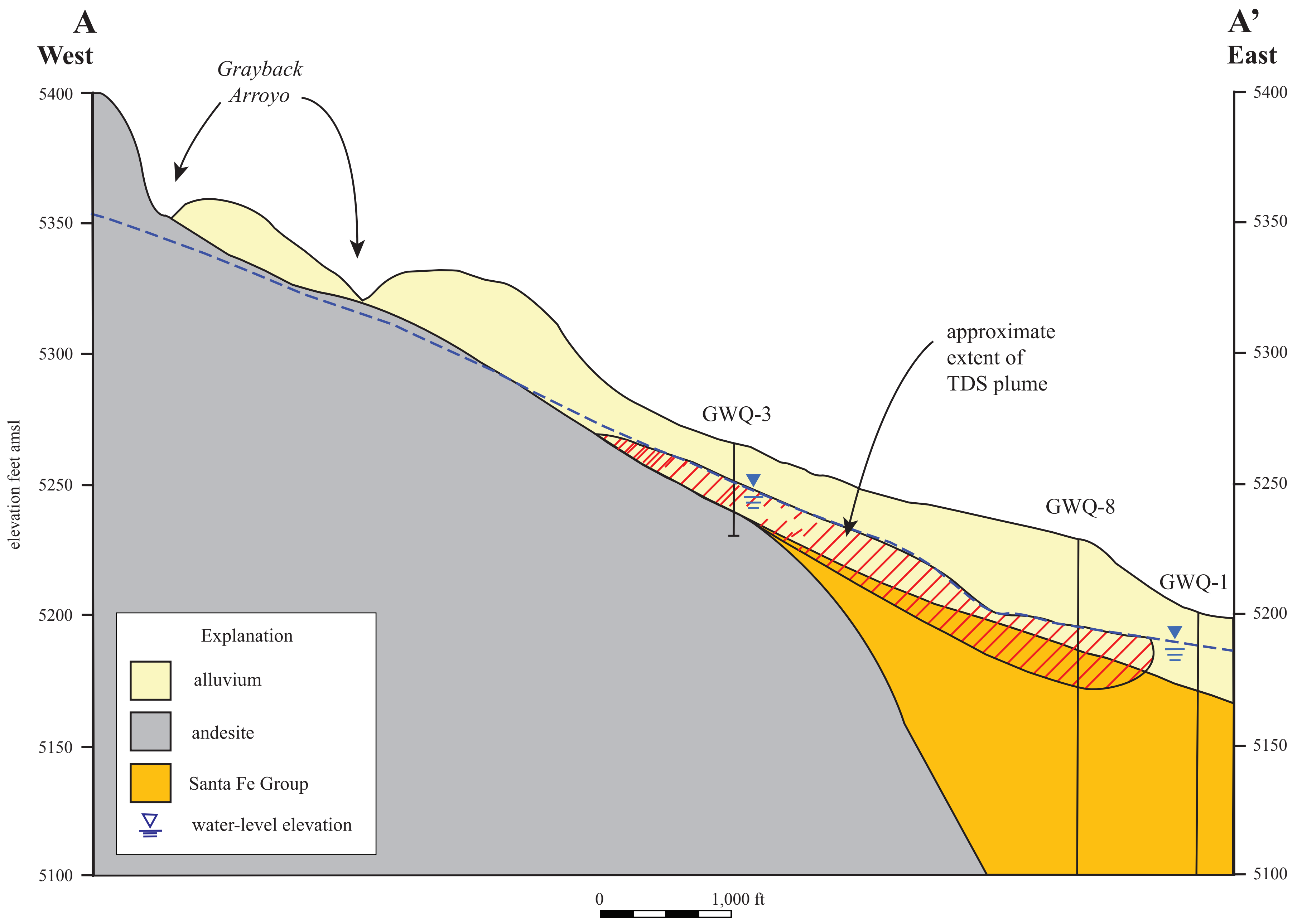

Figure 8. West to east hydrogeologic cross-section through the waste rock/mill site area, Copper Flat Mine, Sierra County, New Mexico.

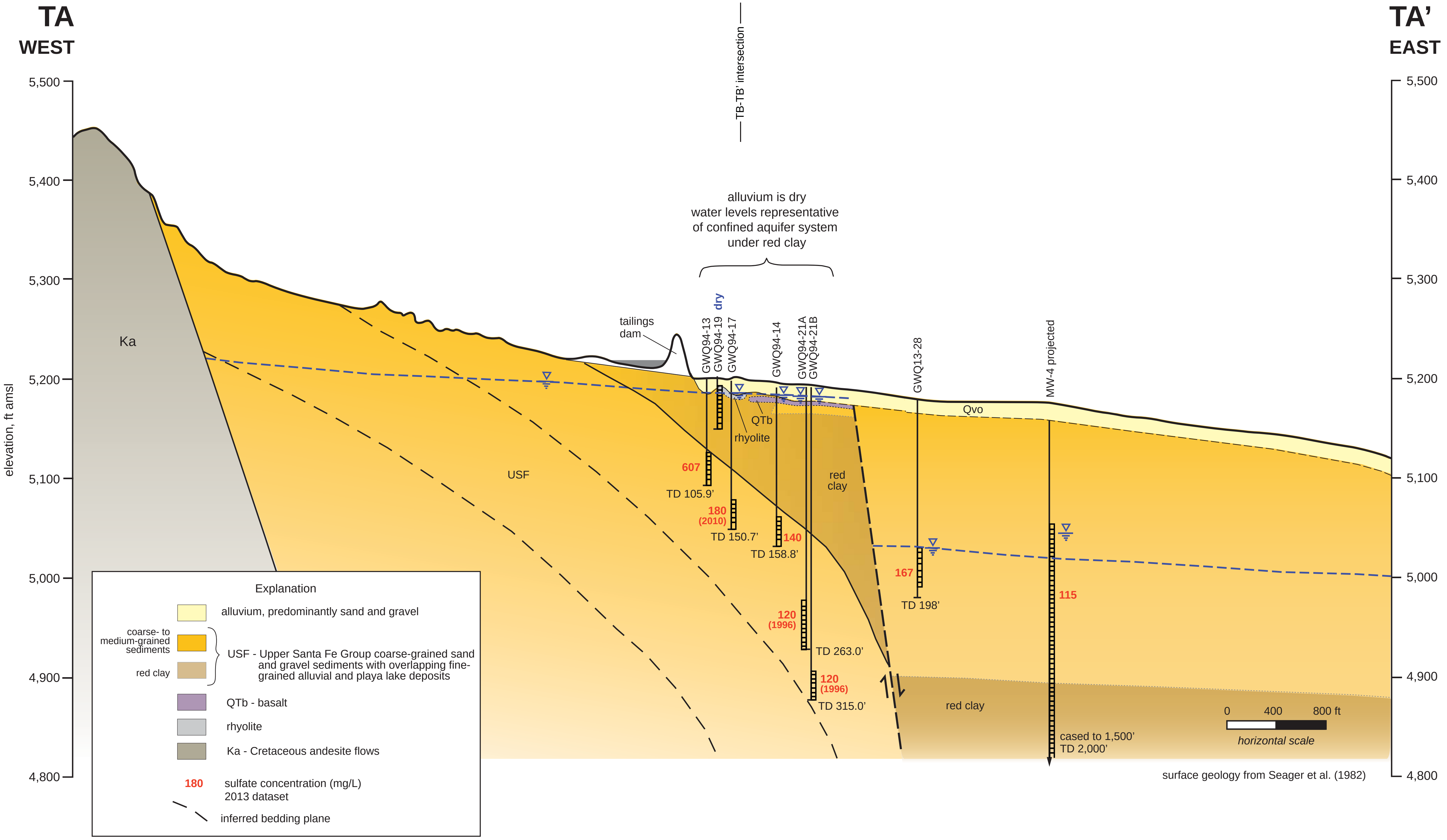

Figure 9. West to east hydrogeologic cross-section TA-TA’ through the tailings storage facility (TSF) area, Copper Flat Mine, Sierra County, New Mexico.

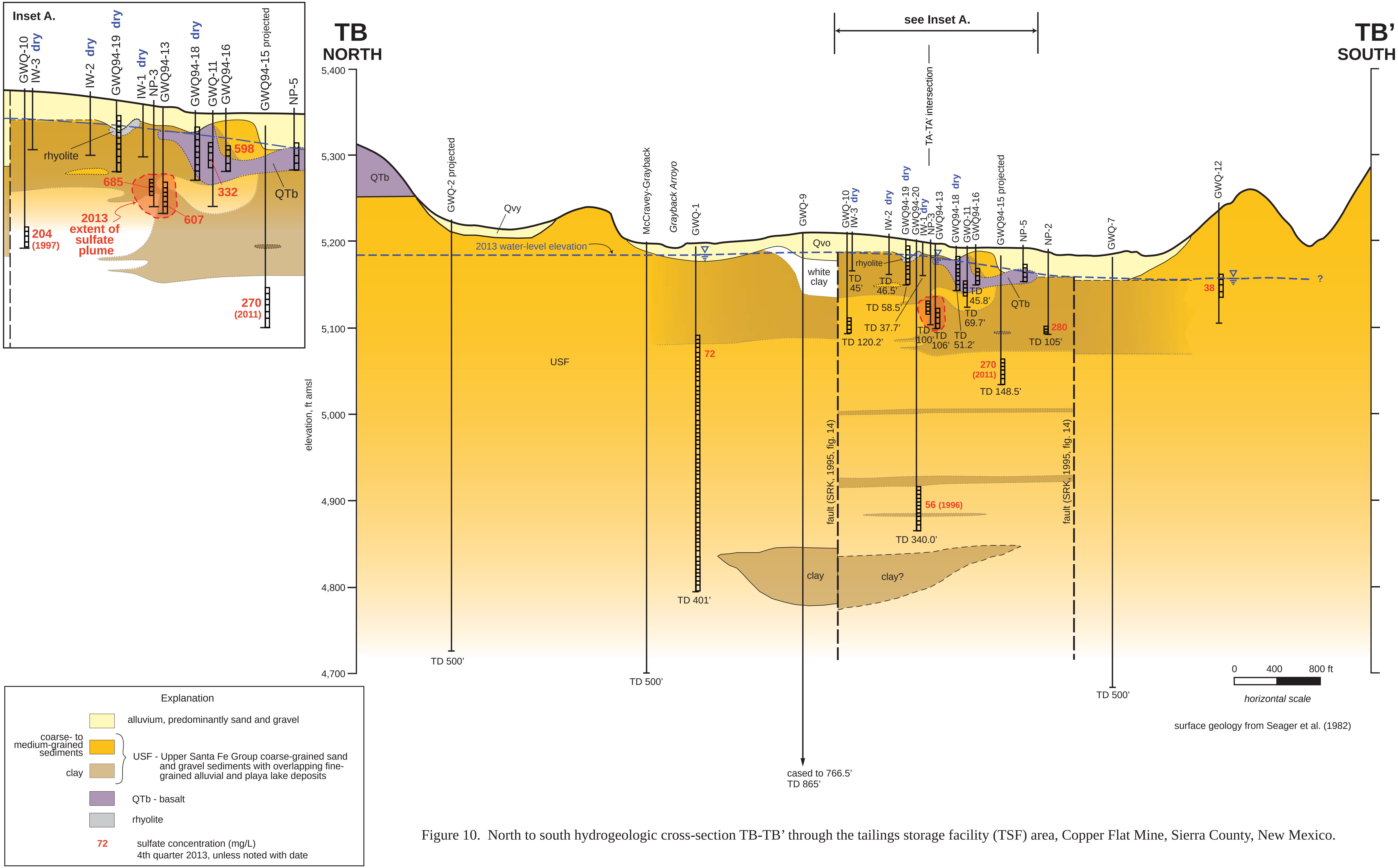

Figure 10. North to south hydrogeologic cross-section TB-TB' through the tailings storage facility (TSF) area, Copper Flat Mine, Sierra County, New Mexico.

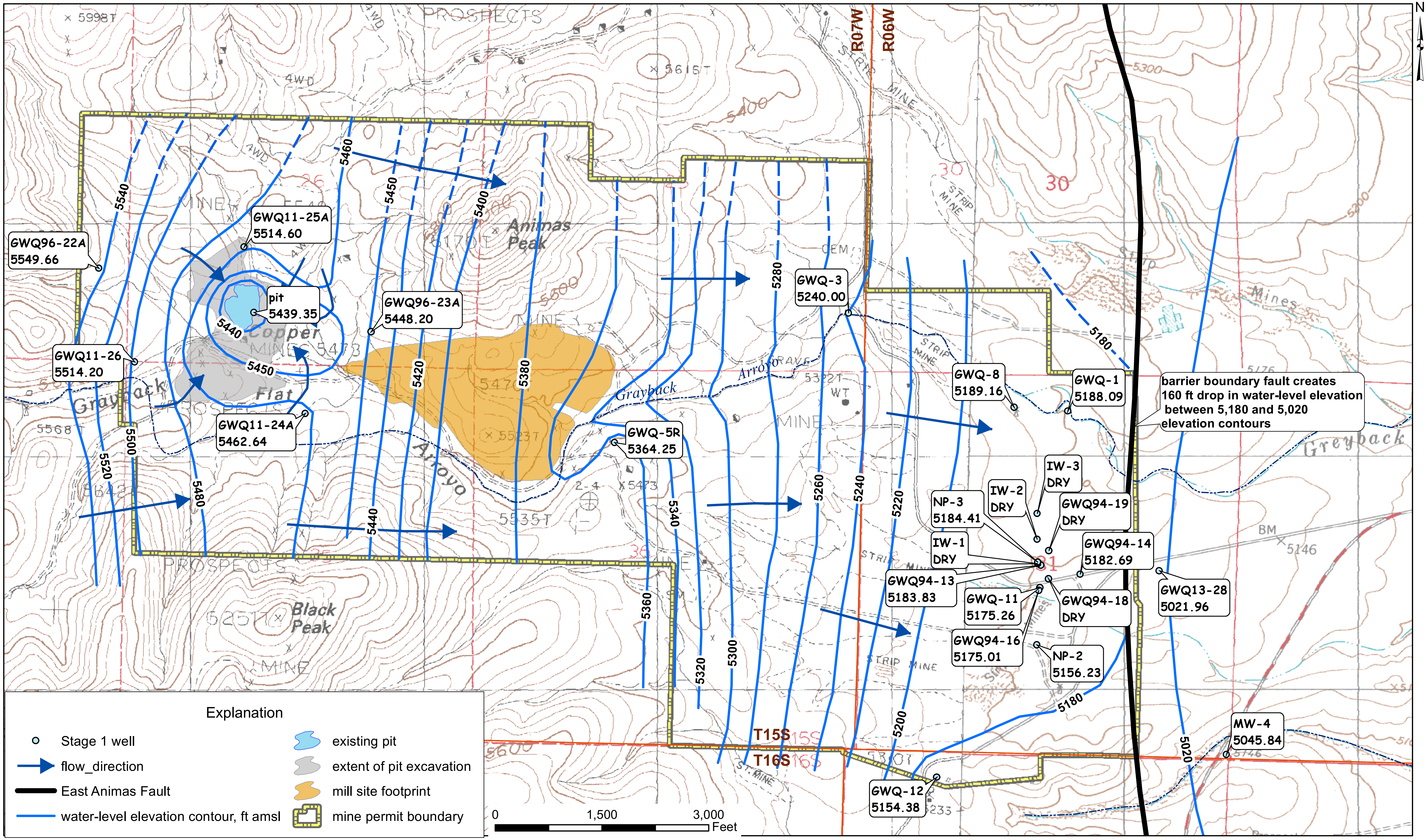

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Figure 11. Water-level elevation contour map for Stage 1 Abatement Plan, 4th Quarter 2013, Copper Flat Mine, Sierra County, New Mexico.

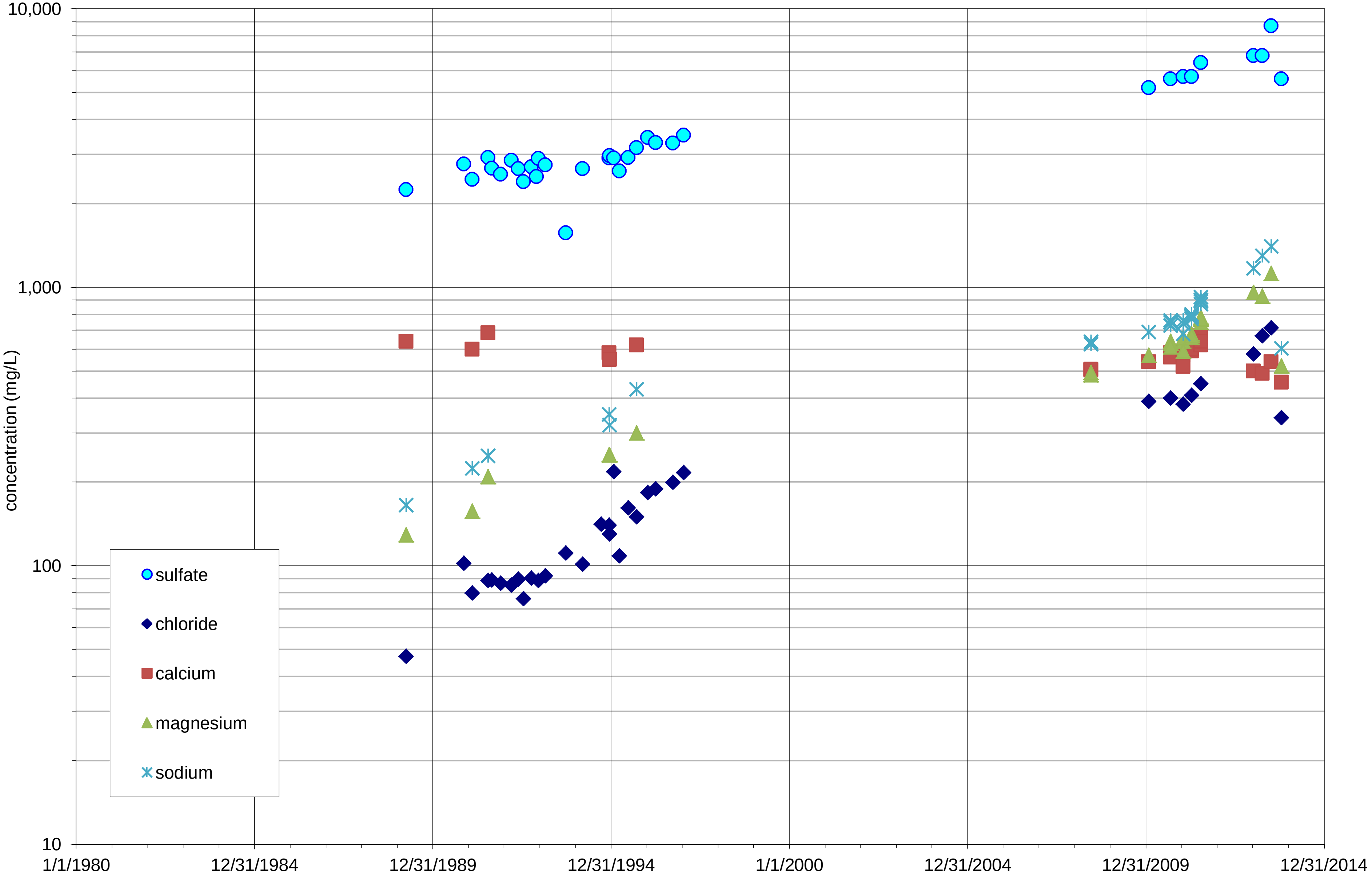


Figure 12. Time-series graph of selected water-quality data for the pit water body, Copper Flat Mine, Sierra County, New Mexico.

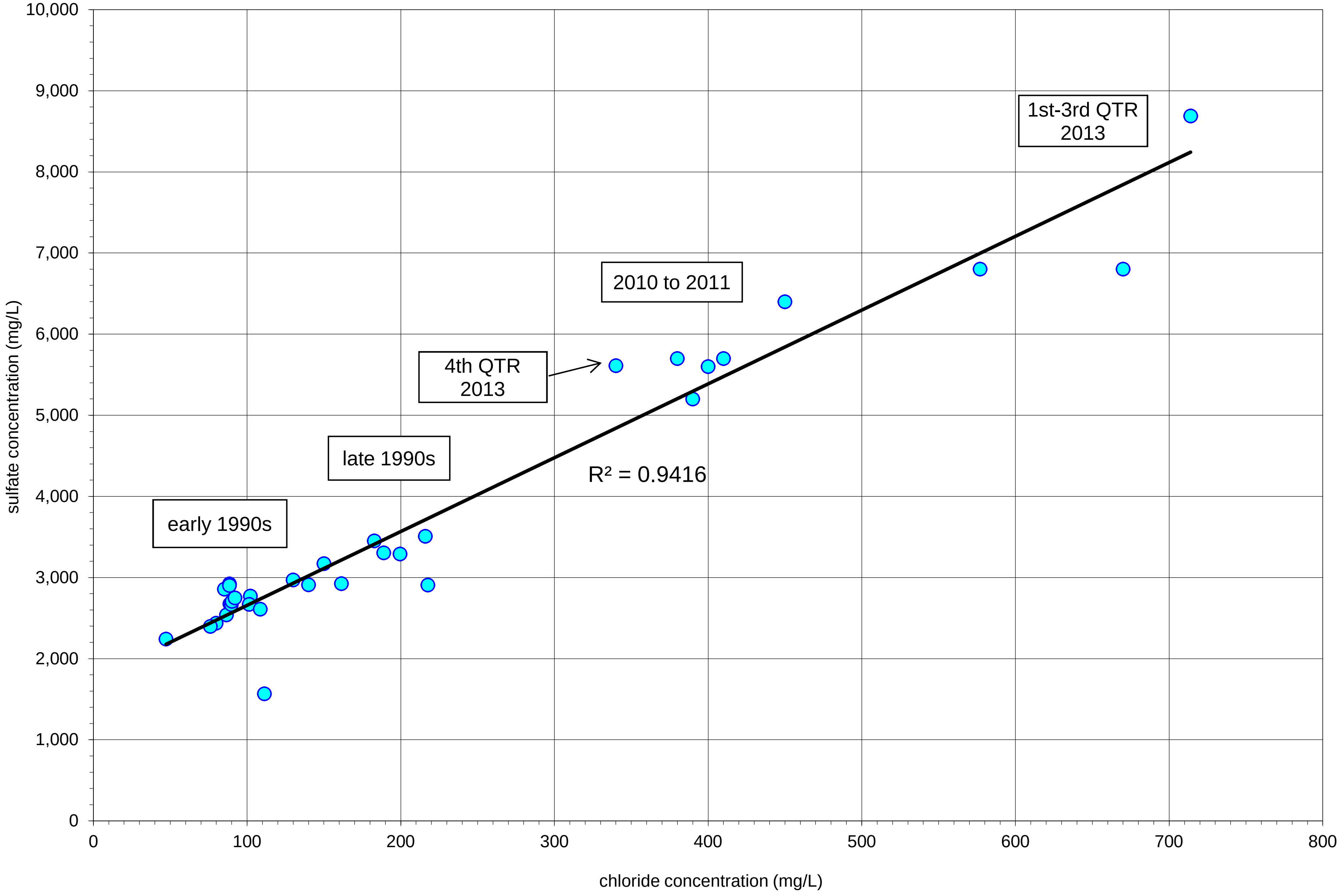


Figure 13. Graph of sulfate versus chloride concentrations for open pit, Copper Flat Mine Sierra County, New Mexico.

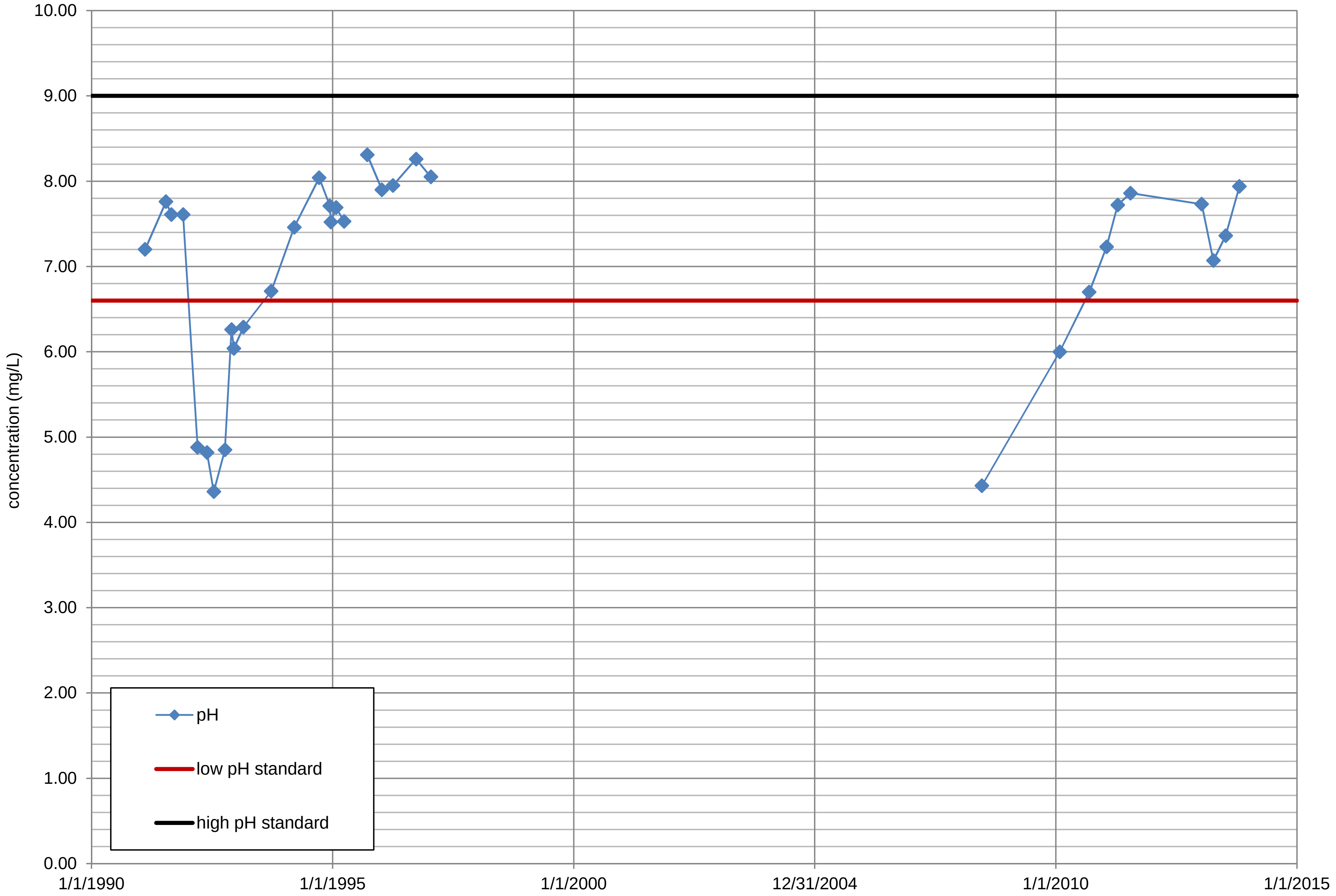


Figure 14. Time-series graph of pH in open pit, Copper Flat Mine, Sierra County, New Mexico.

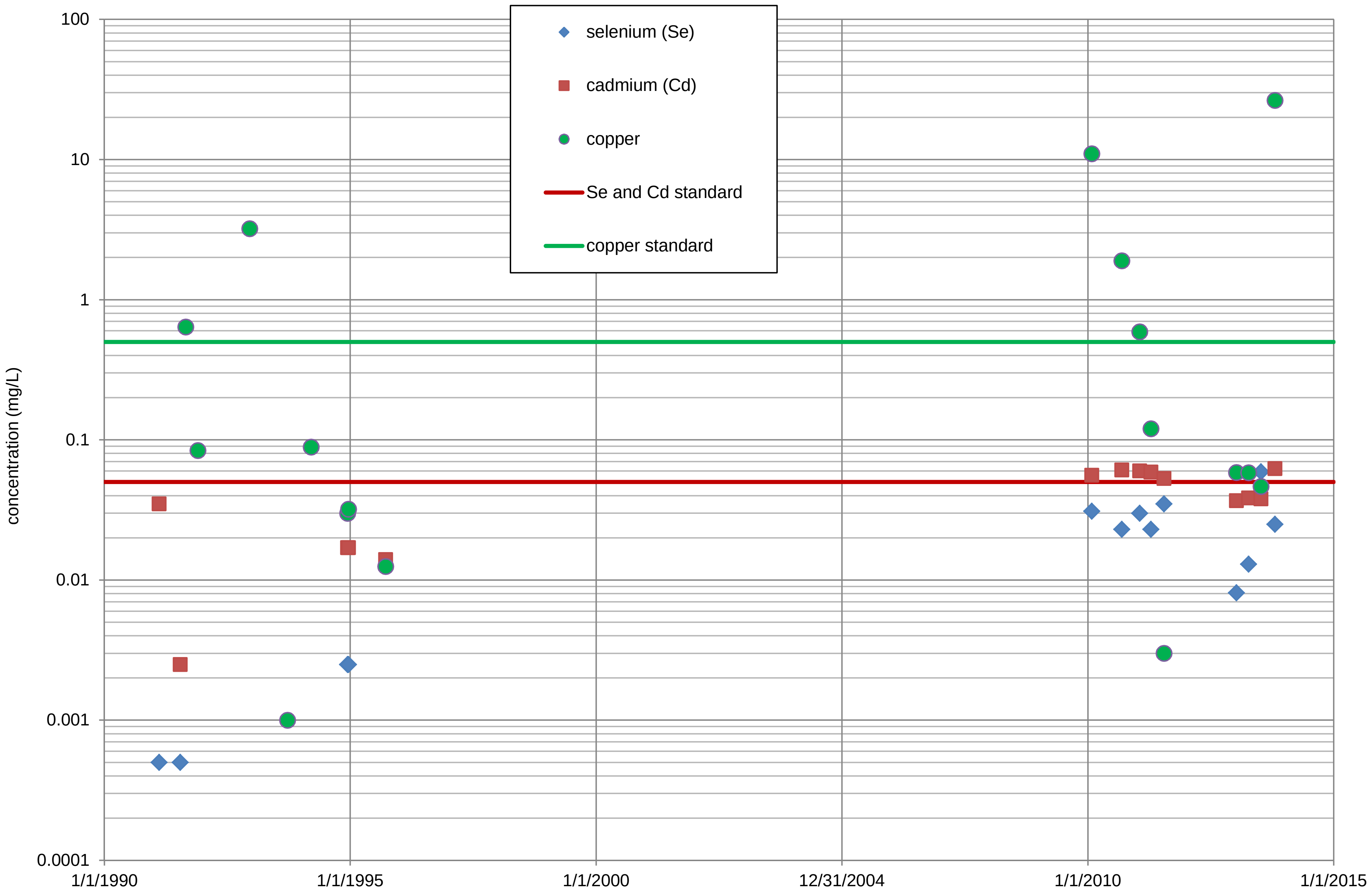


Figure 15. Time-series graph of dissolved metal concentrations in open pit, Copper Flat Mine, Sierra County, New Mexico

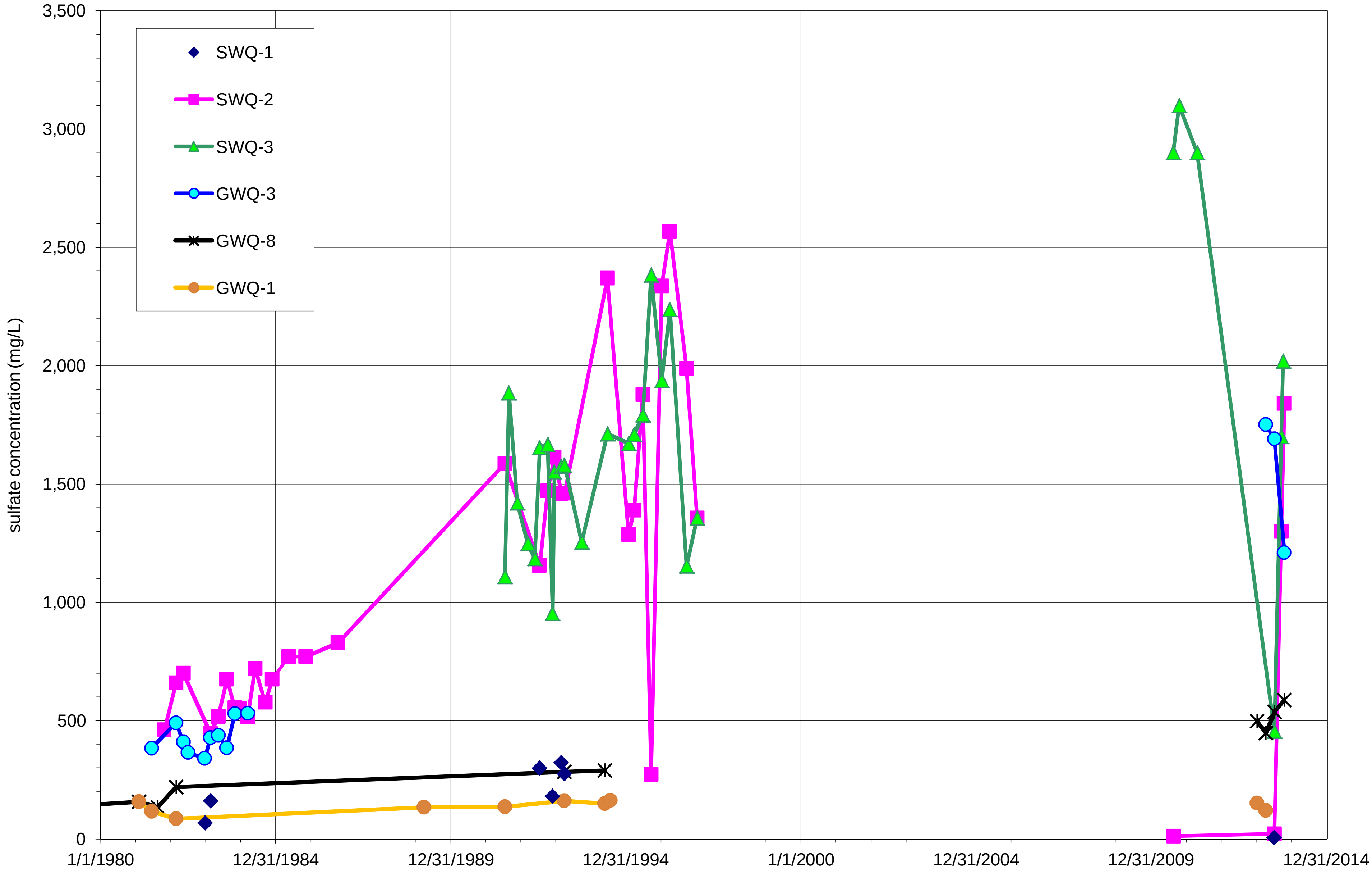


Figure 16. Time-series graph of sulfate concentrations in SWQ-1, SWQ-2, SWQ-3, and monitoring wells GWQ-1, GWQ-3, and GWQ-8 located in Grayback Arroyo below waste rock/mill site area, Copper Flat Mine, Sierra County, New Mexico.

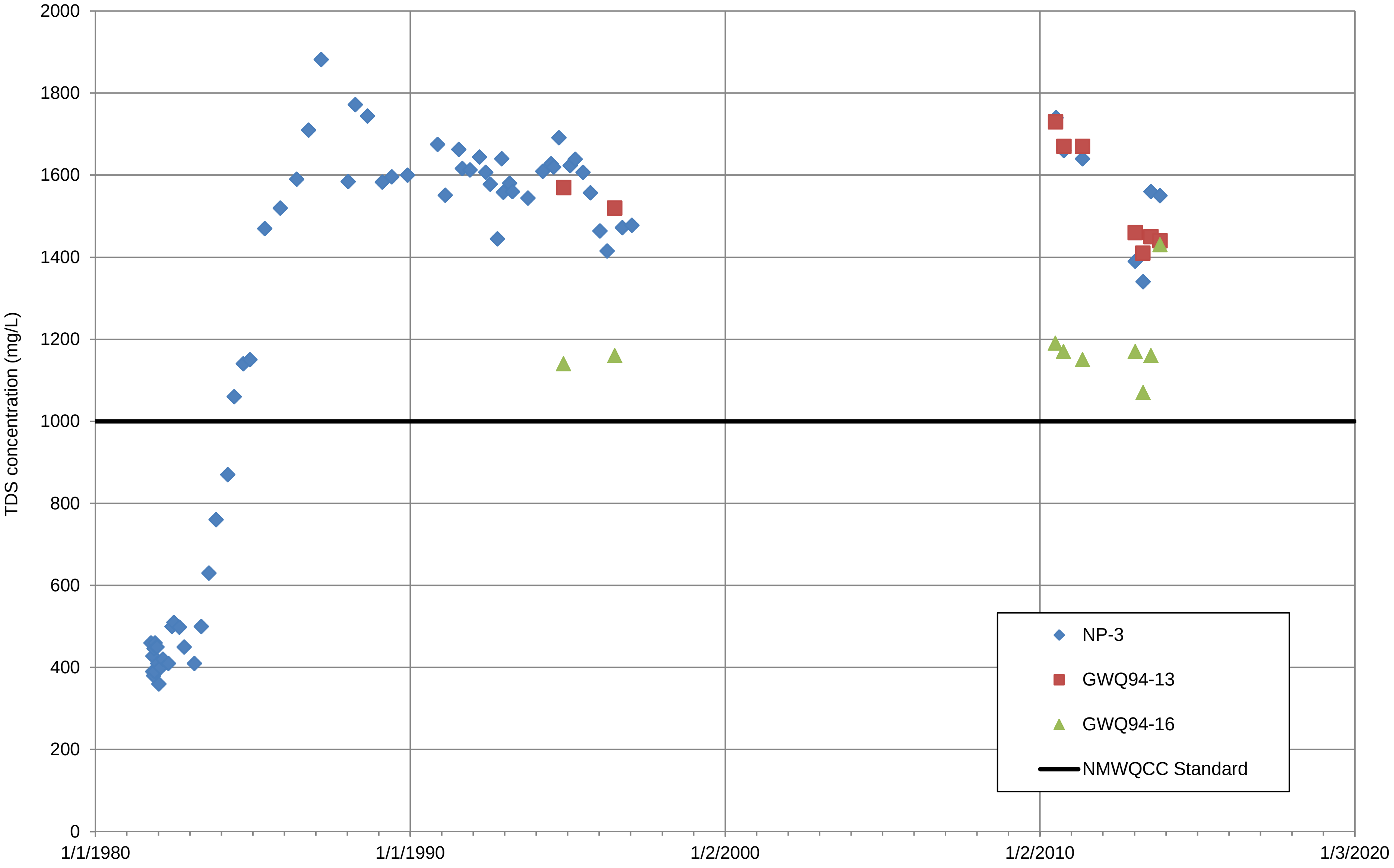


Figure 17. Time-series graph of total dissolved solids (TDS) concentrations in NP-3, GWQ94-13, and GWQ94-16, located down-gradient of the tailings storage facility (TSF), Copper Flat Mine, Sierra County, New Mexico.

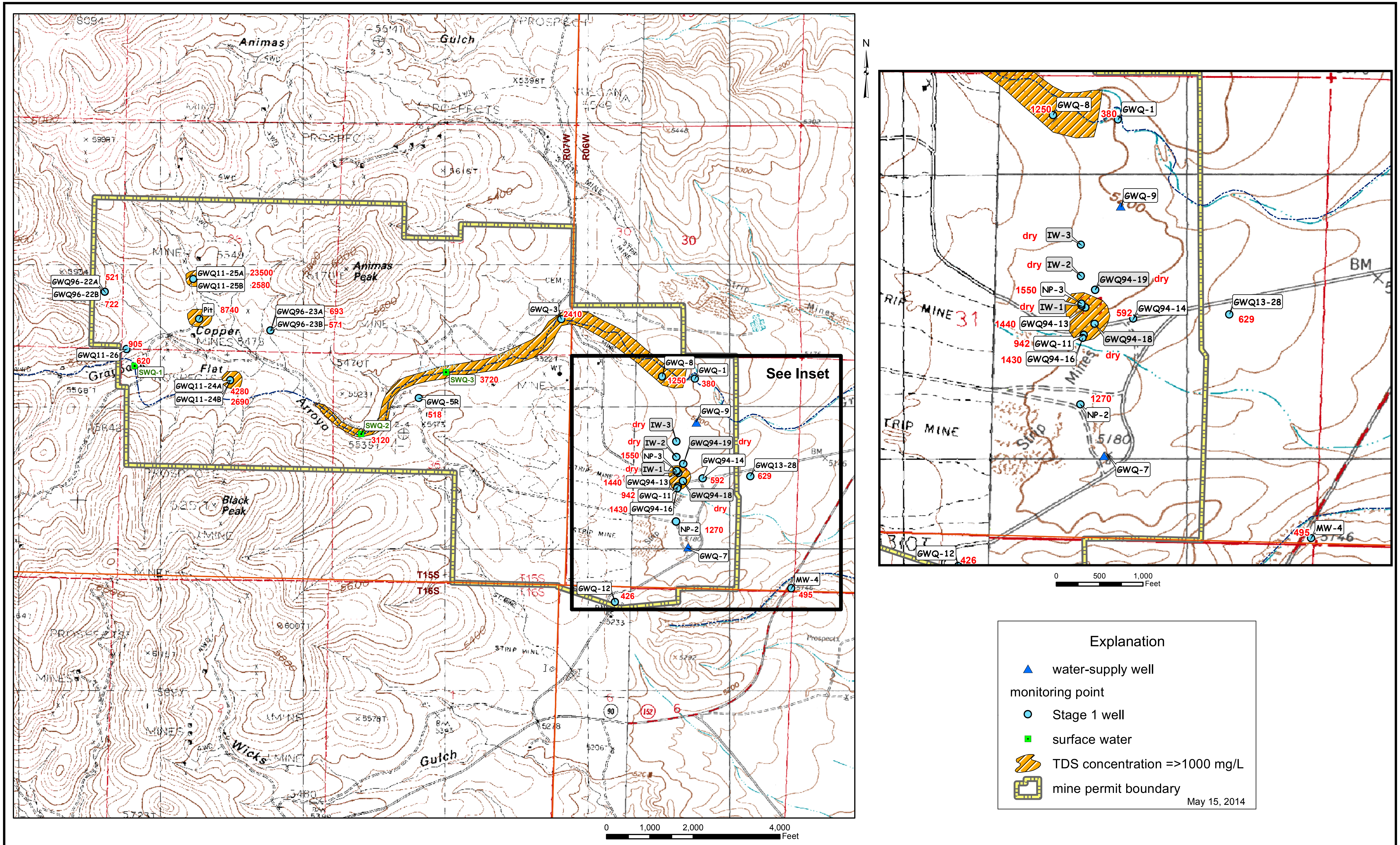


Figure 18. Map showing Stage 1 Abatement Plan monitoring points and lateral extent of 4th Quarter 2013 TDS plumes, Copper Flat Mine, Sierra County, New Mexico.

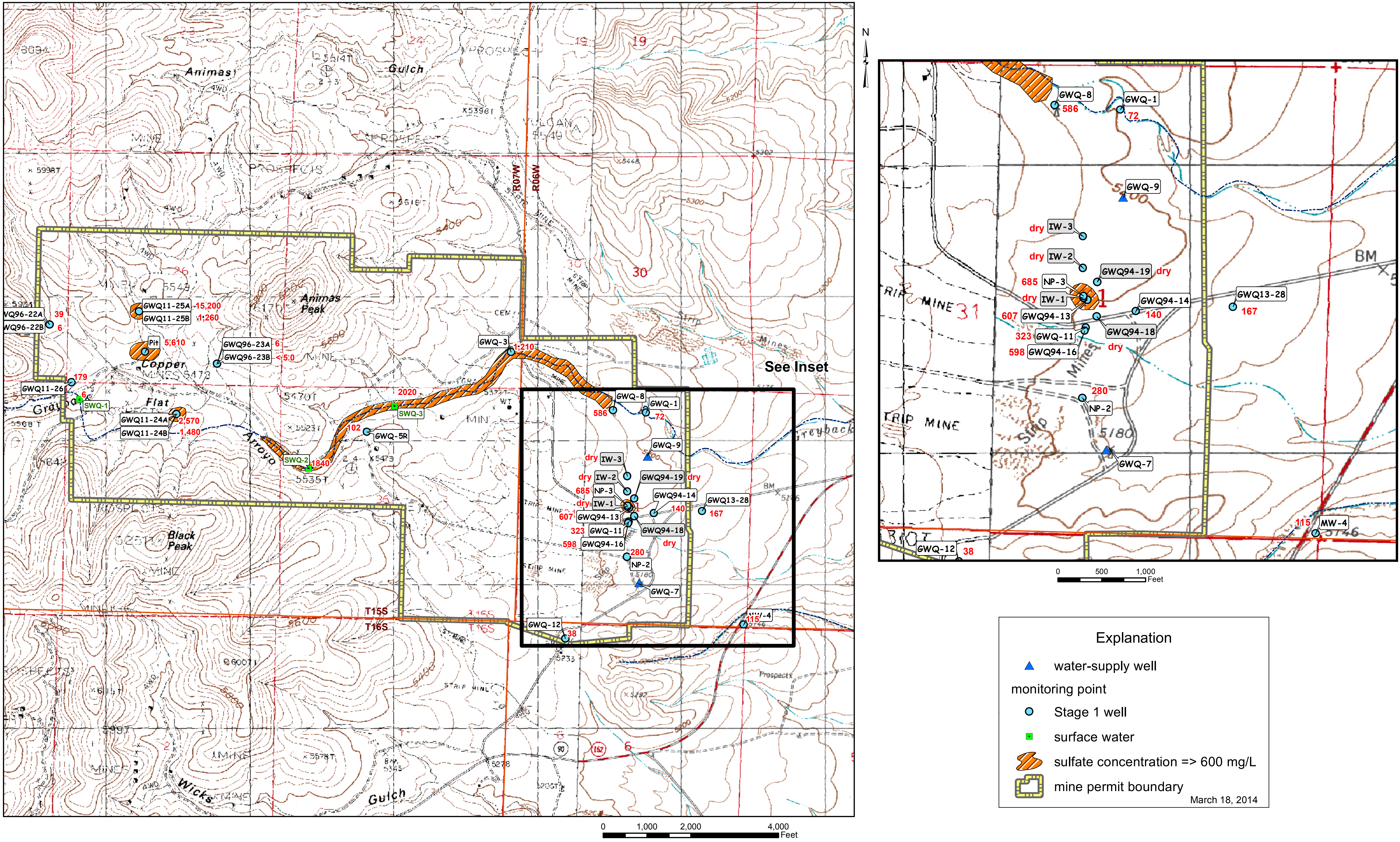


Figure 19. Map showing Stage 1 Abatement Plan monitoring points and lateral extent of 4th Quarter 2013 sulfate plumes, Copper Flat Mine, Sierra County, New Mexico.

APPENDICES

Appendix A.

Well completion diagrams for Copper Flat Mine area

Appendix A. Well completion diagrams

Appendix A figure number	well name	facility area	year drilled	comments
A1	GWQ96-22A	pit	1996	well diagram from well log
A1	GWQ96-22B	pit	1996	well diagram from well log
A2	GWQ96-23A	pit	1996	well diagram from well log
A2	GWQ96-23B	pit	1996	well diagram from well log
A3	GWQ11-24A	pit	2011	as-built well diagram
A3	GWQ11-24B	pit	2011	as-built well diagram
A4	GWQ11-25A	pit	2011	as-built well diagram
A4	GWQ11-25B	pit	2011	as-built well diagram
A5	GWQ11-26	pit	2011	as-built well diagram
n/a	pit	pit	1982	not applicable
A6	GWQ-1	waste rock/mill site	1972	simple well diagram from available information
A15	GWQ-3	waste rock/mill site	1932	Well Schedule form; no diagram
A7	GWQ-5R	waste rock/mill site	2011	as-built well diagram
A8	GWQ-8	waste rock/mill site	1931	well diagram from available information
A17	GWQ-11	tailings storage facility (TSF)	1981	Water Quality Monitor Wells table
A18	GWQ-12	tailings storage facility (TSF)	1981	Water Quality Monitor Wells table
A9	GWQ94-13	tailings storage facility (TSF)	1994	well diagram from well log
A10	GWQ94-14	tailings storage facility (TSF)	1994	well diagram from well log
A11	GWQ94-16	tailings storage facility (TSF)	1994	well diagram from well log
A12	GWQ94-18	tailings storage facility (TSF)	1994	well diagram from well log
A13	GWQ94-19	tailings storage facility (TSF)	1994	well diagram from well log
A16	IW-1	tailings storage facility (TSF)	1982	Water Quality Monitor Wells table; no diagram
A16	IW-2	tailings storage facility (TSF)	1982	Water Quality Monitor Wells table; no diagram
A16	IW-3	tailings storage facility (TSF)	1982	Water Quality Monitor Wells table; no diagram
A19	NP-2	tailings storage facility (TSF)	1981	Water Quality Monitor Wells table
A20	NP-3	tailings storage facility (TSF)	1981	Water Quality Monitor Wells table
A14	MW-4	tailings storage facility (TSF)	1975	simple well diagram from available information

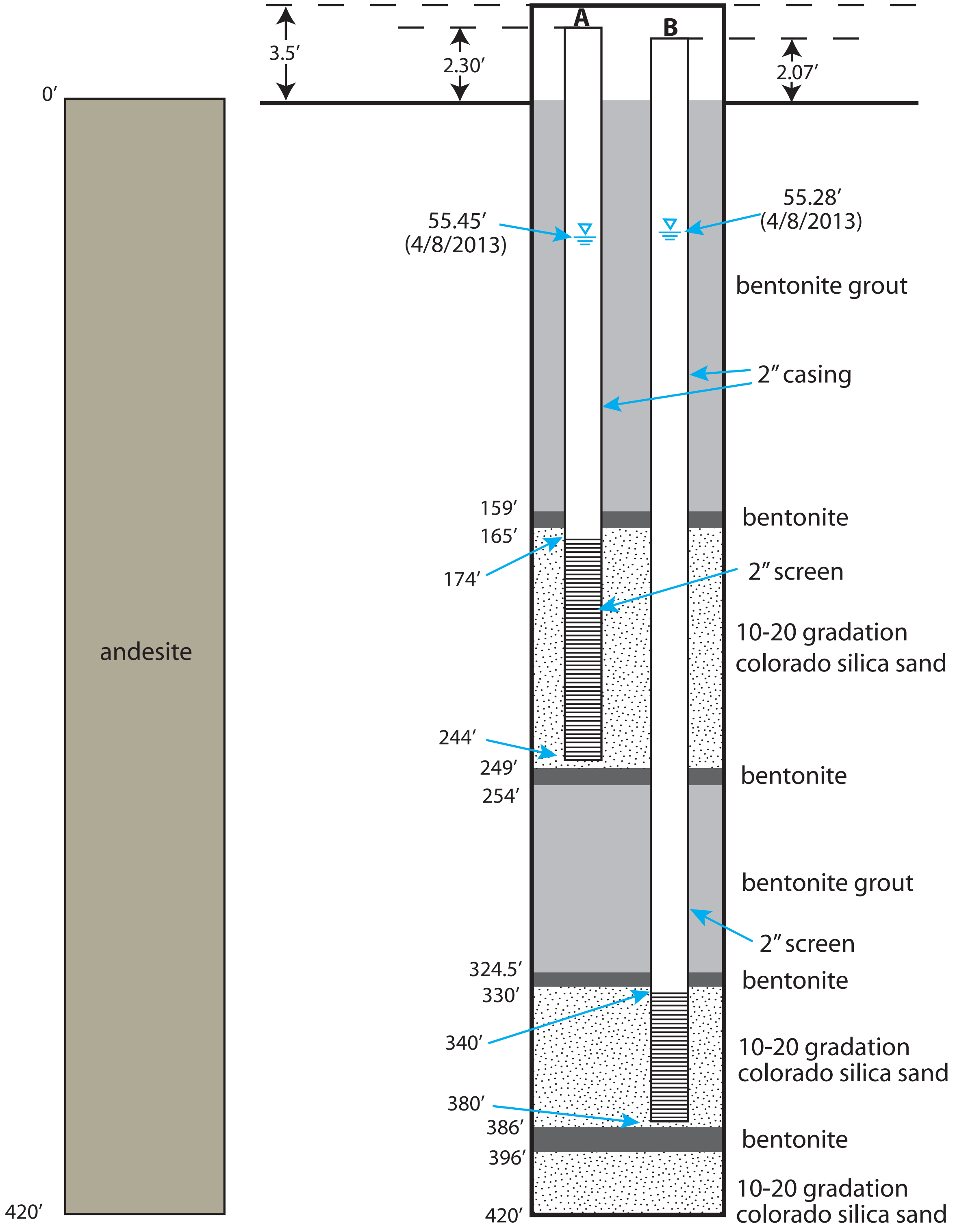


Figure A1. Well diagram, GWQ96-22, Copper Flat Mine, Sierra County, New Mexico.

6-27-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

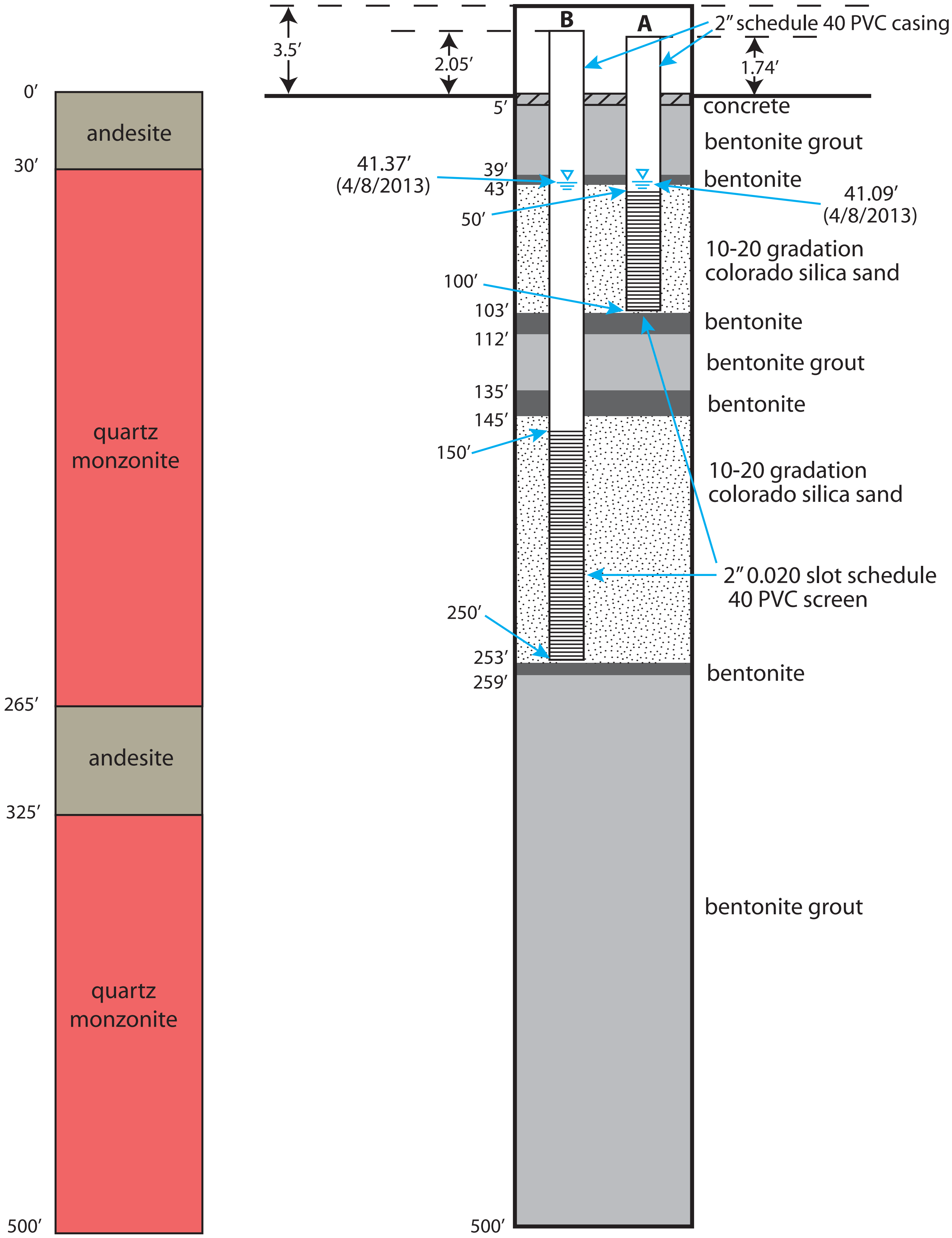


Figure A2. Well diagram, GWQ96-23, Copper Flat Mine, Sierra County, New Mexico.

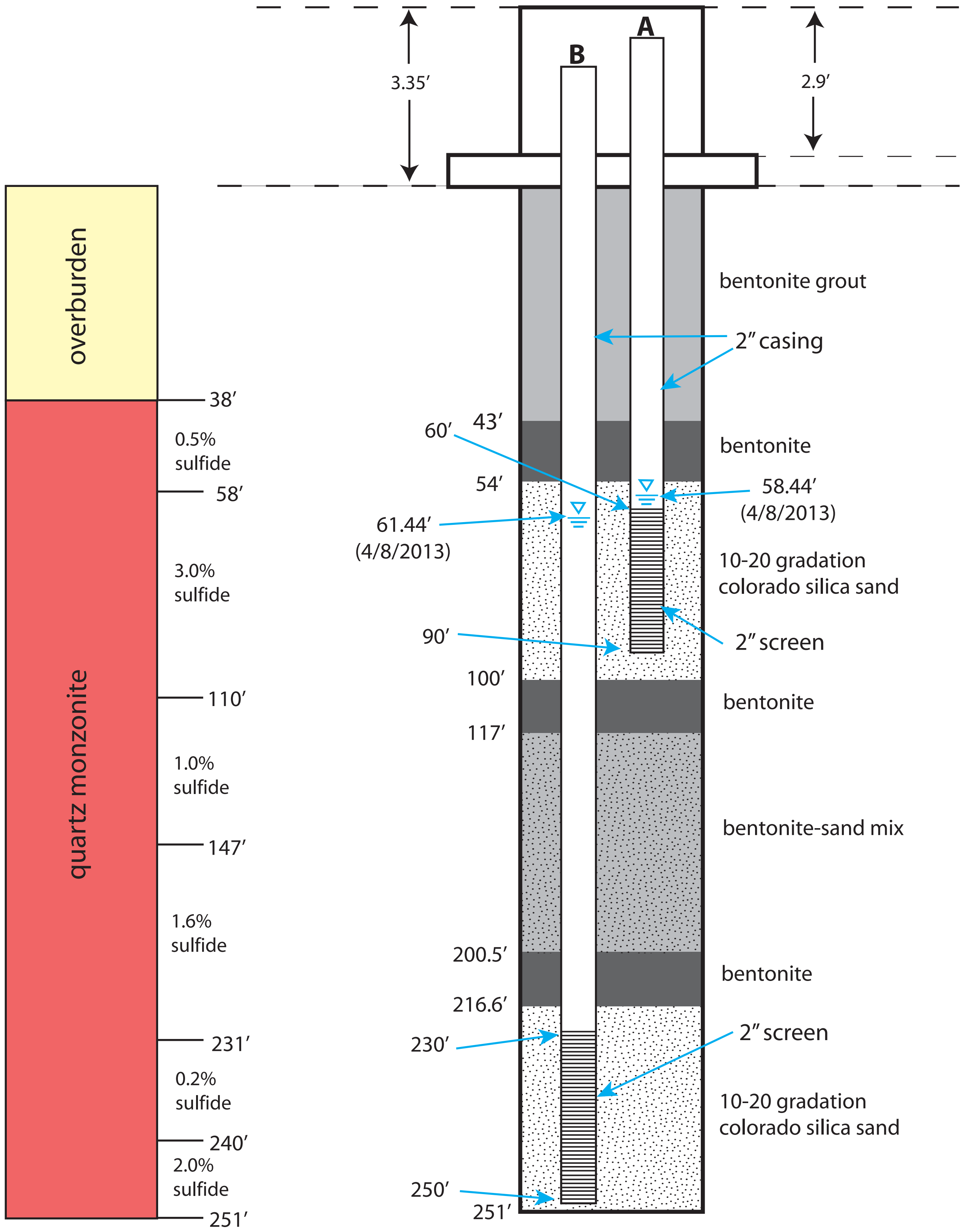


Figure A3. Well diagram, GWQ11-24, Copper Flat Mine, Sierra County, New Mexico.

6-27-2013; DA/PW

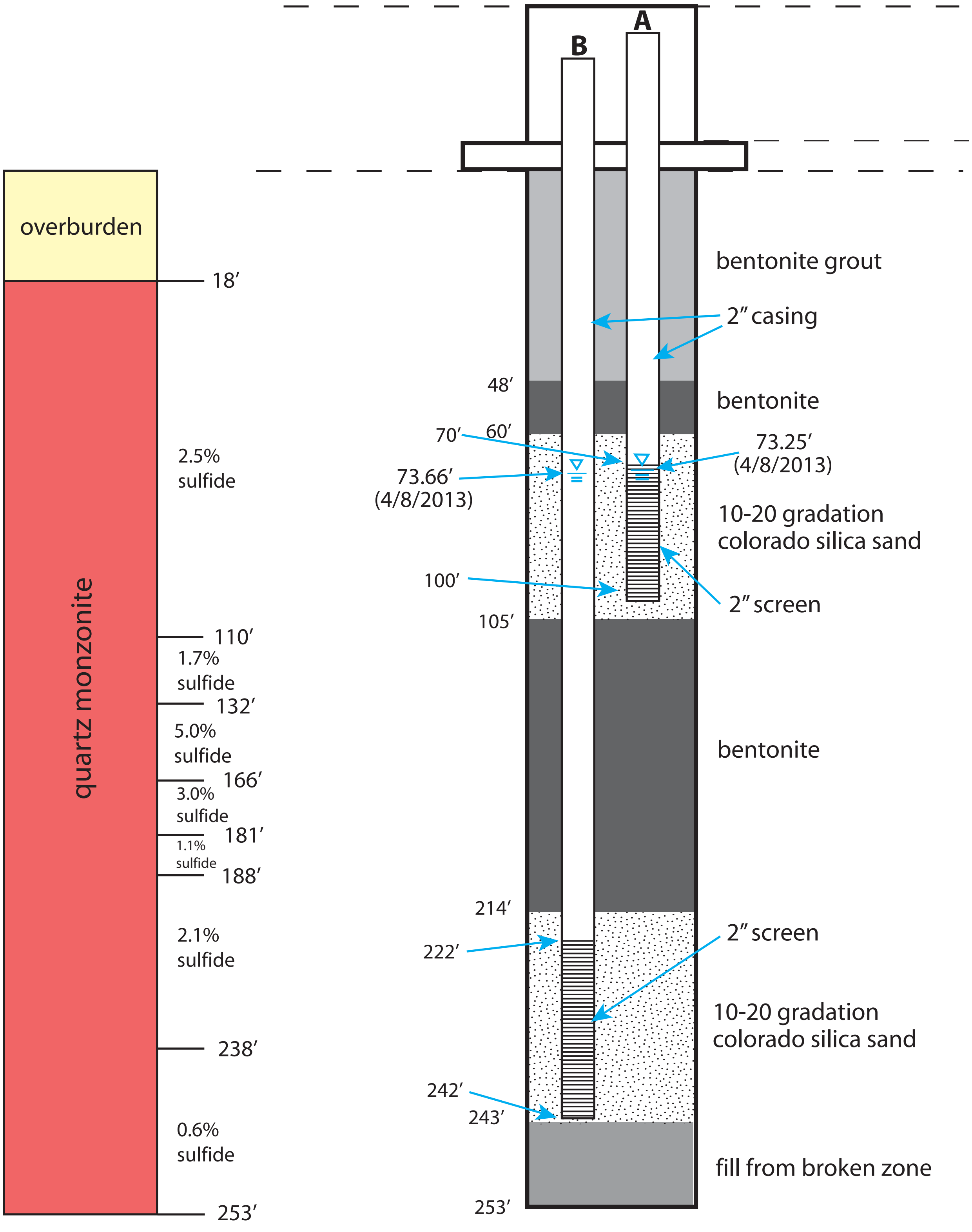


Figure A4. Well diagram, GWQ11-25, Copper Flat Mine, Sierra County, New Mexico.

6-27-2013; DA/PW

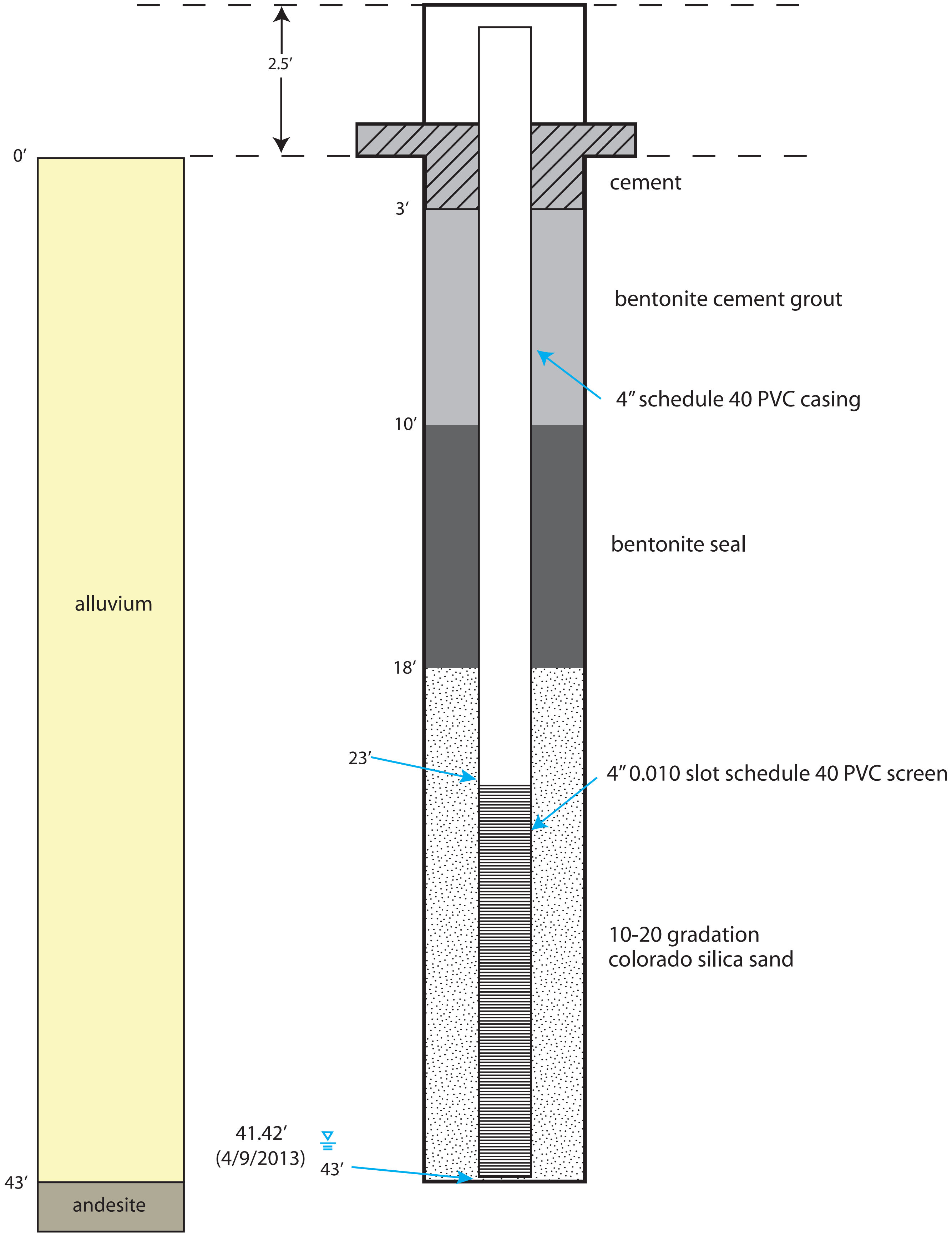


Figure A5. Well diagram, GWQ11-26, Copper Flat Mine, Sierra County, New Mexico.

6-27-2013; DA/PW

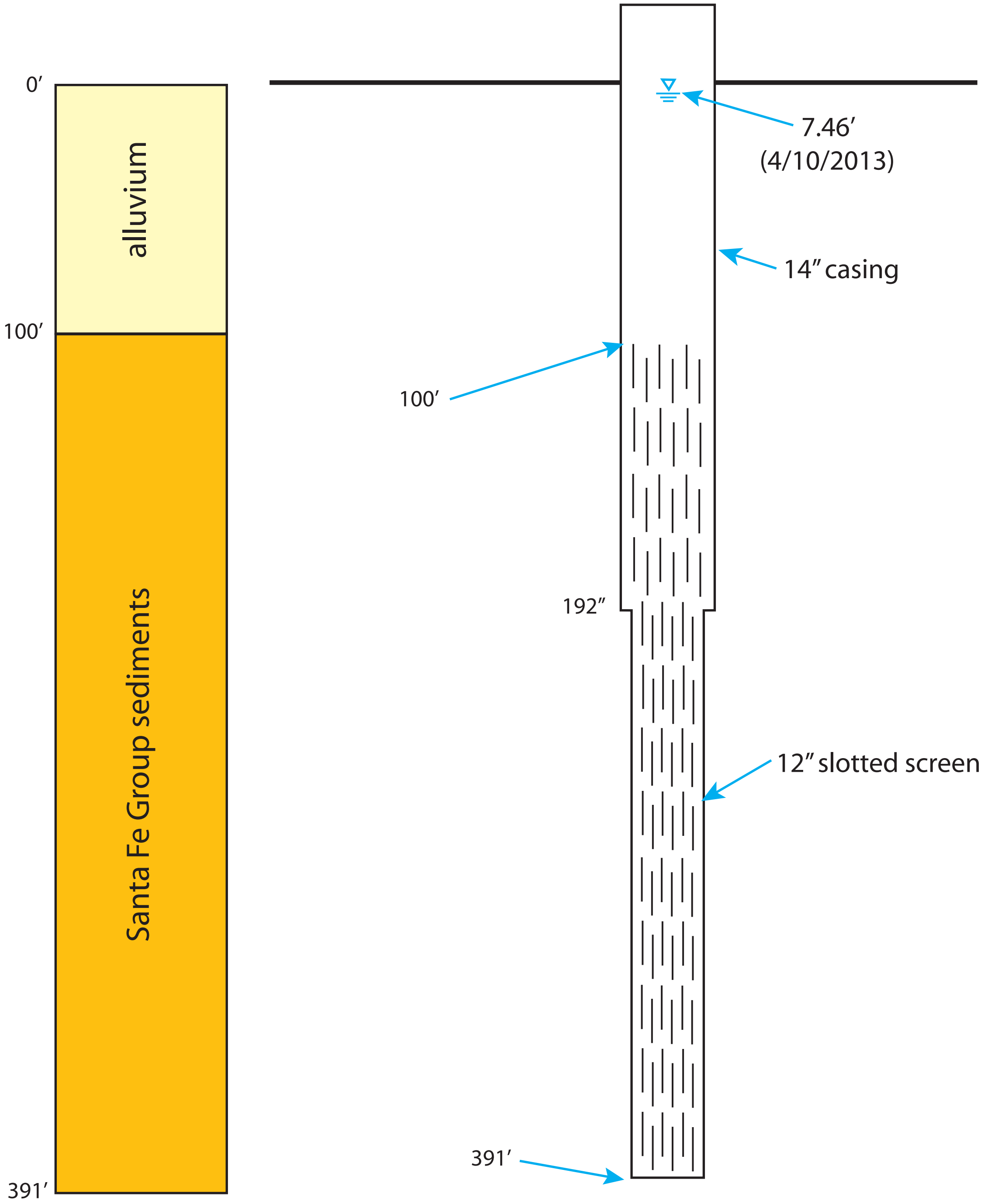


Figure A6. Well diagram, GWQ-1, Copper Flat Mine, Sierra County, New Mexico.

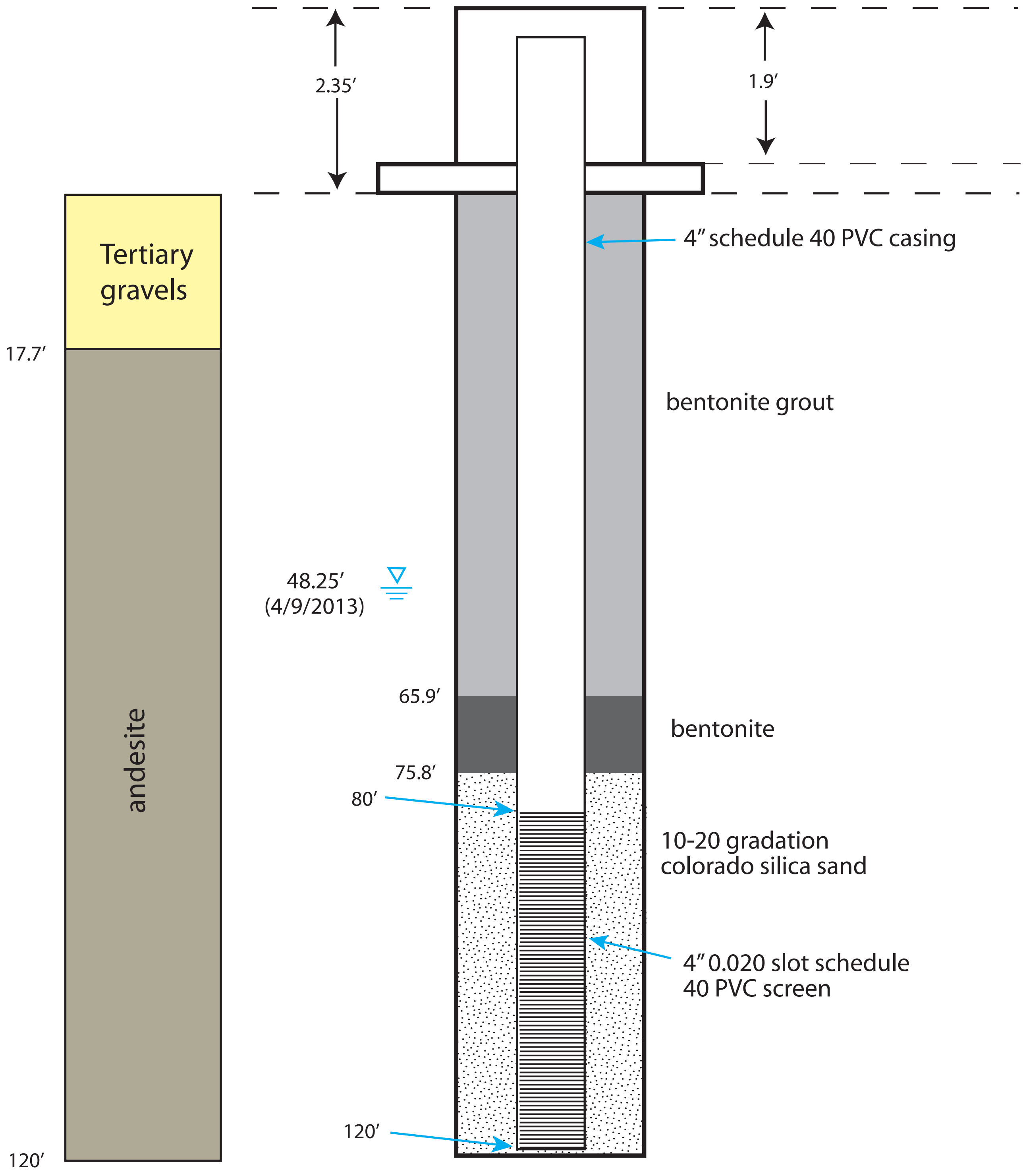


Figure A7. Well diagram, GWQ-5R, Copper Flat Mine, Sierra County, New Mexico.

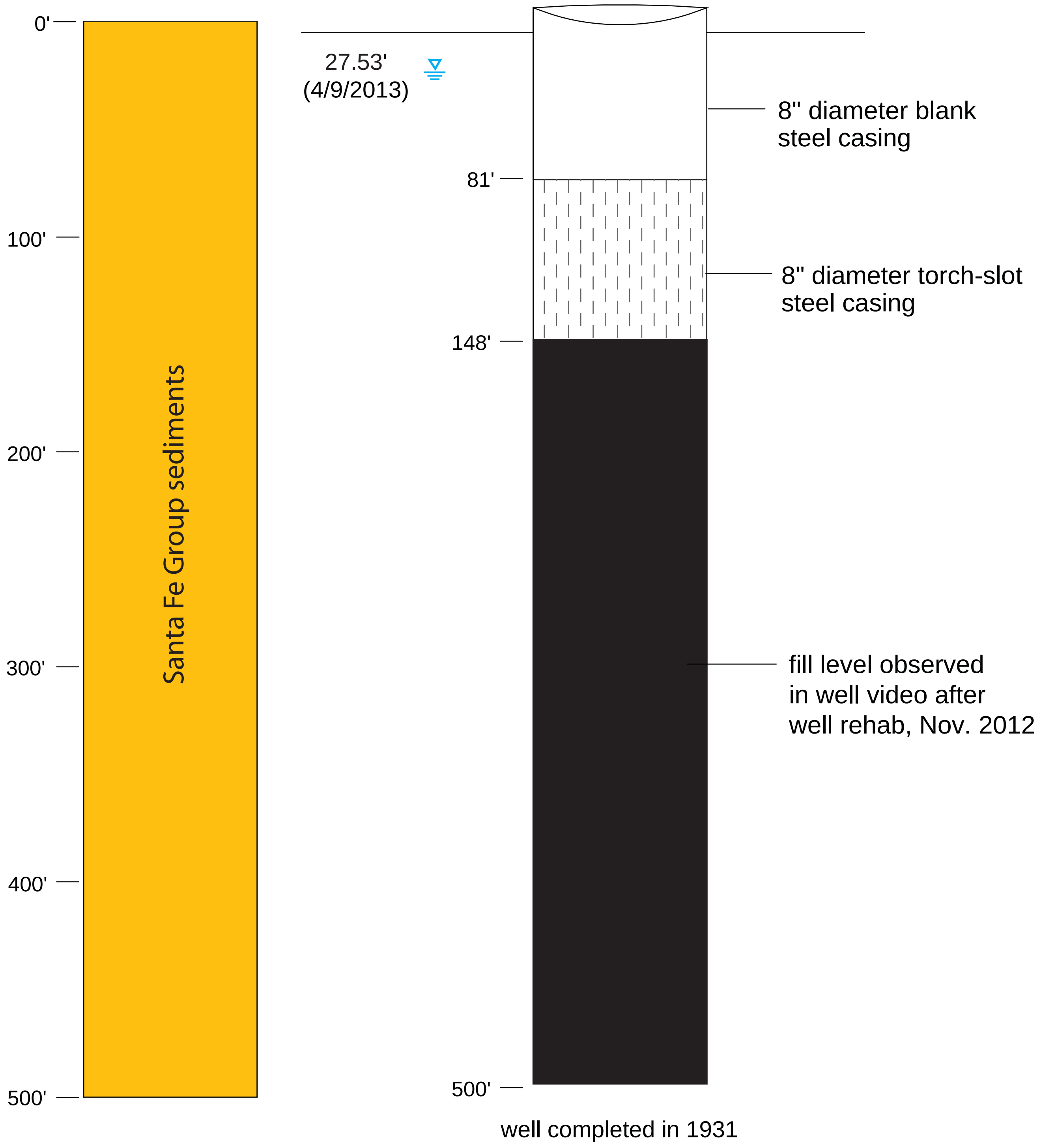


Figure A8. Well Diagram, GWQ-8 (LRG-4652-S-4), Copper Flat Mine, Sierra County, New Mexico.

6-27-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

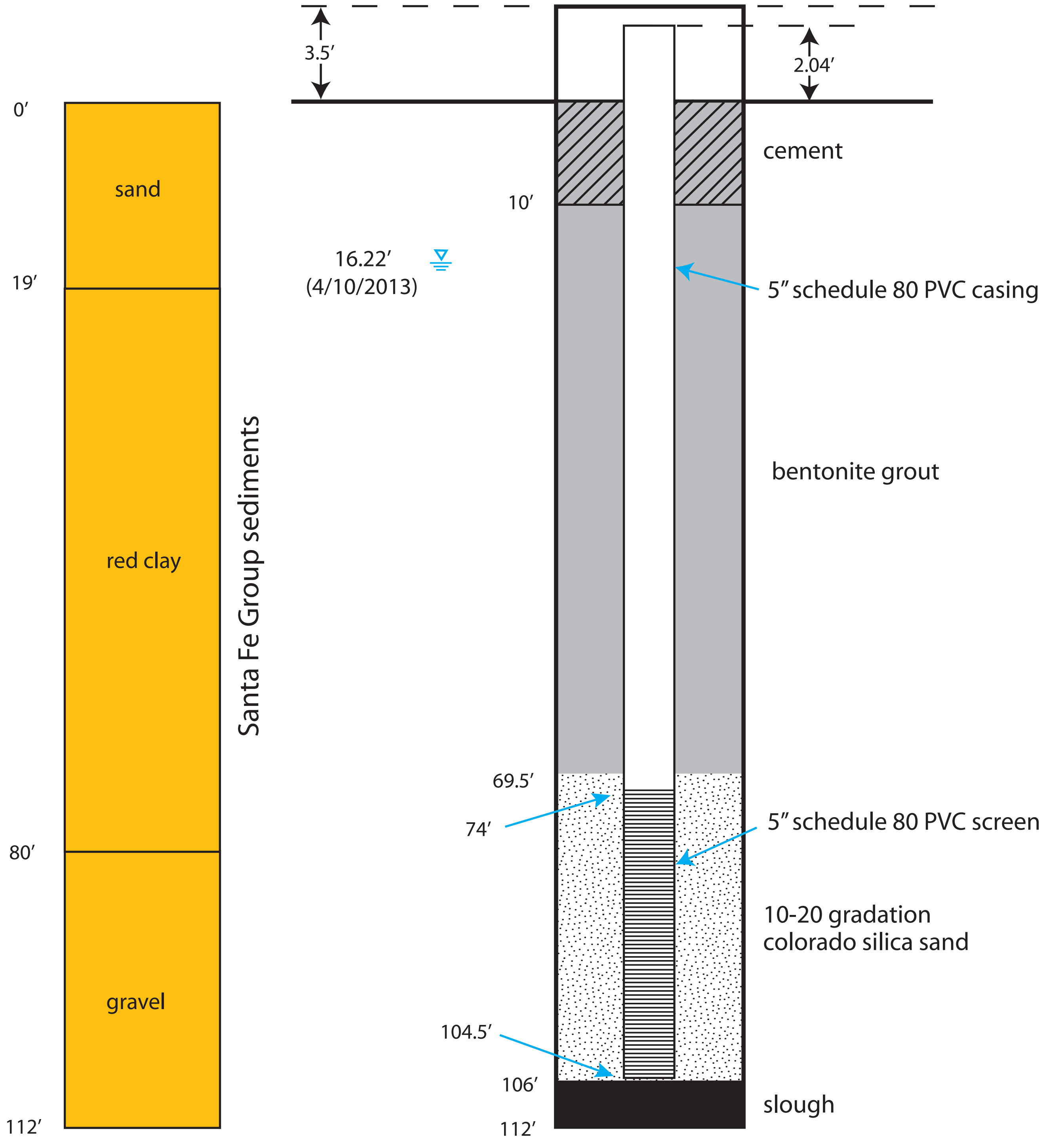


Figure A9. Well diagram, GWQ94-13, Copper Flat Mine, Sierra County, New Mexico.

6-27-2013; DA/PW

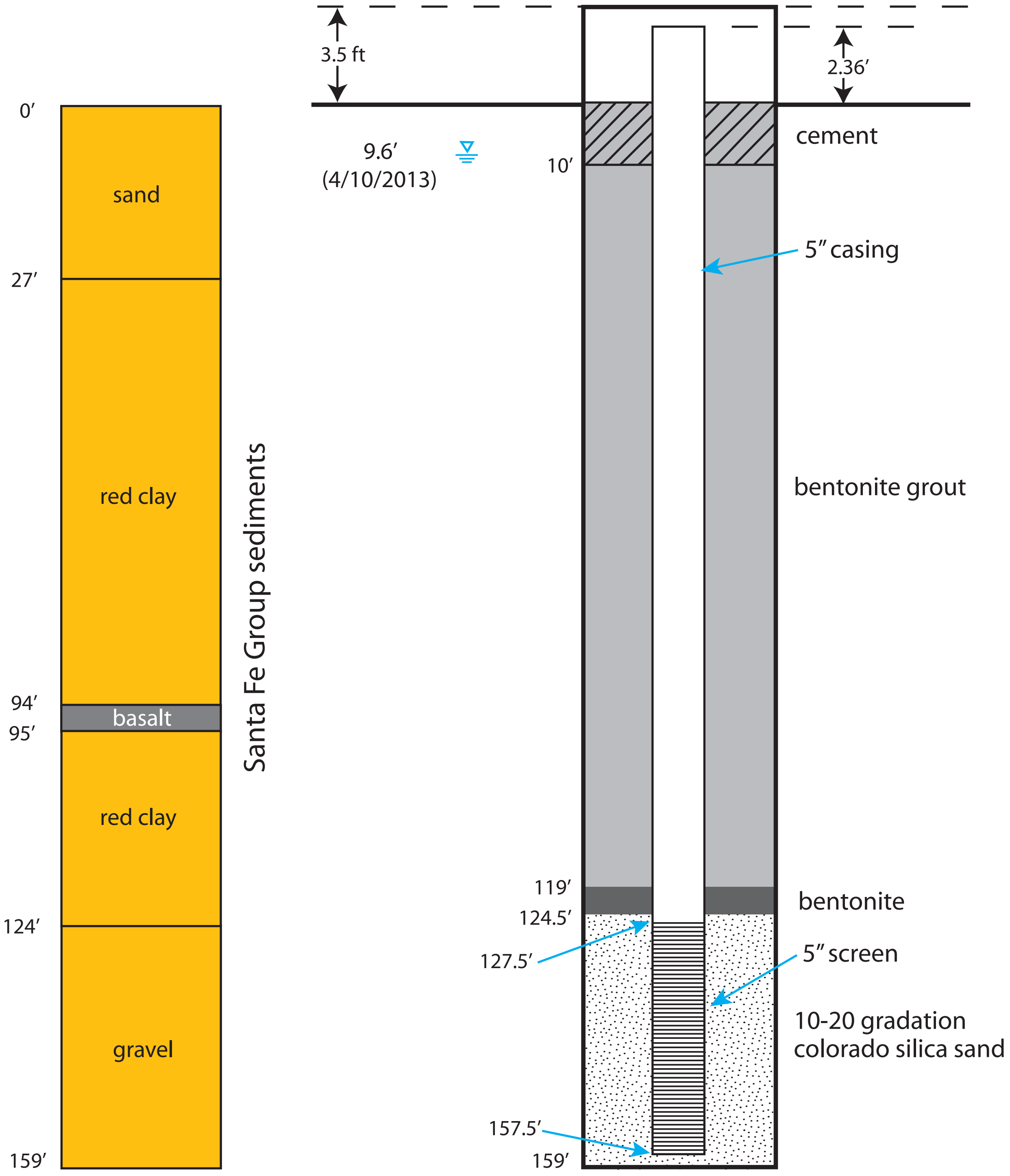


Figure A10. Well diagram, GWQ94-14, Copper Flat Mine, Sierra County, New Mexico.

6-27-2013; DA/PW

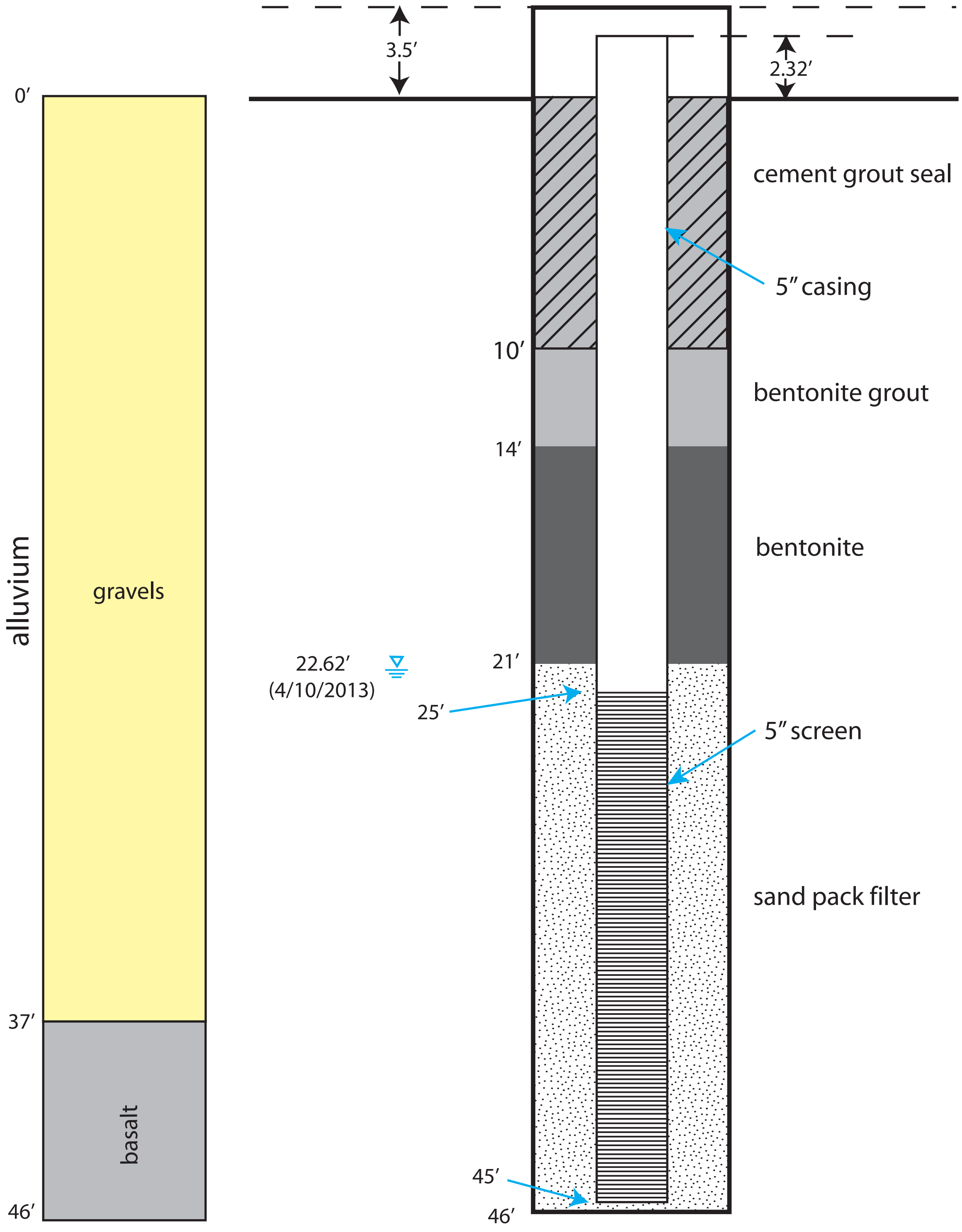


Figure A11. Well diagram, GWQ94-16, Copper Flat Mine, Sierra County, New Mexico.

6-27-2013; DA/PW

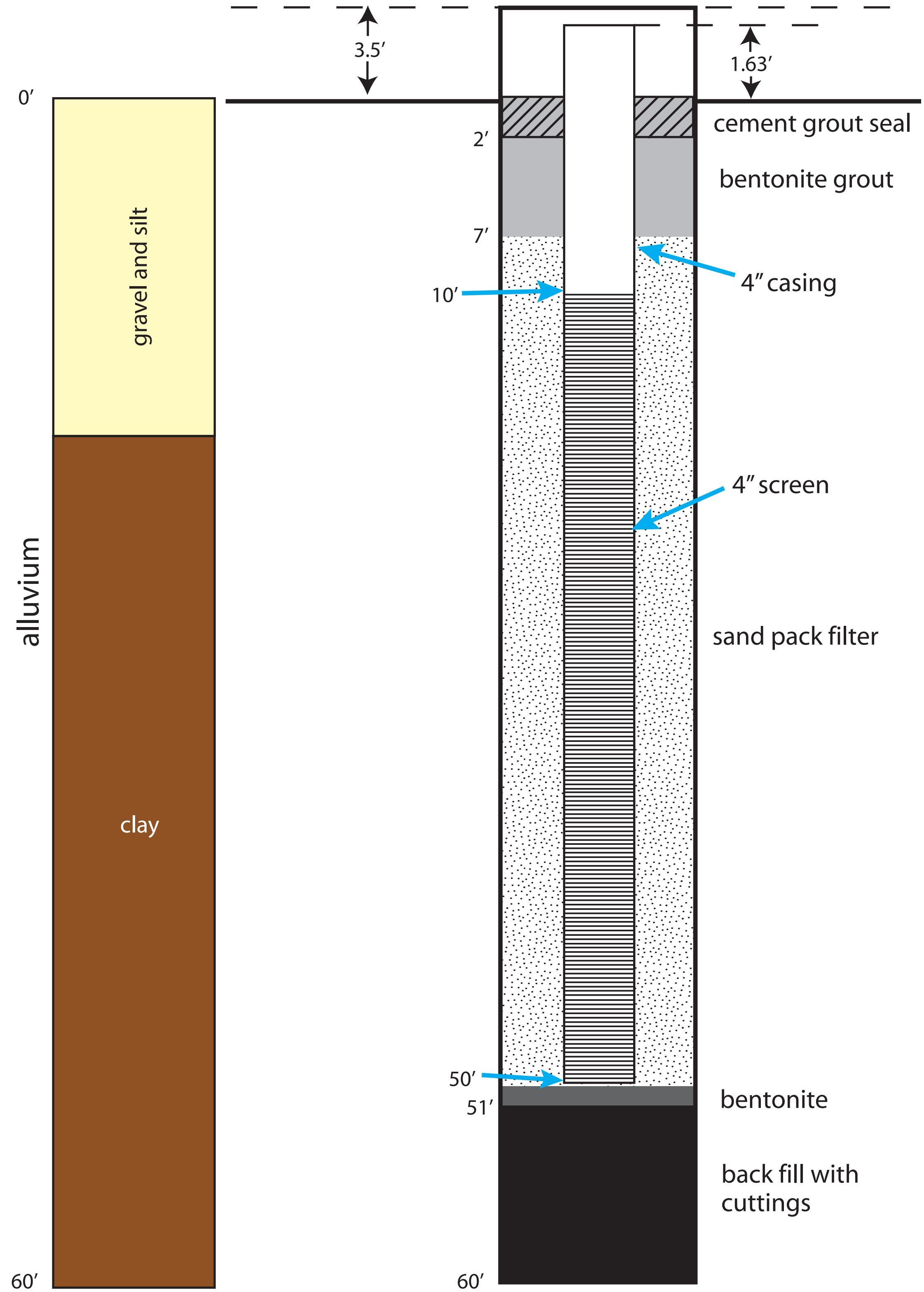


Figure A12. Well diagram, GWQ94-18, Copper Flat Mine, Sierra County, New Mexico.

6-27-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

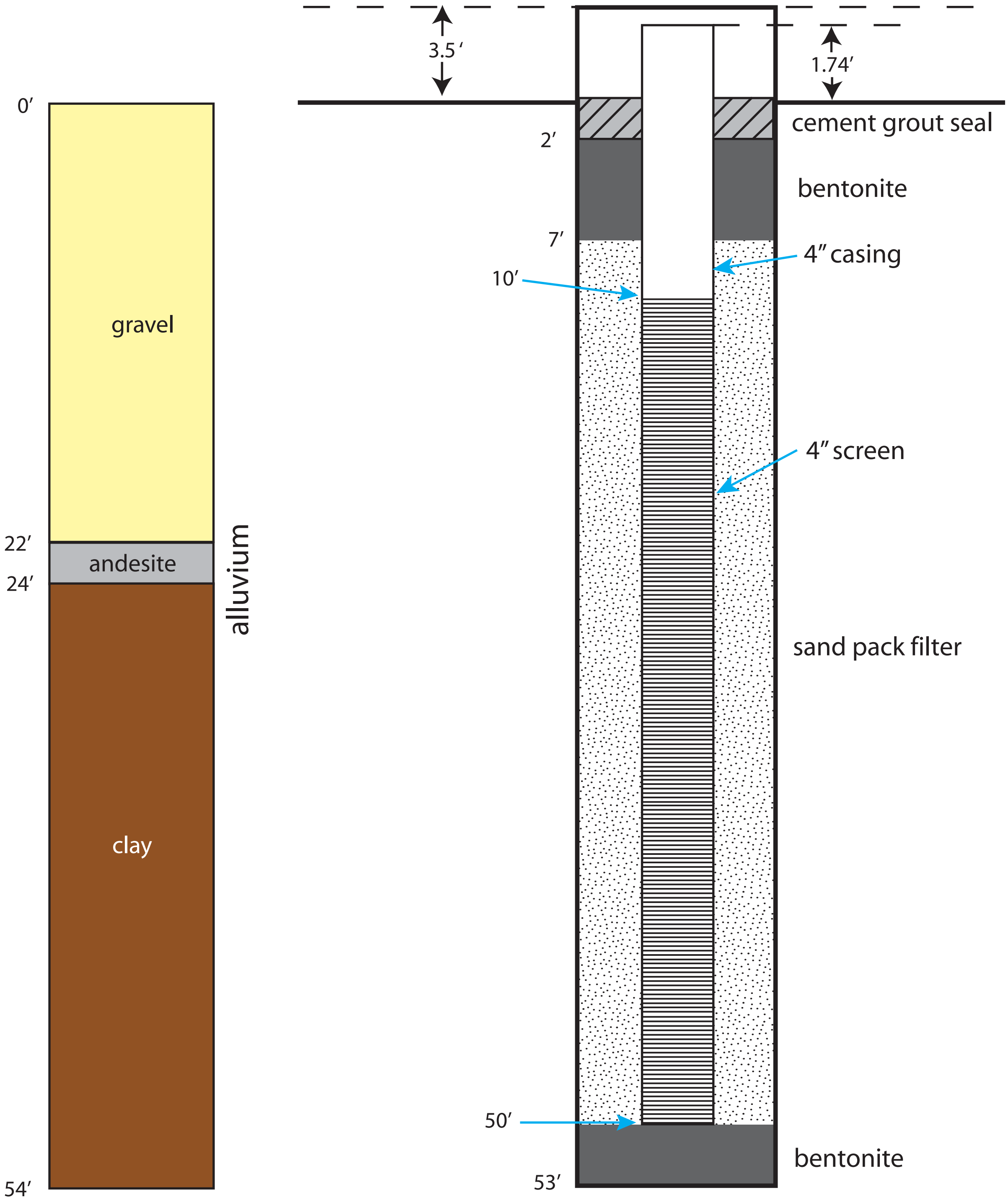


Figure A13. Well diagram, GWQ94-19, Copper Flat Mine, Sierra County, New Mexico.

6-27-2013; DA/PW

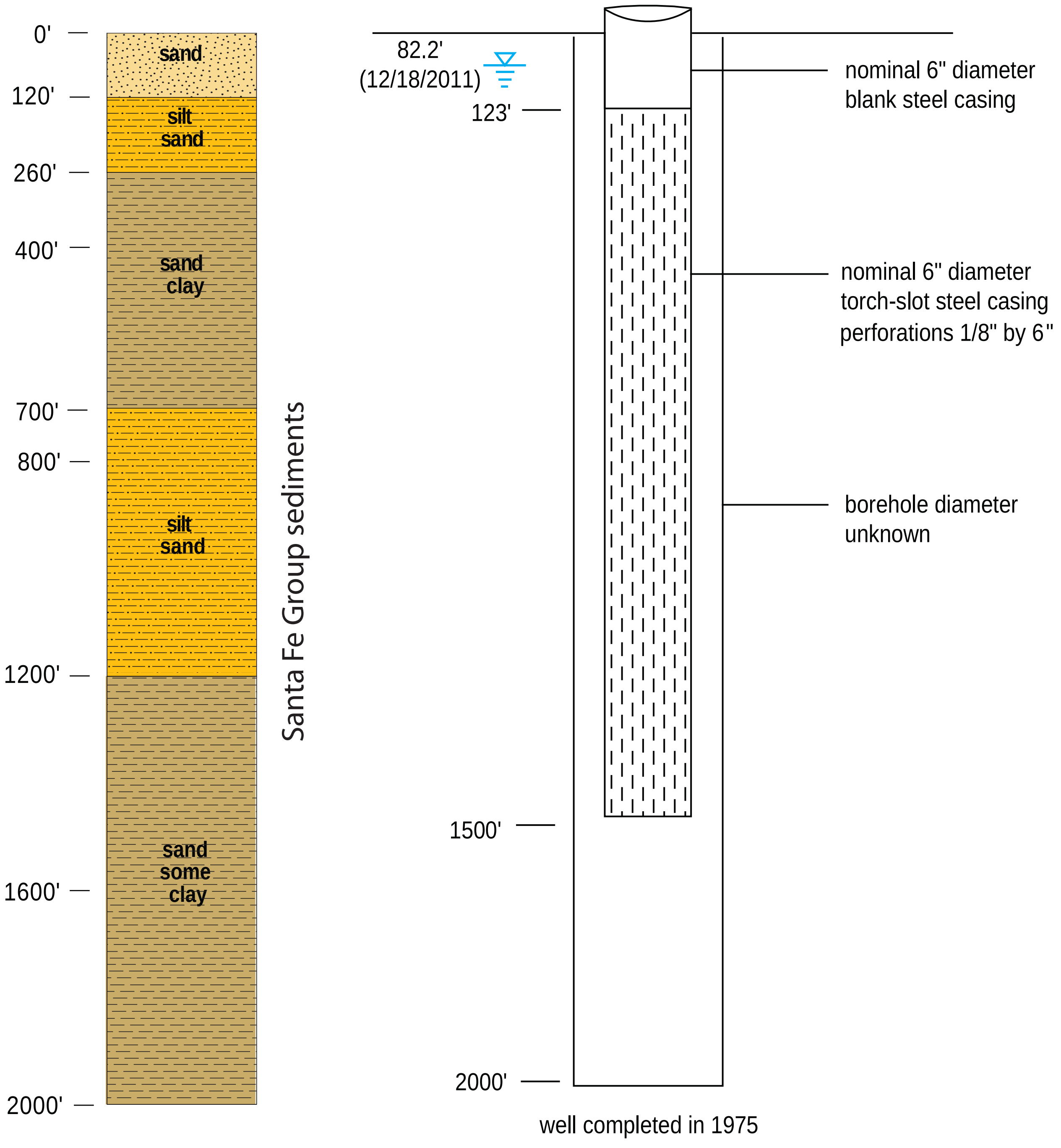


Figure A14. Well diagram, MW-4 (LRG-4652-S-13), Copper Flat Mine, Sierra County, New Mexico.

Copper Flat Project
Quintana Minerals Corporation
Sierra County, New Mexico

Well No. Shale Well GWQ-3

Other
not in NMWRRS

WELL SCHEDULE

Recorded by Jim Humphrey Source of Data Observed Date 11-11-82

State New Mexico County or Town Sierra County Map Quintana Minerals

Legal Description: T 15 N, S, R 7 E, W, Section 25, SE¼, SE¼, NE¼
4 4 2

Owner Quintana Address

Depth Well 32.7 ft. [✓ Measured] Reported By Harvey Chatfield

Depth Cased ? ft. Casing Type concrete Diameter 3.3 X 3.6

Method Drilled hand dug Date Drilled 1932 Log Yes [✓ No]

Finish Use of Water unused

Perforations

Driller drilled for Henry Eisenheart Power none Lift

Description of M.P. 3 ft. [✓ above] below LSD

Altitude: Land Surface M.P.

Water Level 10.6 ft. above below M.P.; 7.6 ft. above [✓ below] LSD

Date Measured 11-11-82 Accuracy cloth type

Quality of Water Data: Field [✓ Yes], No Lab Yes, No Date June 9, 1981

pH 6.98, Spec. Cond. 1100 micromhos, Alkalinity 275 mg/1

Salinity 0.7 ppt, Temperature 19 degrees [✓ C] F

Figure A15. Well Schedule form, GWQ-3, Copper Flat Mine, Grant County, New Mexico.

WATER QUALITY MONITOR WELLS

Well No.	Depth	Depth Cased	Casing Type	Elevation (Top of Casing)
NP-1	115'	106'	Steel-2"	5177.0
NP-2	115'	110'	Steel-2"	5180.2
NP-3	109'6"	100'	Steel-2"	5187.6
NP-4	117'	117'	Steel-2"	5213.8
NP-5	35'	35'	Steel-2"	5187.0
GWQ-10	124'	121'	PVC-3"	5201.4
GWQ-11	80'	76'	PVC-3"	5184.4
GWQ-12	130'	130'	PVC-3"	5225.5
IW-1	49'	49'	PVC-4"	5187.8
IW-2	45'	45'	PVC-4"	5195.8
IW-3	45'	45'	PVC-4"	5201.4

The NP and GWQ wells were installed during July and August of 1981, as referenced in Sergent, Hauskins and Beckwith's "Geohydrological Evaluation for Submission of Discharge Plan, Copper Flat Project, Hillsboro, N.M.", 1981.

The IW wells were installed during May, 1982, by Quintana Minerals Corporation.

Figure A16. Water Quality Monitor Wells table, Copper Flat Mine, Grant County, New Mexico.

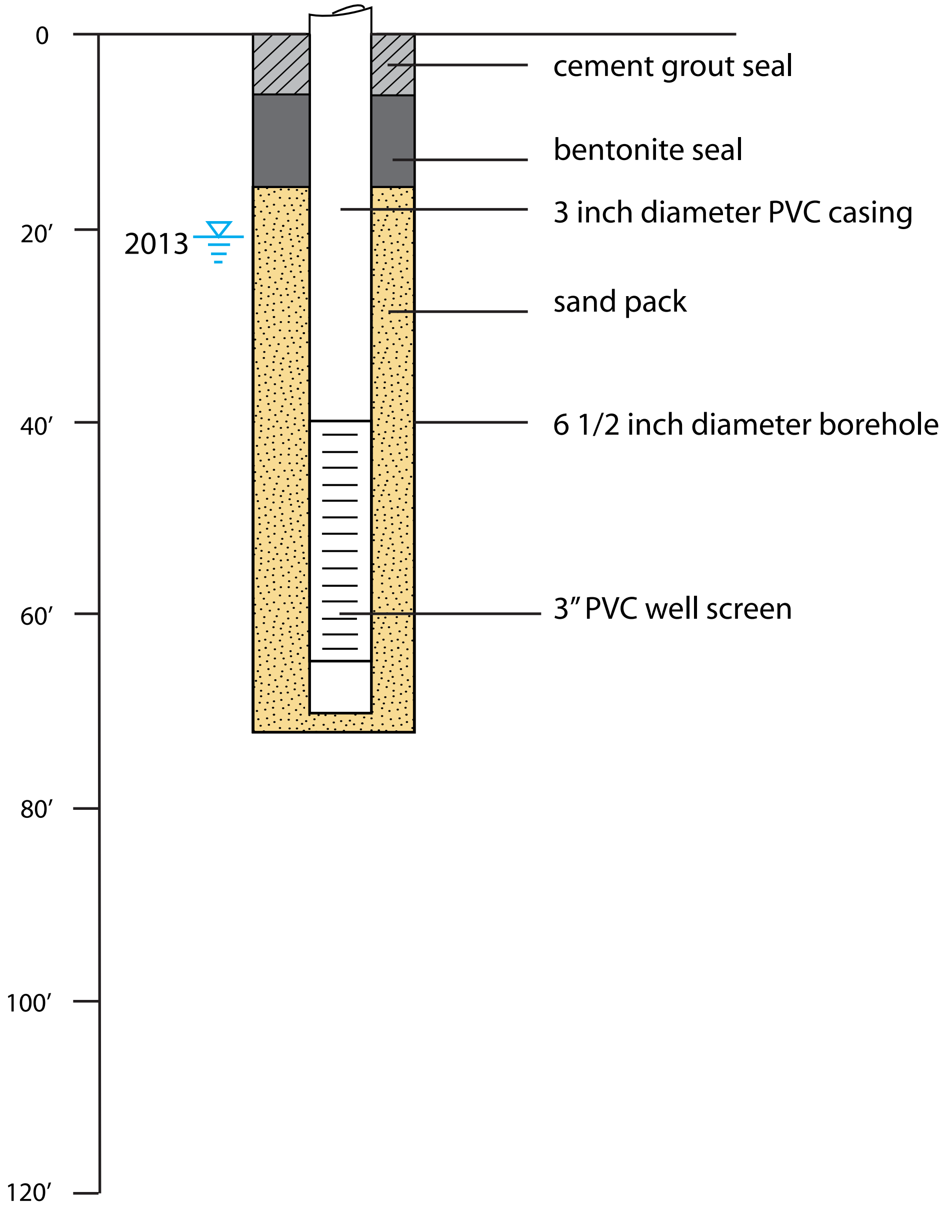


Figure A17. Well diagram, GWQ-11, Copper Flat Mine, Sierra County, New Mexico.

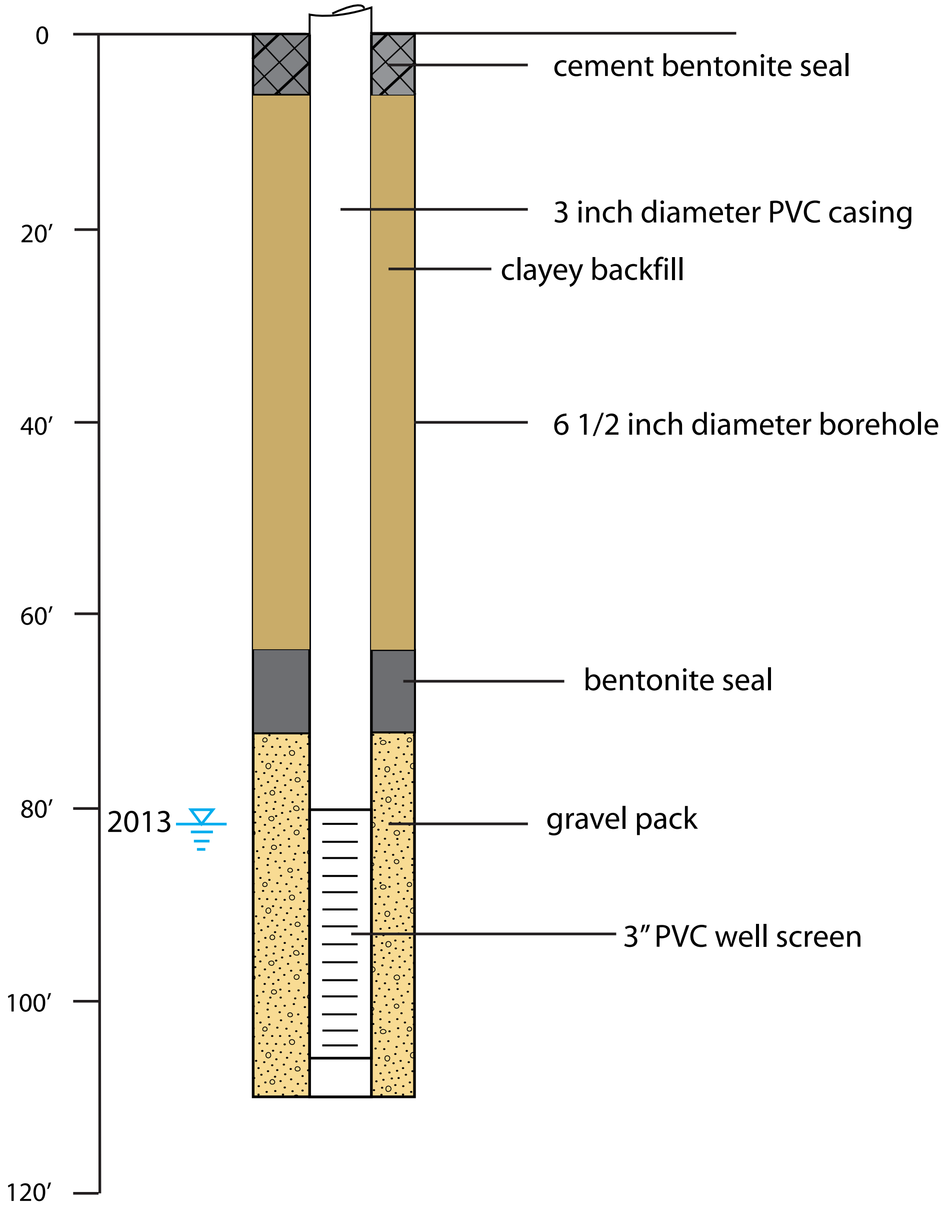


Figure A18. Well diagram, GWQ-12, Copper Flat Mine, Sierra County, New Mexico.

3-11-2014; KJ

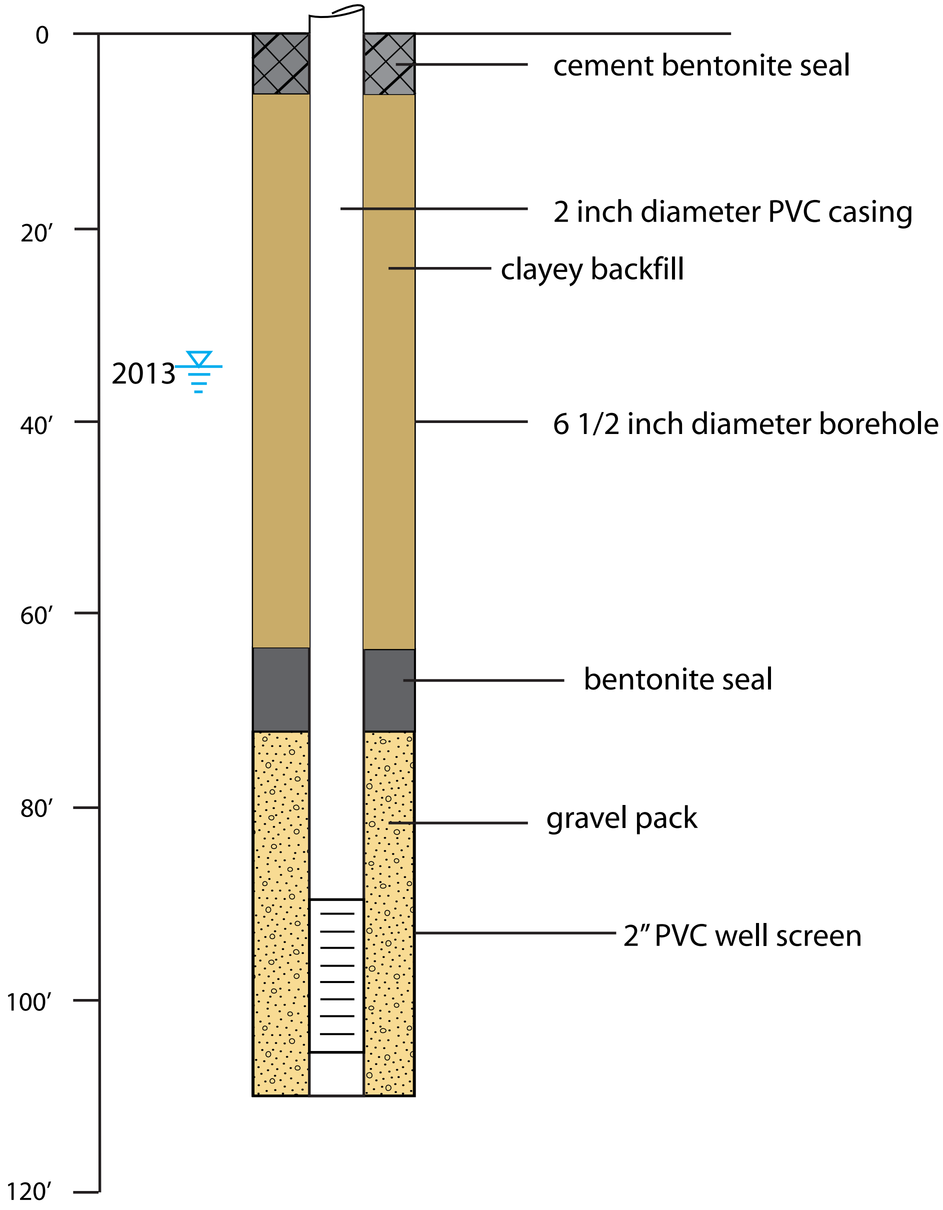


Figure A19. Well diagram, NP-2, Copper Flat Mine, Sierra County, New Mexico.

3-12-2014; KJ

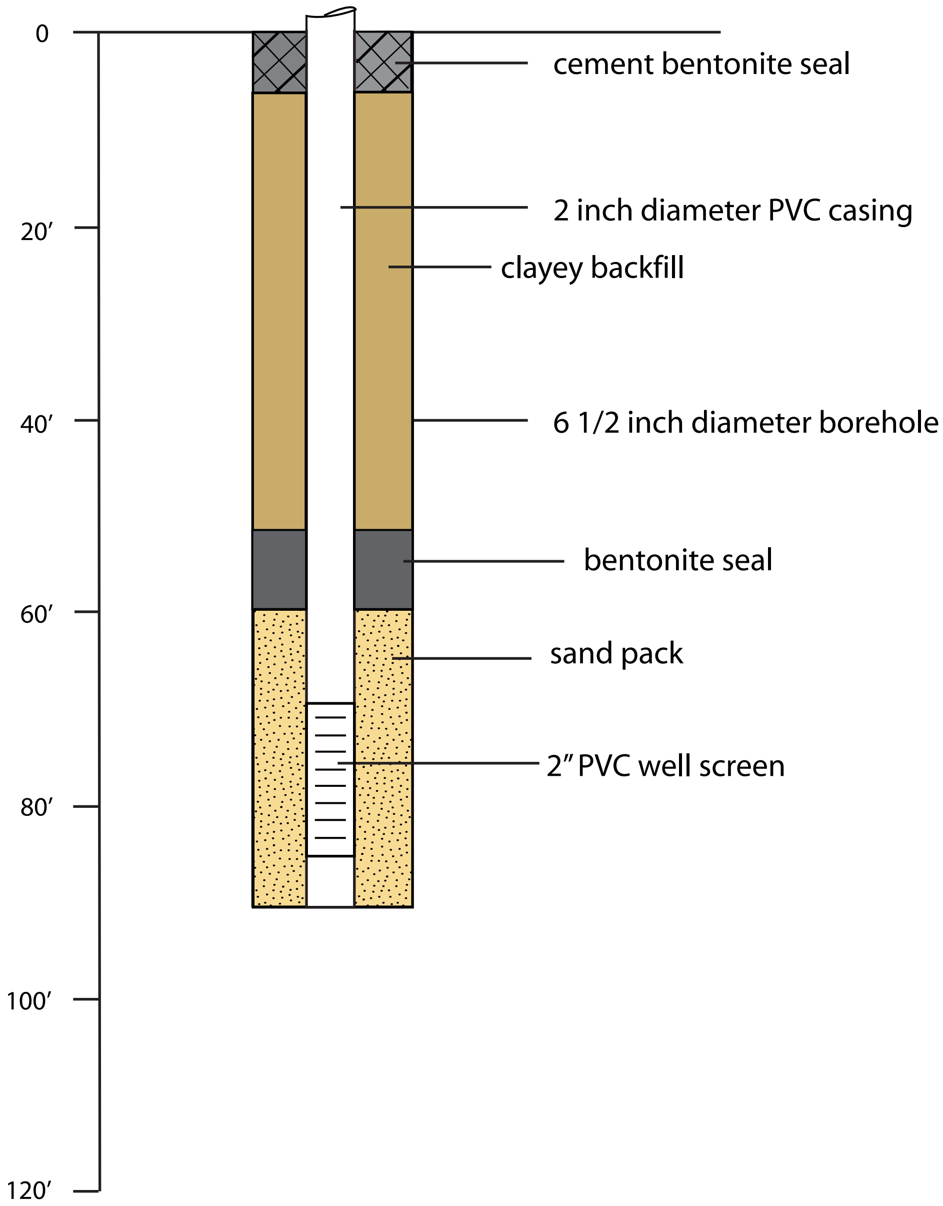


Figure A20. Well diagram, NP-3, Copper Flat Mine, Sierra County, New Mexico.

Appendix B.

Laboratory reports for 3rd and 4th Quarter 2013 sampling

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

July 26, 2013

Steve Finch

John Shomaker & Assoc.
2611 Broadbent Parkway NE
Albuquerque, NM 87107
TEL: (505) 345-3407
FAX (505) 345-9920

RE: Copper Flat OrderNo.: 1307586

Dear Steve Finch:

Hall Environmental Analysis Laboratory received 6 sample(s) on 7/12/2013 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0190

Sincerely,

Andy

Andy Freeman
Laboratory Manager
4901 Hawkins NE
Albuquerque, NM 87109

Analytical Report
Lab Order **1307586**
Date Reported: **7/26/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: Copper Flat
Lab ID: 1307586-001 **Matrix:** AQUEOUS

Client Sample ID: GWQ11-26
Collection Date: 7/9/2013 12:30:00 PM
Received Date: 7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	0.469	0.100		mg/L	1	7/16/2013 8:07:08 PM	R11994
Chloride	16.3	0.500		mg/L	1	7/16/2013 8:07:08 PM	R11994
Sulfate	97.9	10.0		mg/L	20	7/16/2013 8:19:32 PM	R11994
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	0.153	0.0200		mg/L	1	7/18/2013 12:09:56 PM	R12047
Cadmium	ND	0.00200		mg/L	1	7/18/2013 12:09:56 PM	R12047
Calcium	96.7	1.00		mg/L	1	7/18/2013 12:09:56 PM	R12047
Cobalt	ND	0.00600		mg/L	1	7/18/2013 12:09:56 PM	R12047
Copper	ND	0.00600		mg/L	1	7/18/2013 12:09:56 PM	R12047
Magnesium	20.8	1.00		mg/L	1	7/18/2013 12:09:56 PM	R12047
Manganese	0.0437	0.00200		mg/L	1	7/18/2013 12:09:56 PM	R12047
Potassium	1.69	1.00		mg/L	1	7/18/2013 12:09:56 PM	R12047
Sodium	71.6	1.00		mg/L	1	7/18/2013 12:09:56 PM	R12047
Zinc	0.0126	0.0100		mg/L	1	7/18/2013 12:09:56 PM	R12047
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	0.00334	0.00100		mg/L	1	7/17/2013 6:26:21 PM	R12020
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	361	20.0		mg/L CaCO3	1	7/12/2013 9:54:24 PM	R11927
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/12/2013 9:54:24 PM	R11927
Total Alkalinity (as CaCO3)	361	20.0		mg/L CaCO3	1	7/12/2013 9:54:24 PM	R11927
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	317	20.0		mg/L	1	7/17/2013 10:28:00 AM	8379

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Hall Environmental Analysis Laboratory, Inc.

Date Reported: **7/26/2013**

CLIENT: John Shomaker & Assoc.
Client Sample ID: GWQ11-24A
Project: Copper Flat
Collection Date: 7/9/2013 5:10:00 PM
Lab ID: 1307586-002
Matrix: AQUEOUS
Received Date: 7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	24.4	2.00	*	mg/L	20	7/16/2013 8:44:20 PM	R11994
Chloride	29.6	10.0		mg/L	20	7/16/2013 8:44:20 PM	R11994
Sulfate	2720	50.0	*	mg/L	100	7/19/2013 6:22:22 PM	R12091
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	53.9	10.0	*	mg/L	500	7/18/2013 2:36:28 PM	R12047
Cadmium	0.199	0.0100	*	mg/L	5	7/18/2013 12:17:18 PM	R12047
Calcium	415	5.00		mg/L	5	7/18/2013 12:17:18 PM	R12047
Cobalt	0.302	0.0300		mg/L	5	7/18/2013 12:17:18 PM	R12047
Copper	129	3.00	*	mg/L	500	7/18/2013 2:36:28 PM	R12047
Magnesium	110	5.00		mg/L	5	7/18/2013 12:17:18 PM	R12047
Manganese	12.6	0.100	*	mg/L	50	7/18/2013 2:34:05 PM	R12047
Potassium	7.11	5.00		mg/L	5	7/18/2013 12:17:18 PM	R12047
Sodium	121	5.00		mg/L	5	7/18/2013 12:17:18 PM	R12047
Zinc	8.18	0.500	*	mg/L	50	7/18/2013 2:34:05 PM	R12047
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	0.0566	0.0500	*	mg/L	50	7/18/2013 3:40:58 PM	R12053
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	ND	20.0		mg/L CaCO3	1	7/12/2013 10:09:58 PM	R11927
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/12/2013 10:09:58 PM	R11927
Total Alkalinity (as CaCO3)	ND	20.0		mg/L CaCO3	1	7/12/2013 10:09:58 PM	R11927
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	4400	40.0	*	mg/L	1	7/17/2013 10:28:00 AM	8379

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Analytical Report
Lab Order **1307586**
Date Reported: **7/26/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT:	John Shomaker & Assoc.			**Client Sample ID:**	GWQ11-24B
Project:	Copper Flat			**Collection Date:**	7/9/2013 5:40:00 PM
Lab ID:	1307586-003	**Matrix:**	AQUEOUS	**Received Date:**	7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	4.28	2.00	*	mg/L	20	7/16/2013 9:09:10 PM	R11994
Chloride	27.8	10.0		mg/L	20	7/16/2013 9:09:10 PM	R11994
Sulfate	1360	25.0	*	mg/L	50	7/18/2013 1:26:43 AM	R12042
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	0.0216	0.0200		mg/L	1	7/18/2013 12:29:10 PM	R12047
Cadmium	ND	0.00200		mg/L	1	7/18/2013 12:29:10 PM	R12047
Calcium	393	5.00		mg/L	5	7/18/2013 12:31:30 PM	R12047
Cobalt	0.0167	0.00600		mg/L	1	7/18/2013 12:29:10 PM	R12047
Copper	ND	0.00600		mg/L	1	7/18/2013 12:29:10 PM	R12047
Magnesium	74.5	1.00		mg/L	1	7/18/2013 12:29:10 PM	R12047
Manganese	3.30	0.0100	*	mg/L	5	7/18/2013 12:31:30 PM	R12047
Potassium	6.37	1.00		mg/L	1	7/18/2013 12:29:10 PM	R12047
Sodium	91.2	5.00		mg/L	5	7/19/2013 12:00:31 PM	R12085
Zinc	0.217	0.0100		mg/L	1	7/18/2013 12:29:10 PM	R12047
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	0.00391	0.00100		mg/L	1	7/17/2013 6:31:40 PM	R12020
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	181	20.0		mg/L CaCO3	1	7/12/2013 10:14:13 PM	R11927
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/12/2013 10:14:13 PM	R11927
Total Alkalinity (as CaCO3)	181	20.0		mg/L CaCO3	1	7/12/2013 10:14:13 PM	R11927
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	2350	40.0	*	mg/L	1	7/17/2013 10:28:00 AM	8379

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Analytical Report
Lab Order **1307586**
Date Reported: **7/26/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: Copper Flat
Lab ID: 1307586-004 **Matrix:** AQUEOUS

Client Sample ID: GWQ11-25A
Collection Date: 7/10/2013 9:45:00 AM
Received Date: 7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	221	10.0	*	mg/L	100	7/16/2013 9:58:49 PM	R11994
Chloride	10.3	5.00		mg/L	10	7/16/2013 9:46:25 PM	R11994
Sulfate	17900	250	*	mg/L	500	7/18/2013 1:39:07 AM	R12042
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	1600	100	*	mg/L	5E	7/18/2013 3:13:14 PM	R12047
Cadmium	ND	1.00		mg/L	500	7/18/2013 2:57:13 PM	R12047
Calcium	ND	500		mg/L	500	7/18/2013 2:57:13 PM	R12047
Cobalt	4.67	3.00		mg/L	500	7/18/2013 2:57:13 PM	R12047
Copper	60.4	3.00	*	mg/L	500	7/18/2013 2:57:13 PM	R12047
Magnesium	ND	500		mg/L	500	7/18/2013 2:57:13 PM	R12047
Manganese	78.3	1.00	*	mg/L	500	7/18/2013 2:57:13 PM	R12047
Potassium	ND	500		mg/L	500	7/18/2013 2:57:13 PM	R12047
Sodium	ND	500		mg/L	500	7/19/2013 12:02:45 PM	R12085
Zinc	41.4	5.00	*	mg/L	500	7/18/2013 2:57:13 PM	R12047
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	ND	0.500	*	mg/L	500	7/18/2013 3:59:37 PM	R12053
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	ND	20.0		mg/L CaCO3	1	7/12/2013 10:25:49 PM	R11927
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/12/2013 10:25:49 PM	R11927
Total Alkalinity (as CaCO3)	ND	20.0		mg/L CaCO3	1	7/12/2013 10:25:49 PM	R11927
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	27700	200	*	mg/L	1	7/17/2013 10:28:00 AM	8379

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

CLIENT: John Shomaker & Assoc.
Client Sample ID: GWQ11-25B
Project: Copper Flat
Collection Date: 7/10/2013 10:07:00 AM
Lab ID: 1307586-005
Matrix: AQUEOUS
Received Date: 7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	8.82	2.00	*	mg/L	20	7/16/2013 10:23:37 PM	R11994
Chloride	26.9	10.0		mg/L	20	7/16/2013 10:23:37 PM	R11994
Sulfate	1350	25.0	*	mg/L	50	7/18/2013 1:51:32 AM	R12042
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	0.364	0.0200	*	mg/L	1	7/18/2013 12:38:41 PM	R12047
Cadmium	ND	0.00200		mg/L	1	7/18/2013 12:38:41 PM	R12047
Calcium	441	5.00		mg/L	5	7/18/2013 12:41:05 PM	R12047
Cobalt	ND	0.00600		mg/L	1	7/18/2013 12:38:41 PM	R12047
Copper	ND	0.00600		mg/L	1	7/18/2013 12:38:41 PM	R12047
Magnesium	67.5	1.00		mg/L	1	7/18/2013 12:38:41 PM	R12047
Manganese	3.00	0.0100	*	mg/L	5	7/18/2013 12:41:05 PM	R12047
Potassium	3.77	1.00		mg/L	1	7/18/2013 12:38:41 PM	R12047
Sodium	125	5.00		mg/L	5	7/19/2013 12:05:05 PM	R12085
Zinc	0.0298	0.0100		mg/L	1	7/18/2013 12:38:41 PM	R12047
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	0.00526	0.00100		mg/L	1	7/17/2013 6:36:59 PM	R12020
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	342	20.0		mg/L CaCO3	1	7/12/2013 10:30:06 PM	R11927
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/12/2013 10:30:06 PM	R11927
Total Alkalinity (as CaCO3)	342	20.0		mg/L CaCO3	1	7/12/2013 10:30:06 PM	R11927
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	2510	20.0	*	mg/L	1	7/17/2013 10:28:00 AM	8379

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Analytical Report
Lab Order **1307586**
Date Reported: **7/26/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT:	John Shomaker & Assoc.			**Client Sample ID:**	Pit Lake
Project:	Copper Flat			**Collection Date:**	7/10/2013 10:35:00 AM
Lab ID:	1307586-006	**Matrix:**	AQUEOUS	**Received Date:**	7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	24.6	1.00	*	mg/L	10	7/16/2013 10:36:01 PM	R11994
Chloride	714	50.0	*	mg/L	100	7/16/2013 10:48:26 PM	R11994
Sulfate	8690	100	*	mg/L	200	7/18/2013 2:03:57 AM	R12042
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	0.214	0.0200	*	mg/L	1	7/18/2013 12:43:35 PM	R12047
Cadmium	0.0379	0.00200	*	mg/L	1	7/18/2013 12:43:35 PM	R12047
Calcium	539	50.0		mg/L	50	7/18/2013 3:01:41 PM	R12047
Cobalt	0.0489	0.00600		mg/L	1	7/18/2013 12:43:35 PM	R12047
Copper	0.0466	0.00600		mg/L	1	7/18/2013 12:43:35 PM	R12047
Magnesium	1120	50.0		mg/L	50	7/18/2013 3:01:41 PM	R12047
Manganese	29.5	0.100	*	mg/L	50	7/18/2013 3:01:41 PM	R12047
Potassium	60.6	1.00		mg/L	1	7/18/2013 12:43:35 PM	R12047
Sodium	1400	50.0		mg/L	50	7/19/2013 12:07:35 PM	R12085
Zinc	0.877	0.0100		mg/L	1	7/18/2013 12:43:35 PM	R12047
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	0.0591	0.0200	*	mg/L	20	7/18/2013 3:48:58 PM	R12053
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	111	20.0		mg/L CaCO3	1	7/12/2013 11:22:48 PM	R11927
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/12/2013 11:22:48 PM	R11927
Total Alkalinity (as CaCO3)	111	20.0		mg/L CaCO3	1	7/12/2013 11:22:48 PM	R11927
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	14800	200	*	mg/L	1	7/17/2013 10:28:00 AM	8379

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	07/19/13
Project:	Not Indicated	**Collection Date:**	07/09/13 12:30
Lab ID:	B13071276-001	**DateReceived:**	07/16/13
Client Sample ID	1307586-001C, GWQ11-26	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	12	mg/L		4		A2310 B	07/17/13 12:14 / hmb

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	07/19/13
Project:	Not Indicated	**Collection Date:**	07/09/13 17:10
Lab ID:	B13071276-002	**DateReceived:**	07/16/13
Client Sample ID	1307586-002C, GWQ11-24	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	665	mg/L		4		A2310 B	07/16/13 17:38 / hmb

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	07/19/13
Project:	Not Indicated	**Collection Date:**	07/09/13 17:40
Lab ID:	B13071276-003	**DateReceived:**	07/16/13
Client Sample ID	1307586-003C, GWQ11-24B	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	79	mg/L		4		A2310 B	07/16/13 17:49 / hmb

Report Definitions:	RL - Analyte reporting limit. QCL - Quality control limit.	MCL - Maximum contaminant level. ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	07/19/13
Project:	Not Indicated	**Collection Date:**	07/10/13 09:45
Lab ID:	B13071276-004	**DateReceived:**	07/16/13
Client Sample ID	1307586-004C, GWQ11-25A	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as $CaCO_3$	14800	mg/L		4		A2310 B	07/17/13 16:44 / hmb

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Hall Environmental
Project: Not Indicated
Lab ID: B13071276-005
Client Sample ID 1307586-005C, GWQ11-25B

Report Date: 07/19/13
Collection Date: 07/10/13 10:07
DateReceived: 07/16/13
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	76	mg/L		4		A2310 B	07/16/13 18:02 / hmb

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	07/19/13
Project:	Not Indicated	**Collection Date:**	07/10/13 10:35
Lab ID:	B13071276-006	**DateReceived:**	07/16/13
Client Sample ID	1307586-006C, Pit Lake	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	32	mg/L		4		A2310 B	07/16/13 18:11 / hmb

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hall Environmental **Report Date:** 07/19/13

Project: Not Indicated **Work Order:** B13071276

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2310 B										Batch: R208273
Sample ID: MBLK	Method Blank					Run: Metrohm 2_130716A				07/16/13 17:05
Acidity, Total as CaCO3		2	mg/L	0.3						
Sample ID: LCS	Laboratory Control Sample					Run: Metrohm 2_130716A				07/16/13 17:11
Acidity, Total as CaCO3		1050	mg/L	4.0	99	90	110			
Method: A2310 B										Batch: R208273
Sample ID: B13071276-001ADUP	Sample Duplicate					Run: Metrohm 2_130717A				07/17/13 12:21
Acidity, Total as CaCO3		11.1	mg/L	4.0				4.7	10	
Method: A2310 B										Batch: ACID130717B
Sample ID: MBLK	Method Blank					Run: ORION555A_130717A				07/17/13 15:57
Acidity, Total as CaCO3		1	mg/L							
Sample ID: LCS	Laboratory Control Sample					Run: ORION555A_130717A				07/17/13 16:23
Acidity, Total as CaCO3		1100	mg/L	4.0	105	90	110			
Sample ID: B13071276-001ADUP	Sample Duplicate					Run: ORION555A_130717A				07/17/13 16:41
Acidity, Total as CaCO3		12.0	mg/L	4.0				3.0	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1307586**

26-Jul-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **MB**	SampType: **MBLK**	TestCode: **EPA Method 200.7: Dissolved Metals**	
Client ID: **PBW**	Batch ID: **R12047**	RunNo: **12047**	
Prep Date:	Analysis Date: **7/18/2013**	SeqNo: **342447**	Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	ND	0.020								
Cadmium	ND	0.0020								
Calcium	ND	1.0								
Cobalt	ND	0.0060								
Copper	ND	0.0060								
Magnesium	ND	1.0								
Manganese	ND	0.0020								
Potassium	ND	1.0								
Sodium	ND	1.0								
Zinc	ND	0.010								

Sample ID **LCS**	SampType: **LCS**	TestCode: **EPA Method 200.7: Dissolved Metals**	
Client ID: **LCSW**	Batch ID: **R12047**	RunNo: **12047**	
Prep Date:	Analysis Date: **7/18/2013**	SeqNo: **342448**	Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	0.50	0.020	0.5000	0	99.5	85	115			
Cadmium	0.47	0.0020	0.5000	0	93.8	85	115			
Calcium	46	1.0	50.00	0	91.6	85	115			
Cobalt	0.46	0.0060	0.5000	0	92.7	85	115			
Copper	0.46	0.0060	0.5000	0	92.4	85	115			
Magnesium	46	1.0	50.00	0	92.0	85	115			
Manganese	0.47	0.0020	0.5000	0	93.3	85	115			
Potassium	44	1.0	50.00	0	88.9	85	115			
Sodium	45	1.0	50.00	0	89.9	85	115			
Zinc	0.46	0.010	0.5000	0	91.7	85	115			

Sample ID **MB**	SampType: **MBLK**	TestCode: **EPA Method 200.7: Dissolved Metals**	
Client ID: **PBW**	Batch ID: **R12085**	RunNo: **12085**	
Prep Date:	Analysis Date: **7/19/2013**	SeqNo: **343620**	Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sodium	ND	1.0								

Sample ID **LCS**	SampType: **LCS**	TestCode: **EPA Method 200.7: Dissolved Metals**	
Client ID: **LCSW**	Batch ID: **R12085**	RunNo: **12085**	
Prep Date:	Analysis Date: **7/19/2013**	SeqNo: **343621**	Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sodium	49	1.0	50.00	0	97.2	85	115			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Client: John Shomaker & Assoc.
Project: Copper Flat

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R12020** RunNo: **12020**
Prep Date: Analysis Date: **7/17/2013** SeqNo: **341682** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	0.024	0.0010	0.02500	0	96.7	85	115			

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R12020** RunNo: **12020**
Prep Date: Analysis Date: **7/17/2013** SeqNo: **341683** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	0.024	0.0010	0.02500	0	96.5	85	115			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **PBW** Batch ID: **R12020** RunNo: **12020**
Prep Date: Analysis Date: **7/17/2013** SeqNo: **341684** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	ND	0.0010								

Sample ID **MB** SampType: **MBLK** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **PBW** Batch ID: **R12020** RunNo: **12020**
Prep Date: Analysis Date: **7/17/2013** SeqNo: **341685** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	ND	0.0010								

Sample ID **MB** SampType: **MBLK** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **PBW** Batch ID: **R12053** RunNo: **12053**
Prep Date: Analysis Date: **7/18/2013** SeqNo: **342776** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	ND	0.0010								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R12053** RunNo: **12053**
Prep Date: Analysis Date: **7/18/2013** SeqNo: **342779** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	0.024	0.0010	0.02500	0	97.6	85	115			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

QC SUMMARY REPORT
Hall Environmental Analysis Laboratory, Inc.

WO#: **1307586**

26-Jul-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R11994** RunNo: **11994**
Prep Date: Analysis Date: **7/16/2013** SeqNo: **341115** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	ND	0.10								
Chloride	ND	0.50								
Sulfate	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R11994** RunNo: **11994**
Prep Date: Analysis Date: **7/16/2013** SeqNo: **341116** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.49	0.10	0.5000	0	98.0	90	110			
Chloride	4.6	0.50	5.000	0	91.5	90	110			
Sulfate	9.3	0.50	10.00	0	92.8	90	110			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R11994** RunNo: **11994**
Prep Date: Analysis Date: **7/17/2013** SeqNo: **341169** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	ND	0.10								
Chloride	ND	0.50								
Sulfate	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R11994** RunNo: **11994**
Prep Date: Analysis Date: **7/17/2013** SeqNo: **341170** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.52	0.10	0.5000	0	103	90	110			
Chloride	4.6	0.50	5.000	0	91.3	90	110			
Sulfate	9.3	0.50	10.00	0	92.9	90	110			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R12042** RunNo: **12042**
Prep Date: Analysis Date: **7/17/2013** SeqNo: **342203** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	ND	0.50								

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1307586**

26-Jul-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID	**LCS**	SampType:	**LCS**	TestCode:	**EPA Method 300.0: Anions**		
Client ID:	**LCSW**	Batch ID:	**R12042**	RunNo:	**12042**		
Prep Date:		Analysis Date:	**7/17/2013**	SeqNo:	**342204**	Units:	**mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	9.6	0.50	10.00	0	96.5	90	110			

Sample ID	**MB**	SampType:	**MBLK**	TestCode:	**EPA Method 300.0: Anions**		
Client ID:	**PBW**	Batch ID:	**R12091**	RunNo:	**12091**		
Prep Date:		Analysis Date:	**7/19/2013**	SeqNo:	**343759**	Units:	**mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	ND	0.50								

Sample ID	**LCS**	SampType:	**LCS**	TestCode:	**EPA Method 300.0: Anions**		
Client ID:	**LCSW**	Batch ID:	**R12091**	RunNo:	**12091**		
Prep Date:		Analysis Date:	**7/19/2013**	SeqNo:	**343760**	Units:	**mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	9.9	0.50	10.00	0	99.5	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1307586**

26-Jul-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **mb-1** SampType: **mblk** TestCode: **SM2320B: Alkalinity**
Client ID: **PBW** Batch ID: **R11927** RunNo: **11927**
Prep Date: Analysis Date: **7/12/2013** SeqNo: **339134** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-1** SampType: **lcs** TestCode: **SM2320B: Alkalinity**
Client ID: **LCSW** Batch ID: **R11927** RunNo: **11927**
Prep Date: Analysis Date: **7/12/2013** SeqNo: **339135** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	80	20	80.00	0	100	90	110			

Sample ID **mb-2** SampType: **mblk** TestCode: **SM2320B: Alkalinity**
Client ID: **PBW** Batch ID: **R11927** RunNo: **11927**
Prep Date: Analysis Date: **7/12/2013** SeqNo: **339154** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-2** SampType: **lcs** TestCode: **SM2320B: Alkalinity**
Client ID: **LCSW** Batch ID: **R11927** RunNo: **11927**
Prep Date: Analysis Date: **7/12/2013** SeqNo: **339155** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	80	20	80.00	0	99.7	90	110			

Sample ID **1307586-005a ms** SampType: **ms** TestCode: **SM2320B: Alkalinity**
Client ID: **GWQ11-25B** Batch ID: **R11927** RunNo: **11927**
Prep Date: Analysis Date: **7/12/2013** SeqNo: **339173** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	407	20.0	80.00	342.0	80.8	18.3	129			

Sample ID **1307586-005a msd** SampType: **msd** TestCode: **SM2320B: Alkalinity**
Client ID: **GWQ11-25B** Batch ID: **R11927** RunNo: **11927**
Prep Date: Analysis Date: **7/12/2013** SeqNo: **339174** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	403	20.0	80.00	342.0	76.4	18.3	129	0.869	10	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1307586**

26-Jul-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID	**MB-8379**	SampType:	**MBLK**	TestCode:	**SM2540C MOD: Total Dissolved Solids**		
Client ID:	**PBW**	Batch ID:	**8379**	RunNo:	**11989**		
Prep Date:	**7/15/2013**	Analysis Date:	**7/17/2013**	SeqNo:	**340983**	Units:	**mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	ND	20.0								

Sample ID	**LCS-8379**	SampType:	**LCS**	TestCode:	**SM2540C MOD: Total Dissolved Solids**		
Client ID:	**LCSW**	Batch ID:	**8379**	RunNo:	**11989**		
Prep Date:	**7/15/2013**	Analysis Date:	**7/17/2013**	SeqNo:	**340984**	Units:	**mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	1020	20.0	1000	0	102	80	120			

Sample ID	**1307586-002AMS**	SampType:	**MS**	TestCode:	**SM2540C MOD: Total Dissolved Solids**		
Client ID:	**GWQ11-24A**	Batch ID:	**8379**	RunNo:	**11989**		
Prep Date:	**7/15/2013**	Analysis Date:	**7/17/2013**	SeqNo:	**341001**	Units:	**mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	6460	40.0	2000	4396	103	80	120			

Sample ID	**1307586-002AMSD**	SampType:	**MSD**	TestCode:	**SM2540C MOD: Total Dissolved Solids**		
Client ID:	**GWQ11-24A**	Batch ID:	**8379**	RunNo:	**11989**		
Prep Date:	**7/15/2013**	Analysis Date:	**7/17/2013**	SeqNo:	**341002**	Units:	**mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	6330	40.0	2000	4396	96.9	80	120	1.91	5	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

Sample Log-In Check List

Client Name: SHO

Work Order Number: 1307586

RcptNo: 1

Received by/date: AT 07/12/13

Logged By: Anne Thorne 7/12/2013 12:15:00 PM

Completed By: Anne Thorne 7/12/2013

Reviewed By: IO 07/12/13

Chain of Custody

1. Custody seals intact on sample bottles? Yes ☐ No ☐ Not Present ☑
2. Is Chain of Custody complete? Yes ☑ No ☐ Not Present ☐
3. How was the sample delivered? Client

Log In

4. Was an attempt made to cool the samples? Yes ☑ No ☐ NA ☐
5. Were all samples received at a temperature of >0° C to 6.0°C Yes ☑ No ☐ NA ☐
6. Sample(s) in proper container(s)? Yes ☑ No ☐
7. Sufficient sample volume for indicated test(s)? Yes ☑ No ☐
8. Are samples (except VOA and ONG) properly preserved? Yes ☑ No ☐
9. Was preservative added to bottles? Yes ☐ No ☑ NA ☐
10. VOA vials have zero headspace? Yes ☐ No ☐ No VOA Vials ☑
11. Were any sample containers received broken? Yes ☐ No ☑
12. Does paperwork match bottle labels? (Note discrepancies on chain of custody) Yes ☑ No ☐
13. Are matrices correctly identified on Chain of Custody? Yes ☑ No ☐
14. Is it clear what analyses were requested? Yes ☑ No ☐
15. Were all holding times able to be met? (If no, notify customer for authorization.) Yes ☑ No ☐

# of preserved bottles checked for pH:
(<2 or >12 unless noted)
Adjusted? ~~AT~~ no adjustments AT 07/12/13
Checked by: AT 07/12/13

Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified:
Date
By Whom:
Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:
Client Instructions:

17. Additional remarks:

18. **Cooler Information**

Cooler No	Temp °C	Condition	Seal Intact	Seal No	Seal Date	Signed By
1	1.0	Good	Not Present			

Chain-of-Custody Record

List A

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com

4901 Hawkins NE - Albuquerque, NM 87109

Tel. 505-345-3975 Fax 505-345-4107

Client: JSAI

Mailing Address: 2611 Broadbent Pkwy NE

Albuquerque, NM 87107

Phone #: (505) 345-3407

email or Fax#: sfinch@shomaker.com

QA/QC Package:

☑ Standard ☐ Level 4 (Full Validation)

Accreditation

☐ NELAP ☐ Other ______

☐ EDD (Type) ______

Turn-Around Time:

☑ Standard ☐ Rush ______

Project Name: Copper Flat

Project #:

Project Manager: Steve Finch

Sampler: MW/KE/JJK

On Ice: ☑ Yes ☐ No

Sample Temperature: 1.0

Analysis Request

Date 2013	Time	Matrix	Sample Request ID	Container Type and #	Preservative Type	HEAL No. 1307586	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH 8015B (GRO / DRO / MRO)	TPH (Method 418.1)	EDB (Method 504.1)	PAH's (8310 or 8270 SIMS)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)		List A			Air Bubbles (Y or N)
7/9	12:30	H_2O	GWQ11-26	3	HNO_3/None	-001													✓			
7/9	17:10	H_2O	GWQ11-24A	3	HNO_3/None	-002													✓			
7/9	17:40	H_2O	GWQ11-24B	3	HNO_3/None	-003													✓			
7/10	09:45	H_2O	GWQ11-25A	3	HNO_3/None	-004													✓			
7/10	10:07	H_2O	GWQ11-25B	3	HNO_3/None	-005													✓			
7/10	10:35	H_2O	Pit Lake	3	HNO_3/None	-006													✓			

Date:	Time:	Relinquished by:	Received by:	Date	Time
7/12/13	12:15			07/12/13	1215
Date:	Time:	Relinquished by:	Received by:	Date	Time

Remarks: List A.
email results to sfinch@shomaker.com

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

NMCC Copper Flat Stage 1 Abatement Lab Sampling Analysis

List A* Pit Area Groundwater	List B[†] Waste Rock Pile and Tailings Impoundment Area Groundwater
Al	Total Dissolved Solids
Cd	Sulfate
Co	Chloride
Cu	Alkalinity
Mn	Ca
Se	Mg
Zn	Na
Ca	K
Mg	
Na	
K	
Alkalinity	
Total Acidity	
Chloride	
Flouride	
Sulfate	
Total Dissolved Solids	

*List A metals are for dissolved metals (filtered)

[†] List B metals are for total metals (NOT filtered)

HALL
ENVIRONMENTAL
ANALYSIS
LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

July 23, 2013

Steve Finch

John Shomaker & Assoc.
2611 Broadbent Parkway NE
Albuquerque, NM 87107
TEL: (505) 345-3407
FAX (505) 345-9920

RE: Copper Flat OrderNo.: 1307572

Dear Steve Finch:

Hall Environmental Analysis Laboratory received 3 sample(s) on 7/12/2013 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0190

Sincerely,

Andy

Andy Freeman
Laboratory Manager
4901 Hawkins NE
Albuquerque, NM 87109

Analytical Report
Lab Order **1307572**
Date Reported: **7/23/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Client Sample ID: SWQ-1
Project: Copper Flat
Collection Date: 7/9/2013 11:39:00 PM
Lab ID: 1307572-001
Matrix: AQUEOUS
Received Date: 7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	ND	0.500		mg/L	5	7/17/2013 11:59:51 PM	R12042
Chloride	3.48	2.50		mg/L	5	7/17/2013 11:59:51 PM	R12042
Sulfate	5.64	2.50		mg/L	5	7/17/2013 11:59:51 PM	R12042
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	17.3	1.00	*	mg/L	50	7/18/2013 2:24:57 PM	R12047
Cadmium	ND	0.00200		mg/L	1	7/18/2013 11:57:28 AM	R12047
Calcium	27.1	1.00		mg/L	1	7/18/2013 11:57:28 AM	R12047
Cobalt	0.0149	0.00600		mg/L	1	7/18/2013 11:57:28 AM	R12047
Copper	0.0360	0.00600		mg/L	1	7/18/2013 11:57:28 AM	R12047
Magnesium	7.63	1.00		mg/L	1	7/18/2013 11:57:28 AM	R12047
Manganese	1.32	0.0100	*	mg/L	5	7/18/2013 11:59:34 AM	R12047
Potassium	8.52	1.00		mg/L	1	7/18/2013 11:57:28 AM	R12047
Sodium	4.68	1.00		mg/L	1	7/18/2013 11:57:28 AM	R12047
Zinc	0.0796	0.0100		mg/L	1	7/18/2013 11:57:28 AM	R12047
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	ND	0.0100		mg/L	10	7/17/2013 5:59:44 PM	R12020
SM4500-H+B: PH						Analyst:	**JML**
pH	7.20	1.68	H	pH units	1	7/12/2013 9:31:45 PM	R11927
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	64.1	20.0		mg/L CaCO3	1	7/12/2013 9:31:45 PM	R11927
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/12/2013 9:31:45 PM	R11927
Total Alkalinity (as CaCO3)	64.1	20.0		mg/L CaCO3	1	7/12/2013 9:31:45 PM	R11927
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	620	200	*	mg/L	1	7/17/2013 10:28:00 AM	8379

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

CLIENT: John Shomaker & Assoc.
Client Sample ID: SWQ-3
Project: Copper Flat
Collection Date: 7/11/2013 8:35:00 AM
Lab ID: 1307572-002
Matrix: AQUEOUS
Received Date: 7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	ND	0.500		mg/L	5	7/18/2013 12:12:15 AM	R12042
Chloride	16.1	5.00		mg/L	10	7/17/2013 12:50:48 AM	R11991
Sulfate	455	5.00	*	mg/L	10	7/17/2013 12:50:48 AM	R11991
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	1.83	0.400	*	mg/L	20	7/18/2013 2:27:17 PM	R12047
Cadmium	ND	0.00200		mg/L	1	7/18/2013 12:01:31 PM	R12047
Calcium	100	5.00		mg/L	5	7/18/2013 12:03:46 PM	R12047
Cobalt	ND	0.00600		mg/L	1	7/18/2013 12:01:31 PM	R12047
Copper	0.0839	0.00600		mg/L	1	7/18/2013 12:01:31 PM	R12047
Magnesium	25.5	1.00		mg/L	1	7/18/2013 12:01:31 PM	R12047
Manganese	0.352	0.00200	*	mg/L	1	7/18/2013 12:01:31 PM	R12047
Potassium	7.63	1.00		mg/L	1	7/18/2013 12:01:31 PM	R12047
Sodium	67.0	1.00		mg/L	1	7/18/2013 12:01:31 PM	R12047
Zinc	0.0260	0.0100		mg/L	1	7/18/2013 12:01:31 PM	R12047
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	0.0220	0.0100		mg/L	10	7/17/2013 6:02:23 PM	R12020
SM4500-H+B: PH						Analyst:	**JML**
pH	7.55	1.68	H	pH units	1	7/12/2013 9:39:52 PM	R11927
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	44.7	20.0		mg/L CaCO3	1	7/12/2013 9:39:52 PM	R11927
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/12/2013 9:39:52 PM	R11927
Total Alkalinity (as CaCO3)	44.7	20.0		mg/L CaCO3	1	7/12/2013 9:39:52 PM	R11927
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	1080	200	*	mg/L	1	7/17/2013 10:28:00 AM	8379

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Analytical Report
Lab Order **1307572**
Date Reported: **7/23/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Client Sample ID: SWQ-2
Project: Copper Flat
Collection Date: 7/11/2013 2:53:00 AM
Lab ID: 1307572-003
Matrix: AQUEOUS
Received Date: 7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	ND	0.500		mg/L	5	7/18/2013 12:24:40 AM	R12042
Chloride	ND	2.50		mg/L	5	7/18/2013 12:24:40 AM	R12042
Sulfate	21.0	2.50		mg/L	5	7/18/2013 12:24:40 AM	R12042
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	54.7	2.00	*	mg/L	100	7/18/2013 2:32:01 PM	R12047
Cadmium	ND	0.00200		mg/L	1	7/18/2013 12:05:52 PM	R12047
Calcium	21.7	1.00		mg/L	1	7/18/2013 12:05:52 PM	R12047
Cobalt	0.0111	0.00600		mg/L	1	7/18/2013 12:05:52 PM	R12047
Copper	0.0985	0.00600		mg/L	1	7/18/2013 12:05:52 PM	R12047
Magnesium	7.31	1.00		mg/L	1	7/18/2013 12:05:52 PM	R12047
Manganese	0.833	0.00200	*	mg/L	1	7/18/2013 12:05:52 PM	R12047
Potassium	7.13	1.00		mg/L	1	7/18/2013 12:05:52 PM	R12047
Sodium	3.98	1.00		mg/L	1	7/18/2013 12:05:52 PM	R12047
Zinc	0.0930	0.0100		mg/L	1	7/18/2013 12:05:52 PM	R12047
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	ND	0.0100		mg/L	10	7/17/2013 6:05:03 PM	R12020
SM4500-H+B: PH						Analyst:	**JML**
pH	7.19	1.68	H	pH units	1	7/12/2013 9:47:07 PM	R11927
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	34.1	20.0		mg/L CaCO3	1	7/12/2013 9:47:07 PM	R11927
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/12/2013 9:47:07 PM	R11927
Total Alkalinity (as CaCO3)	34.1	20.0		mg/L CaCO3	1	7/12/2013 9:47:07 PM	R11927
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	540	200	*	mg/L	1	7/17/2013 10:28:00 AM	8379

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	07/17/13
Project:	Not Indicated	**Collection Date:**	07/09/13 23:39
Lab ID:	B13071281-001	**DateReceived:**	07/16/13
Client Sample ID	1307572-001C, SWQ-1	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	10	mg/L		4		A2310 B	07/16/13 18:17 / hmb

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Hall Environmental
Project: Not Indicated
Lab ID: B13071281-002
Client Sample ID 1307572-002C, SWQ-3

Report Date: 07/17/13
Collection Date: 07/11/13 08:35
DateReceived: 07/16/13
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L		4		A2310 B	07/16/13 18:21 / hmb

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	07/17/13
Project:	Not Indicated	**Collection Date:**	07/11/13 02:53
Lab ID:	B13071281-003	**DateReceived:**	07/16/13
Client Sample ID	1307572-003C, SWQ-2	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	6	mg/L		4		A2310 B	07/16/13 18:25 / hmb

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hall Environmental

Project: Not Indicated

Report Date: 07/17/13

Work Order: B13071281

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2310 B										Batch: R208273
Sample ID: MBLK		Method Blank				Run: Metrohm 2_130716A				07/16/13 17:05
Acidity, Total as CaCO3		2	mg/L	0.3						
Sample ID: LCS		Laboratory Control Sample				Run: Metrohm 2_130716A				07/16/13 17:11
Acidity, Total as CaCO3		1050	mg/L	4.0	99	90	110			
Method: A2310 B										Batch: R208273
Sample ID: B13071276-001ADUP		Sample Duplicate				Run: Metrohm 2_130717A				07/17/13 12:21
Acidity, Total as CaCO3		11.1	mg/L	4.0				4.7	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Client: John Shomaker & Assoc.
Project: Copper Flat

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **PBW** Batch ID: **R12047** RunNo: **12047**
Prep Date: Analysis Date: **7/18/2013** SeqNo: **342447** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	ND	0.020								
Cadmium	ND	0.0020								
Calcium	ND	1.0								
Cobalt	ND	0.0060								
Copper	ND	0.0060								
Magnesium	ND	1.0								
Manganese	ND	0.0020								
Potassium	ND	1.0								
Sodium	ND	1.0								
Zinc	ND	0.010								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R12047** RunNo: **12047**
Prep Date: Analysis Date: **7/18/2013** SeqNo: **342448** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	0.50	0.020	0.5000	0	99.5	85	115			
Cadmium	0.47	0.0020	0.5000	0	93.8	85	115			
Calcium	46	1.0	50.00	0	91.6	85	115			
Cobalt	0.46	0.0060	0.5000	0	92.7	85	115			
Copper	0.46	0.0060	0.5000	0	92.4	85	115			
Magnesium	46	1.0	50.00	0	92.0	85	115			
Manganese	0.47	0.0020	0.5000	0	93.3	85	115			
Potassium	44	1.0	50.00	0	88.9	85	115			
Sodium	45	1.0	50.00	0	89.9	85	115			
Zinc	0.46	0.010	0.5000	0	91.7	85	115			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1307572**

23-Jul-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**

Client ID: **LCSW** Batch ID: **R12020** RunNo: **12020**

Prep Date: Analysis Date: **7/17/2013** SeqNo: **341682** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	0.024	0.0010	0.02500	0	96.7	85	115			

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**

Client ID: **LCSW** Batch ID: **R12020** RunNo: **12020**

Prep Date: Analysis Date: **7/17/2013** SeqNo: **341683** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	0.024	0.0010	0.02500	0	96.5	85	115			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA 200.8: Dissolved Metals**

Client ID: **PBW** Batch ID: **R12020** RunNo: **12020**

Prep Date: Analysis Date: **7/17/2013** SeqNo: **341684** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	ND	0.0010								

Sample ID **MB** SampType: **MBLK** TestCode: **EPA 200.8: Dissolved Metals**

Client ID: **PBW** Batch ID: **R12020** RunNo: **12020**

Prep Date: Analysis Date: **7/17/2013** SeqNo: **341685** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	ND	0.0010								

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1307572**

23-Jul-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**

Client ID: **PBW** Batch ID: **R11991** RunNo: **11991**

Prep Date: Analysis Date: **7/16/2013** SeqNo: **341039** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	ND	0.50								
Sulfate	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**

Client ID: **LCSW** Batch ID: **R11991** RunNo: **11991**

Prep Date: Analysis Date: **7/16/2013** SeqNo: **341040** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	4.5	0.50	5.000	0	90.1	90	110			
Sulfate	9.1	0.50	10.00	0	91.5	90	110			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**

Client ID: **PBW** Batch ID: **R12042** RunNo: **12042**

Prep Date: Analysis Date: **7/17/2013** SeqNo: **342203** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	ND	0.10								
Chloride	ND	0.50								
Sulfate	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**

Client ID: **LCSW** Batch ID: **R12042** RunNo: **12042**

Prep Date: Analysis Date: **7/17/2013** SeqNo: **342204** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.52	0.10	0.5000	0	104	90	110			
Chloride	4.7	0.50	5.000	0	94.9	90	110			
Sulfate	9.6	0.50	10.00	0	96.5	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1307572**

23-Jul-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **mb-1** SampType: **mblk** TestCode: **SM2320B: Alkalinity**
Client ID: **PBW** Batch ID: **R11927** RunNo: **11927**
Prep Date: Analysis Date: **7/12/2013** SeqNo: **339134** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-1** SampType: **lcs** TestCode: **SM2320B: Alkalinity**
Client ID: **LCSW** Batch ID: **R11927** RunNo: **11927**
Prep Date: Analysis Date: **7/12/2013** SeqNo: **339135** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	80	20	80.00	0	100	90	110			

Sample ID **mb-2** SampType: **mblk** TestCode: **SM2320B: Alkalinity**
Client ID: **PBW** Batch ID: **R11927** RunNo: **11927**
Prep Date: Analysis Date: **7/12/2013** SeqNo: **339154** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-2** SampType: **lcs** TestCode: **SM2320B: Alkalinity**
Client ID: **LCSW** Batch ID: **R11927** RunNo: **11927**
Prep Date: Analysis Date: **7/12/2013** SeqNo: **339155** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	80	20	80.00	0	99.7	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1307572**

23-Jul-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **MB-8379**		SampType: **MBLK**			TestCode: **SM2540C MOD: Total Dissolved Solids**					
Client ID: **PBW**		Batch ID: **8379**			RunNo: **11989**					
Prep Date: **7/15/2013**		Analysis Date: **7/17/2013**			SeqNo: **340983**		Units: **mg/L**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	ND	20.0								

Sample ID **LCS-8379**		SampType: **LCS**			TestCode: **SM2540C MOD: Total Dissolved Solids**					
Client ID: **LCSW**		Batch ID: **8379**			RunNo: **11989**					
Prep Date: **7/15/2013**		Analysis Date: **7/17/2013**			SeqNo: **340984**		Units: **mg/L**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	1020	20.0	1000	0	102	80	120			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

Sample Log-In Check List

Client Name: SHO

Work Order Number: 1307572

RcptNo: 1

Received by/date: AT 07/12/13

Logged By: Anne Thorne 7/12/2013 12:15:00 PM Anne Thorne

Completed By: Anne Thorne 7/12/2013 Anne Thorne

Reviewed By: IO 07/12/13

Chain of Custody

1. Custody seals intact on sample bottles? Yes ☐ No ☐ Not Present ☑
2. Is Chain of Custody complete? Yes ☑ No ☐ Not Present ☐
3. How was the sample delivered? Client

Log In

4. Was an attempt made to cool the samples? Yes ☑ No ☐ NA ☐
5. Were all samples received at a temperature of >0° C to 6.0°C Yes ☑ No ☐ NA ☐
6. Sample(s) in proper container(s)? Yes ☑ No ☐
7. Sufficient sample volume for indicated test(s)? Yes ☑ No ☐
8. Are samples (except VOA and ONG) properly preserved? Yes ☑ No ☐
9. Was preservative added to bottles? Yes ☐ No ☑ NA ☐
10. VOA vials have zero headspace? Yes ☐ No ☐ No VOA Vials ☑
11. Were any sample containers received broken? Yes ☐ No ☑
12. Does paperwork match bottle labels? Yes ☑ No ☐
(Note discrepancies on chain of custody)
13. Are matrices correctly identified on Chain of Custody? Yes ☑ No ☐
14. Is it clear what analyses were requested? Yes ☑ No ☐
15. Were all holding times able to be met? Yes ☑ No ☐
(If no, notify customer for authorization.)

# of preserved bottles checked for pH: 3
([✓ <2] or >12 unless noted)
Adjusted?
Checked by: AT 07/12/13

Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified:
Date
By Whom:
Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:
Client Instructions:

17. Additional remarks:
MARCO WIKSTROM CALLED TO ADD pH TO EACH SAMPLE AT 07/15/13

18. **Cooler Information**

Cooler No	Temp °C	Condition	Seal Intact	Seal No	Seal Date	Signed By
1	1.0	Good	Not Present			

Chain-of-Custody Record

Client: JSAI

2611 Broadbent Pkwy NE

Mailing Address:

Albuquerque NM, 87107

Phone #: (505) 345-3407

email or Fax#: sfinch@shomaker.com

QA/QC Package:

☑ Standard ☐ Level 4 (Full Validation)

Accreditation

☐ NELAP ☐ Other ____________

☐ EDD (Type) ____________

Turn-Around Time:

☑ Standard ☐ Rush ____________

Project Name: Copper Flat

Project #:

Project Manager: Steve Finch

Sampler: MW/JJK

On Ice: ☒ Yes ☐ No

Sample Temperature: 1.0

LIST A

~~Surface Water List~~

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com

4901 Hawkins NE - Albuquerque, NM 87109

Tel. 505-345-3975 Fax 505-345-4107

Date 2013	Time	Matrix	Sample Request ID	Container Type and #	Preservative Type	HEAL No. 1307572	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH 8015B (GRO / DRO / MRO)	TPH (Method 418.1)	EDB (Method 504.1)	PAH's (8310 or 8270 SIMS)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)	List A + pH	~~Surface Water List~~			Air Bubbles (Y or N)
7/9	23:39	H_2O	SWQ-1	4	H_2SO_4/None/ HNO_3	-001												✓	~~✓~~			
7/11	08:35	H_2O	SWQ-3	4	H_2SO_4/None/ HNO_3	-002												✓	~~✓~~			
7/11	02:53	H_2O	SWQ-2	4	H_2SO_4/None/ HNO_3	-003												✓	~~✓~~			

Date:	Time:	Relinquished by:	Received by:	Date	Time
7/12/13	12:15			07/12/13	1215

Date:	Time:	Relinquished by:	Received by:	Date	Time

Remarks: ~~Surface Water List~~

email results to sfinch@shomaker.com

List A. PH added per Marco Wikstrom on 7/15/13. KMS

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

NMCC Copper Flat Stage 1 Abatement Lab Sampling Analysis

List A* Pit Area Groundwater	List B† Waste Rock Pile and Tailings Impoundment Area Groundwater
Al	Total Dissolved Solids
Cd	Sulfate
Co	Chloride
Cu	Alkalinity
Mn	Ca
Se	Mg
Zn	Na
Ca	K
Mg	
Na	
K	
Alkalinity	
Total Acidity	
Chloride	
Flouride	
Sulfate	
Total Dissolved Solids	

*List A metals are for dissolved metals (filtered)

†List B metals are for total metals (NOT filtered)

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

July 26, 2013

Steve Finch
John Shomaker & Assoc.
2611 Broadbent Parkway NE
Albuquerque, NM 87107
TEL: (505) 345-3407
FAX (505) 345-9920

RE: Copper Flat OrderNo.: 1307590

Dear Steve Finch:

Hall Environmental Analysis Laboratory received 12 sample(s) on 7/12/2013 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0190

Sincerely,

Andy

Andy Freeman
Laboratory Manager
4901 Hawkins NE
Albuquerque, NM 87109

Analytical Report
Lab Order **1307590**

Hall Environmental Analysis Laboratory, Inc.

Date Reported: **7/26/2013**

CLIENT: John Shomaker & Assoc.		**Client Sample ID:**	GWQ-5R
Project: Copper Flat		**Collection Date:**	7/9/2013 6:52:00 PM
Lab ID: 1307590-001	**Matrix:** AQUEOUS	**Received Date:**	7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Chloride	17.6	10.0		mg/L	20	7/16/2013 6:26:09 PM	R11991
Sulfate	96.5	10.0		mg/L	20	7/16/2013 6:26:09 PM	R11991
EPA METHOD 200.7: METALS						Analyst:	**JLF**
Calcium	98.9	10.0		mg/L	10	7/19/2013 12:22:40 PM	R12085
Magnesium	21.9	1.00		mg/L	1	7/19/2013 12:20:12 PM	R12085
Potassium	4.76	1.00		mg/L	1	7/19/2013 12:20:12 PM	R12085
Sodium	31.8	1.00		mg/L	1	7/19/2013 12:20:12 PM	R12085
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	281	20.0		mg/L CaCO3	1	7/15/2013 2:38:44 PM	R11959
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/15/2013 2:38:44 PM	R11959
Total Alkalinity (as CaCO3)	281	20.0		mg/L CaCO3	1	7/15/2013 2:38:44 PM	R11959
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	496	20.0		mg/L	1	7/17/2013 3:19:00 PM	8398

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Hall Environmental Analysis Laboratory, Inc.

Analytical Report
Lab Order **1307590**
Date Reported: **7/26/2013**

CLIENT:	John Shomaker & Assoc.	**Client Sample ID:**	GWQ-3
Project:	Copper Flat	**Collection Date:**	7/10/2013 2:00:00 PM
Lab ID:	1307590-002 **Matrix:** AQUEOUS	**Received Date:**	7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Chloride	69.0	10.0		mg/L	20	7/16/2013 7:15:47 PM	R11991
Sulfate	1690	25.0	*	mg/L	50	7/18/2013 12:37:04 AM	R12042
EPA METHOD 200.7: METALS							Analyst: **JLF**
Calcium	446	10.0		mg/L	10	7/19/2013 12:27:51 PM	R12085
Magnesium	96.4	1.00		mg/L	1	7/19/2013 12:25:14 PM	R12085
Potassium	4.31	1.00		mg/L	1	7/19/2013 12:25:14 PM	R12085
Sodium	235	10.0		mg/L	10	7/19/2013 12:27:51 PM	R12085
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	201	20.0		mg/L CaCO3	1	7/15/2013 2:48:47 PM	R11959
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/15/2013 2:48:47 PM	R11959
Total Alkalinity (as CaCO3)	201	20.0		mg/L CaCO3	1	7/15/2013 2:48:47 PM	R11959
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	2980	20.0	*	mg/L	1	7/17/2013 3:19:00 PM	8398

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

CLIENT: John Shomaker & Assoc.
Project: Copper Flat
Lab ID: 1307590-003 **Matrix:** AQUEOUS

Client Sample ID: GWQ-8
Collection Date: 7/10/2013 4:30:00 PM
Received Date: 7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Chloride	83.7	10.0		mg/L	20	7/16/2013 7:40:36 PM	R11991
Sulfate	537	10.0	*	mg/L	20	7/16/2013 7:40:36 PM	R11991
EPA METHOD 200.7: METALS							Analyst: **JLF**
Calcium	208	10.0		mg/L	10	7/19/2013 12:32:31 PM	R12085
Magnesium	32.3	1.00		mg/L	1	7/19/2013 12:30:16 PM	R12085
Potassium	2.62	1.00		mg/L	1	7/19/2013 12:30:16 PM	R12085
Sodium	108	10.0		mg/L	10	7/19/2013 12:32:31 PM	R12085
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	209	20.0		mg/L CaCO3	1	7/15/2013 3:01:15 PM	R11959
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/15/2013 3:01:15 PM	R11959
Total Alkalinity (as CaCO3)	209	20.0		mg/L CaCO3	1	7/15/2013 3:01:15 PM	R11959
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	1230	20.0	*	mg/L	1	7/17/2013 3:19:00 PM	8398

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Hall Environmental Analysis Laboratory, Inc.

CLIENT:	John Shomaker & Assoc.			**Client Sample ID:**	GWQ-1
Project:	Copper Flat			**Collection Date:**	7/10/2013 6:12:00 PM
Lab ID:	1307590-004	**Matrix:**	AQUEOUS	**Received Date:**	7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Chloride	26.1	10.0		mg/L	20	7/16/2013 8:05:24 PM	R11991
Sulfate	120	10.0		mg/L	20	7/16/2013 8:05:24 PM	R11991
EPA METHOD 200.7: METALS						Analyst:	**JLF**
Calcium	61.2	1.00		mg/L	1	7/19/2013 12:35:05 PM	R12085
Magnesium	14.1	1.00		mg/L	1	7/19/2013 12:35:05 PM	R12085
Potassium	2.20	1.00		mg/L	1	7/19/2013 12:35:05 PM	R12085
Sodium	61.1	1.00		mg/L	1	7/19/2013 12:35:05 PM	R12085
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	194	20.0		mg/L CaCO3	1	7/15/2013 3:13:55 PM	R11959
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/15/2013 3:13:55 PM	R11959
Total Alkalinity (as CaCO3)	194	20.0		mg/L CaCO3	1	7/15/2013 3:13:55 PM	R11959
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	448	20.0		mg/L	1	7/17/2013 3:19:00 PM	8398

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: Copper Flat
Lab ID: 1307590-005
Matrix: AQUEOUS
Client Sample ID: NP-3
Collection Date: 7/11/2013 12:30:00 PM
Received Date: 7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Chloride	239	10.0		mg/L	20	7/16/2013 8:30:12 PM	R11991
Sulfate	686	10.0	*	mg/L	20	7/16/2013 8:30:12 PM	R11991
EPA METHOD 200.7: METALS						Analyst:	**JLF**
Calcium	290	10.0		mg/L	10	7/19/2013 12:42:16 PM	R12085
Magnesium	60.1	1.00		mg/L	1	7/19/2013 12:39:56 PM	R12085
Potassium	5.03	1.00		mg/L	1	7/19/2013 12:39:56 PM	R12085
Sodium	108	10.0		mg/L	10	7/19/2013 12:42:16 PM	R12085
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	124	20.0		mg/L CaCO3	1	7/15/2013 3:25:51 PM	R11959
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/15/2013 3:25:51 PM	R11959
Total Alkalinity (as CaCO3)	124	20.0		mg/L CaCO3	1	7/15/2013 3:25:51 PM	R11959
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	1560	200	*	mg/L	1	7/17/2013 3:19:00 PM	8398

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Hall Environmental Analysis Laboratory, Inc.

CLIENT:	John Shomaker & Assoc.			**Client Sample ID:**	GWQ94-13
Project:	Copper Flat			**Collection Date:**	7/11/2013 1:27:00 PM
Lab ID:	1307590-006	**Matrix:**	AQUEOUS	**Received Date:**	7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Chloride	210	10.0		mg/L	20	7/16/2013 8:55:01 PM	R11991
Sulfate	611	10.0	*	mg/L	20	7/16/2013 8:55:01 PM	R11991
EPA METHOD 200.7: METALS							Analyst: **JLF**
Calcium	246	10.0		mg/L	10	7/19/2013 12:54:16 PM	R12085
Magnesium	47.4	1.00		mg/L	1	7/19/2013 12:51:38 PM	R12085
Potassium	3.45	1.00		mg/L	1	7/19/2013 12:51:38 PM	R12085
Sodium	98.6	1.00		mg/L	1	7/19/2013 12:51:38 PM	R12085
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	125	20.0		mg/L CaCO3	1	7/15/2013 3:36:18 PM	R11959
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/15/2013 3:36:18 PM	R11959
Total Alkalinity (as CaCO3)	125	20.0		mg/L CaCO3	1	7/15/2013 3:36:18 PM	R11959
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	1450	20.0	*	mg/L	1	7/17/2013 3:19:00 PM	8398

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Hall Environmental Analysis Laboratory, Inc.

Analytical Report
Lab Order **1307590**
Date Reported: **7/26/2013**

CLIENT: John Shomaker & Assoc.
Project: Copper Flat
Lab ID: 1307590-007
Matrix: AQUEOUS
Client Sample ID: GWQ-11
Collection Date: 7/11/2013 2:23:00 PM
Received Date: 7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Chloride	130	10.0		mg/L	20	7/16/2013 9:44:39 PM	R11991
Sulfate	350	10.0	*	mg/L	20	7/16/2013 9:44:39 PM	R11991
EPA METHOD 200.7: METALS						Analyst:	**JLF**
Calcium	164	10.0		mg/L	10	7/19/2013 12:59:13 PM	R12085
Magnesium	43.2	1.00		mg/L	1	7/19/2013 12:56:57 PM	R12085
Potassium	3.43	1.00		mg/L	1	7/19/2013 12:56:57 PM	R12085
Sodium	65.7	1.00		mg/L	1	7/19/2013 12:56:57 PM	R12085
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	163	20.0		mg/L CaCO3	1	7/15/2013 3:46:47 PM	R11959
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/15/2013 3:46:47 PM	R11959
Total Alkalinity (as CaCO3)	163	20.0		mg/L CaCO3	1	7/15/2013 3:46:47 PM	R11959
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	993	20.0	*	mg/L	1	7/17/2013 3:19:00 PM	8398

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Client Sample ID: GWQ94-16
Project: Copper Flat
Collection Date: 7/11/2013 2:46:00 PM
Lab ID: 1307590-008
Matrix: AQUEOUS
Received Date: 7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Chloride	177	10.0		mg/L	20	7/16/2013 10:09:29 PM	R11991
Sulfate	386	10.0	*	mg/L	20	7/16/2013 10:09:29 PM	R11991
EPA METHOD 200.7: METALS						Analyst:	**JLF**
Calcium	193	10.0		mg/L	10	7/19/2013 1:04:23 PM	R12085
Magnesium	46.4	1.00		mg/L	1	7/19/2013 1:01:51 PM	R12085
Potassium	3.23	1.00		mg/L	1	7/19/2013 1:01:51 PM	R12085
Sodium	73.4	1.00		mg/L	1	7/19/2013 1:01:51 PM	R12085
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	170	20.0		mg/L CaCO3	1	7/15/2013 3:57:10 PM	R11959
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/15/2013 3:57:10 PM	R11959
Total Alkalinity (as CaCO3)	170	20.0		mg/L CaCO3	1	7/15/2013 3:57:10 PM	R11959
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	1160	20.0	*	mg/L	1	7/17/2013 3:19:00 PM	8398

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: Copper Flat
Lab ID: 1307590-009
Matrix: AQUEOUS
Client Sample ID: GWQ94-14
Collection Date: 7/11/2013 4:25:00 PM
Received Date: 7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Chloride	43.3	10.0		mg/L	20	7/16/2013 10:34:18 PM	R11991
Sulfate	138	10.0		mg/L	20	7/16/2013 10:34:18 PM	R11991
EPA METHOD 200.7: METALS						Analyst:	**JLF**
Calcium	94.2	1.00		mg/L	1	7/19/2013 1:07:03 PM	R12085
Magnesium	24.2	1.00		mg/L	1	7/19/2013 1:07:03 PM	R12085
Potassium	1.64	1.00		mg/L	1	7/19/2013 1:07:03 PM	R12085
Sodium	45.8	1.00		mg/L	1	7/19/2013 1:07:03 PM	R12085
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	214	20.0		mg/L CaCO3	1	7/15/2013 4:07:48 PM	R11959
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/15/2013 4:07:48 PM	R11959
Total Alkalinity (as CaCO3)	214	20.0		mg/L CaCO3	1	7/15/2013 4:07:48 PM	R11959
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	565	20.0	*	mg/L	1	7/17/2013 3:19:00 PM	8398

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Analytical Report
Lab Order **1307590**
Date Reported: **7/26/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT:	John Shomaker & Assoc.			**Client Sample ID:**	NP-2
Project:	Copper Flat			**Collection Date:**	7/11/2013 5:10:00 PM
Lab ID:	1307590-010	**Matrix:**	AQUEOUS	**Received Date:**	7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Chloride	166	10.0		mg/L	20	7/16/2013 10:59:06 PM	R11991
Sulfate	292	10.0	*	mg/L	20	7/16/2013 10:59:06 PM	R11991
EPA METHOD 200.7: METALS						Analyst:	**JLF**
Calcium	148	10.0		mg/L	10	7/19/2013 1:14:27 PM	R12085
Magnesium	44.4	1.00		mg/L	1	7/19/2013 1:12:03 PM	R12085
Potassium	4.03	1.00		mg/L	1	7/19/2013 1:12:03 PM	R12085
Sodium	74.0	1.00		mg/L	1	7/19/2013 1:12:03 PM	R12085
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	149	20.0		mg/L CaCO3	1	7/15/2013 4:20:24 PM	R11959
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/15/2013 4:20:24 PM	R11959
Total Alkalinity (as CaCO3)	149	20.0		mg/L CaCO3	1	7/15/2013 4:20:24 PM	R11959
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	840	200	*	mg/L	1	7/17/2013 3:19:00 PM	8398

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Analytical Report
Lab Order **1307590**
Date Reported: **7/26/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: Copper Flat
Lab ID: 1307590-011
Matrix: AQUEOUS

Client Sample ID: GWQ-12
Collection Date: 7/11/2013 6:20:00 PM
Received Date: 7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Chloride	28.1	10.0		mg/L	20	7/16/2013 11:23:56 PM	R11991
Sulfate	47.0	10.0		mg/L	20	7/16/2013 11:23:56 PM	R11991
EPA METHOD 200.7: METALS							Analyst: **JLF**
Calcium	56.5	1.00		mg/L	1	7/19/2013 1:23:59 PM	R12085
Magnesium	17.6	1.00		mg/L	1	7/19/2013 1:23:59 PM	R12085
Potassium	3.29	1.00		mg/L	1	7/19/2013 1:23:59 PM	R12085
Sodium	27.9	1.00		mg/L	1	7/19/2013 1:23:59 PM	R12085
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	181	20.0		mg/L CaCO3	1	7/15/2013 4:31:07 PM	R11959
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/15/2013 4:31:07 PM	R11959
Total Alkalinity (as CaCO3)	181	20.0		mg/L CaCO3	1	7/15/2013 4:31:07 PM	R11959
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	361	20.0		mg/L	1	7/17/2013 3:19:00 PM	8398

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Client Sample ID: MW-4
Project: Copper Flat
Collection Date: 7/11/2013 6:54:00 PM
Lab ID: 1307590-012
Matrix: AQUEOUS
Received Date: 7/12/2013 12:15:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Chloride	19.6	10.0		mg/L	20	7/17/2013 12:13:34 AM	R11991
Sulfate	124	10.0		mg/L	20	7/17/2013 12:13:34 AM	R11991
EPA METHOD 200.7: METALS						Analyst:	**JLF**
Calcium	70.3	1.00		mg/L	1	7/19/2013 1:28:51 PM	R12085
Magnesium	15.0	1.00		mg/L	1	7/19/2013 1:28:51 PM	R12085
Potassium	2.65	1.00		mg/L	1	7/19/2013 1:28:51 PM	R12085
Sodium	52.2	1.00		mg/L	1	7/19/2013 1:28:51 PM	R12085
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	200	20.0		mg/L CaCO3	1	7/15/2013 4:42:36 PM	R11959
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	7/15/2013 4:42:36 PM	R11959
Total Alkalinity (as CaCO3)	200	20.0		mg/L CaCO3	1	7/15/2013 4:42:36 PM	R11959
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	469	20.0		mg/L	1	7/17/2013 3:19:00 PM	8398

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1307590**

26-Jul-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R11991** RunNo: **11991**
Prep Date: Analysis Date: **7/16/2013** SeqNo: **341039** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	ND	0.50								
Sulfate	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R11991** RunNo: **11991**
Prep Date: Analysis Date: **7/16/2013** SeqNo: **341040** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	4.5	0.50	5.000	0	90.1	90	110			
Sulfate	9.1	0.50	10.00	0	91.5	90	110			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R12042** RunNo: **12042**
Prep Date: Analysis Date: **7/17/2013** SeqNo: **342203** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R12042** RunNo: **12042**
Prep Date: Analysis Date: **7/17/2013** SeqNo: **342204** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	9.6	0.50	10.00	0	96.5	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1307590**

26-Jul-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **mb-1** SampType: **mblk** TestCode: **SM2320B: Alkalinity**
Client ID: **PBW** Batch ID: **R11959** RunNo: **11959**
Prep Date: Analysis Date: **7/15/2013** SeqNo: **339854** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-1** SampType: **lcs** TestCode: **SM2320B: Alkalinity**
Client ID: **LCSW** Batch ID: **R11959** RunNo: **11959**
Prep Date: Analysis Date: **7/15/2013** SeqNo: **339855** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	80	20	80.00	0	99.6	90	110			

Sample ID **1307590-012a ms** SampType: **ms** TestCode: **SM2320B: Alkalinity**
Client ID: **MW-4** Batch ID: **R11959** RunNo: **11959**
Prep Date: Analysis Date: **7/15/2013** SeqNo: **339868** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	253	20.0	80.00	200.0	66.7	18.3	129			

Sample ID **1307590-012a msd** SampType: **msd** TestCode: **SM2320B: Alkalinity**
Client ID: **MW-4** Batch ID: **R11959** RunNo: **11959**
Prep Date: Analysis Date: **7/15/2013** SeqNo: **339869** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	248	20.0	80.00	200.0	59.6	18.3	129	2.28	10	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1307590**

26-Jul-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **MB-8398**	SampType: **MBLK**			TestCode: **SM2540C MOD: Total Dissolved Solids**						
Client ID: **PBW**	Batch ID: **8398**			RunNo: **12006**						
Prep Date: **7/16/2013**	Analysis Date: **7/17/2013**			SeqNo: **341293**	Units: **mg/L**					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	ND	20.0								

Sample ID **LCS-8398**	SampType: **LCS**			TestCode: **SM2540C MOD: Total Dissolved Solids**						
Client ID: **LCSW**	Batch ID: **8398**			RunNo: **12006**						
Prep Date: **7/16/2013**	Analysis Date: **7/17/2013**			SeqNo: **341294**	Units: **mg/L**					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	1010	20.0	1000	0	101	80	120			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

Sample Log-In Check List

Client Name: SHO Work Order Number: 1307590 RcptNo: 1

Received by/date: AT 07/12/13

Logged By: Anne Thorne 7/12/2013 12:15:00 PM

Completed By: Anne Thorne 7/12/2013

Reviewed By: 07/12/13

Chain of Custody

1. Custody seals intact on sample bottles? Yes ☐ No ☐ Not Present ☑
2. Is Chain of Custody complete? Yes ☑ No ☐ Not Present ☐
3. How was the sample delivered? Client

Log In

4. Was an attempt made to cool the samples? Yes ☑ No ☐ NA ☐
5. Were all samples received at a temperature of >0° C to 6.0°C Yes ☑ No ☐ NA ☐
6. Sample(s) in proper container(s)? Yes ☑ No ☐
7. Sufficient sample volume for indicated test(s)? Yes ☑ No ☐
8. Are samples (except VOA and ONG) properly preserved? Yes ☑ No ☐
9. Was preservative added to bottles? Yes ☐ No ☑ NA ☐
10. VOA vials have zero headspace? Yes ☐ No ☐ No VOA Vials ☑
11. Were any sample containers received broken? Yes ☐ No ☑
12. Does paperwork match bottle labels? Yes ☑ No ☐
(Note discrepancies on chain of custody)
13. Are matrices correctly identified on Chain of Custody? Yes ☑ No ☐
14. Is it clear what analyses were requested? Yes ☑ No ☐
15. Were all holding times able to be met? Yes ☑ No ☐
(If no, notify customer for authorization.)

# of preserved bottles checked for pH: 12
(<2 or >12 unless noted)
Adjusted?
Checked by: AT 07/12/13

Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified: Date
By Whom: Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:
Client Instructions:

17. Additional remarks:

18. **Cooler Information**

Cooler No	Temp °C	Condition	Seal Intact	Seal No	Seal Date	Signed By
1	1.0	Good	Not Present			

Chain-of-Custody Record

Client: JSAI

2611 Broadbent Pkwy. NE

Mailing Address:

Albuquerque, NM 87107

Phone #: (505) 345-3407

email or Fax#: sfinch@shomaker.com

QA/QC Package:

☑ Standard ☐ Level 4 (Full Validation)

Accreditation

☐ NELAP ☐ Other

☐ EDD (Type)

Turn-Around Time:

☑ Standard ☐ Rush

Project Name: Copper Flat

Project #:

Project Manager: Steve Finch

Sampler: MW/KE/JJK

On Ice: ☒ Yes ☐ No

Sample Temperature: 1.0

LIST IS

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com

4901 Hawkins NE - Albuquerque, NM 87109

Tel. 505-345-3975 Fax 505-345-4107

Analysis Request

Date 2013	Time	Matrix	Sample Request ID	Container Type and #	Preservative Type	HEAL No. 1207590	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH 8015B (GRO / DRO / MRO)	TPH (Method 418.1)	EDB (Method 504.1)	PAH's (8310 or 8270 SIMS)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)		List B			Air Bubbles (Y or N)
7/9	18:52	H_2O	GWQ-5R	2	HNO_3/None	-001													✓			
7/10	1400	H_2O	GWQ-3	2	HNO_3/None	-002													✓			
7/10	16:30	H_2O	GWQ-8	2	HNO_3/None	-003													✓			
7/10	18:12	H_2O	GWQ-1	2	HNO_3/None	-004													✓			
7/11	12:30	H_2O	NP-3	2	HNO_3/None	-005													✓			
7/11	13:27	H_2O	GWQ94-13	2	HNO_3/None	-006													✓			
7/11	14:23	H_2O	GWQ-11	2	HNO_3/None	-007													✓			
7/11	14:46	H_2O	GWQ94-16	2	HNO_3/None	-008													✓			
7/11	16:25	H_2O	GWQ94-14	2	HNO_3/None	-009													✓			
7/11	17:10	H_2O	NP-2	2	HNO_3/None	-010													✓			
7/11	18:20	H_2O	GWQ-12	2	HNO_3/None	-011													✓			
7/11	18:54	H_2O	MW-4	2	HNO_3/None	-012													✓			

Date:	Time:	Relinquished by:	Received by:	Date	Time
7/12/13	12:15			07/12/13	1215

Date:	Time:	Relinquished by:	Received by:	Date	Time

Remarks: List B

email results to sfinch@shomaker.com

09731

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

NMCC Copper Flat Stage 1 Abatement Lab Sampling Analysis

List A* Pit Area Groundwater	List B[†] Waste Rock Pile and Tailings Impoundment Area Groundwater
Al	Total Dissolved Solids
Cd	Sulfate
Co	Chloride
Cu	Alkalinity
Mn	Ca
Se	Mg
Zn	Na
Ca	K
Mg	
Na	
K	
Alkalinity	
Total Acidity	
Chloride	
Flouride	
Sulfate	
Total Dissolved Solids	

*List A metals are for dissolved metals (filtered)

[†]List B metals are for total metals (NOT filtered)

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

October 16, 2013

Katie Emmer

The Mac Resources Group
2424 Louisiana Blvd NE
Ste 301
Albuquerque, NM 87110
TEL: (505) 400-7925
FAX

RE: Copper Flat OrderNo.: 1309A68

Dear Katie Emmer:

Hall Environmental Analysis Laboratory received 2 sample(s) on 9/23/2013 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0190

Sincerely,

Andy Freeman
Laboratory Manager
4901 Hawkins NE
Albuquerque, NM 87109

Analytical Report
Lab Order **1309A68**
Date Reported: **10/16/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: The Mac Resources Group
Client Sample ID: SWQ-2
Project: Copper Flat
Collection Date: 9/20/2013 1:00:00 PM
Lab ID: 1309A68-001
Matrix: AQUEOUS
Received Date: 9/23/2013 12:02:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	0.89	0.50		mg/L	5	9/25/2013 5:09:16 PM	R13643
Chloride	33	2.5		mg/L	5	9/25/2013 5:09:16 PM	R13643
Sulfate	1300	25	*	mg/L	50	10/4/2013 7:15:54 PM	R13865
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	ND	0.020		mg/L	1	10/4/2013 1:53:35 PM	R13857
Cadmium	ND	0.0020		mg/L	1	10/4/2013 1:53:35 PM	R13857
Calcium	380	5.0		mg/L	5	10/4/2013 1:57:12 PM	R13857
Cobalt	ND	0.0060		mg/L	1	10/4/2013 1:53:35 PM	R13857
Copper	0.082	0.0060		mg/L	1	10/7/2013 4:39:37 PM	R13893
Magnesium	88	1.0		mg/L	1	10/4/2013 1:53:35 PM	R13857
Manganese	0.042	0.0020		mg/L	1	10/4/2013 1:53:35 PM	R13857
Potassium	6.8	1.0		mg/L	1	10/4/2013 1:53:35 PM	R13857
Sodium	180	5.0		mg/L	5	10/4/2013 1:57:12 PM	R13857
Zinc	0.15	0.010		mg/L	1	10/4/2013 1:53:35 PM	R13857
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	0.051	0.0050	*	mg/L	5	10/2/2013 4:02:37 PM	R13792
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	150	20		mg/L CaCO3	1	9/25/2013 5:32:18 PM	R13629
Carbonate (As CaCO3)	ND	2.0		mg/L CaCO3	1	9/25/2013 5:32:18 PM	R13629
Total Alkalinity (as CaCO3)	150	20		mg/L CaCO3	1	9/25/2013 5:32:18 PM	R13629
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	2470	40.0	*	mg/L	1	9/30/2013 10:05:00 AM	9517

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

CLIENT: The Mac Resources Group
Client Sample ID: SWQ-3
Project: Copper Flat
Collection Date: 9/20/2013 1:40:00 PM
Lab ID: 1309A68-002
Matrix: AQUEOUS
Received Date: 9/23/2013 12:02:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	1.3	0.50		mg/L	5	9/25/2013 5:34:06 PM	R13643
Chloride	61	2.5		mg/L	5	9/25/2013 5:34:06 PM	R13643
Sulfate	1700	25	*	mg/L	50	10/4/2013 7:28:19 PM	R13865
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	ND	0.020		mg/L	1	10/4/2013 2:00:45 PM	R13857
Cadmium	ND	0.0020		mg/L	1	10/4/2013 2:00:45 PM	R13857
Calcium	440	5.0		mg/L	5	10/4/2013 2:04:25 PM	R13857
Cobalt	ND	0.0060		mg/L	1	10/4/2013 2:00:45 PM	R13857
Copper	0.11	0.0060		mg/L	1	10/7/2013 4:41:34 PM	R13893
Magnesium	110	5.0		mg/L	5	10/4/2013 2:04:25 PM	R13857
Manganese	0.055	0.0020	*	mg/L	1	10/4/2013 2:00:45 PM	R13857
Potassium	6.2	1.0		mg/L	1	10/4/2013 2:00:45 PM	R13857
Sodium	250	5.0		mg/L	5	10/4/2013 2:04:25 PM	R13857
Zinc	0.14	0.010		mg/L	1	10/4/2013 2:00:45 PM	R13857
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	0.050	0.0050	*	mg/L	5	10/2/2013 4:18:56 PM	R13792
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	180	20		mg/L CaCO3	1	9/25/2013 5:42:45 PM	R13629
Carbonate (As CaCO3)	ND	2.0		mg/L CaCO3	1	9/25/2013 5:42:45 PM	R13629
Total Alkalinity (as CaCO3)	180	20		mg/L CaCO3	1	9/25/2013 5:42:45 PM	R13629
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	3030	40.0	*	mg/L	1	9/30/2013 10:05:00 AM	9517

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	Spike Recovery outside accepted recovery limits		

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	10/02/13
Project:	Not Indicated	**Collection Date:**	09/20/13 13:00
Lab ID:	B13092419-001	**DateReceived:**	09/26/13
Client Sample ID	1309A68-001C, SWQ-2	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	8	mg/L		4		A2310 B	10/01/13 17:51 / hmb

Report Definitions:	RL - Analyte reporting limit. QCL - Quality control limit.	MCL - Maximum contaminant level. ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	10/02/13
Project:	Not Indicated	**Collection Date:**	09/20/13 13:40
Lab ID:	B13092419-002	**DateReceived:**	09/26/13
Client Sample ID	1309A68-002C, SWQ-3	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	6	mg/L		4		A2310 B	10/01/13 17:55 / hmb

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hall Environmental
Project: Not Indicated

Report Date: 10/02/13
Work Order: B13092419

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2310 B								Batch: R212579	
Sample ID: MBLK	Method Blank				Run: Metrohm 2_131001A			10/01/13 15:33	
Acidity, Total as CaCO3	2	mg/L	0.3						
Sample ID: LCS	Laboratory Control Sample				Run: Metrohm 2_131001A			10/01/13 15:41	
Acidity, Total as CaCO3	1060	mg/L	4.0	101	90	110			
Sample ID: B13092549-011ADUP	Sample Duplicate				Run: Metrohm 2_131001A			10/01/13 17:10	
Acidity, Total as CaCO3	3.97	mg/L	4.0					10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Client: The Mac Resources Group
Project: Copper Flat

Sample ID	**MB**	SampType:	**MBLK**	TestCode:	**EPA Method 200.7: Dissolved Metals**
Client ID:	**PBW**	Batch ID:	**R13857**	RunNo:	**13857**
Prep Date:		Analysis Date:	**10/4/2013**	SeqNo:	**396103** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	ND	0.020								
Cadmium	ND	0.0020								
Calcium	ND	1.0								
Cobalt	ND	0.0060								
Magnesium	ND	1.0								
Manganese	ND	0.0020								
Potassium	ND	1.0								
Sodium	ND	1.0								
Zinc	ND	0.010								

Sample ID	**LCS**	SampType:	**LCS**	TestCode:	**EPA Method 200.7: Dissolved Metals**
Client ID:	**LCSW**	Batch ID:	**R13857**	RunNo:	**13857**
Prep Date:		Analysis Date:	**10/4/2013**	SeqNo:	**396104** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	0.54	0.020	0.5000	0	108	85	115			
Cadmium	0.51	0.0020	0.5000	0	102	85	115			
Calcium	53	1.0	50.00	0	105	85	115			
Cobalt	0.48	0.0060	0.5000	0	96.1	85	115			
Magnesium	53	1.0	50.00	0	106	85	115			
Manganese	0.48	0.0020	0.5000	0	96.4	85	115			
Potassium	52	1.0	50.00	0	105	85	115			
Sodium	53	1.0	50.00	0	105	85	115			
Zinc	0.48	0.010	0.5000	0	96.9	85	115			

Sample ID	**MB**	SampType:	**MBLK**	TestCode:	**EPA Method 200.7: Dissolved Metals**
Client ID:	**PBW**	Batch ID:	**R13893**	RunNo:	**13893**
Prep Date:		Analysis Date:	**10/7/2013**	SeqNo:	**396940** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Copper	ND	0.0060								

Sample ID	**LCS**	SampType:	**LCS**	TestCode:	**EPA Method 200.7: Dissolved Metals**
Client ID:	**LCSW**	Batch ID:	**R13893**	RunNo:	**13893**
Prep Date:		Analysis Date:	**10/7/2013**	SeqNo:	**396941** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Copper	0.49	0.0060	0.5000	0	97.4	85	115			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1309A68**

16-Oct-13

Client: The Mac Resources Group

Project: Copper Flat

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**

Client ID: **LCSW** Batch ID: **R13792** RunNo: **13792**

Prep Date: Analysis Date: **10/2/2013** SeqNo: **393834** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	0.024	0.0010	0.02500	0	95.6	85	115			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA 200.8: Dissolved Metals**

Client ID: **PBW** Batch ID: **R13792** RunNo: **13792**

Prep Date: Analysis Date: **10/2/2013** SeqNo: **393836** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	ND	0.0010								

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

Client: The Mac Resources Group

Project: Copper Flat

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R13643** RunNo: **13643**
Prep Date: Analysis Date: **9/25/2013** SeqNo: **388467** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	2.3	0.10	2.400	0	96.7	90	110			
Chloride	12	0.50	12.00	0	101	90	110			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R13643** RunNo: **13643**
Prep Date: Analysis Date: **9/25/2013** SeqNo: **388469** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	ND	0.10								
Chloride	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R13643** RunNo: **13643**
Prep Date: Analysis Date: **9/25/2013** SeqNo: **388470** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.49	0.10	0.5000	0	97.1	90	110			
Chloride	4.6	0.50	5.000	0	92.8	90	110			

Sample ID **A4** SampType: **CCV_4** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R13643** RunNo: **13643**
Prep Date: Analysis Date: **9/25/2013** SeqNo: **388480** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.97	0.10	1.000	0	96.6	90	110			
Chloride	4.7	0.50	5.000	0	93.4	90	110			

Sample ID **A5** SampType: **CCV_5** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R13643** RunNo: **13643**
Prep Date: Analysis Date: **9/25/2013** SeqNo: **388493** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	1.6	0.10	1.600	0	100	90	110			
Chloride	7.7	0.50	8.000	0	96.9	90	110			

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R13643** RunNo: **13643**
Prep Date: Analysis Date: **9/25/2013** SeqNo: **388506** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

Client: The Mac Resources Group

Project: Copper Flat

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R13643** RunNo: **13643**
Prep Date: Analysis Date: **9/25/2013** SeqNo: **388506** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	2.5	0.10	2.400	0	102	90	110			
Chloride	12	0.50	12.00	0	102	90	110			

Sample ID **A4** SampType: **CCV_4** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R13643** RunNo: **13643**
Prep Date: Analysis Date: **9/25/2013** SeqNo: **388518** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	1.0	0.10	1.000	0	99.5	90	110			
Chloride	4.6	0.50	5.000	0	93.0	90	110			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R13643** RunNo: **13643**
Prep Date: Analysis Date: **9/25/2013** SeqNo: **388522** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	ND	0.10								
Chloride	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R13643** RunNo: **13643**
Prep Date: Analysis Date: **9/25/2013** SeqNo: **388524** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.49	0.10	0.5000	0	98.7	90	110			
Chloride	4.7	0.50	5.000	0	93.5	90	110			

Sample ID **A5** SampType: **CCV_5** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R13643** RunNo: **13643**
Prep Date: Analysis Date: **9/25/2013** SeqNo: **388531** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	1.6	0.10	1.600	0	101	90	110			
Chloride	7.7	0.50	8.000	0	96.5	90	110			

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R13643** RunNo: **13643**
Prep Date: Analysis Date: **9/26/2013** SeqNo: **388544** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual

Client: The Mac Resources Group

Project: Copper Flat

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R13643** RunNo: **13643**
Prep Date: Analysis Date: **9/26/2013** SeqNo: **388544** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	2.5	0.10	2.400	0	102	90	110			
Chloride	12	0.50	12.00	0	101	90	110			

Sample ID **A4** SampType: **CCV_4** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R13643** RunNo: **13643**
Prep Date: Analysis Date: **9/26/2013** SeqNo: **388557** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.98	0.10	1.000	0	98.0	90	110			
Chloride	4.6	0.50	5.000	0	92.3	90	110			

Sample ID **A5** SampType: **CCV_5** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R13643** RunNo: **13643**
Prep Date: Analysis Date: **9/26/2013** SeqNo: **388569** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	1.6	0.10	1.600	0	100	90	110			
Chloride	7.8	0.50	8.000	0	97.9	90	110			

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R13865** RunNo: **13865**
Prep Date: Analysis Date: **10/4/2013** SeqNo: **396363** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	31	0.50	30.00	0	102	90	110			

Sample ID **A4** SampType: **CCV_4** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R13865** RunNo: **13865**
Prep Date: Analysis Date: **10/5/2013** SeqNo: **396371** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	12	0.50	12.50	0	94.9	90	110			

Sample ID **A4** SampType: **CCV_4** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R13865** RunNo: **13865**
Prep Date: Analysis Date: **10/4/2013** SeqNo: **396373** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	12	0.50	12.50	0	95.3	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1309A68**

16-Oct-13

Client: The Mac Resources Group

Project: Copper Flat

Sample ID **MB**		SampType: **MBLK**			TestCode: **EPA Method 300.0: Anions**					
Client ID: **PBW**		Batch ID: **R13865**			RunNo: **13865**					
Prep Date:		Analysis Date: **10/4/2013**			SeqNo: **396375**		Units: **mg/L**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	ND	0.50								

Sample ID **LCS**		SampType: **LCS**			TestCode: **EPA Method 300.0: Anions**					
Client ID: **LCSW**		Batch ID: **R13865**			RunNo: **13865**					
Prep Date:		Analysis Date: **10/4/2013**			SeqNo: **396376**		Units: **mg/L**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	10	0.50	10.00	0	103	90	110			

Sample ID **A5**		SampType: **CCV_5**			TestCode: **EPA Method 300.0: Anions**					
Client ID: **BatchQC**		Batch ID: **R13865**			RunNo: **13865**					
Prep Date:		Analysis Date: **10/4/2013**			SeqNo: **396385**		Units: **mg/L**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	20	0.50	20.00	0	98.6	90	110			

Sample ID **A6**		SampType: **CCV_6**			TestCode: **EPA Method 300.0: Anions**					
Client ID: **BatchQC**		Batch ID: **R13865**			RunNo: **13865**					
Prep Date:		Analysis Date: **10/4/2013**			SeqNo: **396397**		Units: **mg/L**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	31	0.50	30.00	0	102	90	110			

Sample ID **A4**		SampType: **CCV_4**			TestCode: **EPA Method 300.0: Anions**					
Client ID: **BatchQC**		Batch ID: **R13865**			RunNo: **13865**					
Prep Date:		Analysis Date: **10/4/2013**			SeqNo: **396409**		Units: **mg/L**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	12	0.50	12.50	0	94.8	90	110			

Sample ID **A5**		SampType: **CCV_5**			TestCode: **EPA Method 300.0: Anions**					
Client ID: **BatchQC**		Batch ID: **R13865**			RunNo: **13865**					
Prep Date:		Analysis Date: **10/4/2013**			SeqNo: **396421**		Units: **mg/L**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	20	0.50	20.00	0	97.9	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1309A68**

16-Oct-13

Client: The Mac Resources Group
Project: Copper Flat

Sample ID **mb-1** SampType: **mblk** TestCode: **SM2320B: Alkalinity**
Client ID: **PBW** Batch ID: **R13629** RunNo: **13629**
Prep Date: Analysis Date: **9/25/2013** SeqNo: **388026** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-1** SampType: **lcs** TestCode: **SM2320B: Alkalinity**
Client ID: **LCSW** Batch ID: **R13629** RunNo: **13629**
Prep Date: Analysis Date: **9/25/2013** SeqNo: **388027** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	81	20	80.00	0	101	90	110			

Sample ID **mb-2** SampType: **mblk** TestCode: **SM2320B: Alkalinity**
Client ID: **PBW** Batch ID: **R13629** RunNo: **13629**
Prep Date: Analysis Date: **9/25/2013** SeqNo: **388044** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-2** SampType: **lcs** TestCode: **SM2320B: Alkalinity**
Client ID: **LCSW** Batch ID: **R13629** RunNo: **13629**
Prep Date: Analysis Date: **9/25/2013** SeqNo: **388045** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	81	20	80.00	0	101	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1309A68**

16-Oct-13

Client: The Mac Resources Group

Project: Copper Flat

Sample ID **MB-9517** SampType: **MBLK** TestCode: **SM2540C MOD: Total Dissolved Solids**

Client ID: **PBW** Batch ID: **9517** RunNo: **13691**

Prep Date: **9/26/2013** Analysis Date: **9/30/2013** SeqNo: **390180** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	ND	20.0								

Sample ID **LCS-9517** SampType: **LCS** TestCode: **SM2540C MOD: Total Dissolved Solids**

Client ID: **LCSW** Batch ID: **9517** RunNo: **13691**

Prep Date: **9/26/2013** Analysis Date: **9/30/2013** SeqNo: **390181** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	1020	20.0	1000	0	102	80	120			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

Sample Log-In Check List

Client Name: THE MAC RESOURCES Work Order Number: 1309A68 RcptNo: 1

Received by/date: AG 09/23/13

Logged By: **Michelle Garcia** 9/23/2013 12:02:00 PM Michelle Garcia

Completed By: **Michelle Garcia** 9/24/2013 12:14:55 PM Michelle Garcia

Reviewed By: 09/24/13

Chain of Custody

1. Custody seals intact on sample bottles? Yes ☐ No ☐ Not Present ☑
2. Is Chain of Custody complete? Yes ☑ No ☐ Not Present ☐
3. How was the sample delivered? Client

Log In

4. Was an attempt made to cool the samples? Yes ☑ No ☐ NA ☐
5. Were all samples received at a temperature of >0° C to 6.0°C Yes ☑ No ☐ NA ☐ Not required
6. Sample(s) in proper container(s)? Yes ☑ No ☐
7. Sufficient sample volume for indicated test(s)? Yes ☑ No ☐
8. Are samples (except VOA and ONG) properly preserved? Yes ☑ No ☐
9. Was preservative added to bottles? Yes ☐ No ☑ NA ☐
10. VOA vials have zero headspace? Yes ☐ No ☐ No VOA Vials ☑
11. Were any sample containers received broken? Yes ☐ No ☑
12. Does paperwork match bottle labels? Yes ☑ No ☐
(Note discrepancies on chain of custody)
13. Are matrices correctly identified on Chain of Custody? Yes ☑ No ☐
14. Is it clear what analyses were requested? Yes ☑ No ☐
15. Were all holding times able to be met? Yes ☑ No ☐
(If no, notify customer for authorization.)

# of preserved bottles checked for pH: [illegible]
(<2 or >12 unless noted)
Adjusted? [illegible]
Checked by:

Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified: Date:
By Whom: Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:
Client Instructions:

17. Additional remarks:

18. **Cooler Information**

Cooler No	Temp °C	Condition	Seal Intact	Seal No	Seal Date	Signed By
1	9.5	Good	Not Present			

Chain-of-Custody Record

Client: The Mac Resources

Mailing Address: 2424 Louisiana Blvd NE
Ste 301, ABQ

Phone #: 400-7925

email or Fax#:

QA/QC Package:
☐ Standard ☐ Level 4 (Full Validation)

Accreditation
☐ NELAP ☐ Other

☐ EDD (Type)

Turn-Around Time:
☒ Standard ☐ Rush

Project Name: Copper Flat

Project #:

Project Manager: Katie Emmer

Sampler:

On Ice: ☒ Yes ☐ No

Sample Temperature: 9.5

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com

4901 Hawkins NE - Albuquerque, NM 87109

Tel. 505-345-3975 Fax 505-345-4107

Analysis Request

Date	Time	Matrix	Sample Request ID	Container Type and #	Preservative Type	HEAL No. 1309A68	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH 8015B (GRO / DRO / MRO)	TPH (Method 418.1)	EDB (Method 504.1)	PAH's (8310 or 8270 SIMS)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)	metals, cat/anion list via email				Air Bubbles (Y or N)
9-20	1300	H_2O	SWQ-2			-001												X				
9-20	1340	H_2O	SWQ-3			-002												X				
KE																						

Date:	Time:	Relinquished by:	Received by:	Date	Time
9-23	1202	Katie Emmer		09/23/13	1202
Date:	Time:	Relinquished by:	Received by	Date	Time

Remarks:

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

Table 4. Summary of Copper Flat Mine Stage 1 Abatement Plan constituent lists for lab analysis

List A*	**List B****
pit area	~~**waste rock/mill site and tailings storage facility (TSF) areas**~~
aluminum	~~total dissolved solids (TDS)~~
cadmium	~~sulfate~~
cobalt	~~chloride~~
copper	~~alkalinity~~
manganese	~~calcium~~
selenium	~~magnesium~~
zinc	~~sodium~~
calcium	~~potassium~~
magnesium	
sodium	
potassium	
alkalinity	
total acidity	
chloride	
fluoride	
sulfate	
total dissolved solids (TDS)	

* List A metals are for dissolved metals (filtered)
** List B metals are for total metals (NOT filtered)

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

November 20, 2013

Steve Finch
John Shomaker & Assoc.
2611 Broadbent Parkway NE
Albuquerque, NM 87107
TEL: (505) 345-3407
FAX (505) 345-9920

RE: Copper Flat (List A) OrderNo.: 1310C35

Dear Steve Finch:

Hall Environmental Analysis Laboratory received 9 sample(s) on 10/25/2013 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0190

Sincerely,

Andy

Andy Freeman
Laboratory Manager
4901 Hawkins NE
Albuquerque, NM 87109

Analytical Report
Lab Order **1310C35**
Date Reported: **11/20/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT:	John Shomaker & Assoc.			**Client Sample ID:**	SWQ-3
Project:	Copper Flat (List A)			**Collection Date:**	10/9/2013 12:00:00 PM
Lab ID:	1310C35-001	**Matrix:**	AQUEOUS	**Received Date:**	10/25/2013 8:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	1.02	0.100		mg/L	1	10/25/2013 5:16:55 PM	R14386
Chloride	61.7	10.0		mg/L	20	10/25/2013 5:29:19 PM	R14386
Sulfate	2020	50.0	*	mg/L	100	10/31/2013 1:54:04 AM	R14478
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**ELS**
Aluminum	ND	0.0200		mg/L	1	11/11/2013 8:24:10 PM	R14717
Cadmium	ND	0.00200		mg/L	1	11/11/2013 8:24:10 PM	R14717
Calcium	490	5.00		mg/L	5	11/11/2013 8:26:07 PM	R14717
Cobalt	ND	0.00600		mg/L	1	11/11/2013 8:24:10 PM	R14717
Copper	0.0490	0.00600		mg/L	1	11/11/2013 8:24:10 PM	R14717
Magnesium	133	5.00		mg/L	5	11/11/2013 8:26:07 PM	R14717
Manganese	0.0239	0.00200		mg/L	1	11/11/2013 8:24:10 PM	R14717
Potassium	5.29	1.00		mg/L	1	11/11/2013 8:24:10 PM	R14717
Sodium	283	5.00		mg/L	5	11/11/2013 8:26:07 PM	R14717
Zinc	ND	0.0100		mg/L	1	11/12/2013 7:28:33 PM	R14758
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	0.016	0.0050		mg/L	5	11/5/2013 4:42:45 PM	R14591
SM2510B: SPECIFIC CONDUCTANCE						Analyst:	**JML**
Conductivity	3520	0.0100		µmhos/cm	1	10/26/2013 12:20:21 AM	R14379
SM4500-H+B: PH						Analyst:	**JML**
pH	8.26	1.68	H	pH units	1	10/26/2013 12:20:21 AM	R14379
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	241	20.0	H	mg/L CaCO3	1	10/26/2013 12:20:21 AM	R14379
Carbonate (As CaCO3)	ND	2.00	H	mg/L CaCO3	1	10/26/2013 12:20:21 AM	R14379
Total Alkalinity (as CaCO3)	241	20.0	H	mg/L CaCO3	1	10/26/2013 12:20:21 AM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	3720	20.0	*H	mg/L	1	10/30/2013 12:44:00 PM	10062

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	Spike Recovery outside accepted recovery limits		

CLIENT: John Shomaker & Assoc. **Client Sample ID:** SWQ-2
Project: Copper Flat (List A) **Collection Date:** 10/21/2013 5:55:00 PM
Lab ID: 1310C35-002 **Matrix:** AQUEOUS **Received Date:** 10/25/2013 8:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	0.717	0.100		mg/L	1	10/25/2013 5:41:43 PM	R14386
Chloride	30.4	10.0		mg/L	20	10/25/2013 5:54:08 PM	R14386
Sulfate	1840	25.0	*	mg/L	50	10/31/2013 2:06:29 AM	R14478
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**ELS**
Aluminum	ND	0.0200		mg/L	1	11/11/2013 8:29:59 PM	R14717
Cadmium	ND	0.00200		mg/L	1	11/11/2013 8:29:59 PM	R14717
Calcium	510	10.0		mg/L	10	11/13/2013 3:22:02 PM	R14777
Cobalt	ND	0.00600		mg/L	1	11/11/2013 8:29:59 PM	R14717
Copper	0.0352	0.00600		mg/L	1	11/11/2013 8:29:59 PM	R14717
Magnesium	113	10.0		mg/L	10	11/13/2013 3:22:02 PM	R14777
Manganese	0.0152	0.00200		mg/L	1	11/11/2013 8:29:59 PM	R14717
Potassium	5.68	1.00		mg/L	1	11/11/2013 8:29:59 PM	R14717
Sodium	222	10.0		mg/L	10	11/13/2013 3:22:02 PM	R14777
Zinc	0.0165	0.0100		mg/L	1	11/12/2013 7:32:24 PM	R14758
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	0.013	0.0050		mg/L	5	11/5/2013 4:45:24 PM	R14591
SM2510B: SPECIFIC CONDUCTANCE						Analyst:	**JML**
Conductivity	3060	0.0100		µmhos/cm	1	10/26/2013 12:36:56 AM	R14379
SM4500-H+B: PH						Analyst:	**JML**
pH	8.22	1.68	H	pH units	1	10/26/2013 12:36:56 AM	R14379
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	245	20.0		mg/L CaCO3	1	10/26/2013 12:36:56 AM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/26/2013 12:36:56 AM	R14379
Total Alkalinity (as CaCO3)	245	20.0		mg/L CaCO3	1	10/26/2013 12:36:56 AM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	3180	20.0	*	mg/L	1	10/30/2013 12:44:00 PM	10062

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	Spike Recovery outside accepted recovery limits		

Analytical Report
Lab Order **1310C35**
Date Reported: **11/20/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: Copper Flat (List A)
Lab ID: 1310C35-003 **Matrix:** AQUEOUS

Client Sample ID: Pit Wall Seepage
Collection Date: 10/23/2013 2:30:00 PM
Received Date: 10/25/2013 8:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	75.1	10.0	*	mg/L	100	10/25/2013 6:18:57 PM	R14386
Chloride	20.0	5.00		mg/L	10	10/25/2013 6:06:32 PM	R14386
Sulfate	11300	250	*	mg/L	500	10/31/2013 2:18:53 AM	R14478
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	789	20.0	*	mg/L	1E	11/13/2013 3:24:00 PM	R14777
Cadmium	0.187	0.100	*	mg/L	50	11/12/2013 7:36:15 PM	R14758
Calcium	462	50.0		mg/L	50	11/12/2013 7:36:15 PM	R14758
Cobalt	2.05	0.300		mg/L	50	11/12/2013 7:36:15 PM	R14758
Copper	95.3	0.600	*	mg/L	100	11/12/2013 7:37:45 PM	R14758
Magnesium	174	50.0		mg/L	50	11/12/2013 7:36:15 PM	R14758
Manganese	30.8	0.100	*	mg/L	50	11/12/2013 7:36:15 PM	R14758
Potassium	ND	50.0		mg/L	50	11/12/2013 7:36:15 PM	R14758
Sodium	99.0	50.0		mg/L	50	11/12/2013 7:36:15 PM	R14758
Zinc	16.3	0.500	*	mg/L	50	11/12/2013 7:36:15 PM	R14758
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	ND	0.20	*	mg/L	200	11/6/2013 4:56:05 PM	R14642
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	ND	20.0		mg/L CaCO3	1	10/26/2013 12:49:22 AM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/26/2013 12:49:22 AM	R14379
Total Alkalinity (as CaCO3)	ND	20.0		mg/L CaCO3	1	10/26/2013 12:49:22 AM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	18500	200	*	mg/L	1	10/31/2013 11:31:00 AM	10070

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	Spike Recovery outside accepted recovery limits		

Analytical Report
Lab Order **1310C35**

Hall Environmental Analysis Laboratory, Inc.

Date Reported: **11/20/2013**

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ11-25A
Project: Copper Flat (List A) **Collection Date:** 10/22/2013 5:17:00 PM
Lab ID: 1310C35-004 **Matrix:** AQUEOUS **Received Date:** 10/25/2013 8:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	311	50.0	*	mg/L	500	10/31/2013 3:08:33 AM	R14478
Chloride	11.3	10.0		mg/L	20	10/25/2013 7:08:35 PM	R14386
Sulfate	15200	250	*	mg/L	500	10/31/2013 3:08:33 AM	R14478
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	1460	100	*	mg/L	5E	11/13/2013 3:32:17 PM	R14777
Cadmium	0.399	0.200	*	mg/L	100	11/12/2013 7:50:07 PM	R14758
Calcium	ND	5000		mg/L	5E	11/13/2013 3:32:17 PM	R14777
Cobalt	3.12	0.600		mg/L	100	11/12/2013 7:50:07 PM	R14758
Copper	48.6	0.600	*	mg/L	100	11/12/2013 7:50:07 PM	R14758
Magnesium	ND	5000		mg/L	5E	11/13/2013 3:32:17 PM	R14777
Manganese	61.9	0.200	*	mg/L	100	11/12/2013 7:50:07 PM	R14758
Potassium	ND	5000		mg/L	5E	11/13/2013 3:32:17 PM	R14777
Sodium	ND	5000		mg/L	5E	11/13/2013 3:32:17 PM	R14777
Zinc	30.3	1.00	*	mg/L	100	11/12/2013 7:50:07 PM	R14758
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	ND	0.50	*	mg/L	500	11/5/2013 5:18:47 PM	R14591
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	ND	20.0		mg/L CaCO3	1	10/26/2013 12:53:44 AM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/26/2013 12:53:44 AM	R14379
Total Alkalinity (as CaCO3)	ND	20.0		mg/L CaCO3	1	10/26/2013 12:53:44 AM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	23500	200	*	mg/L	1	10/31/2013 11:31:00 AM	10070

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

Analytical Report
Lab Order **1310C35**
Date Reported: **11/20/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ11-25B
Project: Copper Flat (List A) **Collection Date:** 10/22/2013 4:50:00 PM
Lab ID: 1310C35-005 **Matrix:** AQUEOUS **Received Date:** 10/25/2013 8:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	6.78	2.00	*	mg/L	20	10/25/2013 7:33:24 PM	R14386
Chloride	26.7	10.0		mg/L	20	10/25/2013 7:33:24 PM	R14386
Sulfate	1260	25.0	*	mg/L	50	10/31/2013 3:20:58 AM	R14478
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	0.149	0.0200		mg/L	1	11/12/2013 7:51:40 PM	R14758
Cadmium	ND	0.00200		mg/L	1	11/12/2013 7:51:40 PM	R14758
Calcium	524	10.0		mg/L	10	11/12/2013 7:53:27 PM	R14758
Cobalt	0.00756	0.00600		mg/L	1	11/12/2013 7:51:40 PM	R14758
Copper	ND	0.00600		mg/L	1	11/12/2013 7:51:40 PM	R14758
Magnesium	76.0	1.00		mg/L	1	11/12/2013 7:51:40 PM	R14758
Manganese	3.46	0.0200	*	mg/L	10	11/12/2013 7:53:27 PM	R14758
Potassium	4.15	1.00		mg/L	1	11/12/2013 7:51:40 PM	R14758
Sodium	133	10.0		mg/L	10	11/12/2013 7:53:27 PM	R14758
Zinc	0.0257	0.0100		mg/L	1	11/12/2013 7:51:40 PM	R14758
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	ND	0.0050		mg/L	5	11/5/2013 4:58:45 PM	R14591
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	376	20.0		mg/L CaCO3	1	10/26/2013 12:58:12 AM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/26/2013 12:58:12 AM	R14379
Total Alkalinity (as CaCO3)	376	20.0		mg/L CaCO3	1	10/26/2013 12:58:12 AM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	2580	40.0	*	mg/L	1	10/31/2013 11:31:00 AM	10070

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

Analytical Report
Lab Order **1310C35**
Date Reported: **11/20/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Client Sample ID: GWQ11-24B
Project: Copper Flat (List A)
Collection Date: 10/22/2013 3:25:00 PM
Lab ID: 1310C35-006
Matrix: AQUEOUS
Received Date: 10/25/2013 8:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	3.57	0.100		mg/L	1	10/25/2013 7:45:49 PM	R14386
Chloride	26.4	10.0		mg/L	20	10/25/2013 7:58:13 PM	R14386
Sulfate	1480	25.0	*	mg/L	50	10/31/2013 3:33:22 AM	R14478
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	ND	0.0200		mg/L	1	11/12/2013 7:55:17 PM	R14758
Cadmium	ND	0.00200		mg/L	1	11/12/2013 7:55:17 PM	R14758
Calcium	490	10.0		mg/L	10	11/13/2013 3:42:41 PM	R14777
Cobalt	0.0208	0.00600		mg/L	1	11/12/2013 7:55:17 PM	R14758
Copper	ND	0.00600		mg/L	1	11/12/2013 7:55:17 PM	R14758
Magnesium	88.4	1.00		mg/L	1	11/12/2013 7:55:17 PM	R14758
Manganese	3.58	0.0100	*	mg/L	5	11/12/2013 7:57:04 PM	R14758
Potassium	6.30	1.00		mg/L	1	11/12/2013 7:55:17 PM	R14758
Sodium	97.7	1.00		mg/L	1	11/12/2013 7:55:17 PM	R14758
Zinc	0.231	0.0100		mg/L	1	11/12/2013 7:55:17 PM	R14758
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	ND	0.0050		mg/L	5	11/5/2013 5:01:24 PM	R14591
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	176	20.0		mg/L CaCO3	1	10/26/2013 1:15:47 AM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/26/2013 1:15:47 AM	R14379
Total Alkalinity (as CaCO3)	176	20.0		mg/L CaCO3	1	10/26/2013 1:15:47 AM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	2690	40.0	*	mg/L	1	10/31/2013 11:31:00 AM	10070

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

Hall Environmental Analysis Laboratory, Inc.

CLIENT:	John Shomaker & Assoc.			**Client Sample ID:**	Pit
Project:	Copper Flat (List A)			**Collection Date:**	10/22/2013 3:15:00 PM
Lab ID:	1310C35-007	**Matrix:**	AQUEOUS	**Received Date:**	10/25/2013 8:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	29.8	2.00	*	mg/L	20	10/25/2013 8:23:02 PM	R14386
Chloride	340	100	*	mg/L	200	11/1/2013 6:18:15 AM	R14500
Sulfate	5610	100	*	mg/L	200	10/31/2013 3:45:46 AM	R14478
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	82.6	10.0	*	mg/L	500	11/13/2013 3:48:05 PM	R14777
Cadmium	0.0623	0.0200	*	mg/L	10	11/13/2013 3:44:30 PM	R14777
Calcium	455	10.0		mg/L	10	11/13/2013 3:44:30 PM	R14777
Cobalt	0.486	0.0600		mg/L	10	11/13/2013 3:44:30 PM	R14777
Copper	26.5	0.300	*	mg/L	50	11/13/2013 3:46:06 PM	R14777
Magnesium	522	10.0		mg/L	10	11/13/2013 3:44:30 PM	R14777
Manganese	28.1	0.100	*	mg/L	50	11/13/2013 3:46:06 PM	R14777
Potassium	23.7	10.0		mg/L	10	11/13/2013 3:44:30 PM	R14777
Sodium	604	10.0		mg/L	10	11/13/2013 3:44:30 PM	R14777
Zinc	7.36	0.100	*	mg/L	10	11/13/2013 3:44:30 PM	R14777
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	ND	0.050		mg/L	50	11/5/2013 5:04:04 PM	R14591
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	ND	20.0		mg/L CaCO3	1	10/26/2013 1:27:34 AM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/26/2013 1:27:34 AM	R14379
Total Alkalinity (as CaCO3)	ND	20.0		mg/L CaCO3	1	10/26/2013 1:27:34 AM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	8740	40.0	*	mg/L	1	10/31/2013 11:31:00 AM	10070

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	Spike Recovery outside accepted recovery limits		

Analytical Report
Lab Order **1310C35**
Date Reported: **11/20/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: Copper Flat (List A)
Lab ID: 1310C35-008
Matrix: AQUEOUS

Client Sample ID: GWQ11-24A
Collection Date: 10/22/2013 2:55:00 PM
Received Date: 10/25/2013 8:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	23.7	2.00	*	mg/L	20	10/25/2013 8:47:51 PM	R14386
Chloride	28.1	10.0		mg/L	20	10/25/2013 8:47:51 PM	R14386
Sulfate	2570	50.0	*	mg/L	100	10/31/2013 3:58:11 AM	R14478
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**JLF**
Aluminum	56.6	2.00	*	mg/L	100	11/12/2013 8:12:55 PM	R14758
Cadmium	0.256	0.100	*	mg/L	50	11/12/2013 8:11:12 PM	R14758
Calcium	540	50.0		mg/L	50	11/12/2013 8:11:12 PM	R14758
Cobalt	0.439	0.300		mg/L	50	11/12/2013 8:11:12 PM	R14758
Copper	137	3.00	*	mg/L	500	11/13/2013 3:49:55 PM	R14777
Magnesium	142	50.0		mg/L	50	11/12/2013 8:11:12 PM	R14758
Manganese	13.7	0.100	*	mg/L	50	11/12/2013 8:11:12 PM	R14758
Potassium	ND	50.0		mg/L	50	11/12/2013 8:11:12 PM	R14758
Sodium	160	50.0		mg/L	50	11/12/2013 8:11:12 PM	R14758
Zinc	8.65	0.500	*	mg/L	50	11/12/2013 8:11:12 PM	R14758
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	ND	0.050		mg/L	50	11/5/2013 5:06:43 PM	R14591
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	ND	20		mg/L CaCO3	1	10/25/2013 5:37:24 PM	R14379
Carbonate (As CaCO3)	ND	2.0		mg/L CaCO3	1	10/25/2013 5:37:24 PM	R14379
Total Alkalinity (as CaCO3)	ND	20		mg/L CaCO3	1	10/25/2013 5:37:24 PM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	4280	40.0	*	mg/L	1	10/31/2013 11:31:00 AM	10070

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

CLIENT: John Shomaker & Assoc.
Project: Copper Flat (List A)
Lab ID: 1310C35-009
Matrix: AQUEOUS
Client Sample ID: GWQ11-26
Collection Date: 10/22/2013 1:05:00 PM
Received Date: 10/25/2013 8:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Fluoride	0.390	0.100		mg/L	1	10/25/2013 9:25:05 PM	R14386
Chloride	31.8	10.0		mg/L	20	10/25/2013 9:37:29 PM	R14386
Sulfate	179	10.0		mg/L	20	10/25/2013 9:37:29 PM	R14386
EPA METHOD 200.7: DISSOLVED METALS						Analyst:	**ELS**
Aluminum	0.133	0.0200		mg/L	1	11/11/2013 9:31:27 PM	R14717
Cadmium	ND	0.00200		mg/L	1	11/11/2013 9:31:27 PM	R14717
Calcium	121	5.00		mg/L	5	11/11/2013 9:33:15 PM	R14717
Cobalt	ND	0.00600		mg/L	1	11/11/2013 9:31:27 PM	R14717
Copper	ND	0.00600		mg/L	1	11/11/2013 9:31:27 PM	R14717
Magnesium	27.2	1.00		mg/L	1	11/11/2013 9:31:27 PM	R14717
Manganese	0.0168	0.00200		mg/L	1	11/11/2013 9:31:27 PM	R14717
Potassium	1.46	1.00		mg/L	1	11/11/2013 9:31:27 PM	R14717
Sodium	85.5	1.00		mg/L	1	11/11/2013 9:31:27 PM	R14717
Zinc	ND	0.0100		mg/L	1	11/11/2013 9:31:27 PM	R14717
EPA 200.8: DISSOLVED METALS						Analyst:	**DBD**
Selenium	0.0062	0.0050		mg/L	5	11/5/2013 5:12:04 PM	R14591
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	330	20		mg/L CaCO3	1	10/25/2013 5:41:51 PM	R14379
Carbonate (As CaCO3)	ND	2.0		mg/L CaCO3	1	10/25/2013 5:41:51 PM	R14379
Total Alkalinity (as CaCO3)	330	20		mg/L CaCO3	1	10/25/2013 5:41:51 PM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	905	100	*	mg/L	1	10/31/2013 11:31:00 AM	10070

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	11/05/13
Project:	Not Indicated	**Collection Date:**	10/09/13 12:00
Lab ID:	B13102470-001	**DateReceived:**	10/29/13
Client Sample ID:	1310C35-001C, SWQ-3	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	H	4		A2310 B	11/01/13 11:12 / hmb

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	H - Analysis performed past recommended holding time.	

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	11/05/13
Project:	Not Indicated	**Collection Date:**	10/21/13 17:55
Lab ID:	B13102470-002	**DateReceived:**	10/29/13
Client Sample ID:	1310C35-002C, SWQ-2	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	5	mg/L		4		A2310 B	11/01/13 11:19 / hmb

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	11/05/13
Project:	Not Indicated	**Collection Date:**	10/23/13 14:30
Lab ID:	B13102470-003	**DateReceived:**	10/29/13
Client Sample ID:	1310C35-003C, Pit Wall Seepage	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	9590	mg/L		4		A2310 B	11/04/13 14:52 / hmb

Report Definitions:	RL - Analyte reporting limit. QCL - Quality control limit.	MCL - Maximum contaminant level. ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	11/05/13
Project:	Not Indicated	**Collection Date:**	10/22/13 17:17
Lab ID:	B13102470-004	**DateReceived:**	10/29/13
Client Sample ID:	1310C35-004C, GWQ11-25A	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	14100	mg/L		4		A2310 B	11/04/13 15:35 / hmb

Report Definitions:	RL - Analyte reporting limit. QCL - Quality control limit.	MCL - Maximum contaminant level. ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	11/05/13
Project:	Not Indicated	**Collection Date:**	10/22/13 16:50
Lab ID:	B13102470-005	**DateReceived:**	10/29/13
Client Sample ID:	1310C35-005C, GWQ11-25B	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	105	mg/L		4		A2310 B	11/01/13 11:46 / hmb

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	11/05/13
Project:	Not Indicated	**Collection Date:**	10/22/13 15:25
Lab ID:	B13102470-006	**DateReceived:**	10/29/13
Client Sample ID:	1310C35-006C, GWQ11-24B	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	96	mg/L		4		A2310 B	11/01/13 11:23 / hmb

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	11/05/13
Project:	Not Indicated	**Collection Date:**	10/22/13 15:15
Lab ID:	B13102470-007	**DateReceived:**	10/29/13
Client Sample ID:	1310C35-007C, Pit	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	700	mg/L		4		A2310 B	11/01/13 12:04 / hmb

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	11/05/13
Project:	Not Indicated	**Collection Date:**	10/22/13 14:55
Lab ID:	B13102470-008	**DateReceived:**	10/29/13
Client Sample ID:	1310C35-008C, GWQ11-24A	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	673	mg/L		4		A2310 B	11/01/13 12:13 / hmb

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hall Environmental	**Report Date:**	11/05/13
Project:	Not Indicated	**Collection Date:**	10/22/13 13:05
Lab ID:	B13102470-009	**DateReceived:**	10/29/13
Client Sample ID:	1310C35-009C, GWQ11-26	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	10	mg/L		4		A2310 B	11/01/13 12:22 / hmb

Report Definitions:	RL - Analyte reporting limit. QCL - Quality control limit.	MCL - Maximum contaminant level. ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hall Environmental

Project: Not Indicated

Report Date: 11/05/13

Work Order: B13102470

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2310 B									Batch: R214327
Sample ID: MBLK	Method Blank				Run: Metrohm 2_131101A				11/01/13 09:52
Acidity, Total as CaCO3	2	mg/L	0.3						
Sample ID: LCS	Laboratory Control Sample				Run: Metrohm 2_131101A				11/01/13 09:59
Acidity, Total as CaCO3	1050	mg/L	4.0	100	90	110			
Sample ID: B13102470-001ADUP	Sample Duplicate				Run: Metrohm 2_131101A				11/01/13 11:16
Acidity, Total as CaCO3	2.60	mg/L	4.0					10	
Method: A2310 B									Batch: ACID131104A
Sample ID: MBLK	Method Blank				Run: ORION555A_131104A				11/04/13 14:18
Acidity, Total as CaCO3	1	mg/L							
Sample ID: LCS	Laboratory Control Sample				Run: ORION555A_131104A				11/04/13 14:26
Acidity, Total as CaCO3	1140	mg/L	4.0	109	90	110			
Sample ID: B13102470-002ADUP	Sample Duplicate				Run: ORION555A_131104A				11/04/13 14:48
Acidity, Total as CaCO3	6.02	mg/L	4.0				7.3	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Client: John Shomaker & Assoc.
Project: Copper Flat (List A)

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **PBW** Batch ID: **R14717** RunNo: **14717**
Prep Date: Analysis Date: **11/11/2013** SeqNo: **423546** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	ND	0.020								
Cadmium	ND	0.0020								
Calcium	ND	1.0								
Cobalt	ND	0.0060								
Copper	ND	0.0060								
Magnesium	ND	1.0								
Manganese	ND	0.0020								
Potassium	ND	1.0								
Sodium	ND	1.0								
Zinc	ND	0.010								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R14717** RunNo: **14717**
Prep Date: Analysis Date: **11/11/2013** SeqNo: **423547** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	0.54	0.020	0.5000	0	107	85	115			
Cadmium	0.48	0.0020	0.5000	0	95.9	85	115			
Calcium	48	1.0	50.00	0	96.0	85	115			
Cobalt	0.47	0.0060	0.5000	0	93.0	85	115			
Copper	0.47	0.0060	0.5000	0	94.9	85	115			
Magnesium	49	1.0	50.00	0	99.0	85	115			
Manganese	0.47	0.0020	0.5000	0	93.7	85	115			
Potassium	49	1.0	50.00	0	98.6	85	115			
Sodium	50	1.0	50.00	0	99.2	85	115			
Zinc	0.48	0.010	0.5000	0	95.7	85	115			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **PBW** Batch ID: **R14758** RunNo: **14758**
Prep Date: Analysis Date: **11/12/2013** SeqNo: **424805** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	ND	0.020								
Cadmium	ND	0.0020								
Calcium	ND	1.0								
Cobalt	ND	0.0060								
Copper	ND	0.0060								
Magnesium	ND	1.0								
Manganese	ND	0.0020								
Potassium	ND	1.0								

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1310C35**

20-Nov-13

Client: John Shomaker & Assoc.

Project: Copper Flat (List A)

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 200.7: Dissolved Metals**

Client ID: **PBW** Batch ID: **R14758** RunNo: **14758**

Prep Date: Analysis Date: **11/12/2013** SeqNo: **424805** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sodium	ND	1.0								
Zinc	ND	0.010								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Dissolved Metals**

Client ID: **LCSW** Batch ID: **R14758** RunNo: **14758**

Prep Date: Analysis Date: **11/12/2013** SeqNo: **424806** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	0.53	0.020	0.5000	0	106	85	115			
Cadmium	0.49	0.0020	0.5000	0	97.5	85	115			
Calcium	52	1.0	50.00	0	104	85	115			
Cobalt	0.48	0.0060	0.5000	0	96.5	85	115			
Copper	0.48	0.0060	0.5000	0	95.3	85	115			
Magnesium	52	1.0	50.00	0	103	85	115			
Manganese	0.51	0.0020	0.5000	0	101	85	115			
Potassium	50	1.0	50.00	0	99.6	85	115			
Sodium	50	1.0	50.00	0	100	85	115			
Zinc	0.47	0.010	0.5000	0	94.8	85	115			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 200.7: Dissolved Metals**

Client ID: **PBW** Batch ID: **R14777** RunNo: **14777**

Prep Date: Analysis Date: **11/13/2013** SeqNo: **425465** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	ND	0.020								
Cadmium	ND	0.0020								
Calcium	ND	1.0								
Cobalt	ND	0.0060								
Copper	ND	0.0060								
Magnesium	ND	1.0								
Manganese	ND	0.0020								
Potassium	ND	1.0								
Sodium	ND	1.0								
Zinc	ND	0.010								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Dissolved Metals**

Client ID: **LCSW** Batch ID: **R14777** RunNo: **14777**

Prep Date: Analysis Date: **11/13/2013** SeqNo: **425466** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

Client: John Shomaker & Assoc.

Project: Copper Flat (List A)

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R14777** RunNo: **14777**
Prep Date: Analysis Date: **11/13/2013** SeqNo: **425466** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	0.51	0.020	0.5000	0	102	85	115			
Cadmium	0.48	0.0020	0.5000	0	96.4	85	115			
Calcium	50	1.0	50.00	0	99.1	85	115			
Cobalt	0.48	0.0060	0.5000	0	95.1	85	115			
Copper	0.46	0.0060	0.5000	0	92.6	85	115			
Magnesium	49	1.0	50.00	0	98.2	85	115			
Manganese	0.48	0.0020	0.5000	0	96.0	85	115			
Potassium	48	1.0	50.00	0	95.7	85	115			
Sodium	49	1.0	50.00	0	97.1	85	115			
Zinc	0.49	0.010	0.5000	0	98.8	85	115			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **PBW** Batch ID: **R14777** RunNo: **14777**
Prep Date: Analysis Date: **11/13/2013** SeqNo: **425467** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	ND	0.020								
Cadmium	ND	0.0020								
Calcium	ND	1.0								
Cobalt	ND	0.0060								
Copper	ND	0.0060								
Magnesium	ND	1.0								
Manganese	ND	0.0020								
Potassium	ND	1.0								
Sodium	ND	1.0								
Zinc	ND	0.010								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R14777** RunNo: **14777**
Prep Date: Analysis Date: **11/13/2013** SeqNo: **425468** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	0.52	0.020	0.5000	0	103	85	115			
Cadmium	0.49	0.0020	0.5000	0	97.5	85	115			
Calcium	50	1.0	50.00	0	99.7	85	115			
Cobalt	0.48	0.0060	0.5000	0	96.1	85	115			
Copper	0.47	0.0060	0.5000	0	93.8	85	115			
Magnesium	49	1.0	50.00	0	98.7	85	115			
Manganese	0.48	0.0020	0.5000	0	96.9	85	115			
Potassium	48	1.0	50.00	0	96.5	85	115			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1310C35**
20-Nov-13

Client: John Shomaker & Assoc.
Project: Copper Flat (List A)

Sample ID	**LCS**	SampType:	**LCS**	TestCode:	**EPA Method 200.7: Dissolved Metals**
Client ID:	**LCSW**	Batch ID:	**R14777**	RunNo:	**14777**
Prep Date:		Analysis Date:	**11/13/2013**	SeqNo:	**425468** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sodium	49	1.0	50.00	0	97.7	85	115			
Zinc	0.51	0.010	0.5000	0	102	85	115			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1310C35**

20-Nov-13

Client: John Shomaker & Assoc.

Project: Copper Flat (List A)

Sample ID **MB** SampType: **MBLK** TestCode: **EPA 200.8: Dissolved Metals**

Client ID: **PBW** Batch ID: **R14591** RunNo: **14591**

Prep Date: Analysis Date: **11/5/2013** SeqNo: **419298** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	ND	0.0010								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**

Client ID: **LCSW** Batch ID: **R14591** RunNo: **14591**

Prep Date: Analysis Date: **11/5/2013** SeqNo: **419300** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	0.025	0.0010	0.02500	0	101	85	115			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA 200.8: Dissolved Metals**

Client ID: **PBW** Batch ID: **R14642** RunNo: **14642**

Prep Date: Analysis Date: **11/6/2013** SeqNo: **421212** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	ND	0.0010								

Sample ID **MB** SampType: **MBLK** TestCode: **EPA 200.8: Dissolved Metals**

Client ID: **PBW** Batch ID: **R14642** RunNo: **14642**

Prep Date: Analysis Date: **11/6/2013** SeqNo: **421213** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	ND	0.0010								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**

Client ID: **LCSW** Batch ID: **R14642** RunNo: **14642**

Prep Date: Analysis Date: **11/6/2013** SeqNo: **421215** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	0.025	0.0010	0.02500	0	101	85	115			

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**

Client ID: **LCSW** Batch ID: **R14642** RunNo: **14642**

Prep Date: Analysis Date: **11/6/2013** SeqNo: **421216** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	0.024	0.0010	0.02500	0	97.8	85	115			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT
Hall Environmental Analysis Laboratory, Inc.

WO#: **1310C35**
20-Nov-13

Client: John Shomaker & Assoc.
Project: Copper Flat (List A)

Sample ID **A5** SampType: **CCV_5** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14386** RunNo: **14386**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **413032** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	1.6	0.10	1.600	0	98.2	90	110			
Chloride	7.6	0.50	8.000	0	95.1	90	110			
Sulfate	19	0.50	20.00	0	95.3	90	110			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R14386** RunNo: **14386**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **413034** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	ND	0.10								
Chloride	ND	0.50								
Sulfate	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R14386** RunNo: **14386**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **413035** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.49	0.10	0.5000	0	97.4	90	110			
Chloride	4.7	0.50	5.000	0	93.3	90	110			
Sulfate	9.3	0.50	10.00	0	92.8	90	110			

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14386** RunNo: **14386**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **413044** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	2.5	0.10	2.400	0	103	90	110			
Chloride	12	0.50	12.00	0	98.0	90	110			
Sulfate	30	0.50	30.00	0	98.5	90	110			

Sample ID **A4** SampType: **CCV_4** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14386** RunNo: **14386**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **413056** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	1.0	0.10	1.000	0	100	90	110			
Chloride	4.5	0.50	5.000	0	90.4	90	110			
Sulfate	11	0.50	12.50	0	91.0	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1310C35**

20-Nov-13

Client: John Shomaker & Assoc.

Project: Copper Flat (List A)

Sample ID **A5** SampType: **CCV_5** TestCode: **EPA Method 300.0: Anions**

Client ID: **BatchQC** Batch ID: **R14386** RunNo: **14386**

Prep Date: Analysis Date: **10/25/2013** SeqNo: **413068** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	1.65	0.100	1.600	0	103	90	110			
Chloride	7.53	0.500	8.000	0	94.2	90	110			
Sulfate	19.5	0.500	20.00	0	97.7	90	110			

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**

Client ID: **BatchQC** Batch ID: **R14386** RunNo: **14386**

Prep Date: Analysis Date: **10/25/2013** SeqNo: **413081** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	2.5	0.10	2.400	0	105	90	110			
Chloride	12	0.50	12.00	0	97.8	90	110			
Sulfate	31	0.50	30.00	0	102	90	110			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**

Client ID: **PBW** Batch ID: **R14386** RunNo: **14386**

Prep Date: Analysis Date: **10/25/2013** SeqNo: **413093** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	ND	0.10								
Chloride	ND	0.50								
Sulfate	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**

Client ID: **LCSW** Batch ID: **R14386** RunNo: **14386**

Prep Date: Analysis Date: **10/25/2013** SeqNo: **413095** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.51	0.10	0.5000	0	102	90	110			
Chloride	4.6	0.50	5.000	0	91.8	90	110			
Sulfate	9.8	0.50	10.00	0	97.9	90	110			

Sample ID **A4** SampType: **CCV_4** TestCode: **EPA Method 300.0: Anions**

Client ID: **BatchQC** Batch ID: **R14386** RunNo: **14386**

Prep Date: Analysis Date: **10/25/2013** SeqNo: **413096** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	1.0	0.10	1.000	0	100	90	110			
Chloride	4.5	0.50	5.000	0	90.7	90	110			
Sulfate	12	0.50	12.50	0	95.7	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1310C35**

20-Nov-13

Client: John Shomaker & Assoc.

Project: Copper Flat (List A)

Sample ID **A5** SampType: **CCV_5** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14386** RunNo: **14386**
Prep Date: Analysis Date: **10/26/2013** SeqNo: **413117** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	1.6	0.10	1.600	0	101	90	110			
Chloride	7.6	0.50	8.000	0	94.4	90	110			
Sulfate	19	0.50	20.00	0	97.4	90	110			

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14386** RunNo: **14386**
Prep Date: Analysis Date: **10/26/2013** SeqNo: **413128** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	2.5	0.10	2.400	0	104	90	110			
Chloride	12	0.50	12.00	0	98.5	90	110			
Sulfate	30	0.50	30.00	0	101	90	110			

Sample ID **A4** SampType: **CCV_4** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14386** RunNo: **14386**
Prep Date: Analysis Date: **10/26/2013** SeqNo: **413138** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	1.0	0.10	1.000	0	99.8	90	110			
Chloride	4.5	0.50	5.000	0	89.9	90	110			S
Sulfate	12	0.50	12.50	0	94.3	90	110			

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/30/2013** SeqNo: **415934** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	2.4	0.10	2.400	0	100	90	110			
Sulfate	30	0.50	30.00	0	99.7	90	110			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/30/2013** SeqNo: **415936** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	ND	0.10								
Sulfate	ND	0.50								

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

Client: John Shomaker & Assoc.
Project: Copper Flat (List A)

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/30/2013** SeqNo: **415937** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.49	0.10	0.5000	0	97.4	90	110			
Sulfate	9.3	0.50	10.00	0	93.3	90	110			

Sample ID **A4** SampType: **CCV_4** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/30/2013** SeqNo: **415946** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.96	0.10	1.000	0	96.1	90	110			
Sulfate	11	0.50	12.50	0	90.9	90	110			

Sample ID **A5** SampType: **CCV_5** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/30/2013** SeqNo: **415958** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	1.6	0.10	1.600	0	98.8	90	110			
Sulfate	19	0.50	20.00	0	94.6	90	110			

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/30/2013** SeqNo: **415970** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	2.5	0.10	2.400	0	102	90	110			
Sulfate	30	0.50	30.00	0	98.5	90	110			

Sample ID **A4** SampType: **CCV_4** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **415982** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.98	0.10	1.000	0	97.8	90	110			
Sulfate	11	0.50	12.50	0	91.4	90	110			

Sample ID **A5** SampType: **CCV_5** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **415994** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1310C35**

20-Nov-13

Client: John Shomaker & Assoc.

Project: Copper Flat (List A)

Sample ID **A5** SampType: **CCV_5** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **415994** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	1.64	0.100	1.600	0	103	90	110			
Sulfate	18.9	0.500	20.00	0	94.6	90	110			

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **416002** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	2.51	0.100	2.400	0	105	90	110			
Sulfate	29.5	0.500	30.00	0	98.5	90	110			

Sample ID **A4** SampType: **CCV_4** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14500** RunNo: **14500**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **416496** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	4.5	0.50	5.000	0	90.3	90	110			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R14500** RunNo: **14500**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **416498** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R14500** RunNo: **14500**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **416499** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	4.6	0.50	5.000	0	91.4	90	110			

Sample ID **A5** SampType: **CCV_5** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14500** RunNo: **14500**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **416508** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	7.6	0.50	8.000	0	94.4	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1310C35**
20-Nov-13

Client: John Shomaker & Assoc.
Project: Copper Flat (List A)

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14500** RunNo: **14500**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **416521** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	12	0.50	12.00	0	103	90	110			

Sample ID **A4** SampType: **CCV_4** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14500** RunNo: **14500**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **416533** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	4.5	0.50	5.000	0	90.8	90	110			

Sample ID **A5** SampType: **CCV_5** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14500** RunNo: **14500**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **416545** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	7.5	0.50	8.000	0	93.2	90	110			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R14500** RunNo: **14500**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **416555** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R14500** RunNo: **14500**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **416556** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	4.5	0.50	5.000	0	90.4	90	110			

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14500** RunNo: **14500**
Prep Date: Analysis Date: **11/1/2013** SeqNo: **416557** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	12	0.50	12.00	0	97.9	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1310C35**

20-Nov-13

Client: John Shomaker & Assoc.

Project: Copper Flat (List A)

Sample ID **A4**		SampType: **CCV_4**			TestCode: **EPA Method 300.0: Anions**					
Client ID: **BatchQC**		Batch ID: **R14500**			RunNo: **14500**					
Prep Date:		Analysis Date: **11/1/2013**			SeqNo: **416569**	Units: **mg/L**				
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	4.5	0.50	5.000	0	89.5	90	110			S

Sample ID **A5**		SampType: **CCV_5**			TestCode: **EPA Method 300.0: Anions**					
Client ID: **BatchQC**		Batch ID: **R14500**			RunNo: **14500**					
Prep Date:		Analysis Date: **11/1/2013**			SeqNo: **416581**	Units: **mg/L**				
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	7.4	0.50	8.000	0	92.9	90	110			

Sample ID **A6**		SampType: **CCV_6**			TestCode: **EPA Method 300.0: Anions**					
Client ID: **BatchQC**		Batch ID: **R14500**			RunNo: **14500**					
Prep Date:		Analysis Date: **11/1/2013**			SeqNo: **416590**	Units: **mg/L**				
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	12	0.50	12.00	0	97.7	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1310C35**

20-Nov-13

Client: John Shomaker & Assoc.

Project: Copper Flat (List A)

Sample ID	**1310c35-001a dup**	SampType:	**dup**	TestCode:	**SM2510B: Specific Conductance**	
Client ID:	**SWQ-3**	Batch ID:	**R14379**	RunNo:	**14379**	
Prep Date:		Analysis Date:	**10/26/2013**	SeqNo:	**412687**	Units: **µmhos/cm**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Conductivity	3530	0.0100						0.113	20	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

Client: John Shomaker & Assoc.
Project: Copper Flat (List A)

Sample ID **1310c35-001a dup** SampType: **dup** TestCode: **SM4500-H+B: pH**
Client ID: **SWQ-3** Batch ID: **R14379** RunNo: **14379**
Prep Date: Analysis Date: **10/26/2013** SeqNo: **412702** Units: **pH units**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
pH	8.26	1.68								H

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1310C35**

20-Nov-13

Client: John Shomaker & Assoc.

Project: Copper Flat (List A)

Sample ID **mb-1**	SampType: **mblk**	TestCode: **SM2320B: Alkalinity**	
Client ID: **PBW**	Batch ID: **R14379**	RunNo: **14379**	
Prep Date:	Analysis Date: **10/25/2013**	SeqNo: **412633**	Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-1**	SampType: **lcs**	TestCode: **SM2320B: Alkalinity**	
Client ID: **LCSW**	Batch ID: **R14379**	RunNo: **14379**	
Prep Date:	Analysis Date: **10/25/2013**	SeqNo: **412634**	Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	80	20	80.00	0	100	90	110			

Sample ID **mb-2**	SampType: **mblk**	TestCode: **SM2320B: Alkalinity**	
Client ID: **PBW**	Batch ID: **R14379**	RunNo: **14379**	
Prep Date:	Analysis Date: **10/25/2013**	SeqNo: **412650**	Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-2**	SampType: **lcs**	TestCode: **SM2320B: Alkalinity**	
Client ID: **LCSW**	Batch ID: **R14379**	RunNo: **14379**	
Prep Date:	Analysis Date: **10/25/2013**	SeqNo: **412651**	Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	81	20	80.00	0	102	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1310C35**

20-Nov-13

Client: John Shomaker & Assoc.

Project: Copper Flat (List A)

Sample ID	**MB-10062**	SampType:	**MBLK**	TestCode:	**SM2540C MOD: Total Dissolved Solids**
Client ID:	**PBW**	Batch ID:	**10062**	RunNo:	**14450**
Prep Date:	**10/28/2013**	Analysis Date:	**10/30/2013**	SeqNo:	**415199** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	ND	20.0								

Sample ID	**LCS-10062**	SampType:	**LCS**	TestCode:	**SM2540C MOD: Total Dissolved Solids**
Client ID:	**LCSW**	Batch ID:	**10062**	RunNo:	**14450**
Prep Date:	**10/28/2013**	Analysis Date:	**10/30/2013**	SeqNo:	**415200** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	1030	20.0	1000	0	103	80	120			

Sample ID	**MB-10070**	SampType:	**MBLK**	TestCode:	**SM2540C MOD: Total Dissolved Solids**
Client ID:	**PBW**	Batch ID:	**10070**	RunNo:	**14477**
Prep Date:	**10/29/2013**	Analysis Date:	**10/31/2013**	SeqNo:	**415905** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	ND	20.0								

Sample ID	**LCS-10070**	SampType:	**LCS**	TestCode:	**SM2540C MOD: Total Dissolved Solids**
Client ID:	**LCSW**	Batch ID:	**10070**	RunNo:	**14477**
Prep Date:	**10/29/2013**	Analysis Date:	**10/31/2013**	SeqNo:	**415906** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	1050	20.0	1000	0	105	80	120			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

Sample Log-In Check List

Client Name: SHO   Work Order Number: 1310C35   RcptNo: 1

Received by/date: 10/25/13
Logged By: Lindsay Mangin   10/25/2013 8:45:00 AM
Completed By: Lindsay Mangin   10/25/2013 10:18:01 AM
Reviewed By: 10/25/13

Chain of Custody

1. Custody seals intact on sample bottles? Yes ☐ No ☐ Not Present ☑
2. Is Chain of Custody complete? Yes ☑ No ☐ Not Present ☐
3. How was the sample delivered? Client

Log In

4. Was an attempt made to cool the samples? Yes ☑ No ☐ NA ☐
5. Were all samples received at a temperature of >0° C to 6.0°C Yes ☑ No ☐ NA ☐
6. Sample(s) in proper container(s)? Yes ☑ No ☐
7. Sufficient sample volume for indicated test(s)? Yes ☑ No ☐
8. Are samples (except VOA and ONG) properly preserved? Yes ☑ No ☐
9. Was preservative added to bottles? Yes ☐ No ☑ NA ☐
10. VOA vials have zero headspace? Yes ☐ No ☐ No VOA Vials ☑
11. Were any sample containers received broken? Yes ☐ No ☑
12. Does paperwork match bottle labels? Yes ☑ No ☐
(Note discrepancies on chain of custody)
13. Are matrices correctly identified on Chain of Custody? Yes ☑ No ☐
14. Is it clear what analyses were requested? Yes ☑ No ☐
15. Were all holding times able to be met? Yes ☑ No ☐
(If no, notify customer for authorization.)

# of preserved bottles checked for pH: 9
([<2] or >12 unless noted)
Adjusted? NO
Checked by:

Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified: Date:
By Whom: Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:
Client Instructions:

17. Additional remarks:

18. **Cooler Information**

Cooler No	Temp °C	Condition	Seal Intact	Seal No	Seal Date	Signed By
1	4.1	Good	Not Present			

Chain-of-Custody Record

Client: JSAI

2611 Broadbent Pkwy, NE
Mailing Address: Albuquerque, NM 87107

Phone #: 505 345 3407

email or Fax#: sfinch@shomaker.com

QA/QC Package:
☑ Standard ☐ Level 4 (Full Validation)

Accreditation
☐ NELAP ☐ Other

☐ EDD (Type)

Turn-Around Time:
☑ Standard ☐ Rush

Project Name: Copper Flat (List A)

Project #:

Project Manager: Steve Finch

Sampler: M. Wikstrom, S. Finch

On Ice: ☑ Yes ☐ No

Sample Temperature: 4.1

List "A"

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com
4901 Hawkins NE - Albuquerque, NM 87109
Tel. 505-345-3975 Fax 505-345-4107

Analysis Request

Date 2013	Time	Matrix	Sample Request ID	Container Type and #	Preservative Type	HEAL No. 1310C35	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH 8015B (GRO / DRO / MRO)	TPH (Method 418.1)	EDB (Method 504.1)	PAH's (8310 or 8270 SIMS)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)	List A		pH, specific conductance		Air Bubbles (Y or N)
10/9/13	12:00	H_2O	SWQ-3	3	HNO_3/none	-001												✓		✓		
10/21	17:55	H_2O	SWQ-2	3	HNO_3/none	-002												✓		✓		
10/23	14:30	H_2O	Pit Wall Seepage	2	HNO_3/none	-003												✓				
10/22	17:17	H_2O	GWQ11-25A	3	HNO_3/none	-004												✓				
10/22	16:50	H_2O	GWQ11-25B	3	HNO_3/none	-005												✓				
10/22	15:25	H_2O	GWQ11-24B	3	HNO_3/none	-006												✓				
10/22	15:15	H_2O	Pit	3	HNO_3/none	-007												✓				
10/22	14:55	H_2O	GWQ11-24A	3	HNO_3/none	-008												✓				
10/22	13:05	H_2O	GWQ11-26	3	HNO_3/none	-009												✓				

Date:	Time:	Relinquished by:	Received by:	Date	Time
10/25/13	09:45			10/25/13	0845
Date:	Time:	Relinquished by:	Received by:	Date	Time

Remarks: Please email results to:
sfinch@shomaker.com
List "A" samples.

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

NMCC Copper Flat Stage 1 Abatement Lab Sampling Analysis

List A* Pit Area Groundwater	List B† Waste Rock Pile and Tailings Impoundment Area Groundwater
Al	Total Dissolved Solids
Cd	Sulfate
Co	Chloride
Cu	Alkalinity
Mn	Ca
Se	Mg
Zn	Na
Ca	K
Mg	
Na	
K	
Alkalinity	
Total Acidity (Not pH)	
Chloride	
Flouride	
Sulfate	
Total Dissolved Solids	

*List A metals are for dissolved metals (filtered)

†List B metals are for total metals (NOT filtered)

HALL
ENVIRONMENTAL
ANALYSIS
LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

November 11, 2013

Steve Finch
John Shomaker & Assoc.
2611 Broadbent Parkway NE
Albuquerque, NM 87107
TEL: (505) 345-3407
FAX (505) 345-9920

RE: Copper Flat (List B) OrderNo.: 1310C34

Dear Steve Finch:

Hall Environmental Analysis Laboratory received 13 sample(s) on 10/25/2013 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0190

Sincerely,

Andy

Andy Freeman
Laboratory Manager
4901 Hawkins NE
Albuquerque, NM 87109

Analytical Report
Lab Order **1310C34**
Date Reported: **11/11/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: Copper Flat (List B)
Lab ID: 1310C34-001
Matrix: AQUEOUS
Client Sample ID: GWQ-8
Collection Date: 10/23/2013 1:25:00 PM
Received Date: 10/25/2013 9:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Chloride	91.3	10.0		mg/L	20	10/25/2013 4:56:40 PM	R14384
Sulfate	586	10.0	*	mg/L	20	10/25/2013 4:56:40 PM	R14384
EPA METHOD 200.7: METALS						Analyst:	**JLF**
Calcium	195	10.0		mg/L	10	11/5/2013 7:53:15 PM	R14607
Magnesium	36.0	1.00		mg/L	1	11/5/2013 7:50:06 PM	R14607
Potassium	2.36	1.00		mg/L	1	11/5/2013 7:50:06 PM	R14607
Sodium	113	10.0		mg/L	10	11/5/2013 7:53:15 PM	R14607
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	201	20.0		mg/L CaCO3	1	10/25/2013 9:21:49 PM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/25/2013 9:21:49 PM	R14379
Total Alkalinity (as CaCO3)	201	20.0		mg/L CaCO3	1	10/25/2013 9:21:49 PM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	1250	40.0	*	mg/L	1	11/1/2013 11:56:00 AM	10103

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

Analytical Report

Lab Order **1310C34**

Date Reported: **11/11/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.

Project: Copper Flat (List B)

Lab ID: 1310C34-002

Matrix: AQUEOUS

Client Sample ID: GWQ-1

Collection Date: 10/23/2013 12:38:00 PM

Received Date: 10/25/2013 9:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Chloride	20.3	10.0		mg/L	20	10/25/2013 5:21:30 PM	R14384
Sulfate	72.0	10.0		mg/L	20	10/25/2013 5:21:30 PM	R14384
EPA METHOD 200.7: METALS							Analyst: **JLF**
Calcium	39.2	1.00		mg/L	1	11/5/2013 7:56:49 PM	R14607
Magnesium	12.8	1.00		mg/L	1	11/5/2013 7:56:49 PM	R14607
Potassium	2.08	1.00		mg/L	1	11/5/2013 7:56:49 PM	R14607
Sodium	63.9	1.00		mg/L	1	11/5/2013 7:56:49 PM	R14607
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	177	20.0		mg/L CaCO3	1	10/25/2013 9:33:39 PM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/25/2013 9:33:39 PM	R14379
Total Alkalinity (as CaCO3)	177	20.0		mg/L CaCO3	1	10/25/2013 9:33:39 PM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	380	40.0		mg/L	1	11/1/2013 11:56:00 AM	10103

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

CLIENT: John Shomaker & Assoc.
Client Sample ID: GWQ-3
Project: Copper Flat (List B)
Collection Date: 10/23/2013 11:35:00 AM
Lab ID: 1310C34-003
Matrix: AQUEOUS
Received Date: 10/25/2013 9:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Chloride	62.9	10.0		mg/L	20	10/25/2013 5:46:21 PM	R14384
Sulfate	1210	25.0	*	mg/L	50	10/31/2013 1:41:39 AM	R14478
EPA METHOD 200.7: METALS						Analyst:	**JLF**
Calcium	345	10.0		mg/L	10	11/5/2013 8:35:56 PM	R14607
Magnesium	76.1	5.00		mg/L	5	11/5/2013 8:14:23 PM	R14607
Potassium	2.85	1.00		mg/L	1	11/5/2013 8:03:31 PM	R14607
Sodium	199	5.00		mg/L	5	11/5/2013 8:14:23 PM	R14607
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	237	20.0		mg/L CaCO3	1	10/25/2013 9:44:14 PM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/25/2013 9:44:14 PM	R14379
Total Alkalinity (as CaCO3)	237	20.0		mg/L CaCO3	1	10/25/2013 9:44:14 PM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	2410	20.0	*	mg/L	1	11/1/2013 11:56:00 AM	10103

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

Analytical Report
Lab Order **1310C34**
Date Reported: **11/11/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: Copper Flat (List B)
Lab ID: 1310C34-004
Matrix: AQUEOUS
Client Sample ID: GWQ-5R
Collection Date: 10/23/2013 9:30:00 AM
Received Date: 10/25/2013 9:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Chloride	18.3	10.0		mg/L	20	10/25/2013 6:35:59 PM	R14384
Sulfate	102	10.0		mg/L	20	10/25/2013 6:35:59 PM	R14384
EPA METHOD 200.7: METALS							Analyst: **JLF**
Calcium	96.2	1.00		mg/L	1	11/5/2013 8:39:31 PM	10184
Magnesium	22.9	1.00		mg/L	1	11/5/2013 8:39:31 PM	10184
Potassium	4.32	1.00		mg/L	1	11/5/2013 8:39:31 PM	10184
Sodium	34.0	1.00		mg/L	1	11/5/2013 8:39:31 PM	10184
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	282	20.0		mg/L CaCO3	1	10/25/2013 9:57:09 PM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/25/2013 9:57:09 PM	R14379
Total Alkalinity (as CaCO3)	282	20.0		mg/L CaCO3	1	10/25/2013 9:57:09 PM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	518	20.0	*	mg/L	1	11/1/2013 11:56:00 AM	10103

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ94-16
Project: Copper Flat (List B) **Collection Date:** 10/24/2013 11:46:00 AM
Lab ID: 1310C34-005 **Matrix:** AQUEOUS **Received Date:** 10/25/2013 9:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Chloride	194	10.0		mg/L	20	10/25/2013 7:00:48 PM	R14384
Sulfate	598	10.0	*	mg/L	20	10/25/2013 7:00:48 PM	R14384
EPA METHOD 200.7: METALS							Analyst: **JLF**
Calcium	225	10.0		mg/L	10	11/5/2013 8:50:23 PM	R14607
Magnesium	59.9	1.00		mg/L	1	11/5/2013 8:46:42 PM	R14607
Potassium	3.42	1.00		mg/L	1	11/5/2013 8:46:42 PM	R14607
Sodium	110	10.0		mg/L	10	11/5/2013 8:50:23 PM	R14607
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	178	20.0		mg/L CaCO3	1	10/25/2013 10:10:46 PM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/25/2013 10:10:46 PM	R14379
Total Alkalinity (as CaCO3)	178	20.0		mg/L CaCO3	1	10/25/2013 10:10:46 PM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	1430	20.0	*	mg/L	1	11/1/2013 3:13:00 PM	10127

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	Spike Recovery outside accepted recovery limits		

Analytical Report
Lab Order **1310C34**
Date Reported: **11/11/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT:	John Shomaker & Assoc.			**Client Sample ID:**	GWQ-11
Project:	Copper Flat (List B)			**Collection Date:**	10/24/2013 11:12:00 AM
Lab ID:	1310C34-006	**Matrix:**	AQUEOUS	**Received Date:**	10/25/2013 9:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Chloride	131	10.0		mg/L	20	10/25/2013 7:25:38 PM	R14384
Sulfate	323	10.0	*	mg/L	20	10/25/2013 7:25:38 PM	R14384
EPA METHOD 200.7: METALS							Analyst: **JLF**
Calcium	149	10.0		mg/L	10	11/5/2013 8:57:25 PM	R14607
Magnesium	43.6	1.00		mg/L	1	11/5/2013 8:53:56 PM	R14607
Potassium	3.09	1.00		mg/L	1	11/5/2013 8:53:56 PM	R14607
Sodium	71.7	1.00		mg/L	1	11/5/2013 8:53:56 PM	R14607
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	165	20.0		mg/L CaCO3	1	10/25/2013 10:21:41 PM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/25/2013 10:21:41 PM	R14379
Total Alkalinity (as CaCO3)	165	20.0		mg/L CaCO3	1	10/25/2013 10:21:41 PM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	942	20.0	*	mg/L	1	11/1/2013 3:13:00 PM	10127

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	Spike Recovery outside accepted recovery limits		

CLIENT: John Shomaker & Assoc.
Project: Copper Flat (List B)
Lab ID: 1310C34-007
Matrix: AQUEOUS

Client Sample ID: GWQ94-13
Collection Date: 10/24/2013 10:26:00 AM
Received Date: 10/25/2013 9:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Chloride	211	10.0		mg/L	20	10/25/2013 7:50:28 PM	R14384
Sulfate	607	10.0	*	mg/L	20	10/25/2013 7:50:28 PM	R14384
EPA METHOD 200.7: METALS						Analyst:	**JLF**
Calcium	233	10.0		mg/L	10	11/5/2013 9:04:32 PM	R14607
Magnesium	49.7	1.00		mg/L	1	11/5/2013 9:00:55 PM	R14607
Potassium	3.02	1.00		mg/L	1	11/5/2013 9:00:55 PM	R14607
Sodium	107	10.0		mg/L	10	11/5/2013 9:04:32 PM	R14607
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	126	20.0		mg/L CaCO3	1	10/25/2013 10:32:04 PM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/25/2013 10:32:04 PM	R14379
Total Alkalinity (as CaCO3)	126	20.0		mg/L CaCO3	1	10/25/2013 10:32:04 PM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	1440	20.0	*	mg/L	1	11/1/2013 3:13:00 PM	10127

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	Spike Recovery outside accepted recovery limits		

CLIENT: John Shomaker & Assoc.
Client Sample ID: NP-3
Project: Copper Flat (List B)
Collection Date: 10/24/2013 8:40:00 AM
Lab ID: 1310C34-008
Matrix: AQUEOUS
Received Date: 10/25/2013 9:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Chloride	238	10.0		mg/L	20	10/25/2013 8:15:17 PM	R14384
Sulfate	685	10.0	*	mg/L	20	10/25/2013 8:15:17 PM	R14384
EPA METHOD 200.7: METALS						Analyst:	**JLF**
Calcium	252	10.0		mg/L	10	11/5/2013 9:25:27 PM	10184
Magnesium	59.4	1.00		mg/L	1	11/5/2013 9:08:03 PM	10184
Potassium	4.56	1.00		mg/L	1	11/5/2013 9:08:03 PM	10184
Sodium	109	10.0		mg/L	10	11/5/2013 9:25:27 PM	10184
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	118	20.0		mg/L CaCO3	1	10/25/2013 10:41:37 PM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/25/2013 10:41:37 PM	R14379
Total Alkalinity (as CaCO3)	118	20.0		mg/L CaCO3	1	10/25/2013 10:41:37 PM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	1550	200	*	mg/L	1	11/1/2013 3:13:00 PM	10127

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

Analytical Report
Lab Order **1310C34**
Date Reported: **11/11/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT:	John Shomaker & Assoc.	**Client Sample ID:**	NP-1
Project:	Copper Flat (List B)	**Collection Date:**	10/23/2013 4:25:00 PM
Lab ID:	1310C34-009 **Matrix:** AQUEOUS	**Received Date:**	10/25/2013 9:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Chloride	158	10.0		mg/L	20	10/25/2013 9:04:57 PM	R14384
Sulfate	280	10.0	*	mg/L	20	10/25/2013 9:04:57 PM	R14384
EPA METHOD 200.7: METALS						Analyst:	**JLF**
Calcium	208	10.0		mg/L	10	11/5/2013 9:31:55 PM	10184
Magnesium	61.4	1.00		mg/L	1	11/5/2013 9:28:33 PM	10184
Potassium	6.36	1.00		mg/L	1	11/5/2013 9:28:33 PM	10184
Sodium	71.7	1.00		mg/L	1	11/5/2013 9:28:33 PM	10184
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	153	20.0		mg/L CaCO3	1	10/25/2013 10:51:07 PM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/25/2013 10:51:07 PM	R14379
Total Alkalinity (as CaCO3)	153	20.0		mg/L CaCO3	1	10/25/2013 10:51:07 PM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	1270	200	*	mg/L	1	10/31/2013 11:31:00 AM	10070

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	Spike Recovery outside accepted recovery limits		

Analytical Report
Lab Order **1310C34**
Date Reported: **11/11/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: Copper Flat (List B)
Lab ID: 1310C34-010
Matrix: AQUEOUS
Client Sample ID: GWQ-12
Collection Date: 10/23/2013 3:35:00 PM
Received Date: 10/25/2013 9:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst:	**JRR**
Chloride	22.7	10.0		mg/L	20	10/25/2013 9:29:46 PM	R14384
Sulfate	37.7	10.0		mg/L	20	10/25/2013 9:29:46 PM	R14384
EPA METHOD 200.7: METALS						Analyst:	**JLF**
Calcium	54.0	1.00		mg/L	1	11/5/2013 9:35:00 PM	10184
Magnesium	18.8	1.00		mg/L	1	11/5/2013 9:35:00 PM	10184
Potassium	3.58	1.00		mg/L	1	11/5/2013 9:35:00 PM	10184
Sodium	31.5	1.00		mg/L	1	11/5/2013 9:35:00 PM	10184
SM2320B: ALKALINITY						Analyst:	**JML**
Bicarbonate (As CaCO3)	194	20.0		mg/L CaCO3	1	10/25/2013 11:01:36 PM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/25/2013 11:01:36 PM	R14379
Total Alkalinity (as CaCO3)	194	20.0		mg/L CaCO3	1	10/25/2013 11:01:36 PM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst:	**KS**
Total Dissolved Solids	426	40.0		mg/L	1	10/31/2013 11:31:00 AM	10070

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

Analytical Report
Lab Order **1310C34**
Date Reported: **11/11/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT:	John Shomaker & Assoc.			**Client Sample ID:**	GWQ13-28
Project:	Copper Flat (List B)			**Collection Date:**	10/23/2013 2:30:00 PM
Lab ID:	1310C34-011	**Matrix:**	AQUEOUS	**Received Date:**	10/25/2013 9:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Chloride	51.5	10.0		mg/L	20	10/25/2013 9:54:36 PM	R14384
Sulfate	167	10.0		mg/L	20	10/25/2013 9:54:36 PM	R14384
EPA METHOD 200.7: METALS							Analyst: **JLF**
Calcium	98.4	1.00		mg/L	1	11/5/2013 9:41:45 PM	10184
Magnesium	17.0	1.00		mg/L	1	11/5/2013 9:41:45 PM	10184
Potassium	2.91	1.00		mg/L	1	11/5/2013 9:41:45 PM	10184
Sodium	66.6	1.00		mg/L	1	11/5/2013 9:41:45 PM	10184
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	185	20.0		mg/L CaCO3	1	10/25/2013 11:12:46 PM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/25/2013 11:12:46 PM	R14379
Total Alkalinity (as CaCO3)	185	20.0		mg/L CaCO3	1	10/25/2013 11:12:46 PM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	629	20.0	*	mg/L	1	10/31/2013 11:31:00 AM	10070

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	Spike Recovery outside accepted recovery limits		

CLIENT:	John Shomaker & Assoc.	**Client Sample ID:**	GWQ94-14
Project:	Copper Flat (List B)	**Collection Date:**	10/22/2013 11:52:00 AM
Lab ID:	1310C34-012 **Matrix:** AQUEOUS	**Received Date:**	10/25/2013 9:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Chloride	44.3	10.0		mg/L	20	10/25/2013 10:19:25 PM	R14384
Sulfate	140	10.0		mg/L	20	10/25/2013 10:19:25 PM	R14384
EPA METHOD 200.7: METALS							Analyst: **JLF**
Calcium	85.9	1.00		mg/L	1	11/5/2013 9:48:30 PM	10184
Magnesium	24.8	1.00		mg/L	1	11/5/2013 9:48:30 PM	10184
Potassium	1.67	1.00		mg/L	1	11/5/2013 9:48:30 PM	10184
Sodium	48.0	1.00		mg/L	1	11/5/2013 9:48:30 PM	10184
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	217	20.0		mg/L CaCO3	1	10/25/2013 11:23:52 PM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/25/2013 11:23:52 PM	R14379
Total Alkalinity (as CaCO3)	217	20.0		mg/L CaCO3	1	10/25/2013 11:23:52 PM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	592	20.0	*	mg/L	1	10/31/2013 11:31:00 AM	10070

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	Spike Recovery outside accepted recovery limits		

CLIENT: John Shomaker & Assoc. **Client Sample ID:** MW-4
Project: Copper Flat (List B) **Collection Date:** 10/22/2013 9:50:00 AM
Lab ID: 1310C34-013 **Matrix:** AQUEOUS **Received Date:** 10/25/2013 9:45:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Chloride	18.4	10.0		mg/L	20	10/25/2013 10:44:14 PM	R14384
Sulfate	115	10.0		mg/L	20	10/25/2013 10:44:14 PM	R14384
EPA METHOD 200.7: METALS							Analyst: **JLF**
Calcium	64.7	1.00		mg/L	1	11/5/2013 9:55:37 PM	R14607
Magnesium	15.9	1.00		mg/L	1	11/5/2013 9:55:37 PM	R14607
Potassium	2.62	1.00		mg/L	1	11/5/2013 9:55:37 PM	R14607
Sodium	57.1	1.00		mg/L	1	11/5/2013 9:55:37 PM	R14607
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	202	20.0		mg/L CaCO3	1	10/25/2013 11:35:46 PM	R14379
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	10/25/2013 11:35:46 PM	R14379
Total Alkalinity (as CaCO3)	202	20.0		mg/L CaCO3	1	10/25/2013 11:35:46 PM	R14379
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	495	20.0		mg/L	1	10/31/2013 11:31:00 AM	10070

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1310C34**

11-Nov-13

Client: John Shomaker & Assoc.

Project: Copper Flat (List B)

Sample ID **MB-10184** SampType: **MBLK** TestCode: **EPA Method 200.7: Metals**

Client ID: **PBW** Batch ID: **10184** RunNo: **14586**

Prep Date: **11/5/2013** Analysis Date: **11/5/2013** SeqNo: **419145** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Calcium	ND	1.0								
Magnesium	ND	1.0								
Potassium	ND	1.0								
Sodium	ND	1.0								

Sample ID **LCS-10184** SampType: **LCS** TestCode: **EPA Method 200.7: Metals**

Client ID: **LCSW** Batch ID: **10184** RunNo: **14586**

Prep Date: **11/5/2013** Analysis Date: **11/5/2013** SeqNo: **419146** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Calcium	51	1.0	50.00	0	103	85	115			
Magnesium	51	1.0	50.00	0	102	85	115			
Potassium	51	1.0	50.00	0	101	85	115			
Sodium	50	1.0	50.00	0	99.2	85	115			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 200.7: Metals**

Client ID: **PBW** Batch ID: **R14607** RunNo: **14607**

Prep Date: Analysis Date: **11/5/2013** SeqNo: **420095** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Calcium	ND	1.0								
Magnesium	ND	1.0								
Potassium	ND	1.0								
Sodium	ND	1.0								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Metals**

Client ID: **LCSW** Batch ID: **R14607** RunNo: **14607**

Prep Date: Analysis Date: **11/5/2013** SeqNo: **420096** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Calcium	56	1.0	50.00	0	112	85	115			
Magnesium	57	1.0	50.00	0	114	85	115			
Potassium	55	1.0	50.00	0	110	85	115			
Sodium	57	1.0	50.00	0	114	85	115			

Sample ID **1310C34-003BMS** SampType: **MS** TestCode: **EPA Method 200.7: Metals**

Client ID: **GWQ-3** Batch ID: **R14607** RunNo: **14607**

Prep Date: Analysis Date: **11/5/2013** SeqNo: **420137** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

Client: John Shomaker & Assoc.

Project: Copper Flat (List B)

Sample ID **1310C34-003BMS**	SampType: **MS**			TestCode: **EPA Method 200.7: Metals**						
Client ID: **GWQ-3**	Batch ID: **R14607**			RunNo: **14607**						
Prep Date:	Analysis Date: **11/5/2013**			SeqNo: **420137**	Units: **mg/L**					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Potassium	51.4	1.00	50.00	2.853	97.0	70	130			

Sample ID **1310C34-003BMSD**	SampType: **MSD**			TestCode: **EPA Method 200.7: Metals**						
Client ID: **GWQ-3**	Batch ID: **R14607**			RunNo: **14607**						
Prep Date:	Analysis Date: **11/5/2013**			SeqNo: **420138**	Units: **mg/L**					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Potassium	53.2	1.00	50.00	2.853	101	70	130	3.56	20	

Sample ID **1310C34-003BMS**	SampType: **MS**			TestCode: **EPA Method 200.7: Metals**						
Client ID: **GWQ-3**	Batch ID: **R14607**			RunNo: **14607**						
Prep Date:	Analysis Date: **11/5/2013**			SeqNo: **420140**	Units: **mg/L**					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Magnesium	323	5.00	250.0	76.05	98.8	70	130			
Sodium	455	5.00	250.0	199.3	102	70	130			

Sample ID **1310C34-003BMSD**	SampType: **MSD**			TestCode: **EPA Method 200.7: Metals**						
Client ID: **GWQ-3**	Batch ID: **R14607**			RunNo: **14607**						
Prep Date:	Analysis Date: **11/5/2013**			SeqNo: **420141**	Units: **mg/L**					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Magnesium	331	5.00	250.0	76.05	102	70	130	2.38	20	
Sodium	461	5.00	250.0	199.3	105	70	130	1.24	20	

Client: John Shomaker & Assoc.

Project: Copper Flat (List B)

Sample ID **A5** SampType: **CCV_5** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14384** RunNo: **14384**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **412899** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	7.8	0.50	8.000	0	96.9	90	110			
Sulfate	19	0.50	20.00	0	96.3	90	110			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R14384** RunNo: **14384**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **412900** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	ND	0.50								
Sulfate	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R14384** RunNo: **14384**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **412901** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	4.6	0.50	5.000	0	91.4	90	110			
Sulfate	9.2	0.50	10.00	0	91.9	90	110			

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14384** RunNo: **14384**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **412910** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	12	0.50	12.00	0	102	90	110			
Sulfate	30	0.50	30.00	0	100	90	110			

Sample ID **A4** SampType: **CCV_4** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14384** RunNo: **14384**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **412922** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	4.64	0.500	5.000	0	92.9	90	110			
Sulfate	11.6	0.500	12.50	0	93.0	90	110			

Sample ID **A5** SampType: **CCV_5** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14384** RunNo: **14384**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **412934** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1310C34**

11-Nov-13

Client: John Shomaker & Assoc.

Project: Copper Flat (List B)

Sample ID	**A5**	SampType:	**CCV_5**	TestCode:	**EPA Method 300.0: Anions**
Client ID:	**BatchQC**	Batch ID:	**R14384**	RunNo:	**14384**
Prep Date:		Analysis Date:	**10/25/2013**	SeqNo:	**412934** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	7.7	0.50	8.000	0	96.9	90	110			
Sulfate	19	0.50	20.00	0	96.0	90	110			

Sample ID	**A6**	SampType:	**CCV_6**	TestCode:	**EPA Method 300.0: Anions**
Client ID:	**BatchQC**	Batch ID:	**R14384**	RunNo:	**14384**
Prep Date:		Analysis Date:	**10/26/2013**	SeqNo:	**412946** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	12	0.50	12.00	0	102	90	110			
Sulfate	30	0.50	30.00	0	99.8	90	110			

Sample ID	**A4**	SampType:	**CCV_4**	TestCode:	**EPA Method 300.0: Anions**
Client ID:	**BatchQC**	Batch ID:	**R14384**	RunNo:	**14384**
Prep Date:		Analysis Date:	**10/26/2013**	SeqNo:	**412958** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	4.7	0.50	5.000	0	94.0	90	110			
Sulfate	12	0.50	12.50	0	93.0	90	110			

Sample ID	**A6**	SampType:	**CCV_6**	TestCode:	**EPA Method 300.0: Anions**
Client ID:	**BatchQC**	Batch ID:	**R14478**	RunNo:	**14478**
Prep Date:		Analysis Date:	**10/30/2013**	SeqNo:	**415934** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	30	0.50	30.00	0	99.7	90	110			

Sample ID	**MB**	SampType:	**MBLK**	TestCode:	**EPA Method 300.0: Anions**
Client ID:	**PBW**	Batch ID:	**R14478**	RunNo:	**14478**
Prep Date:		Analysis Date:	**10/30/2013**	SeqNo:	**415936** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	ND	0.50								

Sample ID	**LCS**	SampType:	**LCS**	TestCode:	**EPA Method 300.0: Anions**
Client ID:	**LCSW**	Batch ID:	**R14478**	RunNo:	**14478**
Prep Date:		Analysis Date:	**10/30/2013**	SeqNo:	**415937** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	9.3	0.50	10.00	0	93.3	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.
E	Value above quantitation range
J	Analyte detected below quantitation limits
O	RSD is greater than RSDlimit
R	RPD outside accepted recovery limits
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2 for VOA and TOC only.
RL	Reporting Detection Limit

Client: John Shomaker & Assoc.
Project: Copper Flat (List B)

Sample ID **A4** SampType: **CCV_4** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/30/2013** SeqNo: **415946** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	11	0.50	12.50	0	90.9	90	110			

Sample ID **A5** SampType: **CCV_5** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/30/2013** SeqNo: **415958** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	19	0.50	20.00	0	94.6	90	110			

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/30/2013** SeqNo: **415970** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	30	0.50	30.00	0	98.5	90	110			

Sample ID **A4** SampType: **CCV_4** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **415982** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	11	0.50	12.50	0	91.4	90	110			

Sample ID **A5** SampType: **CCV_5** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **415994** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	19	0.50	20.00	0	94.6	90	110			

Sample ID **A6** SampType: **CCV_6** TestCode: **EPA Method 300.0: Anions**
Client ID: **BatchQC** Batch ID: **R14478** RunNo: **14478**
Prep Date: Analysis Date: **10/31/2013** SeqNo: **416002** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	30	0.50	30.00	0	98.5	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1310C34**

11-Nov-13

Client: John Shomaker & Assoc.

Project: Copper Flat (List B)

Sample ID **mb-1** SampType: **mblk** TestCode: **SM2320B: Alkalinity**
Client ID: **PBW** Batch ID: **R14379** RunNo: **14379**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **412633** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-1** SampType: **lcs** TestCode: **SM2320B: Alkalinity**
Client ID: **LCSW** Batch ID: **R14379** RunNo: **14379**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **412634** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	80	20	80.00	0	100	90	110			

Sample ID **mb-2** SampType: **mblk** TestCode: **SM2320B: Alkalinity**
Client ID: **PBW** Batch ID: **R14379** RunNo: **14379**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **412650** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-2** SampType: **lcs** TestCode: **SM2320B: Alkalinity**
Client ID: **LCSW** Batch ID: **R14379** RunNo: **14379**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **412651** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	81	20	80.00	0	102	90	110			

Sample ID **1310c34-013a ms** SampType: **ms** TestCode: **SM2320B: Alkalinity**
Client ID: **MW-4** Batch ID: **R14379** RunNo: **14379**
Prep Date: Analysis Date: **10/25/2013** SeqNo: **412665** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	254	20.0	80.00	202.1	64.7	18.3	129			

Sample ID **1310c34-013a msd** SampType: **msd** TestCode: **SM2320B: Alkalinity**
Client ID: **MW-4** Batch ID: **R14379** RunNo: **14379**
Prep Date: Analysis Date: **10/26/2013** SeqNo: **412666** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	250	20.0	80.00	202.1	60.0	18.3	129	1.49	10	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

Client: John Shomaker & Assoc.

Project: Copper Flat (List B)

Sample ID **MB-10070** SampType: **MBLK** TestCode: **SM2540C MOD: Total Dissolved Solids**

Client ID: **PBW** Batch ID: **10070** RunNo: **14477**

Prep Date: **10/29/2013** Analysis Date: **10/31/2013** SeqNo: **415905** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	ND	20.0								

Sample ID **LCS-10070** SampType: **LCS** TestCode: **SM2540C MOD: Total Dissolved Solids**

Client ID: **LCSW** Batch ID: **10070** RunNo: **14477**

Prep Date: **10/29/2013** Analysis Date: **10/31/2013** SeqNo: **415906** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	1050	20.0	1000	0	105	80	120			

Sample ID **MB-10103** SampType: **MBLK** TestCode: **SM2540C MOD: Total Dissolved Solids**

Client ID: **PBW** Batch ID: **10103** RunNo: **14511**

Prep Date: **10/30/2013** Analysis Date: **11/1/2013** SeqNo: **416762** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	ND	20.0								

Sample ID **LCS-10103** SampType: **LCS** TestCode: **SM2540C MOD: Total Dissolved Solids**

Client ID: **LCSW** Batch ID: **10103** RunNo: **14511**

Prep Date: **10/30/2013** Analysis Date: **11/1/2013** SeqNo: **416763** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	1050	20.0	1000	0	105	80	120			

Sample ID **MB-10127** SampType: **MBLK** TestCode: **SM2540C MOD: Total Dissolved Solids**

Client ID: **PBW** Batch ID: **10127** RunNo: **14518**

Prep Date: **10/31/2013** Analysis Date: **11/1/2013** SeqNo: **417104** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	ND	20.0								

Sample ID **LCS-10127** SampType: **LCS** TestCode: **SM2540C MOD: Total Dissolved Solids**

Client ID: **LCSW** Batch ID: **10127** RunNo: **14518**

Prep Date: **10/31/2013** Analysis Date: **11/1/2013** SeqNo: **417105** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	1030	20.0	1000	0	103	80	120			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2 for VOA and TOC only.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

Sample Log-In Check List

Client Name: SHO Work Order Number: 1310C34 RcptNo: 1

Received by/date: 10/25/13

Logged By: **Lindsay Mangin** 10/25/2013 9:45:00 AM

Completed By: **Lindsay Mangin** 10/25/2013 10:08:37 AM

Reviewed By: 10/25/13

Chain of Custody

1. Custody seals intact on sample bottles? Yes ☐ No ☐ Not Present ☑
2. Is Chain of Custody complete? Yes ☑ No ☐ Not Present ☐
3. How was the sample delivered? Client

Log In

4. Was an attempt made to cool the samples? Yes ☑ No ☐ NA ☐
5. Were all samples received at a temperature of >0° C to 6.0°C Yes ☑ No ☐ NA ☐
6. Sample(s) in proper container(s)? Yes ☑ No ☐
7. Sufficient sample volume for indicated test(s)? Yes ☑ No ☐
8. Are samples (except VOA and ONG) properly preserved? Yes ☑ No ☐
9. Was preservative added to bottles? Yes ☐ No ☑ NA ☐
10. VOA vials have zero headspace? Yes ☐ No ☐ No VOA Vials ☑
11. Were any sample containers received broken? Yes ☐ No ☑
12. Does paperwork match bottle labels? Yes ☑ No ☐
    (Note discrepancies on chain of custody)
13. Are matrices correctly identified on Chain of Custody? Yes ☑ No ☐
14. Is it clear what analyses were requested? Yes ☑ No ☐
15. Were all holding times able to be met? Yes ☑ No ☐
    (If no, notify customer for authorization.)

# of preserved bottles checked for pH: 16
(<2 or >12 unless noted)
Adjusted? NO
Checked by:

Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified: Date:
By Whom: Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:
Client Instructions:

17. Additional remarks:

18. **Cooler Information**

Cooler No	Temp °C	Condition	Seal Intact	Seal No	Seal Date	Signed By
1	4.1	Good	Not Present			

Chain-of-Custody Record

lient: JSAI
611 Broadbent Pkwy. NE
ailing Address: Albuquerque, NM 87107
hone #: 505 345 3407
mail or Fax#: sfinch@shomaker.com
A/QC Package:
☑ Standard ☐ Level 4 (Full Validation)
ccreditation
☐ NELAP ☐ Other
☐ EDD (Type)

urn-Around Time:
☑ Standard ☐ Rush
Project Name: Copper Flat (List B)
Project #:
Project Manager: Steve Finch
Sampler: M. Wikstrom, S. Finch
On Ice: ☑ Yes ☐ No
Sample Temperature: 4.1

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com
4901 Hawkins NE - Albuquerque, NM 87109
Tel. 505-345-3975 Fax 505-345-4107

Analysis Request

Date 013	Time	Matrix	Sample Request ID	Container Type and #	Preservative Type	HEAL No. 1310C34	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH 8015B (GRO / DRO / MRO)	TPH (Method 418.1)	EDB (Method 504.1)	PAH's (8310 or 8270 SIMS)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)	List B				Air Bubbles (Y or N)
/23	13:25	H_2O	GWQ-8	2	HNO_3/none	-001												✓				
/23	12:38	H_2O	GWQ-1	2	HNO_3/none	-002												✓				
/23	11:35	H_2O	GWQ-3	2	HNO_3/none	-003												✓				
/23	09:30	H_2O	GWQ-5R	2	HNO_3/none	-004												✓				
/24	11:46	H_2O	GWQ94-16	2	HNO_3/none	-005												✓				
/24	11:12	H_2O	GWQ-11	2	HNO_3/none	-006												✓				
/24	10:26	H_2O	GWQ94-13	2	HNO_3/none	-007												✓				
/24	08:40	H_2O	NP-3	2	HNO_3/none	-008												✓				
/23	16:25	H_2O	NP-1	2	HNO_3/none	-009												✓				
/23	15:35	H_2O	GWQ-12	2	HNO_3/none	-010												✓				
/23	14:30	H_2O	GWQ13-28	2	HNO_3/none	-011												✓				
/22	11:52	H_2O	GWQ94-14	2	HNO_3/none	-012												✓				

ate: /25/13 Time: 09:45 Relinquished by:
Received by: Date 10/25/13 Time 0945
ate: Time: Relinquished by:
Received by: Date Time

Remarks: Please email results to: sfinch@shomaker.com
List "B" Samples

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

Chain-of-Custody Record

Client: JSAI
2611 Broadbent Pkwy. NE
Mailing Address: Albuquerque, NM 87107

Phone #: 505 345-3407
Email or Fax#: sfinch@shomaker.com
QA/QC Package:
☑ Standard ☐ Level 4 (Full Validation)
Accreditation
☐ NELAP ☐ Other ________
☐ EDD (Type) ________

Turn-Around Time:
☑ Standard ☐ Rush ________
Project Name: Copper Flat (list B)
Project #:
Project Manager: Steve Finch
Sampler: M. Wikstrom
On Ice: ☒ Yes ☐ No
Sample Temperature: 4.1

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com
4901 Hawkins NE - Albuquerque, NM 87109
Tel. 505-345-3975 Fax 505-345-4107

Analysis Request

Date 2013	Time	Matrix	Sample Request ID	Container Type and #	Preservative Type	HEAL No. 1310C34	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH 8015B (GRO / DRO / MRO)	TPH (Method 418.1)	EDB (Method 504.1)	PAH's (8310 or 8270 SIMS)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)		List B			Air Bubbles (Y or N)
0/22	09:50	H2O	MW-4	2	HNO3/none	-013													✓			

Date:	Time:	Relinquished by:	Received by:	Date	Time
/25/13	09:45			10/25/13	0945
Date:	Time:	Relinquished by:	Received by:	Date	Time

Remarks: Please email results to:
sfinch@shomaker.com
List "B" Sample

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

Appendix C.

NMCC Stage 1 water-quality database

Table C-1. Pit lake water-quality data

Appendix C.
Table C-1. Pit lake water-quality data

gray shading = outlier

sample location	collection date	silver (mg/L)	aluminum (mg/L)	arsenic (mg/L)	barium (mg/L)	beryllium (mg/L)	boron (mg/L)	cadmium (mg/L)	cobalt (mg/L)	chro-mium (mg/L)	copper (mg/L)	iron (mg/L)	mercury (mg/L)	man-ganese (mg/L)	molyb-denum (mg/L)	nickel (mg/L)	lead (mg/L)	antimony (mg/L)	selenium (mg/L)	thallium (mg/L)	uranium (mg/L)	vanadium (mg/L)
PL-WQ	4/3/1989	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1		1.10	<0.1	<0.1	<0.1					
PL-WQ	11/14/1990																					
PL-WQ	2/11/1991	0.03		<0.001	<0.01			0.035		0.06		0.18	0.0004	1.84			0.006		<0.001			
PL-WQ	7/19/1991	<0.02		<0.002	<0.01			<0.005		<0.02		0.27	<0.0002	2.03			<0.005		<0.001			
PL-WQ	8/29/1991										0.64											
PL-WQ	11/26/1991										0.08											
PL-WQ	3/15/1992																					
PL-WQ	5/25/1992																					
PL-WQ	7/16/1992																					
PL-WQ	10/8/1992																					
PL-WQ	11/27/1992																					
PL-WQ	12/15/1992										3.21											
PL-WQ	2/25/1993																					
PL-WQ	9/23/1993										0.00			0.02								
PL-WQ	3/17/1994	<0.02									0.09			4.43								
PL-WQ	9/22/1994																					
PL-WQ	12/12/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	0.017	<0.05	<0.025	0.03	<0.05	<0.001	3.6	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005		
PL-WQ	12/19/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	0.017	<0.05	<0.025	0.03	<0.05	<0.001	3.4	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005		
PL-WQ	1/29/1995																					
PL-WQ	3/29/1995																					
PL-WQ	6/27/1995																					
PL-WQ	9/21/1995	<0.025	0.13	<0.005	<0.05	<0.002	<0.1	0.014	<0.05	<0.025	<0.025	<0.05	<0.001	3.0	<0.05	<0.05	<0.005	<0.005	<0.25	<0.005		
PL-WQ	1/10/1996																					
PL-WQ	4/3/1996																					
PL-WQ	9/25/1996																					
PL-WQ	1/15/1997																					
PL-NW	6/20/2008																					
PL-E	6/20/2008																					
PL-WQ (0 ft)	1/30/2010	<0.025	5.50	0.006	<0.010	0.017	<0.20	0.056	0.37	<0.030	11.00	1.30	<0.00020	41	<0.040	0.067	<0.025	<0.0025	0.031	<0.005		
PL-WQ-03 (3 ft)	9/10/2010	<0.005	1.70	<0.001	0.012	0.016	0.13	0.063	0.34	<0.006	2.00	0.03	<0.0002	45	0.015	0.067	<0.005	<0.001	0.021	<0.005	0.12	<0.05
PL-WQ-01 (28 ft)	9/10/2010	<0.005	1.60	<0.001	0.012	0.016	0.13	0.064	0.35	<0.006	1.90	0.03	<0.0002	44	0.015	0.068	0.0054	<0.001	0.022	<0.001	0.12	<0.05
PL-WQ-04 (comp)	9/10/2010	<0.005	1.60	<0.001	0.011	0.015	0.13	0.061	0.33	<0.006	1.90	0.02	<0.0002	43	0.015	0.065	0.0056	<0.001	0.023	<0.005	0.11	<0.05
PL-WQ-05 (7ft)	1/20/2011	<0.025	0.48	<0.001	0.010	0.016	<0.2	0.062	0.39	<0.03	0.61	<0.1	<0.0002	42	<0.04	0.069	<0.025	<0.001	0.025	<0.001	0.11	<0.25
PL-WQ-06 (17 ft)	1/20/2011	<0.025	0.51	<0.001	0.011	0.016	<0.2	0.062	0.38	<0.03	0.59	<0.1	<0.0002	44	<0.04	0.066	<0.025	<0.001	0.025	<0.005	0.11	<0.25
PL-WQ-07 (26 ft)	1/20/2011	<0.025	0.54	<0.005	0.012	0.016	<0.2	0.061	0.39	<0.03	0.64	<0.1	<0.0002	39	<0.04	0.068	0.026	<0.005	0.031	<0.005	0.11	<0.25
PL-WQ-08 (comp)	1/20/2011	<0.025	0.48	<0.005	0.010	0.015	<0.2	0.060	0.37	<0.03	0.59	<0.1	<0.0002	44	<0.04	0.066	<0.025	<0.005	0.030	<0.005	0.11	<0.25
PL-WQ-09 (1 ft)	4/14/2011	<0.005	0.13	<0.0010	0.012	0.010	0.16	0.059	0.34	<0.006	0.11	<0.02	<0.0002	44	0.025	0.061	<0.005	< 0.0010	0.019	<0.001	0.11	<0.05
PL-WQ-10 (3 ft)	4/14/2011	<0.005	0.13	<0.0010	0.012	0.010	0.16	0.057	0.33	<0.006	0.11	<0.02	<0.0002	41	0.023	0.058	<0.005	< 0.0010	0.019	<0.001	0.12	<0.05
PL-WQ-11 (16 ft)	4/14/2011	<0.005	0.13	<0.0010	0.012	0.010	0.16	0.058	0.34	<0.006	0.12	<0.02	<0.0002	41	0.024	0.059	0.0055	< 0.0010	0.020	<0.001	0.12	<0.05
PL-WQ-12 (comp)	4/14/2011	<0.005	0.13	<0.0010	0.012	0.010	0.16	0.059	0.34	<0.006	0.12	<0.02	<0.0002	42	0.024	0.060	<0.005	< 0.0010	0.023	<0.001	0.11	<0.05
PL-WQ-13 (2 ft)	7/20/2011	<0.025	0.03	0.0073	0.014	0.0047	0.18	0.053	0.28	<0.006	<0.006	<0.02	<0.0002	48	0.023	0.039	<0.005		0.033	<0.002	0.12	<0.05
PL-WQ-14 (11 ft)	7/20/2011	<0.005	0.02	0.0077	0.014	0.0046	0.19	0.054	0.29	<0.006	<0.006	<0.02	<0.0002	46	0.024	0.040	<0.005		0.033	<0.002	0.12	<0.05
PL-WQ-15 (23.5 ft)	7/20/2011	<0.025	<0.02	0.0066	0.013	0.0044	0.17	0.053	0.28	<0.006	<0.006	<0.02	<0.0002	45	0.025	0.038	<0.005		0.034	<0.002	0.12	<0.05
PL-WQ-16 (comp)	7/20/2011	<0.005	<0.02	0.0064	0.013	0.0043	0.18	0.053	0.28	<0.006	<0.006	<0.02	<0.0002	46	0.025	0.039	0.0051		0.035	<0.005	0.12	<0.05
Pit Lake	1/9/2013		0.08					0.037	0.086		0.06								0.008			
Pit Lake 1	4/8/2013		0.11					0.039	0.069		0.06			32					0.013			
Pit Lake 1a	4/8/2013		0.11					0.039	0.070		0.06			33					0.015			
Pit Lake	7/10/2013		0.21					0.038	0.049		0.05			30					0.059			
Pit Lake	10/22/2013		82.60					0.062	0.486		26.50			28					<0.050			
pit wall seepage	2/25/1993		3720.00								684.00	375		142								
pit wall seepage	8/19/2010	<0.25	540.00	0.0016	<0.1	0.140	<0.2	0.140	1.50	<0.3	80.00	1600	<0.001	24	<0.4	<0.5	<0.25	<0.01	0.086	<0.0010	1.40	<2.5
pit wall seepage	10/23/2013		789.00					0.187	2.05		95.30			31					<0.200			

Appendix C.
Table C-1. Pit lake water-quality data

gray shading = outlier																						
sample location	**collection date**	**zinc (mg/L)**	**temp-erature °C**	**pH (std. units)**	**specific conduc-tance (µS/cm)**	**total dissolved solids (mg/L)**	**total alkalinity (mg/L as CaCO3)**	**total acidity (mg/L as CaCO3)**	**nitrate as total N (mg/L)**	**total cyanide (mg/L)**	**calcium (mg/L)**	**magne-sium (mg/L)**	**sodium (mg/L)**	**potas-sium (mg/L)**	**carbon-ate (mg/L)**	**bicarbon-ate (mg/L)**	**chloride (mg/L)**	**sulfate (mg/L)**	**fluoride (mg/L)**	**ammo-nia (mg/L)**	**total suspended solids**	**comments**
PL-WQ	4/3/1989	0.4				3,546					640	129	165	11		96	47	2240				
PL-WQ	11/14/1990					4,064											102	2770				
PL-WQ	2/11/1991			7.20	3,980	2,711			0.1		600	157.3	224	16.4	0	55	80	2437	4.8			
PL-WQ	7/19/1991			7.76	6,340	4,520			0.03		684	209.1	248	20.3	0	88	89	2920	6.3			
PL-WQ	8/29/1991			7.61		4,384											89	2674				
PL-WQ	11/26/1991			7.61		4,175											87	2540				
PL-WQ	3/15/1992			4.88		3,819											85	2857				
PL-WQ	5/25/1992			4.82		3,846											90	2665				
PL-WQ	7/16/1992			4.36		4,229											76	2397				
PL-WQ	10/8/1992			4.85		4,258											90	2706				
PL-WQ	11/27/1992			6.26		3,900											731	2500				
PL-WQ	12/15/1992			6.04		4,151											89	2902				
PL-WQ	2/25/1993			6.29		3,951											92	2748				
PL-WQ	9/23/1993	0.0		6.71		4,468											111	1566				
PL-WQ	3/17/1994	1.0		7.46		3,179											101	2670				
PL-WQ	9/22/1994			8.04		5,124											141					
PL-WQ	12/12/1994	0.1		7.71	4,720	4,600			<5		580	250	350	17	0	102	140	2910	8.1			
PL-WQ	12/19/1994	0.1		7.52	4,690	4,380			<5		550	250	320	18	0	104	130	2970	8.1			
PL-WQ	1/29/1995			7.69		4,675											218	2906				
PL-WQ	3/29/1995			7.53		4,891											109	2610				
PL-WQ	6/27/1995					5,640											161	2924				
PL-WQ	9/21/1995	0.1		8.31	5,230	5,230			<5		620	300	430	21	0	122	150	3170	10.0			
PL-WQ	1/10/1996			7.90		5,398											183	3452				
PL-WQ	4/3/1996			7.95		5,378											189	3304				
PL-WQ	9/25/1996			8.26		6,041											200	3290				
PL-WQ	1/15/1997			8.05		5,772											216	3509				
PL-NW	6/20/2008			4.43		7,540	<2.5				504	485	624	23	<2.5	<3	259	4520				NMED
PL-E	6/20/2008			4.43		7,950	<2.5				508	495	638	24	<2.5	<3	230	4460				NMED
PL-WQ (0 ft)	1/30/2010	6.4		6.00	5,700	7,770	<20		<2.0	<0.005	540	570	690	25	<2	<20	390	5200	18.0			Baseline Data
PL-WQ-03 (3 ft)	9/10/2010	6.8		6.71	6,700	8,390	<20		<1.0	<0.01	580	640	760	26	<2	<20	400	5600	17.0		<10	Baseline Data
PL-WQ-01 (28 ft)	9/10/2010	6.7		6.67	6,600	8,400	<20		<1.0	<0.01	570	630	750	26	<2	<20	400	6200	18.0		<10	Baseline Data
PL-WQ-04 (comp)	9/10/2010	6.6		6.70	6,700	8,340	<20		<1.0	<0.01	560	610	730	26	<2	<20	380	6000	15.0		<10	Baseline Data
PL-WQ-05 (7ft)	1/20/2011	5.8		7.17	7,900	8,170	31		<0.1	<0.01	570	640	740	29	<2	31	380	5700	15.0	<1	<10	Baseline Data
PL-WQ-06 (17 ft)	1/20/2011	5.7		7.19	8,000	8,120	31		<0.1	<0.01	570	640	740	29	<2	31	380	5600	16.0	<1	12	Baseline Data
PL-WQ-07 (26 ft)	1/20/2011	6.0		7.18	8,000	8,210	30		<0.1	<0.01	590	660	760	29	<2	30	400	5900	16.0	<1	<10	Baseline Data
PL-WQ-08 (comp)	1/20/2011	5.3		7.23	8,000	7,780	30		<0.1	<0.01	520	590	680	28	<2	30	380	5500	16.0	<1	14	Baseline Data
PL-WQ-09 (1 ft)	4/14/2011	5.2		7.62	7,800	8,590	41		<0.1	<0.01	610	680	800	32	<2	41	420	5600	17.0	<1	<10	Baseline Data
PL-WQ-10 (3 ft)	4/14/2011	5.0		7.68	7,800	8,700	41		<0.1	<0.01	600	670	790	32	<2	41	420	5800	16.0	<1	<10	Baseline Data
PL-WQ-11 (16 ft)	4/14/2011	5.1		7.69	7,800	8,600	41		<0.1	<0.01	590	660	770	32	<2	41	400	5700	16.0	<1		Baseline Data
PL-WQ-12 (comp)	4/14/2011	5.0		7.72	7,800	8,390	41		0.1	<0.01	600	670	780	32	<2	41	410	5700	16.0	<1	<10	Baseline Data
PL-WQ-13 (2 ft)	7/20/2011	2.4		7.71	8,300	9,520	48		<0.1	<0.01	670	770	870	35	<2	48	470	6400	19.0		<10	Baseline Data
PL-WQ-14 (11 ft)	7/20/2011	2.5		7.83	8,300	9,680	48		0.24	0.011	640	780	920	35	<2	48	460	6200	18.0		<10	Baseline Data
PL-WQ-15 (23.5 ft)	7/20/2011	2.5		7.83	8,100	9,350	46		<0.1	<0.01	620	750	890	34	<2	46	430	6200	18.0		<10	Baseline Data
PL-WQ-16 (comp)	7/20/2011	2.4		7.86	8,200	9,410	47		<0.1	<0.01	640	770	900	34	<2	47	450	6400	19.0		<10	Baseline Data
Pit Lake	1/9/2013	0.78	4.30	7.73	10,510	11,100	112				500	958	1170	44	< 2	112	577	6800	18.7			Stage 1 Abatement
Pit Lake 1	4/8/2013	0.86	17.60	7.07	10,610	11,700	122				494	929	1320	49	<2	122	670	6750	22.1			Stage 1 Abatement
Pit Lake 1a	4/8/2013	0.88	17.60	7.07	10,610		123				453	859	1230	40	<2	123	599	7130	20.4			Stage 1 Abatement
Pit Lake	7/10/2013	0.88	26.30	7.36	12,600	14,800	111	<20			539	1120	1400	61	<2	111	714	8690	24.6			Stage 1 Abatement
Pit Lake	10/22/2013	7.36	16.70	7.94	7,980	8,740	<20	700			455	522	604	24	<2	<20	340	5610	29.8			Stage 1 Abatement
pit wall seepage	2/25/1993	51.0		1.90					0.9		446	236	93	3		<1	35	10000	11.1			JSAI (1993)
pit wall seepage	8/19/2010	12.0		2.00	6,500	13,900	<20		<1.0	<0.005	470	190	<50	<50	<2	<20	21	11000	51.0			Baseline Data
pit wall seepage	10/23/2013	16.3	23.80	2.43	6,600	18,500	<20	9,590			462	174	99	<50	<2	<20	20	11300	75.1			Stage 1 Abatement

Table C-2. Surface-water-quality data

Appendix C.
Table C-2. Surface-water-quality data

sample location	analysis date	silver (mg/L)	aluminum (mg/L)	arsenic (mg/L)	barium (mg/L)	beryllium (mg/L)	boron (mg/L)	cadmium (mg/L)	cobalt (mg/L)	chromium (mg/L)	copper (mg/L)	iron (mg/L)	mercury (mg/L)	manganese (mg/L)	molybdenum (mg/L)	nickel (mg/L)	lead (mg/L)	antimony (mg/L)	selenium (mg/L)	thallium (mg/L)	uranium (mg/L)	vanadium (mg/L)	zinc (mg/L)	pH (std. units)	specific conductance (µS/cm)	total dissolved solids (mg/L)	total alkalinity (mg/L as CaCO3)	nitrate as total N (mg/L)	total cyanide (mg/L)	calcium (mg/L)	magnesium (mg/L)	sodium (mg/L)	potassium (mg/L)	carbonate (mg/L)	bicarbonate (mg/L)	chloride (mg/L)	sulfate (mg/L)	fluoride (mg/L)	original order	comments
SWQ-1	12/28/1982							<0.005			<0.05	<0.01	<0.001	<0.05	<0.05				<0.005					8.00		250		0.90	<0.01							10.0	68	0.3	1	
SWQ-1	2/21/1983							<0.005			<0.05	<0.01	<0.001	<0.05	<0.05				<0.005					8.00		470		4.40	<0.01							20.0	161	0.3	2	
SWQ-1	7/16/1992																							7.37		965										47.2	298		3	
SWQ-1	11/27/1992																							8.31		545										16.7	181		4	
SWQ-1	2/25/1993																							8.34		844										28.9	323		5	
SWQ-1	4/1/1993	<0.01	<0.1	<0.005	<0.5		0.02	<0.002	<0.05	<0.02	<0.01	<0.05	<0.001	<0.02	<0.02	<0.01	<0.02		<0.005				<0.01	8.30	1150	782	360	0.00	<0.01	109	36	107	1.8	0	430	27.0	276	0.5	6	
SWQ-1	7/9/2013		17.3					<0.002	0.0149		0.036			1.32					<0.01				0.08	7.20		620	64.1			27	7.6	4.7	8.52	<2	64	3.5	6	<0.5		Stage 1 Abatement
SWQ-2	10/27/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.05	0.004	<0.05	<0.05		<0.02		<0.005					8.70		1060		6.60	<0.01	175						46.0	460	0.8	7	
SWQ-2	2/25/1982							<0.005			<0.05	0.13	<0.001	<0.05	<0.05				<0.005					8.10		1360		4.20	<0.01							80.0	658	0.7	8	
SWQ-2	5/12/1982							<0.005			<0.05	<0.01	<0.001	<0.05	<0.05				<0.005					7.90		1380		3.00	<0.01							108.0	700	0.7	9	
SWQ-2	2/21/1983							<0.005			<0.05	<0.01	<0.001	<0.05	<0.05				<0.005					8.40		990		0.80	<0.01							68.0	445	0.7	10	
SWQ-2	5/13/1983							<0.005			<0.05	<0.01	<0.001	<0.05	<0.05				<0.005					8.40		1120		0.30	<0.01							84.0	517	0.8	11	
SWQ-2	8/9/1983							<0.005			<0.05	<0.01	<0.001	0.06	<0.05				<0.005					8.00		1620		<0.20	<0.01							142.0	675	0.7	12	
SWQ-2	11/1/1983							<0.005			<0.05	<0.01	<0.001	<0.05	<0.05				<0.005					8.20		1170		0.30	<0.01							72.0	553	0.8	13	
SWQ-2	12/23/1983							<0.005			<0.05	<0.01	<0.001	<0.05	<0.05				<0.005					8.00		1180		11.20	<0.01							82.0	550	0.5	14	
SWQ-2	3/16/1984							<0.005			<0.05	<0.01	<0.001	<0.05	<0.05				<0.005					8.30		1140		5.30	<0.01							68.0	515	0.8	15	
SWQ-2	5/30/1984							<0.005			<0.05	<0.01	<0.001	<0.05	<0.05				<0.005					8.10		1420		0.40	<0.01							94.0	720	0.8	16	
SWQ-2	9/12/1984							<0.005			<0.05	<0.01	<0.001	<0.05	<0.05				<0.005					8.10		1190		0.40	<0.01							80.0	577	0.9	17	
SWQ-2	11/27/1984							<0.005			<0.05	<0.01	<0.001	<0.05	<0.05				<0.005					8.20		1360		<0.20	<0.01							88.0	675	0.8	18	
SWQ-2	5/17/1985																							8.00		1640										102.0	770		19	
SWQ-2	11/13/1985																							7.90		1590										94.0	770		20	
SWQ-2	10/13/1986																							7.90		1840										136.0	830		21	
SWQ-2	7/19/1991	<0.02		<0.002	<0.01			<0.005		<0.02		<0.05	<0.0002	<0.02			<0.005		<0.001					7.57	4310	3019		12.74		561	129	264	10.9	0	362	216.7	1586	0.6	22	
SWQ-2	7/16/1992																							7.57		2305										93.4	1155		23	
SWQ-2	10/8/1992																							7.53		2685										130.7	1471		24	
SWQ-2	12/15/1992																							7.61		3108										192.5	1613		25	
SWQ-2	2/25/1993																							7.58		2713										135.9	1459		26	
SWQ-2	3/31/1993	<0.01	<0.1	<0.005	<0.5		0.08	<0.002	<0.05	<0.02	0.01	<0.05	<0.001	0.03	<0.02	<0.01	<0.02		0.008				0.01	7.70	3150	2720	300	14.50	<0.01	436	83	279	2.1	0	376	123.0	1460	0.6	27	
SWQ-2	6/23/1994																							8.87		3958										197.3	2369		28	
SWQ-2	1/29/1995																							7.64		2653										89.2	1286		29	
SWQ-2	3/29/1995																							7.83		2866										83.9	1388		30	
SWQ-2	6/27/1995																							7.74		3235										127.3	1877		31	
SWQ-2	9/21/1995																							7.58		500										31.1	271		32	
SWQ-2	1/10/1996																							7.37		3991										167.2	2337		33	
SWQ-2	4/3/1996																							8.06		4464										222.6	2566		34	
SWQ-2	9/25/1996																							7.66		3997										143.7	1987		35	
SWQ-2	1/15/1997																							7.43		3436										148.0	1356		36	
SWQ-2	8/25/2010	<0.005	1.5	<0.001	0.010	<0.002	<0.04	<0.002	<0.006	<0.006	0.09	0.67	<0.0002		<0.008	<0.01	<0.005	<0.001	<0.001	<0.001	<0.001	<0.05	<0.01	7.42	89	78	21	<1.00	<0.01	6.5		3.3	1.9	<2	21	0.7	11	0.6	37	Baseline Data
SWQ-2	4/28/2011	<0.005	<0.02	<0.001	0.019	<0.002	<0.04	<0.002	<0.006	<0.006	0.01	<0.02	<0.0002		0.008	<0.01	<0.005	<0.001	0.002	<0.001	<0.001	<0.05	<0.01							79		41	2.9						38	Baseline Data
SWQ-2	5/4/2011																												<0.01										39	Baseline Data
SWQ-2	7/11/2013		54.7					<0.002	0.011		0.10			0.833					<0.01				0.09	7.19		540	34.1			22	7.3	4	7.13	<2	34	<2.5	21	<0.5		Stage 1 Abatement
SWQ-2	9/20/2013		<0.02					<0.002	<0.006		0.08			0.042					0.051				0.15			2470	150			380	88	180	6.8	<2	150	33.0	1300	0.9		Stage 1 Abatement
SWQ-2	10/21/2013		<0.02					<0.002	<0.006		0.04			0.015					0.013				0.02	8.22	3060	3180	245			510	113	222	5.68	<2	245	30.4	1840	0.7		Stage 1 Abatement
SWQ-2A	10/27/1981	<0.02	<0.01	<0.01	<0.2		<0.01	<0.005	<0.02	<0.01	<0.05	<0.05	<0.001	<0.05	<0.05		<0.02		<0.005					8.20		830		0.30	<0.01	107						46.0	360	0.6	40	
SWQ-2A	2/25/1982							<0.005			<0.05	0.10	<0.001	<0.05	<0.05				<0.005					8.40		800		0.20	<0.01							50.0	320	0.7	41	
SWQ-3	7/19/1991	<0.02		<0.002	0.030			<0.005		<0.02		0.14	<0.0002	<0.02			<0.005		<0.001					7.52	3120	2191		1.39		334	85	190	7.4	0		143.9	1108	0.7	42	
SWQ-3	8/29/1991										0.02													7.82		3596								0		231.3	1884		43	
SWQ-3	11/26/1991										0.00													7.71		2857										141.1	1419		44	
SWQ-3	3/15/1992																							8.08		2393										99.2	1248		45	
SWQ-3	5/25/1992																							8.07		2380										102.9	1185		46	
SWQ-3	7/16/1992																							7.66		3364										128.7	1654		47	
SWQ-3	10/8/1992																							7.49		3611										174.4	1667		48	

Appendix C.

Table C-2. Surface-water-quality data

sample location	analysis date	silver (mg/L)	aluminum (mg/L)	arsenic (mg/L)	barium (mg/L)	beryllium (mg/L)	boron (mg/L)	cadmium (mg/L)	cobalt (mg/L)	chromium (mg/L)	copper (mg/L)	iron (mg/L)	mercury (mg/L)	manganese (mg/L)	molybdenum (mg/L)	nickel (mg/L)	lead (mg/L)	antimony (mg/L)	selenium (mg/L)	thallium (mg/L)	uranium (mg/L)	vanadium (mg/L)	zinc (mg/L)	pH (std. units)	specific conductance (µS/cm)	total dissolved solids (mg/L)	total alkalinity (mg/L as CaCO3)	nitrate as total N (mg/L)	total cyanide (mg/L)	calcium (mg/L)	magnesium (mg/L)	sodium (mg/L)	potassium (mg/L)	carbonate (mg/L)	bicarbonate (mg/L)	chloride (mg/L)	sulfate (mg/L)	fluoride (mg/L)	original order	comments
SWQ-3	11/27/1992																							8.35		1866										160.5	952		49	
SWQ-3	12/15/1992																							8.15		3436										221.6	1549		50	
SWQ-3	2/25/1993																							8.01		2974										150.7	1574		51	
SWQ-3	3/31/1993	<0.01	<0.1	<0.005	<0.5		0.06	<0.002	<0.05	<0.02	0.01	<0.05	<0.001	<0.02	<0.02	<0.01	<0.02		<0.005				<0.01	8.10	3330	2950	310	6.90	<0.01	445	109	271	2.2	0	409	135.0	1580	1.0	52	
SWQ-3	9/28/1993																							8.13		4432										226.9	1254		53	
SWQ-3	6/23/1994																							8.37		2934										157.4	1712		54	
SWQ-3	1/29/1995																							7.93		3185										237.6	1672		55	
SWQ-3	3/29/1995																							8.23		3216										100.6	1710		56	
SWQ-3	6/27/1995																							7.51		3393										200.3	1792		57	
SWQ-3	9/21/1995																							8.73		3741										178.5	2382		58	
SWQ-3	1/10/1996																							7.78		3666										112.0	1937		59	
SWQ-3	4/3/1996																									3635										157.0	2236		60	
SWQ-3	9/25/1996																							7.64		2568										96.7	1153		61	
SWQ-3	1/15/1997																							8.13		3436										148.0	1356		62	
SWQ-3	8/19/2010	<0.005	<0.02	<0.001	0.062	<0.002	0.14	<0.002	<0.006	<0.006	0.06	0.06	<0.0002	0.14	0.05	<0.01	<0.005	<0.001	0.013	<0.001	0.029	<0.05	0.02	8.00	4100	4500	250	<1.00	<0.005	530	190	490	5.7	<2	250	130.0	2900	1.5	64	Baseline Data
SWQ-3	10/21/2010	<0.005	<0.02	<0.005	0.053	<0.002	0.09	<0.002	<0.006	<0.006	0.02	0.05	<0.0002	0.03	0.03	<0.01	<0.005	<0.001	0.016	<0.001	0.027	<0.05	0.48	7.99	4600	5080	530	<1.00		630	260	520	4.3	<2	530	93.0	3100	1.3	65	Baseline Data
SWQ-3	1/27/2011																							7.81	3868														63	Baseline Data
SWQ-3	4/27/2011	<0.005	0.079	<0.001	0.032	<0.002	0.08	<0.002	<0.006	<0.006	0.01	0.03	<0.033	0.03	0.02	<0.01	<0.005	<0.001	0.007	<0.001	0.012	<0.05	0.03	7.92	4400	4590	430	0.15	<0.01	610	210	410	3.8	<2	430	74.0	2900	1.4	66	Baseline Data
SWQ-3	7/11/2013		1.83					<0.002	<0.006		0.08			0.35					0.022				0.03	7.55		1080	44.7			100	26	67	7.63	<2	45	16.1	455	<0.5		Stage 1 Abatement
SWQ-3	9/20/2013		<0.02					<0.002	<0.006		0.11			0.055					0.050				0.14			3030	180			440	110	250	6.2	<2	180	61	1700	1.3		Stage 1 Abatement
SWQ-3	10/9/2013		<0.02					<0.002	<0.006		0.049			0.024					0.016				<0.01	8.26	3520	3720	241			490	133	283	5.29	<2	241	61.7	2020	1.0		Stage 1 Abatement

Table C-3. Groundwater-quality data

Appendix C.
Table C-3. Groundwater-quality data

gray shading = outlier

sample location	analysis date	silver (mg/L)	aluminum (mg/L)	arsenic (mg/L)	barium (mg/L)	beryllium (mg/L)	boron (mg/L)	cadmium (mg/L)	cobalt (mg/L)	chromium (mg/L)	copper (mg/L)	iron (mg/L)	mercury (mg/L)	manganese (mg/L)	molybdenum (mg/L)	nickel (mg/L)	lead (mg/L)	antimony (mg/L)	selenium (mg/L)	thallium (mg/L)	uranium (mg/L)	vanadium (mg/L)	zinc (mg/L)	temperature °C	pH (std. units)	specific conductance (µS/cm)	total dissolved solids (mg/L)	total alkalinity (mg/L as CaCO3)	total acidity (mg/L as CaCO3)	nitrate as total N (mg/L)	total cyanide (mg/L)	calcium (mg/L)	magnesium (mg/L)	sodium (mg/L)	potassium (mg/L)	carbonate (mg/L)	bicarbonate (mg/L)	chloride (mg/L)	sulfate (mg/L)	fluoride (mg/L)	total suspended solids
GWQ-1	2/2/1981											1.70													7.90		520					74	20	60		0	276	20	156		
GWQ-1	3/27/1981			<0.01							<0.05						<0.02						0.16							5.50	<0.01									0.6	
GWQ-1	6/11/1981	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.05																		
GWQ-1	6/15/1981	<0.02	<0.25	<0.002	<0.2		0.076	<0.005	<0.05	<0.05	<0.02	<0.05	<0.001	<0.02	<0.1	<0.05	<0.02		0.0022	<0.005			0.12		7.40	700	500			3.75	<0.01	81	12	49	3.06	0	251	22	117	0.5	
GWQ-1	2/25/1982							<0.005			<0.05	0.14	<0.001	0.063	<0.05				<0.005						7.90		410			0.20	<0.01							22	84	0.3	
GWQ-1	3/30/1989	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1		<0.05	<0.1	<0.1	<0.1						<0.1				512					84	16	61	3		280	20	133		
GWQ-1	7/19/1991	<0.02		0.003	0.01			<0.005		<0.02	<0.02	<0.05	<0.0002	<0.02			<0.005		<0.002						7.34	799	543			5.19		88	18	40	2.7	0	262	21	136	0.6	
GWQ-1	3/31/1993	<0.01	<0.01	<0.005	<0.5		0.03	<0.002	<0.05	<0.02	<0.01	<0.05	<0.001	<0.02	<0.02	<0.01	<0.02		<0.005				<0.01		7.70	822	536	230		4.90	<0.01	82	21	67	2.1	0	297	22	160	0.5	
GWQ-1	5/25/1994	<0.025	0.025	<0.005	<0.1			<0.0005		<0.025	<0.025	<0.05	<0.001	<0.03		<0.05	<0.005	<0.005	<0.005				<0.05		7.90	760	614			4.30		80	18	55	2.7	0	270	22	150	0.5	
GWQ-1	7/21/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	0.0052	<0.005	<0.005			<0.05		7.97	861	558			4.20		95	19	66	2.7	0	278	25	162	0.5	
GWQ-1	1/10/2013		< 0.02					< 0.002	< 0.006		< 0.001								< 0.001				< 0.01	19.60	7.20	659	487	164				63	18	65	2.1	< 2	164	38	152	0.4	
GWQ-1	4/11/2013																							20.00	7.33	723	465	195				57	14	60	2.0	<2	195	30	120		
GWQ-1	7/10/2013																							21.70	7.49	692	448	194				61	14	61	2.2	<2	194	26	120		
GWQ-1	10/23/2013																							20.60	7.88	491	380	177				39	13	64	2.1	<2	177	20	72		
GWQ-3	3/27/1981			<0.01							<0.05						<0.02						0.16							5.50	<0.01									0.6	
GWQ-3	6/15/1981	<0.02	<0.01	0.004	<0.2		0.108	<0.005	<0.05	<0.01	<0.05	<0.1	<0.001	<0.05	<0.05	<0.05	0.073		0.0037				0.32		7.00	1100	868			0.10	<0.01	146	33	95	1.7	0	327	32	383	0.7	
GWQ-3	2/25/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.90		1040			0.40	<0.01							56	490	0.6	
GWQ-3	5/12/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.90		930			0.20	<0.01							56	410	0.7	
GWQ-3	6/30/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.60		860			0.40	<0.01							48	365	0.7	
GWQ-3	12/23/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.50		990			0.20	<0.01							64	340	0.7	
GWQ-3	2/21/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.70		970			0.20	<0.01							68	428	0.7	
GWQ-3	5/13/1983							<0.005			<0.05	<0.1	<0.001	<0.05	0.11				<0.005						8.00		980			0.30	<0.01							82	437	0.6	
GWQ-3	8/9/1983							<0.005			<0.05	0.11	<0.001	<0.05	<0.05				<0.005						7.80		1060			<0.2	<0.01							78	385	0.7	
GWQ-3	11/1/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.00		1240			0.30	<0.01							90	529	0.7	
GWQ-3	3/16/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.20		1190			3.40	<0.01							74	530	0.3	
GWQ-3	4/11/2013																							17.50	7.50	2782	3060	188				477	111	253	3.99	<2	188	75	1,750		
GWQ-3	7/10/2013																							21.50	7.44	3112	2980	201				446	96	235	4.31	<2	201	69	1,690		
GWQ-3	10/23/2013																							20.70	7.30	2700	2410	237				345	76	199	2.85	<2	237	63	1,210		
GWQ-6	6/15/1981	<0.02	<0.01	<0.01	<0.2		0.135	<0.005	<0.05	<0.01	<0.02	<0.1	<0.001	0.11	<0.05	<0.05	<0.02		0.0046				<0.025		7.30	600	400			3.30	<0.01	68	11	57	2.4	0	309	33	41	1.1	
GWQ-6	2/25/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.30		810			0.50	<0.01							102	220	1.1	
GWQ-6	4/1/1993	<0.01	<0.1	<0.005	0.6		0.09	<0.002	<0.05	<0.02	0.03	5.05	<0.001	0.36	<0.02	<0.01	<0.02		<0.005				0.03		7.70	597	304	310		1.10	<0.01	49	14	53	3.1	0	322	22	10	0.8	
GWQ-7	2/2/1981											3.80													7.90		530					74	27	51		0	278	20	156		
GWQ-7	3/27/1981			<0.01							<0.05						<0.02						0.28							1.40	<0.01									0.6	
GWQ-7	4/6/1981			0.003							<0.05						<0.01						0.24							0.90	0.36									0.6	
GWQ-7	6/15/1981	<0.02	<0.01	<0.002	<0.2		<0.1	<0.005	<0.05	<0.01	<0.02	<0.05	<0.001	<0.02	<0.05	<0.05	<0.05		<0.0005				0.38		7.20	700	496			1.10	<0.01	88	24	61	2.33	0	285	25	165	0.5	
GWQ-7	8/7/1981											0.02													7.40		475					80	19	139			268	100	150		
GWQ-7	8/10/1981			<0.01							<0.05	1.70					<0.02						0.63		7.70		490			1.20	<0.01	68	21	48			229	24	162	0.6	
GWQ-7	10/23/1981	<0.02	<0.01	<0.01	<0.02		<0.1	<0.005	<0.02	<0.01	<0.05	0.14	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.41				500			1.30	<0.01	71						26	162	0.5	
GWQ-7	11/6/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.19		8.10		480			1.20	<0.01	71						24	158	0.8	
GWQ-7	2/25/1982							<0.005			<0.05	0.17	<0.001	<0.05	<0.05				<0.005						8.00		510			0.80	<0.01							26	162	0.5	
GWQ-7	12/28/1982							<0.005			<0.05	0.26	<0.001	0.16	<0.05				<0.005						8.10		250			<0.2	<0.01							20	40	0.3	
GWQ-7	2/21/1983							<0.005			<0.05	<0.1	<0.001	0.27	<0.05				<0.005						8.30		250			2.80	<0.01							22	47	0.4	
GWQ-7	3/16/1983													<0.05																											
GWQ-7	5/13/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.10		470			1.20	<0.01							20	158	0.6	
GWQ-7	8/9/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.00		490			1.00	<0.01							22	130	0.6	
GWQ-7	11/1/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.10		500			1.80	<0.01							22	137	0.6	
GWQ-7	3/16/1984							<0.005			<0.05	<0.1	<0.001	<0.05	0.08				<0.005						8.30		450			1.00	<0.01							20	140	0.8	
GWQ-7	5/30/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.70		470			0.90	0.02							20	154	0.6	
GWQ-7	9/12/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.00		500			1.40	<0.01							20	128	0.6	
GWQ-7	11/27/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.70		490			1.40	<0.01							18	144	0.6	
GWQ-7	5/17/1985																								7.90		500											20	144		
GWQ-7	11/13/1985																								7.80		450											18	137		
GWQ-7	5/23/1986																								7.90		490											22	142		
GWQ-7	10/8/1986																								7.40		460											22	116		
GWQ-7	3/30/1989	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1		<0.05	<0.1	<0.1	<0.1						0.10				492					80	22	47	2		278	16	131		
GWQ-7	3/30/1993	<0.01	<0.1	<0.005	<0.5		0.04	<0.002	<0.05	<0.02	<0.01	<0.05	<0.001	<0.02	<0.02	<0.01	<0.02		<0.005				0.10		7.80	752	482	250		1.38	<0.01	68	31	52	1.6	0	298	21	138	0.6	
GWQ-7	5/25/1994	<0.025	0.25	<0.005	<0.1			0.00058		<0.025	0.11	0.72	<0.001	1.1		<0.05	<0.005	<0.005	<0.005				<0.05		7.26	2630	2420			<1		490	51	80	14	0	480	20	1,300	2.1	

Appendix C.
Table C-3. Groundwater-quality data

sample location	analysis date	silver (mg/L)	aluminum (mg/L)	arsenic (mg/L)	barium (mg/L)	beryllium (mg/L)	boron (mg/L)	cadmium (mg/L)	cobalt (mg/L)	chromium (mg/L)	copper (mg/L)	iron (mg/L)	mercury (mg/L)	manganese (mg/L)	molybdenum (mg/L)	nickel (mg/L)	lead (mg/L)	antimony (mg/L)	selenium (mg/L)	thallium (mg/L)	uranium (mg/L)	vanadium (mg/L)	zinc (mg/L)	temperature °C	pH (std. units)	specific conductance (µS/cm)	total dissolved solids (mg/L)	total alkalinity (mg/L as CaCO3)	total acidity (mg/L as CaCO3)	nitrate as total N (mg/L)	total cyanide (mg/L)	calcium (mg/L)	magnesium (mg/L)	sodium (mg/L)	potassium (mg/L)	carbonate (mg/L)	bicarbonate (mg/L)	chloride (mg/L)	sulfate (mg/L)	fluoride (mg/L)	total suspended solids
GWQ-7	7/21/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	1.20	<0.001	0.21	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.05		7.72	660	224			<1		14	8	47	13	0	349	22	<5	16.0	
GWQ-8	6/4/1976						<0.1					0.00		0.003											7.48	780	560			16.80		122	16	76	1.72		241	17	114	0.5	
GWQ-8	2/2/1981											1.70													7.90		520			60.00		74	20				276	20	156		
GWQ-8	8/19/1981	<0.02	<0.25	<0.004	<1		0.076	<0.01	<0.05	<0.05	<0.05	<0.1	<1	0.047	<0.1	<0.05	<0.05		0.004				0.69		7.42		608			2.80	<0.05	73	12	84	4.2	<1	283	24	134	0.6	
GWQ-8	2/25/1982							<0.005			<0.05	<0.1	<0.001	0.17	<0.05				<0.005						7.60		380			0.30	<0.01							38	220	1.0	
GWQ-8	3/31/1993	<0.01	<0.05	<0.005	0.042		0.03	<0.0005	<0.01	<0.01	0.01	<0.05	<0.0002	<0.01	<0.02	<0.01	<0.002		<0.005				0.09		7.60	1110	764	240		6.30	<0.01	132	18	94	1.8	0	298	38	283	0.5	
GWQ-8	5/25/1994	<0.025	<0.025	<0.005	<0.1		<0.1	<0.0005	<0.05	<0.025	<0.025	0.24	<0.001	<0.03	<0.05	<0.05	<0.005	<0.005	<0.005				<0.05		7.97	1060	792			5.30		120	20	76	2.4	0	272	41	290	0.5	
GWQ-8	1/10/2013		< 0.02					< 0.002	< 0.006		< 0.001								0.002				0.01	19.10	6.77	1358	1200	213				202	34	107	2.43	< 2	213	89	498	< 0.5	
GWQ-8	4/9/2013																							19.60	7.16	1564	1190	214				214	36	113	2.73	<2	214	85	447		
GWQ-8	7/10/2013																							22.00	7.11	1611	1230	209				208	32	108	2.62	<2	209	84	537		
GWQ-8	10/23/2013																							20.20	7.27	1410	1250	201				195	36	113	2.36	<2	201	91	586		
GWQ-9	6/4/1976						<0.1					0.00		0.001											8.60	480	350			4.00		69	15	30	1.56		188	20	34	0.4	
GWQ-9	2/2/1981											1.80													7.90		510					73	24	49		0	273	20	156		
GWQ-9	3/27/1981			<0.01							<0.05						<0.02						0.16							1.40	<0.01									0.6	
GWQ-9	4/6/1981			0.002							<0.05						<0.01						0.13							1.20	0.15									0.6	
GWQ-9	8/7/1981											0.06													7.40		450					80	19	129			268	100	140		
GWQ-9	8/10/1981			<0.01							<0.05	0.49					0.033						0.96		8.00		470			1.40	<0.01	76	20	47			268	22	148	0.5	
GWQ-9	10/8/1981	<0.02	<0.25	<0.004	<1		0.044	<0.01	<0.05	<0.05	<0.05	<0.1	<1	<0.02	<0.1	<0.05	<0.05		<0.002				0.35		7.22		476			0.96	<0.05	52	17	71	3.3	<1	302	22	133	0.6	
GWQ-9	2/25/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.30		430			0.90	<0.01							26	160	0.5	
GWQ-9	12/28/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.80		480			1.00	<0.01							20	150	0.5	
GWQ-9	2/21/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.00		480			1.40	<0.01							20	161	0.5	
GWQ-9	5/13/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.20		460			1.10	<0.01							20	158	0.5	
GWQ-9	8/9/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.00		480			0.90	<0.01							20	135	0.5	
GWQ-9	11/1/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.20		460			0.80	<0.01							18	132	0.5	
GWQ-9	3/16/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.10		460			1.70	<0.01							18	132	0.7	
GWQ-9	5/30/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.60		450			0.90	<0.01							18	154	0.5	
GWQ-9	9/12/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.00		470			1.30	<0.01							20	132	0.5	
GWQ-9	11/27/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.90		470			1.50	<0.01							16	132	0.5	
GWQ-9	5/17/1985																								8.00		490											20	149		
GWQ-9	11/13/1985																								7.80		450											20	142		
GWQ-9	5/23/1986																								7.90		490											36	137		
GWQ-9	10/8/1986																								7.60		460											20	125		
GWQ-10	4/6/1981			0.002				<0.01			<0.05		<1				<0.01						0.12							4.60	0.02				8.25					0.5	
GWQ-10	8/10/1981	<0.02	10.2	<0.004	<1		0.016	<0.01	<0.05	<0.05	<0.05	2.31	<1	1.18	<0.1	<0.05	<0.05		<0.002				0.23		7.48		528			0.22	<0.05	74	11	59	8.32	<1	219	24	143	1.1	
GWQ-10	10/27/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.01	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.25		8.20		520			1.10	<0.01	68						22	168	0.6	
GWQ-10	10/30/1981	<0.02	<0.25	<0.005	<1		0.77	<0.01	<0.05	<0.05	<0.05	<1	<0.001	<0.02	<0.1	<0.02	<0.05		<0.002				0.24		8.10		588			0.66	<0.05	72						23	122	1.0	
GWQ-10	11/6/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.28		7.90		500			2.00	<0.01	84						22	162	0.7	
GWQ-10	11/13/1981	<0.001	0.37	<0.005	0.25		0.037	0.001		<0.005			<0.0005	0.5	<0.01	<0.05	<0.005		0.01	<0.005			0.90		7.75	700	509			1.80	0.001	70	17	39	2.34		276	23	141	0.6	
GWQ-10	11/17/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.28		7.90		500			1.80	<0.01	70						26	156	0.6	
GWQ-10	11/23/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.37		7.70		650			1.80	<0.01							26	161	0.6	
GWQ-10	12/7/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.87		8.20		490			1.80	<0.01	67						24	168	0.5	
GWQ-10	12/15/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.44		7.90		550			2.60	<0.01	89						24	181	0.7	
GWQ-10	12/22/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.35		8.10		480			2.50	<0.01	85						24	168	0.5	
GWQ-10	1/5/1982	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	0.13	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.31		7.50		430			2.90	<0.01	80						22	174	0.6	
GWQ-10	1/26/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.1				<0.005						7.80		490			2.30	<0.01							24	162	0.6	
GWQ-10	2/22/1982							<0.005			<0.05	0.12	<0.001	<0.05	<0.05				<0.005						7.60		510			2.10	<0.01							24	161	0.6	
GWQ-10	4/26/1982							<0.005			<0.05	0.41	<0.001	<0.05	<0.05				<0.005						7.40		840			2.00	<0.01							20	168	0.6	
GWQ-10	5/17/1982							<0.005			<0.05	0.10	<0.001	<0.05	<0.05				<0.005						7.70		490			2.30	<0.01							28	175	0.6	
GWQ-10	6/8/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.00		500			2.20	<0.01							22	162	0.5	
GWQ-10	6/30/1982							<0.005			<0.05	0.62	<0.001	<0.05	<0.05				<0.005						8.00		510			3.30	<0.01							20	160	0.6	
GWQ-10	9/2/1982							<0.001						<0.05	<0.01				<0.005						7.30	690	506			2.25		83	17	58	2.73		278	22	143	0.5	
GWQ-10	12/23/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.50		500			1.70	<0.01							26	138	0.6	
GWQ-10	2/21/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.90		470			2.40	<0.01							24	161	0.6	
GWQ-10	5/13/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.00		480			2.40	0.02							32	161	0.6	
GWQ-10	8/9/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.90		510			2.40	<0.01							36	142	0.6	
GWQ-10	11/1/1983							<0.005			<0.05	0.17	<0.001	<0.05	<0.05				<0.005						8.10		500			4.80	<0.01							34	125	0.6	
GWQ-10	3/16/1984							<0.005			<0.05	0.11	<0.001	<0.05	<0.05				<0.005						8.20		500			3.50	<0.01							42	128	0.5	
GWQ-10	5/30/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.50		530			3.30	<0.01							56	161	0.5	

Appendix C.
Table C-3. Groundwater-quality data

sample location	analysis date	silver (mg/L)	aluminum (mg/L)	arsenic (mg/L)	barium (mg/L)	beryllium (mg/L)	boron (mg/L)	cadmium (mg/L)	cobalt (mg/L)	chromium (mg/L)	copper (mg/L)	iron (mg/L)	mercury (mg/L)	manganese (mg/L)	molybdenum (mg/L)	nickel (mg/L)	lead (mg/L)	antimony (mg/L)	selenium (mg/L)	thallium (mg/L)	uranium (mg/L)	vanadium (mg/L)	zinc (mg/L)	temperature °C	pH (std. units)	specific conductance (µS/cm)	total dissolved solids (mg/L)	total alkalinity (mg/L as CaCO3)	total acidity (mg/L as CaCO3)	nitrate as total N (mg/L)	total cyanide (mg/L)	calcium (mg/L)	magnesium (mg/L)	sodium (mg/L)	potassium (mg/L)	carbonate (mg/L)	bicarbonate (mg/L)	chloride (mg/L)	sulfate (mg/L)	fluoride (mg/L)	total suspended solids
GWQ-10	9/12/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.80		580			4.20								68	158	0.5	
GWQ-10	11/27/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.70		580			4.90	<0.01							64	163	0.6	
GWQ-10	5/17/1985																								7.80		570											52	163		
GWQ-10	11/13/1985																								7.70		500											42	149		
GWQ-10	5/23/1986																								7.90		560											58	151		
GWQ-10	10/8/1986																								7.50		550											54	137		
GWQ-10	3/4/1987	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1		<0.05	<0.1	<0.1	<0.1	0.9					<0.1			740	568					90	21	74	2.34		256	59	150		
GWQ-10	5/25/1987																																						154		
GWQ-10	1/12/1988	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1		<0.05	<0.1	<0.1	<0.1						<0.1				648					116	24	64	3		243	79	173		
GWQ-10	4/4/1988																										552											65	171		
GWQ-10	8/23/1988																										692											63	179		
GWQ-10	2/9/1989																										618											76	181		
GWQ-10	6/1/1989																										604											68	163		
GWQ-10	11/30/1989																										620											72	162		
GWQ-10	11/14/1990																										635											93	178		
GWQ-10	2/11/1991			<0.001																							696											78	214		
GWQ-10	7/19/1991	<0.02		0.002	0.02			<0.005		<0.02		0.07	<0.0002	<0.02			<0.005		0.002						8.05	975	645			3.88		106	24	47	3.9	0	242	83	167	0.5	
GWQ-10	8/29/1991																								7.44		665											85	192		
GWQ-10	11/26/1991																								7.46		648											58	171		
GWQ-10	3/15/1992																								7.85		641											83	192		
GWQ-10	5/25/1992																								7.41		621											84	169		
GWQ-10	7/16/1992																								7.51		626											76	167		
GWQ-10	10/8/1992																								7.43		659											83	161		
GWQ-10	11/27/1992																								7.89		654											80	174		
GWQ-10	12/15/1992																								7.48		582											91	169		
GWQ-10	2/25/1993																								7.39		620											96	176		
GWQ-10	3/30/1993	<0.01	<0.1	<0.005	<0.5		0.04	<0.002	<0.05	<0.02	<0.01	<0.05	<0.001	<0.02	<0.02	<0.01	<0.02		<0.005				0.11		7.80	1020	642	200		3.90	<0.01	104	27	71	2.3	0	254	94	183	0.5	
GWQ-10	9/28/1993																								7.70		693											96	143		
GWQ-10	5/26/1994	<0.025	0.85	<0.005	<0.1			<0.0005		<0.025	0.026	1.10	<0.001	0.059		<0.05	<0.005	<0.005	<0.005				0.55		7.82	1050	1000			3.50		100	25	56	3.1	0	232	92	175	0.5	
GWQ-10	6/23/1994																								7.97		671											104	192		
GWQ-10	7/23/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.05		7.97	1050	696			3.50		110	26	66	2.8	0	238	98	184	0.5	
GWQ-10	9/22/1994																								7.45		668											89	156		
GWQ-10	1/29/1995																								7.52		672											88	66		
GWQ-10	3/29/1995																								7.67		622											85	176		
GWQ-10	6/27/1995																								7.29		677											85	169		
GWQ-10	9/21/1995																								7.42		693											91	187		
GWQ-10	1/10/1996																								7.29		654											98	198		
GWQ-10	4/3/1996																								6.95		628											97	218		
GWQ-10	9/25/1996																								7.56		679											86	191		
GWQ-10	1/15/1997																								7.59		746											91	204		
GWQ-11	8/10/1981	<0.02	<0.25	<0.004	<1		0.092	<0.01	<0.05	<0.05	<0.05	1.14	<1	0.45	<0.1	<0.05	<0.05		0.006				<0.05		7.38		612			1.02	<0.05	68	14	48	7.88	<1	237	37	123	0.9	
GWQ-11	10/27/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.17		8.10		550			0.70	<0.01	72						36	183	1.0	
GWQ-11	10/30/1981	<0.02	<0.25	<0.005	<1		0.55	<0.01	<0.05	<0.05	<0.05	<0.1	<0.001	<0.02	<0.1	<0.02	<0.05		<0.011				0.23		8.40		536			0.61	<0.05							39	101	1.0	
GWQ-11	11/6/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.29		8.10		520			1.50	<0.01	67						36	168	1.0	
GWQ-11	11/13/1981	<0.001	<0.25	<0.005	0.2		0.041	0.001		<0.005			<0.0005	<0.05	0.12	<0.05	<0.005		0.023				0.79		7.70	700	544			1.33	<0.001	83	17	44	3.9		241	38	156	1.0	
GWQ-11	11/17/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.64		8.00		520			1.30	<0.01	71						36	165	1.0	
GWQ-11	11/23/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.53		7.80		570			1.70	<0.01	67						36	181	0.9	
GWQ-11	12/7/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	0.0064	<0.05	<0.05	<0.05	<0.02		<0.005				1.60		7.90		560			1.60	<0.01	57						56	184	0.9	
GWQ-11	12/15/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				1.10		7.90		570			1.50	<0.01	85						38	191	1.0	
GWQ-11	12/22/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	0.27	<0.001	0.093	<0.05	<0.05	<0.02		<0.005				0.42		8.00		530			1.90	<0.01	82						40	185	0.5	
GWQ-11	1/5/1982	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	0.14	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.44		7.50		480			2.50	<0.01	79						40	174	1.0	
GWQ-11	1/26/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.1				<0.005						7.90		500			1.70	<0.01							40	168	1.0	
GWQ-11	2/22/1982							<0.005			<0.05	0.11	<0.001	<0.05	<0.05				<0.005						7.70		510			1.40	<0.01							38	168	0.9	
GWQ-11	4/26/1982							<0.005			<0.05	0.36	<0.001	<0.05	0.05				<0.005						7.60		510			1.30	<0.01							40	165	0.8	
GWQ-11	5/17/1982							<0.005			<0.05	0.11	<0.001	<0.05	<0.05				<0.005						7.80		510			1.90	<0.01							44	185	0.8	
GWQ-11	6/8/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.90		530			1.70	<0.01							44	185	0.8	
GWQ-11	6/30/1982							<0.005			<0.05	0.39	<0.001	<0.05	<0.05				<0.005						7.90		590			2.30	<0.01							44	198	0.8	
GWQ-11	9/2/1982							<0.001						<0.05	<0.01				<0.005						7.30	940	700			1.94		111	28	58	3.51		226	52	248	0.8	

Appendix C.

Table C-3. Groundwater-quality data

sample location	analysis date	silver (mg/L)	aluminum (mg/L)	arsenic (mg/L)	barium (mg/L)	beryllium (mg/L)	boron (mg/L)	cadmium (mg/L)	cobalt (mg/L)	chromium (mg/L)	copper (mg/L)	iron (mg/L)	mercury (mg/L)	manganese (mg/L)	molybdenum (mg/L)	nickel (mg/L)	lead (mg/L)	antimony (mg/L)	selenium (mg/L)	thallium (mg/L)	uranium (mg/L)	vanadium (mg/L)	zinc (mg/L)	temperature °C	pH (std. units)	specific conductance (µS/cm)	total dissolved solids (mg/L)	total alkalinity (mg/L as CaCO3)	total acidity (mg/L as CaCO3)	nitrate as total N (mg/L)	total cyanide (mg/L)	calcium (mg/L)	magnesium (mg/L)	sodium (mg/L)	potassium (mg/L)	carbonate (mg/L)	bicarbonate (mg/L)	chloride (mg/L)	sulfate (mg/L)	fluoride (mg/L)	total suspended solids
GWQ-11	12/23/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.50		650			1.60	<0.01							52	235	0.8	
GWQ-11	2/21/1983							<0.005			<0.05	0.38	<0.001	<0.05	<0.05				<0.005						8.00		600			1.70	<0.01							44	218	0.8	
GWQ-11	5/13/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.10		570			1.90	0.01							44	206	0.8	
GWQ-11	8/9/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.90		580			2.00	<0.01							46	168	0.8	
GWQ-11	11/1/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.00		580			4.80	<0.01							46	174	0.8	
GWQ-11	3/16/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.30		540			3.80	<0.01							52	184	0.6	
GWQ-11	5/30/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.50		550			1.90	<0.01							58	195	0.8	
GWQ-11	9/12/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.90		590			2.30	<0.01							60	181	0.8	
GWQ-11	11/27/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.70		570			2.30	<0.01							60	165	0.8	
GWQ-11	5/17/1985																								7.80		640											64	197		
GWQ-11	11/13/1985																								7.70		600											62	183		
GWQ-11	5/23/1986																								7.80		650											66	210		
GWQ-11	10/8/1986																								7.60		560											70	200		
GWQ-11	3/4/1987	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1		<0.05	<0.1	<0.1	<0.1	1.1					<0.1		6.70	820	696					108	26	62	3.51		220	69	200		
GWQ-11	5/25/1987																																						230		
GWQ-11	1/12/1988	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1		<0.05	<0.1	<0.1	<0.1						<0.1				718					128	31	63	4		214	77	253		
GWQ-11	4/4/1988																										694											75	278		
GWQ-11	8/23/1988																										772											73	294		
GWQ-11	2/9/1989																										730											77	258		
GWQ-11	6/1/1989																										708											70	238		
GWQ-11	11/30/1989																										732											80	254		
GWQ-11	11/14/1990																										746											104	257		
GWQ-11	2/11/1991			<0.001																							790											89	233		
GWQ-11	7/19/1991	<0.02		0.004	0.1			<0.005		<0.02		<0.05	<0.0002	<0.02			<0.002		0.002						7.36	1100	785			3.93		123	34	40	3.9	0	221	90	210	0.7	
GWQ-11	8/29/1991																								7.46		771											93	279		
GWQ-11	11/26/1991																								7.29		770											89	241		
GWQ-11	3/15/1992																								7.91		765											65	260		
GWQ-11	5/25/1992																								7.45		761											96	258		
GWQ-11	10/8/1992																								7.42		755											96	227		
GWQ-11	11/27/1992																								7.85		763											96	248		
GWQ-11	12/15/1992										0.017														7.59		741											98	220		
GWQ-11	2/25/1993																								7.64		762											104	273		
GWQ-11	3/30/1993	<0.01	0.2	<0.005	<0.5		0.04	<0.002	<0.05	<0.02	<0.01	0.33	<0.001	0.03	<0.02	<0.01	<0.02		<0.005				0.03		7.70	1170	776	180		4.10	<0.01	126	34	68	2.9	0	227	104	271	0.5	
GWQ-11	9/28/1993																								7.57		800											106	208		
GWQ-11	5/25/1994	<0.025	0.14	<0.005	<0.1			<0.0005		<0.025	<0.025	0.16	<0.001	<0.03		<0.05	<0.005	<0.005	<0.005				<0.05		7.88	1130	820			3.80		120	34	55	3.5	0		110	260	0.7	
GWQ-11	6/23/1994																								7.42		802											117	275		
GWQ-11	7/22/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	0.0055	<0.005	<0.005			<0.05		7.70	1210	808			3.80		140	37	66	3.4	0		116	272	0.7	
GWQ-11	9/22/1994																								7.37		816											112	235		
GWQ-11	1/29/1995																								7.60		861											200	159		
GWQ-11	3/29/1995																								7.96		793											99	137		
GWQ-11	6/27/1995																								7.67		835											102	279		
GWQ-11	9/21/1995																								7.58		865											112	290		
GWQ-11	1/10/1996																								7.36		777											121	288		
GWQ-11	4/3/1996																								7.38		767											119	277		
GWQ-11	9/25/1996																								7.78		835											116	230		
GWQ-11	1/15/1997																								7.68		860											127	304		
GWQ-11	4/10/2013																							19.80	6.73	1351	952	163				155	43	69	3.34	<2	163	142	359		
GWQ-11	7/11/2013																							20.80	7.20	1260	993	163				164	43	66	3.43	<2	163	130	350		
GWQ-11	10/24/2013																							20.00	7.44	1185	942	165				149	44	72	3.09	<2	165	131	323		
GWQ-12	8/9/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.01				<0.005						7.90					2.20								14	30	1.0	
GWQ-12	11/27/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.01				<0.005						7.80					2.30								14	37	1.0	
GWQ-12	4/10/2013																							20.10	7.19	553	360	179				50	16	27	2.66	<2	179	27	5		
GWQ-12	7/11/2013																							21.70	7.24	518	361	181				57	18	28	3.29	<2	181	28	47		
GWQ-12	10/23/1013																							21.10	7.10	477	426	194				54	19	32	3.58	<2	194	23	38		
GWQ94-13	11/15/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	0.11	<0.001	<0.03	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.05		7.74	2026	1570			4.60		270	56	110	3.9	0	159	190	720	0.4	
GWQ94-13	7/1/1996	<0.05	<0.025	<0.005	<0.05	<0.002	<0.05	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	<0.002	0.007	<0.001			<0.05		7.76	2000	1520			5.20		290	62	120	3.6	0	156	200	620	0.3	
GWQ94-13	7/2/2010	<0.005	<0.020	<0.001	0.04	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	<0.02	0.00026	<0.002	<0.008	<0.01	<0.005	<0.001	0.024	<0.001	0.0016	<0.05	<0.01		8.00	2200	1730	120		5.90		320	62	110	3.4	<2	120	290	770	0.4	10
GWQ94-13	10/5/2010	<0.005	<0.02	<0.005	0.038	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.001	0.024	<0.001	0.0015	<0.05	<0.01		7.39	2100	1670	120		5.80		300	62	110	3.4	<2	120	280	760	0.3	<10

Appendix C.
Table C-3. Groundwater-quality data

sample location	analysis date	silver (mg/L)	aluminum (mg/L)	arsenic (mg/L)	barium (mg/L)	beryllium (mg/L)	boron (mg/L)	cadmium (mg/L)	cobalt (mg/L)	chromium (mg/L)	copper (mg/L)	iron (mg/L)	mercury (mg/L)	manganese (mg/L)	molybdenum (mg/L)	nickel (mg/L)	lead (mg/L)	antimony (mg/L)	selenium (mg/L)	thallium (mg/L)	uranium (mg/L)	vanadium (mg/L)	zinc (mg/L)	temperature °C	pH (std. units)	specific conductance (µS/cm)	total dissolved solids (mg/L)	total alkalinity (mg/L as CaCO3)	total acidity (mg/L as CaCO3)	nitrate as total N (mg/L)	total cyanide (mg/L)	calcium (mg/L)	magnesium (mg/L)	sodium (mg/L)	potassium (mg/L)	carbonate (mg/L)	bicarbonate (mg/L)	chloride (mg/L)	sulfate (mg/L)	fluoride (mg/L)	total suspended solids
GWQ94-13	5/11/2011	<0.005	<0.02	0.0038	0.037	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.001	0.028	<0.001	0.0017	<0.05	0.04		7.66	2100	1670	130		6.50	<0.005	310	61	120	3.3	<2	130	290	800	0.3	<10
GWQ94-13	1/10/2013		< 0.02					< 0.002	< 0.006		< 0.001								0.017				< 0.01	19.30	6.90	1638	1460	126				246	50	106	3.2	< 2	126	184	543	< 0.5	
GWQ94-13	4/10/2013																							19.40	7.16	1711	1410	124				231	44	91	2.7	<2	124	177	517		
GWQ94-13	7/11/2013																							21.30	7.33	1898	1450	125				246	47	99	3.5	<2	125	210	611		
GWQ94-13	10/24/2013																										1440	126				233	50	107	3.0	<2	126	211	607		
GWQ94-14	11/14/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.05		7.95	745	560			1.30		81	23	46	1.9	0	279	22	140	0.5	
GWQ94-14	6/30/1996	<0.05	<0.025	<0.005	<0.05	<0.002	<0.05	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	<0.002	<0.005	<0.001			<0.05		8.44	641	520			1.50		87	23	51	1.9	5	261	26	140	0.5	
GWQ94-14	1/29/2010	<0.005	<0.02	0.0032	0.045	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.0025	0.0068	<0.0025			0.01		8.00	820	550	210		2.20	<0.005	96	26	49	2	<2	210	50	150	0.5	
GWQ94-14	6/29/2010	<0.005	<0.020	0.0023	0.048	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.001	0.0052	<0.001	0.0014	<0.05	<0.01		8.00	820	573	210		2.30		98	25	45	1.7	<2	210	49	150	0.5	<10
GWQ94-14	10/5/2010	<0.005	<0.02	0.0024	0.045	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.001	0.0053	<0.001	0.0013	<0.05	<0.01		7.57	840	563	210		2.20		94	27	47	1.7	<2	210	50	150	0.5	<10
GWQ94-14	5/13/2011	<0.005	<0.02	0.0028	0.045	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.001	0.0061	<0.001	0.0015	<0.05	0.05		7.84	840	570	210		2.20	0.012	97	27	49	1.8	<2	210	48	150	0.6	<10
GWQ94-14	1/11/2013		< 0.02					< 0.002	< 0.006		< 0.001								0.0034				< 0.01	20.70	6.97	743	583	218				90	25	46	1.6	< 2	218	44	140	0.4	
GWQ94-14	4/10/2013																							19.70	7.21	721	553	213				95	26	49	1.7	<2	213	44	141		
GWQ94-14	7/11/2013																							21.80	7.12	832	565	214				94	24	46	1.6	<2	214	43	138		
GWQ94-14	10/22/2013																							21.30	7.72	734	592	217				86	25	48	1.7	<2	217	44	140		
GWQ94-15	11/14/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.05		7.74	1058	790			2.10		110	29	68	2.5	0	265	110	180	0.5	
GWQ94-15	7/1/1996	<0.05	<0.025	<0.005	<0.05	<0.002	<0.05	<0.0005	<0.05	<0.025	<0.025	0.41	<0.001	<0.03	<0.05	<0.05	<0.005	<0.002	<0.005	<0.001			<0.05		7.31	1190	780			2.50		140	38	77	2.4	0	227	130	240	0.4	
GWQ94-15	1/29/2010	<0.005	<0.020	0.0042	0.058	<0.002	<0.040	<0.002	<0.0060	<0.0060	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.0025	0.021	<0.0025			0.02		7.00	1500	1080	160		4.10	<0.005	180	47	84	3	<2	160	170	420	0.3	
GWQ94-15	6/29/2010	<0.005	<0.020	<0.0010	0.059	<0.002	<0.040	<0.002	<0.0060	<0.0060	<0.006	<0.02	<0.0002	0.0049	<0.008	<0.01	<0.005	<0.001	0.0095	<0.001	0.0017	<0.05	<0.01		8.00	1100	805	180		2.70		140	34	60	2.1	<2	180	110	260	0.4	<10
GWQ94-15	10/1/2010	<0.005	<0.02	<0.001	0.056	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.001	0.012	<0.001	0.0018	<0.05	<0.01		7.52	1100	794	190		2.70	<0.01	130	37	65	2.2	<2	190	110	260	0.4	<10
GWQ94-15	5/13/2011	<0.005	<0.02	0.0036	0.056	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.001	0.012	<0.001	0.0018	<0.05	<0.01		7.74	1200	808	190		2.80	<0.005	130	38	68	2.3	<2	190	120	270	0.4	<10
GWQ94-16	11/13/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	0.038	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.05		7.55	1600	1140			3.80		190	51	78	3.7	0	199	190	410	0.7	
GWQ94-16	7/1/1996	<0.05	<0.025	<0.005	<0.05	<0.002	<0.05	<0.0005	<0.05	<0.025	<0.025	0.22	<0.001	<0.03	<0.05	<0.05	<0.005	<0.002	<0.005	<0.001			<0.05		7.95	1620	1160			3.70		200	54	80	3.4	0	193	200	500	0.6	
GWQ94-16	6/29/2010	<0.005	<0.02	0.0022	0.039	<0.002	0.048	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.001	0.011	<0.001	0.0025	<0.05	<0.01		8.00	1600	1190	180		3.70		210	50	74	3.1	<2	180	180	440	0.6	<10
GWQ94-16	9/30/2010	<0.005	<0.02	0.0024	0.038	<0.002	0.053	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.001	0.015	<0.001	0.0024	<0.05	<0.01		7.50	1500	1170	180		3.90	<0.01	200	51	78	3.1	<2	180	190	440	0.7	<10
GWQ94-16	5/10/2011	<0.005	<0.02	0.0026	0.038	<0.002	0.056	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.001	0.012	<0.001	0.0023	<0.05	0.01		7.58	1600	1150	180		4.00	<0.01	200	49	74	3.1	<2	180	190	430	0.6	<10
GWQ94-16	1/10/2013		0.0446					< 0.002	< 0.006		< 0.001								0.0021				< 0.01	18.60	7.59	1477	1170	173				188	48	76	3.3	< 2	173	192	407	0.6	
GWQ94-16	4/10/2013																							19.00	7.36	1576	1070	171				281	51	65	4.8	<2	171	191	421		
GWQ94-16	7/11/2013																							21.20	7.28	1456	1160	170				193	46	73	3.2	<2	170	177	386		
GWQ94-16	10/24/2013																							20.00	7.44	1652	1430	178				225	60	110	3.4	<2	178	194	598		
GWQ94-17	11/15/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.05		7.71	1147	820			2.40		120	33	62	2.4	0	232	110	240	0.5	
GWQ94-17	6/30/1996	<0.05	<0.025	<0.005	<0.05	<0.002	<0.05	<0.0005	<0.05	<0.025	<0.025	0.06	<0.001	<0.03	<0.05	<0.05	<0.005	<0.002	<0.005	<0.001			<0.05		8.56	925	690			2.00		120	28	61	2	7	227	81	190	0.5	
GWQ94-17	7/6/2010	<0.005	<0.02	0.0022	0.047	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.001	0.0062	<0.001	0.0016	<0.05	<0.01		8.00	880	629	200		2.00		110	27	49	1.8	<2	200	68	180	0.5	61
GWQ94-20	11/15/1994	<0.025	<0.05	<0.005	<0.1	<0.002	0.11	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	0.42	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.05		7.66	588	370			1.00		48	10	67	3.2	0	296	19	40	0.4	
GWQ94-20	6/30/1996	<0.05	<0.025	<0.005	0.12	<0.002	0.086	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	<0.002	<0.005	<0.001			<0.05		8.79	597	390			<1		58	10	75	3.1	19	273	21	56	0.3	
GWQ94-21A	11/13/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	0.20	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.05		7.25	672	480			1.00		82	23	39	2.1	0	267	18	130	0.6	
GWQ94-21A	6/30/1996	<0.05	<0.025	<0.005	<0.05	<0.002	<0.05	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	<0.002	<0.005	<0.001			<0.05		8.22	649	470			1.10		86	22	37	1.5	0	268	16	120	0.5	
GWQ94-21B	11/13/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	0.37	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.05		7.57	669	440			<1		71	18	56	2.6	0	255	19	130	0.4	
GWQ94-21B	6/30/1996	<0.05	<0.025	<0.005	<0.05	<0.002	<0.05	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	<0.002	<0.005	<0.001			<0.05		8.60	648	470			1.10		87	22	40	1.7	10	256	17	120	0.5	
GWQ96-22A	7/13/1996	<0.05	<0.025	<0.005	<0.05	<0.002	<0.05	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	0.08	<0.05	<0.05	<0.005	<0.003	<0.005	<0.001			<0.05		7.50	1040	700			<1		71	7	150	2.5	0	124	89	250	3.3	
GWQ96-22A	4/9/1997										<0.025	6.50	<0.001	2.80					<0.005						7.58	930	770											20	150	0.8	
GWQ96-22A	8/8/1997	<0.025	0.028	<0.005	0.057	<0.002	0.23	<0.002	<0.05	<0.025	<0.05	0.13		0.53	<0.05	<0.05	<0.005		<0.005	<0.001			<0.05		7.65	1140	700			<1		73	8	170	6.2	0	177	89	230	2.2	
GWQ96-22A	1/30/2010	<0.005	<0.02	0.0029	0.094	<0.002	0.28	<0.002	<0.006	<0.006	<0.006	2.10	<0.0002	0.74	<0.008	<0.01	<0.005	<0.0025	<0.0025	<0.0025			<0.01		8.00	920	557	320		<1	<0.005	51	4	160	2.8	<2	320	81	44	2.6	
GWQ96-22A	7/1/2010	<0.005	<0.02	0.0035	0.079	<0.002	0.28	<0.002	<0.006	<0.006	<0.006	0.02	<0.0002	0.65	<0.008	<0.01	<0.005	<0.001	0.0011	<0.001	<0.001	<0.05	<0.01		8.00	920	573	310		<1		53	4	150	2.8	<2	310	70	52	2.7	19
GWQ96-22A	10/7/2010	<0.005	<0.02	0.0035	0.084	<0.002	0.28	<0.002	<0.006	<0.006	<0.006	0.32	<0.0002	0.49	<0.008	<0.01	<0.005	<0.001	<0.001	<0.001	<0.001	<0.05	<0.01		8.00	720	564	340		<1		49	4	150	2.8	<2	340	75	34	2.7	11
GWQ96-22A	1/9/2013		0.0202					< 0.002	< 0.006		< 0.001								< 0.001				< 0.01		7.85		521	301				41	3	147	2.3	< 2	301	61	39	3.1	
GWQ96-22B	7/13/1996	<0.05	<0.025	<0.005	0.096	<0.002	0.12	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	0.41	<0.05	<0.05	<0.005	<0.003	<0.005	<0.001			<0.05		7.75	1070	650			<1		66	10	130	10	0	141	210	79	1.8	
GWQ96-22B	10/7/2010	<0.005	<0.02	0.0057	0.11	<0.002	0.24	<0.002	<0.006	<0.006	<0.006	9.30	<0.0002	1.20	<0.008	<0.01	<0.005	<0.001	0.0011	<0.001	<0.001	<0.05	<0.01		7.52	1200	730	480		2.10		72	6	200	3.6	<2	480	110	<0.5	3.0	25
GWQ96-22B	1/9/2013		0.0432					< 0.002	< 0.006		0.0031								< 0.001				0.05		7.52		722	477				70	6	193	3.7	< 2	477	101	6.2	3.3	
GWQ96-23A	7/14/1996	<0.05	0.28	<0.005	0.064	<0.002	<0.05	<0.0005	<0.05	<0.025	<0.025	0.26	<0.001	0.05	<0.05	<0.05	<0.005	<0.003	<0.005	<0.001			<0.05		7.95	760	520			<1		59	18	98	4.2	0	280	22	140	0.8	
GWQ96-23A	4/9/1997										<0.025	0.10	<0.001	0.75					<0.005							850	580											16	170	1.4	
GWQ96-23A	8/8/1997	<0.025	0.036	<0.005	0.13	<0.002	0.067	<0.002	<0.05	<0.025	<0.025	0.82		1.60	<0.05	<0.05	<0.005		<0.005	<0.001			<0.05		7.68	1310	920			<1		130	36	72	2.5	0	328	18	410	1.2	
GWQ96-23A	1/30/2010	<0.005	<0.02	0.0027	0.091	<0.002	0.074	<0.002	<0.006	<0.006	<0.006	0.66	<0.0002	0.63	<0.008	<0.01	<0.005	<0.0025	<0.0025	<0.0025			<0.01		8.00	1100	689	640		<1		150	45	69	1.6	<2	640	12	6	1.7	
GWQ96-23A	7/1/2010	<0.005	<0.02	0.0011	0.13	<0.002	0.068	<0.002	<0.006	<0.006	<0.006	0.05	<0.0002	0.37	<0.008	<0.01	<0.005	<0.001	0.0014	<0.001	0.0025	<0.05	<0.01		8.00	1200	804	510		<1		150	40	81	1.5	<2	510	14	140	1.5	13
GWQ96-23A	10/6/2010	<0.005	<0.02	<0.001	0.087	<0.002	0.08	<0.002	<0.006	<0.006	<0.006	0.31	<0.0002	0.41	<0.008	<0.01	<0.005	<0.001	0.0013	<0.001	0.0037	<0.05	<0.01		7.89	1200	769	580		<1		140	45	80	1.3	<2	580	12	99	1.6	<10
GWQ96-23A	5/12/2011	<0.005	<0.02	<0.001	0.078	<0.002	0.071	<0.002	<0.006	<0.006	<0.006	0.04	<0.0002	0.29	<0.008	<0.01	<0.005	<0.001	0.0012	<0.001	0.003	<0.05	0.02		8.16	1100	752	600		<0.1	<0.005	150	42	78	1.3	<2	600	13	74	1.7	<10
GWQ96-23A	1/11/2013		0.0314					< 0.002	< 0.006		0.0011								< 0.001				< 0.01		8.07		693	627				129	38	71	1.37	< 2	627	12	6	2.0	
GWQ96-23B	7/14/1996	<0.05	7.4	<0.005	0.093	<0.002	0.058	<0.0005	<0.05	<0.025	<0.025	3.70	<0.001	0.13	<0.05	<0.05	<0.005	<0.003	<0.005	<0.001			<0.05		8.15	780	550			<1		67	20	79	4	0	234	20	170	1.1	

Appendix C.
Table C-3. Groundwater-quality data

sample location	analysis date	silver (mg/L)	aluminum (mg/L)	arsenic (mg/L)	barium (mg/L)	beryllium (mg/L)	boron (mg/L)	cadmium (mg/L)	cobalt (mg/L)	chromium (mg/L)	copper (mg/L)	iron (mg/L)	mercury (mg/L)	manganese (mg/L)	molybdenum (mg/L)	nickel (mg/L)	lead (mg/L)	antimony (mg/L)	selenium (mg/L)	thallium (mg/L)	uranium (mg/L)	vanadium (mg/L)	zinc (mg/L)	temperature °C	pH (std. units)	specific conductance (µS/cm)	total dissolved solids (mg/L)	total alkalinity (mg/L as CaCO3)	total acidity (mg/L as CaCO3)	nitrate as total N (mg/L)	total cyanide (mg/L)	calcium (mg/L)	magnesium (mg/L)	sodium (mg/L)	potassium (mg/L)	carbonate (mg/L)	bicarbonate (mg/L)	chloride (mg/L)	sulfate (mg/L)	fluoride (mg/L)	total suspended solids
GWQ96-23B	10/6/2010	<0.005	<0.02	<0.001	0.1	<0.002	0.14	<0.002	<0.006	<0.006	<0.006	1.40	<0.0002	0.36	<0.008	<0.01	<0.005	<0.001	0.0011	<0.001	<0.001	<0.05	<0.01		7.85	900	554	480		<1		78	22	110	1.6	<2	480	19	<0.5	2.1	<10
GWQ96-23B	5/12/2011	<0.005	<0.02	<0.001	0.11	<0.002	0.14	<0.002	<0.006	<0.006	<0.006	0.93	<0.0002	0.34	<0.008	<0.01	<0.005	<0.001	0.0014	<0.001	<0.001	<0.05	0.07		7.99	890	556	490		<0.1	<0.005	81	22	110	1.7	<2	490	17	<0.5	2.1	24
GWQ96-23B	1/11/2013		< 0.02					< 0.002	< 0.006		< 0.001								< 0.001				0.01		8.03		571	502				77	21	98	1.57	< 2	502	15	< 5.0	2.1	
IW-1	3/4/1987																								6.60	3950	3802					564		274	3.12		193	575	1,901		
IW-1	7/19/1991	<0.02		<0.002	<0.01			<0.005		<0.02	<0.02	<0.05	0.0005	<0.02			<0.005		0.015						7.87	6460	4235			9.06		636	182	375	7	0	222	633	1,985	0.7	
IW-1	8/29/1991																								7.13		4120											642	1,918		
IW-1	11/26/1991																								7.53		3979											615	1,634		
IW-1	3/15/1992																								7.88		4026											611	2,201		
IW-1	5/25/1992																								7.09		4155											598	2,203		
IW-1	7/16/1992																								7.12		4297											585	1,775		
IW-1	10/8/1992																								6.96		3996											617	1,727		
IW-1	11/27/1992																								7.71		4004											605	1,717		
IW-1	12/15/1992																								7.40		3969											609	1,415		
IW-1	9/28/1993																								7.12		3661											521	1,150		
IW-1	3/17/1994																								7.00		3684											405	1,569		
IW-1	5/24/1994	<0.025	0.94	<0.005	<0.1			<0.0005		<0.025	<0.025	1.00	<0.001	<0.03		<0.05	<0.005	<0.005	<0.005				0.05		7.84	3920	3500			5.80		550	170	250	2.9	0	248	470	1,500	0.7	
IW-1	6/23/1994																								7.69		3555											474	1,444		
IW-1	7/22/1994	<0.025	<0.05	<0.005	<0.1	<0.002	0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	<0.005	0.018	0.0063			<0.05		7.51	4100	3450			5.90		570	200	280	2.5	0	256	431	1,480	0.7	
IW-1	9/22/1994																								7.05		3466											436	1,348		
IW-1	1/29/1995																								7.18		3395											663	1,479		
IW-1	3/29/1995																								7.49		3465											419	1,351		
IW-1	6/27/1995																								6.99		3599											446	1,680		
IW-1	9/21/1995																								6.82		35											459	1,711		
IW-1	1/10/1996																								7.23		3437											442	1,596		
IW-1	9/25/1996																								7.17		3551											568	1,493		
IW-1	1/15/1997																								7.44		36											410	1,695		
IW-2	9/2/1982							<0.001						<0.05	<0.01				<0.005						7.30	4250	4010			1.38		320	174	720	234		185	409	2,252	1.2	
IW-2	5/25/1994	<0.025	22	<0.005	0.12	<0.002		<0.0005		0.046	<0.025	16.00	<0.001	0.77		0.097	0.0073	<0.005	<0.005				0.08		7.75	2890	2400			1.50		430	94	290	3.2	0	534	340	1,000	0.7	
IW-2	7/22/1994	<0.025	<0.05	<0.005	<0.1	<0.002	0.15	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	0.036	<0.05	<0.05	<0.005	<0.005	0.014	0.0073			<0.05		7.78	3400	2390			<1		390	110	360	1.3	0	300	380	1,040	0.7	
IW-2	1/31/2010	<0.005	0.13	0.0092	0.024	<0.002	0.075	<0.002	0.0065	<0.006	<0.006	1.30	<0.0002	1.6	0.02	<0.01	<0.005	<0.0025	0.033	<0.0025			<0.01		8.00	3200	2770	260		<2	<0.005	390	120	290	1.6	<2	260	600	1,200	0.7	
IW-2	6/29/2010	<0.005	<0.02	<0.001	0.029	<0.002	0.061	<0.002	<0.006	<0.006	<0.006	0.87	0.00048	2.2	0.024	<0.01	<0.005	<0.001	0.029	<0.001	0.006	<0.05	<0.01		7.00	3400	2700	250		<2		390	110	260	1.8	<2	250	580	1,100	0.7	31,000
IW-2	9/30/2010	<0.005	0.044	<0.001	0.028	<0.002	0.073	<0.002	<0.006	<0.006	<0.006	0.41	<0.0002	2.2	0.02	<0.01	<0.005	<0.001	0.037	<0.001	0.0057	<0.05	0.02		7.36	3000	2280	250		<2	<0.01	360	110	270	1.6	<2	250	500	1,000	0.7	71,000
IW-2	5/9/2011	<0.005	<0.02	<0.001	0.037	<0.002	0.081	<0.002	0.017	<0.006	<0.006	0.36	<0.0002	3.6	0.021	<0.01	<0.005	0.0032	0.031	<0.001	0.0062	<0.05	0.02		7.31	3200	2360	240		1.70	<0.01	370	110	260	2.3	<2	240	520	1,100	0.6	20,000
IW-3	9/2/1982							<0.001						<0.05	<0.01				<0.005						7.20	1700	1562			4.12		234	42	168	3.51		179	159	707	0.4	
IW-3	2/25/1993																								7.27		3892											590	1,739		
IW-3	5/26/1994	<0.025	32	<0.005	0.2			<0.0005		0.059	6	22.00	<0.001	0.35		0.19	0.077	<0.005	<0.005				0.15		7.83	1790	1870			5.70		240	51	69	4	0	341	209	415	0.5	
IW-3	7/23/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	0.058	<0.05	<0.001	0.13	0.062	<0.05	<0.005	0.0055	0.011	<0.005			<0.05		7.76	1860	1300			5.00		200	66	89	3.5	0	255	206	437	0.5	
IW-3	4/3/1996																								7.04		3364											433	1,566		
MW-4	6/13/1975																								7.90	620						46	10	73	4.4	0	226	15	110	0.6	
MW-4	7/20/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.05		8.34	408	256			<1		15	13	56	3.4	2	139	17	66	0.3	
MW-4	4/12/2013																							19.40	8.29	427	267	87				23	7	48	2.3	<2	87	21	92		
MW-4	7/11/2013																							29.70	8.80	713	469	200				70	15	52	2.65	<2	200	20	124		
MW-4	10/22/2013																							18.80	7.85	647	495	202				65	16	57	2.62	<2	202	18	115		
NP-1	10/8/1981	<0.02	<0.25	<0.004	<1		<0.004	<0.01	<0.05	<0.05	<0.05	0.27	<1	0.92	<0.1	<0.05	<0.05		0.003				0.40		7.60		496			0.47	<0.05	56	14	62	8.25	<1	266	25	108	0.8	
NP-1	11/4/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	0.6	<0.05	<0.05	<0.02		<0.005				0.14		8.10		470			0.30	0.04	54						28	148	1.0	
NP-1	11/13/1981	<0.001	<0.25	<0.005	0.2		0.044	0.006		<0.005			<0.0005	1.34	0.011	<0.05	<0.005		0.029				0.44		7.65	625	470			0.09	0.001	72	19	39	5.85		274	24	131	0.8	
NP-1	11/17/1981	<0.02	<0.01	<0.005	0.24		<0.1	<0.005	<0.02	<0.01	0.069	<0.1	<0.001	1.4	0.06	<0.05	<0.02		<0.005				3.90		8.00		460			0.20	<0.01	59						24	154	0.8	
NP-1	11/23/1981	<0.02	<0.01	<0.01	0.02		<0.1	<0.005	<0.02	<0.02	<0.05	<0.1	<0.001	1.2	<0.05	<0.05	<0.02		<0.005				4.10		7.70		530			0.20	<0.01	58						26	146	0.8	
NP-1	12/7/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	1.2	<0.05	<0.05	<0.02		<0.005				5.10		7.30		490			0.20	<0.01	58						24	158	0.8	
NP-1	12/15/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	1.2	<0.05	<0.05	<0.02		<0.005				5.30		7.80		480			<0.2	<0.01	68						24	151	0.8	
NP-1	12/22/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	1	<0.05	<0.05	<0.02		<0.005				4.10		7.80		450			0.30	<0.01	66						22	149	0.8	
NP-1	1/5/1982	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	0.14	0.0012	0.71	<0.05	<0.05	<0.02		<0.02				4.10		7.60		400			0.70	<0.01	67						22	163	0.8	
NP-1	1/26/1982							<0.005			<0.05	<0.1	<0.001	0.45	<0.1				<0.005						7.90		440			0.50	<0.01							22	154	0.7	
NP-1	2/22/1982							<0.005			0.48	0.83	<0.001	0.26	<0.05				<0.005						7.90		460			0.60	<0.01							24	158	0.7	
NP-1	4/26/1982							<0.005			<0.05	1.20	<0.001	0.16	<0.05				<0.005						7.90		440			0.70	<0.01							26	154	0.6	
NP-1	5/24/1982											<0.1		0.28																											
NP-1	5/28/1982											<0.1		0.22																											
NP-1	6/8/1982							<0.005			<0.05	<0.1	<0.001	0.25	<0.05				<0.005						7.50		500			1.10	<0.01							20	162	0.6	

Appendix C.
Table C-3. Groundwater-quality data

sample location	analysis date	silver (mg/L)	aluminum (mg/L)	arsenic (mg/L)	barium (mg/L)	beryllium (mg/L)	boron (mg/L)	cadmium (mg/L)	cobalt (mg/L)	chromium (mg/L)	copper (mg/L)	iron (mg/L)	mercury (mg/L)	manganese (mg/L)	molybdenum (mg/L)	nickel (mg/L)	lead (mg/L)	antimony (mg/L)	selenium (mg/L)	thallium (mg/L)	uranium (mg/L)	vanadium (mg/L)	zinc (mg/L)	temperature °C	pH (std. units)	specific conductance (µS/cm)	total dissolved solids (mg/L)	total alkalinity (mg/L as CaCO3)	total acidity (mg/L as CaCO3)	nitrate as total N (mg/L)	total cyanide (mg/L)	calcium (mg/L)	magnesium (mg/L)	sodium (mg/L)	potassium (mg/L)	carbonate (mg/L)	bicarbonate (mg/L)	chloride (mg/L)	sulfate (mg/L)	fluoride (mg/L)	total suspended solids
NP-1	6/30/1982							<0.005			<0.05	<0.1	<0.001	0.18	<0.05				<0.005						7.70		500			1.10	<0.01							18	143	0.6	
NP-1	10/27/1982							<0.005			<0.05	0.45	<0.001	0.058	<0.05				<0.005						7.70		470			1.30	<0.01							20	151	0.7	
NP-1	2/21/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.70		490			1.30	<0.01							18	156	0.7	
NP-1	5/13/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.90		470			1.10	<0.01							24	149	0.6	
NP-1	8/9/1983							<0.005			<0.05	0.22	<0.001	<0.05	<0.05				<0.005						7.80		480			1.10	<0.01							22	130	0.6	
NP-1	11/1/1983							<0.005			<0.05	0.14	<0.001	<0.05	<0.05				<0.005						7.80		500			2.10	<0.01							18	125	0.6	
NP-1	3/16/1984							<0.005			<0.05	<0.1	0.0083	<0.05	<0.05				<0.005						8.20		480			1.80	<0.01							22	124	0.6	
NP-1	4/9/1984												<0.001																												
NP-1	5/30/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.50		510			0.70	<0.01							22	154	0.6	
NP-1	9/12/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.70		480			1.10	<0.01							22	137	0.6	
NP-1	11/27/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.80		480			1.10	<0.01							16	144	0.6	
NP-1	5/17/1985																								7.60		510											20	144		
NP-1	11/13/1985																								7.30		480											16	149		
NP-1	5/23/1986																								7.60		500											18	142		
NP-1	10/8/1986																								7.40		470											22	107		
NP-1	3/30/1989	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1		<0.05	<0.1	<0.1	<0.1						2.60				492					88	23	46	3		279	15	137		
NP-1	7/19/1991	<0.02		0.003	0.02			<0.005		<0.02		0.59	<0.0002	<0.02			0.007		<0.002						8.04	761	530			0.99		81	24	31	2	0	256	22	133	0.6	
NP-1	8/29/1991																								7.69		501											21	141		
NP-1	11/26/1991																								7.12		1484											23	137		
NP-1	3/15/1992																								7.80		510											22	146		
NP-1	5/25/1992																								7.49		608											29	128		
NP-1	7/16/1992																								7.50		487											22	142		
NP-1	10/8/1992																								7.35		517											22	129		
NP-1	11/27/1992																								7.85		498											21	142		
NP-1	12/15/1992																								7.58		502											24	125		
NP-1	2/25/1993																								7.42		510											23	138		
NP-1	3/30/1993	<0.01	<0.1	<0.005	<0.5		0.03	<0.002	<0.05	<0.02	<0.01	0.17	<0.001	<0.02	<0.02	<0.01	<0.02		<0.005				1.13		7.70	767	496	240		1.10	<0.01	79	27	52	1.8	0	306	22	145	0.6	
NP-1	9/28/1993																								7.48		508											36	110		
NP-1	3/17/1994																								7.30		516											24	134		
NP-1	5/24/1994	<0.025	0.83	0.005	<0.1			0.0096		<0.025	<0.025	9.50	<0.001	0.1		<0.05	0.016	<0.005	<0.005				5.70		7.53	680	510			1.10		79	23	48	2.5	0	263	22	130	0.6	
NP-1	6/23/1994																								7.50		453											40	142		
NP-1	7/21/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	0.05	<0.001	0.27	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			4.90		7.87	698	464			<1		71	23	47	2.2	0	249	23	133	0.7	
NP-1	9/22/1994																								7.49		488											24	119		
NP-1	1/29/1995																								7.94		407											26	125		
NP-1	3/29/1995																								7.98		392											23	86		
NP-1	6/27/1995																								8.02		385											24	114		
NP-1	9/21/1995																								7.96		373											27	145		
NP-1	1/10/1996																								7.73		277											26	109		
NP-1	4/3/1996																								7.89		300											26	123		
NP-1	9/25/1996																								8.22		320											24	94		
NP-1	1/15/1997																								8.42		318											26	109		
NP-1	1/31/2010	<0.005	<0.020	<0.0025	0.037	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	0.10	<0.0002	0.0088	<0.008	<0.01	<0.005	<0.0025	0.0055	<0.0025			0.38		8.00	780	514	220		1.40	<0.005	87	29	52	2	<2	220	38	140	0.6	
NP-1	6/28/2010	<0.005	<0.020	0.0034	0.043	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.001	0.0045	<0.001	0.0019	<0.05	0.05		8.00	790	548	230		1.40		90	26	46	1.9	<2	230	37	150	0.6	<10
NP-1	10/5/2010	<0.005	0.14	0.0035	0.041	<0.002	0.04	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.001	0.0045	<0.001	0.0018	<0.05	0.06		7.63	800	537	220		4.90		86	28	50	1.9	<2	220	35	140	0.6	13
NP-2	10/8/1981	<0.02	<0.25	0.024	<1		0.08	<0.01	<0.05	<0.05	<0.05	<0.1	<1	0.62	<0.1	<0.05	<0.05		<0.002				0.31		7.39		476			0.23	<0.05	46	15	94	9.57	<1	159	45	198	1.8	
NP-2	11/6/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	0.39	0.21	<0.05	<0.02		<0.005				1.70		7.60		450			0.40	<0.01	53						35	164	1.4	
NP-2	11/13/1981	<0.001	<0.25	<0.005	<0.1		0.04	<0.001		<0.005			<0.0005	0.79	0.04	<0.01	<0.005		0.017				3.18		7.65	675	466			0.25	0.0026	65	19	60	3.9		221	31	162	1.1	
NP-2	11/23/1981	<0.02	<0.01	<0.01	0.02		<0.1	<0.005	<0.02	<0.02	<0.05	<0.1	<0.001	0.54	0.06	<0.05	<0.02		<0.005				3.50		7.70		520			0.70	<0.01	57						30	156	0.9	
NP-2	12/7/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	0.54	0.06	<0.05	<0.02		<0.005				4.40		7.50		490			0.60	<0.01	53						30	160	0.8	
NP-2	12/15/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	0.52	0.072	<0.05	<0.02		<0.005				2.90		8.00		480			0.50	<0.01	62						32	161	0.9	
NP-2	12/22/1981	<0.02	<0.01	<0.01	0.21		<0.1	<0.005	<0.02	<0.01	<0.05	0.12	<0.001	0.51	0.053	<0.05	<0.02		<0.005				2.80		8.00		440			0.80	<0.01	73						32	161	0.6	
NP-2	1/5/1982	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	0.14	<0.001	0.49	0.07	<0.05	<0.02		<0.02				3.20		7.60		400			0.90	<0.01	65						28	158	0.9	
NP-2	1/26/1982							<0.005			<0.05	<0.1	<0.001	0.34	<0.1				<0.005						8.00		450			1.10	<0.01							24	160	0.7	
NP-2	2/22/1982							<0.005			0.069	0.37	<0.001	0.3	<0.05				<0.005						8.00		440			0.80	<0.01							30	151	0.7	
NP-2	4/26/1982							<0.005			<0.05	1.20	<0.001	0.29	<0.05				<0.005						8.00		450			2.40	<0.01							42	149	1.0	
NP-2	5/18/1982							0.015			<0.05	0.68	<0.001	0.078	<0.05				<0.005						7.90		460			1.80	<0.01							34	128	0.6	
NP-2	5/24/1982											<0.1		<0.05																											
NP-2	5/28/1982											<0.1		<0.05																											

Appendix C.
Table C-3. Groundwater-quality data

sample location	analysis date	silver (mg/L)	aluminum (mg/L)	arsenic (mg/L)	barium (mg/L)	beryllium (mg/L)	boron (mg/L)	cadmium (mg/L)	cobalt (mg/L)	chromium (mg/L)	copper (mg/L)	iron (mg/L)	mercury (mg/L)	manganese (mg/L)	molybdenum (mg/L)	nickel (mg/L)	lead (mg/L)	antimony (mg/L)	selenium (mg/L)	thallium (mg/L)	uranium (mg/L)	vanadium (mg/L)	zinc (mg/L)	temperature °C	pH (std. units)	specific conductance (µS/cm)	total dissolved solids (mg/L)	total alkalinity (mg/L as CaCO3)	total acidity (mg/L as CaCO3)	nitrate as total N (mg/L)	total cyanide (mg/L)	calcium (mg/L)	magnesium (mg/L)	sodium (mg/L)	potassium (mg/L)	carbonate (mg/L)	bicarbonate (mg/L)	chloride (mg/L)	sulfate (mg/L)	fluoride (mg/L)	total suspended solids
NP-2	6/8/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.80		490			0.90	<0.01							26	158	0.5	
NP-2	6/30/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.80		490			1.40	<0.01							26	133	0.6	
NP-2	9/2/1982							<0.001						<0.05	<0.01				<0.005						7.40	650	468			1.66		74	18	58	1.95		316	26	127	0.5	
NP-2	10/27/1982							<0.005			<0.05	0.29	<0.001	<0.05	<0.05				<0.005						7.90		440			1.60	<0.01							26	120	0.6	
NP-2	2/21/1983							<0.005			<0.05	0.12	<0.001	<0.05	<0.05				<0.005						7.80		440			1.60	<0.01							24	127	0.6	
NP-2	5/13/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.10		460			1.50	<0.01							24	139	0.6	
NP-2	8/9/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.90		560			1.60	<0.01							36	148	0.6	
NP-2	11/1/1983							<0.005			<0.05	0.17	<0.001	<0.05	<0.05				<0.005						8.00		470			2.30	<0.01							24	111	0.6	
NP-2	3/16/1984							<0.005			<0.05	<0.1	0.001	<0.05	<0.05				<0.005						8.20		500			1.60	<0.01							30	146	0.8	
NP-2	5/30/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.70		520			1.40	<0.01							32	175	0.6	
NP-2	9/12/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.80		470			1.70	<0.01							22	134	0.6	
NP-2	11/27/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.90		470			1.70	<0.01							20	125	0.6	
NP-2	5/17/1985																								7.80		480											22	120		
NP-2	11/13/1985																								7.40		460											22	115		
NP-2	5/23/1986																								7.60		480											28	113		
NP-2	10/8/1986																								7.40		430											24	100		
NP-2	3/30/1989	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1		0.06	<0.1	<0.1	<0.1						0.50				376					52	18	65	3		183	29	124		
NP-2	7/19/1991	<0.02		<0.002	<0.01			<0.005		<0.02	<0.02	<0.05	<0.0002	<0.02			<0.005		0.018						7.55	726	453			0.02		34	24	48	0.8	0	56	61	181	0.6	
NP-2	8/29/1991																								8.11		471											63	198		
NP-2	11/26/1991																								7.45		460											63	170		
NP-2	3/15/1992											<0.05													8.07		467											68	194		
NP-2	5/25/1992											<0.05													8.34		456											67	162		
NP-2	7/16/1992											<0.05													8.13		479											65	184		
NP-2	10/8/1992																								8.26		494											78	179		
NP-2	11/27/1992																								8.38		451											64	179		
NP-2	12/15/1992											<0.05													8.43		612											83	167		
NP-2	2/25/1993																								8.62		475											78	197		
NP-2	3/30/1993	<0.01	0.5	<0.005	0.6		0.1	<0.002	<0.05	<0.02	0.01	1.85	<0.001	0.07	<0.02	<0.01	<0.02		0.005				0.67		7.70	1910	1310	240		3.30	<0.01	163	61	163	0.9	0	289	239	436	1.3	
NP-2	9/28/1993																								7.92		1170											207	300		
NP-2	3/17/1994																								7.65		971											118	301		
NP-2	5/24/1994	<0.025	4.6	<0.005	<0.1			0.00097		<0.025	<0.025	4.50	<0.001	0.19		<0.05	0.0079	<0.005	<0.005				4.10		8.03	1250	878			<0.1		120	47	100	2.3	0	261	130	300	1.0	
NP-2	6/23/1994																								7.69		848											124	268		
NP-2	7/22/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	0.0059	<0.005	<0.005			1.20		7.88	1360	878			1.50		120	43	120	1.3	0	270	128	299	0.9	
NP-2	9/22/1994																								7.55		963											124	253		
NP-2	1/29/1995																								7.57		791											94	121		
NP-2	3/29/1995																								7.69		1164											91	229		
NP-2	6/27/1995																								7.93		778											96	247		
NP-2	9/21/1995																								7.36		722											87	212		
NP-2	1/10/1996																								7.10		632											79	173		
NP-2	4/3/1996																								7.23		603											77	169		
NP-2	9/25/1996																								7.68		598											57	118		
NP-2	1/15/1997																								7.44		536											56	148		
NP-2	1/31/2010	<0.005	<0.02	0.0032	0.058	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	0.09	<0.0002	0.19	<0.008	<0.01	<0.005	<0.0025	0.017	<0.0025			1.10		8.00	1100	746	160		2.50	<0.005	120	35	75	2.4	<2	160	150	210	0.5	
NP-2	6/28/2010	<0.005	<0.02	<0.001	0.057	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	0.021	<0.008	<0.01	<0.005	<0.001	0.012	<0.001	0.0017	<0.05	0.26		7.00	1200	846	170		2.70		130	35	71	2.2	<2	170	170	260	0.4	740
NP-2	4/10/2013																							19.10	7.38	1364	872	167				147	41	69	4.24	<2	167	170	299		
NP-2	7/11/2013																							19.10	8.79	1307	840	149				148	44	74	4	<2	149	166	292		
NP-2	10/23/2013																							20.70	7.10	1154	1270	153				208	61	72	6.36	<2	153	158	280		
NP-3	10/8/1981	<0.02	<0.25	0.005	<1		0.188	<0.01	<0.05	<0.05	<0.05	<0.1	<1	0.81	<0.1	<0.05	<0.05		0.005				1.25		6.98		460			<0.05	<0.05	41	10	79	9.71	<1	211	29	95	1.6	
NP-3	10/27/1981	<0.02	<0.01	<0.01	0.2		<0.1	<0.005	<0.02	<0.01	<0.05	0.39	<0.001	1	0.16	<0.05	<0.02		<0.005				0.98		8.00		390			0.40	<0.01	41						28	148	1.9	
NP-3	10/30/1981	<0.02	<0.25	<0.005	<1		0.29	<0.01	<0.05	<0.05	<0.05	<0.1	<0.001	1.03	<0.1	<0.02	<0.05		<0.002				0.93		7.89		428			<0.05	<0.05							31	102	1.6	
NP-3	11/6/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	0.47	0.26	<0.05	<0.02		<0.005				1.10		7.90		380			0.20	<0.01	39						28	140	1.6	
NP-3	11/13/1981	0.023	<0.25	0.009	<0.1		0.034	<0.001		<0.005			<0.0005	1.01	0.065	<0.05	<0.005		0.023				1.59		7.60	600	446			0.16		55	13	44	5.85		190	27	141	1.4	
NP-3	11/17/1981	<0.02	<0.01	<0.01	0.24		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	1	0.2	<0.05	<0.02		<0.005				1.20		8.10		390			<0.2	<0.01	44						26	144	1.4	
NP-3	11/23/1981	<0.01	<0.01	<0.01	0.02		<0.1	<0.005	<0.02	<0.02	<0.05	<0.1	<0.001	0.96	0.15	<0.05	<0.02		<0.005				1.90		7.80		460			0.20	<0.01	47						26	144	1.2	
NP-3	12/7/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	0.78	0.13	<0.05	<0.02		<0.005				3.50		7.90		450			<0.2	<0.01	47						28	153	1.1	
NP-3	12/15/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	0.87	0.094	<0.05	<0.02		<0.005				2.50		7.80		450			0.20	<0.01	56						26	149	1.1	
NP-3	12/22/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	0.76	0.1	<0.05	<0.02		<0.005				2.10		7.90		410			0.20	<0.01	73						26	149	0.9	
NP-3	1/5/1982	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	0.31	<0.001	0.72	0.01	<0.05	<0.02		<0.02				1.70		7.70		360			0.20	<0.01	56						26	154	1.1	

Appendix C.
Table C-3. Groundwater-quality data

sample location	analysis date	silver (mg/L)	aluminum (mg/L)	arsenic (mg/L)	barium (mg/L)	beryllium (mg/L)	boron (mg/L)	cadmium (mg/L)	cobalt (mg/L)	chromium (mg/L)	copper (mg/L)	iron (mg/L)	mercury (mg/L)	manganese (mg/L)	molybdenum (mg/L)	nickel (mg/L)	lead (mg/L)	antimony (mg/L)	selenium (mg/L)	thallium (mg/L)	uranium (mg/L)	vanadium (mg/L)	zinc (mg/L)	temperature °C	pH (std. units)	specific conductance (µS/cm)	total dissolved solids (mg/L)	total alkalinity (mg/L as CaCO3)	total acidity (mg/L as CaCO3)	nitrate as total N (mg/L)	total cyanide (mg/L)	calcium (mg/L)	magnesium (mg/L)	sodium (mg/L)	potassium (mg/L)	carbonate (mg/L)	bicarbonate (mg/L)	chloride (mg/L)	sulfate (mg/L)	fluoride (mg/L)	total suspended solids
NP-3	1/26/1982							<0.005			<0.05	<0.1	<0.001	0.7	<0.1				<0.005						8.10		400			0.20	<0.01							30	151	1.0	
NP-3	2/22/1982							<0.005			<0.05	0.14	<0.001	0.66	<0.05				<0.005						8.00		420			<0.2	<0.01							28	137	0.9	
NP-3	4/26/1982							<0.005			<0.05	0.24	<0.001	0.4	<0.05				<0.005						7.90		410			<0.2	<0.01							28	146	0.8	
NP-3	5/24/1982											<0.1		0.053																											
NP-3	5/28/1982											<0.1		0.063																											
NP-3	6/8/1982							<0.005			<0.05	<0.1	<0.001	0.1	<0.05				<0.005						7.90		500			1.90	<0.01							30	150	0.5	
NP-3	6/30/1982							<0.005			<0.05	<0.1	<0.001	0.081	<0.05				<0.005						7.90		510			1.80	<0.01							26	128	0.5	
NP-3	9/2/1982							<0.001						<0.05	<0.01				<0.005						7.50	750	498			1.94		77	15	64	3.9		308	28	124	0.5	
NP-3	10/27/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.00		450			1.60	<0.01							26	132	0.6	
NP-3	2/21/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.20		410			1.40	<0.01							26	131	0.5	
NP-3	5/13/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.00		500			2.10	<0.01							64	139	0.5	
NP-3	8/9/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.80		630			2.30	<0.01							114	100	0.5	
NP-3	11/1/1983							<0.005			<0.05	0.14	<0.001	<0.05	<0.05				<0.005						7.90		760			3.80	<0.01							162	163	0.5	
NP-3	3/16/1984							<0.005			<0.05	<0.1	0.001	<0.05	<0.05				<0.005						8.10		870			3.20	<0.01							228	216	0.6	
NP-3	5/30/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.80		1060			2.90	<0.01							248	292	0.4	
NP-3	9/12/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.70		1140			3.10	<0.01							270	292	0.4	
NP-3	11/27/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.80		1150			3.50	<0.01							290	348	0.4	
NP-3	5/17/1985																								7.70		1470											310	453		
NP-3	11/13/1985																								7.20		1520											288	541		
NP-3	5/23/1986																								7.50		1590											282	624		
NP-3	10/8/1986																								7.40		1710											272	620		
NP-3	3/3/1987																																						695		
NP-3	3/4/1987																								6.80	1850	1882					320	67	117	4.29		188	283	695		
NP-3	5/25/1987																																						736		
NP-3	1/12/1988	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1		0.57	<0.1	<0.1	<0.1						1.10				1584					268	57	142	38		30	359	755		
NP-3	4/4/1988																										1772											254	587		
NP-3	8/23/1988																										1744											251	835		
NP-3	2/9/1989																										1583											254	763		
NP-3	6/1/1989																										1596											241	714		
NP-3	11/30/1989																										1600											159	743		
NP-3	11/14/1990																										1675											229	822		
NP-3	2/11/1991			<0.001																							1551											256	971		
NP-3	7/19/1991	<0.02		<0.002	<0.01			<0.005		<0.02	<0.02	0.28	0.0002	0.08			<0.005		0.011						8.29	2520	1663			0.23		287	53	190	7	0	192	239	820	0.7	
NP-3	8/29/1991																								7.84		1616											254	854		
NP-3	11/26/1991																								7.08		1613											248	745		
NP-3	3/15/1992																								7.63		1644											228	921		
NP-3	5/25/1992																								7.85		1607											216	753		
NP-3	7/16/1992																								7.26		1578											226	802		
NP-3	10/8/1992																								7.69		1445											212	799		
NP-3	11/27/1992																								7.49		1640											255	796		
NP-3	12/15/1992										0.01														7.75		1558											223	545		
NP-3	2/25/1993																								7.65		1580											219	794		
NP-3	3/30/1993	<0.01	0.1	<0.005	<0.5		0.02	<0.002	<0.05	<0.02	0.01	4.99	<0.001	0.32	<0.02	<0.01	<0.02		<0.005				6.98		7.40	2070	1560				<0.01	296	35	129	4.1	0	29	205	825	0.5	
NP-3	9/28/1993										<0.001	<0.05		0.24									1.04		7.88		1544											210	619		
NP-3	3/17/1994										0.012	0.24		0.33									2.58		7.46		1609											170	747		
NP-3	6/23/1994																								7.77		1628											206	779		
NP-3	7/22/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	0.61	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			1.80		7.83	2160	1620			<1		320	73	120	4.5	0	118	194	796	0.3	
NP-3	9/22/1994																								7.65		1691											196	707		
NP-3	1/29/1995																								7.45		1623											566	652		
NP-3	3/29/1995																								7.48		1639											186	558		
NP-3	6/27/1995																								7.38		1607											203	717		
NP-3	9/21/1995																								7.50		1557											208	822		
NP-3	1/10/1996																								7.32		1464											209	724		
NP-3	4/3/1996																								7.29		1415											208	723		
NP-3	9/25/1996																								7.72		1472											191	537		
NP-3	1/15/1997																								7.51		1478											207	657		
NP-3	7/8/2010	<0.005	<0.02	<0.0010	0.03	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	0.05	<0.0002	0.031	<0.008	<0.01	<0.005	<0.001	0.023	<0.001	0.0014	<0.05	0.44		8.00	2100	1740	120		6.80		310	60	120	3.6	<2	120	270	790	0.4	100
NP-3	10/7/2010	<0.005	<0.02	<0.005	0.031	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	0.10	<0.0002	0.015	<0.008	<0.01	<0.005	<0.001	0.023	<0.001	0.0015	<0.05	0.31		7.57	2000	1660	120		5.60		290	60	110	3.5	<2	120	290	830	0.3	97

Appendix C.
Table C-3. Groundwater-quality data

sample location	analysis date	silver (mg/L)	aluminum (mg/L)	arsenic (mg/L)	barium (mg/L)	beryllium (mg/L)	boron (mg/L)	cadmium (mg/L)	cobalt (mg/L)	chromium (mg/L)	copper (mg/L)	iron (mg/L)	mercury (mg/L)	manganese (mg/L)	molybdenum (mg/L)	nickel (mg/L)	lead (mg/L)	antimony (mg/L)	selenium (mg/L)	thallium (mg/L)	uranium (mg/L)	vanadium (mg/L)	zinc (mg/L)	temperature °C	pH (std. units)	specific conductance (µS/cm)	total dissolved solids (mg/L)	total alkalinity (mg/L as CaCO3)	total acidity (mg/L as CaCO3)	nitrate as total N (mg/L)	total cyanide (mg/L)	calcium (mg/L)	magnesium (mg/L)	sodium (mg/L)	potassium (mg/L)	carbonate (mg/L)	bicarbonate (mg/L)	chloride (mg/L)	sulfate (mg/L)	fluoride (mg/L)	total suspended solids
NP-3	5/11/2011	<0.005	<0.02	0.0029	0.032	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	0.04	<0.0002	0.022	<0.008	<0.01	<0.005	<0.001	0.027	<0.001	0.0015	<0.05	0.24		7.69	2100	1640	130		6.20	<0.005	300	57	120	3.3	<2	130	270	790	0.3	400
NP-3	1/10/2013		< 0.02					< 0.002	< 0.006		0.0013								0.0061				1.85	19.50	6.36	1605	1390	54.2				218	50	107	3.23	< 2	54	190	557	< 0.1	
NP-3	4/10/2013																							18.90	6.95	2134	1340	71.4				219	48	98	3.41	<2	71	191	561		
NP-3	7/11/2013																							22.40	7.57	2077	1560	124				290	60	108	5.03	<2	124	239	686		
NP-3	10/24/2013																							19.20	7.31	1749	1550	118				238	59	109	4.56	<2	118	238	685		
NP-4	4/26/1982							<0.005			0.051	3.80	<0.001	0.6	0.07				<0.005						8.60		410			0.60	<0.01							46	132	1.5	
NP-4	5/17/1982							<0.005			<0.05	0.11	<0.001	<0.05	<0.05				<0.005						9.40		310			1.30	<0.01							46	138	1.0	
NP-4	5/24/1982											<0.1		<0.05																											
NP-4	5/28/1982											<0.1		<0.05																											
NP-4	6/8/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.40		420			4.50	<0.01							26	140	0.5	
NP-4	6/30/1982							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						9.50		270			<0.2	<0.01							28	115	0.4	
NP-4	9/2/1982							<0.001						<0.05	<0.01				<0.005						8.50	410	252			0.03		7	4	71	3.9		63	29	107	0.4	
NP-4	10/27/1982							0.0061			<0.05	0.34	<0.001	<0.05	<0.05				<0.005						8.90		230			<0.2	<0.01							36	108	0.4	
NP-4	2/21/1983							<0.005			<0.05	0.28	0.001	<0.05	<0.05				<0.005						9.30		250			0.20	<0.01							48	115	0.4	
NP-4	5/13/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.90		340			<0.2	<0.01							76	134	0.4	
NP-4	8/9/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.80		430			<0.2	<0.01							94	156	0.3	
NP-4	11/1/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.20		530			0.60	<0.01							114	206	0.3	
NP-4	3/16/1984							<0.005			<0.05	<0.1	0.001	<0.05	<0.05				<0.005						8.00		540			0.20	<0.01							126	256	0.6	
NP-4	5/30/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.00		630			<0.2	<0.01							134	320	0.3	
NP-4	9/12/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.00		760			0.90	<0.01							134	339	0.3	
NP-4	11/27/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.50		740			0.20	<0.01							140	354	0.3	
NP-4	5/17/1985																								8.20		770											146	348		
NP-4	11/13/1985																								8.00		690											142	292		
NP-4	5/23/1986																								8.00		690											136	300		
NP-4	10/8/1986																								7.80		660											134	290		
NP-4	5/25/1987																																						279		
NP-4	1/12/1988	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1		0.06	<0.1	<0.1	<0.1						0.10				612					76	21	86	5		24	137	256		
NP-4	4/4/1988																										610											130	329		
NP-4	8/23/1988																										688											132	292		
NP-4	2/9/1989																										604											130	267		
NP-4	6/1/1989																										580											116	244		
NP-4	11/30/1989																										572											97	237		
NP-4	11/14/1990																										262											153	255		
NP-4	2/11/1991			<0.001																							676											126	289		
NP-4	7/19/1991	<0.02		<0.002	0.28			<0.005		<0.02		5.14	<0.0002	<0.02			<0.005		<0.002						7.81	802	532			0.07		63	21	67	3.1	0	55	112	199	0.4	
NP-4	8/29/1991																								8.37		532											111	232		
NP-4	11/26/1991																								8.54		522											99	194		
NP-4	3/15/1992																								8.85		465											103	217		
NP-4	5/25/1992																								8.62		439											106	171		
NP-4	7/16/1992																								7.64		458											94	177		
NP-4	10/8/1992																								9.01		535											103	183		
NP-4	11/27/1992																								8.12		495											98	202		
NP-4	12/15/1992																								9.52		424											84	151		
NP-4	2/25/1993																								9.85		349											77	151		
NP-4	3/31/1993	<0.01	0.3	<0.005	<0.5		0.04	<0.002	<0.05	<0.02	0.01	0.62	0.009	0.84	<0.02	<0.01	<0.02		<0.005				2.41		7.60	813	504	230		3.70	<0.01	76	17	79	2.2	0	275	45	134	0.5	
NP-4	9/28/1993																								8.20		437											57	109		
NP-4	5/26/1994	<0.025	3.5	<0.005	<0.1			0.0034		<0.025	<0.025	15.00	<0.001	0.16		<0.05	0.018	<0.005	<0.005				12.00		8.10	800	666			4.30		73	15	62	3	0	320	39	131	0.5	
NP-4	6/23/1994																								8.13		498											49	134		
NP-4	7/23/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	0.01	<0.005	<0.005			0.51		7.90	828	536			4.60		88	16	72	2.5	0	279	34	120	0.5	
NP-4	9/22/1994																								7.73		547											37	111		
NP-4	1/29/1995																								7.88		447											35	111		
NP-4	3/29/1995																								7.86		494											34	122		
NP-4	6/27/1995																								7.37		487											33	134		
NP-4	9/21/1995																								7.51		509											35	132		
NP-4	1/10/1996																								7.35		483											35	123		
NP-4	4/3/1996																								7.19		475											26	123		
NP-4	9/25/1996																								7.75		504											32	126		
NP-4	1/15/1997																								7.43		2651											98	1,113		

Appendix C.
Table C-3. Groundwater-quality data

sample location	analysis date	silver (mg/L)	aluminum (mg/L)	arsenic (mg/L)	barium (mg/L)	beryllium (mg/L)	boron (mg/L)	cadmium (mg/L)	cobalt (mg/L)	chromium (mg/L)	copper (mg/L)	iron (mg/L)	mercury (mg/L)	manganese (mg/L)	molybdenum (mg/L)	nickel (mg/L)	lead (mg/L)	antimony (mg/L)	selenium (mg/L)	thallium (mg/L)	uranium (mg/L)	vanadium (mg/L)	zinc (mg/L)	temperature °C	pH (std. units)	specific conductance (µS/cm)	total dissolved solids (mg/L)	total alkalinity (mg/L as CaCO3)	total acidity (mg/L as CaCO3)	nitrate as total N (mg/L)	total cyanide (mg/L)	calcium (mg/L)	magnesium (mg/L)	sodium (mg/L)	potassium (mg/L)	carbonate (mg/L)	bicarbonate (mg/L)	chloride (mg/L)	sulfate (mg/L)	fluoride (mg/L)	total suspended solids
NP-4	1/31/2010	<0.005	<0.02	<0.0025	0.036	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	0.04	<0.0002	0.0098	<0.008	<0.01	<0.005	<0.0025	0.0057	<0.0025			1.30		8.00	900	626	210		7.40	<0.005	100	18	79	2.4	<2	210	40	190	0.5	
NP-4	7/2/2010	<0.005	<0.02	<0.001	0.039	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	0.002	<0.008	<0.01	<0.005	<0.001	0.0043	<0.001	0.0023	<0.05	0.82		8.00	910	640	210		7.50		110	18	70	2.1	<2	210	39	190	0.5	140
NP-5	11/4/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	0.1	<0.05	<0.05	<0.02		<0.005				0.14		8.00		570			4.10	<0.01	86						50	196	1.3	
NP-5	11/13/1981	<0.001	0.239	<0.005	0.218		0.07	<0.001		<0.005	<0.1		<0.0005	0.14	0.015	0.019	<0.005		0.014				<0.05		7.70	650	488			3.56	0.001	89	14	44	5.07		187	38	162	1.3	
NP-5	11/17/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	0.3	0.07	<0.05	<0.02		<0.005				0.19		8.00		500			2.70	<0.01	72						42	158	1.3	
NP-5	11/23/1981	<0.1	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.02	<0.05	<0.1	<0.001	0.091	<0.05	<0.05	<0.02		<0.005				0.21		7.80		580			4.00	<0.01	73						36	161	1.2	
NP-5	12/7/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.24		7.90		510			3.10	<0.01	66						34	172	1.2	
NP-5	12/15/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	0.08	<0.05	<0.05	<0.02		<0.005				0.37		7.80		500			3.30	<0.01	90						36	168	1.2	
NP-5	12/22/1981	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	<0.1	<0.001	<0.05	<0.05	<0.05	<0.02		<0.005				0.32		7.90		460			3.80	<0.01	101						36	161	1.1	
NP-5	1/5/1982	<0.02	<0.01	<0.01	<0.2		<0.1	<0.005	<0.02	<0.01	<0.05	0.18	<0.001	<0.05	<0.05	<0.05	<0.02		<0.02				0.40		7.70		420			4.10	<0.01	87						34	163	1.1	
NP-5	1/26/1982							<0.005			<0.05	<0.01	<0.001	<0.05	<0.1				<0.005						8.00		440			2.90	<0.01							32	158	1.1	
NP-5	2/22/1982							<0.005			<0.05	0.12	<0.001	<0.05	<0.05				<0.005						8.00		450			2.00	<0.01							32	150	1.0	
NP-5	4/26/1982							<0.005			0.31	3.80	<0.001	6.9	<0.05				<0.005						7.90		450			1.10	0.04							30	154	1.1	
NP-5	5/17/1982							<0.005			<0.05	0.14	<0.001	<0.05	<0.05				<0.005						8.00		490			6.70	<0.01							36	165	1.1	
NP-5	5/24/1982											<0.1		<0.05																											
NP-5	5/28/1982											<0.1		<0.05																											
NP-5	6/8/1982							<0.005			<0.05	0.44	<0.001	<0.05	<0.05				<0.005						8.10		420			4.50	<0.01							30	150	0.9	
NP-5	6/30/1982							<0.005			<0.05	0.36	<0.001	<0.05	<0.05				<0.005						8.10		460			3.90	<0.01							28	133	0.9	
NP-5	9/2/1982							<0.001						<0.05	<0.01				<0.005						7.60	650	472			4.20		73	22	46	3.9		206	34	137	0.8	
NP-5	10/27/1982							<0.005			<0.05	0.21	<0.001	<0.05	<0.05				<0.005						8.00		440			3.70	<0.01							34	139	0.8	
NP-5	2/21/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.30		420			1.30	<0.01							26	139	0.5	
NP-5	5/13/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.90		290			0.20	<0.01							70	134	0.4	
NP-5	8/9/1983							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.10		460			3.70	<0.01							26	108	0.8	
NP-5	11/1/1983							<0.005			<0.05	0.10	<0.001	<0.05	<0.05				<0.005						8.20		440			5.20	<0.01							30	111	0.8	
NP-5	3/16/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.00		380			3.00	<0.01							26	130	0.4	
NP-5	5/30/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						7.80		400			2.90	<0.01							22	139	0.8	
NP-5	9/12/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.00		420			3.40	<0.01							28	125	0.8	
NP-5	11/27/1984							<0.005			<0.05	<0.1	<0.001	<0.05	<0.05				<0.005						8.20		420			3.20	<0.01							28	120	0.8	
NP-5	5/17/1985																								7.90		450											28	130		
NP-5	11/13/1985																								7.80		400											24	134		
NP-5	5/23/1986																								7.90		430											28	120		
NP-5	10/8/1986																								7.80		420											28	113		
NP-5	3/30/1989	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1		<0.05	<0.1	<0.1	<0.1						0.40				458					82	22	39	3		211	32	125		
NP-5	8/29/1991																								7.68		499											39	152		
NP-5	11/26/1991																								7.00		472											38	130		
NP-5	3/15/1992																								7.89		456											47	141		
NP-5	5/25/1992																								7.80		490											76	131		
NP-5	7/16/1992																								7.63		476											38	132		
NP-5	10/8/1992																								7.64		431											39	133		
NP-5	11/27/1992																								8.01		475											117	134		
NP-5	12/15/1992										0.025														7.80		402											40	104		
NP-5	2/25/1993																								7.65		487											41	141		
NP-5	3/30/1993	<0.01	0.2	<0.005	<0.5		0.04	<0.002	<0.05	<0.02	<0.01	0.29	<0.001	0.02	<0.02	<0.01	<0.02		<0.005				0.19		7.80	746	488	200		4.00	<0.01	76	26	43	2.5	0	221	39	146	0.8	
NP-5	9/28/1993																								7.79		518											48	109		
NP-5	5/24/1994	<0.025	1.1	<0.005	<0.1			<0.0005		<0.025	<0.025	1.20	<0.001	0.086		<0.05	0.0077	<0.005	<0.005				2.30		7.84	680	520			3.40		86	26	40	3.4	0	211	41	130	0.7	
NP-5	6/23/1994																								7.66		466											54	142		
NP-5	7/23/1994	<0.025	<0.05	<0.005	<0.1	<0.002	<0.1	<0.0005	<0.05	<0.025	<0.025	<0.05	<0.001	<0.03	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.05		7.89	749	494			3.30		79	24	45	3.1	0	206	41	131	0.7	
NP-5	9/22/1994																								7.73		526											43	118		
NP-5	1/29/1995																								7.99		490											44	101		
NP-5	3/29/1995																								7.94		449											42	131		
NP-5	6/27/1995																								7.64		525											43	119		
NP-5	9/21/1995																								7.71		483											44	135		
NP-5	1/10/1996																								8.04		406											42	137		
NP-5	4/3/1996																								7.67		405											32	130		
NP-5	9/25/1996																								8.09		504											43	129		
NP-5	1/15/1997																								7.76		498											46	141		
NP-5	6/28/2010	<0.005	<0.02	0.0014	0.018	<0.002	<0.04	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.001	0.0067	<0.001	0.0013	<0.05	0.29		8.00	900	623	160		3.90		100	31	44	2.9	<2	160	80	180	0.7	23
NP-5	9/30/2010	<0.005	<0.02	0.0015	0.018	<0.002	0.041	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	0.005	<0.008	<0.01	<0.005	<0.001	0.0079	<0.001	0.0013	<0.05	0.20		7.72	910	629	170		4.00	<0.01	99	33	46	2.8	<2	170	83	170	0.7	31

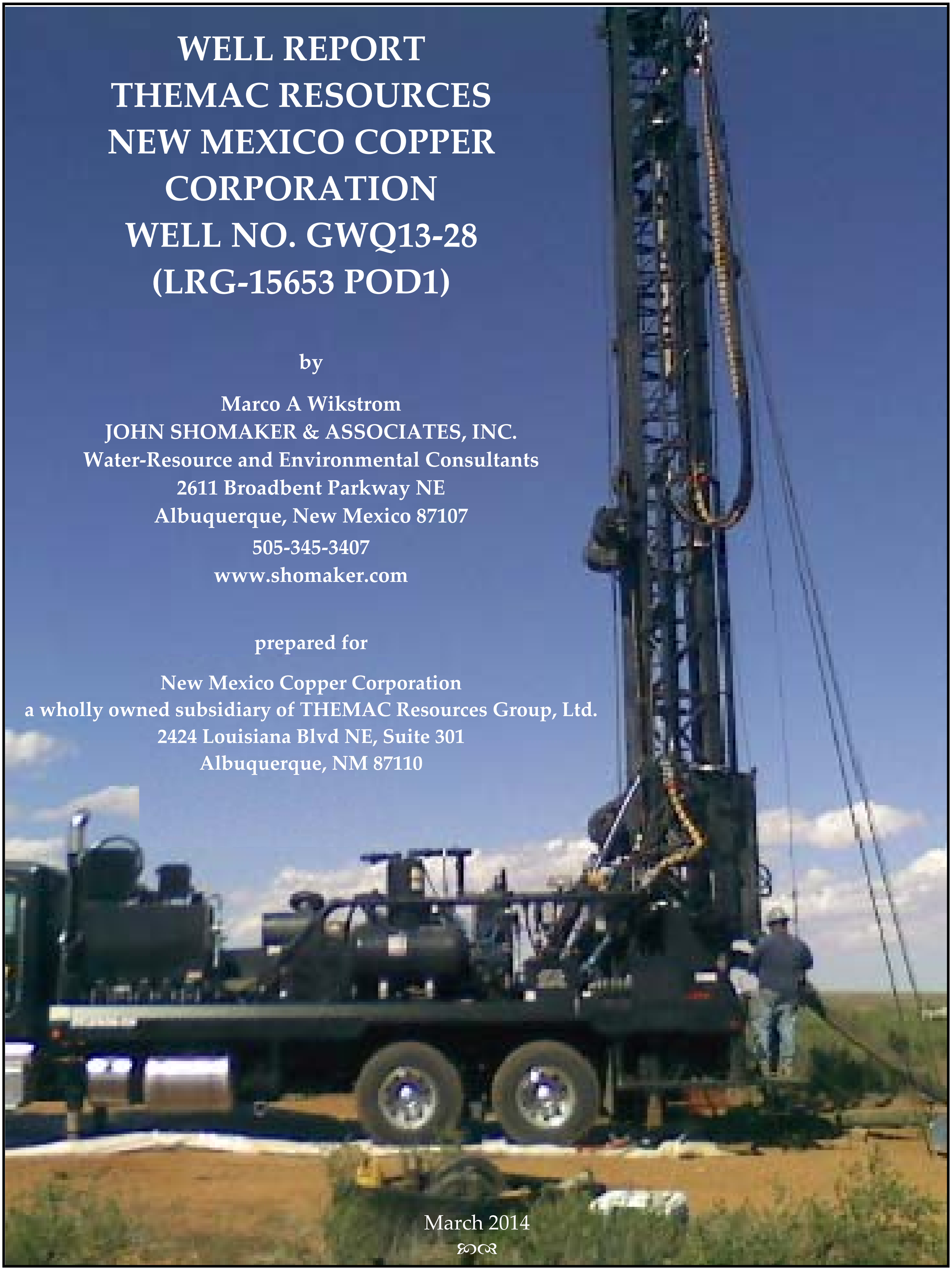
Appendix C.
Table C-3. Groundwater-quality data

sample location	analysis date	silver (mg/L)	aluminum (mg/L)	arsenic (mg/L)	barium (mg/L)	beryllium (mg/L)	boron (mg/L)	cadmium (mg/L)	cobalt (mg/L)	chromium (mg/L)	copper (mg/L)	iron (mg/L)	mercury (mg/L)	manganese (mg/L)	molybdenum (mg/L)	nickel (mg/L)	lead (mg/L)	antimony (mg/L)	selenium (mg/L)	thallium (mg/L)	uranium (mg/L)	vanadium (mg/L)	zinc (mg/L)	temperature °C	pH (std. units)	specific conductance (µS/cm)	total dissolved solids (mg/L)	total alkalinity (mg/L as CaCO3)	total acidity (mg/L as CaCO3)	nitrate as total N (mg/L)	total cyanide (mg/L)	calcium (mg/L)	magnesium (mg/L)	sodium (mg/L)	potassium (mg/L)	carbonate (mg/L)	bicarbonate (mg/L)	chloride (mg/L)	sulfate (mg/L)	fluoride (mg/L)	total suspended solids
NP-5	5/10/2011	<0.005	<0.02	0.0018	0.019	<0.002	0.042	<0.002	<0.006	<0.006	<0.006	<0.02	<0.0002	<0.002	<0.008	<0.01	<0.005	<0.001	0.0076	<0.001	0.0013	<0.05	0.26		7.76	940	636	160		4.10	<0.01	100	32	45	2.9	<2	160	79	180	0.6	130
GWQ11-24A	1/8/2013		38.0					0.181	0.256		104								0.0294				5.72	18.0	4.08	2807	4180	< 20				464	108	129	7.0	< 2	< 20	30	2550	17.4	
GWQ11-24A	4/11/2013		46.0					0.206	0.290		126			11.4					0.0350				6.32	18.6	4.48	3662	4320	<20				468	110	126	<10	<2	<20	30	2730	22.9	
GWQ11-24A	7/9/2013		53.9					0.199	0.302		129			12.6					0.0566				8.18	20.9	3.72	3677	4400	<20	665			415	110	121	7.1	<2	<20	30	2720	24.4	
GWQ11-24A	10/22/2013		56.6					0.256	0.439		137			13.7					<0.050				8.65	18.8	4.21	3700	4280	<20	673			540	142	160	<50	<2	<20	28	2570	23.7	
GWQ11-24B	1/9/2013		< 0.02					< 0.002	0.011		< 0.001								< 0.001				0.05	18.0	6.72	1904	2280	219				417	75.9	95.7	6.2	< 2	219	27	1280	3.4	
GWQ11-24B	4/8/2013		<0.02					<0.002	0.019		<0.006			3.54					<0.005				0.23	20.1	6.18	2470	2440	189				469	77.7	91.4	5.8	<2	189	28	1510	4.0	
GWQ11-24B	7/9/2013		0.02					<0.002	0.017		<0.006			3.30					0.0039				0.22	23.0	6.29	2409	2350	181	79			393	74.5	91.2	6.4	<2	181	28	1360	4.3	
GWQ11-24B	10/22/2013		<0.02					<0.002	0.021		<0.006			3.58					<0.0050				0.23	22.3	6.55	2770	2690	176	96			490	88.4	97.7	6.3	<2	176	26	1480	3.6	
GWQ11-25A	1/9/2013		414					0.385	1.72		12.6								0.087				14.9	16.5	3.63	6410	11300	< 20				419	149	647	< 100	< 2	< 20	21	7900	124	
GWQ11-25A	4/9/2013		1730					0.656	3.91		63.9			77.5					<0.5				42.1	14.4	3.30	10120	23800	<20				556	<500	<500	<500	<2	<20	11	17400	324	
GWQ11-25A	7/10/2013		1600					<1.000	4.67		60.4			78.3					<0.5				41.4	19.6	2.12	12210	27700	<20	14800			<500	<500	<500	<500	<2	<20	10	17900	221	
GWQ11-25A	10/22/2013		1460					0.399	3.12		48.6			61.9					<0.5				30.3	19.3	2.53	11510	23500	<20	14100			<500	<500	<500	<500	<2	<20	11	15200	311	
GWQ11-25B	1/9/2013		0.336					< 0.002	< 0.006		0.0015								0.0016				0.02	19.8	6.28	2390	2540	343				493	76.2	139	3.9	< 2	343	27	1400	8.0	
GWQ11-25B	4/8/2013		0.383					<0.002	<0.006		<0.006			3.3					0.0017				0.02	21.0	6.54	2722	2530	339				465	80.6	128	4.4	<2	339	27	1470	8.1	
GWQ11-25B	7/10/2013		0.364					<0.002	<0.006		<0.006			3.0					0.0053				0.03	21.4	6.25	2647	2510	342	76			441	67.5	125	3.8	<2	342	27	1350	8.8	
GWQ11-25B	10/22/2013		0.149					<0.002	0.0076		<0.006			3.46					<0.005				0.026	20.1	6.74	2810	2580	376	105			524	76	133	4.2	<2	376	27	1260	6.8	
GWQ11-26	1/8/2013		0.0313					< 0.002	< 0.006		0.0027								0.0015				< 0.01	17.4	6.81	735	654	361				96	22	72	1.3	< 2	361	14	96.5	< 1.0	
GWQ11-26	4/9/2013		<0.02					< 0.002	< 0.006		<0.006			0.0194					0.0018				<0.01	18.5	7.05	891	582	354				93	23	68	1.7	<2	354	16	98.2	0.4	
GWQ11-26	7/9/2013		0.153					<0.002	<0.006		<0.006			0.0437					0.0033				0.013	19.4	6.94	910	317	361				97	21	72	1.7	<2	361	16	97.9	0.5	
GWQ11-26	10/22/2013		0.133					<0.002	<0.006		<0.006			0.0168					0.0062				<0.01	18.5	7.45	1013	905	330	10			121	27	86	1.5	<2	330	32	179	0.4	
GWQ-5R	1/10/2013		< 0.02					< 0.002	< 0.006		< 0.001								< 0.001				0.011	16.4	7.21	624	504	293				97	23	34	5.2	< 2	293	17	97	1.3	
GWQ-5R	4/9/2013																							19.0	7.12	771	500	285				87	20	31	4.63	<2	285	17	101		
GWQ-5R	7/9/2013																							22.9	6.89	781	496	281				99	22	32	4.76	<2	281	18	97		
GWQ-5R	10/23/2013																							20.7	7.39	669	518	282				96	23	34	4.32	<2	282	18	102		
GWQ13-28	10/23/2013																							21.50	7.62	783	629	185				98	17	67	2.91	<2	185	52	167		

Appendix D.

Well completion report for GWQ13-28
and
Geotechnical drilling below TSF

Well completion report for GWQ13-28



WELL REPORT
THEMAC RESOURCES NEW MEXICO COPPER CORPORATION
WELL NO. GWQ13-28
(LRG-15653 POD1)

by

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prepared for

New Mexico Copper Corporation
a wholly owned subsidiary of THEMAC Resources Group, Ltd.
2424 Louisiana Blvd NE, Suite 301
Albuquerque, NM 87110

March 2014

WELL REPORT
THEMAC RESOURCES
NEW MEXICO COPPER CORPORATION
WELL NO. GWQ13-28 (LRG-15653 POD1)

by

Marco A Wikstrom

JOHN SHOMAKER & ASSOCIATES, INC.
Water-Resource and Environmental Consultants
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Albuquerque, NM 87110

March 2014

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THEMAC RESOURCES WELL REPORT, NEW MEXICO COPPER CORPORATION WELL NO. GWQ13-28 (LRG-15653 POD1)

1.0 INTRODUCTION

This report summarizes the construction of New Mexico Copper Corporation (NMCC) Well No. GWQ13-28 (New Mexico Office of the State Engineer No. LRG-15653 POD1). This well was constructed for NMCC by Yellow Jacket Drilling Services of Phoenix, Arizona. Well No. GWQ13-28 is a monitoring well that was constructed for the purpose of further characterization of water quality at the Copper Flat site. A second well, east of GWQ13-28 was planned, but never built because water quality in GWQ13-28 reflected low concentrations of sulfate, and is likely outside the area of high sulfate concentration that is evident in wells near the tailings dam to the west. The decision not to build a second well was based on field test results of specific conductance and sulfate concentration.

Monitoring Well No. GWQ13-28 is located east of the tailings dam area. Geographic location is Universal Transverse Mercator (UTM), Zone 13, 267100 meters east, 3649708 meters north, North American Datum 1983. A map showing the location of Well No. GWQ13-28 is presented as Figure 1. John Shomaker and Associates, Inc. (JSAI) personnel were present during all of the drilling, logging, and most of the construction, and development of NMCC Well No. GWQ13-28. The New Mexico Office of the State Engineer (NMOSE) permit to drill the monitoring well (LRG-15653 POD1) is presented in Appendix 1. The well completion report filed by the contractor with the NMOSE is presented in Appendix 2.

2.0 SUMMARY, WELL NO. GWQ13-28

(all depths in feet below ground level, rounded to the nearest foot)

Start of Drilling:		October 9, 2013
Demobilize:		October 13-14, 2013
		ft
Borehole Depth:		
	10-in. diameter	198
Pipe Depths:		
	4.5-in. OD, 4-in. ID monitoring well casing:	
	blank, PVC Schedule 40, with threaded O-ring connections	+2.5 to 150
	screen, PVC Schedule 40, 0.020-in. machine-slot with threaded O-ring connections	150 to 190
Log:	lithologic log, JSAI	0 to 198
Gravel Pack:	Colorado Silica Sand, 10-20 gradation	140 to 198
Annular Seals:		
	neat cement grout around blank casing	2.5 to 120
	bentonite seal above gravel pack	120 to 140
Surface Completion:		
	8-5/8-in. diameter lockable well vault	+3 to 2
	1/4-in. pea gravel	0 to 2.5
	4-ft diameter 6-in.-thick concrete pad	+4 in. to 2 in.

3.0 WELL HISTORY, WELL NO. GWQ13-28

The sequence of activities during the drilling and construction of Well No. GWQ13-28 is summarized as follows:

2013

Oct. 9	Mobilize drilling rig and equipment
Oct. 9	Begin drilling 10-in. borehole
Oct. 10	Finish drilling 10-in. borehole
Oct. 10	Install 4-in. diameter casing and screen
Oct. 10 to 13	Install annular materials
Oct. 10	Development by bailing
Oct. 13	Surface completion
Oct. 13 to 14	Demobilize drilling rig and equipment

4.0 DRILLING AND CASING

The borehole for Well No. GWQ13-28 was drilled between October 9 and 10, 2013. The borehole was drilled using reverse air-rotary casing advance method, utilizing a Star 50K-CH drilling rig to a total depth (TD) of 198 ft bgl. The well was completed to a depth of 190 ft bgl. No drilling fluids were used, only compressed air.

Drilling was accomplished in a single pass using a 10-in. under-reamer while advancing a 9-3/4-in. outside diameter (OD) temporary casing. Use of casing advance methods was due to site lithology consisting of sand with cobbles and boulders. Drilling in these conditions with conventional methods tends to have a high risk of failure.

Compressed air was used instead of fluids or foam to avoid introduction of foreign materials into the borehole and to accurately gauge depth to water. Temporary casing was used as a tremie and then removed by hydraulic jacking during placement of annular materials. All downhole equipment including temporary casing were cleaned by steam cleaning prior to commencement of drilling, and again after completion of the well.

Well casing was installed on October 10, 2013, and consists of new 4-1/2-in. OD schedule-40 PVC threaded with O-ring seals at each joint. Screened sections have 0.020-in. factory-machined slots. All casing and screen sections were removed from original factory packaging immediately prior to installation. Stainless-steel centralizers were clamped to the bottom, middle, and top of the screened interval, and one centralizer was clamped to the blank casing near the top of the grout seal to more effectively seal the well from intrusion of contaminants.

5.0 LITHOLOGY

The borehole for well No. GWQ13-28 was drilled to a total depth of 198 ft bgl into basin-fill strata consisting of cobbles and boulders with a matrix of very fine to coarse sand, silt, and poorly-consolidated sandstone from the surface to 190 ft bgl, and coarse sand and fine gravel from 190 to 198 ft bgl. Drill cuttings were collected by the contractor every 5 ft at the discharge point above the cuttings hopper. JSAI described the samples during drilling and constructed a chipboard of drill cuttings from the surface to 198 ft bgl (Fig. 3). Cuttings became moist at around 156 ft bgl, and discharge was wet at 176 ft bgl. Upon well installation water level stabilized at 154 ft bgl. A summarized description of the lithology is presented as Table 1, and complete field lithologic descriptions are presented as Appendix 3.

Table 1. Summary of lithology of New Mexico Copper Corporation Well No. GWQ13-28

depth (ft bgl)	description of cuttings
0-5	<u>Silt with sand, gravel, and cobbles</u>; yellowish tan color, 60%. Sand is yellowish-tan color, fine to coarse, rounded to sub-angular, 20%. Gravel is sub-anglular soft sandstone and hard angular shards of volcanoclastic cobbles composed mostly of andesite and/or basalt. Sandstone gravel has a strong reaction to dilute hydrochloric acid (HCl).
5-10	<u>Rock shards and gravel with sand;</u> gray, angular, and composed of andesite and/or basalt cobbles, shards up to 30mm, 70%. Coarse sand is rounded to angular, mostly gray, various lithology.
10-190	<u>Intervals of rock shards, gravel, sand, and silt;</u> rock shards are angular, gray, and composed of andesite and/or basalt. Sand and silt is grayish-tan, angular to rounded, and composed of various lithologies and rock dust from drilling through cobbles and boulders. Sand and trace sandstone with weak calcarious cement reacts to dilute HCl, grayish-tan color.
190-198	<u>Sand with fine gravel;</u> coarse, rounded to angular, various colors and lithology, no reaction to dilute HCl, 80%. Gravel is gray, angular, and is granular size. Sand and gravel grade into each other.

ft bgl - feet below ground level

6.0 WELL CONSTRUCTION

Construction of Well No. GWQ13-28 began on October 10, 2013 with the installation of 4-in. ID PVC monitor well casing. A well completion diagram is presented as Figure 2. String weight and smoothness of descent were observed for the installation of each joint, and at no time was the casing string put under compression. The casing including end cap was landed at 190 ft bgl as per specifications and site conditions. The screen interval for Well No. GWQ13-28 was placed from 150 to 190 ft bgl based on site conditions. When the full 4-in. casing string was installed in the borehole it was suspended by cable or clamp and thus held in suspension throughout gravel packing and annular seal placement to keep the screen section at the designated interval and to prevent compression of the screen. Stainless-steel centralizers were clamped to the bottom, middle, and top of the screened interval during installation, and one centralizer was clamped to the blank casing at approximately 5 ft bgl.

Colorado Silica Sand of 10-20 gradation was installed in the annulus on October 10, 2013 from 140 ft bgl to 198 ft bgl. The gravel pack was placed in the annulus through the temporary casing, and the temporary casing was continually raised above the level of the gravel as it was added. The total gravel volume installed in the borehole was 100 percent of the theoretical annular volume calculated for the borehole diameter and casing volume. Fifty-three 50-pound sacks of gravel pack, or 21.5 cubic ft, were installed, and the theoretical borehole volume was 21.5 cubic ft. No obvious gaps or bridging were evident during gravel pack installation.

A bentonite plug was placed above the filter gravel from 120 to 140 ft bgl. Fourteen 5-gallon buckets of PDS 1/4-in. TR-30 PEL PLUG bentonite pellets were placed through the temporary casing and hydrated with municipal water obtained from the City of Truth or Consequences, New Mexico. Between October 11 and 13, 2013, approximately 70 cubic ft of neat cement grout were pumped into the annulus through the temporary casing from 120 ft bgl to 2.5 ft bgl. Because of pressure and temperature limitations of schedule 40 PVC, to prevent collapse the neat cement grout was installed in four lifts. The installed cement weighed between approximately 13.5 and 14 lbs/gal. Municipal utility water was used to mix the cement grout that was obtained from the City of Truth or Consequences, New Mexico. From 2.5 ft bgl to surface 1/4-in. pea gravel was placed into the annular space.

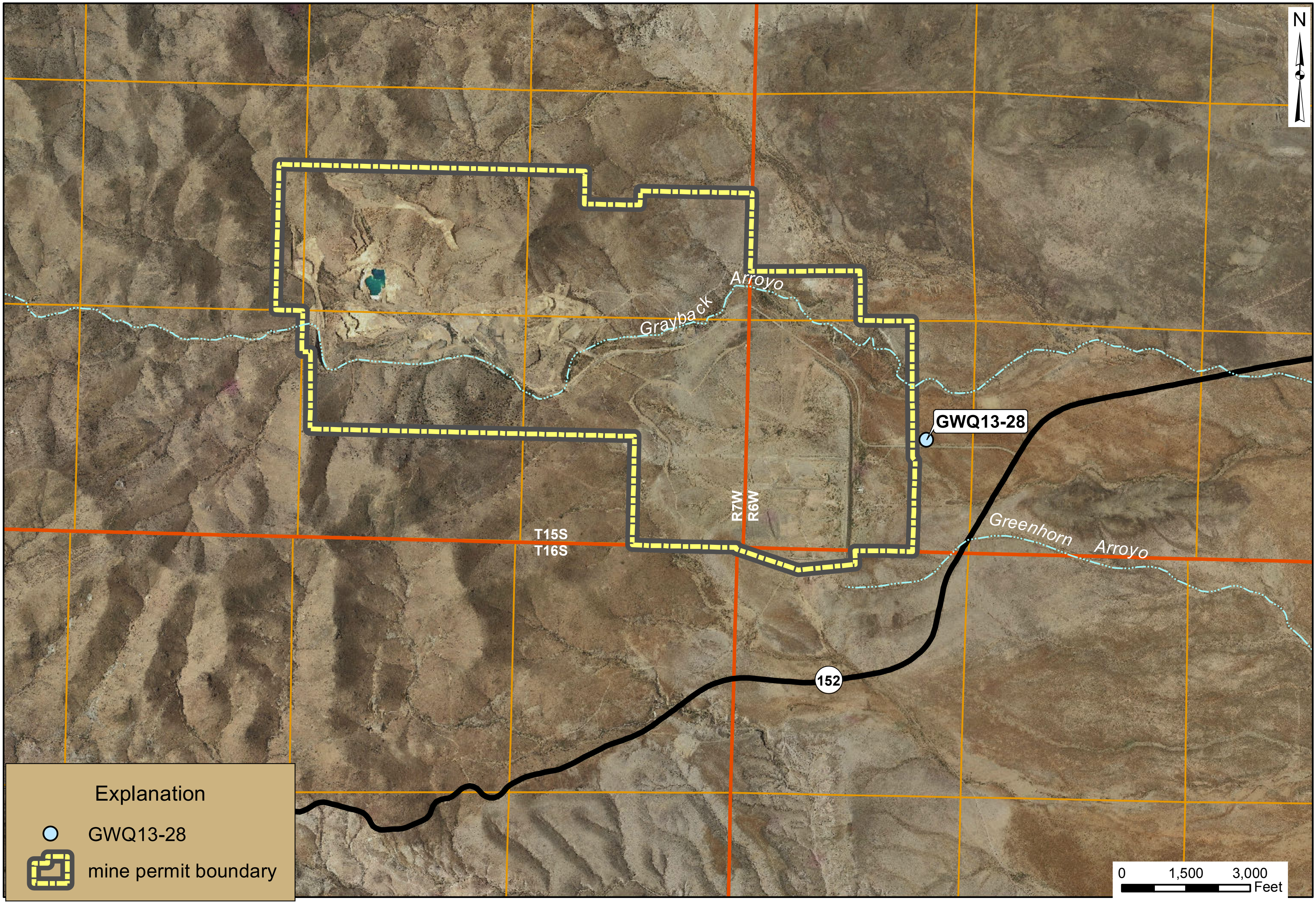
A locking 8-5/8-in. diameter well vault was installed from below ground level to 3 ft above ground level and painted yellow. A concrete pad 4 ft in diameter and 6 in. thick was installed around the well vault. The top of the PVC casing was cut to approximately 2.5 ft above ground level and a well cap with a rubber gasket was installed. A padlock was used to secure the well vault.

7.0 DEVELOPMENT AND WATER QUALITY

Development consisted of surging and bailing with a 10-gallon capacity steel bailer for approximately 5 hours. Purged water cleared while bailing and sand content was monitored with an Imhoff cone. No sand or silt were evident by the end of bailing. Further development was conducted by pumping before the well was sampled on October 23, 2013.

Specific conductance during development and subsequent sampling of Well No. GWQ13-28 ranged between 783 and 901 microSiemens per centimeter (µS/cm). At the end of bailing, a field kit was used to test the concentration of sulfate. The field kit indicated a sulfate concentration of equal or less than 200 milligrams per liter (mg/L). Specific conductance and sulfate concentration from field testing were used to make a decision not to drill the second well east of GWQ13-28, since GWQ13-28 appeared to lie outside the sulfate-impacted area of the tailings dam.

ILLUSTRATIONS



March 12, 2014

Figure 1. Aerial photograph showing the location of GWQ13-28, Copper Flat Mine, Sierra County, New Mexico.

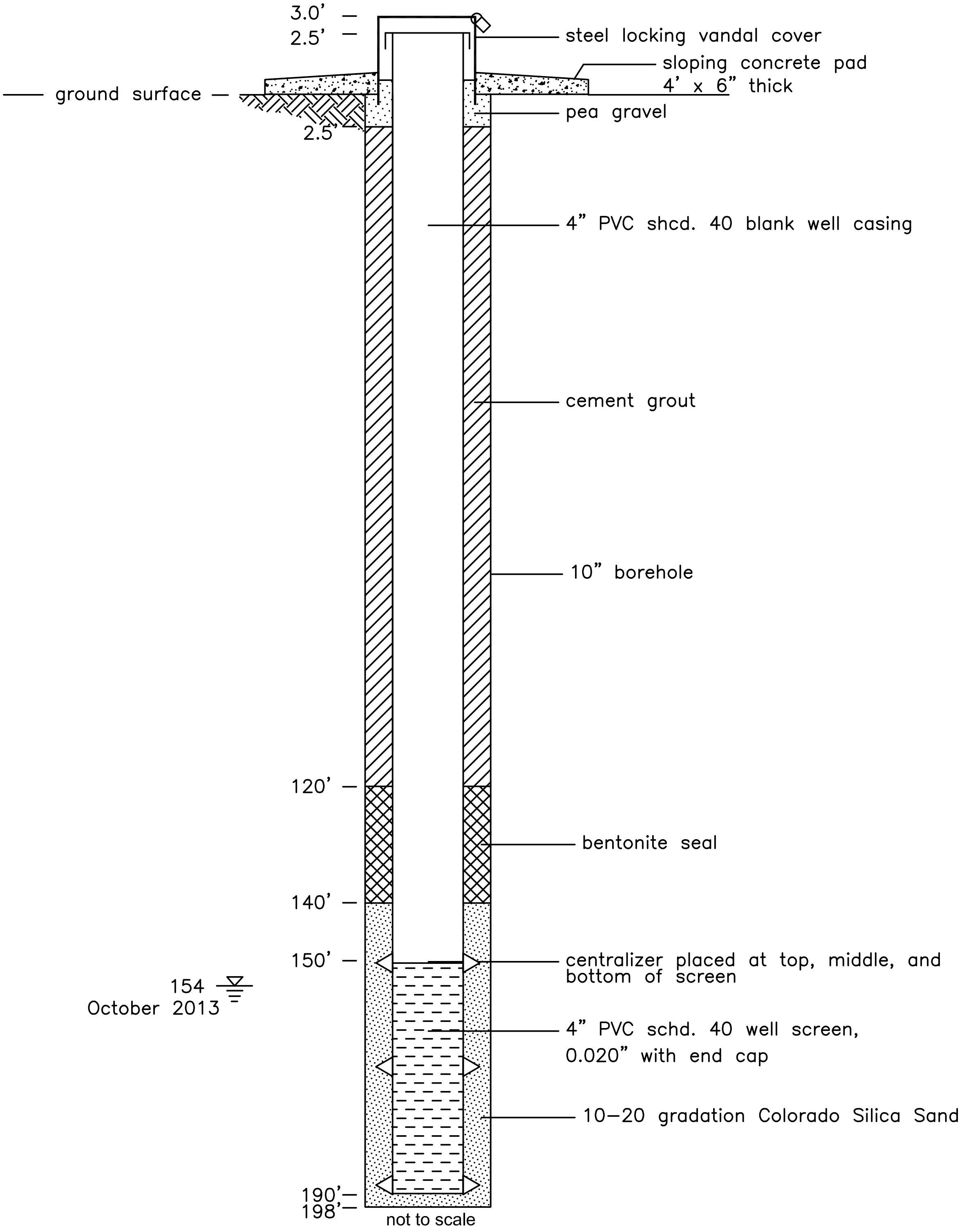
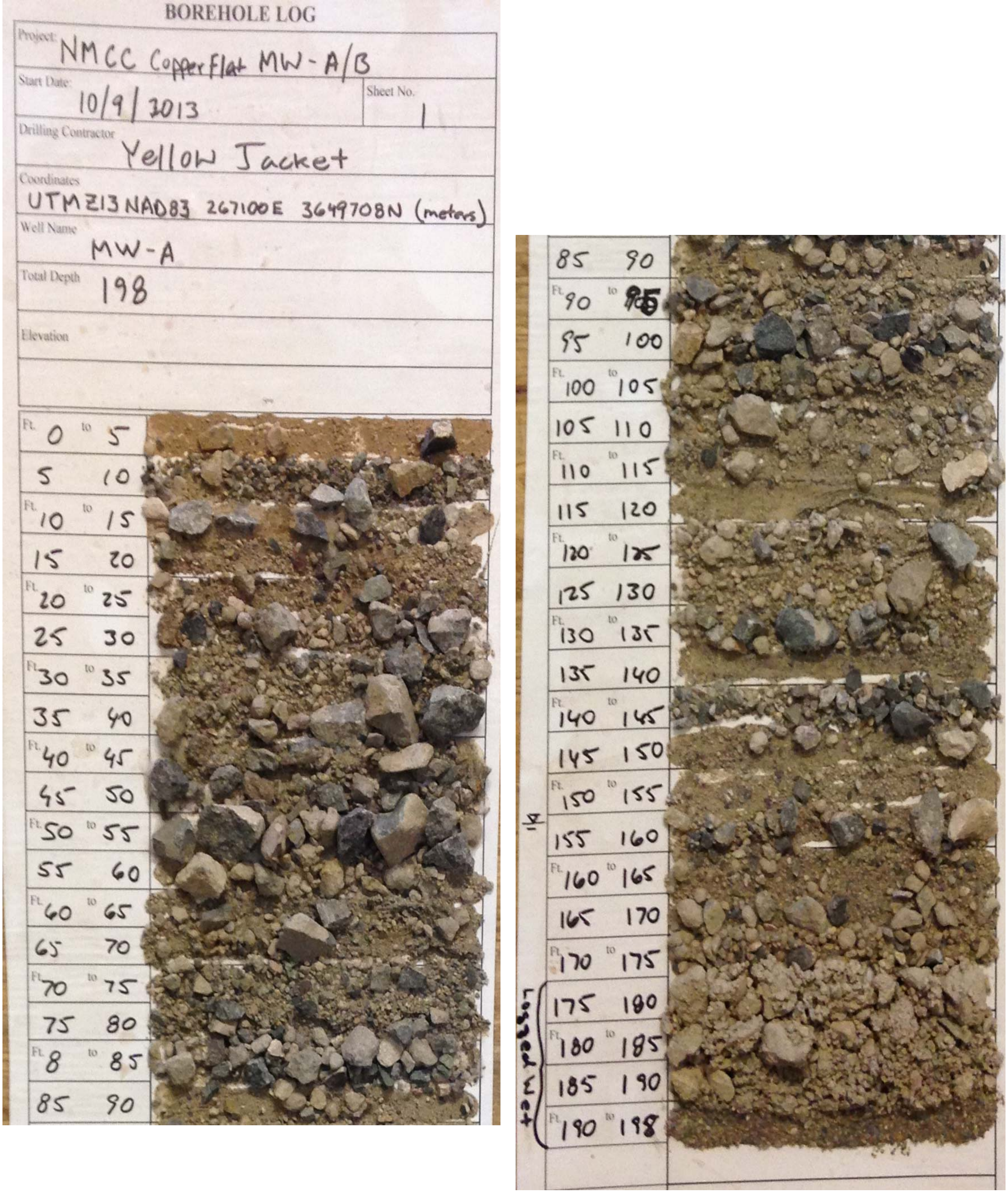


Figure 2. Well completion diagram for monitoring well GWQ13-28, LRG-15653 POD1, completed Octover 13, 2013.



BOREHOLE LOG

Project: NMCC Copper Flat MW-A/B

Start Date: 10/9/2013

Sheet No. 1

Drilling Contractor: Yellow Jacket

Coordinates: UTM Z13 NAD83 267100E 3649708N (meters)

Well Name: MW-A

Total Depth: 198

Elevation:

Ft. 0	to 5
5	10
Ft. 10	to 15
15	20
Ft. 20	to 25
25	30
Ft. 30	to 35
35	40
Ft. 40	to 45
45	50
Ft. 50	to 55
55	60
Ft. 60	to 65
65	70
Ft. 70	to 75
75	80
Ft. 8	to 85
85	90
85	90
Ft. 90	to 95
95	100
Ft. 100	to 105
105	110
Ft. 110	to 115
115	120
Ft. 120	to 125
125	130
Ft. 130	to 135
135	140
Ft. 140	to 145
145	150
Ft. 150	to 155
155	160
Ft. 160	to 165
165	170
Ft. 170	to 175
175	180
Ft. 180	to 185
185	190
Ft. 190	to 198

Logged wet

Figure 3. Photograph of GWQ13-28 borehole lithologic chipboard.

APPENDICES

Appendix 1.

New Mexico Office of the State Engineer Monitoring Well Permit

WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

www.ose.state.nm.us

1. GENERAL AND WELL LOCATION

OSE POD NUMBER (WELL NUMBER) POD 1	OSE FILE NUMBER(S) LRG - 15653
WELL OWNER NAME(S) New Mexico Copper Corporation	PHONE (OPTIONAL) (505) 400 - 7925
WELL OWNER MAILING ADDRESS 2424 Louisiana Blvd. NE Ste 301	CITY / STATE / ZIP Albuquerque NM 87110

WELL LOCATION (FROM GPS)		DEGREES	MINUTES	SECONDS		
	LATITUDE	32	57	39.223	N	* ACCURACY REQUIRED: ONE TENTH OF A SECOND
	LONGITUDE	107	29	22.313	W	* DATUM REQUIRED: WGS 84

DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS - PLSS (SECTION, TOWNSHIP, RANGE) WHERE AVAILABLE

2. DRILLING & CASING INFORMATION

LICENSE NUMBER WD-1458	NAME OF LICENSED DRILLER Richard LeBlanc	NAME OF WELL DRILLING COMPANY Yellow Jacket Drilling

DRILLING STARTED 10/9/13	DRILLING ENDED 10/13/13	DEPTH OF COMPLETED WELL (FT) 190'	BORE HOLE DEPTH (FT) 198'	DEPTH WATER FIRST ENCOUNTERED (FT) 150'

COMPLETED WELL IS: ○ ARTESIAN ○ DRY HOLE ☒ SHALLOW (UNCONFINED)

STATIC WATER LEVEL IN COMPLETED WELL (FT) 154'

DRILLING FLUID: ☒ AIR ○ MUD ADDITIVES – SPECIFY:

DRILLING METHOD: ○ ROTARY ○ HAMMER ○ CABLE TOOL ☒ OTHER – SPECIFY: ARCH

DEPTH (feet bgl)		BORE HOLE DIAM (inches)	CASING MATERIAL AND/OR GRADE (include each casing string, and note sections of screen)	CASING CONNECTION TYPE	CASING INSIDE DIAM. (inches)	CASING WALL THICKNESS (inches)	SLOT SIZE (inches)
FROM	TO						
+3	150	10"	PVC Sch40	Flush Threaded	3.998	.237	
150	190	10"	PVC Sch40	Flush Threaded	3.998	.237	.020

3. ANNULAR MATERIAL

DEPTH (feet bgl)		BORE HOLE DIAM. (inches)	LIST ANNULAR SEAL MATERIAL AND GRAVEL PACK SIZE-RANGE BY INTERVAL	AMOUNT (cubic feet)	METHOD OF PLACEMENT
FROM	TO				
0	120	10"	Cement	55	Tremmie
120	140	10"	Bentonite Pellets	9	Tremmie
140	198'	10"	10/20 Sand	27	Tremmie

FOR OSE INTERNAL USE

WR-20 WELL RECORD & LOG (Version 06/08/2012)

FILE NUMBER	POD NUMBER	TRN NUMBER
LOCATION		PAGE 1 OF 2

4. HYDROGEOLOGIC LOG OF WELL

DEPTH (feet bgl)		THICKNESS (feet)	COLOR AND TYPE OF MATERIAL ENCOUNTERED - INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES (attach supplemental sheets to fully describe all units)	WATER BEARING? (YES / NO)	ESTIMATED YIELD FOR WATER-BEARING ZONES (gpm)
FROM	TO				
				○ Y ○ N	
				○ Y ○ N	
			*SEE ATTACHED	○ Y ○ N	
				○ Y ○ N	
				○ Y ○ N	
				○ Y ○ N	
				○ Y ○ N	
				○ Y ○ N	
				○ Y ○ N	
				○ Y ○ N	
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				○ Y ○ N	
				○ Y ○ N	
				○ Y ○ N	
				○ Y ○ N	
				○ Y ○ N	
				○ Y ○ N	

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA: ○ PUMP

○ AIR LIFT ☒ BAILER ○ OTHER – SPECIFY:

TOTAL ESTIMATED WELL YIELD (gpm):

5. TEST; RIG SUPERVISION

WELL TEST: TEST RESULTS - ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING DISCHARGE METHOD, START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

MISCELLANEOUS INFORMATION:

PRINT NAME(S) OF DRILL RIG SUPERVISOR(S) THAT PROVIDED ONSITE SUPERVISION OF WELL CONSTRUCTION OTHER THAN LICENSEE:

Quentin Stevens

6. SIGNATURE

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WILL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 20 DAYS AFTER COMPLETION OF WELL DRILLING:

SIGNATURE OF DRILLER / PRINT SIGNEE NAME

10/28/13
DATE

FOR OSE INTERNAL USE

WR-20 WELL RECORD & LOG (Version 06/08/2012)

FILE NUMBER:

POD NUMBER:

TRN NUMBER:

LOCATION:

PAGE 2 OF 2

WELL COMPLETION DIAGRAM

Completed 10/13/13

JOHN SHOMAKER & ASSOCIATES, INC.
WATER-RESOURCE AND ENVIRONMENTAL CONSULTANTS
2611 BROADBENT PARKWAY NE
ALBUQUERQUE, NEW MEXICO 87107
(505) 345-3407, FAX (505) 345-9920
www.shomaker.com

Date: 10/10/2013 Time:

Well Id #: ~~MW-A~~ GWQ13-28

Geologist: MW

Drilling Contractor: Yellow Jacket

Project: Copper Flat Monitoring Wells Rig Type: Star 50K

Notes:

2.5' measure upon return to site

stick-up (ft)

top of vault 3'
top of ~~casing~~ Locking cap 2.5'

Concrete pad

4' x 6" thick pad
~~2.5-0~~
0-2.5

ground level

Centralizer 5 ft bgl

casing: size 4.5" OD (4.0 ID)
type PVC Sch. 40
length (ft)

approx. water level 154

depth to top of gravel pack (ft) 140

depth to top of screen (ft) 150
depth to bottom of screen (ft) 190

Centralizers placed at bottom, middle, and top of screen.

total depth of borehole (ft) 198

Cement grout type of backfill

2.5 ~~0~~ depth to top of backfill (ft)

10 dia. borehole

20 bentonite seal thickness

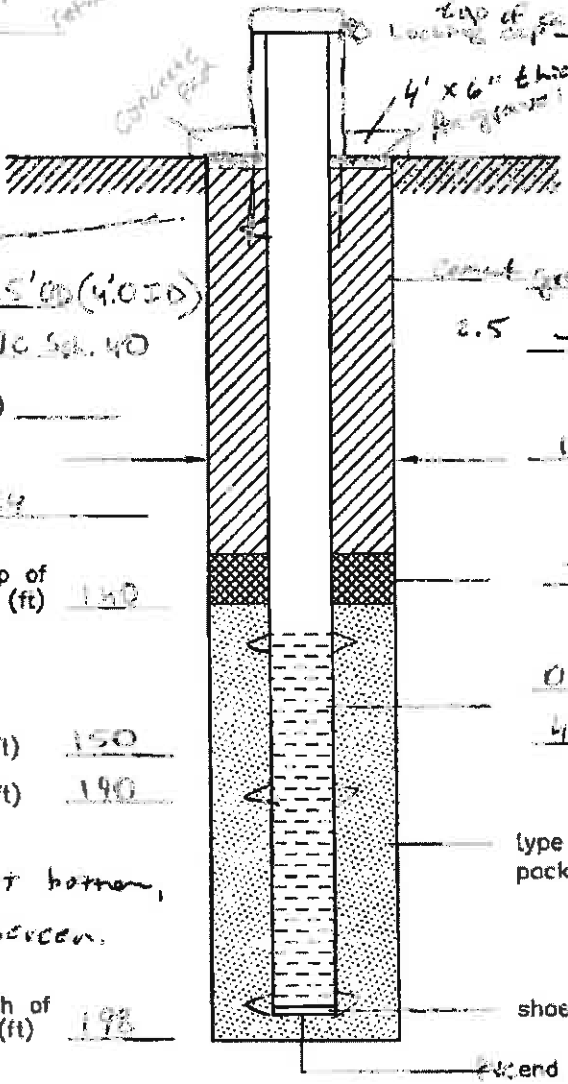
0.020 slot size

40 screen length (ft)

type of gravel pack 10-20 Colorado Silica Sand

shoe length (ft) 0.25 ft.

end cap at 190 ft.



NOT TO SCALE

depth (ft bgl)	**description of cuttings**
0-5	Silt with sand, gravel, and cobbles; tan color, 60%. Sand is yellowish-tan color, fine to coarse, rounded to sub-angular, 20%. Gravel is sub-anglular soft sandstone and hard angular shards of volcanoclastic cobbles composed mostly of andesite and/or basalt. Sandstone gravel has a strong reaction to dilute hydrochloric acid (HCl).
5-10	Rock shards and gravel with sand; gray, angular, and composed of andesite and/or basalt cobbles, shards up to 30mm, 70%. Coarse sand is rounded to angular, mostly gray, various lithology.
10-190	Intervals of rock shards, gravel, sand and silt; rock shards are angular, gray, and composed of andesite and/or basalt. Sand and silt is grayish-tan, angular to rounded, and composed of various lithologies and rock dust from drilling through cobbles and boulders. Sand and trace sandstone with weak calcarious cement reacts to dilute HCl, grayish-tan color.
190-198	Sand with fine gravel; coarse, rounded to angular, various colors and lithology, no reaction to dilute HCl, 80%. Gravel is gray, angular, and is granular size. Sand and gravel grade into each-other.

Appendix 2.

Driller Well Completion Report filed with the New Mexico Office of the State Engineer

Scott A. Verhines, P.E.
State Engineer

Las Cruces Office
1680 HICKORY LOOP, SUITE J
LAS CRUCES, NM 88005

STATE OF NEW MEXICO
OFFICE OF THE STATE ENGINEER

Trn Nbr: 534201
File Nbr: LRG 15653

September 26, 2013

KATIE EMMER
NEW MEXICO COPPER CORPORATION
2424 LOUISIANA BLVD. NE
SUITE 301
ALBUQUERQUE, NM 87110

Greetings:

Enclosed is your copy of the above numbered permit that has been approved subject to the conditions set forth on the approval page. In accordance with the conditions of approval, the well is to be plugged, unless a permit to use the water is acquired from this office.

A Well Record & Log (OSE Form wr-20) shall be filed in this office within twenty (20) days after completion of drilling, but no later than 09/30/2014.

Appropriate forms can be downloaded from the OSE website www.ose.state.nm.us or will be mailed upon request.

Sincerely,

Cheryl Thacker
(575)524-6161

Enclosure

explore

4-19873
cr2

File No. LRG 15653

NEW MEXICO OFFICE OF THE STATE ENGINEER

Office of the State Engineer
Interstate Stream Commission

APPLICATION FOR PERMIT TO DRILL A WELL WITH NO CONSUMPTIVE USE OF WATER

(check applicable box):

For fees, see State Engineer website: http://www.ose.state.nm.us/

Purpose:	☐ Pollution Control And / Or Recovery	☐ Geo-Thermal
☐ Exploratory	☐ Construction Site De-Watering	☐ Other (Describe):
☒ Monitoring	☐ Mineral De-Watering	

A separate permit will be required to apply water to beneficial use.

☐ Temporary Request - Requested Start Date: Requested End Date:

Plugging Plan of Operations Submitted? ☐ Yes ☒ No

---

1. APPLICANT(S)

Name: **New Mexico Copper Corporation**	Name:
Contact or Agent: check here if Agent ☐ **Katie Emmer**	Contact or Agent: check here if Agent ☐
Mailing Address: **2424 Louisiana Blvd NE, Suite 301**	Mailing Address:
City: **Albuquerque**	City:
State: **NM** Zip Code: **87110**	State: Zip Code:
Phone: **505-400-7925** ☐ Home ☒ Cell Phone (Work): **505-830-6919**	Phone: ☐ Home ☐ Cell Phone (Work):
E-mail (optional): **kemmer@themacresourcesgroup.com**	E-mail (optional):

FOR OSE INTERNAL USE

Application for Permit, Form wr-07, Rev 4/12/12

File Number: LRG 15653	Trn Number: 534201
Trans Description (optional):	
Sub-Basin:	
PCW/LOG Due Date: 9/30/2014	

534201

2. WELL(S) Describe the well(s) applicable to this application.

Location Required: Coordinate location must be reported in NM State Plane (NAD 83), UTM (NAD 83), or Latitude/Longitude (Lat/Long - WGS84).
District II (Roswell) and District VII (Cimarron) customers, provide a PLSS location in addition to above.

☐ NM State Plane (NAD83) (Feet)
  ☐ NM West Zone
  ☐ NM East Zone
  ☐ NM Central Zone

☐ UTM (NAD83) (Meters)
  ☐Zone 12N
  ☐Zone 13N

☒ Lat/Long (WGS84) (to the nearest 1/10th of second)

Well Number (if known):	**X or Easting or Longitude:**	**Y or Northing or Latitude:**	**Provide if known:** **-Public Land Survey System (PLSS)** **(*Quarters or Halves , Section, Township, Range)* OR** **- Hydrographic Survey Map & Tract; OR** **- Lot, Block & Subdivision; OR** **- Land Grant Name**
GWQ-13-28 LRG-15653POD1	**-107.491734932** 107° 29' 30.246"W:	**32.9608953554** 32° 57' 39.223"N	S31 T15S R06W
GWQ-13-29 LRG-15653POD2	**-107.489531255** 107° 29' 22.313"W	**32.9608928777** 32°57' 39.214"N	

NOTE: If more well locations need to be described, complete form WR-08 (Attachment 1 – POD Descriptions)
Additional well descriptions are attached: ☐ **Yes** ☒ **No** **If yes, how many** ______

Other description relating well to common landmarks, streets, or other: **Well locations are east of the tailings dam at Copper Flat**

Well is on land owned by: **New Mexico Copper Corporation**

Well Information: NOTE: If more than one (1) well needs to be described, provide attachment. Attached? ☒ **Yes** ☐ **No**
If yes, how many **2**

Approximate depth of well (feet): **270.00**	Outside diameter of well casing (inches): **4.50**
Driller Name: **TBD - Contract Not Let**	Driller License Number:

3. ADDITIONAL STATEMENTS OR EXPLANATIONS

A licensed driller will be engaged to complete this work. Depth of well will be determined based on field conditions, estimating a total depth of 270' bgs or less. The well will be screened at the uppermost water table from five feet above the water table to thirty-five feet below the water table per New Mexico Environment Department (NMED) requirements.

Reason for the monitoring wells: Monitoring wells are required by the NMED's February 7, 2012 approval of the Site-Wide Stage I Abatement Plan Proposal for the Copper Flat Mine Facility.

Duration of planned monitoring: Quarterly monitoring as required by the NMED.

FOR OSE INTERNAL USE

File Number: LRG 15653	Trn Number: 534201

4. SPECIFIC REQUIREMENTS: The applicant must include the following, as applicable to each well type. Please check the appropriate boxes, to indicate the information has been included and/or attached to this application:

Exploratory: ☐ Include a description of any proposed pump test, if applicable.	**Pollution Control and/or Recovery:** ☐ Include a plan for pollution control/recovery, that includes the following: ☐ A description of the need for the pollution control or recovery operation. ☐ The estimated maximum period of time for completion of the operation. ☐ The annual diversion amount. ☐ The annual consumptive use amount. ☐ The maximum amount of water to be diverted and injected for the duration of the operation. ☐ The method and place of discharge. ☐ The method of measurement of water produced and discharged. ☐ The source of water to be injected. ☐ The method of measurement of water injected. ☐ The characteristics of the aquifer. ☐ The method of determining the resulting annual consumptive use of water and depletion from any related stream system. ☐ Proof of any permit required from the New Mexico Environment Department. ☐ An access agreement if the applicant is not the owner of the land on which the pollution plume control or recovery well is to be located.	**Construction De-Watering:** ☐ Include a description of the proposed dewatering operation, ☐ The estimated duration of the operation, ☐ The maximum amount of water to be diverted, ☐ A description of the need for the dewatering operation, and, ☐ A description of how the diverted water will be disposed of.	**Mine De-Watering:** ☐ Include a plan for pollution control/recovery, that includes the following: ☐ A description of the need for mine dewatering. ☐ The estimated maximum period of time for completion of the operation. ☐ The source(s) of the water to be diverted. ☐ The geohydrologic characteristics of the aquifer(s). ☐ The maximum amount of water to be diverted per annum. ☐ The maximum amount of water to be diverted for the duration of the operation. ☐ The quality of the water. ☐ The method of measurement of water diverted. ☐ The recharge of water to the aquifer. ☐ Description of the estimated area of hydrologic effect of the project. ☐ The method and place of discharge. ☐ An estimation of the effects on surface water rights and underground water rights from the mine dewatering project. ☐ A description of the methods employed to estimate effects on surface water rights and underground water rights. ☐ Information on existing wells, rivers, springs, and wetlands within the area of hydrologic effect.
Monitoring: ☒ Include the reason for the monitoring well, and, ☒ The duration of the planned monitoring.		**Geo-Thermal:** ☐ Include a description of the geothermal heat exchange project, ☐ The amount of water to be diverted and re-injected for the project, ☐ The time frame for constructing the geothermal heat exchange project, and, ☐ The duration of the project. ☐ Preliminary surveys, design data, and additional information shall be included to provide all essential facts relating to the request.	

ACKNOWLEDGEMENT

I, We (name of applicant(s)), **Katie Emmer**
Print Name(s)

affirm that the foregoing statements are true to the best of (my, our) knowledge and belief.

Katie Emmer Aug. 9, 2013
Applicant Signature

Applicant Signature

ACTION OF THE STATE ENGINEER

This application is:

☒ approved ☐ partially approved ☐ denied

provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare and further subject to the attached conditions of approval.

Witness my hand and seal this 26th day of September 20 13 , for the State Engineer,

Scott A. Verhines, P.E., STATE ENGINEER ______, State Engineer

By: BY ______ Print
Cheryl S. Thacker

Title: Lower Rio Grande Basin Supervisor
Print

FOR OSE INTERNAL USE

File Number: LRG 15653	Trn Number: 534201

Attachment
Conditions of Approval

Application for Permit to Drill Wells with No Consumptive Use
LRG-15653 POD1 & LRG-15653 POD2

1) There is no water right associated with this Permit. No water shall be appropriated and beneficially used under this Permit.

2) This Permit authorizes the drilling of Wells LRG-15653 POD1 and LRG-15653 POD2 as monitoring wells. These wells may not be used for any other purpose.

3) Monitoring wells LRG-15653 POD1 and LRG-15653 POD2 shall be drilled by a well driller licensed in the State of New Mexico by the New Mexico Office of the State Engineer (NMOSE) and shall be completed as described on the application. A well record for wells LRG-15653 POD1 and LRG-15653 POD2 shall be filed with the Office of the State Engineer in Las Cruces within twenty (20) days of drilling the wells.

4) Monitoring wells LRG-15653 POD1 and LRG-15653 POD2 drilled under this Permit shall be located as identified in the application. The permittee shall consider surface drainage and proximity of the well sites to other wells or surface water features in the area prior to drilling. All monitoring holes drilled under this permit must be located at least 50 feet away from wells of other ownership. The permittee shall comply with federal, state and local regulations concerning setbacks from structures and property lines.

5) A Well Record (NMOSE Form WR-20) shall be submitted to the NMOSE in Las Cruces (NMOSE, 1680 Hickory Loop, Ste. J, Las Cruces, NM 88005) within 20 days of completion of the drilling of each monitoring hole, but no later than September 30, 2014. Failure to submit the required Well Records within the time allowed will cause this permit to be cancelled. A separate Well Record is required for each monitoring well and each must contain the location using Longitude and Latitude (WGS84) in degrees, minutes, and seconds to at least a 10th of a second accuracy, as obtained through the use of GPS.

6) Monitoring wells LRG-15653 POD1 and LRG-15653 POD2 drilled under this Permit shall be maintained in a manner acceptable to the State Engineer during monitoring activities so as to prevent groundwater contamination and/or other safety hazards.

7) Should another regulatory agency sharing jurisdiction of the project authorize, or by regulation, require more stringent requirements then stated herein, the more-stringent procedure should be followed. This, in part, includes provisions regarding pre-authorization to proceed, type of methods and materials used, inspection, or prohibition of free discharge of any fluid or other material to or from the borehole that is related to the drilling and/or plugging process.

8) This permit shall not be exercised to the detriment of valid existing water rights, shall not be contrary to conservation of water within the state, and shall not be detrimental to the public welfare of the state of New Mexico.

9) The State Engineer retains jurisdiction over this permit.

10) If well/wells are to be plugged, then they shall be plugged completely using the following method per Rules and Regulations Governing Well Driller Licensing, Construction, Repair and Plugging of Wells; 19.27.4.30.C unless an alternative plugging method is proposed by the well owner and approved by the State Engineer. A Plugging Report for said well/wells shall be filed with the Office of the State Engineer in Las Cruces within 20 days of completion of the plugging.

To plug a well, the entire well shall be filled form the bottom upwards to land surface using a tremie pipe. The well shall be plugged with neat cement slurry, bentonite based plugging material, or other sealing material approved by the State Engineer for use in the plugging of non-artesian wells. Wells that do not encounter a water bearing stratum shall be immediately plugged by filling the well with drill cuttings or clean native fill to within ten (10) feet of land surface and by plugging the remaining ten (10) feet of the well to land surface with a plug of neat cement slurry, bentonite based plugging material, or other sealing material approved by the State Engineer.

Date: 9/26/2013

Cheryl S. Thacker
Lower Rio Grande Basin Supervisor
Office of the State Engineer
District IV, Las Cruces

NEW MEXICO STATE ENGINEER OFFICE
PERMIT TO EXPLORE

SPECIFIC CONDITIONS OF APPROVAL

4 No water shall be appropriated and beneficially used under this permit.

6 The well shall be plugged upon completion of the permitted use, and a plugging report shall be filed with the State Engineer within 10 days.

7 The Permittee shall utilize the highest and best technology available to ensure conservation of water to the maximum extent practical.

B The well shall be drilled by a driller licensed in the State of New Mexico in accordance with Section 72-12-12 New Mexico Statutes Annotated.

C Driller's well record must be filed with the State Engineer within 20 days after the well is drilled or driven. Well record forms will be provided by the State Engineer upon request.

LOG The Point of Diversion LRG 15653 POD1 must be completed and the Well Log filed on or before 09/30/2014.

LOG The Point of Diversion LRG 15653 POD2 must be completed and the Well Log filed on or before 09/30/2014.

SEE ATTACHED CONDITIONS OF APPROVAL

ACTION OF STATE ENGINEER

Notice of Intention Rcvd:
Formal Application Rcvd: 08/21/2013
Date Returned - Correction:

Date Rcvd. Corrected:
Pub. of Notice Ordered:
Affidavit of Pub. Filed:

This application is approved provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare of the state; and further subject to the specific conditions listed previously.

Witness my hand and seal this 24 day of Sep A.D., 2013

Scott A. Verhines, P.E. State Engineer

By:
CHERYL S. THACKER

Trn Desc: LRG 15653

File Number: LRG 15653
Trn Number: 534201

Appendix 3

Lithologic Log, New Mexico Copper Corporation Well No. GWQ13-28

JOHN SHOMAKER & ASSOCIATES, INC.
WATER-RESOURCE AND ENVIRONMENTAL CONSULTANTS
2611 BROADBENT PARKWAY NE
ALBUQUERQUE, NEW MEXICO 87107
(505) 345-3407, FAX (505) 345-9920
www.shomaker.com

Borehole Logging Form

Well Name: GWQ13-28

Client: New Mexico Copper Corp.	Project: 2013 Copper Flat Monitoring Well		Hole: MW-A
Site: Copper Flat, east of tailings dam well field			Date: 10/9-10/2013
Geologist: Marco Wikstrom	Contractor: Yellow Jacket Drilling Services		Map: UTM (meters), Zone 13, NAD83, 267100E, 3649708N
Drill Method: Rev. Air Rotary Casing Adv.	Rig: Star 50K		
Bit size:10-in.	Notes: Most “gravel” composed of rock shards broken by drilling		
Elevation, ft:	Land Surface:	TOC:	

Sample Depth, ft	lith		Description
0-5			<u>Gravelly silty sand</u>; yellowish tan color, 60%. Sand is yellowish-tan color, fine to coarse, rounded to sub-angular, 20%. Gravel is sub-anglular soft sandstone and hard angular shards of volcanoclastic cobbles composed of andesite and/or basalt. Sandstone gravel, sand, and silt has a strong reaction to dilute hydrochloric acid (HCl).
5-10			<u>Sandy Gravel;</u> gray, angular, and composed of andesite and/or basalt cobbles, shards up to 30mm, 70%. Coarse sand is rounded to angular, mostly gray, various lithology.
10-15			<u>Silty sandy gravel</u>; shards are angular, gray, up to 30mm, 60%. Silt and sand tan, very fine to medium, strong reaction to dilute HCl.
15-25			<u>Gravelly sand</u>; medium to coarse, rounded to sub-rounded, grayish-tan, various lithology, 70%. Gravel composed of angular shards (rock chips), gray, up to 10mm.
25-40			<u>Sandy gravel</u>; gray, angular, volcanoclastic, shards up to 30mm, 70%. Sand is medium to coarse, mostly tan, various lighologies, rounded to sub-rounded.
40-50			<u>Silty sandy gravel</u>; gray angular chips up to 20mm, 60%. Sand is very fine to coarse, various lithologies and colors, rounded to sub-angular, 30%. Silt is tan. Sand and silt have mild reaction to dilute HCl.
50-55			<u>Gravel</u>; gray to greenish-gray angular shards up to 30mm. Driller reports drilling through cobbles or boulders.
55-60			<u>Silty sandy gravel</u>; gray angular chips up to 20mm, 60%. Sand is very fine to coarse, various lithologies and colors, rounded to sub-angular, 30%. Silt is tan. Sand and silt have strong reaction to dilute HCl.
60-70			<u>Silty gravelly sand</u>; overall gray, fine to coarse, rounded to sub-angular, various lithology, 70-80%. Gravel is gray, angular, up to 10mm, 10%. Silt is gray to tan. Sand and silt very weak to mild reaction to dilute HCl.
70-85			<u>Sandy silty gravel</u>; gray, angular chips up to 10mm, 60-80%. Sand fine to coarse sub-rounded to sub-angular, various lithology, 15-30%, no reaction to dilute HCl. Silt is tan to gray.
85-95			<u>Silty gravelly sand</u>; yellowish-gray, very fine to coarse, sub-rounded to sub-angular, 60-75%. Gravel various lithology, 10-20%. Sand and silt has strong reaction to dilute HCl.
95-115			<u>Sandy silty gravel</u>; gray, angular, shards up to 20mm, 80%. Sand is tannish-gray, very fine, 10%. Sand and silt have moderate reaction to HCl.
115-120			<u>Sand and rock flour</u>; rate of penetration slowed at 117 ft bgl. Very fine to coarse, sand portion tan to gray, rounded to angular, strong reaction to HCl. Rock chips and dust gray, chips angular. Drilling rate of penetration increased after 120 ft bgl.

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www.shomaker.com

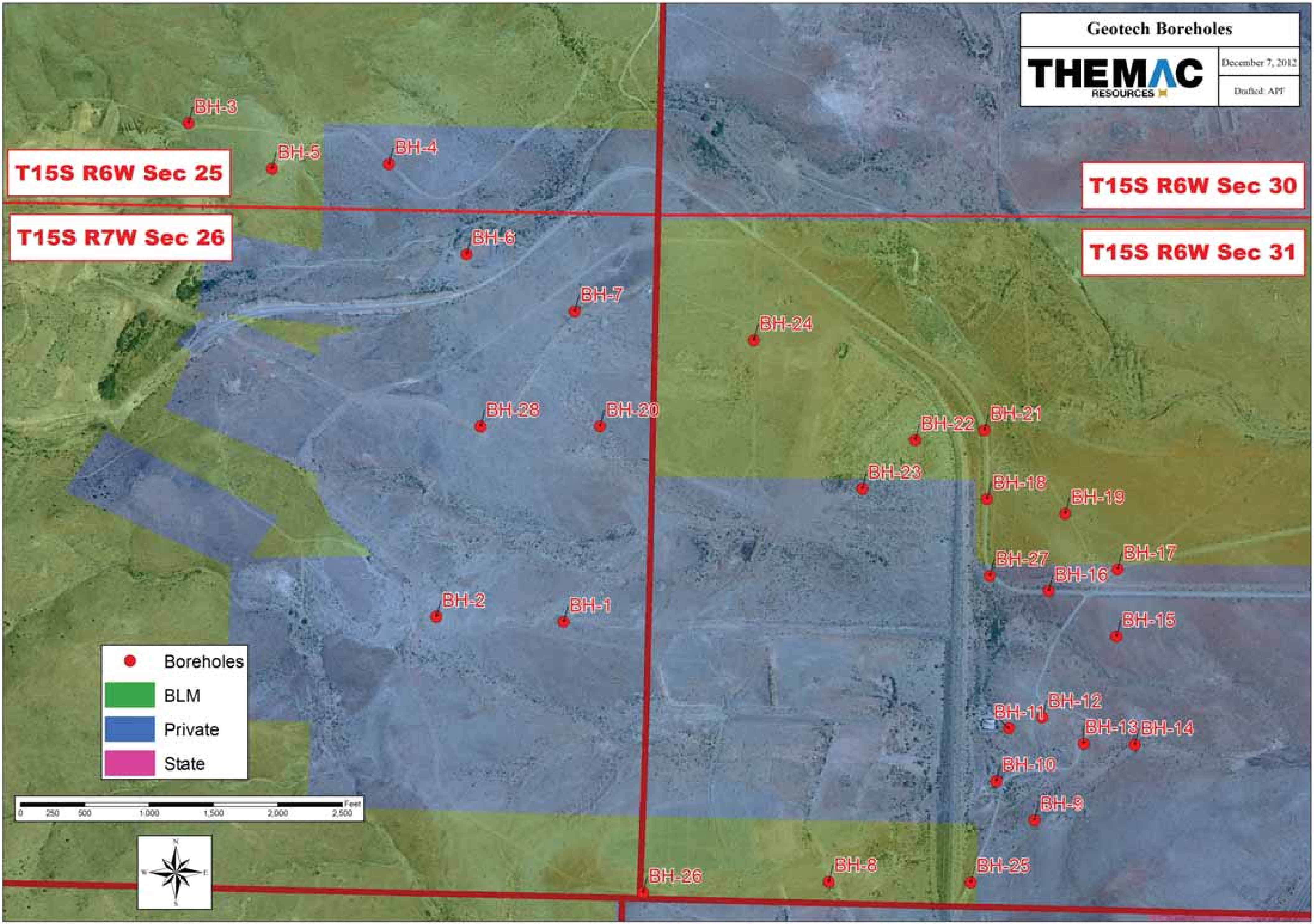
Borehole Logging Form

Well Name: GWQ13-28

Client: New Mexico Copper Corp.	Project: 2013 Copper Flat Monitoring Well		Hole: MW-A
Site: Copper Flat, east of tailings dam well field			Date: 10/9-10/2013
Geologist: Marco Wikstrom	Contractor: Yellow Jacket Drilling Services		Map: UTM (meters), Zone 13, NAD83, 267100E, 3649708N
Drill Method: Rev. Air Rotary Casing Adv.	Rig: Star 50K		
Bit size:10-in.	Notes: Most “gravel” composed of rock shards broken by drilling		
Elevation, ft:	Land Surface:	TOC:	

Sample Depth, ft	lith		Description
120-130			Sandy silty gravel; sub-angular to angular, composed of sandstone and volcanic rock fragments. Sandstone has strong reaction to dilute HCl, up to 10mm, 70%. Sand very fine to coarse, tan to gray, 20%. Silt is tan.
130-135			Sandy silty gravel; gray and gray-tan, angular to sub-angular, gray chips up to 20mm, various lithology, 70%. Sand is rounded to sub-angular, gray-tan, 20%. Sand and silt have strong reaction to dilute HCl.
135-140			Sandy gravel; very fine to coarse, tan-gray, rounded to sub-angular, 70%, strong reaction to HCl. Rock chips gray1-2mm, angular, no reaction to HCl.
140-145			Sandy gravel; gray, angular, up to 10mm, 90%. Sand coarse, angular to sub-angular.
145-175			Silty sandy gravel; very fine to coarse, rounded to angular, grayish-tan to gray. 70%, strong reaction to dilute HCl. Gravel is gray and grayish-tan, angular to sub-angular, up to 20mm, 25%. Silt is tan to gray. **Moist below 156 ft bgl.**
175-190			Silty sandy gravel, **wet below 176 ft bgl**; gray, angular, shards up to 30mm, 80%. Sand fine to coarse, rounded to angular, gray and tan, 10%. Silt is tan.
190-198			Gravelly sand; rounded to angular, 90%, various lithologies, gravel composed of small gray, angular chips less than 4mm. TD at 198 ft bgl.
			Water level stabilized at 154 ft bgl after drilling was complete.

Geotechnical drilling below TSF


Geotech Boreholes
THEMAC RESOURCES
December 7, 2012
Drafted: APF
T15S R6W Sec 25
T15S R7W Sec 26
T15S R6W Sec 30
T15S R6W Sec 31
BH-1
BH-2
BH-3
BH-4
BH-5
BH-6
BH-7
BH-8
BH-9
BH-10
BH-11
BH-12
BH-13
BH-14
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● Boreholes
🟩 BLM
🟦 Private
🟪 State
0 250 500 1,000 1,500 2,000 2,500 Feet
N
E
S
W

BORING NUMBER BH-1

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.

PROJECT NAME Geotech Investigation, Tailings Storage Facility

PROJECT NUMBER 103-92557

PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico

DATE STARTED 12/17/12 **COMPLETED** 12/17/13

GROUND ELEVATION **HOLE SIZE** 8.25 inches

DRILLING CONTRACTOR Yellow Jacket

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

AT TIME OF DRILLING ---

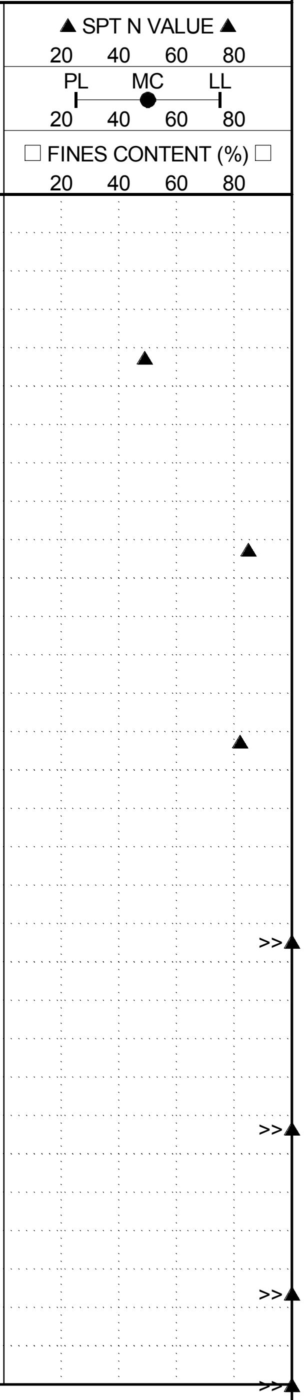
LOGGED BY CMT **CHECKED BY**

AT END OF DRILLING ---

NOTES Moved BH-1 43.5 feet west

AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(GM) compact, light gray, SILTY GRAVEL with sand, dry, (<1.5" - 60%; 1.5-3" - 25%; >3" - 15%)	AU Bag				
5	(GM) dense, gray, SILTY GRAVEL with sand, dry, (<1.5" - 50%; 1.5-3" - 30%; >3" - 20%)			18-17-32 (49)		
		AU Bulk				
10	(GM) very dense, gray, SILTY GRAVEL with sand, dry (<.15" - 50%, 1.5-3" - 40%, >3" - 10%)			4-40-45 (85)		
15		SS		13-32-50 (82)		
		AU Bag				
20	(ML) hard, brown, GRAVELLY SILT, dry, (<1.5% - 60%, 1.5-3" - 25%, >3" - 15%)			26-50/5"		
		AU Bulk				
25				45-30/2"		
		AU Bag		40/3"		
30						
	Refusal			10/0"		



Refusal at 31.0 feet.
Bottom of borehole at 31.0 feet.

BORING NUMBER BH-2

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.

PROJECT NAME Geotech Investigation, Tailings Storage Facility

PROJECT NUMBER 103-92557

PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico

DATE STARTED 12/18/12 **COMPLETED** 12/18/12

GROUND ELEVATION ____ **HOLE SIZE** 8.25 inches

DRILLING CONTRACTOR Yellow Jacket

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

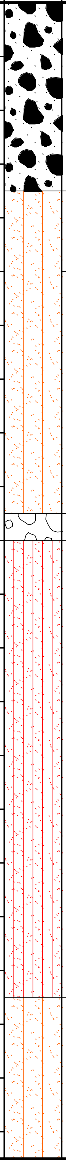
AT TIME OF DRILLING ---

LOGGED BY CMT **CHECKED BY** ____

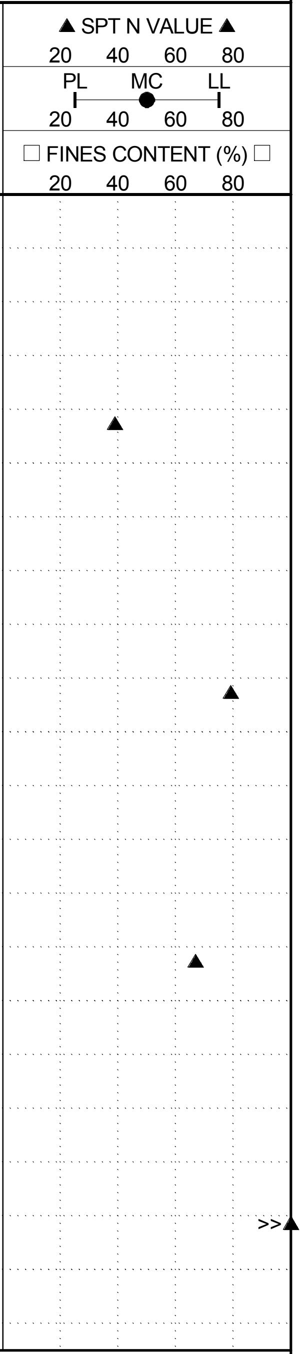
AT END OF DRILLING ---

NOTES Moved BH-2 2 feet east

AFTER DRILLING ---



DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(GW) compact, light gray, SANDY GRAVEL, dry, (<1.5" - 60%; 1.5-3" - 25%; >3" - 15%)	AU B/Bag				
	(SM) dense, light gray, SILTY SAND, rock inclusions, dry	SS		17-16-23 (39)		
5	(SM) dense, light brown, SILTY SAND and gravel, dry, (<1.5"-60%; 1.5-3" - 25%, >3" - 15%)	AU B/Bag		16-29-50 (79)		
10	(GW) very dense, gray, GRAVEL, dry	SS				
	(ML) hard, brown, SANDY SILT and gravel, dry, (<1.5" - 70%; 1.5-3" - 20%; >3" - 10%)	SS		17-50 (67)		
15		AU Bulk				
	(SM) very dense, brown and gray, SILTY SAND, some gravel, dry	SS		26-47-50/3"		
20		SS				



Refusal at 21.5 feet.
Bottom of borehole at 21.5 feet.

GEOTECH BH PLOTS - GINT STD US LAB.GDT - 2/20/13 17:08 - P:\COPPER FLAT MINE NM\2013 GEOTECH INVESTIGATIONS\BORING LOGS 2.GPJ

BORING NUMBER BH-3

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.

PROJECT NAME Geotech Investigation, Tailings Storage Facility

PROJECT NUMBER 103-92557

PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico

DATE STARTED 1/25/13 **COMPLETED** 1/26/13

GROUND ELEVATION ______ **HOLE SIZE** 8.25 inches

DRILLING CONTRACTOR Yellow Jacket

GROUND WATER LEVELS:

DRILLING METHOD Air Hammer

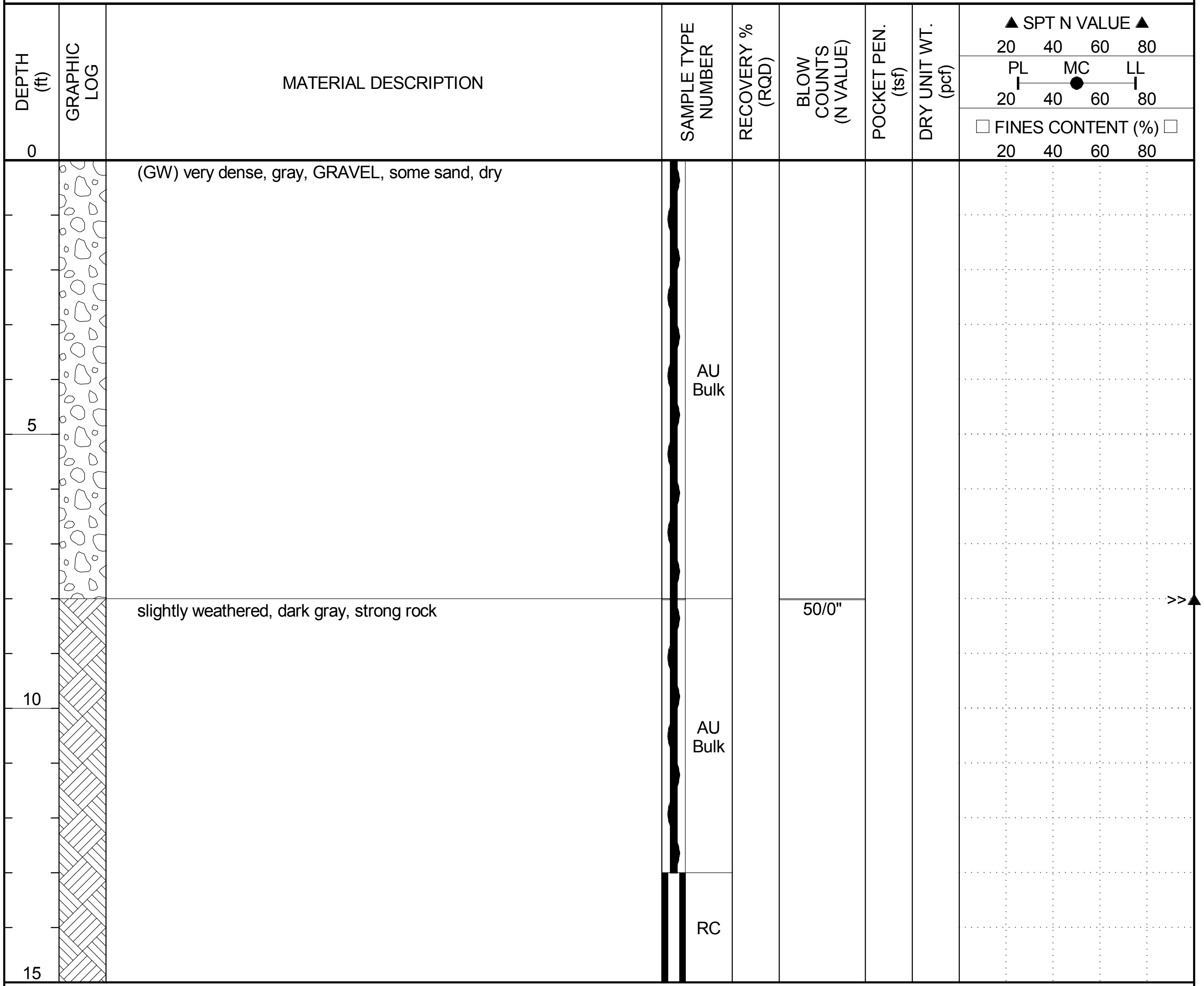
AT TIME OF DRILLING ---

LOGGED BY CMT **CHECKED BY** ______

AT END OF DRILLING ---

NOTES Moved BH-3 5 feet south

AFTER DRILLING ---



DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲
0 – 8	(GW) very dense, gray, GRAVEL, some sand, dry	AU Bulk					
8 – 15	slightly weathered, dark gray, strong rock	AU Bulk		50/0"			>>▲
		RC					

Refusal at 8.0 feet.
Bottom of borehole at 15.0 feet.

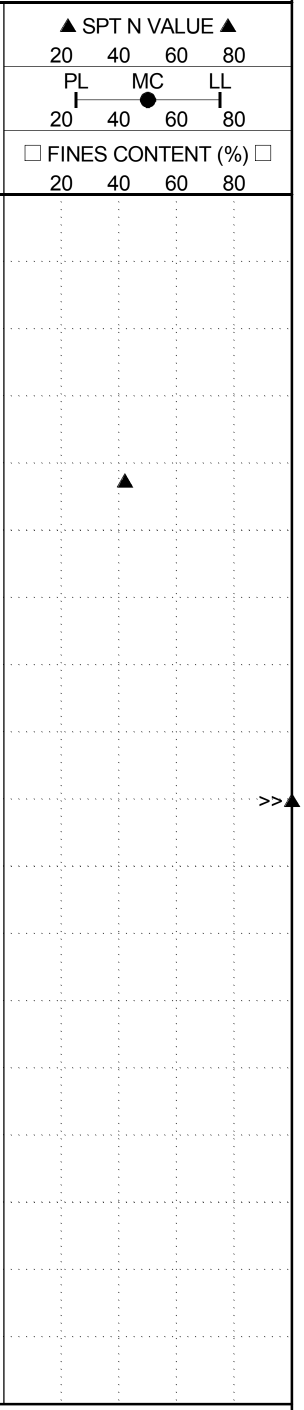
Golder Associates

BORING NUMBER BH-4

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 1/5/13 **COMPLETED** 1/5/13
GROUND ELEVATION ______ **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger, Diamond Coring
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY** ______
AT END OF DRILLING ---
NOTES ______
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		(SW-SM) compact, gray/light gray, SILTY SAND, some gravel, oversized rock, dry, CaCO3	AU Bag				
					14-23-19 (42)		
		(ML) dense, gray, SANDY SILT, dry, some CaCO3					
5			AU Bag				
		very dense, dark gray, fragmented rock, trace silty sand, trace CaCO3	RC Bag		25/0"		
10							
		very dense, dark gray, weathered and fragmented rock, trace silty sand, some CaCO3, cemented conglomerate, strong cementation					
15			RC Bag				
		very dense, dark gray, weathered and fragmented rock, cementation					
			RC Bag				



Bottom of borehole at 18.0 feet.

GEOTECH BH PLOTS - GINT STD US LAB.GDT - 2/20/13 17:09 - P:\COPPER FLAT MINE NM\2013 GEOTECH INVESTIGATIONS\BORING LOGS 2.GPJ

BORING NUMBER BH-5

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.

PROJECT NAME Geotech Investigation, Tailings Storage Facility

PROJECT NUMBER 103-92557

PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico

DATE STARTED 1/7/13 **COMPLETED** 1/7/13

GROUND ELEVATION **HOLE SIZE** 8.25 inches

DRILLING CONTRACTOR Yellow Jacket

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger, Diamond Coring

AT TIME OF DRILLING ---

LOGGED BY CMT **CHECKED BY**

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft) 0.0	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 ☐ FINES CONTENT (%) ☐ 20 40 60 80
2.5		(SW-SM) compact, gray/ light gray, SILTY SAND and gravel, dry, trace CaCO3, oversized rock	AU Bulk					
5.0		(SW-SM) very dense, gray/ light gray, SILTY SAND and gravel, dry, trace CaCO3, oversized rock			12-24-41 (65)			▲
7.5 10.0 12.5		very dense, dark gray, weathered and fragmented rock, some sandy silt, strongly cemented rock inclusions	RC					

Bottom of borehole at 13.0 feet.

Golder Associates

BORING NUMBER BH-6

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 1/25/13 **COMPLETED** 1/25/13
GROUND ELEVATION **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Air Hammer, Diamond Coring
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

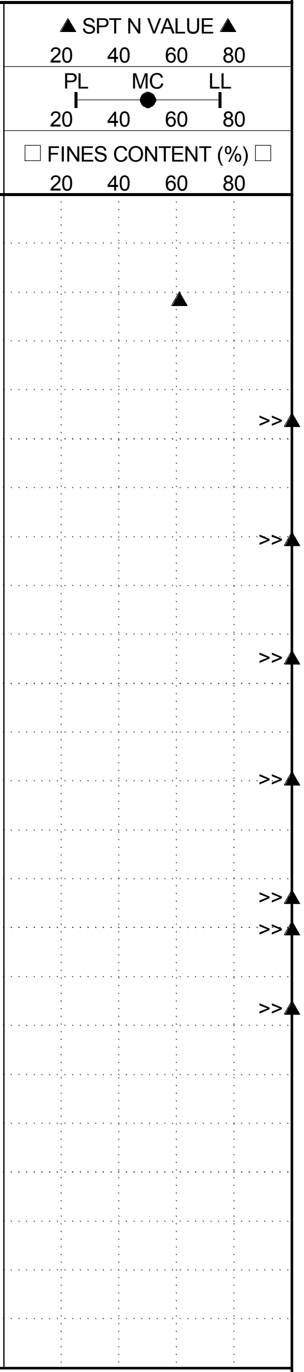
DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 ☐ FINES CONTENT (%) ☐ 20 40 60 80
0		(SW-SM) very dense, brown, SILTY SAND and gravel, dry	AU Bag					
		(SW-SM) very dense, gray, SILTY SAND and gravel, dry	AU Bulk					
5								
		slightly weathered, dark gray, strong rock	AU Bulk		50/0"			>>▲
10								
15								
			RC					
20								
25								

Bottom of borehole at 25.0 feet.

BORING NUMBER BH-7

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 12/18/12 **COMPLETED** 12/19/12
GROUND ELEVATION **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger, Diamond Coring
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(SM) loose, brown, SILTY SAND, rock inclusions, dry	AU Bag				
	(GP) compact, light gray, SANDY GRAVEL, dry, (<1.5" - 85%; 1.5-3" - 10%, >3" - 5%)	AU Bag				
	(SM) very dense, brown/white, SILTY SAND, rock inclusions, dry	SS		14-28-33 (61)		
	(GW) very dense, white/gray, SANDY GRAVEL, dry					
10	(SW-SM) very dense, gray, SILTY SAND and gravel, dry, (<1.5" - 75%, 1.5-3" - 20%, >3" - 5%)	AU B/Bag SS		12-39-50/5" 11-37-50/2"		
20	(GW-GM) very dense, gray, GRAVEL and silty sand, dry, (<1.5"- 65%; 1.5-3" - 20%; >3" - 15%)	AU B/Bag SS		25-30/4" 23-32/3"		
	(SW-SM) very dense, brown, SILTY SAND and gravel, dry, (<1.5" - 65%; 1.5-3" - 20%; >3" - 15%)	AU Bulk AU Bag		36/5"		
30 40	very dense, dark gray weathered and fractured rock, some gravel, strong cementation	RC SS RC		50/0" 20-50/0"		



Bottom of borehole at 48.0 feet.

BORING NUMBER BH-8

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.

PROJECT NAME Geotech Investigation, Tailings Storage Facility

PROJECT NUMBER 103-92557

PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico

DATE STARTED 1/19/13 **COMPLETED** 1/19/13

GROUND ELEVATION **HOLE SIZE** 8.25 inches

DRILLING CONTRACTOR Yellow Jacket

GROUND WATER LEVELS:

DRILLING METHOD Air Hammer

AT TIME OF DRILLING ---

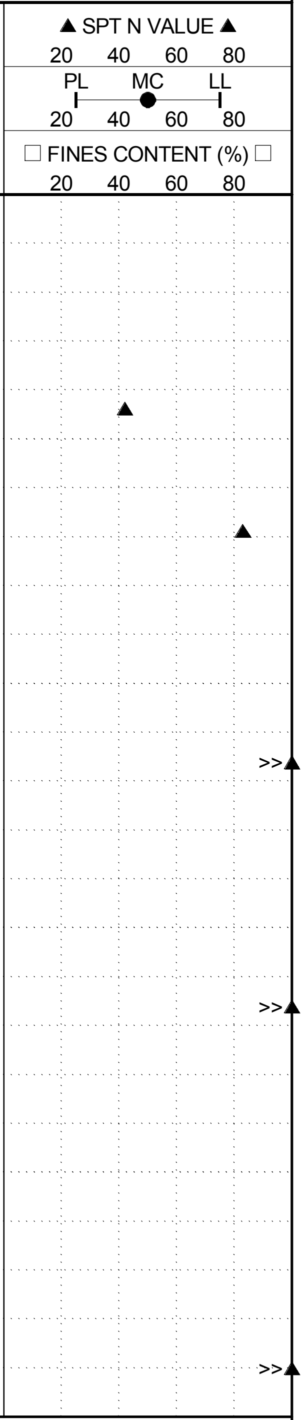
LOGGED BY CMT **CHECKED BY**

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(SW-SM) dense, brown, SILTY SAND, some gravel, slightly cohesive, trace CaCO3, trace clayey silt	AU Bag SS		 18-19-23 (42)		
10	(SW-SM) very dense, brown, SILTY SAND, some gravel, trace clayey silt, slightly cohesive, dry	SS AU Bulk		50-53-30 (83)		
20	(ML) hard/very dense, brown, SANDY SILT and gravel, some clayey silt (low plasticity), dry, trace CaCO3	AU Bulk		50/5"		
30	(SW-SM) very dense, gray/brown, SILTY SAND and gravel, some clayey silt, dry	AU Bag				
40	(SW) very dense, gray, SAND and gravel, dry	AU Bulk		50/5"		
50	(GW) very dense, gray, GRAVEL and sand, trace clayey silt, dry			50/0"		



Bottom of borehole at 50.0 feet.

GEOTECH BH PLOTS - GINT STD US LAB.GDT - 2/20/13 17:09 - P:\COPPER FLAT MINE NM\2013 GEOTECH INVESTIGATIONS\BORING LOGS 2.GPJ

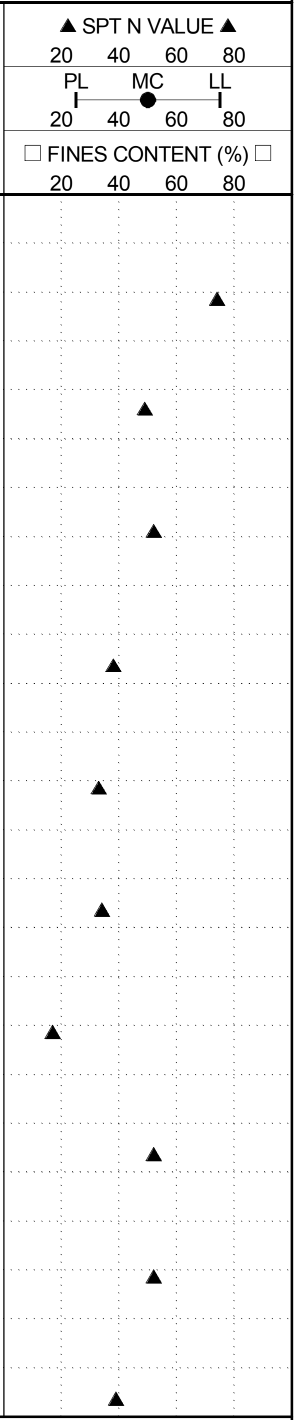
Golder Associates

BORING NUMBER BH-9

PAGE 1 OF 1

CLIENT	New Mexico Copper Corp.	**PROJECT NAME**	Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER	103-92557	**PROJECT LOCATION**	Copper Flat Mine, Sierra County, New Mexico
DATE STARTED	12/21/13 **COMPLETED** 1/17/13	**GROUND ELEVATION**	**HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR	Yellow Jacket	**GROUND WATER LEVELS:**	
DRILLING METHOD	Hollow Stem Auger, Air Hammer	**AT TIME OF DRILLING**	---
LOGGED BY	CMT **CHECKED BY**	**AT END OF DRILLING**	---
NOTES	Moved BH-9 2 feet east	**AFTER DRILLING**	---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(ML) hard, brown, SANDY SILT, rock inclusions, dry	AU Bulk				
		SS		20-34-40 (74)		
	(SW) dense, light gray/brown, SAND and gravel, dry			50		
10		AU Bag(2) SS		20-25-24 (49)		
	(ML) hard, light brown, SILT, rock inclusions, dry, slightly cohesive, trace CaCO3	AU Bag				
	(ML) hard, light reddish brown, SILT, little gravel, dry, slightly cohesive			16-25-27 (52)		
		AU Bulk				
20		SS		4-14-24 (38)		
	(MH) hard, reddish brown, CLAYEY SILT, dry, cohesive	AU Bulk SS		22-14-19 (33)		
30	(CL-ML) hard, red SILTY CLAY, dry, cohesive, moderate plasticity	SS AU B/Bag		16-15-19 (34)		
		SS		6-4-13 (17)		
40	(CL) hard, red, CLAY, dry	SS		14-21-31 (52)		
		AU Bulk				
	(CL-ML) hard, red, SILTY CLAY, dry			13-20-32 (52)		
	(CH) hard, red, CLAY, dry					
50				9-15-24 (39)		



Bottom of borehole at 50.0 feet.

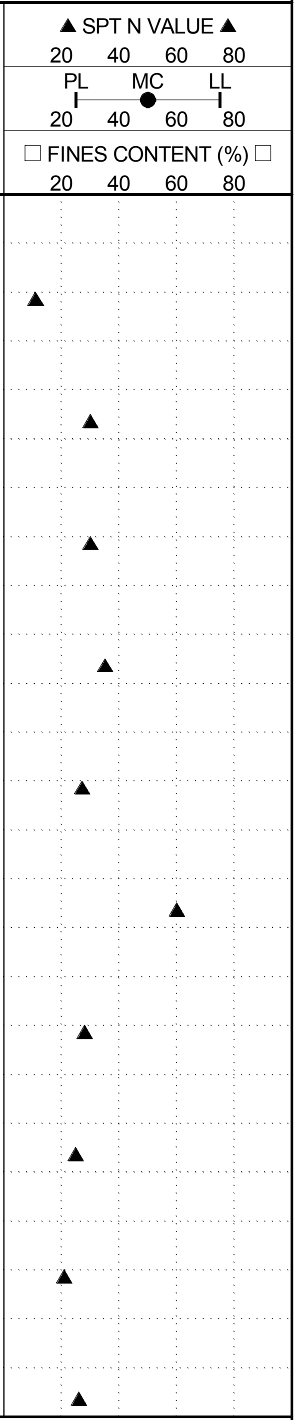
Golder Associates

BORING NUMBER BH-10

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 1/12/13 **COMPLETED** 1/12/13
GROUND ELEVATION **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		(ML) stiff-very stiff, light gray, SANDY SILT, some gravel, dry, (<1.5" - 70%; 1.5-3" - 20%; >3" - 10%)					
					17-6-5 (11)		
			AU B/Bag				
10					9-12-18 (30)		
		(GW) stiff, light gray, GRAVEL and silty sand, dry, (<1.5" - 60%; 1.5-3" - 25%; >3" - 15%)					
					20-16-14 (30)		
		(MH) very stiff, red/light brown, CLAYEY SILT, dry, little gravel	SS				
			AU Bag				
20		(CL-ML) very stiff-hard, red, SILTY CLAY, dry, trace gravel, cohesive, low plasticity	SS		8-15-20 (35)		
			SS		3-10-17 (27)		
			AU B/Bag				
30			SS		10-19-41 (60)		
		(CL-ML) very stiff, red, SILTY CLAY, dry, moderate plasticity	SS		8-11-17 (28)		
		(CL) very stiff, red, CLAY, slightly moist, moderate plasticity					
40			AU B/Bag SS		4-6-19 (25)		
		(CH) very stiff, red, CLAY, slightly moist, high plasticity			4-7-14 (21)		
			AU B/Bag				
50			SS		7-10-16 (26)		



Bottom of borehole at 50.0 feet.

BORING NUMBER BH-11

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.

PROJECT NAME Geotech Investigation, Tailings Storage Facility

PROJECT NUMBER 103-92557

PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico

DATE STARTED 1/3/13 **COMPLETED** 1/3/13

GROUND ELEVATION **HOLE SIZE** 8.25 inches

DRILLING CONTRACTOR Yellow Jacket

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

AT TIME OF DRILLING ---

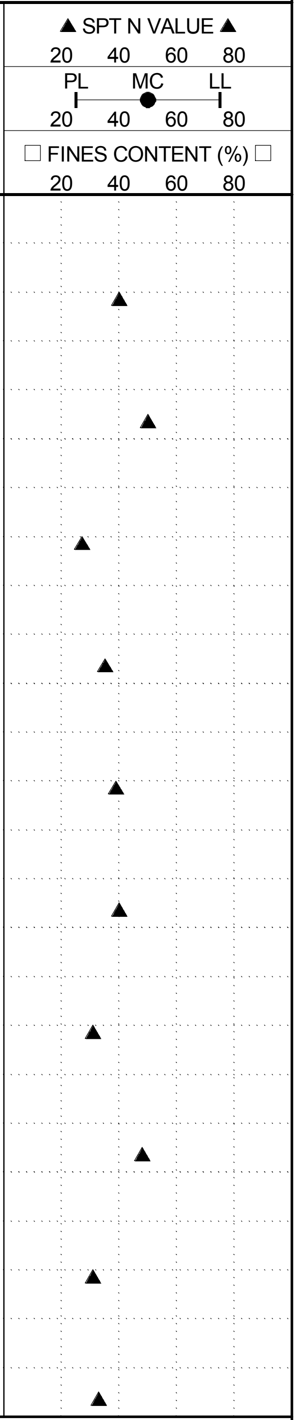
LOGGED BY CMT **CHECKED BY**

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(ML) stiff-very stiff, brown, SILT, trace sand and gravel, dry, (<1.5" - 80%; 1.5-3" - 15%, >3" - 5%)	AU Bag(2)				
	(SW) dense, white/light gray, GRAVELLY SAND, dry, (<1.5" - 90%; 1.5-3" - 5%; >3" - 5%)	AU Bulk		9-13-27 (40)		
10	(SW-SM) very dense, light brown, SILTY SAND and gravel, dry, (<1.5" - 80%; 1.5-3" - 20%; >3" - 0%)			12-27-23 (50)		
	(MH) very stiff, brown, CLAYEY SILT, dry, low plasticity	SS		5-11-16 (27)		
		AU Bulk				
20	(CL-ML) hard, reddish brown, SILTY CLAY, white and black inclusions, dry	SS		7-12-23 (35)		
	(CL-ML) hard, red SILTY CLAY, rock inclusions, slightly moist, moderate plasticity			24-16-23 (39)		
		AU B/Bag				
30		SS		7-15-25 (40)		
	(CH) hard, red/light brown, CLAY, slightly moist, moderate plasticity	SS		11-13-18 (31)		
		AU Bulk				
40		SS		12-18-30 (48)		
		SS		11-13-18 (31)		
50		SS		11-12-21 (33)		

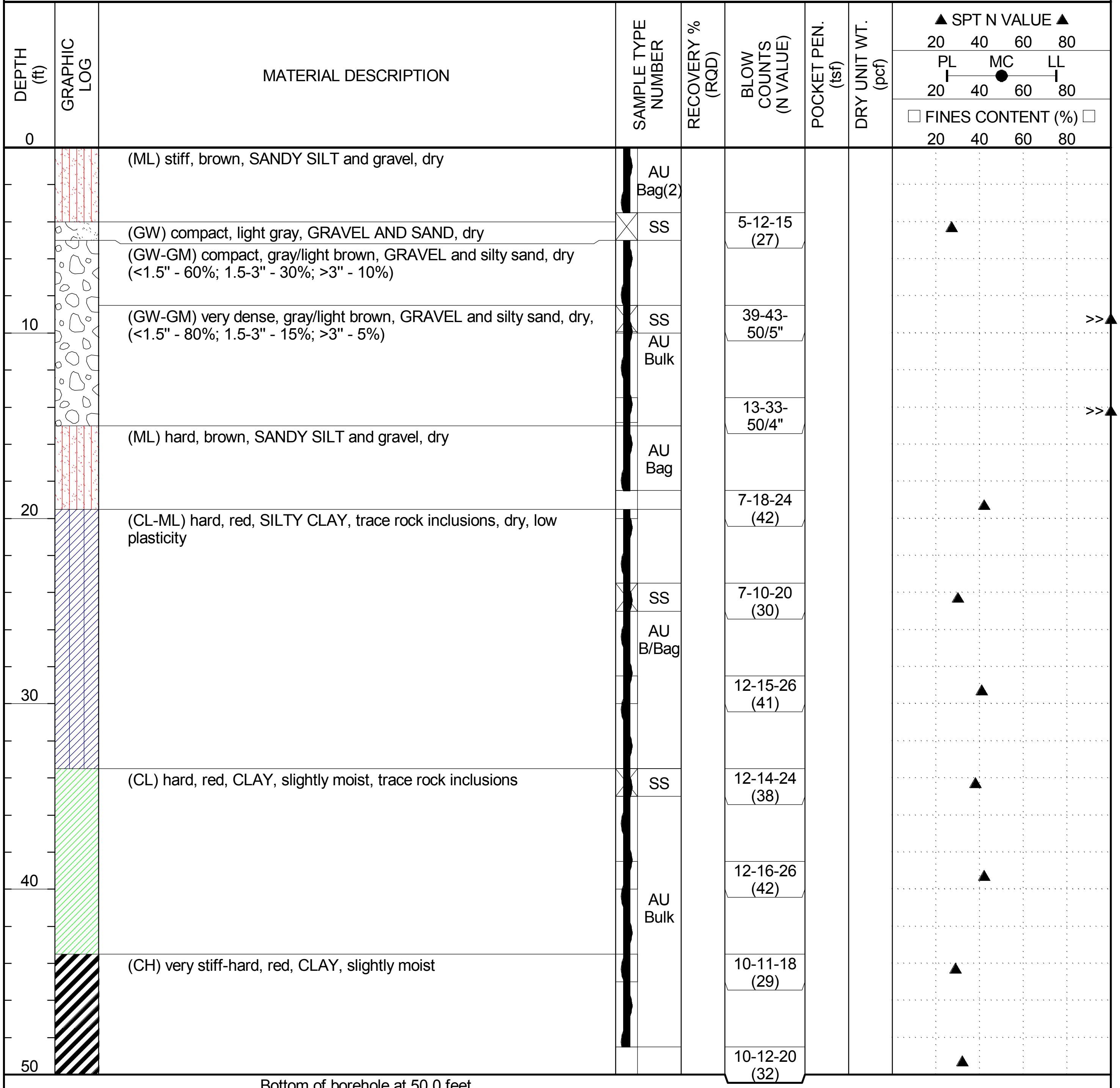


Bottom of borehole at 50.0 feet.

BORING NUMBER BH-12

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 1/4/13 **COMPLETED** 1/4/13
GROUND ELEVATION **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---



MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
(ML) stiff, brown, SANDY SILT and gravel, dry	AU Bag(2)				
(GW) compact, light gray, GRAVEL AND SAND, dry	SS		5-12-15 (27)		
(GW-GM) compact, gray/light brown, GRAVEL and silty sand, dry (<1.5" - 60%; 1.5-3" - 30%; >3" - 10%)					
(GW-GM) very dense, gray/light brown, GRAVEL and silty sand, dry, (<1.5" - 80%; 1.5-3" - 15%; >3" - 5%)	SS		39-43-50/5"		
	AU Bulk				
			13-33-50/4"		
(ML) hard, brown, SANDY SILT and gravel, dry	AU Bag				
			7-18-24 (42)		
(CL-ML) hard, red, SILTY CLAY, trace rock inclusions, dry, low plasticity					
	SS		7-10-20 (30)		
	AU B/Bag				
			12-15-26 (41)		
(CL) hard, red, CLAY, slightly moist, trace rock inclusions	SS		12-14-24 (38)		
			12-16-26 (42)		
	AU Bulk				
(CH) very stiff-hard, red, CLAY, slightly moist			10-11-18 (29)		
			10-12-20 (32)		

Bottom of borehole at 50.0 feet.

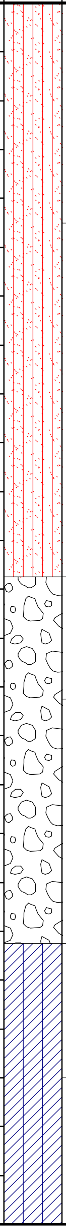
BORING NUMBER BH-13

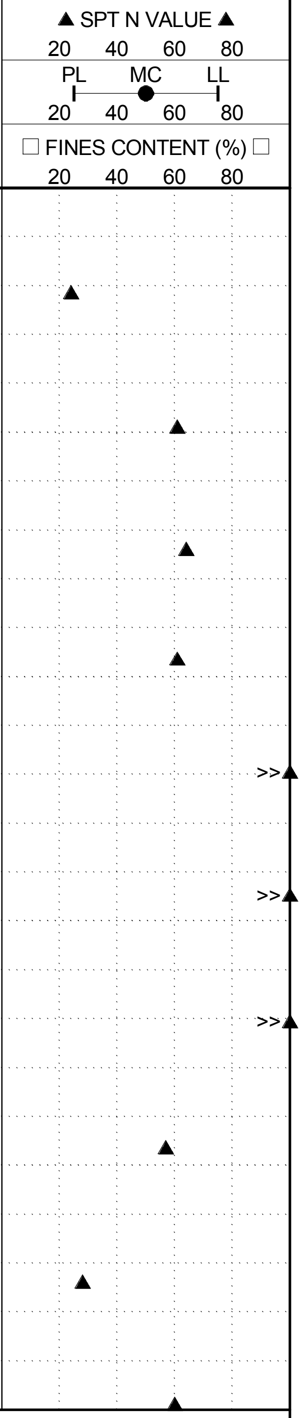
PAGE 1 OF 1

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 1/17/13 **COMPLETED** 1/17/13
GROUND ELEVATION ____ **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY** ____
AT END OF DRILLING ---
NOTES ____
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(ML) very stiff, light gray, SANDY SILT and gravel, dry, slightly cohesive					
		AU Bulk		12-11-13 (24)		
10	(ML) hard, light brown, SANDY SILT and gravel, dry, slightly cohesive, trace CaCO3			28-28-33 (61)		
		AU Bag AU Bulk		13-29-35 (64)		
20				21-30-31 (61)		
	(GW-GM) very dense, brown, GRAVEL and sandy silt, dry, slightly cohesive fines	AU Bulk		28-50/3"		
30	(GW) very dense, brown, GRAVEL, some silty sand, dry, reddish brown clayey silt encountered at 34'			21-50/4"		
		AU Bulk		27-49- 50/2"		
40	(CL-ML) hard, reddish brown, SILTY CLAY, slightly moist, cohesive, trace rock inclusions	SS AU Bag AU Bulk		13-24-33 (57)		
	(CL-ML) very stiff-hard, red, SILTY CLAY, dry, rock inclusions, cohesive	SS		9-14-14 (28)		
50				25-32-28 (60)		

Bottom of borehole at 50.0 feet.



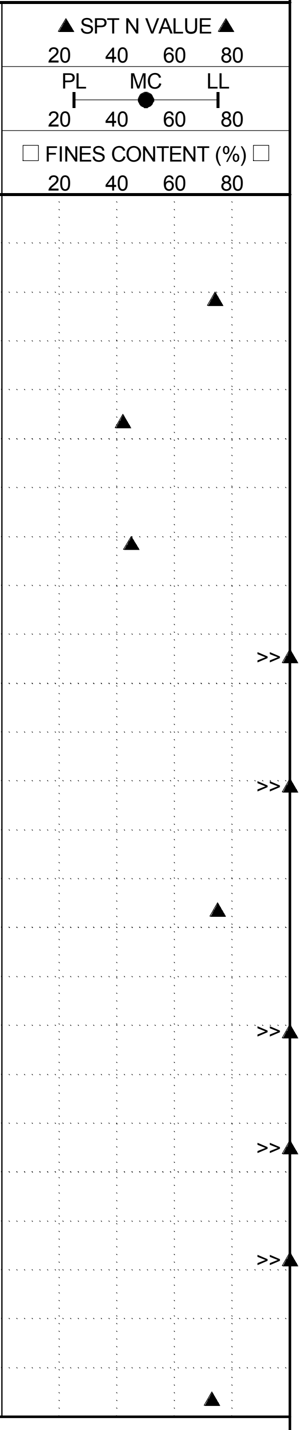


BORING NUMBER BH-14

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 1/22/13 **COMPLETED** 1/22/13
GROUND ELEVATION **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(ML) very stiff, brown, SILT, some gravel, dry	AU Bulk				
	(ML) hard, brown, SILT and gravel, dry, cementation at 4-5 ft	SS		23-44-30 (74)		
		AU Bulk				
10	(GW-GM) dense, light brown/gray, GRAVEL and sandy silt, dry, slightly cohesive fines, (<1.5" - 60%; 1.5-3" - 20%, >3" - 20%)	SS		15-19-23 (42)		
		AU Bulk		22-20-25 (45)		
20	(GW) very dense, light brown/gray, GRAVEL and silty sand	AU Bag(2)		17-50/3"		
	(ML) hard, light gray, SANDY SILT and gravel, dry	AU Bulk		18-35-50/4"		
30 40	(SW-SM) very dense, brown/gray, SILTY SAND and gravel, dry	AU Bulk		25-50 (75) 33-32-50/5" 16-50/5" 50/1"		
50		SS		31-29-44 (73)		



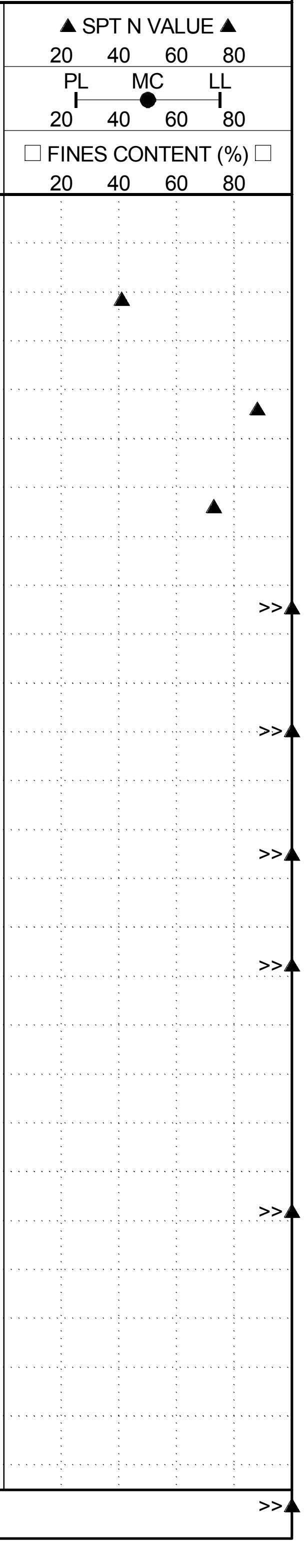
Bottom of borehole at 50.0 feet.

BORING NUMBER BH-15

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 1/4/13 **COMPLETED** 1/8/13
GROUND ELEVATION ____ **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger, Air Hammer
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY** ____
AT END OF DRILLING ---
NOTES ____
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(ML) hard, light gray/light brown, SILT, little gravel, dry	AU Bulk		9-15-26 (41)		
	(GW) very dense, brown, SANDY GRAVEL, dry	SS AU Bag		38-50 (88)		
10	(SW) very dense, gray, SAND and gravel, dry	AU Bag				
	(GW) very dense, gray, SANDY GRAVEL, dry	SS AU Bag(2) SS		17-23-50 (73) 30-50/3"		
20	(SW) very dense, light gray, SAND and gravel, dry	AU Bulk				
	(ML) hard, light gray, SANDY SILT and gravel, dry	AU Bag(2) SS		28-50/4" 22-50/5"		
30	(SW) very dense, gray, SAND and gravel, dry	AU Bag(2)				
	(SW-SM) very dense, light gray, SILTY SAND, some gravel, dry	AU Bag(2)		20/0"		
40	(SW) very dense, light gray, SAND and gravel, dry	AU Bag(2)				
	(ML) very dense, gray/brown, SANDY SILT, and gravel, dry, slightly cohesive	AU Bag(2)		50/2"		
50	(MH) hard, reddish brown, CLAYEY SILT, some gravel, slightly moist, slightly cohesive					
	Bottom of borehole at 53.0 feet.			24-54- 38/3"		



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BORING NUMBER BH-16

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.

PROJECT NAME Geotech Investigation, Tailings Storage Facility

PROJECT NUMBER 103-92557

PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico

DATE STARTED 1/22/13 **COMPLETED** 1/22/13

GROUND ELEVATION **HOLE SIZE** 8.25 inches

DRILLING CONTRACTOR Yellow Jacket

GROUND WATER LEVELS:

DRILLING METHOD Air Hammer

AT TIME OF DRILLING ---

LOGGED BY CMT **CHECKED BY**

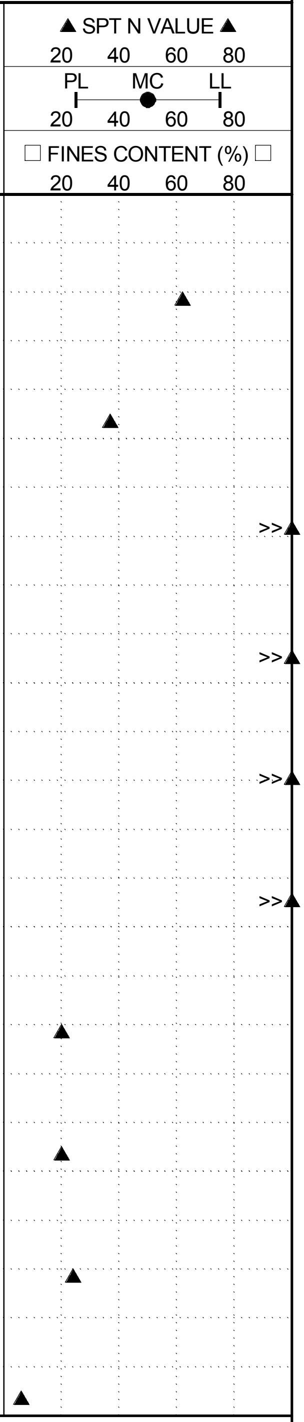
AT END OF DRILLING ---

NOTES Moved BH-16 4 feet north

AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(GW-GM) very dense, brown, GRAVEL and sandy silt, dry	AU Bulk		9-32-30 (62)		
10	(GP-GM) very dense, gray, GRAVEL and sandy silt, dry	AU Bulk		26-18-19 (37)		
20	(GW) very dense, light brown, GRAVEL and silty sand, dry, trace CaCO3	AU B/Bulk		50/3" 26-50/4" 48-50/3" 21-50/3"		
30	(ML) very stiff - hard, gray, SANDY SILT, some gravel, trace clayey silt, trace CaCO3, dry, some cementation	AU Bulk				
	(MH) very stiff, light reddish brown, CLAYEY SILT, dry	SS AU Bulk		13-8-12 (20)		
40	(CL-ML) very stiff, reddish brown, SILTY CLAY, slightly moist	AU Bulk		14-9-11 (20) 17-11-13 (24)		
50	(CL-ML) firm, reddish brown, SILTY CLAY, slightly moist, caliche and rock inclusions	SS		4-2-4 (6)		

Bottom of borehole at 50.0 feet.



Golder Associates

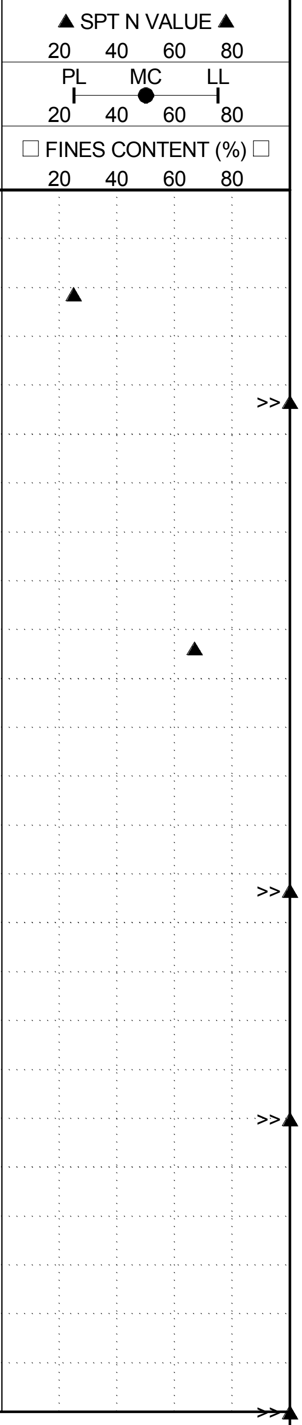
BORING NUMBER BH-17

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 1/5/13 **COMPLETED** 1/10/13
GROUND ELEVATION **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(ML) very stiff, gray/light brown, SANDY SILT and gravel, dry	AU Bag AU Bulk		10-13-12 (25)		
	(GW) very dense, gray, SANDY GRAVEL, dry	SS		4-45-50/4"		
10	(GW) very dense, brown/gray, GRAVEL, some sand, dry	AU Bulk				
20	(GW) very dense, brown/gray, GRAVEL, some sand, dry	AU Bulk		7-28-39 (67)		
	(SW) very dense, light brown, SAND and gravel, dry					
	(SW) very dense, light gray/ light brown, SAND, some gravel, dry					
30	(SW-SM) very dense, brown, SILTY SAND and gravel, dry, slightly cohesive fines	SS		24-50-50/4"		
40	very dense, white/gray caliche, dry	AU Bulk		25/0"		
50	very dense, white/gray caliche, dry, little gravel, seam of light brown silt at 44-45'			25/0"		

Bottom of borehole at 50.0 feet.



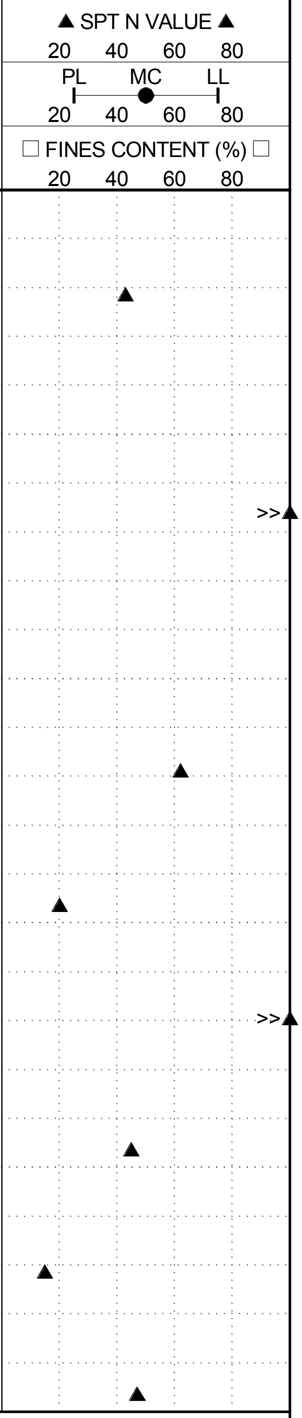
BORING NUMBER BH-18

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 1/23/13 **COMPLETED** 1/23/13
GROUND ELEVATION **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger, Air Hammer
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY**
AT END OF DRILLING ---
NOTES Moved BH-18 2 feet east
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		(ML) stiff, light brown, SANDY SILT, some gravel, dry	AU Bag				
		(GP-GM) dense, light brown, GRAVEL and sandy silt, dry, *hollow stem auger stopped at 8 ft.	AU Bulk		9-23-20 (43)		
10		(GW) very dense, light brown/gray, GRAVEL and sand, dry, little CaCO3	AU Bulk		50/4"		
20		(ML) hard, light reddish white, SANDY SILT, some gravel, dry, some CACO3	AU Bag(2)				
30		(MH) hard, light reddish brown, CLAYEY SILT, trace gravel, dry	AU Bulk SS		24-31-31 (62) 13-8-12 (20)		
		(CL-ML) hard, reddish brown, CLAY, some silty clay, rock inclusions, moderate plasticity, dry			38-50/3"		
40		(CL) hard, reddish brown, CLAY, moderate plasticity, slightly moist	SS AU Bulk		11-21-24 (45)		
50		(CH) stiff-hard, reddish brown, CLAY, high plasticity, slightly moist, blocky	SS AU Bag SS		5-6-9 (15) 10-19-28 (47)		

Bottom of borehole at 50.0 feet.



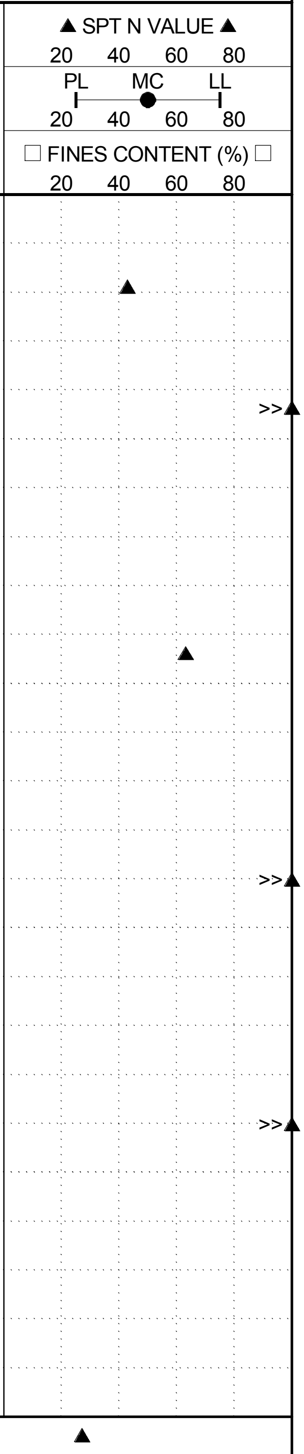
Golder Associates

BORING NUMBER BH-19

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 1/10/13 **COMPLETED** 1/11/13
GROUND ELEVATION **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Air Hammer
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(ML) soft, brown, SANDY SILT, little gravel, dry					
	(SW-SM) dense, light brown, SILTY SAND and gravel, dry	SS		11-21-22 (43)		
		AU Bulk		19-38-50/5"		
10	(GW) very dense, brown/gray, SANDY GRAVEL, dry	AU Bulk				
	(GW) very dense, dark gray, GRAVEL, dry	AU Bag				
20	(GW) very dense, brown/gray, SANDY GRAVEL, dry	AU Bag(2)		27-40-23 (63)		
30	very dense, light gray/white, CALICHE, little gravel, dry	AU B/Bag		50/0"		
40	very dense, white, CALICHE, seam of brown sandy silt at 41' - 42', dry	AU Bulk		25/0"		
	(CL-ML) very stiff, red, SILTY CLAY, slightly moist, cohesive	AU Bulk				
50	(CL-ML) very stiff, red, SILTY CLAY, moist, cohesive	AU Bag				
	Bottom of borehole at 50.0 feet.			5-13-14 (27)		

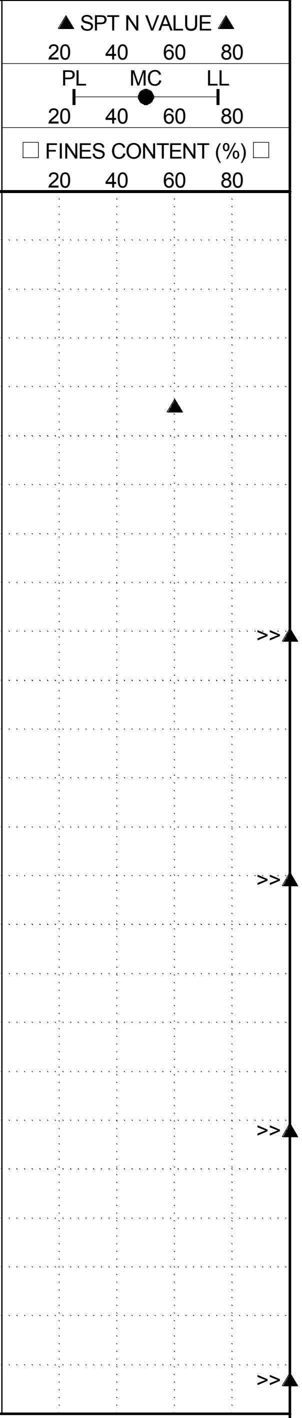


BORING NUMBER BH-20

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 1/20/13 **COMPLETED** 1/20/13
GROUND ELEVATION **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Air Hammer
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY**
AT END OF DRILLING ---
NOTES BH-20 on top of waste rock pile, moved BH-20 25 feet east
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		(SM) compact, brown, SILTY SAND, little gravel, dry	AU Bag(2)				
		(SM) compact - dense, light gray, SILTY SAND, little gravel, dry, slightly cohesive, trace clayey silt	AU Bag				
10		(GW) very dense, gray, GRAVEL, some silty sand, dry, trace clayey silt inclusions	AU Bulk		16-29-31 (60)		
20 30 40		(SW-SM) very dense, light brown/gray, SILTY SAND and gravel, dry, slightly cohesive, some light reddish brown clayey silt	AU Bulk AU Bulk SS		50/3" 50/3" 15-50/3"		
50		(SM) very dense, light brown, SILTY SAND, some gravel, slightly moist, slightly cohesive	AU Bulk		21-36-50/2"		



Bottom of borehole at 50.0 feet.

BORING NUMBER BH-21

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.

PROJECT NAME Geotech Investigation, Tailings Storage Facility

PROJECT NUMBER 103-92557

PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico

DATE STARTED 1/24/13 **COMPLETED** 1/24/13

GROUND ELEVATION **HOLE SIZE** 8.25 inches

DRILLING CONTRACTOR Yellow Jacket

GROUND WATER LEVELS:

DRILLING METHOD Air Hammer

AT TIME OF DRILLING ---

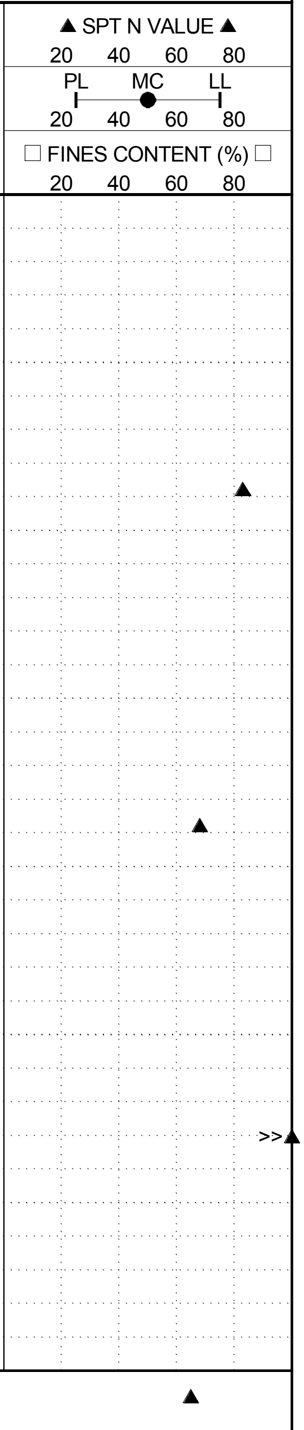
LOGGED BY CMT **CHECKED BY**

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		(GW) very dense, brown/gray, GRAVEL and sand, dry					
8			AU Bulk		21-36-47 (83)		
18		(SW-SM) very dense, light brown/reddish white, SILTY SAND and gravel, trace clayey silt, cementation, dry			25-30-38 (68)		
28					50/0"		
30		(MH) hard, light reddish brown, CLAYEY SILT and silty clay, trace gravel, dry	AU Bag(2)				
35		Bottom of borehole at 35.0 feet.			15-26-39 (65)		



BORING NUMBER BH-22

CLIENT New Mexico Copper Corp.

PROJECT NAME Geotech Investigation, Tailings Storage Facility

PROJECT NUMBER 103-92557

PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico

DATE STARTED 1/21/13 **COMPLETED** 1/22/13

GROUND ELEVATION **HOLE SIZE** 8.25 inches

DRILLING CONTRACTOR Yellow Jacket

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger, Air Hammer

AT TIME OF DRILLING ---

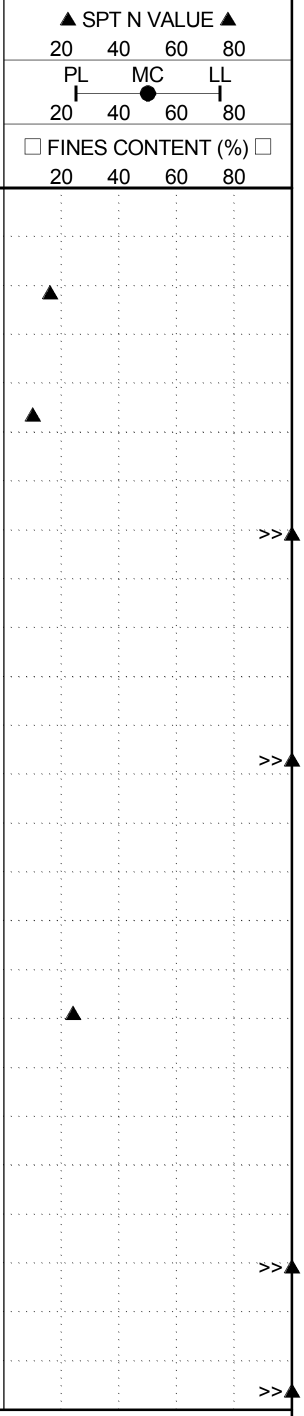
LOGGED BY CMT **CHECKED BY**

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		(ML) loose, dark brown, SANDY SILT, some gravel, dry	AU Bag				
		(ML) very stiff, yellowish/orange, SILT, trace gravel, dry (old tailings)	AU Bulk		16-8-8 (16)		
		(ML) very stiff, orange/brown, SILT, slightly moist, cohesive, (old tailings)	AU Bulk				
10		(ML) stiff, greenish-gray, SILT, some sand, moist, cohesive, (old tailings)	AU Bulk		5-4-6 (10) 9-10-50/3"		
20		(GW) very dense, light gray-gray, GRAVEL and sand, dry, CaCO3 inclusions	AU Bag				
		(ML) hard, light gray/yellowish, SILT, some gravel, slightly moist, slightly cohesive	AU Bag(2)		23-50/3"		
30		(ML) hard, brown, SANDY SILT, some clayey silt, trace gravel, moist, cohesive fines	AU Bag				
		(CL-ML) very stiff, reddish brown, SILTY CLAY, moist, cohesive	AU Bulk		7-11-13 (24)		
40		(CL) hard, reddish brown, CLAY, dry, moderate plasticity	AU Bulk				
		(SM) hard, gray/brown, SILTY SAND, slightly moist	SS		20-45-50/3"		
50		(CL-ML) hard, brown, SILTY CLAY, slightly moist, rock inclusions	AU Bulk		10-17-50/5"		



Bottom of borehole at 50.0 feet.

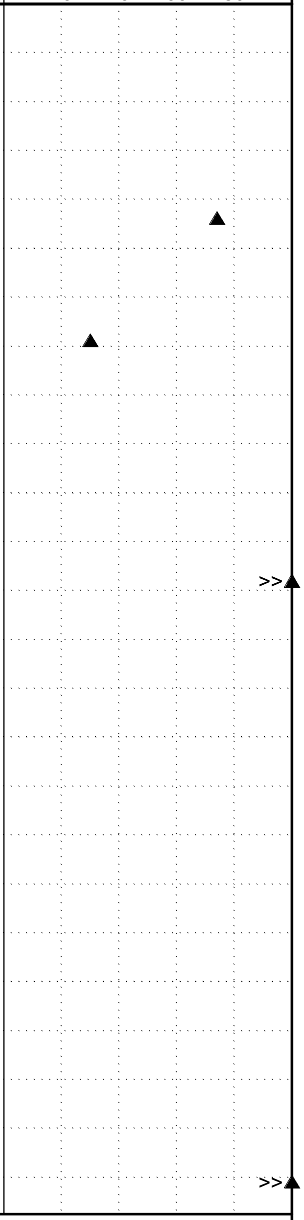
Golder Associates

BORING NUMBER BH-23

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 1/20/13 **COMPLETED** 1/21/13
GROUND ELEVATION **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Air Hammer
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY**
▼ **AT END OF DRILLING** 44.90 ft
NOTES Moved BH-23 20 feet southwest
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 ☐ FINES CONTENT (%) ☐ 20 40 60 80
0		(SP) loose, brown, SAND and gravel, dry	AU Bag					
		(ML) very stiff, yellowish, SILT, trace gravel, dry (old tailings)	AU SS					
		(ML) very stiff, yellowish, SILT, dry, slightly cohesive (old talings)	AU Bulk					
10		(GM) very dense, gray/brown, GRAVEL and silt, dry, slight cementation	AU SS AU SS		13-38-36 (74)			
		(ML) hard, white, SANDY SILT, little gravel, dry	AU Bag		13-16-14 (30)			
20		(SM) dense, gray, SILTY SAND and gravel, dry, CaCO3 inclusions, slight cementation	AU SS AU Bulk					
		(SM) very dense, gray, SILTY SAND and gravel, dry	AU Bag(2)		16-18-50/2"			
30		(SM) very dense, brown/gray, SILTY SAND, some gravel, dry, trace clayey silt, slightly moist	AU Bulk					
40	▼	(SM) very dense, brown, SILTY SAND, some gravel, some blocky and cohesive clayey silt (low plasticity), slightly moist	AU Bulk		50			
		(ML) very dense, brown, SANDY SILT, wet, rock inclusions	AU SS		50/4"			



Bottom of borehole at 49.5 feet.

BORING NUMBER BH-24

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 1/19/13 **COMPLETED** 1/19/13
GROUND ELEVATION **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Air Hammer
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 ☐ FINES CONTENT (%) ☐ 20 40 60 80
0		(SP) dense, gray/brown, SAND and gravel, dry, trace CaCO3	AU Bag(2)					
		(GW) very dense, gray, GRAVEL and sand (50%), dry			50/4"			>>▲
10			AU Bulk					
		(GW) very dense, gray/light brown, GRAVEL and silty sand, dry			50/3"			>>▲
20			AU Bulk					
		(ML) hard/very dense, brown, SANDY SILT and gravel, trace clayey silt, dry			41-50/3"			>>▲
30			AU Bulk					
		(SM) very dense, gray/brown, SILTY SAND, some gravel, trace clayey silt, dry	AU Bulk					
					44-50/3"			>>▲
40		(ML) hard, light reddish brown, SANDY SILT, some gravel, trace clayey silt, dry, slightly cohesive	AU Bulk					
					50/1"			>>▲
50								

Bottom of borehole at 50.0 feet.

Golder Associates

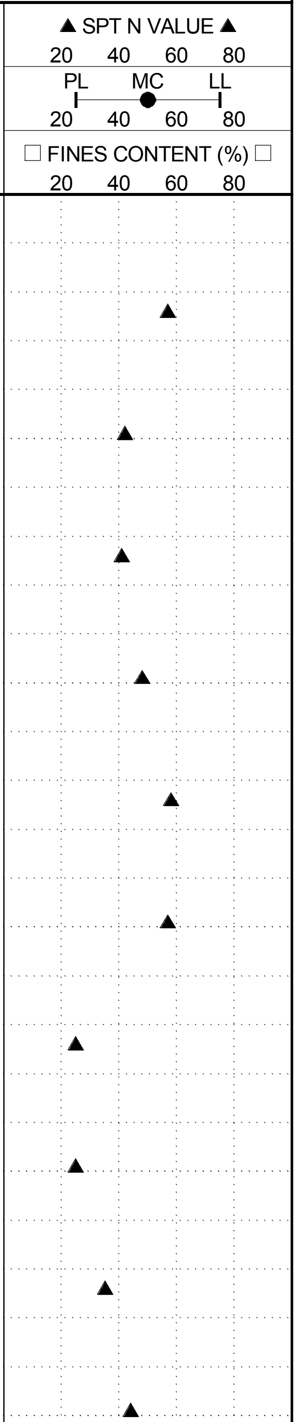
BORING NUMBER BH-25

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 1/18/13 **COMPLETED** 1/18/13
GROUND ELEVATION **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(GW) dense-very dense, gray/brown, GRAVEL and sandy silt, well graded, dry	AU Bulk		22-28-29 (57)		
10				39-26-16 (42)		
	(ML) hard, brown, SANDY SILT and gravel, dry, slightly cohesive fines, trace CaCO3	AU Bulk		18-21-20 (41)		
20				15-15-33 (48)		
	(MH) hard, light reddish brown, CLAYEY SILT, dry, cohesive, trace rock inclusions, trace CaCO3			10-27-31 (58)		
		AU Bulk				
30		AU SS		5-22-35 (57)		
		AU SS		6-9-16 (25)		
	(CL-ML) very stiff, red, SILTY CLAY, dry, cohesive	AU Bulk		8-8-17 (25)		
40		AU SS				
		AU SS		11-10-25 (35)		
	(CH) hard, red, CLAY, dry, sand seam at 44' to 44.5'	AU Bulk				
50		AU SS		10-18-26 (44)		

Bottom of borehole at 50.5 feet.



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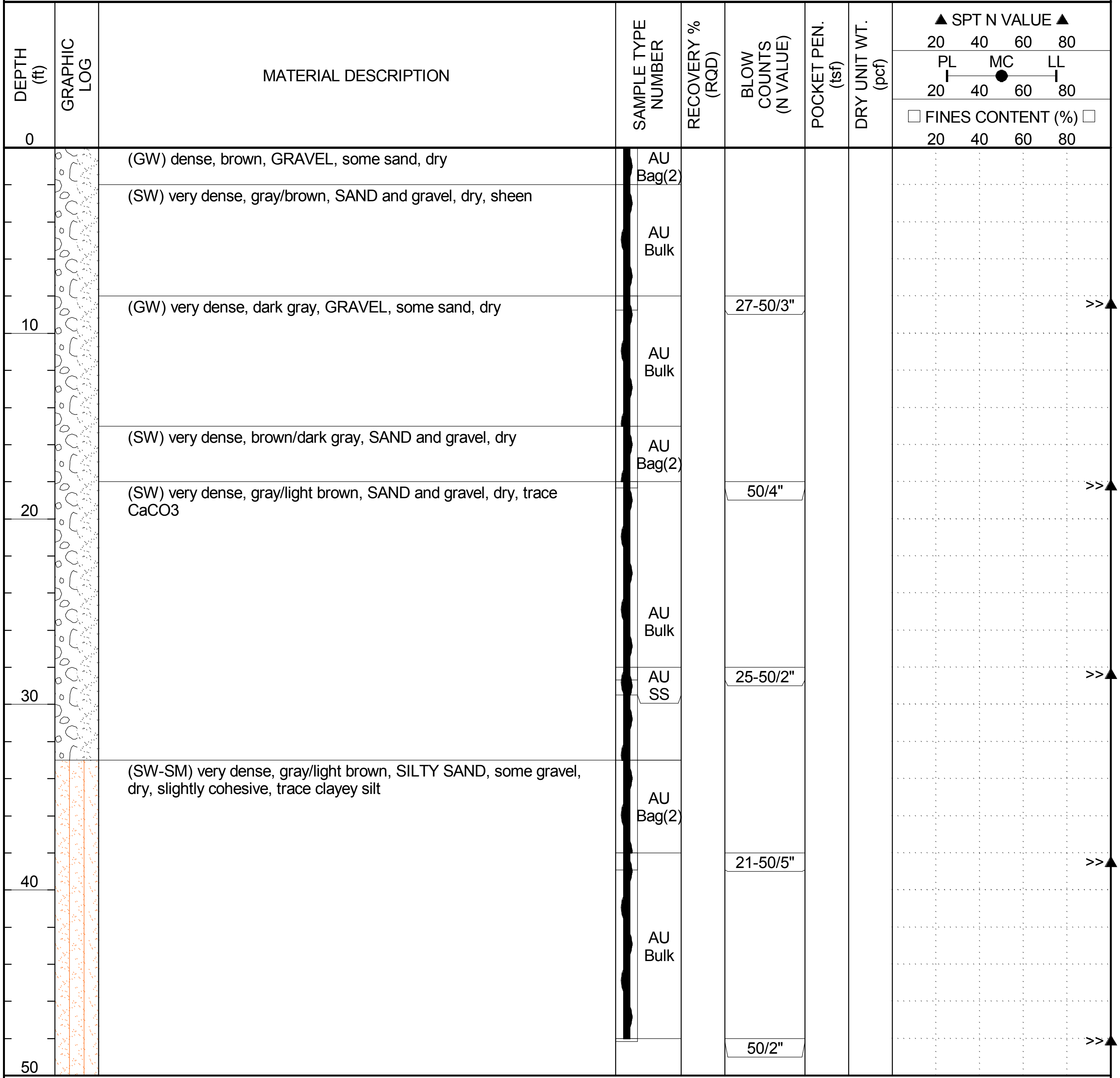
BORING NUMBER BH-26

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 1/18/13 **COMPLETED** 1/18/13
GROUND ELEVATION **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Air Hammer
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY**
AT END OF DRILLING ---
NOTES Moved BH-26 2 feet south
AFTER DRILLING ---



MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)
(GW) dense, brown, GRAVEL, some sand, dry	AU Bag(2)	
(SW) very dense, gray/brown, SAND and gravel, dry, sheen	AU Bulk	
(GW) very dense, dark gray, GRAVEL, some sand, dry	AU Bulk	27-50/3"
(SW) very dense, brown/dark gray, SAND and gravel, dry	AU Bag(2)	
(SW) very dense, gray/light brown, SAND and gravel, dry, trace CaCO3	AU Bulk AU SS	50/4" 25-50/2"
(SW-SM) very dense, gray/light brown, SILTY SAND, some gravel, dry, slightly cohesive, trace clayey silt	AU Bag(2) AU Bulk	21-50/5" 50/2"

Bottom of borehole at 50.0 feet.

Golder Associates

BORING NUMBER BH-27

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.

PROJECT NAME Geotech Investigation, Tailings Storage Facility

PROJECT NUMBER 103-92557

PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico

DATE STARTED 1/23/13 **COMPLETED** 1/23/13

GROUND ELEVATION **HOLE SIZE** 8.25 inches

DRILLING CONTRACTOR Yellow Jacket

GROUND WATER LEVELS:

DRILLING METHOD Air Hammer, Hollow Stem Auger

AT TIME OF DRILLING ---

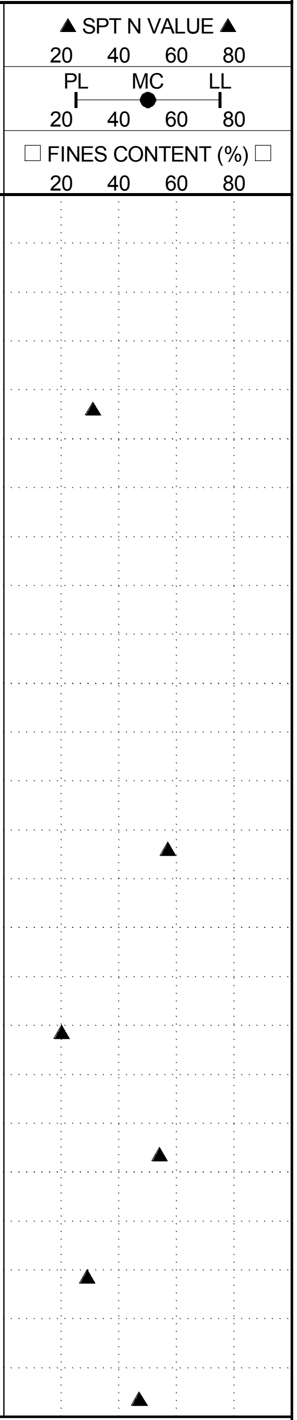
LOGGED BY CMT **CHECKED BY**

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		(SM) dense, brown, SILTY SAND and gravel (50%), dry, trace CaCO3, some cementation	AU Bulk AU SS		17-16-15 (31)		
10		(ML) hard, light brown/white-gray, SANDY SILT, some gravel, dry, some CaCO3, cementation	AU Bulk AU SS		30-58		
20		(SW) very dense, brown, SAND and gravel, dry					
		(CH) hard, reddish brown, CLAY, dry	AU SS		20-24-33 (57)		
30		(MH) very stiff, light reddish brown, CLAYEY SILT, some clay, dry, trace gravel	AU Bulk		10-7-13 (20)		
40		(CL-ML) very stiff-hard, reddish brown, SILTY CLAY, dry, low plasticity, trace CaCO3 inclusions	AU SS AU Bulk AU SS		12-24-30 (54) 10-12-17 (29) 14-20-27 (47)		
50							



Bottom of borehole at 50.0 feet.

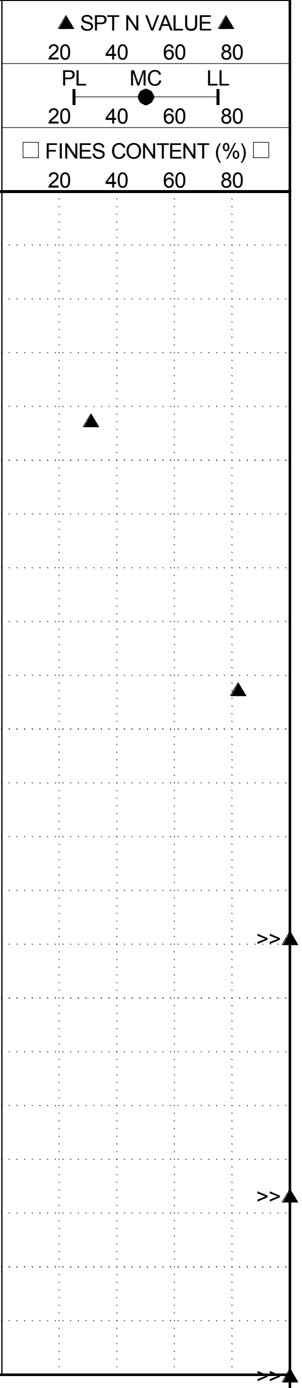
Golder Associates

BORING NUMBER BH-28

PAGE 1 OF 1

CLIENT New Mexico Copper Corp.
PROJECT NAME Geotech Investigation, Tailings Storage Facility
PROJECT NUMBER 103-92557
PROJECT LOCATION Copper Flat Mine, Sierra County, New Mexico
DATE STARTED 12/18/12 **COMPLETED** 12/18/12
GROUND ELEVATION **HOLE SIZE** 8.25 inches
DRILLING CONTRACTOR Yellow Jacket
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY CMT **CHECKED BY**
AT END OF DRILLING ---
NOTES Moved BH-28 2 feet east
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(GW) dense, light gray, SANDY GRAVEL, dry, < 1.5" - 50%, 1.5" to 3" - 30%, > 3" - 20%	AU Bag				
		AU SS AU Bulk and Bag		9-13-18 (31)		
5	(GP) dense, light gray, SANDY GRAVEL, dry, < 1.5" - 70%, 1.5" to 3" - 25%, > 3" - 5%					
	(GP) very dense, light gray, SANDY GRAVEL, white inclusions, sheen, dry	AU SS		22-32-50 (82)		
10	(GW) very dense, light gray, SANDY GRAVEL, dry, < 1.5" - 50%, 1.5" to 3" - 35%, > 3" - 15%	AU Bag				
	(SM) very dense, light brown and gray, gravelly SILTY SAND, dry	AU Bulk and Bag				
15	(SW) very dense, light brown and gray, gravelly SAND, sheen, dry			30-30/3"		
	(GW) seam, very dense, light gray, SANDY GRAVEL, dry	AU SS		50/4"		
20	(GW) very dense, light brown, SANDY GRAVEL, dry, < 1.5" - 75%, 1.5" to 3" - 20%, > 3" - 5%	AU Bag				
	(SW) very dense, light brown and gray, gravelly SAND, sheen, dry			50/0"		



Refusal at 22.0 feet.
Bottom of borehole at 22.0 feet.

Appendix E.

Hydrographs
(pit, pit area wells, waste rock/mill site area wells, and TSF wells)

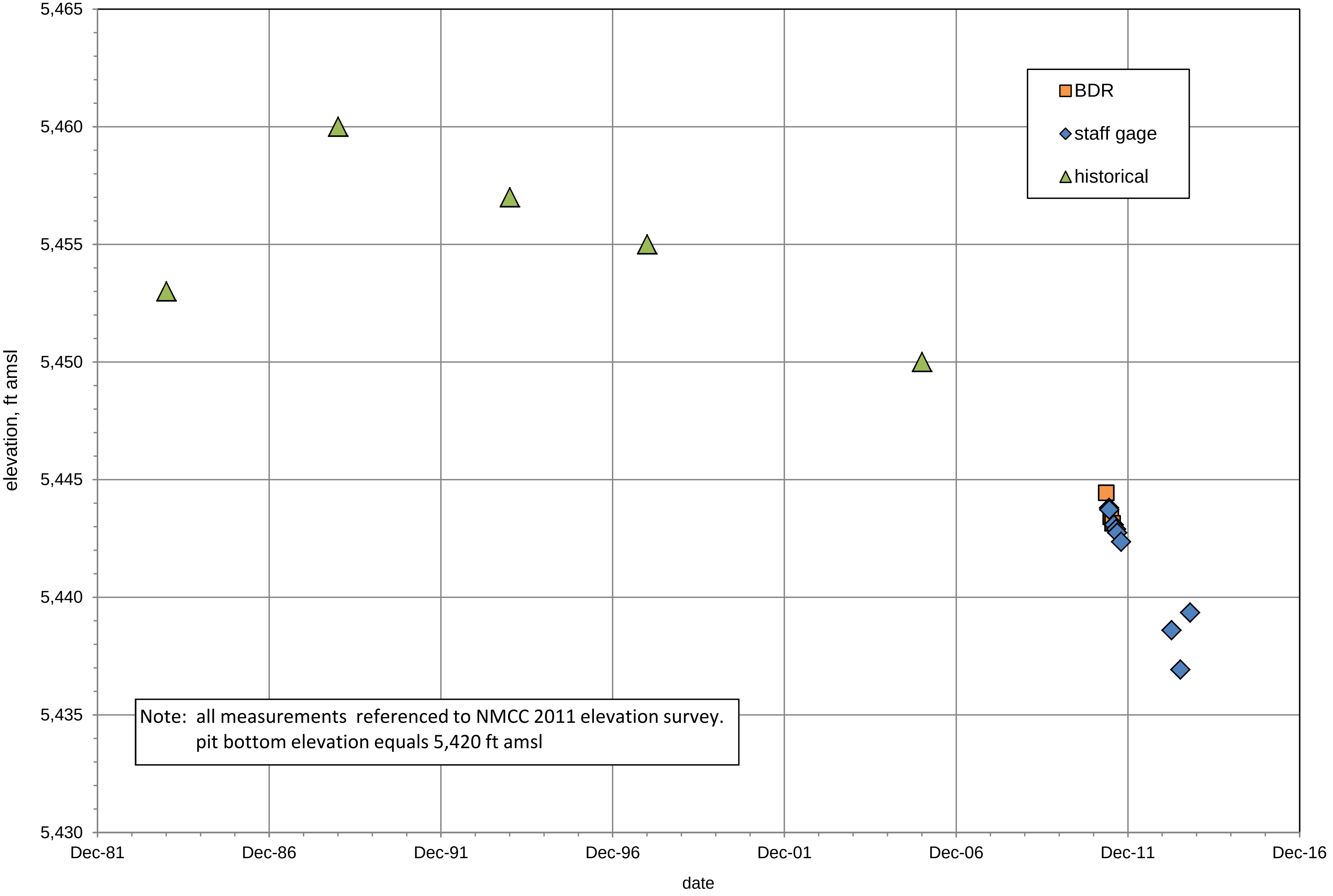


Figure E1. Hydrograph of pit water level elevation (reconstructed historical, BDR, Staff gage).

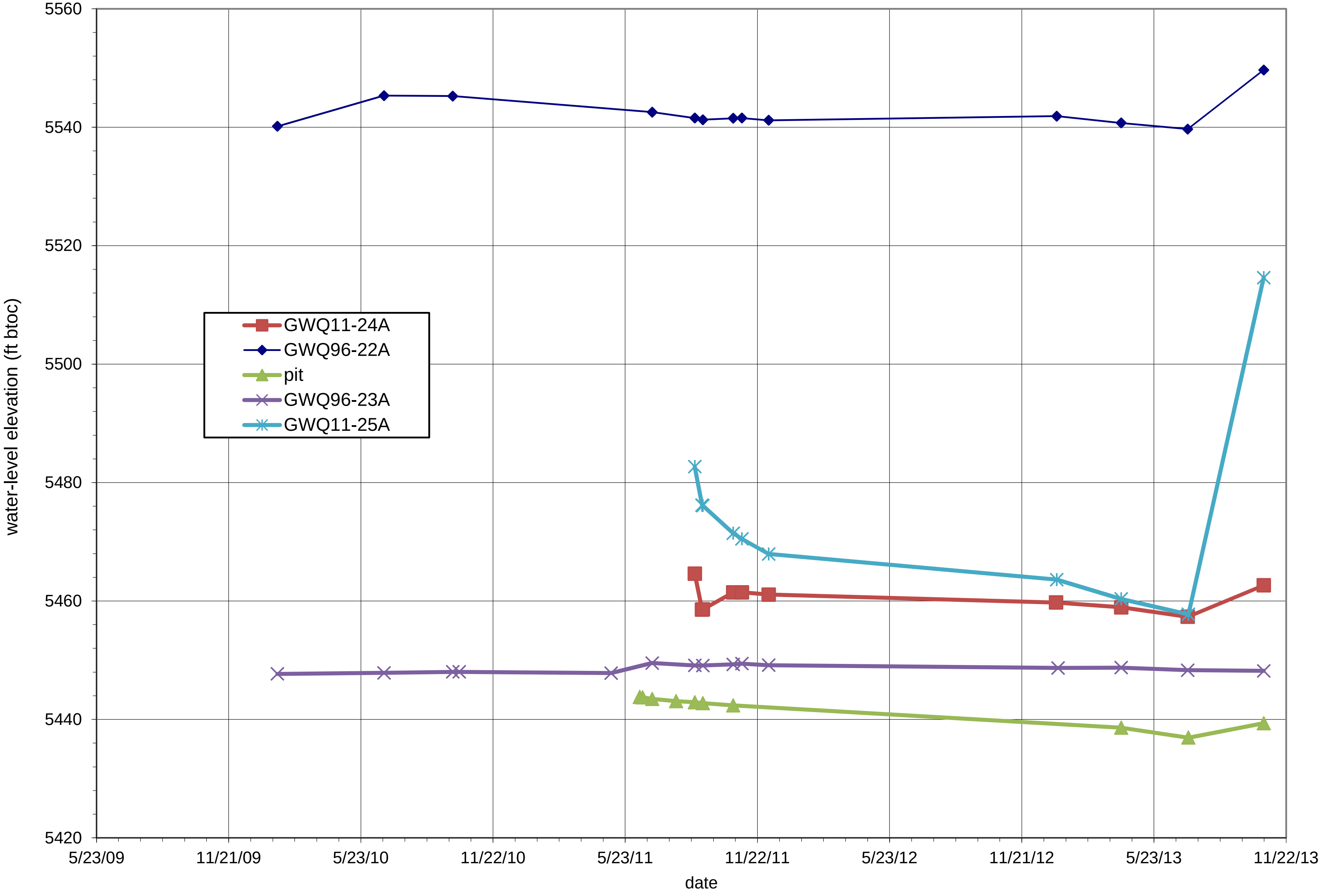


Figure E2. Hydrograph of pit area wells and pit water levels.

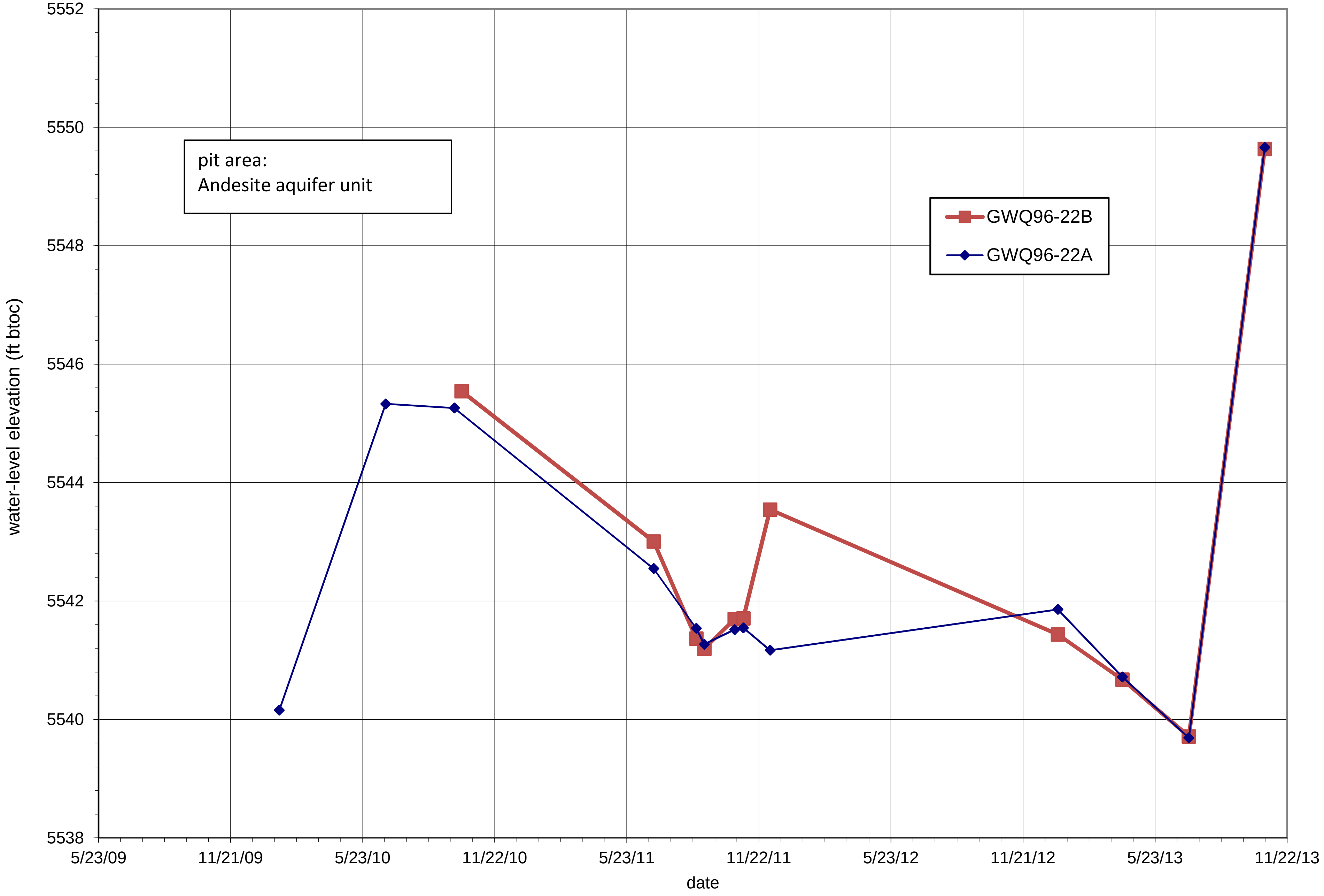


Figure E3. Hydrograph of pit area well GWQ96-22(A, B).

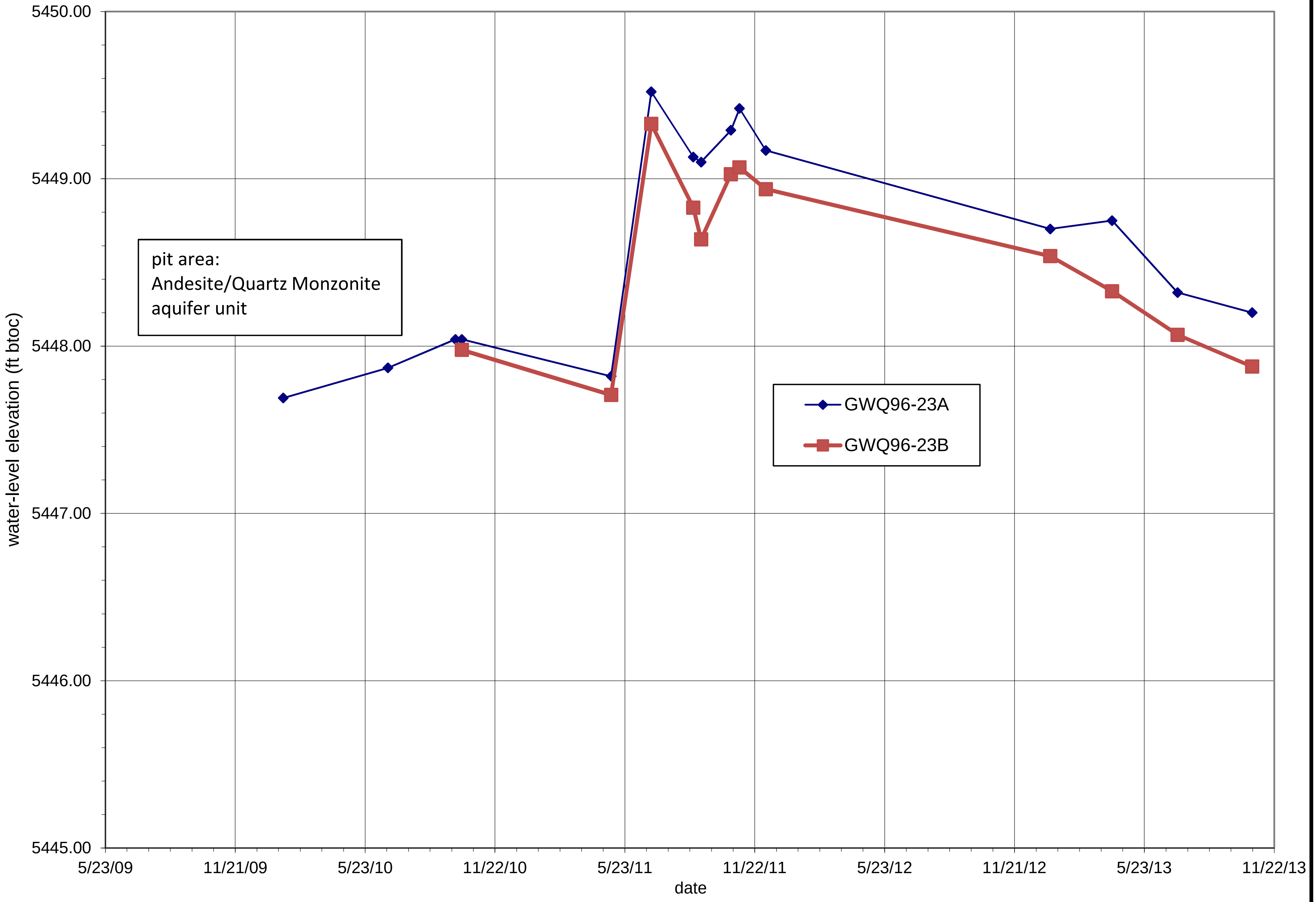


Figure E4. Hydrographs of pit area well GWQ96-23(A, B).

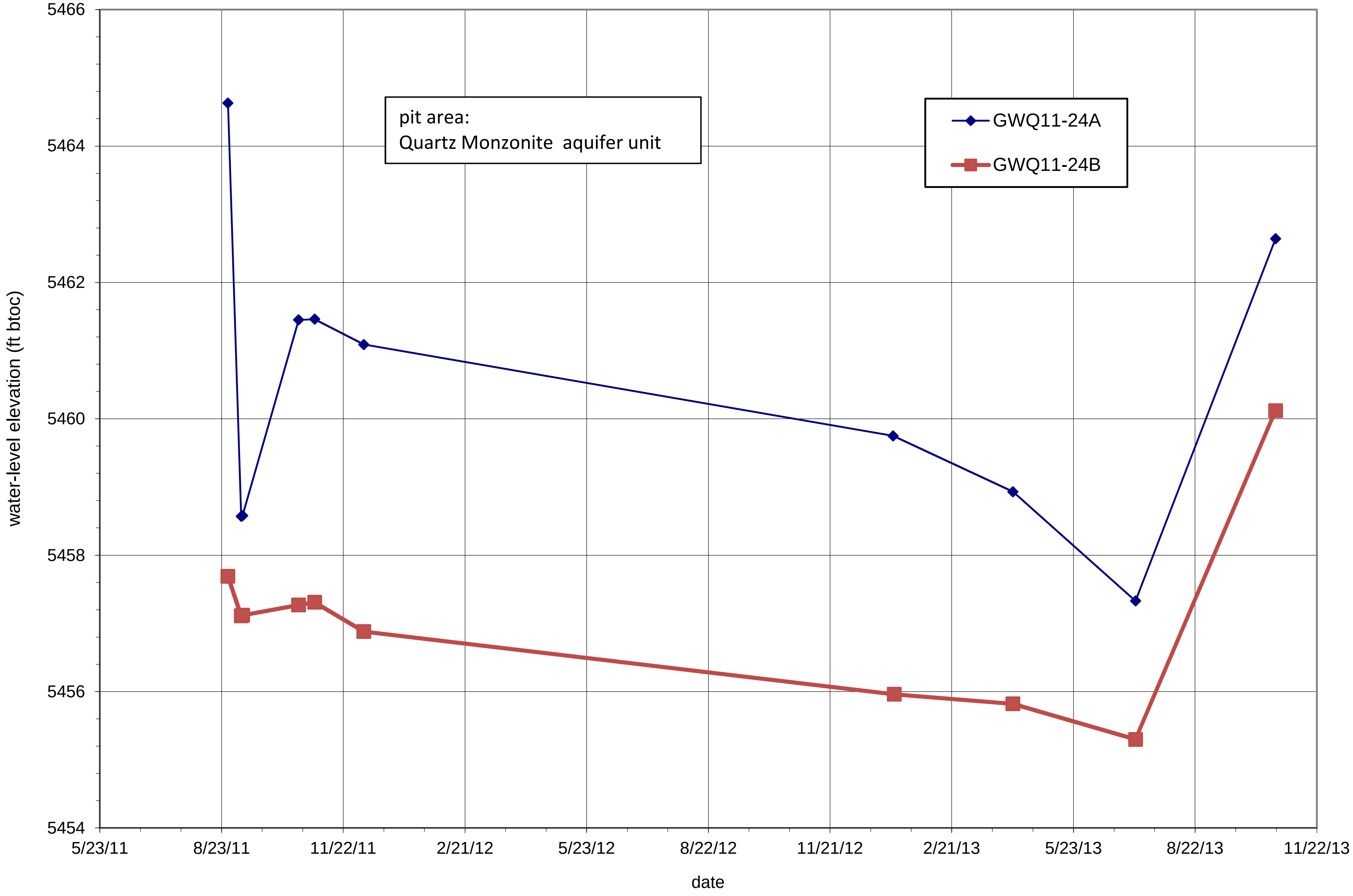


Figure E5. Hydrographs of pit area well GWQ11-24(A,B).

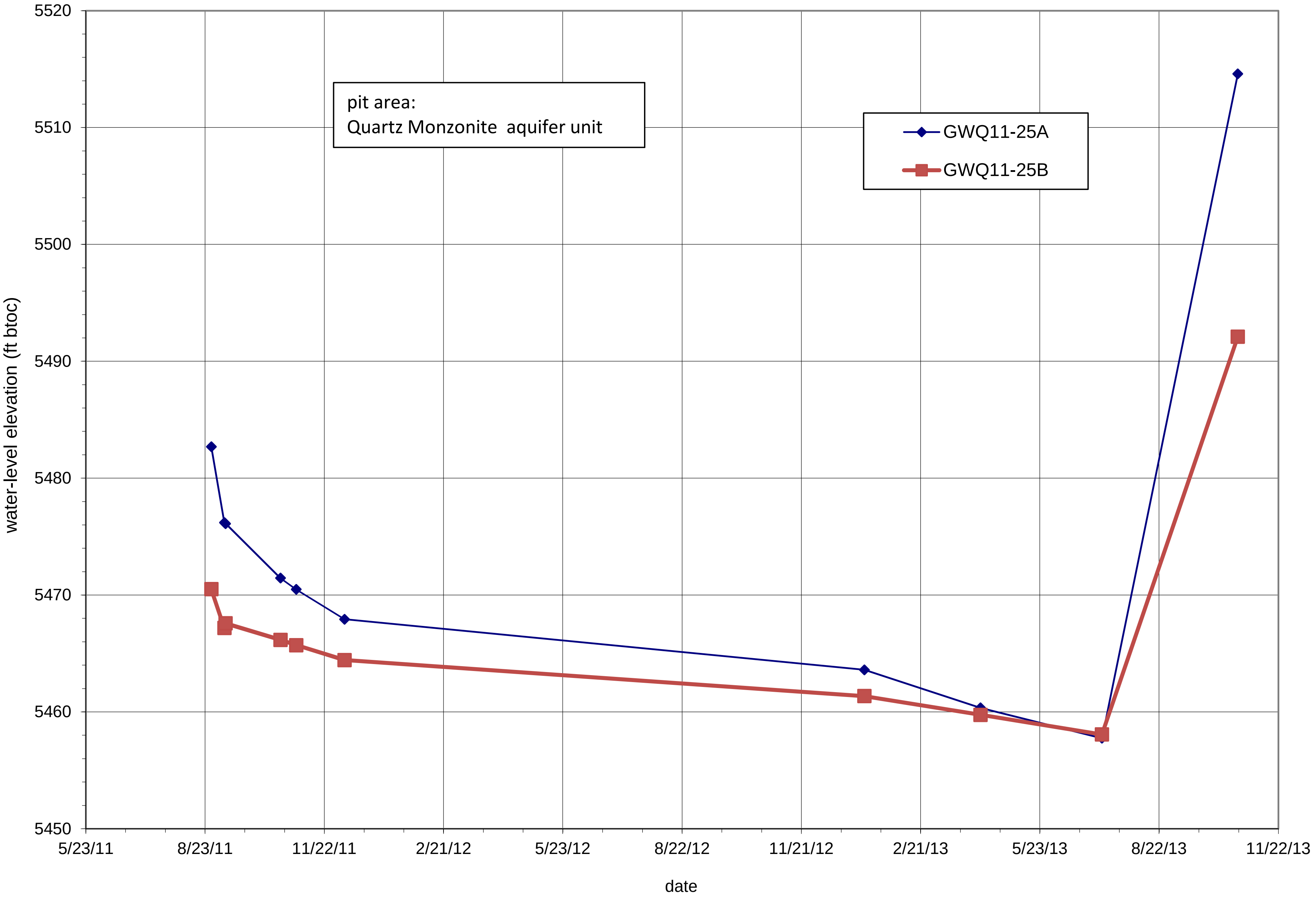


Figure E6. Hydrographs of pit area well GWQ11-25(A, B).

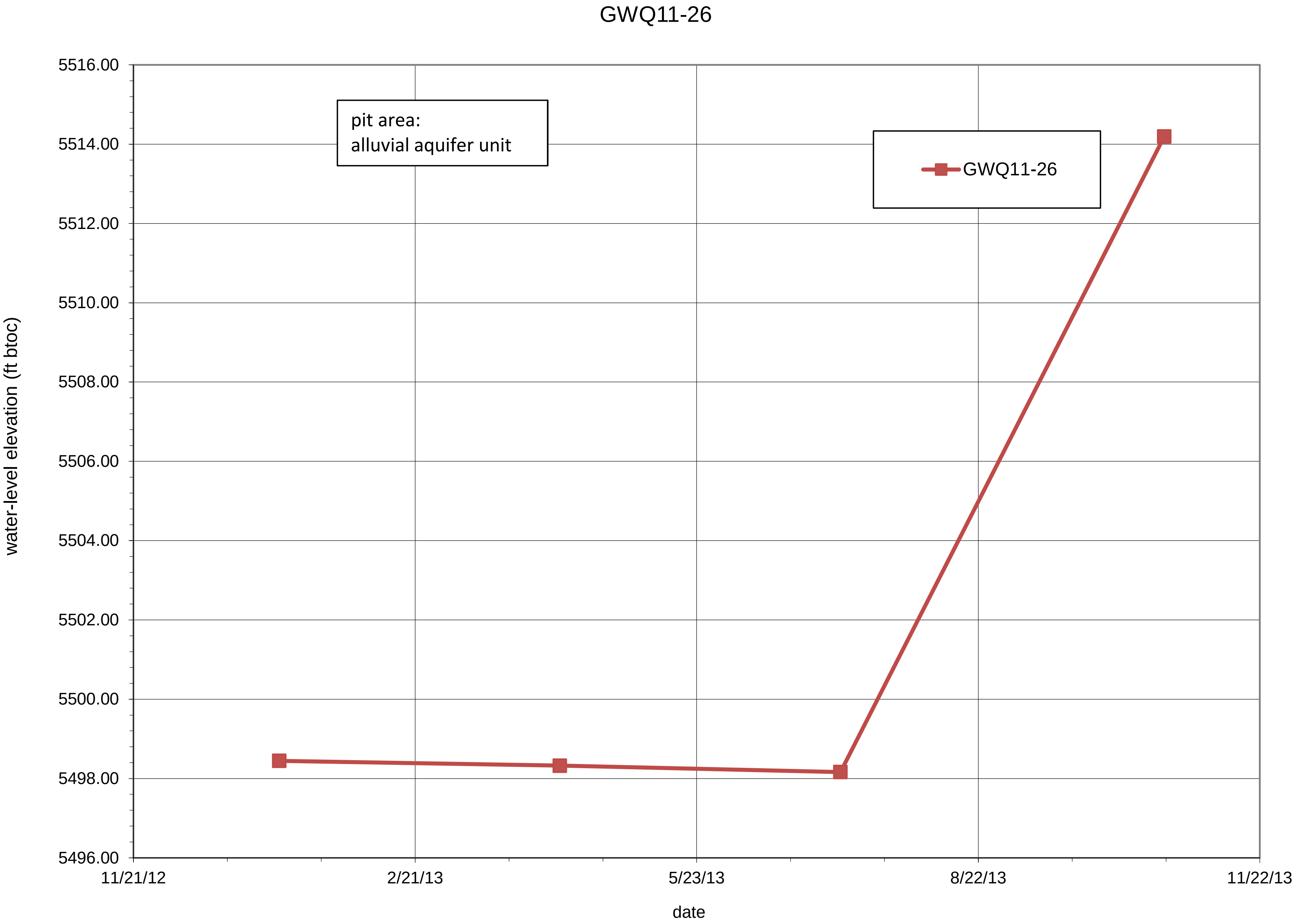


Figure E7. Hydrograph of pit area well GWQ11-26

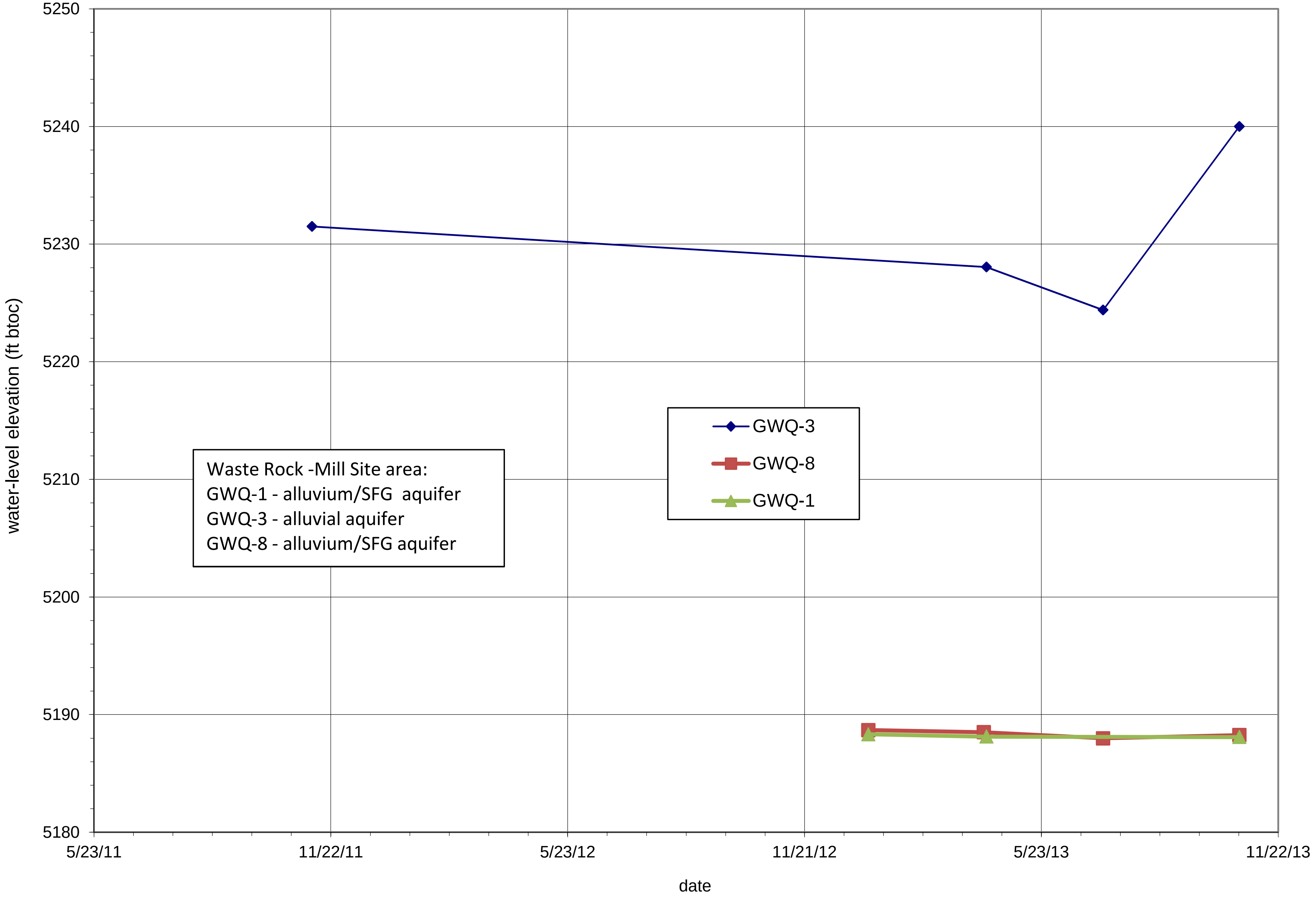


Figure E8. Hydrographs of waste rock pile area wells in GWQ-1, GWQ-3, and GWQ-8 Grayback Arroyo.

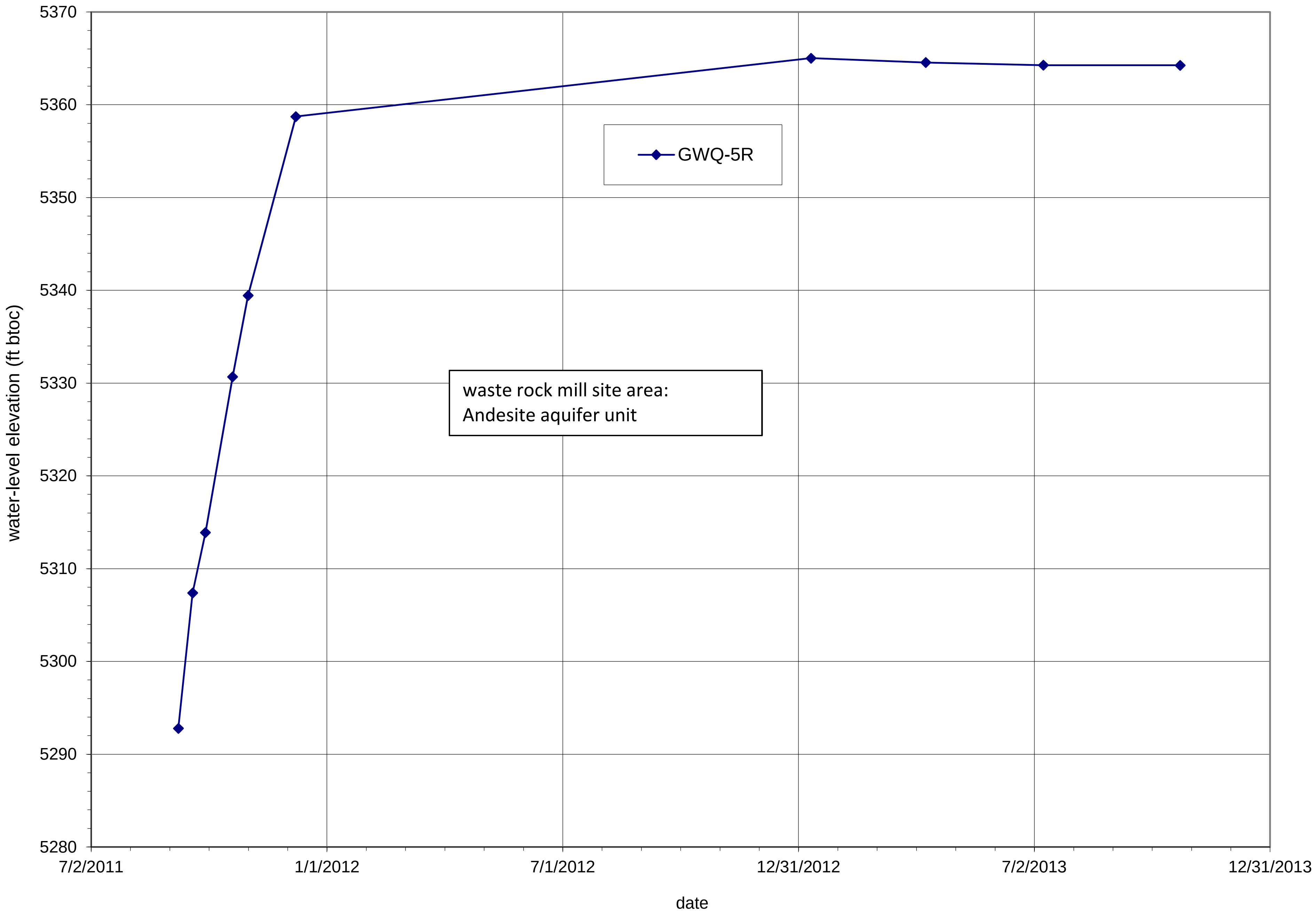


Figure E9. Hydrograph of waste rock area well GWQ-5R.

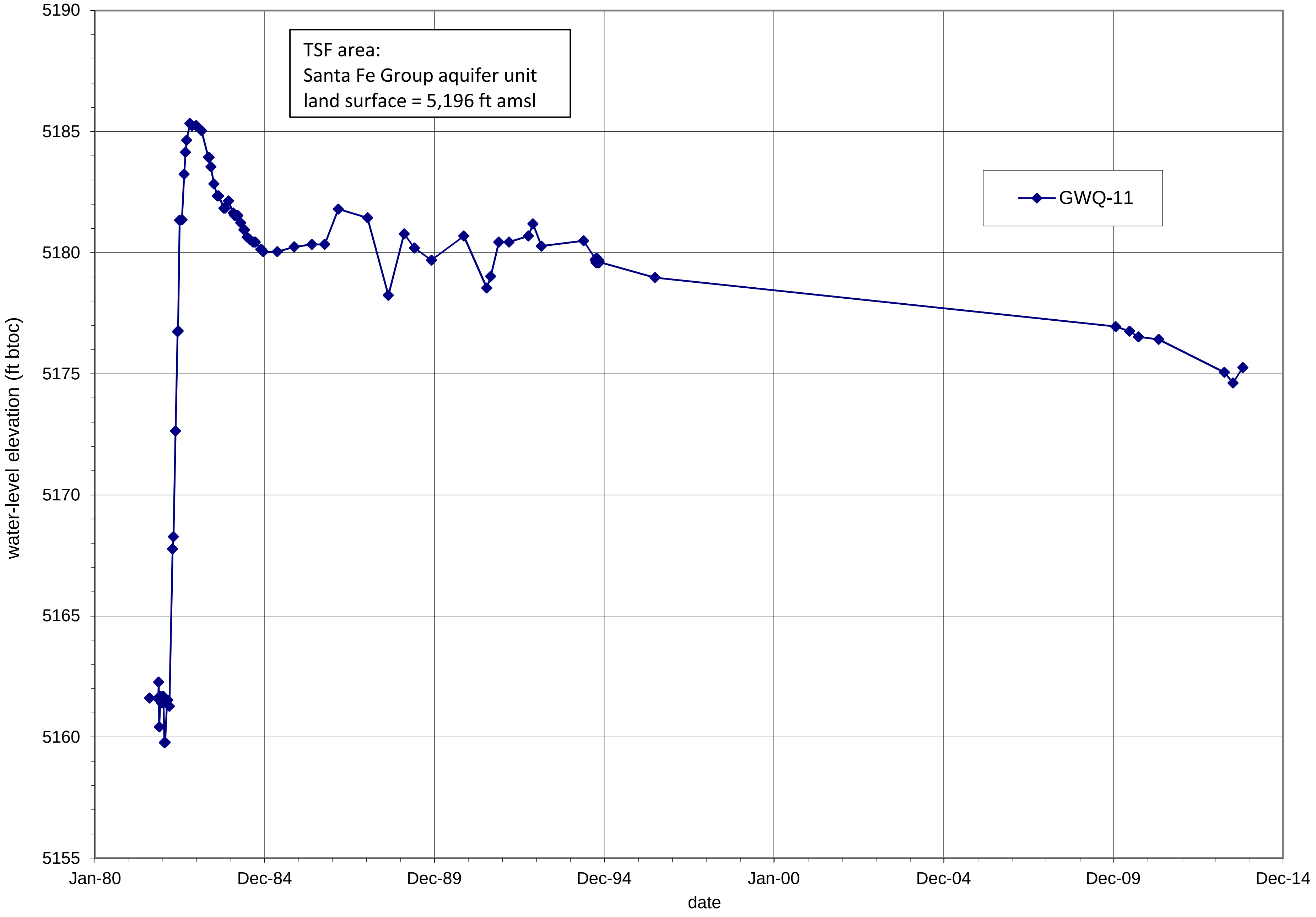


Figure E10. Hydrograph of TSF area well GWQ-11.

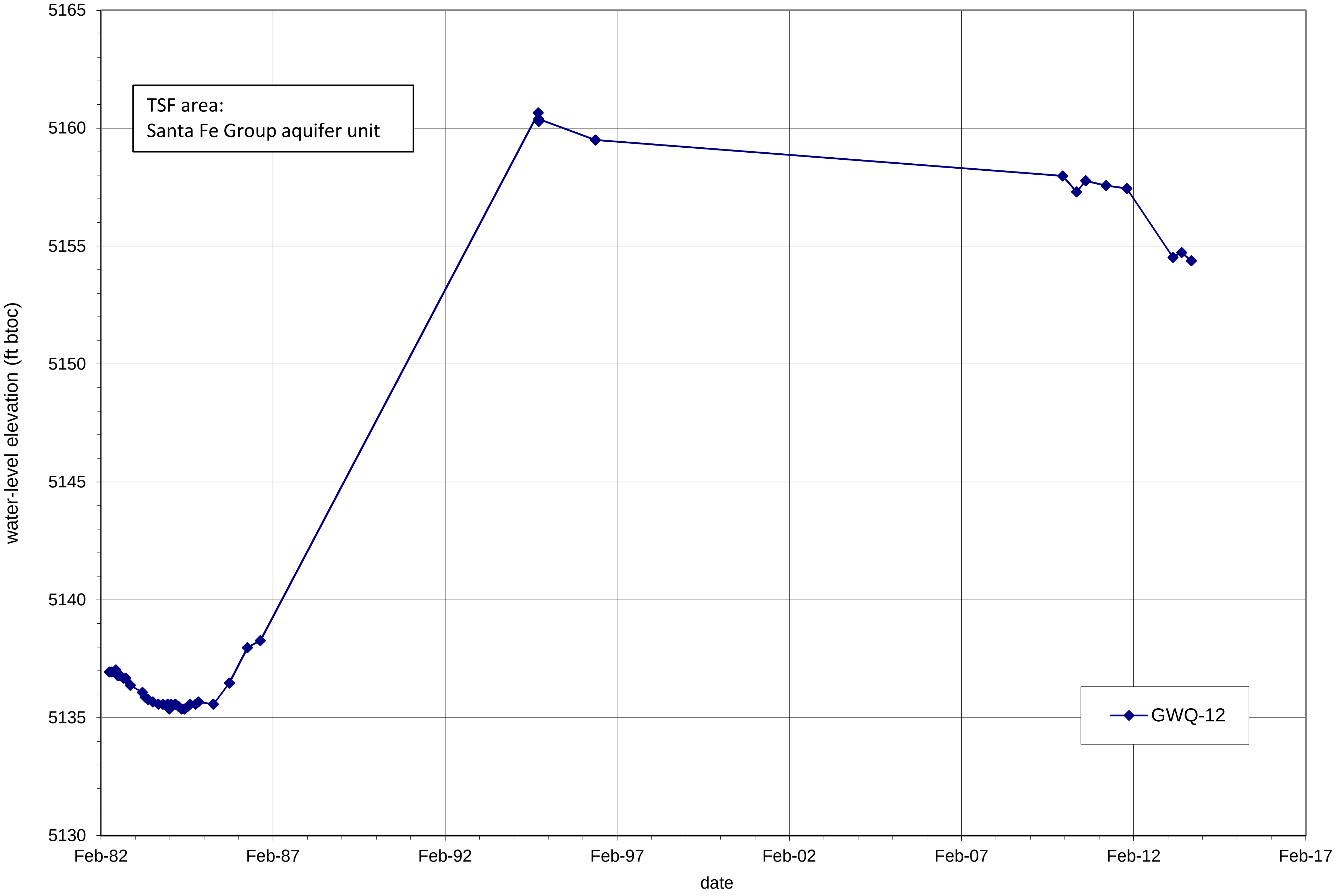


Figure E11. Hydrograph of TSF area well GWQ-12.

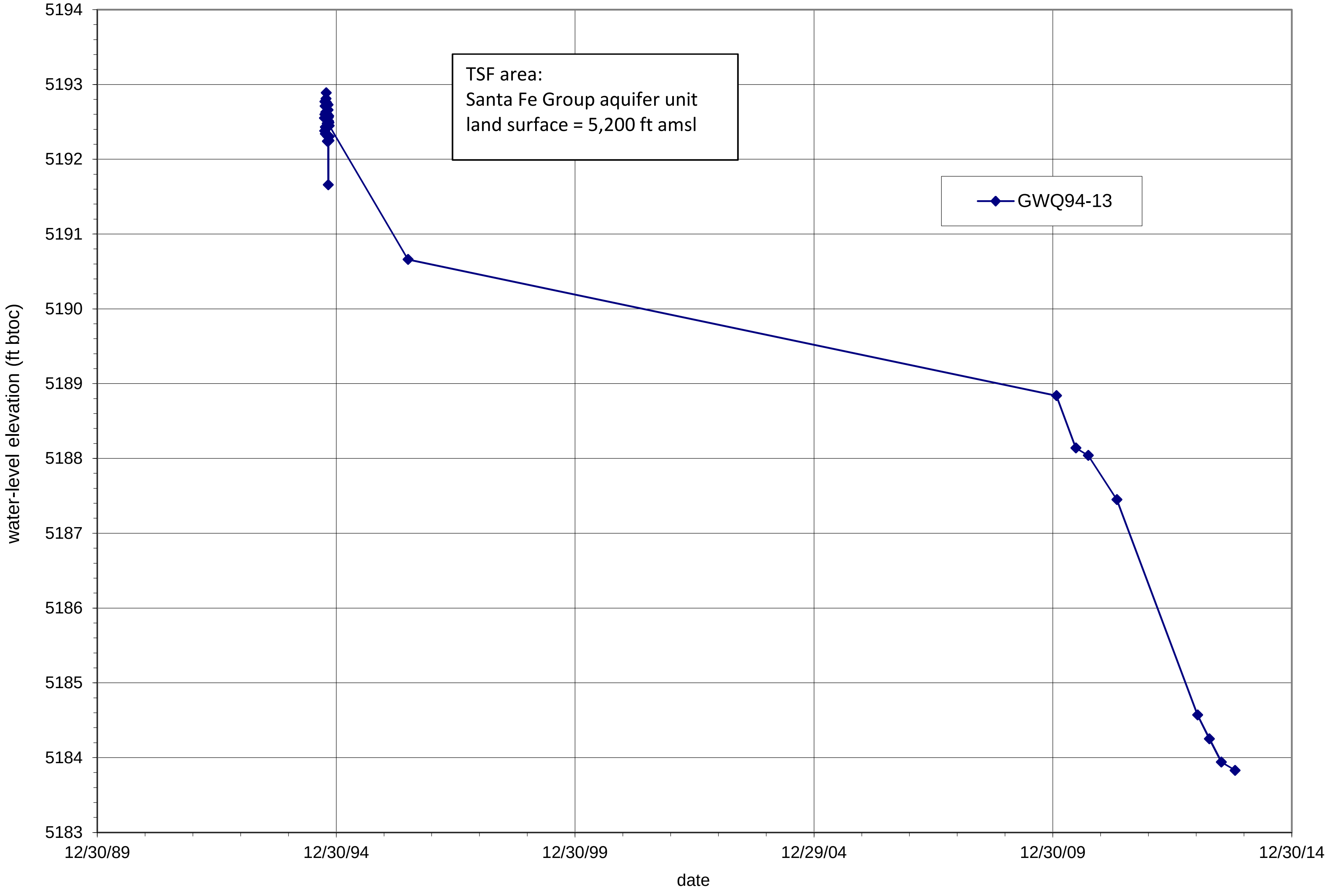


Figure E12. Hydrograph of TSF area well GWQ94-13.

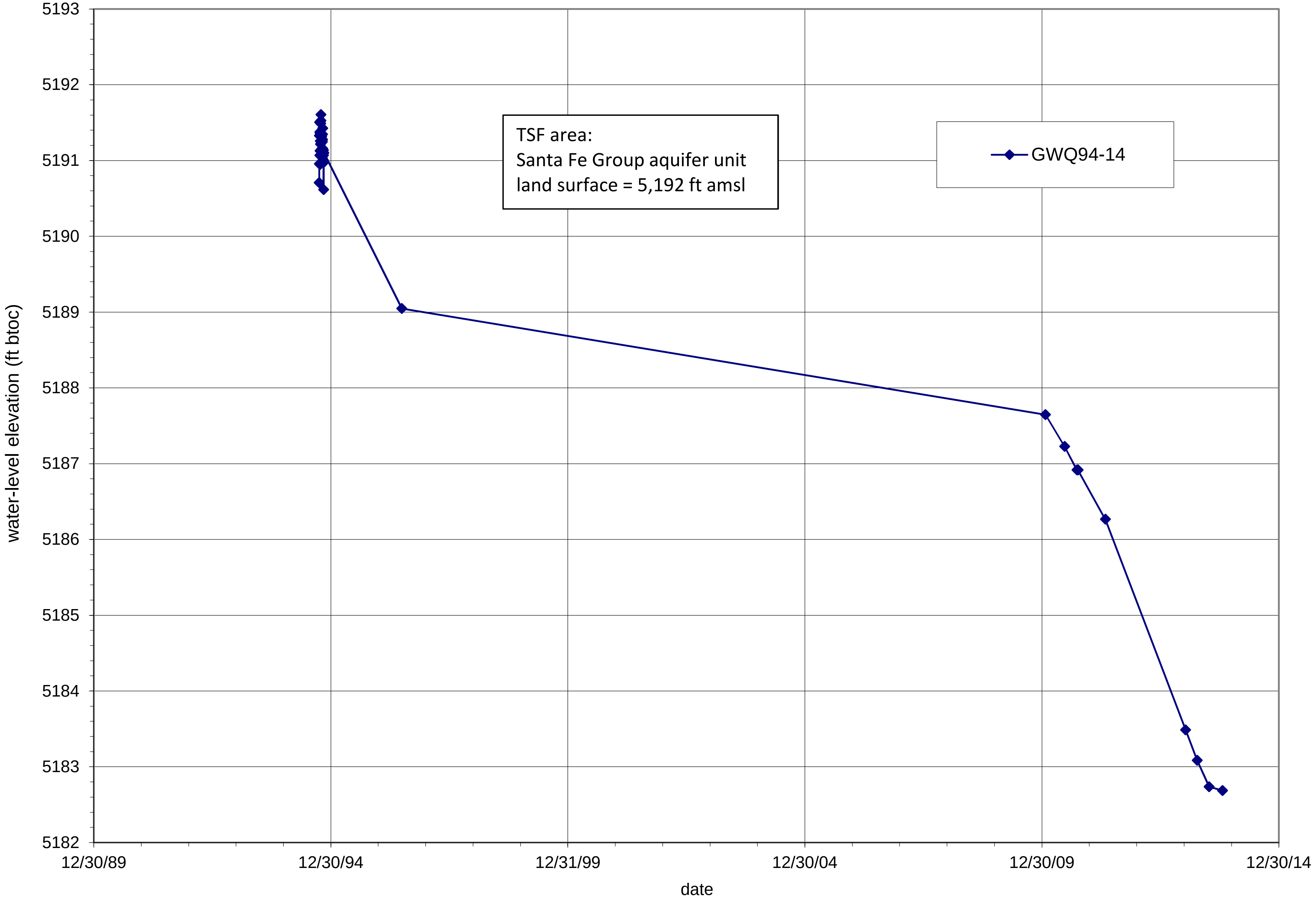


Figure E13. Hydrograph of TSF Area Well GWQ94-14.

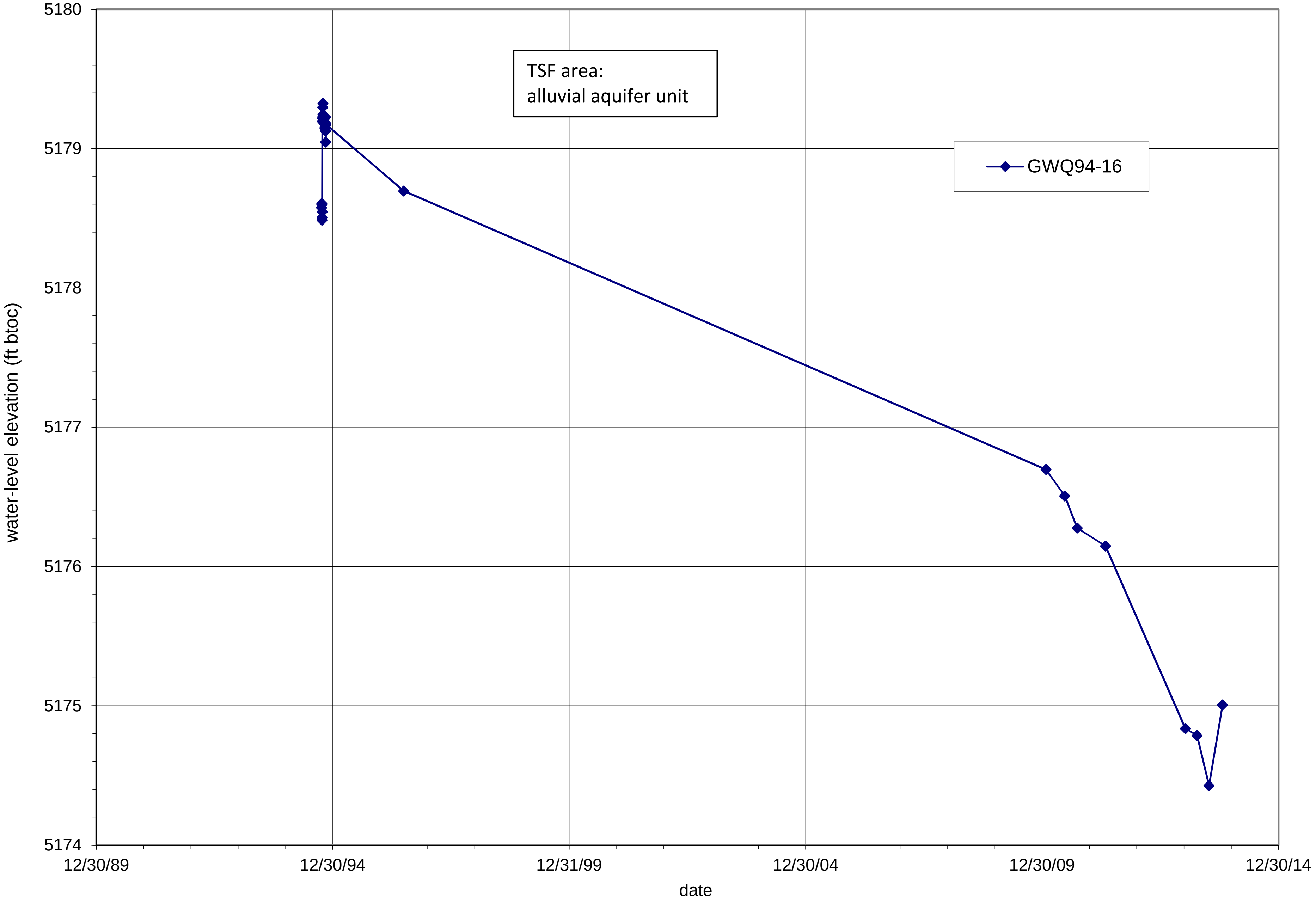


Figure E14. Hydrograph of TSF area well GWQ94-16.

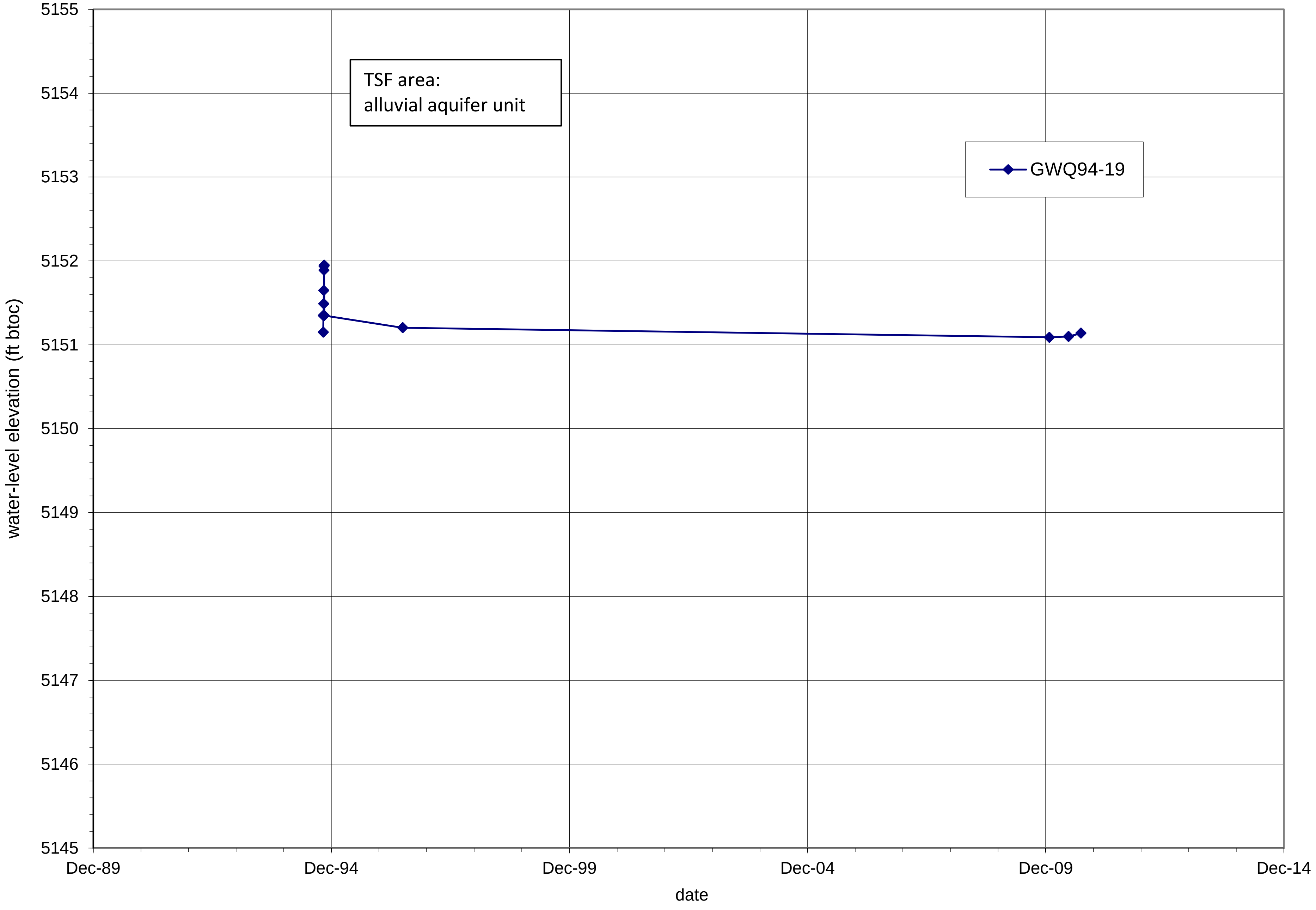


Figure E15. Hydrograph of TSF area well GWQ94-19.

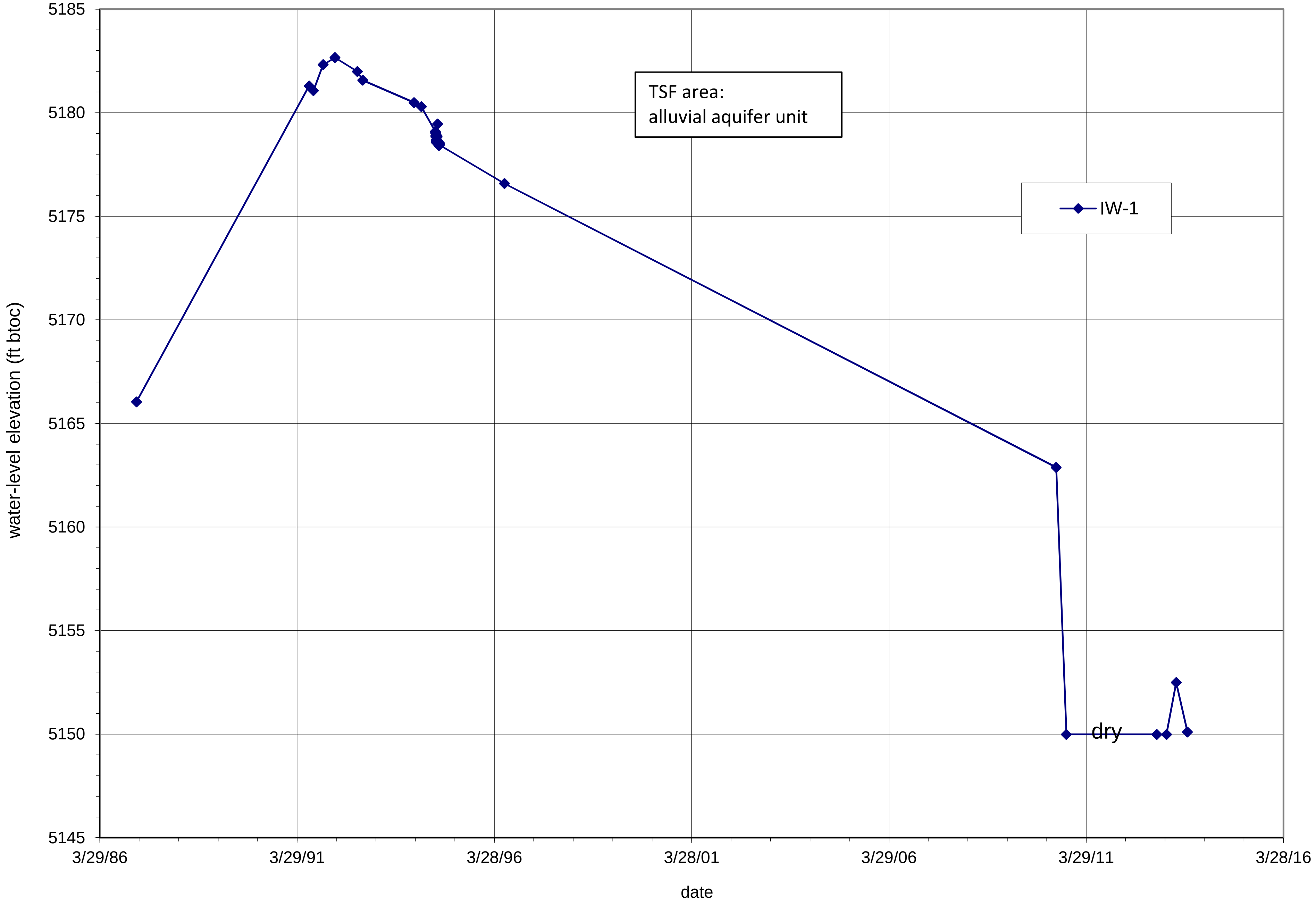


Figure E16. Hydrograph of TSF area well IW-1.

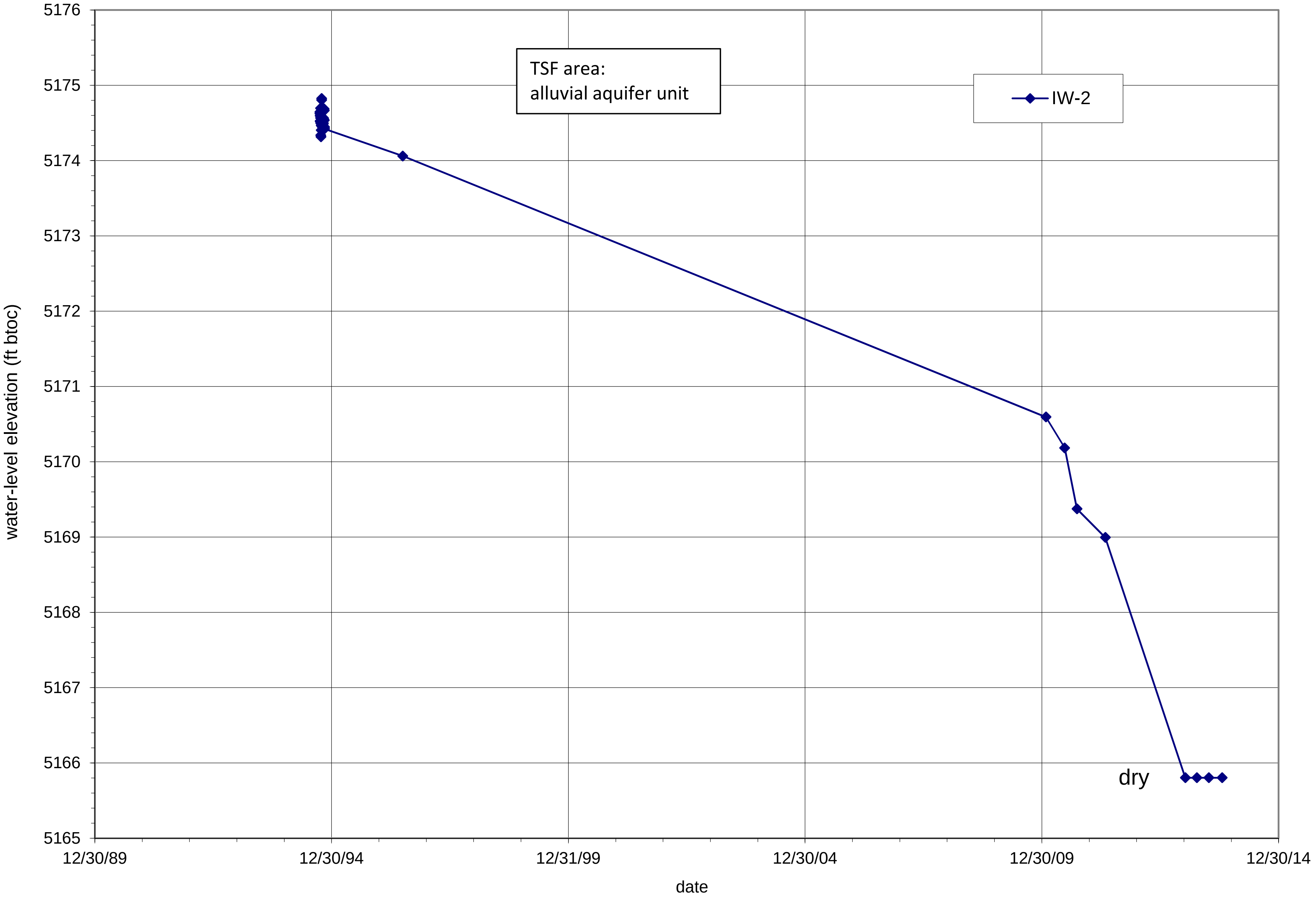


Figure E17. Hydrograph of TSF area well IW-2.

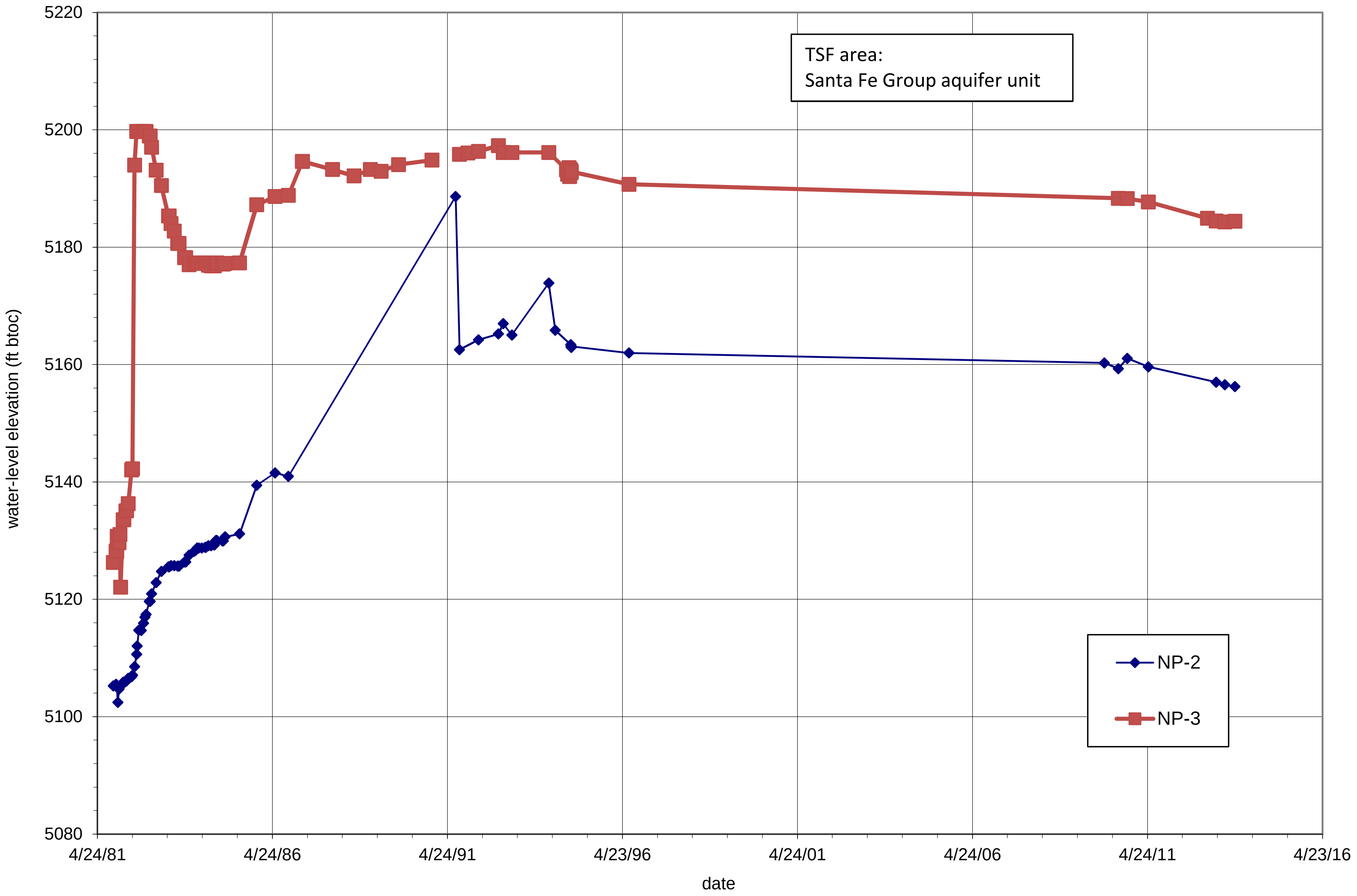


Figure E18. Hydrographs of TSF area wells NP-2 and NP-3.

Reid, Brad, NMENV

From:	Reid, Brad, NMENV
Sent:	Friday, June 27, 2014 11:44 AM
To:	Longmire, Patrick, NMENV
Subject:	FW: CuFlat Geochem Reports - Ennis comments
Attachments:	2014-04-08_D Ennis_comments on various geochem reports_Copper Flat_SI025RN.docx

Patrick,

We are trying to formalize some of the comments made by DJ Ennis over at MMD so that we can send them out to NMCC. In speaking with DJ about the comments, he intimated that some of the comments were primarily for your attention (e.g., are certain model assumptions reasonable?). If/when you have some free time, can you take a look at his attachment again and let me know if we should include some of his comments related to the *Geochemical Characterization Report/HCT Termination Report/DFS Gap Analysis?* Can you specifically look at his comments made on Section 8.1.1 of the first page related to the model assumptions and let me know if the assumptions are in fact, reasonable, or if we should question NMCC/SRK about them. I seem to remember that you thought his comments on the *DFS Gap Analysis* and *HCT Termination Report* should be included.

Hope all is well for you. Did you do your gig at Hillsboro yet? Sorry we keep missing your band at Zia. We were set to go a couple weeks back but my son's friend had a last minute b-day party so that (unfortunately) is where we ended up having to go that night.

Brad

From: Ennis, David, EMNRD
Sent: Tuesday, April 08, 2014 10:47 AM
To: Eustice, Chris, EMNRD; Reid, Brad, NMENV; Vollbrecht, Kurt, NMENV; Longmire, Patrick, NMENV
Subject: CuFlat Geochem Reports - Ennis comments

I've been reviewing 4 various CuFlat geochem reports over time and have compiled a list of questions that I thought ya'll might be interested in seeing prior to our upcoming discussion on April 24. See attached.

Patrick, you might be able to answer some of these for me, so I wasn't necessarily intending for these to be brought to THEMAC or SRK at this point. They may be a little late in the game, but I have some questions regarding the Geochemical Characterization Report that we've already discussed on the phone with SRK. My questions there are about the predictive modeling of the WRDF and TSF.

Thanks,
DJ

DJ Ennis, P.G.
Mining and Minerals Division / 1220 S. St. Francis Drive / Santa Fe, NM 87505
(505) 476-3434 / david.ennis@state.nm.us

***Geochemical Characterization Report for the Copper Flat Project, New Mexico, Volume 1 – Text,* May 2013**

- Section 8: Quantitative Numerical Predictions
    - The sensitivity analyses for the WRDF and TSF appear to only account for varying groundwater mixing zones (10 ft., 30 ft., and 50 ft. mixing zones for the WRDF and 50 ft., 75 ft., and 100 ft. for the TSF). Do other parameters of the model typically get a sensitivity analysis? Observation: the predicted results using the various mixing zones are nearly identical, suggesting this parameter is not sensitive to the model output.
- Section 8.1.1: Waste Rock Disposal Facility
    - Model assumptions. Are these reasonable?
        - Page 79, long-term infiltration through the WRDF cover = 2 percent of mean annual precipitation. Exerts "moderate" control (10-50%) on the model output.
        - Page 79, andesite will function as a liner. However, it seems to this reviewer that the andesite could convey water down-dip.
        - Page 79, the upper end of possible flow from the WRDF to groundwater is estimated to be 5-10% of infiltration through the waste rock cover, equating to 0.1 to 0.2% of annual precipitation.
        - Page 82, it is assumed that 20% of the total mass in the WRDF is available for weathering reactions.
        - Page 87 and 89, scaling factors of 10 were applied. Exerts moderate (10-50%) on the model output.
    - Table 8-9: WRDF Model Results:
        - In several cases, the predicted gw chemistry improves slightly compared to the average gw chemistry in the andesite, e.g. iron, vanadium, zine, selenium, fluoride, TDS
        - Increasing the seepage from 5% to 10% has little to no effect. Why? In a couple of odd cases, the 10% seepage predicts better water quality than 5% seepage (e.g., alkalinity as CaCO3, bicarbonate).

***Copper Flat PFS and DFS Gap Analysis,* February 13, 2014**

- Table 1: Summary of PFS and DFS Design Criteria Pertinent to Geochemical Characterization Program
    - Cu cut-off grade (wt%) row, Implications for Geochemical Characterization Study column: "The numerical predictions undertaken for the WRDF as part of the PFS area based (on) the higher cut-off grade and therefore represent a conservative estimate of future water quality." In this table, the PFS cutoff is 0.164 and the DFS cutoff is 0.168. Therefore, isn't the PSF area based on a lower cut-off grade and therefore is not a more conservative estimate? Regardless, this reviewer recognizes that the difference between 0.164 and 0.168 is minor and likely does not adversely affect the overall results.

***Humidity Cell Termination Report for the Copper Flat Project, New Mexico*, February 2014:**

- Section 2.1 Sample Selection, Page 1 states "The results of static geochemical testwork were used to select a sub-set of 23 waste rock and ore samples for kinetic testing." Please provide a brief description of the criteria used to select the HCT samples or the rational/justification for sample selection. For example, why were more sulfide ore samples (12 samples) run for HCT compared to sulfide waste samples (3 samples)? Considering that ore is run through the mill and waste is stockpiled, it would seem that the HCT results for sulfide waste samples are more important than sulfide ore samples.

- Page 28, Sulfide Mineral Texture:

    - This section states that it is possible that the medium to course grained and equigranular nature of the pyrite means it is more likely to be thermodynamically stable and difficult to weather. Is there a literature reference to support this hypothesis? Are fine grained or smaller grains of pyrite less thermodynamically stable? Maybe less reactively stable due to increased surface area, but less thermodynamically stable?

- Page 29, Presence of Buffering Silicate Minerals

    - Statement: "Despite the limited presence of carbonate minerals in the samples, the silicate minerals phlogopite and/or clinochlore were observed in all eight samples submitted for testing." Each occurrence of phlogopite in the mineralogy is described in Table 4-1 as trace (≤1% by area), and clinochlore is either a trace (2 occurrences) or minor (<10% by area; 4 occurrences). Is there a way to estimate how much buffering potential is really expected given the relative obscurity of these minerals in the assemblage?

        - Page 3 of *Geochemical Characterization Report for the Copper Flat Project, New Mexico, Volume 1 – Text*, May 2013 states "even for minerals in the intermediate and fast minerals weathering groups, they will not be practical neutralizing materials unless they occur in excess of ~10% (Sverdrup, 1990)." This statement seems to contradict the possibility that phlogopite and/or clinochlore will produce any substantial buffering capacity.

    - Statement: "(Phlogopite and/or clinochlore) are known to offer some buffering capacity..." Please describe and provide references for the mechanism by which phlogoite and/or clinochlore "are known" to provide buffering capacity.

***Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico*, September 2013:**

General Comments:

- A sensitivity analysis should be performed on the pit lake PHREEQC model and presented as an addendum to the report. A detailed description of the uncertainties in the model should also be presented.

- Section 3.3, Hydrogeologic Model
  - The watershed area affecting the pit is described as 230 acres, however Figure 3-4 seems somewhat incorrect. For instance, the watershed line appears to cross contours across the low grade ore stockpile incorrectly. What is the effect of a change in the watershed area (both increased and decreased) reporting to the pit? How sensitive is the PHREEQC model results to this input?
  - Statement on page 21: "Sulfidization in the hypolimnion will lead to natural attenuation of metals and metalloids as well as sulfur." Please provide additional explanation on how this geochemical mechanism works.
  - Statement on page 21: "For Copper Flat, the presence of solute material that will modify pit lake chemistry (i.e., sulfide minerals and gypsum) will likely prevent permanent chemical stratification or layering of the lake." Please explain how this mechanism works.
  - A current assumption to the model appears to be that there will be sufficient mixing in the pit to prevent stratification. Could PHREEQC be used to predict whether lake stratification will occur or not?
  - Figure 3-6: Pit Lake Flux. This figure shows evaporation as an outflow that decreases over time post-closure. At closure, wouldn't evaporation be more or less constant?

- Table 3-2: The groundwater chemistry input into the PHREEQC model uses an average of sampling results. Is using the average typical as the industry standard for PHREEQC modeling? Why not something more conservative like 95th percentile?
- Section 3.6 Adsorption: "The models assumed that trace metals may be removed from solution via sorption onto freshly generated mineral precipitates such as iron oxides." Is this a good assumption?
- Table 3-6: Analysis of pit lake model input variability: The "significant" controls on final model results should be available for agency review including the 100-year water balance by JSAI. What about the geologic block model for the pit? Should this also be reviewed? Is there any in-house experience reviewing a geologic block model?
- Section 3.12: Existing Pit Lake Calculations. Page 37 states "The results show generally good correlation between measured and predicted pit lake water quality. This demonstrates that the input parameters used for future pit lake water quality predictions are valid and the model approach produces generally reproducible results." Please provide the R^2 value on the regression presented in Figure 3-12.
- Table 3-9: Predicted vs. Measured Pit Lake Chemistry for the Existing Pit Lake
  - Several PHREEQC predicted parameters are low compared to the measured chemistry in the existing pit lake. For example, the predicted concentration of aluminum is 3 orders

  of magnitude low, chromium and iron are 2 orders of magnitude low, and arsenic, barium and copper are 1 order of magnitude low. It appears to this reviewer that most of the parameters are under-predicted by the model compared to known concentrations, however page 37 states that there appears to be a good correlation. Please explain the industry standard with respect to calibration; what is considered a good calibration in modeling?

- Section 3.13 Future Pit Lake Results:
  - Page 39 states "However, the calibration model for the existing pit (Section 3.12) shows that PHREEQC overestimates boron concentrations by over fifteen-fold (over one order of magnitude), demonstrating that the mineralogical controls in PHREEQC may not be adequately controlling the boron chemistry."
  - Page 40 states "However, the calibration model for the existing pit lake overestimates selenium by eight-fold (approximately one order of magnitude; Section 3.12). Most likely similar over-estimation issues will occur in the predictions for the future pit lake as well."
    - In these instances, one order of magnitude difference is used as justification for why the predictive model is incorrect through overestimation, yet several parameters in Table 3-9 that are under-predicted by 1 to 3 orders of magnitude are considered a good calibration. This appears to be an inconsistent interpretation; please explain.

Cooperating Agencies - NMCC Meeting – Notes
8 July 2014 14:00 MST

Attendee	Company	Initial	Present
Doug Haywood (via phone)	BLM	D.Haywood	X
Rachel Jankowitz	NM G&F	RJ	Will no longer attend due to job change
Patrick Longmire	NMED	PL	Not present
Brad Reid	NMED	BR	X
Kurt Vollbrecht	NMED	KV	X
Bryan Dail	NMED SWQB	BD	Not present
Kristine Pintado	NMED SWQB	KP	Not present
Kevin Myers	NMOSE	KM	X
Dave Henney (via phone)	Solv	D.Henney	X
DJ Ennis	MMD	DJE	X
Chris Eustice	MMD	CE	X
Holland Shepherd	MMD	HS	X
Katie Emmer	THEMAC	KE	X

Next Meeting Date: Tuesday August 19, 2014 at 14:00, Same location, Same call in number

Action Items

- NMCC will submit (to state agencies and BLM/Solv) responses to geochemistry comments in July
- NMCC and Solv will work out scope/schedule/cost for groundwater modeling and restart work as soon as possible, hopefully by 11 July
- NMED will contact NMCC to set up a meeting to discuss the May 2014 Stage I report within the next month
- BR will send NMCC Anne Maurer's checklist for Discharge Permits using the Copper Rule (Done: NMCC received checklist on 10 July from BR.)
- BLM will return edited version of Chapter 2 back to Solv by the end of July

Meeting Discussion

1. Geochemistry Report Comment Response Status –

   JSAI and SRK are preparing a joint response to Dr. Longmire's comments; we hope to turn these in to state agencies and BLM/Solv for review this month – in July.

2. Pit water standards navigation plans

   - Use Attainability Analysis path forward:

     KE: These are steps we are following to hopefully address designated use standards of primary contact and warm water aquatics. I haven't given SWQB projected dates, but I did speak to KP and BD about our plans to do this.

a. Requesting federal determination on jurisdiction of pit water: USACOE will hopefully deem the pit not a "water of the US": NMCC is submitting requested documentation about the pit in July
b. Develop UAA work plan and submitting to NMED SWQB for comment/approval: NMCC is aiming to submit this for NMED SWQB review in July
c. Data collection: biological, physical, chemical: Hoping to conduct this work in Aug/Sept
d. UAA report on data: Shooting for October
e. NMED review and proposal to WQCC for consideration: Schedule TBD
f. Public hearings: TBD
g. Removal or modification of standards for warm water aquatics and primary contact: TBD

- Conceptual design of pit reclamation plans-

KE: Per Holland's request, I am going to talk through our main considered strategies for pit reclamation to meet the existing use standards for Livestock and wildlife. These are being considered and developed, we need to do some estimates for cost and design. The pit reclamation plans are being developed by JSAI, the result could be a report that comes in as a stand alone document or part of the revised Mine Operation and Reclamation Plan that is being prepared.

a. Rapid fill with alkaline groundwater at end of mine life (source: production wells)
b. Source controls (ie covering >10% sulfide wall areas as the pit is mined down with shotcrete or something else)
c. Reclaiming haul road – the idea here is to deliver as much clean precipitation to the pit water as quickly as possible.
d. Expand the pit watershed to capture more runoff – this would deliver more precipitation to the pit

KE: The plan is to find strategies that we can show with reasonable confidence will allow the pit water to meet applicable surface water standards without perpetual care.

KV: Would you re-run the geochemistry model?
KE: The geochemistry model could be re-run, or we have discussed creating a mixing model to show the effects of proposed reclamation. We haven't decided but we do know we need to demonstrate with reasonable certainty the efficacy of the reclamation design.
KM: Steve Finch (at JSAI) will be working on the water balance to show how these plans effect pit water quality. He might just use a spreadsheet to show his analysis, a spreadsheet is a model. A mixing model would illustrate how conservative the reclamation plan is and whether you need to consider additional strategies.
HS: Does a mixing model take into account water off the pit walls?
KE: yes.
Discussion: HS would like to know if pit walls will meet standards, KE: theoretically yes, they would. CE would like to know how conservative the model will be. KE: We are working on this and know we need to present a convincing argument.
Discussion: Regarding the draft illustrations KE brought in – what is known/not known, what is shown on cross sections of the pit. The illustrations show where JSAI currently estimates final exposed pit wall would have >10% sulfide and thus be a likely source of acid drainage. Actual locations of high sulfide material would have to be identified and dealt with during mine operation. These illustrations were presented temporarily during the meeting but not submitted to agencies as they are still in draft form.

3. Groundwater Model Status-

   KE: I believe LWA has a model they can work with, there are no known additional requested changes to the groundwater model. We are working out some contract issues with Solv, so there has been some hold up on progress for the GW Model. Once the scope of work is agreed and costs are authorized, next steps will be:

   - LWA review of JSAI response to comments/steady state model via a sensitivity analysis of their choosing
   - LWA or JSAI will generate outputs for EIS analysts
   - LWA's model conversion will be provided to JSAI and OSE for review

   D. Haywood: Do you know when (the scope and cost) will be worked out?
   KE: I received additional information from D. Henney so I am hoping this week.
   D.Henney: I would agree that we are very close on having things worked out.
   CE: How critical is the groundwater model? Is this holding up the EIS?
   KE: Oh yes, it's critical on a number of fronts. It's holding up writing analysts sections for Chapter 4 on the EIS, it's holding up submission of Probable Hydrologic Effects to the state. The discussion of water with the public is being postponed until the groundwater model has been fully reviewed by the EIS subcontractor and we are confident no more changes are necessary. It's very important to get this worked out as quickly as possible, we are very aware of that.

4. EIS status

D.Haywood: Received Ch2 from Solv in June, added comments and sent it to BLM analysts. I have asked the analysts to return comment to me by 25 July. I will likely review it for a few days and should get the BLM edited version back to Solv by the end of July.

Discussion: With BLM permission KE provided MMD with temporary copies of Ch2 today, CE and DJE have had a look. They identified no surprises or concerns. Discussion of different mine plans, water use by year vs. overall. There is an economy of scale realized in water use with EIS Alternative 2.
CE: What are the main concerns the public has voiced? Is the main issue water?
KE: Water quantity and quality are big issues, but the public has also listed other concerns the EIS will consider including traffic on HWY 152, cyclists coming through Hillsboro, jobs, how and which wells would be impacted, Percha Box… there are a number of items but it is true water is a big concern. Doug and Dave, would you add anything to that?
D.Haywood: You're covering it.

5. Permit Application Package Status-

   KE: These outstanding steps remain: resolve geochemistry comments, preparing and submitting probably hydrologic consequences, submitting a revised MORP. NMCC just kicked off work with AMEC, they will be responding to outstanding MMD comments on the 2012 MORP and preparing the revised MORP based on the EIS Alt2 mine plan. We are targeting November 2014 for submission of the revised MORP.

6. Stage I Abatement Plan status-

   Summary of 2013 characterization submitted to NMED.

BR: Have you suspended characterization at the site?

KE: We are not planning any groundwater sampling at this time. We have set up the surface water quality samplers again this year: SWQ-1, SWQ-2, SWQ-3 are all back in place and will continue to monitor as possible, ephemeral water flow in Grayback. We have added a forth autosampler further downgradient of SWQ-3. We are doing some informal sampling at the pit for internal record.

Discussion: Opportunistic sampling of ephemeral surface water in 2013 – had some trouble with samplers but did get a few events. Water flows the longest at the furthest reaches, so there were a couple of events, if KE recalls correctly, in which no flow was observed at SWQ-1 but samples were collected further downstream. NMCC has observed that generally a 1” rainfall event is needed to cause sufficient water in Grayback for successful sample collection at all surface water sample locations.

7. Revised Discharge Permit Status

NMCC does not have a schedule on when we plan to submit this. We would like to get that ball rolling but I do not have a planned submission date.

Discussion: KV is sure a public hearing will be very likely. KV encourages NMCC to get this Discharge Permit application in as soon as possible. KE agrees this would be a very good step to take, it has been pushed back previously due to management decisions, it’s on the schedule for internal discussion in July.

BR: When you turn in your discharge permit application, make sure you present the data that the Copper Rule requires.
KV: Anne Maurer put together a checklist against the Copper Rule, Brad could sent that to you. When you do the application, we are asking you use the Application online for Part A. Beyond that, switch to the Copper Rule and use Anne’s spreadsheet.

8. Next meeting date: **19 August at 2pm Mountain time selected, MMD Conference Room**

Other Discussion:

KE: NMCC will be working with Juan Velasquez in the future; he has joined us in a consulting role and will be helping focus and push forward our permitting and EIS efforts.

9. Geochemistry Conversation without NMCC present: MMD, NMED, NMOSE, BLM, Solv

Mark Nelson 605-578-9739

Reid, Brad, NMENV

From: Steve Raugust <sraugust@themacresourcesgroup.com>
Sent: Monday, July 28, 2014 2:09 PM
To: Longmire, Patrick, NMENV
Cc: Vollbrecht, Kurt, NMENV; Reid, Brad, NMENV; Eustice, Chris, EMNRD; Ennis, David, EMNRD; Shepherd, Holland, EMNRD; dhaywood@blm.gov; Myers, Kevin, OSE
Subject: NMCC Pit Water Quality Comment Responses
Attachments: Responses to Pit Geochemistry_NMCC 28Jul2014_MEMO.pdf; Copper Flat base case_v10.pqo

→ Send this to Bryan

All,

Attached are NMCCs responses to the NMED and CDM Smith April 2014 comments to the September 2013 Predictive Geochemical Modeling of the Copper Flat pit water quality.

Our intent is to address NMED and CDM Smith's comments (reviewers) and identify the constituents of concern (COCs) for the future pit water quality. We hope these responses satisfy that goal. Unlike the predictive geochemical modeling for the tailings storage facility (TSF) and the waste rock disposal facility (WDRF), there were no engineering controls or reclamation design considered in the predictive modeling of the pit. NMCC would like to work with the reviewers to obtain agreement on the predicted pit water quality COCs so that we can address those COCs with the engineering controls and reclamation strategies that NMCC is currently developing.

Once those engineering controls and reclamation strategies are finalized in terms of economic and technical feasibility, the model assumptions will be revised. The revised assumptions will be used to re-calculate estimates of future pit COC concentrations, which may be an iterative process. (However before that can be done, it is necessary to agree that the current predictive geochemical model for the pit will serve as the an adequate and appropriate basis for future predictive calculations.) *Key parameter *

We hope to obtain that agreement with the responses presented in the attached memorandum and look forward to working with the reviewers to that end.

The enclosed memorandum is a PDF that has two attachments:

- Attachment 1 contains a technical memorandum from JSAI regarding the evaluation of mercury as a COC. This memo is included in the attached PDF
- Attachment 2 is the PHREEQE output file from the September 2013 predictive pit water quality modeling. It is a PQO file, which is the interface that the PHREEQE software uses and it is attached separately. The PQO file is 12 megabytes, which may be larger than some recipients can receive. Therefore, a CD will also be sent to each agency or contractor on this email's distribution list.

Please refer any questions or comments to Katie Emmer or myself.

Regards.

Sept. 3, Sept 5

Steve Raugust, CEG | Resource Development Manager

T: +1 505.881.1353 | **F:** +1 505.881.4616 | **M:** +1 505.967.9542
A: 2424 Louisiana Blvd. NE, Suite 301, Albuquerque, NM 87110
W: themacresourcesgroup.com | **E:** sraugust@themacresourcesgroup.com

Cl, Hg, Se, Cu

www.drhomeair.com = radon
Coleman Lantern mantle

- Confusing why reclamation wasn't accounted for on initial. model runs

THEMAC
RESOURCES

TO: Patrick, Longmire, Ph.D., New Mexico Environment Department (NMED)
FROM: New Mexico Copper Corporation (NMCC)
CC: Kurt Volbrecht, NMED, Brad Reid NMED, Douglas Haywood, Bureau of Land Management, Dave Henney, Solv LLC
DATE: July 28, 2014
SUBJECT: Response to NMED Comments to the September 2013 Flat Pit Geochemical Modeling Report

---

1 Introduction

SRK Consulting, Inc. (SRK) has conducted a predictive geochemical modeling exercise to assess potential future pit lake chemistry associated with the Copper Flat project, New Mexico. This work was undertaken on behalf of New Mexico Copper Corporation (NMCC – a subsidiary of THEMAC Resources Group Ltd. [THEMAC]) to evaluate the future environmental impacts of the project from a National Environmental Policy Act (NEPA) perspective as well as a State regulatory compliance perspective. The approach and results of the modeling exercise were presented in the *Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico* report submitted in September 2013 (SRK, 2013). The report has since undergone peer review by Dr. Patrick Longmire of the New Mexico Environment Department (NMED) and Mark Nelson of CDM Smith. Draft comments were received on April 22, 2014 and this was followed by a conference call on April 24, 2014 between SRK, NMED, THEMAC and John Shomaker and Associates Inc. (JSAI), during which the comments were discussed and verbal responses were provided for some of the comments. The purpose of this memorandum is to provide a formal response to comments and to provide additional information to supplement the *Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico* (SRK (2013).

Effects of possible variations of the main components of the pit water balance are currently being evaluated by JSAI and THEMAC as the details of the mine closure plans, including in-pit reclamation, watershed management and source controls, are considered. The water-balance and water-chemistry implications of different possibilities and options are being evaluated as part of the pit reclamation and source control study in order to identify options for mitigation of remaining constituents of concern in the post mining open pit water.

One of the primary objectives of the pit lake geochemical modeling was to identify potential constituents of concern for purpose of the ongoing pit reclamation and source control study. The results of the geochemical model demonstrate that selenium will be the only constituent of concern for the future pit lake at Copper Flat. Although vanadium and mercury are predicted to be elevated in the future pit lake, the model overestimates concentrations of these trace constituents by up to an order of magnitude. Vanadium and mercury are also below analytical detection limits in the existing pit water and for these reasons are not considered constituents of concern for the future pit lake.

2 Response to Comments and Amendments

Responses to comments from NMED and CDM Smith have been prepared by SRK and JSAI on behalf of THEMAC and are provided below. In each case, the comment has been summarized and a response has been provided in italics that details additional information to resolve the comment. In each case, the party responsible for preparing the response (i.e., SRK or JSAI) has been indicated in square brackets at the start of the text.

2.1 New Mexico Environment Department Comments

1. Executive Summary (Page vi) – More detail should be provided on why the predicted exceedance of mercury does not represent a true ecological risk to wildlife.
    - *[SRK and JSAI] Mercury does not represent a constituent of concern for the future pit lake for the following reasons:*
        - a) *The calibration model shows mercury concentrations are over-predicted by approximately an order of magnitude. The predicted mercury concentrations in the future pit lake are based on reported trace detections in the HCT effluent, which are close to both the analytical detection limit and the NMAC 20.6.4900 guideline. The over-prediction is likely an artifact of scaling values that are close to analytical detection limits, coupled with the effects of evapoconcentration.*
        - b) *Mercury has not been detected in the exiting pit lake, with concentrations being consistently below analytical detection limits (0.001 mg/L or 0.0002 mg/L) throughout the period 1991 to 2011.*
        - c) *Mercury has not been detected in groundwater wells adjacent to the pit (GWQ96-22A, GWQ96-22B, GWQ96-23A or GWQ96-23B) during the period 1996 to 2011. Additional analyses conducted with lower analytical detection limits in July 2013 showed very low mercury concentrations (0.0000009 mg/L to 0.000004 mg/L). Therefore any groundwater flowing into the future pit is likely to have non-detectable mercury concentrations.*
        - d) *Mercury has not been detected in surface run-off waters either above or below the pit during the period 1982 to 2011.*
        - e) *Although mercury may occur as a trace element in pyrite, sphalerite and copper sulfosalts (all of which have been identified at Copper Flat), there has been no source mineral for mercury identified in the ore body.*
        - f) *Mercury has not been detected in the salt rim surrounding the existing pit lake, indicating there has been minimal adsorption of mercury onto iron oxyhydroxides in the salt rim.*
    - *Additional discussion on why mercury does not represent a constituent of concern for the future Copper Flat pit lake is provided in Attachment 1.*
2. Executive Summary (Page vi) – Results of the PHREEQC simulations relevant to selenium should be summarized in the Executive Summary. In addition a discussion needs to be provided that addresses the fate of selenium in the pit lake under future conditions.
    - *[SRK] The geochemical model over-predicts selenium by an order of magnitude; however, selenium concentrations are still predicted to exceed the wildlife standard when adjusted for this over-prediction. The current pit water also contains selenium concentrations above the wildlife standard, therefore selenium is likely to represent a constituent of concern for wildlife uses in any future pit lake that forms. The likely future geochemical behavior of selenium in the pit lake and the potential controls by precipitation and adsorption will be investigated as part of the ongoing pit reclamation and source control study.*
3. Executive Summary (Page vi) – Results of the surface complexation simulations involving vanadium should be summarized in the Executive Summary. In addition a discussion needs to be provided that addresses the fate of vanadium in the pit lake under future conditions.
    - *[SRK] The geochemical model over-predicts concentrations of vanadium by approximately four times. The geochemical behavior of vanadium in the future pit lake will likely be controlled by precipitation and adsorption reactions, but these reactions are not adequately characterized for vanadium in the PHREEQC thermodynamic code. Therefore, the predicted exceedance of the wildlife standard in the Copper Flat pit lake at*

75 and 100 years post-closure relates to the lack of appropriate mineralogical controls for vanadium in the PHREEQC database, rather than a true exceedance. Vanadium concentrations are also below analytical detection limit in the existing pit water (Table 3-9). For these reasons vanadium is not considered a constituent of concern.

4. Calculation of Pit Wall Rock Available for Leaching (Page 19) – More detail should be provided on the validity of assuming an average fracture density of 10 percent in the pit walls. This should include a discussion on uncertainties in oxygen penetration, fracture depth and density calculations. In addition, more detail on the humidity cell tests previously conducted by SRK regarding water infiltration and products of reactivity up to 0.04 feet into rock fragments should also be presented.
    - *[JSAI] The assumption of 10% fractures used in the current pit lake model is a conservative assumption; the rock comprising the proposed pit shell has low fracture permeability and the limited natural fractures are mineralized (i.e., quartz and calcite are common minerals in fractures). In the current pit, water is conducted only through a few individual fractures. As chemical load from the pit walls is one of the major controls on future pit water chemistry (see Table 3-6 of pit chemistry modeling report), control of water-yielding fractures and pit-wall runoff will be investigated as part of the ongoing pit reclamation and source control study.*
5. Hydrologic Model (Page 20) – Details of the water balance performed by JSAI should be provided, including all assumptions and site-specific hydrological data and information relevant to the pit lake at Copper Flat.
    - *[JSAI] Details on the groundwater-flow model and projected pit water level and water balance are presented in JSAI (2014). The primary factor controlling the pit water elevation and water balance is the availability of water. The local watershed and groundwater system are currently projected to support an open water surface of about 20 acres, with water consumption (evaporation) of about 100 acre-feet per year*
    - *[JSAI] The three main components of inflow to the pit (watershed runoff, pit wall runoff and groundwater inflow) are dependent on the details of the mine closure plans, including in-pit reclamation, watershed management and source controls. The water-balance and water-chemistry implications of different closure options are being evaluated as part of the pit reclamation and source control study. Included in this study is the evaluation of pit water conditions during wet and dry periods.*
6. Hydrologic Model (Page 20) – It would be helpful to understand how potential stratification of the pit lake will affect water quality. Additional simulations should be conducted using PHREEQC to quantify the observed and future heterogeneous conditions within the pit lake.
    - *[SRK and JSAI] Stratification within the pit lake has implications for redox conditions, mineral solubility and sorption reactions. The pit lake model results presented in the report are conservative in that they assume the pit lake will be fully mixed. Several sampling exercises have been completed to evaluate stratification in the current pit lake and all demonstrate that the lake is currently homogeneous. For example, temperature and dissolved oxygen profiles for the existing pit lake (BDR fig 8-9) show the pit water is not significantly stratified. The water stays well oxygenated for the entire depth for each season (6 to 8 mg/L). Thermal stratification requires a 1°C change in temperature per meter (Wetzel, 2001), which can occur in the summer months as the upper water column heats up and the lower water column remains cool, and well oxygenated . Several limnological studies on deep pit lakes in the United States have shown the tendency for incomplete seasonal overturn so development of a metal-rich brine in the hypolimnion is unlikely. The future pit lake is expected to be mixed and well oxygenated because: 1) the existing and future pit lake can be classified as polymictic with frequent or continuous periods of circulation with no ice cover in the winter; 2) the existing and future pit lake can also be characterized as oligotrophic - having little to no nutrient input and organic production, with dissolved oxygen content regulated largely by physical processes; and*

3) during pit reclamation, efforts will be made to prevent chemical stratification by eliminating significant inputs of highly concentrated dissolved solids.

7. 3.4.1 Groundwater Chemistry – The range (minimum and maximum) of groundwater compositions (field parameters, major ions and trace elements) should be included as input to the PHREEQC simulations.
    - *[SRK and JSAI] There are four sets of piezometers currently surrounding the existing pit that have been sampled as part of Stage 1 Abatement monitoring, with two piezometer sets in the andesite rocks (GWQ96-22, GWQ96-23), and two in the quartz monzonite (GWQ11-24 and GWQ11-25). SRK used the results from GWQ96-22 and GWQ96-23 because dewatering for the proposed pit will remove the groundwater from storage represented by GWQ11-24 and GWQ11-25, and induced inflow would be representative of GWQ96-22 and GWQ96-23. Table 1 shows the average, minimum and maximum elemental concentrations for these wells over the period 1996 to 2013.*
8. 3.5 Mineral and Gas Phase Equilibrium – A detailed discussion is warranted on why kinetic modeling of sulfide oxidation of residual pyrite, chalcopyrite, molybdenite, bornite and other nonreactive sulfate and silicate phases was not considered for the PHREEQC simulations and the potential limitations of not considering kinetics.
    - *[SRK] Sulfide mineral reactions are already accounted for in the model because HCT data were used as inputs to the model. The HCT test provides an estimate of long-term accelerated rates of elemental release as a result of oxidation reactions, including sulfide mineral oxidation. Furthermore, the kinetic database for PHREEQC is still under development and has not yet been published. Kinetic data for sulfide mineral phases are also limited, with data generally being limited to silicate mineral phases. In evaluating long term changes to water chemistry, it is reasonable to assume thermodynamic equilibrium will be attained by the system and as such the approach taken in this study is valid. For these reasons, kinetic modeling is not warranted or recommended.*
9. Mineral and Gas Phase Equilibrium – A table should be provided that identifies and quantifies precipitating and dissolving minerals as part of mass transfer calculations for equilibrium and non-equilibrium conditions. Spreadsheets should be provided showing the molal concentrations of each mineral precipitating or dissolving at the various time steps.
    - *[SRK] SRK agrees including this information would enable the reader to see which mineral phases are forming at each time step in the model and how this controls pit lake chemistry under equilibrium conditions. This comment is addressed by including an electronic version of the full PHREEQC output file (which contains this information) as an appendix to this memorandum. Inclusion of the PHREEQC output file also addresses comments 13 and 0, below.*

Table 1: Average, Minimum and Maximum Groundwater Chemistry for Wells GWQ96-22A, GWQ96-22B, GWQ96-23A and GWQ96-23B

Parameter	Units	NMAC 20.6.4.900 standards for livestock watering	NMAC 20.6.4.900 standards for wildlife	Average	Minimum	Maximum
pH	s.u.	-	-	7.85	7.50	8.16
HCO_3	mg/L	-	-	394	124	640
Aluminum	mg/L	-	-	0.41	0.01	7.40
Antimony	mg/L	-	-	<0.002†		
Arsenic	mg/L	0.2	-	0.003	0.001	0.006
Boron	mg/L	5	-	0.14	0.05	0.28
Barium	mg/L	-	-	0.09	0.05	0.13
Calcium	mg/L	-	-	87.1	45	150
Cadmium	mg/L	0.05	-	<0.002†		
Chloride	mg/L	-	-	49.1	12.0	210
Cobalt	mg/L	1	-	<0.006†		
Chromium	mg/L	1	-	<0.006†		
Copper	mg/L	0.5	-	0.014	0.002	0.05
Fluoride	mg/L	-	-	2.02	0.80	3.30
Iron	mg/L	-	-	1.49	0.021	9.3
Mercury	mg/L	0.01	0.00077	<0.000002†		
Potassium	mg/L	-	-	3.1	1.30	10.0
Magnesium	mg/L	-	-	19.8	3.20	45.0
Manganese	mg/L	-	-	0.66	0.05	2.80
Molybdenum	mg/L	-	-	0.02	0.008	0.05
Sodium	mg/L	-	-	117	66.0	200
Nickel	mg/L	-	-	<0.01†		
Lead	mg/L	0.1	-	<0.005†		
Sulfate	mg/L	-	-	96.9	0.50	410
Silica	mg/L	-	-	13.8	12.0	16.0
Silver	mg/L	-	-	0.018	0.005	0.05
Selenium	mg/L	-	0.005	0.003	0.001	0.005
Uranium	mg/L	0.05	-	0.002	<0.001	0.004
Vanadium	mg/L	0.1	-	<0.0009†		
Zinc	mg/L	-	-	0.04	<0.01	0.33
Ion balance	%	-	-	*0.60%*	=	=

†	*Indicates parameter is uniformly below detection limits in groundwater over monitoring period and was excluded from the PHREEQC input .Concentration shown in table represents lower limit of analytical detection.*
'-'	*Indicates no standard for parameter*

10. Table 3.5 Equilibrium Phases Included in the Pit Lake Geochemical Model (Page 28) – Table 3-5 should be updated to include a revised list of minerals observed in the various rock types that are exposed in the existing pit lake. This should be based on the findings presented in the Humidity Cell Termination Report.

    - *[SRK] Revising the list of equilibrium phases to reflect the mineral phases identified in the Humidity Cell Termination Report is unlikely to have any significant effect on the predicted chemistry, since any mineral phases that are close to saturation have already been allowed to precipitate in the current models. Inclusion of additional mineral phases that are significantly under-saturated in the current models will not have a material effect on the observed pit lake chemistry. Therefore, SRK believes the addition of these mineral phases is not justified.*

11. Table 3.5 Equilibrium Phases Included in the Pit Lake Geochemical Model (Page 28) – Additional discussion should be added to Section 3-5 to explain the use of the various uranium equilibrium phases in the PHREEQC model and discuss their importance in controlling dissolved uranium concentrations.

    - *[SRK] Uranium mineral phases observed to be close to saturation in the initial code evaluation were added to the model. Inclusion of these minerals as equilibrium phases in the PHREEQC code allows them to precipitate should the saturation index be reached under the geochemical conditions (i.e., Eh, pH, pCO_2, pO_2, and ionic strength) predicted by the model.*

12. 3.6 Adsorption – The PHREEQC simulations should account for the existing mass of HFO, amorphous $Fe(OH)_3$ and ferrihydrite in the pit lake to more accurately model adsorption-surface complexation. A comparison of filtered (for example 0.05, 0.2 and 0.45 µm) and non-filtered pit lake water samples will provide useful information to evaluate this component.

    - *[SRK] The PHREEQC simulations already accounts for the mass of ferrihydrite that would be available for adsorption and surface complexation reactions based on the mass of solid that precipitates during the previous reaction step. Because the future pit lake predictions start from time zero (i.e., cessation of mining), there will be no prior pit lake in the void at that point. Any HFO/ferrihydrite will therefore originate from the precipitation of oversaturated mineral phases that develop upon solution mixing (which is already accounted for within the pit lake model). The collection of filtered samples from the existing pit lake at 0.05, 0.2 and 0.45 µm would provide information in terms of the presence of colloidal vs. dissolved iron, but would not results in a change in the pit lake model results.*

13. 3.6 Adsorption – Results of surface complexation simulations should be provided to further understand adsorbate affinity for adsorption sites (strong and weak) present on HFO, competing adsorbates, and complexing ligands such as sulfate and carbonate.

    - *[SRK] The results of surface complexation simulations are provided in the PHREEQC output file, which is provided as an attachment to this memorandum. The predicted pH conditions of the future pit lake (~pH 8) are likely to be favorable for sorption reactions, with many metal(loid) ions sorbing more effectively at circum-neutral to moderately alkaline pH. Sorption onto precipitated HFO will therefore represent an important metal removal mechanism in the future pit lake. SRK believes that any additional discussion regarding competing adsorbates would be too detailed for the objectives of the pit lake report.*

14. 3.8 Model Logic and Coding – Uncertainties associated with the HCT analytical results and predicted pit lake water chemistries should be thoroughly evaluated and presented. Additional PHREEQC simulations should be run that consider the range of solute concentrations associated with the humidity cell testwork to bound the uncertainties in the model input and output under current and future conditions.

- *[SRK] The HCT results show little variation between cells and SRK therefore feels it is justifiable to use average HCT chemistry as the model input. Running additional model iterations using upper and lower bound HCT chemistry is likely to have minimal effect of the predicted chemistry. NMED are referred to Appendix C of the HCT Termination Report (SRK 2014) which provides time-series plots of elemental release and shows similar effluent chemistry for the majority of cells.*

15. 3.8 Model Logic and Coding – Additional PHREEQC simulations should be run that consider varying redox conditions or heterogeneities occurring within the future pit lake. Redox conditions within the future pit lake may be bounded by the range of pe = 12 – pH and pe = 20 – pH.

    - *[SRK] The model assumes sub-atmospheric equilibrium with oxygen and carbon dioxide gas, with pH + pE equal to 12, representing a transitional equilibrium between mixed pit lake water and the atmosphere. SRK believe this is the most likely scenario based on the conceptual model for Copper Flat. Furthermore, values greater than 15 are unrealistic. Therefore, SRK does not see any merit in running additional simulations where the redox conditions are greater than currently modeled.*

16. 3.8 Model Logic and Coding – A detailed discussion regarding selection of the specific time steps as a function of the pit lake water balance need to be presented so that the reader will understand the rationale behind this component.

    - *[SRK] Figure 1 (below) shows the time steps that were selected for the geochemical model in the context of the pit lake water balance. During the early stage of pit infilling, predictions of water chemistry were made at more frequent time intervals, as there is likely to be more rapid variations in chemistry prior to the pit establishing hydrologic equilibrium. As the pit lake approaches equilibrium, however, less frequent water quality predictions were carried out as the variations in chemistry are not likely to be as significant.*

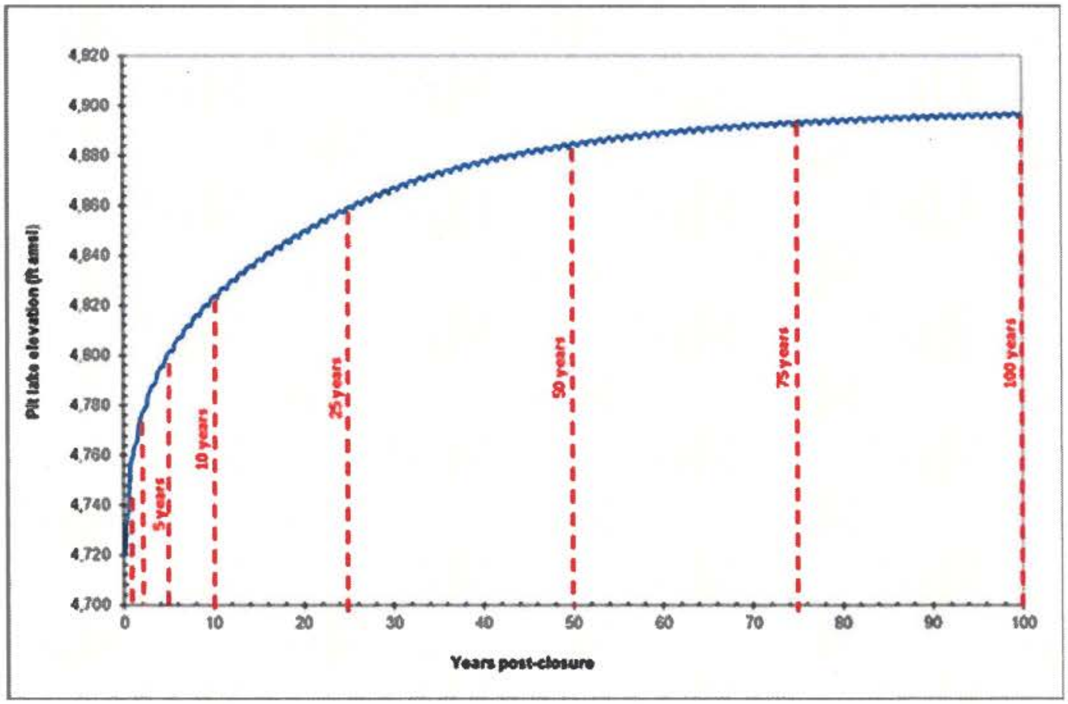


Figure 1: Geochemical Model Iterations in Context of Pit Lake Water Balance

17. 3.8 Model Logic and Coding – Spreadsheets should be provided for each time step that detail the PHREEQC results for key field parameters, selected solute concentrations, adsorption results and mass transfer of precipitating and dissolving solids.
    - *[SRK] This information is contained in the PHREEQC output file, which is included as an attachment to this memorandum.*
18. 3.9 Geochemical Modeling Assumptions (Page 31) – A detailed discussion on assumptions regarding the following topics should be provided:
    - Accuracy of the water balance and the influence of climate change in controlling evaporation and surface water/groundwater flow into the pit lake.
        - *[JSAI] Consideration of the effects of climate change is beyond the scope of the current study. Effects of possible variations of the main components of the pit water balance are being evaluated as the details of the mine closure plans, including in-pit reclamation, watershed management and source controls, are considered. Included in this study is the evaluation of pit water conditions during wet and dry periods. The water-balance and water-chemistry implications of different possibilities and options are being evaluated as part of pit reclamation and source control study.*
    - Steady-state versus transient geochemical and hydrological conditions.
        - *[SRK] Modeling has been undertaken assuming steady-state, average conditions at each time-step.*
    - Technical defensibility of the geochemical conceptual models considered for modeling various geochemical processes.
        - *[SRK] The conceptual models presented are consistent with the industry-standard approach for modeling pit lake chemistry and comparable approaches are reported in Tempel et al. (2000); Eary (1998) and Castendyk and Webster-Brown (2007).*
    - Heterogeneities in pH, Eh and solute concentrations as functions of season, depth interval and location.
        - *See response to comment* 6, *above*
    - The use of relevant reactive minerals observed or anticipated to occur at Copper Flat.
        - *[SRK] Table 3-5 has been amended to show the rationale for including specific mineral phases in the PHREEQC model. The revised table is shown in Table 2, below.*
    - Kinetic versus thermodynamic modeling.
        - *See response to comment* 8, *above.*
    - The limitations of the thermodynamic databases.
        - *[SRK] A discussion on this is provided in Section 3.14 of the report.*

Table 2: Revision to Table 3-5 of Pit Lake Modeling Report

Equilibrium phase	Ideal formula	Rationale for inclusion in PHREEQC model
Alunite	$KAl_3(SO_4)_2(OH)_6$	Mineral observed at Copper Flat (SRK, 1996; 1997).
Anhydrite	$CaSO_4$	Close to saturation in initial model runs.
Ag_2Se	Ag_2Se	Close to saturation in initial model runs.
Barite	$BaSO_4$	Primary control on barium at neutral to alkaline pH (Eary, 1999). Mineral observed in Copper Flat mineralogical study (SRK, 2014).
$Ba_3(AsO_4)_2$	$Ba_3(AsO_4)_2$	Close to saturation in initial model runs.
Boehmite	$AlOOH$	Close to saturation in initial model runs.
Brochantite	$Cu_4^{2+}(SO_4)(OH)_6$	Primary control on copper at neutral to alkaline pH (Eary, 1999). Mineral observed at Copper Flat (SRK, 1996; 1997).
Brucite	$Mg(OH)_2$	Close to saturation in initial model runs.
Calcite	$CaCO_3$	Primary control on alkalinity at neutral to alkaline pH (Eary, 1999). Mineral observed at Copper Flat (SRK, 1996; 1997).
Carnotite	$K_2(UO_2)_2(VO_4)_2.H_2O$	Close to saturation in initial model runs.
Chrysotile	$Mg_3Si_2O_5(OH_4)$	Close to saturation in initial model runs.
Diaspore	α-$AlOOH$	Close to saturation in initial model runs.
Epsomite	$MgSO_4.7H_2O$	Close to saturation in initial model runs.
Ferrihydrite	$5Fe_2O_3.9H_2O$	Major control on iron. Thermodynamic properties well defined (Dzombak and Morel, 1990).
Fluorite	CaF_2	Primary control on fluoride (Eary, 1999). Mineral observed in Copper Flat mineralogical study (SRK, 2014).
Gibbsite	$Al(OH)_3$	Primary control on aluminum at neutral to alkaline pH (Eary, 1999).
Gummite	UO_3	Close to saturation in initial model runs.
Gypsum	$CaSO_4.2H_2O$	Primary control on sulfate (Eary, 1999). Observed in significant quantities around existing pit lake (SRK, 1996; 1997; 2014).
HgSe	$HgSe$	Close to saturation in initial model runs.
Magnesite	$MgCO_3$	Close to saturation in initial model runs.
Malachite	$Cu_2^{2+}(CO_3)(OH)_2$	Primary control on copper at neutral to alkaline pH (Eary, 1999). Mineral observed at Copper Flat (SRK, 1996; 1997).
Mirabilite	$NaSO_4.10H_2O$	Mineral observed at Copper Flat (SRK, 1996; 1997).
$NiCO_3$	$NiCO_3$	Primary control on nickel at neutral to alkaline pH.
Otavite	$CdCO_3$	Primary control on cadmium at neutral to alkaline pH (Eary, 1999).
Pyromorphite	$Pb_5(PO_4)_3Cl$	Close to saturation in initial model runs.
Rhodochrosite	$Mn^{2+}CO_3$	Primary control on manganese at neutral to alkaline pH (Eary, 1999).
Rutherfordine	UO_2CO_3	Close to saturation in initial model runs.
Schoepite	$UO_2(OH)_2.H_2O$	Close to saturation in initial model runs.
Sepiolite	$Mg_4Si_6O_{15}(OH)_2.6H_2O$	Close to saturation in initial model runs.
SiO_2 (am-ppt)	SiO_2	Close to saturation in initial model runs.
Tenorite	$Cu^{2+}O$	Close to saturation in initial model runs. Likely solubility control for copper at neutral to alkaline pH (Eary, 1999).
U_3O_8	U_3O_8	Close to saturation in initial model runs.
UO_3	UO_3	Close to saturation in initial model runs.
$UO_2(OH)_2$ (beta)	$UO_2(OH)_2$ (beta)	Close to saturation in initial model runs.

19. Figure 3-12 Predicted Versus Measured Pit Lake Chemistry of the Existing Pit Lake (Page 37) – Figure 3-12 should be revised to include measured and simulated concentrations of dissolved Al, Fe and Mo.

    - *[SRK] Figure 3-12 has been updated to include aluminum, iron and molybdenum and the amended figure is shown Figure 2 below.*

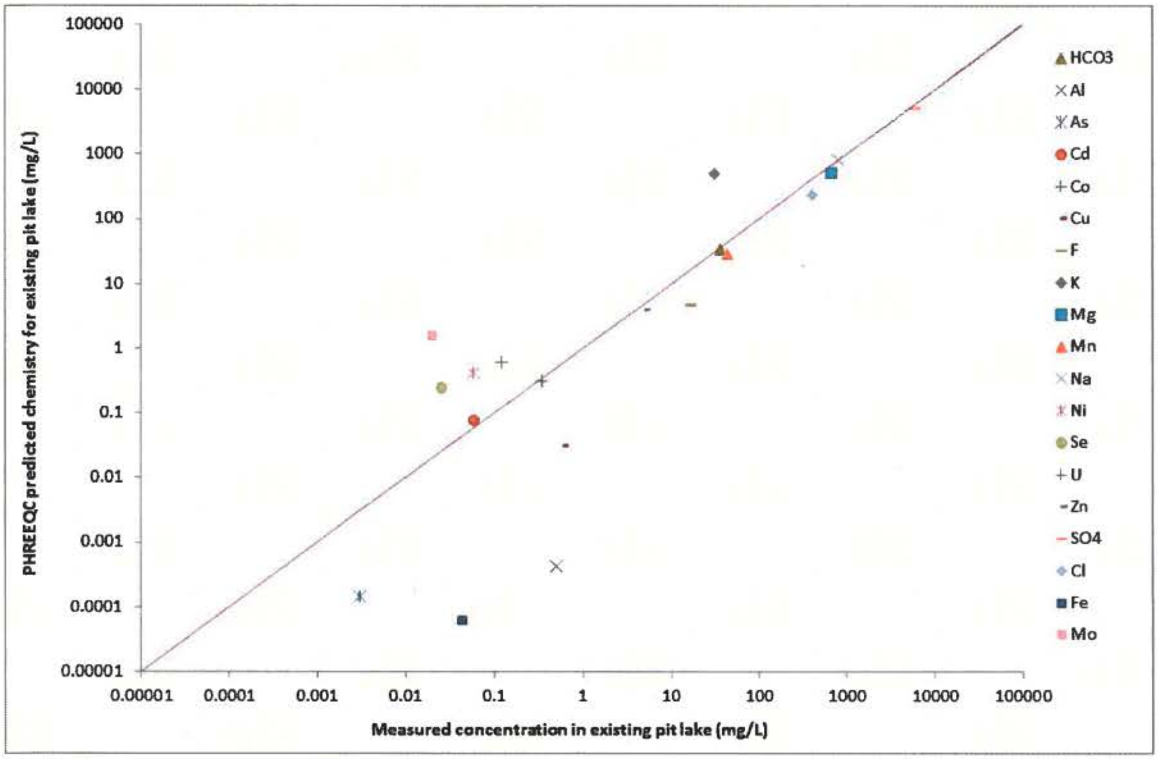


Figure 2: Revision to Figure 3-12 of Pit Lake Modeling Report

20. Table 3-9 Predicted Versus Measured Pit Lake Chemistry for the Existing Pit Lake (Page 38) – Additional discussion should be added to Section 3.1.2 that explains the discrepancy between predicted and measured concentrations of certain parameters in the existing pit lake. In particular a detailed discussion should be added focusing on model uncertainties and understanding geochemical processes controlling the fate of major ion and trace element chemistry under existing and future conditions.

    - *[SRK] The existing pit lake model shows good calibration for pH, alkalinity, calcium, cadmium, cobalt, magnesium, manganese, sodium, lead, zinc, sulfate, chloride and TDS. However, a number of trace constituents are either positively- or negatively-biased in the pit lake calibration model. The model overestimates the concentrations of boron, potassium, mercury, molybdenum, nickel, antimony, selenium, uranium and vanadium. This likely relates to a combination of one or more of factors including: evapoconcentration effects within the PHREEQC model; challenge of incorporating analyses below detection; and the lack of appropriate mineralogical controls in the thermodynamic code. This means the mechanisms that are responsible for removal of these constituents from solution in the existing pit lake (e.g., adsorption onto clays or precipitation of mineralogical phases that are not included in the .minteq database) are* *not accounted for in the geochemical model, resulting in concentrations of these constituents being artificially increased over time.*

- *[SRK] The model underestimates the concentrations of a number of parameters, including aluminum, arsenic, barium, chromium, copper, fluoride and iron. For aluminum and iron, this underestimate likely relates to the fact that PHREEQC reports only truly dissolved phases. It is possible that aluminum and iron in the existing pit lake may exist in the form of fine-grained colloids that pass through a 0.45 µm filter, which explains the higher measured concentrations of these parameters in the existing pit lake. For barium and fluoride, the lower concentrations predicted by the model may relate to an over-estimate of barite and fluorite precipitation. Although these mineral phases have been observed around the existing pit lake at Copper Flat and are likely to form based on the predicted chemistry, the model may overestimate the mass of these minerals that will precipitate, resulting in a lower predicted concentration.*
- *[SRK] For chromium and arsenic the discrepancy between predicted and measured concentrations may be related to the incorporation of results below the detection limit that can lead to an under or over estimate of composition depending on the value selected. In addition, both chromium and arsenic are predicted in the calculations to adsorb onto iron-oxyhydroxides; however, speciation of these oxyanions in the lake may be more complex than predicted and may occur in other species that are less strongly adsorbed than the thermodynamically stable species predicted by the model. For example, arsenic may occur as arsenite rather than arsenate, which is not as strongly adsorbed to iron-oxyhydroxides as arsenate due to kinetic effects. The underestimate of copper by the model may be related to the incorporation of results below analytical detection or may also be explained by a kinetic inhibition for mineral formation of secondary copper phases in the existing pit lake that are predicted to be saturated according to the thermodynamic code and precipitated. Alternatively, or in conjunction, some of the measured arsenic, chromium and copper in solution could occur as particulates or colloids less than 0.45 µm in size. As such they form solids but do not settle and are detected in water sampling.*

21. Table 3-9 Predicted Versus Measured Pit Lake Chemistry for the Existing Pit Lake (Page 38) – There are errors in the reported concentrations of alkalinity as $CaCO_3$ and/or HCO_3 provided in Table 3-9. These errors should be corrected.
    - *[SRK] This error has been corrected and the revised table is provided in Table 3 below.*

Table 3: Revision to Table 3-9 of Pit Lake Modeling Report

			Measured chemistry in existing pit lake	PHREEQC predicted chemistry for existing pit lake
pH	**pH**	s.u.	7.35	7.90
pe	**pe**	s.u.	-	4.88
HCO_3	**Bicarbonate**	mg/L	35.7	34.2
Ag	**Silver**	mg/L	<0.0025	0.001
Al	**Aluminum**	mg/L	0.502	0.0004
As	**Arsenic**	mg/L	0.003	0.0001
B	**Boron**	mg/L	0.16	2.44
Ba	**Barium**	mg/L	0.012	0.003
Ca	**Calcium**	mg/L	592	465
Cd	**Cadmium**	mg/L	0.06	0.08
Co	**Cobalt**	mg/L	0.34	0.30
Cr	**Chromium**	mg/L	0.012	0.0001
Cu	**Copper**	mg/L	0.60	0.03
F	**Fluoride**	mg/L	17.0	4.62
Fe	**Iron**	mg/L	0.04	0.0001
Hg	**Mercury**	mg/L	<0.0002	0.001
K	**Potassium**	mg/L	31.0	492
Mg	**Magnesium**	mg/L	677	498
Mn	**Manganese**	mg/L	44.0	29.8
Mo	**Molybdenum**	mg/L	0.02	1.56
Na	**Sodium**	mg/L	792	831
Ni	**Nickel**	mg/L	0.058	0.42
Pb	**Lead**	mg/L	<0.005	0.00005
Sb	**Antimony**	mg/L	<0.001	0.09
Se	**Selenium**	mg/L	0.03	0.24
U	**Uranium**	mg/L	0.12	0.62
V	**Vanadium**	mg/L	<0.05	0.18
Zn	**Zinc**	mg/L	4.87	3.88
SO_4	**Sulfate**	mg/L	5,900	5,152
Cl	**Chloride**	mg/L	412	235
TDS	**Total Dissolved Solids**	mg/L	8,589	7,751

22. Section 3.13 Future Pit Lake Results (Page 39) – In section 3.1.3, the sentence "over time, the groundwater contribution will decrease as the pit lake is established (Figure 3.6)" needs to be revised.
    - *[JSAI] The sentence is revised as follows: Over time, the groundwater contribution will decrease slightly as the pit lake is established.*
23. Section 3.13 Future Pit Lake Results (Page 39) – A detailed discussion on the potential for constituents to be biased (positive or negative) in the predicted future pit lake based on results of the predictive model for the existing pit lake. In addition, a statement needs to be made addressing the positive bias of sodium enhancing precipitation of sodium carbonate and sodium sulfate (mirabilite) phases predicted to precipitate in the pit lake.
    - *[SRK] The existing pit lake model demonstrates that although there is good calibration for many parameters, the model over- or under-estimates several constituents. This means the geochemical predictions for the future pit lake may represent a positive or negative bias for these parameters. The existing pit lake model showed good calibration for pH, alkalinity, calcium, cadmium, cobalt, magnesium, manganese, sodium, lead, zinc, sulfate, chloride and TDS. As such, concentrations of these constituents in the future pit lake can be predicted with a high level of certainty. In comparison, the calibration model showed an over-estimate of boron, potassium, molybdenum, mercury, nickel, antimony, selenium, uranium and vanadium. Therefore, the concentrations of these parameters in the future pit lake are likely to be lower than those predicted by the model. Despite this over-prediction, the majority of these constituents are below the NMAC 20.6.4900 guideline and therefore these elements are not considered constituents of concern for the future pit lake. For mercury, selenium and vanadium, however, the predicted concentrations are greater than the NMAC 20.6.4900 guideline. Further discussion regarding the over-prediction of mercury, selenium and vanadium is provided in the response to comments 1, 2 and 3 above. Additional information regarding the potential geochemical reasons for the under- or over-estimation of other modeled constituents is also provided in the response to comment 20, above.*
    - *The predicted sodium concentrations are only over-estimated by approximately 5%, with a predicted concentration of 831 mg/L compared to an average measured concentration in the existing pit lake of 792 mg/L. This minor over-estimate is unlikely to enhance the precipitation of sodium carbonate and sodium carbonate phases.*
24. Section 3.13 Future Pit Lake Results (Page 39) – A detailed discussion on the pit wall interaction mix calculator used in the PHREEQC input file should be provided.
    - *[SRK] The equations provided below show how the HCT data are scaled to field conditions and how the mass of the pit wall rock is taken into account in the model input calculations.*

$$C_i = \frac{r_i . R_m}{Q}$$

- *Where:* C_i *represents the predicted concentration (in mg/L) of element* i, r_i *represents the average release rate of element* i *in mg/kg/day in the humidity cell tests,* R_m *indicates the pit wall reactive mass in kg and* Q *represents either the rate of groundwater inflow into the pit or the rate of pit wall run-off in L/week.*
- *The reactive mass of material in the pit wall (*R_m*) is calculated as:*

$$R_m = S \times F_D \times T_{FZ} \times D$$

- *Where: S is the three-dimensional pit wall surface area in square meters,* F_D *is the fracture density,* T_{FZ} *is the thickness of the fracture zone in meters and D is the rock density in kg/m*^{3}.

25. Section 3.13 Future Pit Lake Results (Page 39) – A discussion should be provided that addresses the fate of cadmium, mercury, selenium and vanadium in the pit lake under future conditions.

    - *[SRK] Under the aerobic conditions of the Copper Flat pit lake, Se(VI) should be the dominant oxidation state. However, pure mineral forms that incorporate Se(VI) are too soluble to be expected to limit selenium concentrations (Eary, 1999). One of the primary controls on selenium attenuation in mine pit lakes has been shown to be adsorption onto ferrihydrite (Eary, 1999). However, this process is negligible when sulfate concentrations are greater than 100 mg/L (as with Copper Flat) because sulfate effectively prevents Se(VI) adsorption. In addition, Se(VI) forms anionic solutes that are less strongly adsorbed under neutral to alkaline pH conditions, thus explaining the presence of selenium in the existing pit lake at Copper Flat (pH 7.94) and the predicted selenium concentrations in the future pit lake (pH 8.0). The source of selenium in the current pit is attributed to minor and infrequent input of acid wall seepage from a limited zone within the pit. From the model, the selenium concentrations are predicted to increase to a concentration of 0.10 mg/L 10 years after mining ceases. The current pit has had selenium concentrations in the range of 0.013 to 0.059 mg/L, which is representative of more than 30 years since mining stopped. Therefore, the model conservatively simulates selenium concentrations on the high side (also see Table 3-9).*
    - *[SRK] Under the circum-neutral to moderately alkaline pH conditions predicted by the pit lake model, cadmium will be present at very low concentrations and its chemistry will likely be controlled by adsorption onto ferrihydrite. At these low concentrations, the solubility limit of mineral phases such as otavite is unlikely to be reached (Hem, 1992) and precipitation of cadmium-bearing mineral phases is an unlikely mechanism for the removal of cadmium from solution. The model results support this theory, showing otavite to be significantly undersaturated in the model output. Cadmium is not expected to be a constituent of concern in the future pit lake at Copper Flat; it is below analytical detection limits in the existing groundwater and was almost uniformly below analytical detection limits in the HCTs. Detectable cadmium concentrations were only recorded for two samples of transitional material for the initial 50 weeks of the humidity cell program. The PHREEQC model also showed good calibration for cadmium in the existing pit lake.*
    - *[SRK] The geochemical behavior of vanadium in the future pit lake will likely be controlled by precipitation and adsorption reactions. Because of vanadium's tendency to form anions, a fairly high solubility is possible in oxidizing alkaline environments such as the Copper Flat pit lake (Hem, 1992). It is recognized, however, that precipitation reactions involving vanadium-bearing mineral species are not adequately characterized in the PHREEQC thermodynamic code and hence the model shows a tendency to over-predict vanadium concentrations as demonstrated by the pit lake calibration model.*
    - *[SRK] The geochemical model over-predicts mercury concentrations by at least an order of magnitude (see response to comment 1). However, any mercury present is likely to be in the form of Hg^0, which would be expected under the circum-neutral to moderately alkaline pH conditions. The geochemical behavior of mercury under the oxidizing conditions of the pit lake may be controlled by both sorption onto inorganic matter and also the formation of strong organic complexes (USGS, 1970).*

26. Section 3.14 Model Limitations (Page 47) – Additional model simulations should be run to evaluate the reactivity of residual sulfides under equilibrium and non-equilibrium conditions.

    - *[SRK] This is covered by comment 9 above. It would be possible to run a SULFIDOX model to assess sulfide oxidation; however, this is likely to provide only limited information on the pit walls and based on experience elsewhere is unlikely change the pit lake chemistry predictions.*

27. The revised report should present a detailed discussion on how simulated evaporation of pit lake water over time is related to the future time steps used in the model input.

    - *See response to comment 16, above.*

28. Summary and Recommendations (Page 48) – Sensitivity analyses should be conducted on all input parameters (physical and chemical) listed in Table 3-6 and used in the PHREEQC simulations. This includes the water balance, estimated fracture density and surface area of pit wall rock, non-uniform redox conditions, solute chemistry (groundwater and HCT) observed and predicted reactive minerals, and equilibrium versus non-equilibrium (kinetic) conditions.
    - *[SRK and JSAI] The water quality predictions presented in the pit lake modeling report represent a conservative estimate of future pit lake chemistry at the Copper Flat Project. One of the primary objectives of the pit lake geochemical modeling was to identify potential constituents of concern for purpose of the ongoing pit reclamation and source control study. This objective has been met and therefore it is believed that running additional model sensitivity analyses would not add any additional benefit to the pit lake characterization study. See also responses to comments 4, 7, and 14, above.*

2.2 CDM Smith Comments

1. The pit lake model does not account for sulfide mineral oxidation within the entire cone of depression formed by dewatering the open pit. Additional discussion should be added to the report to help understand the sensitivity of the model to variations in the volume of rock that is assumed to oxidize and contribute contaminants to the pit lake.
    - *[SRK] This component is already accounted for by the pit lake groundwater chemistry input that reflects current equilibrium conditions. Dewatering of the surrounding rock will expose more rock but this is regulated by groundwater flow so this will not change the inputs to the PHREEQC code. The existing groundwater chemistry is likely to be in equilibrium with the bedrock surrounding the existing pit and SRK does not feel it is necessary to include the fracturing in the entire cone of depression as an additional solute lode since the main control on pit lake chemistry is not the density of fractures in the cone of depression but rather total inflow of groundwater to the pit. The primary solute loading is likely to come from rinsing of oxidation products from the pit wall surfaces and any fractures in the immediate (<1-foot) wall rock (see also response to comments 4 and 27, above).*
2. The discussion of potential thermal and chemical stratification in the pit lake should be strengthened.
    - *[SRK] See response to NMED comment 6, above.*
3. More detail needs to be added regarding how the humidity cell data were scaled, including any scaling assumptions made and how sensitive the model results are to this scaling.
    - *[SRK] The method by which the HCT data were scaled to field conditions is different for the pit lake model compared to the waste rock and tailings models. The scaling relates to differences in liquid:solid ratio between the laboratory HCT tests and field conditions. These differences in liquid:solid ratio are taken into account using information from the pit wall calculations (which defines the mass of solid available for reaction) and the pit lake water balance (which defines the volume of liquid). The scaling of the humidity cell data for the pit model is shown in the equations provided in the response to NMED comment 24 above.*

3 Summary

SRK, JSAI and NMCC believe that the majority of comments provided by NMED and CDM Smith are addressed by the incorporation of additional discussion and clarification in this addendum to the pit lake geochemistry report. However, there are several comments that will be addressed in more detail as part of the ongoing pit reclamation and source control study. For example:

- Variations of open-pit water balance are being evaluated, including potential minimizing, maximizing or re-routing of the pit wall and watershed components of runoff, and possible rapid filling of the pit with a clean alkaline groundwater source. These and other variations in pit water balance will have a corresponding effect on the predicted pit water chemistry.

- Localized pit bench reclamation, remediation of individual fractures, or re-routing of in-pit stormwater runoff, would alter the effect that contact of water with pit wall fractures has on predicted pit lake chemistry thereby mitigating pit lake chemistry by limiting contact of storm water inflow with the pit shell.

SRK, JSAI, and NMCC believe the pit lake modeling report and the addendum contained herein adequately characterize the geochemistry and water quality predictions for a conservative scenario, such that constituents of concern can be identified and mitigated through reclamation effects.

The results of the geochemical model demonstrate that selenium will be the only constituent of concern for the future pit lake at Copper Flat. Although vanadium and mercury were predicted to be elevated by the geochemical model, the model overestimates concentrations of these trace constituents by up to an order of magnitude. Vanadium and mercury are also below analytical detection limits in the existing pit water and for these reasons are not considered constituents of concern for the future pit lake.

4 Closing

SRK, JSAI and NMCC wish to thank NMED and CDM Smith for their constructive comments on the pit lake modeling report. The responses provided herein are based on our understanding and interpretation of these comments. Should you have any questions or require any additional information, please do not hesitate to contact Steve Raugust at 505.881.1353 or sraugust@themacresourcesgroup.com.

5 References

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Attachment 1: Evaluation of Mercury as a CoC for Copper Flat Pit Water

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TECHNICAL MEMORANDUM

To: Steve Raugust, New Mexico Copper Corporation
Katie Emmer, New Mexico Copper Corporation

From: Steven T. Finch, Jr., Principal Hydrogeologist-Geochemist, JSAI

Date: July 25, 2014

Subject: **Evaluation of mercury as a COC for Copper Flat pit water**

John Shomaker & Associates, Inc. (JSAI) has reviewed the report *"Predictive Geochemical Modeling of Pit Lake water quality at the Copper Flat Project, New Mexico"* (SRK, September 2013), the supporting report "*Geochemical Characterization report for the Copper Flat Project, New Mexico*" (*SRK,* May 2013), and Stage 1 abatement data to determine if mercury is a potential contaminant of concern for the existing and future pit water at the Copper Flat mine.

The following review comment for the SRK pit lake geochemistry report was provided by the New Mexico Environment Department (NMED):

1. Executive Summary (Page vi) – More detail should be provided on why the predicted exceedance of mercury does not represent a true ecological risk to wildlife.

JSAI Response: The only model-simulated input for mercury is from the source terms for the pit wall material (Table 3-3), with values for the HCT effluent testing ranging from 0.00001 to 0.000005 mg/L. It was assumed that mercury detections in the HCT samples would be scaled with the other constituents. However, it may not be representative to scale up detectable traces of mercury because there is no source mineral in the ore body and concentrations in the HCT testing do not significantly vary (see Fig B-6). Furthermore, the NMWQCC surface water standard for wildlife is 0.00077 mg/L, which is near or below the detection limit for the input data. For these reasons, mercury does not provide an ecological risk.

SUPPORTING DATA AND BACKGROUND INFORMATION

Background information includes mineralogical characterization of the ore body, laboratory analysis of pit water, surface water and surrounding groundwater, geochemical analysis of salt rind from the existing pit, and SRK HCT testing results.

Mineralogy of Ore Body

Mercury is known to occur as HgS (Cinnabar), and as a trace constituent in some sulfides and sulfosalts. Cinnabar has not been identified with the Copper Flat Deposit (McLemore, 2001).. However, mercury may occur as a trace constituent in pyrite, galena and copper sulfosalts such as tennantite, which have been identified at Copper Flat.

Whole Rock Analysis of Open Pit Salts

Mercury can also be adsorbed onto iron hydroxides and other mineral surfaces. Whole rock analysis of the salt rim that has formed around the existing pit resulted in non detection (<0.034 mg/kg) of mercury. The lab analysis is attached. The Salt rim is mostly composed of gypsum with iron and aluminum oxyhydroxides. If mercury were present in the pit water, it would adsorb onto the oxyhydroxides within the salt and would be detected in the salt residue.

Water-Quality Analyses

Laboratory water quality analysis for mercury has been performed on samples from open pit water, surface water runoff above (SWQ-1) and below (SWQ-2 and SWQ-3) the pit, and from monitoring wells adjacent to the pit. Attached Tables 1, 2, and 3 summarize the results; mercury was not detected in any of the samples.

Laboratory method detection limits vary, but are most commonly 0.001 and 0.0002 mg/L mercury. The samples with a detection limit of 0.0002 mg/L should be used to compare to the NMED surface water standard of 0.0077 mg/L for wildlife uses. Many of the sample points that were analyzed with a detection limit of 0.001 mg/L were also analyzed using a method with 0.0002 mg/L detection limit.

Geochemical Characterization (HCT testing)

SRK pit lake geochemistry report figure B-6 shows the results of the humidity cell effluent for mercury. Most of the samples tested show mercury below detection (0.0001 mg/L or approximately 0.00005 mg/kg) in the effluent. Three detections occurred: 1) six of the 23 samples showed detectable mercury release at week zero (i.e. during the initial flush); 2) two samples showed detectable mercury release approximately 92 weeks into the testing; and 3) one cell of coarse crystalline porphyry material (sample CF-11-02, 0-27) shows sustained release of mercury during the first 8 weeks of testing, which indicates flushing of mercury (albeit at very low concentrations) from the material. Although no mercury minerals such as cinnabar or mercury sulfosalts have been identified in the Copper Flat mineralization, mercury in copper porphyry systems may also occur as a trace element in pyrite, copper sulfosalts and sphalerite, all of which have been identified at Copper Flat. The detectable mercury release from two of the humidity cells at week ~92 may therefore relate to sulfide oxidation. This is supported by the associated increase in Eh and iron release around week 92, suggesting the mercury release is not analytical error.

Mercury inputs into the geochemistry model included:

- Solution 7, coarse crystalline porphyry-oxide/transitional, at 0.00005 mg/L
- Solution 11, Quartz Monzonite, at 0.000011 mg/L
- Solution 12, coarse crystalline porphyry-sulfide, at 0.000019 mg/L
- Solution 13, undefined material, at 0.000009 mg/L

These inputs are then scaled as part of the model calibration. For example, the runoff mix scaling factor for Solution 11 is 102.3, resulting in a solution concentration of 0.001125 mg/L.

Surface water samples SWQ-2 and SWQ-3 from below the existing waste rock facility had mercury concentrations below detection (Table 2). SWQ-2 and SWQ-3 should be analogous to model simulated runoff mix to the pit because quartz monzonite covers the largest area of the pit shell, and storm water is the largest component of inflow.

Model Results

The observed Mercury value for the existing pit water is <0.0002 mg/L, where the SRK geochemistry model calibrates to a value of 0.001 mg/L. Model simulated mercury concentrations are at least an order of magnitude too high. Mercury is mentioned as a potential concern, but the result is acknowledged to be a model artifact rather than a true reflection of concentration.

The lack of detected mercury in the existing pit water, surface water runoff from the existing waste rock piles, and groundwater are evidence that mercury should not be a constituent of concern for the future pit water.

Attachments:

Tables 1 through 3

Table 1. Summary of mercury results from Copper Flat open pit water

sample location	collection date	mercury (mg/L)
pit wall seepage	8/19/2010	<0.001
PL-WQ	7/19/1991	<0.0002
PL-WQ	12/12/1994	<0.001
PL-WQ	12/19/1994	<0.001
PL-WQ	9/21/1995	<0.001
PL-WQ (0 ft)	1/30/2010	<0.0002
PL-WQ-01 (28 ft)	9/10/2010	<0.0002
PL-WQ-03 (3 ft)	9/10/2010	<0.0002
PL-WQ-04 (comp)	9/10/2010	<0.0002
PL-WQ-05 (7ft)	1/20/2011	<0.0002
PL-WQ-06 (17 ft)	1/20/2011	<0.0002
PL-WQ-07 (26 ft)	1/20/2011	<0.0002
PL-WQ-08 (comp)	1/20/2011	<0.0002
PL-WQ-09 (1 ft)	4/14/2011	<0.0002
PL-WQ-10 (3 ft)	4/14/2011	<0.0002
PL-WQ-11 (16 ft)	4/14/2011	<0.0002
PL-WQ-12 (comp)	4/14/2011	<0.0002
PL-WQ-13 (2 ft)	7/20/2011	<0.0002
PL-WQ-14 (11 ft)	7/20/2011	<0.0002
PL-WQ-15 (23.5 ft)	7/20/2011	<0.0002
PL-WQ-16 (comp)	7/20/2011	<0.0002

Table 2. Summary of mercury results from Copper Flat surface water

sample location	analysis date	mercury (mg/L)
SWQ-1	12/28/1982	<0.001
SWQ-1	2/21/1983	<0.001
SWQ-1	4/1/1993	<0.001
SWQ-2	2/25/1982	<0.001
SWQ-2	5/12/1982	<0.001
SWQ-2	2/21/1983	<0.001
SWQ-2	5/13/1983	<0.001
SWQ-2	8/9/1983	<0.001
SWQ-2	11/1/1983	<0.001
SWQ-2	12/23/1983	<0.001
SWQ-2	3/16/1984	<0.001
SWQ-2	5/30/1984	<0.001
SWQ-2	9/12/1984	<0.001
SWQ-2	11/27/1984	<0.001
SWQ-2	7/19/1991	<0.0002
SWQ-2	3/31/1993	<0.001
SWQ-2	8/25/2010	<0.0002
SWQ-2	4/28/2011	<0.0002
SWQ-2A	10/27/1981	<0.001
SWQ-2A	2/25/1982	<0.001
SWQ-3	7/19/1991	<0.0002
SWQ-3	3/31/1993	<0.001
SWQ-3	8/19/2010	<0.0002
SWQ-3	10/21/2010	<0.0002
SWQ-3	4/27/2011	<0.033

Table 3. Summary of mercury results from Copper Flat groundwater

sample location	analysis date	mercury (mg/L)
GWQ96-22A	7/13/1996	<0.001
GWQ96-22A	4/9/1997	<0.001
GWQ96-22A	1/30/2010	<0.0002
GWQ96-22A	7/1/2010	<0.0002
GWQ96-22A	10/7/2010	<0.0002
GWQ96-22A	7/9/2013	0.000004
GWQ96-22B	7/13/1996	<0.001
GWQ96-22B	10/7/2010	<0.0002
GWQ96-22B	7/9/2013	0.000003
GWQ96-23A	7/14/1996	<0.001
GWQ96-23A	4/9/1997	<0.001
GWQ96-23A	1/30/2010	<0.0002
GWQ96-23A	7/1/2010	<0.0002
GWQ96-23A	10/6/2010	<0.0002
GWQ96-23A	5/12/2011	<0.0002
GWQ96-23A	7/9/2013	0.0000009
GWQ96-23B	7/14/1996	<0.001
GWQ96-23B	10/6/2010	<0.0002
GWQ96-23B	5/12/2011	<0.0002
GWQ96-23B	7/9/2013	0.000001

Attachment 2: PHREEQC Output File

(PQO file)

THEMAC
RESOURCES

GROUND WATER
JUL 31 2014
BUREAU

TO: Patrick Longmire
FROM: New Mexico Copper Corporation
CC: Kurt Volbrecht, Brad Reid, NMED; Chris Eustice, D.J. Ennis, Holland Shephard, MMD; Kevin Myers, OSE; Doug Haywood, BLM; Dave Henney, SOLV.
DATE: July 29, 2014
SUBJECT: Transmittal of NMCC response to NMED comments to the September 2013 Copper Flat Pit Geochemical Modeling Report

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Cooperating Agencies - NMCC Meeting – Notes
19 Aug 2014 14:00 MST

Attendee	Company	Initial	Present
Doug Haywood (via phone)	BLM	D.Haywood	X
Steve Finch	JSAI	SF	X
Matthew Wunder	NM G & F	M.Wunder	Not present
Mark Watson	NM G & F	M.Watson	X
Brad Reid	NMED	BR	X
Kurt Vollbrecht	NMED	KV	X
Bryan Dail	NMED SWQB	BD	Not present
Kristine Pintado	NMED SWQB	KP	Not present
Kevin Myers	NMOSE	KM	X
Dave Henney (via phone)	Solv	D.Henney	X
DJ Ennis	MMD	DJE	Not present
Chris Eustice	MMD	CE	X
Holland Shepherd	MMD	HS	X
Katie Emmer	THEMAC	KE	X

Next Meeting Date: 30 September, 2014 14:00

Action Items

Upcoming Meetings

- Further discussion of NMCC Pit at end of mine life: 23 Sept, 2014
- NMCC meeting with BLM and Solv Aug 26 & 27 to discuss EIS schedule and path forward

NMCC Upcoming Deliverables

- NMCC & JSAI will submit final UAA workplan for NMED SWQB review soon: week of August 25th or week of Sept 1.
- NMCC is working with AMEC on development of revised MORP for submission perhaps later this year.

Other Action Items

- NMED will discuss geochemistry responses with P.Longmire during week of August 25th and get back to NMCC on this
- NMED will contact NMCC for a meeting to discuss the May 2014 report *Results from First Year of Stage 1 Abatement Investigation at the Copper Flat Mine Site Near Hillsboro, New Mexico* prior to sending an official response letter.

1. Geochemistry report comment responses

   KE: NMCC submitted responses to comments on the 28th of July 2014. BR communicated with JSR on the 1st of August that NMED would meet with PL in the following 5-10 days to discuss. I have noted as an agenda item at the end of this meeting a geochemistry conversation for everyone to discuss this topic without NMCC present, but wanted to check with Brad and ask how things are going on NMED's end with the responses NMCC provided?

   BR: NMED has been trying to set up a meeting with Patrick Longmire but have had trouble getting in touch with him. PLongmire is busy on other projects; however NMED is trying to set up a meeting with him for internal discussion the week of August 25th. PLongmire does have NMCC's submitted geochemistry responses. After NMED discusses with PLongmire, NMED will respond to NMCC.

2. Pit water standards navigation plans

   KE: I have been including SWQB on the meeting invite and I'll give those guys a call after this one to see if they can attend. I am copying them on the notes and I did speak with Dr. Bryan Dail after the last meeting so I know we are on their radar.

   SF: We met with NMED SWQB earlier in the year and agreed to do a biologic assessment of the current pit, we have received their feedback on an initial workplan and are finalizing the UAA workplan for evaluation of the pit's current capacity for warmwater aquatic life, we hope to submit it next week.

   Discussion: Warmwater aquatic life standards are different from the wildlife standards. Since wildlife standards apply to a known existing use, NMCC does not plan to do anything other than meet those standards. Since warmwater aquatic life is a "designated use", but it's not known if it's an existing use currently, NMCC has elected to do a Use Attainability Analysis (UAA) to assess whether this use can be modified or removed. Dr. James Hogan has indicated he would like NMCC to do this UAA on the current pit as he doesn't want to attempt to modify or remove standards on a future pit that does not currently exist.

   Jurisdictional determination request: JSAI submitted documentation on the physical characteristics of the Copper Flat Pit on behalf of NMCC on the 1st of August to Rick Gatewood at the USACOE. Mr. Gatewood has been in touch with us a couple of times with requests for additional information to show that the pit water is not contributing to Grayback Arroyo. JSAI is pulling together some additional information for ACOE to review.

   M.Watson: NMG& F would like to review the results of the biological assessment being conducted for the UAA once that is complete.

   CE: The biological assessment might also be an addendum to the baseline characterization of the mine site.

KE: Sure, it's an existing condition, we could submit that.

HS: SWQB ought to be in these meetings. You have to meet their requirements but we need to understand that too.

3. Pit reclamation plans

KE: I had a conversation with DJ Ennis a couple of weeks ago about MMD's take on the NMAC 19.10.6 regulation for new mining operations as they pertain to the pit at the end of mine life, Chris Eustice has discussed this topic with me as well. Steve Finch and I have looked at MMD regulations and definitions and put together a document listing how NMCC plans to meet regulation requirements for the reclamation of the Copper Flat pit at the end of mine life. We see Title 19 Chapter 10 Part 6, under 19.10.6.603, Performance and Reclamation Standards and Requirements as setting forth MMD expectations for reclamation at the end of mine life to achieve a self-sustaining ecosystem appropriate for the surrounding areas.

Distribute: Proposed Copper Flat Open-Pit Mine Reclamation Plan For Discussion, August 19, 2014.

SF: We have some definitions from 19.10.1 just to remind ourselves what's expected for reclamation, self-sustaining ecosystem. We see the main items we need to achieve with the pit to be a self-sustaining ecosystem for wildlife and stability. Looking at this document, we have listed:

A. Dimension
B. Safety Benches
C. Source Controls
D. Rapid Fill

BR: Are there other mines that use rapid fill?
CE: How would you address the life-span of grouted fracture areas?
SF: It it's subsurface, it will be a long time. You can engineer grout for the application.
D.Haywood: I have a question on the water issue. Is this considered in the groundwater model? It needs to be accounted for in the model.
KE: This is an ongoing discussion and the pit reclamation plans are still being developed. We need to get through the geochemistry comments and responses so that we can finalize pit plans and only then can we work with the groundwater modelers.
BR: The geochemistry model will effect this.
D.Haywood: You need to make sure that it's addressed in the EIS.
SF: This is a discussion at this point, hopefully we can create an incentive to move the geochemistry review along.
D.Haywood: Do you have a timeline on a decision?

KE: I don't have a timeline because we need to work through NMED responses and there could be more response from NMCC needed to resolve concerns.

F. Haul road
H. Design storm water controls-

KM: So the idea is that you have clean water on the haul road.
HS: So there are storm water controls for what purpose?
SF: You don't want storm water in the fractures, the idea is to limit time in fractures or on benches.
HS: So the haul road will be ripped and revegetated?
SF: Not the haul road, it will be armored, also access for wildlife, personnel as needed.
CE: in point L. you have a pit crest perimeter, do you want storm water going away from the lake?
SF: Exactly right.
KM: So there will be culverts and features to get water under the road? A French drain?
SF: This is delicate, some work might have to be done during mining.
CE: Once the geochemistry model is agreed will you re-run the model?
BR: Is this stuff that can be modeled?
SF: You look at how much source material can be exposed, re-calculate.
HS: So you have a pit lake, rapid fill to meet equilibrium with 200' of water above the pit floor, how much is inundated?
SF: 200' is water, 700' of benches and highwalls.
HS: Those benches and highwalls have to meet the self-sustaining ecosystem, how? There's a vegetation requirement in NMAC 19.10.6.603 G.
SF: I want to make a note about trees – you don't want deep percolation, which trees would cause with deep roots. There's another regulation that states you must mitigate disturbance of affected areas.
HS: In the requirements for Part 6 there is no provision for a waiver. Under Part 5 you could get a waiver for an existing facility but in this case the pit has to meet the requirements for reclamation.
KE: I think the pit can meet the requirements.
CE: Is this pit slope 1:1?
KE: It's 1.1:1, it's very steep.
HS: So how can you re-veg? None on the walls? Benches?
SF: It's in concept, but accessibility is a big issue. Some things aren't feasible. Reclaiming all benches would be impossible.
CE: Are there not any plans to lay back the walls?
KE: There are no plans to lay back the walls.
HS: You need a reference area – the pit walls would not be a reference area.
CE: What about a vertical cliff?
HS: The pit today is not a reference area.
KE: So a cliff or natural high wall type area would be one of the reference areas.
HS: It could be one. A pit has a use of mining. But it can't be mining as a post mine land use.
KM: Can you consider how wide the bench will be?

HS: Bench berm width during mining have a width set by MSHA but that goes away after mining.
KM: Not a lot you can do when it's that steep.
HS: If you want vegetation and stability 1.1:1 will not work. Pit walls with wider benches, topsoil, you can't place it on a 1.1:1 slope, bench or highwall.
HS: This can't just ben an engineered pit.
CE: You have to lay back the walls for access.
HS: We worry about groundwater, it's a sink, surface water – address rapid fill and reclamation, creating post mining land use. You have to create a self-sustaining ecosystem. Vegetation, clean water, habitat, part of that could be the walls in the pit, NM Game and Fish could help. Try to reclaim, meet requirements of rules, how are you going to do this?
D.Haywood: Once you work out a reclamation plan we need one for the proposed action, which has it's own bench widths and depths, one for alternative 1, one for alternative 2. There has to be a plan for all 3 so the EIS can look at them.
HS: 1.1:1 is really steep. You can't reclaim it.
SF: What did they do at Little Rock?
HS: They have a partial backfill, some remaining highwall. They never needed a waiver.
KV: Little Rock has a shallow and wider pit.
HS: Reclaim the flat areas, benches you can get at.
HS: At Cunningham Hill that also never required a waiver. They never reclaimed the lower benches and highwalls. They have remnants of highwalls. I think you need to take a different look, this doesn't look like it meets the requirements.
BR: Some vegetation may need to be contemporaneous.
KE: Maybe the concern here is that it's not all sewn up. As it gets finalized there will be more clarification on what exactly we plan to do.
HW: We wanted to have this conversation as it's always an issue that's hanging out there for us. What's going to happen at final close out? You have to deal with it?
KE: When was it decided that Copper Flat would go under the "new mine" rules?
HS: It's an old mine that does not meet the definition of an old mine.
KV: Alta Gold applied under the new mine rules back in the 90s.
HS: Think about it seriously, put in some level of reclamation.
SF: We have put a lot of thought into this, we've looked at the regulations, we have cover where feasible.
KV: Maybe a schematic.
KM: Something conceptual that provides width, the % we are talking about.
HS: I should mention. The areas you cannot reclaim, you could look at getting a variance under Part 10.
KE: I have looked at the variance regulation.
HS: Variance applies where you cannot meet regulation, you can't ask for a variance if it is in the statute. Maybe you are meeting the regulation. If you lay back the walls it would be a huge pit.
KE: We have no plans to lay back the walls. If you lay the walls back to a 3:1 slope it would be a big big pit, it would be 8,000 feet across and take out both Animas Peak and Black Peak, no one is proposing that because no one would want to do that, it's a huge impact to the surrounding

area not to mention the waste rock it would generate. Waste rock would cover almost 7 sq miles, we cannot do that.
HS: We aren't asking you to do that, we are not asking for 3:1, that would be enormously expensive and infeasible. If done right, reclamation can address surface water quality.
KV: Can you combine benches, vegetation and cover- rather than 3 benches have 2 highwalls.. I'm just trying to think about it, skinny benches are hard to reclaim.
SF: We could put some prickly pears in a chipper and spray the highwalls.
D.Haywood if you want to mulch with prickly pear and ocotillo you can do that on private land but not BLM.

Discussion: This topic will be re-visited.

4. Groundwater model status

KE: JSAI and LWA have been working collaboratively since mid July. JSAI has generated EIS outputs and a sensitivity run that LWA defined and requested. Due to some difficulty producing EIS outputs with the LWA conversion of the JSAI model, it has been agreed to use the JSAI model to generate the EIS outputs and JSAI has revised and re-issued the groundwater model report on the 15th of August, this was sent via FedEx overnight to BLM, LWA, and Solv and I have copies and a transmittal letter to deliver this report to MMD, NMED, and OSE today.

I understand LWA still plans to review some requested changes to the model and I believe there are still some outstanding items to work through but it appears the two teams are close to resolving any outstanding issues with the model and LWA may be close to finishing their portion of the EIS, although I know Lee was out on travel and Dave Henney have been out on travel last week so I need to catch up with them to get clear on what remains to be done and how long it will take. I understand once LWA has reviewed the latest items JSAI has sent to them they may have additional outputs and sensitivity runs they will request JSAI generates.

I understand LWA still plans to provide their conversion of the model with the EIS document and to OSE for review. I spoke with Kevin Myers last week and he confirmed OSE would still like to look at LWA's model, so it remains the plan to have LWA send their model conversion to OSE once everything is done.

Dave, do you have any corrections or updates on that understanding?

D.Henney: This is about it. I just sent you a proposal for moving forward, it would have come to your email while you were driving to the meeting. Have a look and we can discuss later.

5. EIS status – Doug, Dave

DHaywood: BLM has finished reviewing Ch2, we are getting it back to Solv two weeks late but our people have been fighting fires in OR and WA, on vacation, on other projects.

D.Henney: I have looked at Doug's email, S.Sheil has looked at comments. Solv will need to send questions to NMCC for some assistance in addressing these.

KE note: NMCC did inquire with Chris and Kurt regarding the set review durations for the EIS draft and final, they both indicated the current durations are ok with them. This inquiry was in support of some discussions we plan to have with BLM and Solv next week, one of the topics of conversation will be the EIS schedule. We hope to come to an agreement on a reasonable schedule for the EIS in the go forward and we'll share that with everyone once that is agreed.

CE: I assume we could ask for an extension if we needed one.

Discussion of number of EIS reviews for state agencies, durations.

6. Permit application package status

   KE: AMEC continues their work on the revised MORP to reflect the EIS Alternative2 mine plan, we have a call with them this week to discuss the 30% design at this point. Recall that AMEC is writing most of the MORP with the intention to meet Mining Act requirements and the Copper Rule, as well as address comments on the 2012 MORP, with the exception of the pit reclamation plan, which JSAI is working on. We know the pit reclamation plan will depend on the timing on the resolution of all geochemistry comments. It may mean we submit the MORP in November 2014 with everything but the pit reclamation plans, or hold it until everything is ready together. We are considering both options.

   Outstanding items re: the PAP
   - Revised MORP with reclamation plans for mine and the pit
   - Probable hydrologic effects
   - Resolve geochemistry comments

7. Stage I Abatement Plan, revised Discharge Permit status

   KE: We are available to meet with NMED re: the Stage I report that was submitted in May any time you are ready. Any comment from NMED?
   BR/KV: NMED will request a meeting with NMCC prior to sending an official letter response.

   KE: The discharge permit is being discussed internally at NMCC. We agree with NMED that it would be advantageous to submit this as soon as possible and we will let you know when it's coming. I apologize that I don't have any new updates on this topic at this time.

   DHaywood: is there still a water hearing on the 21st of this month regarding NMCC's water rights?

   KE: I believe that's been delayed. I will get that date to you after this meeting.

KM: I think it's been postponed about a month, it's roughly the 3rd week of September, the court will be considering whether to do an expedited inter se or a regular one.

8. Next meeting date: Tuesday, September 30th at 14:00

Additional discussion:

HS: I think we should keep this pit reclamation discussion moving. I'd like MMD to meet with NMCC again prior to the Sept 30th meeting just to talk about the pit, anyone else that would like to attend that would be fine.
CE: We could discuss our explanation.
KM: Ultimately the pit reclamation plans need to take water rights into account, consider the timeframe for rapid fill. If you want to do it in 6 months you could be approaching a yearly limit.
D.Haywood: I would be willing to participate.
Decision: Separate meeting to further pit at the end of mine life plans, to include MMD, NMED, OSE, G&F, BLM. Tuesday Sept 23, 14:00.

Geochemistry Conversation without NMCC present is foregone pending additional information

THEMAC
RESOURCES

August 18, 2014

Needs Date Stamp
8/19/14

Brad Reid and Kurt Vollbrecht
New Mexico Environment Department
Groundwater Quality Bureau
Harold Runnels Building, Room N2250
1190 St. Francis Drive
Santa Fe, NM 87505

RE: Model of Groundwater Flow in the Animas Uplift and Palomas Basin, Copper Flat Project, Sierra County, New Mexico, August 15, 2014

Dear Messrs. Reid and Vollbrecht,

This letter transmits the 2nd revised groundwater model report for the Copper Flat Project, noted above. Included with this transmittal:

- CD with pdf of full report

The report and CD was prepared by John Shomaker and Associates, Inc. Please contact me or Jeff Smith with any questions. Please email me to confirm receipt of the report and disk. My email address is kemmer@themacresourcesgroup.com.

Sincerely,

Katie Emmer

Katie Emmer
Permitting & Environmental Compliance Manager

cc: Chris Eustice, Mining and Minerals Division
Douglas Haywood, Bureau of Land Management
David Henney, Solv, LLC
Kevin Myers, Office of the State Engineer
Lee Wilson, Lee Wilson & Associates Inc.

MODEL OF GROUNDWATER FLOW IN THE ANIMAS UPLIFT AND PALOMAS BASIN, COPPER FLAT PROJECT, SIERRA COUNTY, NEW MEXICO

prepared by

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2424 Louisiana Blvd NE, Suite 301
Albuquerque, NM 87110

August 15, 2014

MODEL OF GROUNDWATER FLOW IN THE ANIMAS UPLIFT AND PALOMAS BASIN, COPPER FLAT PROJECT, SIERRA COUNTY, NEW MEXICO

EXECUTIVE SUMMARY

This report documents a numerical model of groundwater flow in and around Copper Flat, near Hillsboro, New Mexico. The model was developed and calibrated based on previously available information and on new studies of the system. The calibrated model will be used to project the effects, to groundwater and surface water, of the proposed development of the Copper Flat Mine.

The report first introduces the study area then summarizes the climate and meteorology, hydrology and water balance, and geology and hydrogeology of the area. Then an overall conceptual model of the hydrological and hydrogeological system is presented, followed by a presentation of data available to confirm and calibrate the model. Next the numerical model is presented, including model structure, inputs and calibration. Finally, the sensitivity of model results to unknown parameters is evaluated.

Extensive information on the system is available, from previous studies and previous mine operations, and from new studies including the 2012 extended well field pumping test. The model accurately represents the conceptual model and accurately reproduces the calibration data, particularly the results of the 2012 well field pumping test. As a result the model is considered suitable for use in projecting the effects of future well field pumping.

The calibrated model will be used to generate projections related to the results and effects of mine development. Projections will be generated as required and reported separately. Results of interest include the following:

- Groundwater drawdown due to water-supply pumping, for selected mine development scenarios
- Effects on surface discharge to the Las Animas Creek and Rio Grande systems
- Long-term post-mining residual groundwater drawdown and effects to surface discharge
- Potential ground subsidence due to groundwater drawdown
- Open pit dewatering rates and groundwater drawdown in bedrock
- Post-mining open-pit water level and water balance
- Down-gradient migration of potential leakage from tailings and waste rock storage facilities

The large amount of information has allowed development of a model that can reliably project effects of future development. In particular, aquifer properties around the well field are relatively known, and sensitivity of the primary model projection results, groundwater drawdown and surface discharge changes due to well field pumping, to plausible variation in model inputs, is low.

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MODEL OF GROUNDWATER FLOW IN THE ANIMAS UPLIFT AND PALOMAS BASIN, COPPER FLAT PROJECT, SIERRA COUNTY, NEW MEXICO

1.0 INTRODUCTION

The report presents a numerical model of the hydrogeological system in the area of the Copper Flat Project (Project) near Truth or Consequences, New Mexico. The Project location is shown on Figure 1.1.

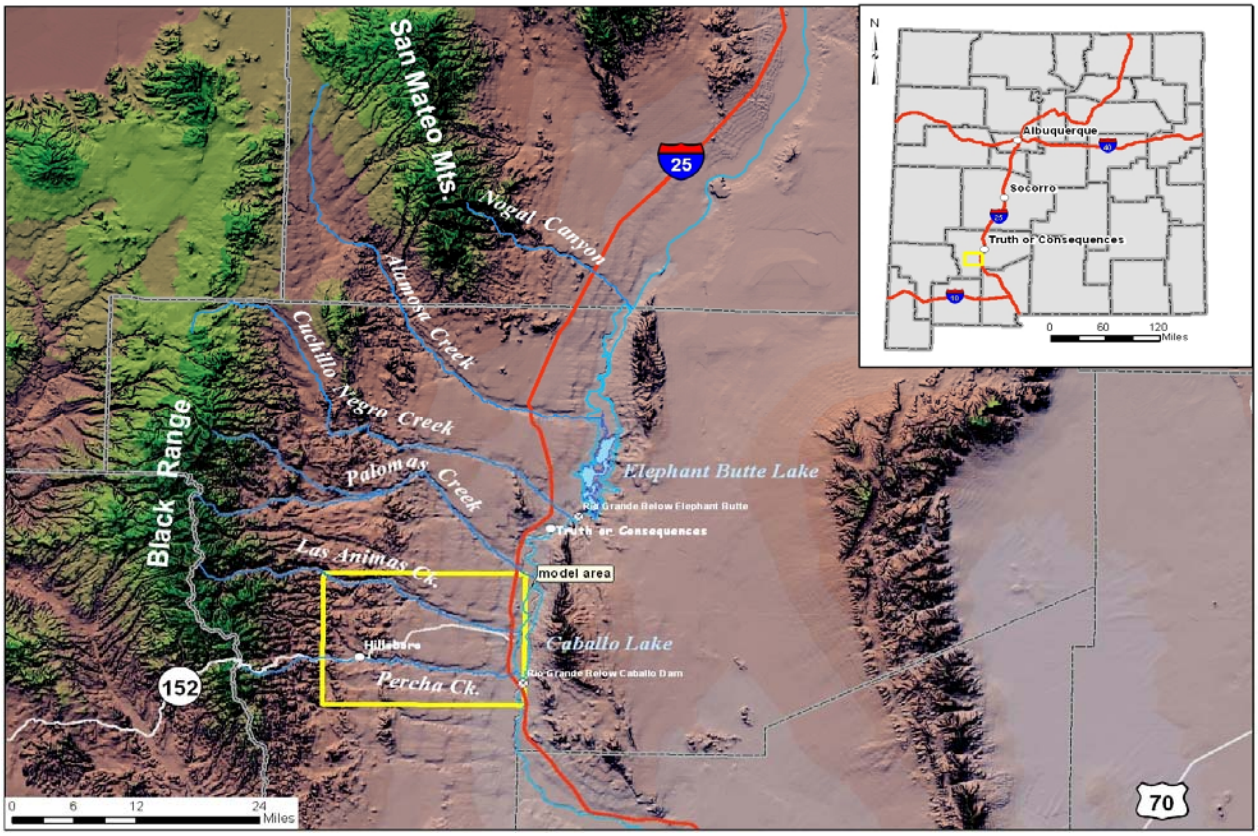


Figure 1.1. Copper Flat Project location.

The report first summarizes the climate and meteorology of the study area, then summarizes the hydrology and estimates a basin water balance. Then the geological and hydrogeological framework is presented. These are used to formulate and present a conceptual model of the system. Then the data available for model calibration are presented, followed by the details of the numerical model and results of the model calibration. Finally, sensitivity of model results to unknown parameters is evaluated. Model projections of the effects of the proposed mining project are reported separately.

2.0 CLIMATE AND METEOROLOGY

Precipitation and evaporation in the study area are examined using data from regional meteorological stations. The station at Hillsboro, New Mexico, has a long record (with at least partial data from 1893), is located nearby (about 4 miles from the Copper Flat open pit), and is at a similar elevation (5,270 ft above mean sea level (amsl)) as the Copper Flat Mine site. Locations of the Hillsboro station and other meteorological stations along the east side of the Black Range are shown on Figure 2.1.

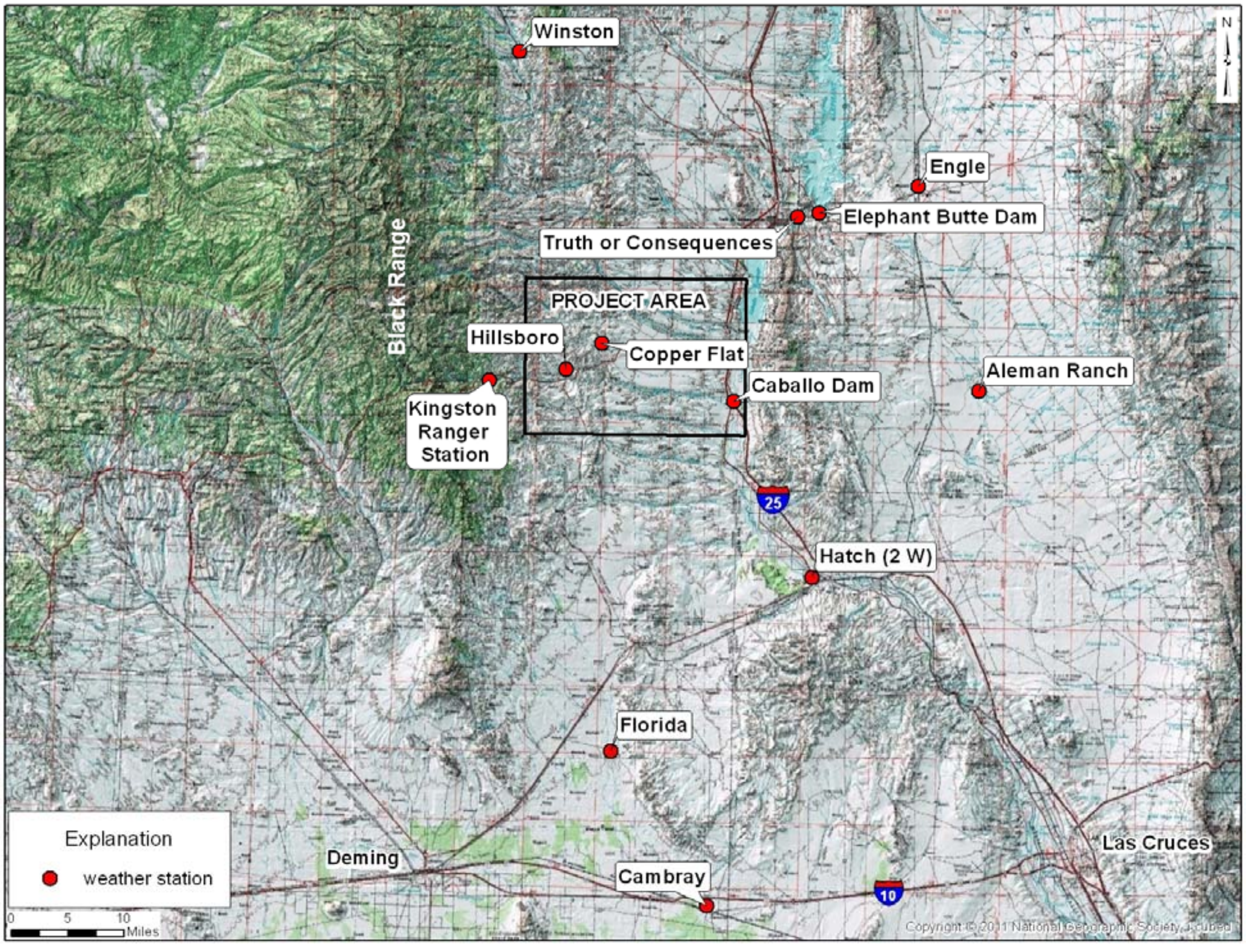


Figure 2.1. Locations of meteorological stations surrounding the Project area.

2.1 Annual Precipitation

The range of variability between wet and dry climatic conditions is seen in the annual precipitation recorded at Hillsboro from 1925 through 2010, shown on Figure 2.2. Annual precipitation ranges from less than 5 to more than 20 inches per year (in./yr) and averages about 12.5 in. Copper Flat weather station recorded 7.7 in. of precipitation in 2011, and 3.8 in. in 2012, signifying drought conditions during this period.

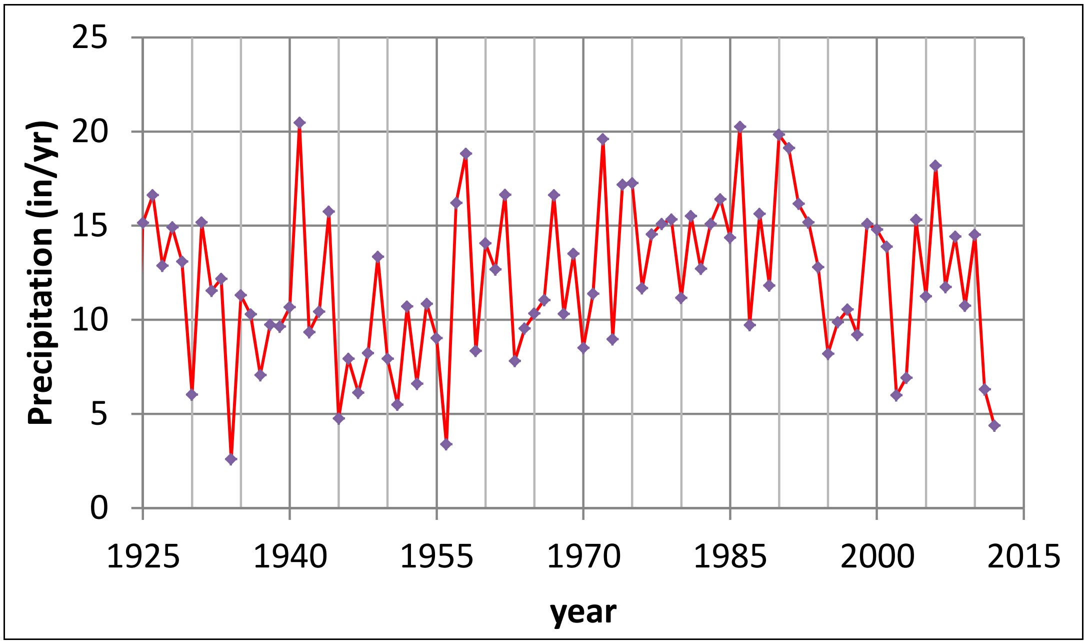


Figure 2.2. Recorded annual precipitation at Hillsboro meteorological station.

2.2 Precipitation Events

The frequency and magnitude of precipitation events are examined in the statistical distribution of daily precipitation at Hillsboro, shown on Figure 2.3. Daily precipitation of 1 in. or more occurs, on average, twice per year. Storm events of magnitude 2 in. can be expected to occur every 4 years, and the 100-year storm event is about 3.5 in.

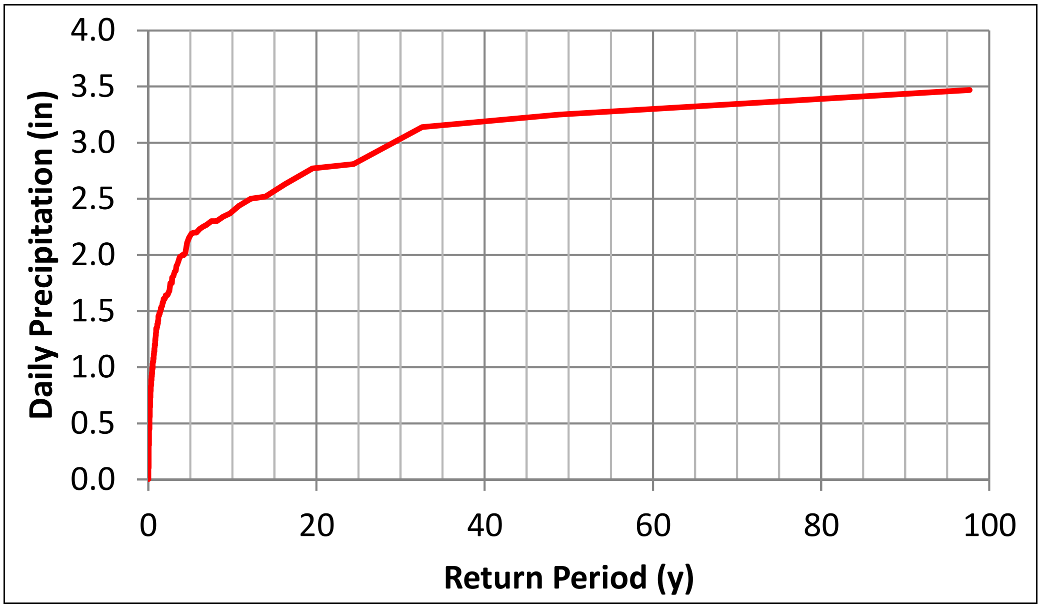


Figure 2.3. Distribution of daily precipitation at Hillsboro meteorological station.

2.3 Precipitation and Elevation

Precipitation is known to increase with elevation, and the bulk of surface-water runoff and groundwater recharge in the study area is generated by precipitation on the higher elevations of the Percha Creek and Las Animas Creek watersheds.

Mean annual precipitation was compared to elevation for other meteorological stations east of the Black Range as shown on Figure 2.4. The best-fit linear relationship estimates about 8.6 in./yr mean annual precipitation at elevation 4,000 ft amsl, and about 26.2 in./yr at elevation 10,000 ft amsl, approximately the maximum in the study area.

Given the large spatial and temporal variability of annual precipitation, the trend line shown on Figure 2.4 does not characterize precipitation patterns in any detail. It does however give realistic average precipitation rates for the study area that increase with elevation. The average annual precipitation trend shown on Figure 2.4 is used below to compute a realistic upper bound for basin water yield (water yield is a portion of total precipitation over the basin).

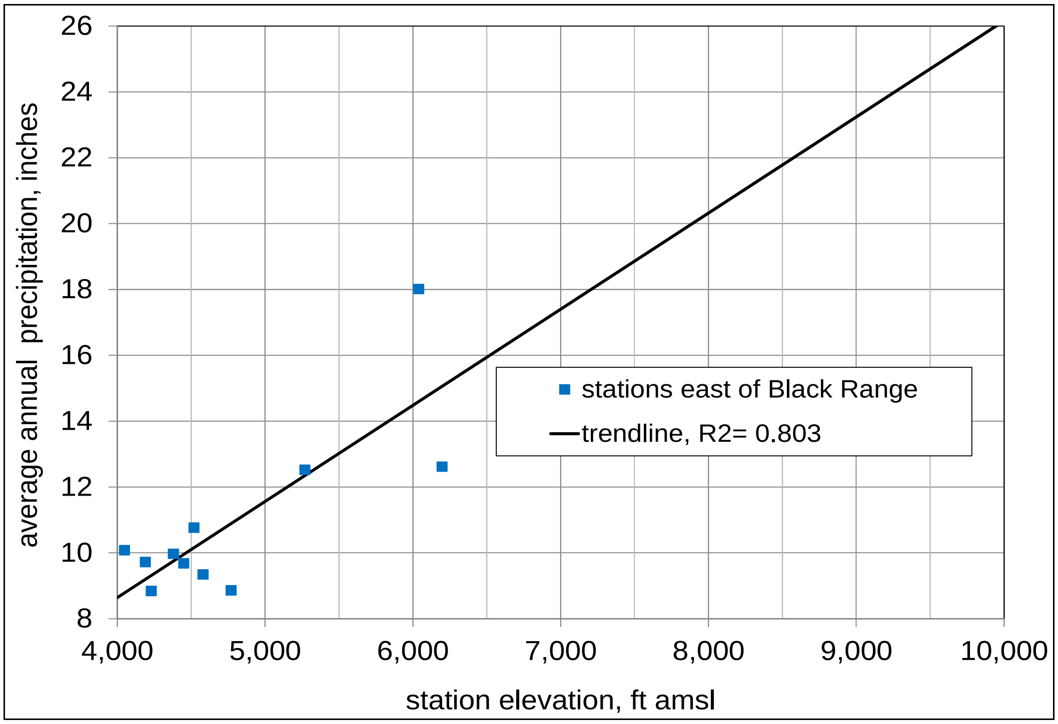


Figure 2.4. Mean annual precipitation versus elevation of meteorological station.

2.4 Evaporation and Transpiration

Most precipitation evaporates where it falls, or is consumed (transpired) by nearby vegetation. Of the remaining precipitation, most eventually discharges down-gradient as evapotranspiration (ET) from vegetated areas and open water surfaces.

Potential ET, or the maximum evaporation and plant transpiration that can occur given full availability of water, is a function of geographical and climatic conditions and is commonly estimated using the Penman-Monteith equations (Monteith, 1965). These relate maximum ET (ET_0) to meteorological parameters including temperature, relative humidity and wind speed, and to geographical parameters (altitude, latitude and time of year).

Annual ET_0 computed from results at Hillsboro meteorological station (incomplete weather data for 1997 and 1998 filled in with data from comparable years) is shown on Figure 2.5 to be about 60 in./yr. This compares well to previous estimates (SRK, 1997) of 65 in./yr of potential evaporation, and 64.6 in./yr estimated as 74 percent (an accepted conversion factor for the region (NOAA, 1982) between pan evaporation and evaporation from a normal open water surface) of Copper Flat pan evaporation (measured between October 2010 and September 2011, except for four winter months. The missing months were estimated by extrapolation of Hillsboro ET_0 data). Actual evaporation or ET is less, depending on sun and wind exposure, ground conditions, and availability of water.

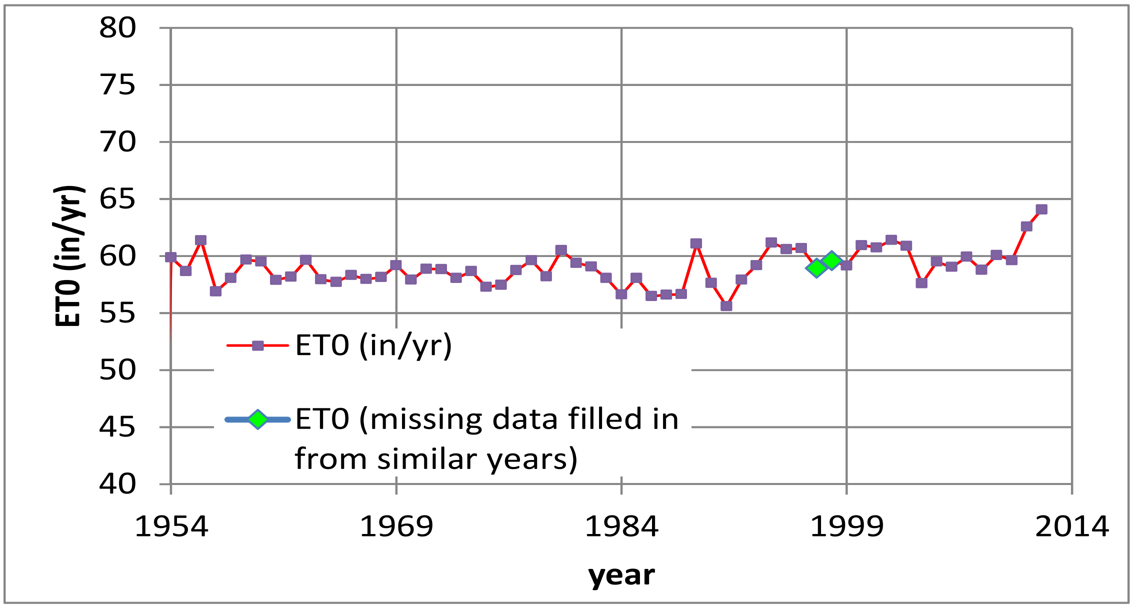


Figure 2.5. Computed Penman-Monteith evapotranspiration (ET_0) at Hillsboro meteorological station.

Evaporation in the study area is higher at lower elevations. An estimate of reservoir evaporation along the Rio Grande (Middle Rio Grande Endangered Species Collaborative, 2003) is:

$$\text{annual evaporation} = 135.8 \text{ in.} - (0.0135 \text{ in./ft amsl}) * Z,$$

where,

Z is elevation in feet above mean sea level (ft amsl).

The equation predicts evaporation of 62.4 in./yr at the Copper Flat open pit (elevation 5,440 ft amsl), in agreement with the above-presented estimates, and 79.1 in./yr at Caballo Lake (elevation 4,200 ft amsl), in agreement (equivalent to 74 percent of pan evaporation) with measurements at Caballo Dam (WRCC, 2012).

The estimated average evaporation, precipitation (from Fig. 2.4) and net evaporation for Caballo Lake and the Copper Flat open pit are presented in Table 2.1.

Table 2.1. Estimated average total and net reservoir evaporation

location	elevation (ft amsl)	mean annual precipitation (in.)	annual reservoir evaporation (in.)	net evaporation (in./yr)
Caballo Lake	4,200	9.2	79.1	69.9
Copper Flat open pit	5,440	12.8	64.6	51.8

ft amsl - feet above mean sea level

3.0 HYDROLOGY AND WATER BALANCE

Topographic basins of the study area are shown on Figure 3.1 and include Las Animas Creek and Percha Creek watersheds as well as the Grayback and Greenhorn Arroyo drainages. A portion (approximately 230 acres) of the original Grayback Arroyo watershed now drains to the Copper Flat open pit.

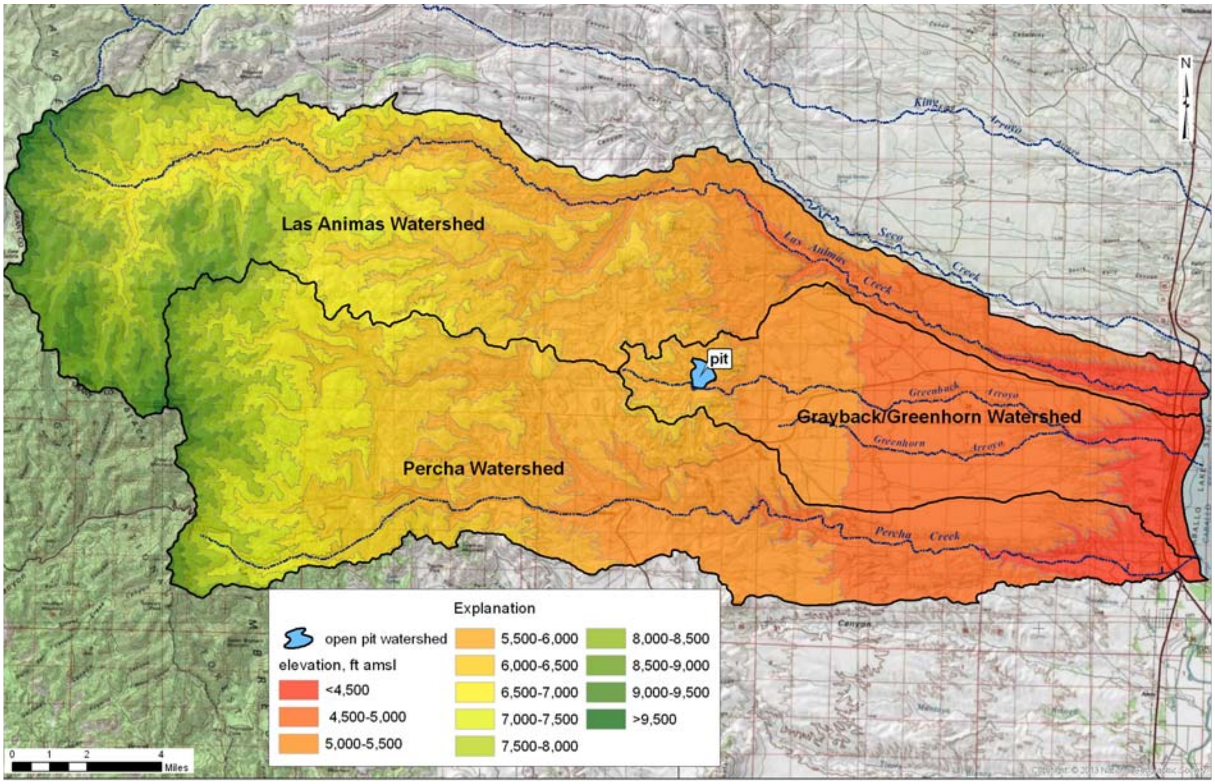


Figure 3.1. Study area watersheds.

3.1 Watershed Area and Precipitation

The areas of each of the watersheds within defined elevation bands are listed on Table 3.1. The mean annual precipitation (Fig. 2.4) estimated for the midpoint of each band is presented on Table 3.2, along with the estimated total annual volume of precipitation for each watershed.

3.2 Runoff and Groundwater Recharge

Basin water yield (surface water runoff plus groundwater recharge) is estimated here following the method of Maxey and Eakin (1949), in which estimated mean annual precipitation, a function of elevation, is correlated with an independent estimate of discharge. The result is a set of recharge factors, defined as the proportion of precipitation that becomes runoff or recharge (excess precipitation), for a given level of mean annual precipitation (an elevation band).

Table 3.1. Study area watershed areas and hypsometry

elevation range (ft amsl)	Las Animas watershed	Percha watershed	Grayback / Greenhorn watershed	open pit watershed
	area (acres)			
<4,500	2,888	3,576	4,539	
4,500-5,000	7,030	11,035	17,095	
5,000-5,500	8,412	12,614	9,708	230
5,500-6,000	14,539	14,072	2,864	
6,000-6,500	12,369	13,030	635	
6,500-7,000	10,279	8,219		
7,000-7,500	6,507	5,355		
7,500-8,000	5,808	4,159		
8,000-8,500	6,160	3,021		
8,500-9,000	6,362	1,749		
>9,000	3,305	509		
total	**83,659**	**77,339**	**34,841**	**230**

ft amsl - feet above mean sea level

Table 3.2. Study area precipitation by watershed and elevation band

midpoint elevation (ft amsl)	precipitation (in./yr)	Las Animas watershed	Percha watershed	Grayback / Greenhorn watershed	open pit watershed
		precipitation (ac-ft/yr)			
4,350	9.7	2,326	2,880	3,655	
4,750	10.8	6,345	9,961	15,431	
5,250	12.3	8,617	12,921	9,944	236
5,750	13.8	16,661	16,126	3,282	
6,250	15.2	15,679	16,516	804	
6,750	16.7	14,279	11,417		
7,250	18.1	9,832	8,091		
7,750	19.6	9,482	6,790		
8,250	21.0	10,805	5,298		
8,750	22.5	11,933	3,280		
9,500	24.7	6,802	1,048		
total		**112,761**	**94,328**	**33,116**	**236**

ft amsl - feet above mean sea level
ac-ft/yr - acre-feet per year

Some example sets of recharge factors are presented in Table 3.3. These include the formulation of Bennett and Finch (2002) used to estimate recharge in the trans-Pecos region of Texas, that was subsequently used to estimate recharge to the Salt Basin in New Mexico and Texas (JSAI, 2010), and the Davis Mountains/Salt Basin in Texas (LBG-Guyton, 2004).

Another example is that of Maxey and Eakin (1949), which studied dry, closed basins in southern Nevada, estimating discharge as playa ET. This example was modified by McDonald-Morrissey (1998) in BLM (2000), in a study of wetter, exoreic (outflowing) basins along the Carlin Trend in northern Nevada. Total basin discharge was estimated from gaged surface flows and from ET in vegetated areas.

Actual runoff and recharge are influenced by site-specific conditions including topography, soil type and thickness, land cover, and surface geology. However, in the absence of an independent estimate of discharge, the previously published estimates may indicate a potential range of basin water yield.

The above formulas suggest, respectively, a study-area water balance of 8,000 ac-ft/yr (Bennett and Finch), 30,000 ac-ft/yr (Maxey and Eakin) and 51,000 ac-ft/yr (BLM). In the absence of other information, water yield of the study area is anticipated to be within the range of these estimates, or between about 8,000 and 50,000 ac-ft/yr. This range of yield is compared below to a basin-specific estimate of discharge.

Table 3.3. Published recharge factors

midpoint elevation (ft amsl)	precipitation (in./yr)	fraction of precipitation that becomes runoff and/or recharge		
		Bennett and Finch (2002)	Maxey - Eakin (1949)	BLM (2000)
4,350	9.7	0.00	0.03	0.03
4,750	10.8	0.00	0.03	0.03
5,250	12.3	0.00	0.07	0.07
5,750	13.8	0.02	0.07	0.07
6,250	15.2	0.03	0.15	0.3
6,750	16.7	0.04	0.15	0.3
7,250	18.1	0.05	0.15	0.3
7,750	19.6	0.07	0.15	0.3
8,250	21.0	0.08	0.25	0.45
8,750	22.5	0.09	0.25	0.45
9,500	24.7	0.11	0.25	0.45

BLM - U.S. Bureau of Land Management ft amsl - feet above mean sea level

3.3 Discharge

Regional discharge from the study area occurs mainly as groundwater and surface-water discharge to Caballo Lake and the Rio Grande, and as ET discharge from riparian and irrigated areas along Las Animas and Percha Creeks. Areas of open-water evaporation and of ET discharge in the Palomas basin are shown on Figure 3.2.

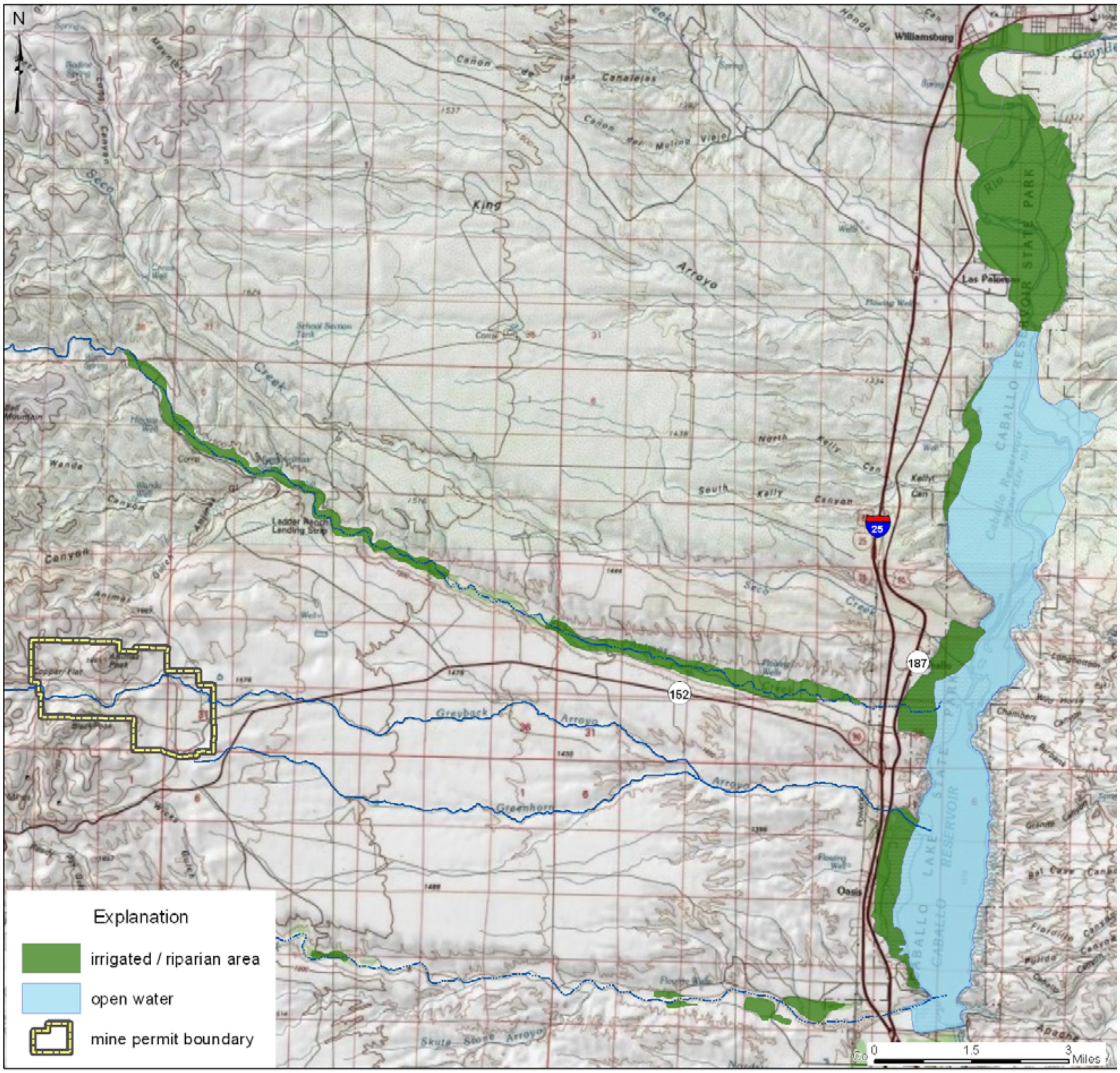


Figure 3.2. Regional discharge areas.

The Caballo Lake and North Caballo Lake discharge areas shown on Figure 3.2 are only partly supplied from the study area. Water is also provided by:

- Direct contribution from the Rio Grande upstream; based on average daily discharge below Elephant Butte dam (U.S. Geological Survey (USGS) station No. 08361000) and below Caballo dam (USGS station No. 08362500) from 1938 through 2010, an average of 12,364 ac-ft/yr more water is released from Elephant Butte (into Caballo) than from Caballo.
- Runoff from the watersheds east of Caballo Lake. These basins lack large high-altitude catchment areas and yield less water than basins west of the lake. They do, however, contribute water to Caballo after major precipitation events.
- Contribution from the Palomas Creek (catchment area 233,942 ac) and Cuchillo Creek (catchment area 235,493 ac) basins north of the study area, with similar hypsometry to the study area basins. Assuming water yield proportional to (elevation-weighted) catchment area (Table 3.1), Palomas and Cuchillo Creek basins would be expected to produce about 71 percent of the total yield from the basins west of Caballo, with the study area basins contributing the remainder.

In addition to regional discharge from the Palomas Basin, local discharge areas over the Animas Uplift and in the Animas Graben include riparian areas along perennial stretches of upper Las Animas and Percha Creeks. These areas are shown on Figure 3.3 including about 600 acres in the “Percha Box” (Percha Creek above the mountain front) and about 200 acres along the Upper Animas.

Also shown on Figure 3.3 is a stretch of upper Grayback Arroyo in the area of Copper Flat. This part of Grayback does not flow perennially, but groundwater levels are close to the surface, and there is baseflow discharge to Grayback Arroyo following wet periods (S. Finch, personal communication, 2012).

Evaporation/ET for Caballo Lake and for the study area watersheds is estimated on Table 3.4; ET from irrigated crops or riparian vegetation was estimated at 36 in./yr. Net evaporation for Caballo Lake, estimated at about 70 in./yr (Table 2.1), was rounded down to 60 in./yr, to account for runoff from the east side of the lake. Net evaporation for North Caballo Lake and ET for Rio Grande riparian areas were estimated as the average of combined net Caballo evaporation and riparian ET rate, or 48 in./yr.

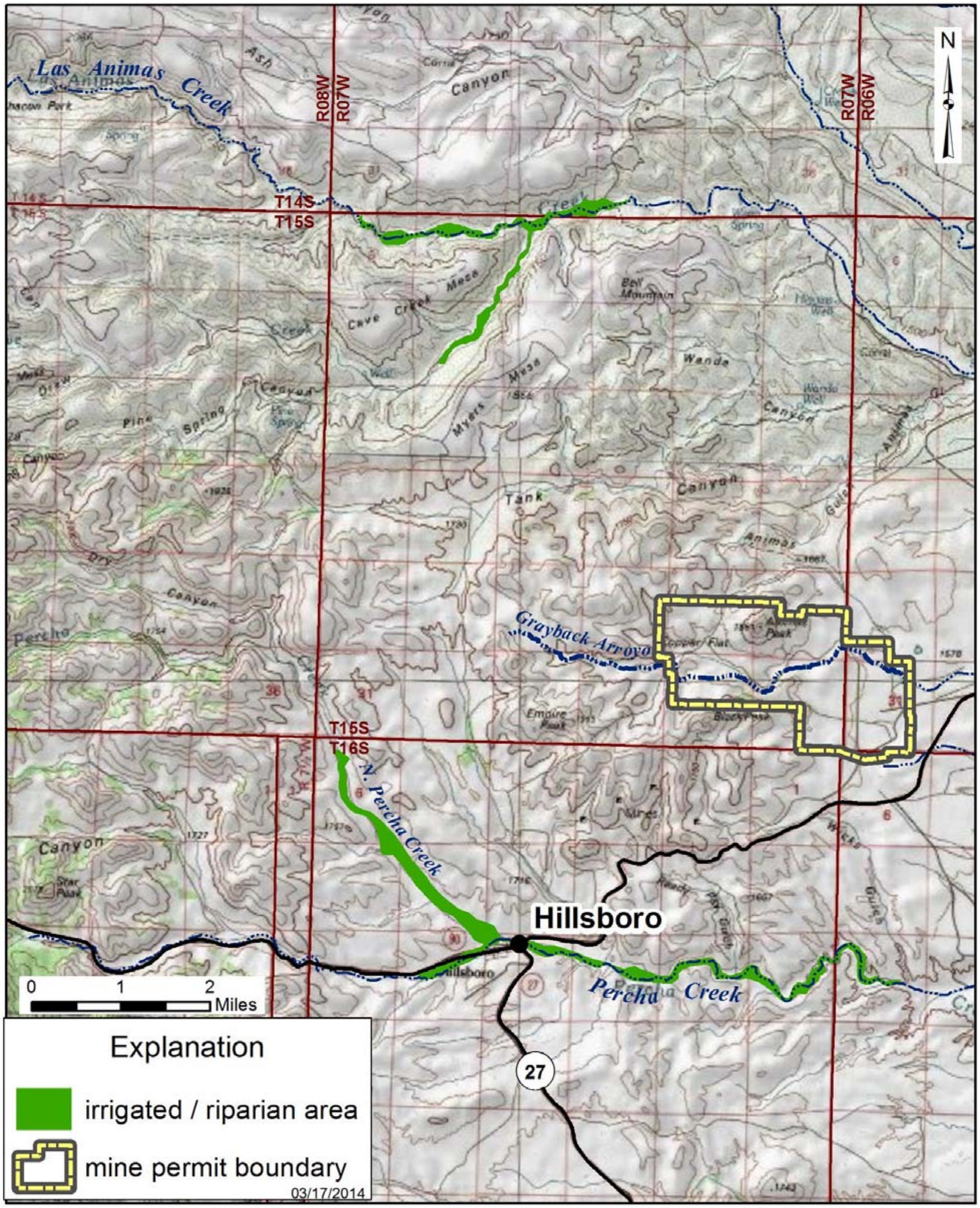


Figure 3.3. Local discharge areas.

Table 3.4. Estimated evaporation and evapotranspiration (ET)

		area (acre)	**net ET (ft/yr)**	**net ET (ac-ft/yr)**
Palomas Basin	Caballo Lake (water surface at 4,200 ft amsl)	6,344	5	31,720
	North Caballo Lake / Rio Grande	5,214	4	20,856
	Lower Las Animas Creek	1,421	3	4,263
	Lower Percha Creek	280	3	840
Animas Uplift Animas Graben	Upper Animas Creek	200	3	600
	Upper Percha Creek	600	3	1800
	Copper Flat open pit	5	4	20
	total			**60,079**

ac-ft/yr - acre-feet per year ft amsl - feet above mean sea level

3.4 Water Balance

The Caballo Lake and North Caballo Lake discharge components in Table 3.4, totaling 52,576 acre-feet per year (ac-ft/yr), are only partly supplied from the study area. In order to estimate the portion provided from the study area, the following adjustments were made:

- Based on USGS gage data discussed above (Sec. 3.3), 12,364 ac-ft/yr is assumed to be provided by the Rio Grande upstream of Caballo Lake.
- The estimated rate of evaporation from Caballo Lake was rounded down to account for runoff from the watersheds east of the lake as described above.
- Of the remaining Caballo Lake and North Caballo Lake discharge (40,212 ac-ft/yr), 71 percent was assumed to be provided by the Palomas and Cuchillo Creek Basins, as discussed above. The remainder was assumed to be generated within the study area.

Based on the discharge estimates in Table 3.4 and the adjustments listed above, an estimated water balance for the study area is presented in Table 3.5. The system receives water as runoff and recharge to the four watersheds listed in the upper part of the table. The estimated water yield of about 17,000 ac-ft/yr falls within the range of water yield (8,000-50,000 ac-ft/yr) estimated in Section 3.2 above.

The system discharges water as groundwater outflow and ET, as listed in the lower part of the table. The main component of discharge is groundwater flow to the Rio Grande / Caballo system. There is discharge of ET from three of the four watersheds, but not from Grayback/Greenhorn, which has no significant groundwater discharge area (depth to water is too great for ET of groundwater).

Table 3.5. Estimated water balance

	runoff and recharge (ac-ft/yr)	
	Las Animas Creek	11,509
	Percha Creek	7,874
	Grayback and Greenhorn Arroyos	201
	Copper Flat open pit	1
	total	**19,585**
	discharge (ac-ft/yr)	
Palomas Basin	Lower Las Animas Creek	4,263
	Lower Percha Creek	840
	discharge to Rio Grande and Caballo Reservoir	11,850
	total	**16,953**
Animas Uplift Animas Graben	Upper Animas Creek	600
	Upper Percha Creek	1800
	Copper Flat open pit	20
	total	**2,420**

ac-ft/yr - acre-feet per year

The water balance in Table 3.5 may also be compared with the water balance of the Upper Mimbres Basin, located on the opposite side of the Black Range from the study area, with a similar distribution of elevations. The average yield of the 300,000-acre basin above the Faywood gaging station is estimated (based on gaged flows) at 26,700 ac-ft/yr (White, 1930). The same per-acre water yield in the study area would be 17,450 ac-ft/yr, similar to the (regional) discharge estimate of about 17,000 ac-ft/yr from Table 3.5.

4.0 GEOLOGY AND HYDROGEOLOGY

The surface-water basins discussed above are shown on Figure 4.1, along with the smaller groundwater-flow model domain. Although most of the precipitation that recharges the groundwater system originates in the upper part of the watersheds (left-hand side of Fig. 4.1, outside of the groundwater study area), the main groundwater systems are found in sedimentary deposits downstream.

The study area consists of three major hydrogeologic zones (Fig. 4.1), shown in west-east cross-section on Figure 4.2. The three zones are 1) The sediment-filled Animas Graben west of the Animas Uplift and east of the Black Range mountain block, 2) The Animas Uplift, the bedrock in which the ore body is located, and 3) the Palomas Basin, the main sedimentary basin along the Rio Grande rift east of the Animas Uplift, in which the mine water-supply wells are located.

The Animas Graben between the Black Range and the Animas Uplift drains north to Animas Creek and south to Percha Creek via Warm Springs Valley. Santa Fe Group (SFG) sedimentary deposits overlie older sedimentary bedrock units (Fig. 4.2).

The Animas Uplift in the vicinity of Copper Flat (Fig. 4.1) consists of crystalline bedrock that conducts little water. The Copper Flat open pit and the main part of the other Project facilities, including waste rock and tailings storage facilities, would be located on the Animas Uplift. To the north and south of the Copper Flat area the Animas Uplift consists of sedimentary rocks that conduct more groundwater flow.

The Palomas (geologic) Basin lies within the Lower Rio Grande Underground Water (administrative) Basin. Parts of the waste rock and tailings storage facilities would be located overlying the western margin of the Palomas Basin. The Project water-supply wells are completed within the SFG aquifer between Las Animas Creek and Percha Creek (Fig. 4.1), and will be the main source of groundwater and surface-water effects of the Project.

The Project water-supply wells are completed within the Palomas Graben (Fig. 4.2), a significant geological and hydrogeological feature within the Palomas Basin. The feature was identified in the 1970s (Dunn, 1984), during water-supply exploration for the previous Copper Flat mine. The graben was identified as the western-most part of the Palomas basin with sufficient aquifer productivity to develop an adequate water supply.

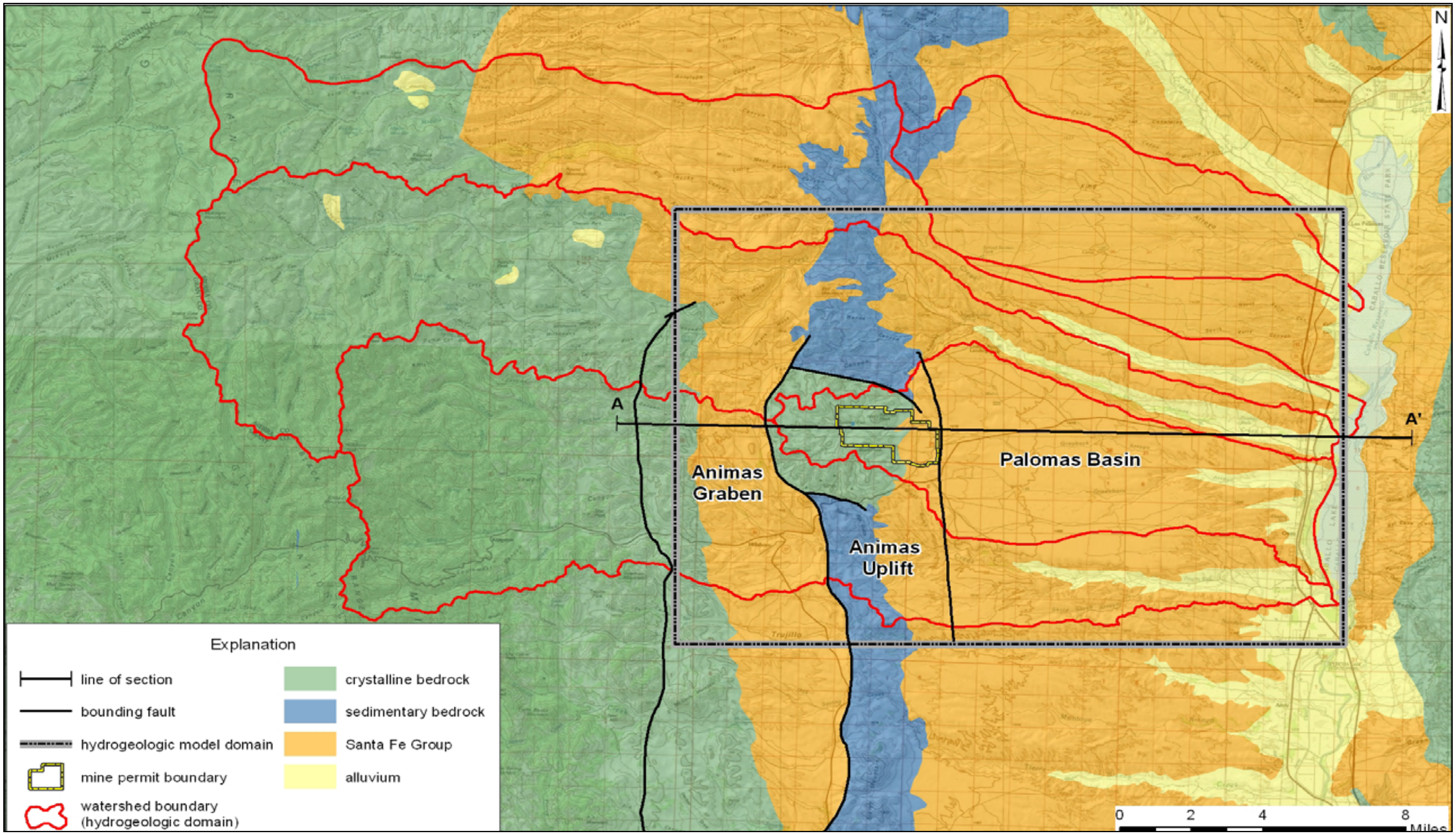
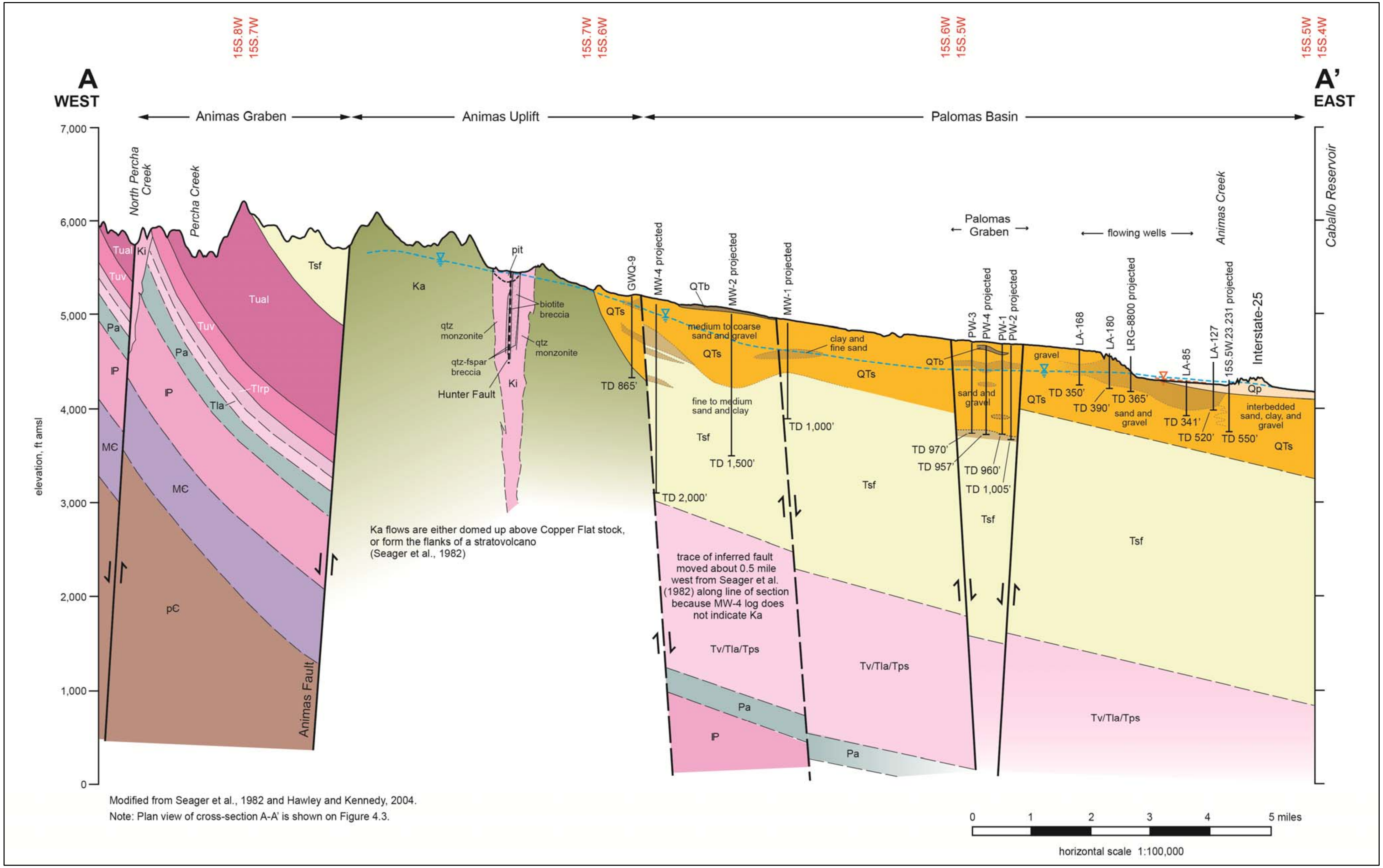


Figure 4.1. Hydrogeologic zones.



Modified from Seager et al., 1982 and Hawley and Kennedy, 2004.
Note: Plan view of cross-section A-A' is shown on Figure 4.3.

Figure 4.2. Hydrogeologic zones, west-to-east cross-section.

4.1 Geology

The geologic description is adapted from Shomaker (1993), who cites Harley (1934), Hedlund (1975), Dunn (1982), and Seager et al. (1982). An extended bibliography of geology references is presented as Appendix A. The geologic map of the study area is presented on Figure 4.3. Three major geologic subdivisions (Figs. 4.1 and 4.2), the Animas Uplift, the Animas Graben east of the Black Range, and the Palomas Basin, are described below.

4.1.1 Animas Uplift

The Animas Uplift is an upthrown block, ranging from less than 2 to about 4 miles wide, bounded by north-south trending faults (Fig. 4.1). The Copper Flat ore body is located within a nearly circular remnant of a Cretaceous-age andesite volcano about 4 miles in diameter that is part of the Animas Uplift. Drilling has shown that andesite is present to a depth of more than 3,000 ft (Dunn, 1982, p. 314).

The hills surrounding Copper Flat, referred to as the Hillsboro Hills, consist of Cretaceous-age andesite flows, breccias, and volcaniclastic rocks that were erupted from the volcano (McLemore, 2001; Raugust and McLemore, 2004).

The volcano intrudes through the Paleozoic-age sedimentary rock sequence. The andesite is bounded on the north and south by Paleozoic-age limestone, and on the east by the SFG sediments of the Palomas Basin, in fault contact. On the west, the andesite body is in fault contact with Paleozoic-age limestone, Tertiary-age volcanic rocks, and overlying SFG sediments of the Animas Graben (Fig. 4.2).

The ore body itself is in the Copper Flat quartz monzonite stock, within the body of andesite. The quartz monzonite porphyry intruded the vent of the volcano, and then dikes and mineralized veins intruded the monzonite porphyry and radiated outward from the porphyry into faults and fracture zones in the andesite. The porphyry copper deposit is concentrated within a breccia pipe in the quartz monzonite stock.

4.1.2 Graben West of Animas Uplift

West of the Animas Uplift, between it and the Black Range, lies a half-graben in which Tertiary-age alluvial-fan deposits, sandstones, and mudstones of the SFG overlie Tertiary-age volcanic rocks and Paleozoic-age sedimentary rocks. Dips are eastward, and the half-graben is bounded on the east by normal faults. The Santa Fe beds may reach a thickness of 1,000 ft on the east side of the half-graben (Seager et al., 1982, sheet 2).

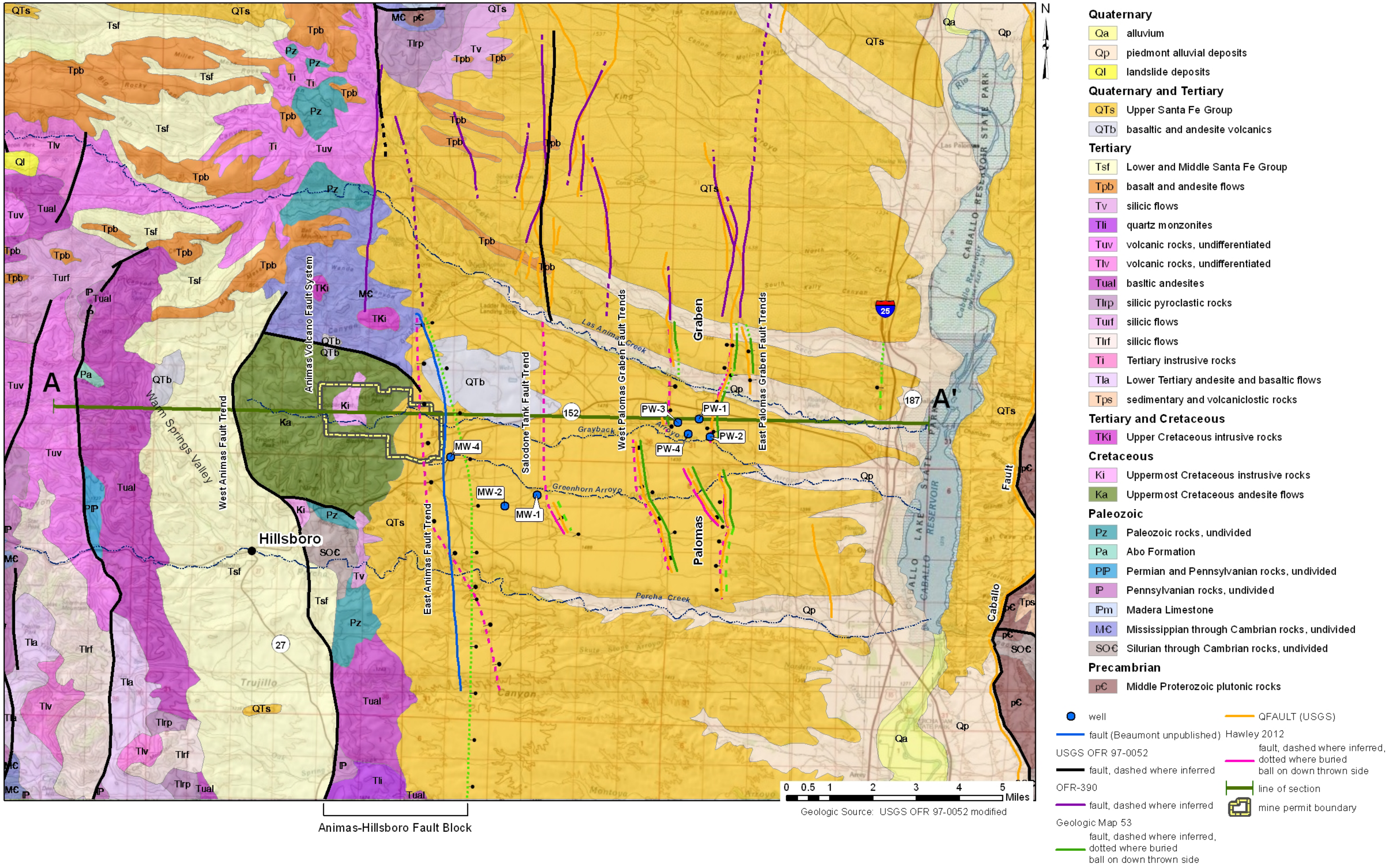


Figure 4.3. Geologic map of study area.

4.1.3 Palomas Basin

The Palomas Basin is a sediment-filled structural trough about 35 miles long by 12 miles wide. It is part of the Rio Grande rift, a north-south trending zone of approximately east-west oriented extension that bisects the state of New Mexico. The extension is caused by the Colorado Plateau crustal block pulling away from the High Plains block, which stretches and thins the Earth's crust in the area of the rift (Seager and Morgan, 1979).

Rio Grande rift extension began in southern New Mexico about 36 million years ago in late Eocene time, with the rate of extension peaking between 16 and 10 million years ago, in Miocene time (Lozinsky, 1986; Mack, 2004). The axial basins (such as the Palomas Basin) are in the form of half-grabens that are tilted strongly toward the east or the west, depending on which side of the main rift fault the basin is located.

The Palomas Basin is an eastward-tilted half graben as evidenced by gravity data and by geologic mapping of eastward dips of Santa Fe Group beds along the western edge of the basin (Lozinsky, 1986). The basin is defined between the north-south trending Caballo and Animas-Hillsboro fault blocks (Fig 4.3; Kelley, 1955; Kelley and Silver, 1952). Most of the displacement has occurred on the east side of the Palomas Basin along the Caballo Fault (the main rift fault system).

Basin-fill thickness is probably greater than 6,000 ft along the eastern side of the Palomas Basin (Lozinsky, 1986, figure 2). Basin-fill thickness is greater than 2,000 ft at well MW-4 (Fig. 4.3), located in the thinner western part of the basin, near the Animas Uplift.

The sedimentation of the Palomas Basin occurred contemporaneously with the down-dropping of the half graben and the rise of the Animas Uplift (Mack, 2004). Las Animas and Percha Creeks were established prior to structural development of the Animas Uplift and maintained the water course by channel cutting through the bedrock units, and downstream deposition of fluvial sediments in the Palomas Basin (Mack, 2004).

North-south extensional faulting followed the formation of the Palomas Basin and deposition of the majority of the Santa Fe Group sediments. North-south faults within the Santa Fe Group Sediments have been mapped by Kelley et al. (unpublished, 1979), Seager et al. (1982), Harrison et al. (1993), and Hawley (unpublished, 2012).

North-south extensional faulting formed the Palomas Graben (Figs. 4.2 and 4.3) which filled with sediments that are coarser-grained than the Santa Fe Group sediments on either side. The Palomas Graben was identified as a productive aquifer, and the Copper Flat well field was completed within it in the mid-1970s.

The faults forming the Palomas Graben are mapped from Percha Creek north to about Palomas Creek. However, similar north-south trending faults mapped by Harrison et al. (1993) suggest the Palomas Graben may continue as far north as the San Mateo Mountains (Hawley, personal communication, 2012). The graben is thought to be an ancestral tributary of the Rio Grande which joins the main channel south of the study area.

The mapped individual fault segments (Fig. 4.3) form several continuous north-south fault trends. A summary of the fault trends, from west to east, follows:

1. <u>West Animas Fault Trend</u> – north-south fault that forms boundary between Animas half-graben and west side of Animas Uplift. Normal fault downthrown on the west side. Primary references Murray (1959); Hedlund (1975).
2. <u>Animas Volcano Fault System</u> – faults formed around andesite volcano, downthrown on exterior side of volcano. Primary references Harley (1934); Hedlund (1975); Dunn (1982).
3. <u>East Animas Fault Trend</u> – north-south normal fault that forms boundary between Animas Uplift and Palomas Basin. Downthrown on east side. Mapped as inferred fault at slightly different longitude by Seager et al. (1982) than by Hawley (2012). Key references include Harrison et al. (1993), Beaumont (2011), JSAI (2011a), and Hawley (2012). Work performed by JSAI (2011a) and Beaumont (2011) is based on analysis of well logs and lineaments identified from aerial photographs.
4. <u>Saladone Tank Fault Trend</u> – north-south normal fault down thrown on the east side. Mapped by Kelley et al. (1979), Seager et al. (1982), Harrison et al. (1993), and Hawley (2012).
5. <u>West Palomas Graben Fault Trends</u> – north-south normal faults downthrown on the east side. Forms western boundary of the Palomas Graben. Faults mapped by Kelley et al. (1979), Seager et al. (1982), Harrison et al. (1993), and Hawley (2012).
6. <u>East Palomas Graben Fault Trends</u> – north-south normal faults downthrown on the west side. Forms eastern boundary of the Palomas Graben. Faults mapped by Kelley et al. (1979), Seager et al. (1982), Harrison et al. (1993), and Hawley (2012).

4.2 Hydrogeology

Hydrogeologic units, aquifer characteristics, and recharge and discharge locations are discussed below for the three geologic subdivisions of the study area. A hydrogeologic map of the study area is shown with surface water features and mapped springs on Figure 4.4.

Some of the mapped springs, such as “Las Animas Creek Community Spring” (Murray, 1959) and “LA-52” (Davie and Spiegel, 1967), were identified long ago and may no longer flow. However, the locations identified within the Santa Fe Group lie along the main faults, demonstrating the structural controls on groundwater flow.

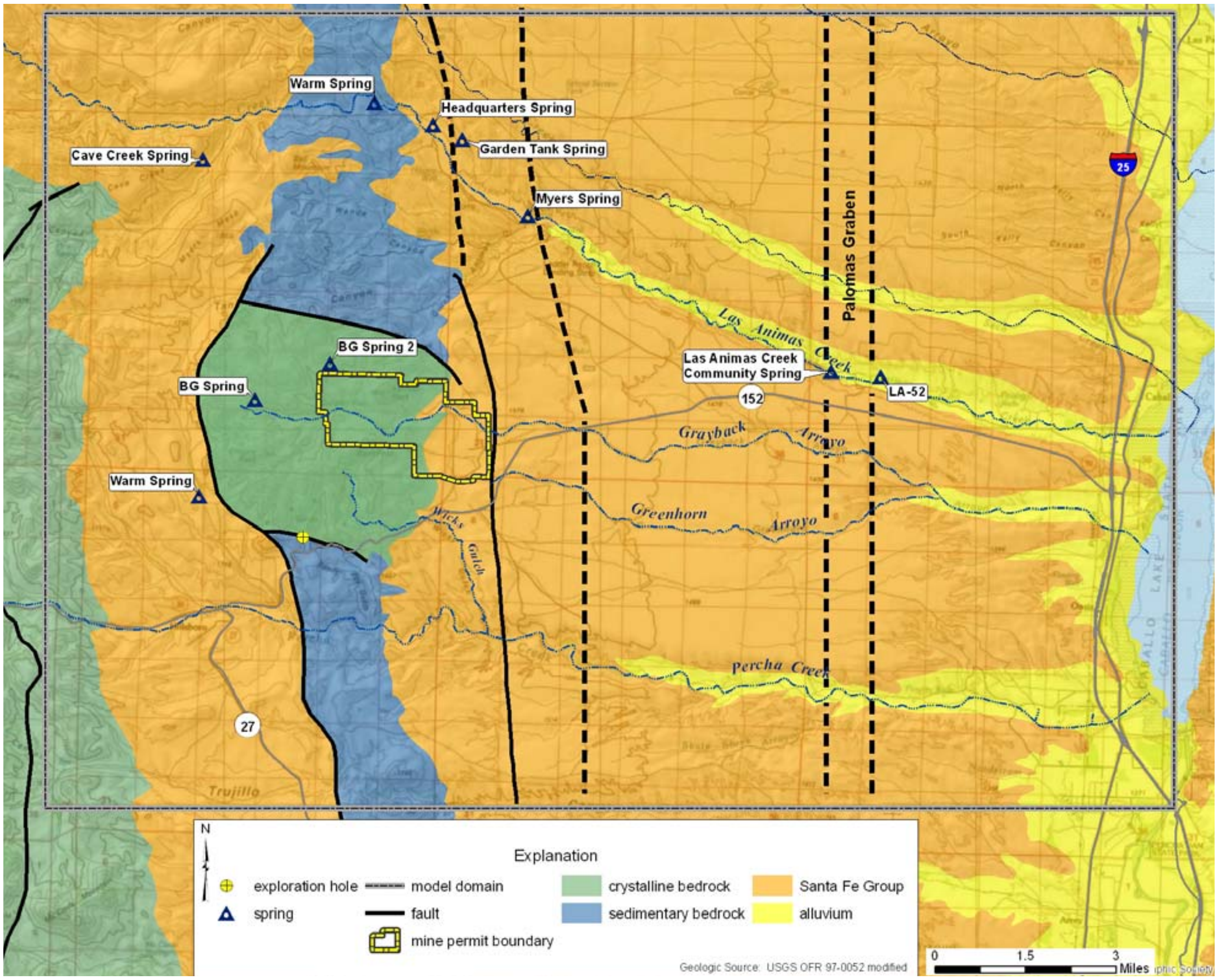


Figure 4.4. Hydrogeologic units and mapped spring locations.

4.2.1 Animas Uplift

Hydrogeologic units in the Animas Uplift include the relatively impermeable andesite and monzonite of the Copper Flat area and the relatively permeable carbonate rocks and other sedimentary rocks to the north and south of Copper Flat.

Groundwater recharge from local precipitation to the quartz monzonite and andesite is limited by low hydraulic conductivity. Recharge to the limestone outcrop areas north and south of the andesite is greater. Recharge to the limestone also includes infiltration of runoff generated at higher elevation, from the Las Animas Creek and Percha Creek watersheds.

Groundwater discharges from the limestone at the foot of the uplift, as spring flow (Fig. 4.4) and base flow to Percha and Las Animas Creeks. Groundwater discharges from the andesite as subsurface flow across the fault contacts with the Palomas Basin, and as evaporation from the open pit.

The existing Copper Flat open pit, which the New Mexico Copper Corporation (NMCC) proposes to expand, was excavated in 1982 by Quintana Minerals. The Quintana pit was excavated to a maximum depth corresponding to elevation 5,400 ft amsl. The current water level in the pit is about 5,439 ft amsl (April 2013). The pre-mining groundwater level (without lake evaporation) was about 5,450 ft amsl (JSAI, 2011b).

The low hydraulic conductivity of the quartz monzonite and andesite is reflected in the low pumping rates required in 1982 to dewater the Quintana pit. The dewatering rate required to maintain the greater-than 45-ft drawdown, in an excavation about 100 ft by 200 ft in area at maximum depth, was estimated at 22 gallons per minute (gpm) (Shomaker, 1993). SRK (1997) reports pumping rates up to 50 gpm. The range in reported dewatering rates was likely due to the variability of precipitation and runoff to the pit.

The low conductivity of the andesite and monzonite are confirmed below in the evaluation of the pit water balance (Sec. 5.4) and in the results of the 2011 pit-area pressure-injection testing (Sec. 5.4.1). It can be expected that the hydraulic conductivity of rock deeper in the andesite and quartz monzonite will have still lower hydraulic conductivity, because of the decrease in weathering effects and the closing of fractures with depth. The andesite acts as a hydrologic containment vessel for the existing and proposed open pits.

The radiating dikes and veins may be inferred to have relatively low conductivity as well. Several mine shafts in Wicks Gulch (Fig. 4.4) were examined, and found to be almost full of water; if there were significant hydraulic conductivity, either along fractures or through the rock matrix, water levels would be closer to the elevation of nearby surface channels.

Away from the andesite body, where the Animas Uplift consists of fractured, predominantly limestone and dolomite bedrock, it is likely that significant permeability has developed by the combination of fracturing and enlargement of fracture-openings by dissolution of carbonate minerals. This hypothesis is supported by the account of an air-drilled exploration hole (Fig. 4.4) in SW/4 SE/4 Sec. 3, T. 16 S., R. 7 W, which was abandoned because large water production overcame the capacity of the compressor to continue circulation (Sonny Hale, personal communication). The well is close to the fault which offsets the andesite against the predominantly limestone Paleozoic-age section.

4.2.2 Graben West of Animas Uplift

Local precipitation, and runoff from the Black Range, provide groundwater recharge to the graben. Discharge occurs mainly as spring flow and possibly also as subsurface discharge to the Animas Uplift. Spring flow in the Warm Springs drainage discharges as base flow to Percha Creek. The emergence of water at Warm Springs (Fig. 4.4) at the eastern edge of the graben demonstrates that the andesite of the Animas Uplift acts at depth as a barrier to flow from the graben. Groundwater in the graben flows west to east across the Animas Uplift, south toward Percha Creek and north toward Las Animas Creek, flowing around the body of low-permeability andesite (Fig. 4.4).

The contrast between the chemical makeup of water from Warm Springs, as compared with water from wells and springs within the Animas Uplift (Newcomer and Finch, 1993), indicates that the source of Warm Springs water is not within the uplift, as might otherwise be inferred from the relative heads at the spring and at wells and springs within the uplift (Fig. 4.4).

4.2.3 Palomas Basin

Water recharges the Palomas Basin at its western edge, through alluvial fans at the edge of the Animas Uplift, including infiltration of runoff from Greenhorn and Grayback Arroyos and infiltration of base flow and runoff from the upper catchments of Las Animas and Percha Creeks.

Groundwater flows mainly east toward the Rio Grande and Caballo Lake. Calibration of the groundwater-flow model (Sec. 6.0) presented below also suggests that there is a north-to-south component of groundwater flow within the Palomas graben, discharging toward the Rio Grande system south of the study area.

Besides discharging to the Rio Grande and Caballo, groundwater also discharges locally, by pumping, from flowing wells, and as evapotranspiration from irrigated and riparian vegetated areas along Las Animas Creek and Percha Creek. The principal water-bearing sediments of the Palomas Basin are (1) alluvial-fan deposits, fluvial sands and gravels of the Santa Fe Group, and (2) alluvium in the inner valleys of the Rio Grande and principal tributaries (Hawley and Kennedy, 2004).

Davie and Spiegel (1967, p. 9) describe the Santa Fe Group in Las Animas Creek area as consisting of (a) an alluvial fan facies, interfingering eastward with (b) a clay facies, possibly representing the distal or deltaic beds of the alluvial fan facies, which in turn interfingers with (c) an axial river facies consisting of well-sorted sand and gravel containing well-rounded quartzite pebbles. The sediments are stratified and in general dip to the east.

Geologic logs from wells along Las Animas Creek provide evidence that the coarse-grained sediments in the Palomas Graben are overlain by a clay layer that creates perched groundwater conditions in the alluvium along Animas Creek.

Stratification and heterogeneity of the SFG creates confined conditions at depth in the lower Palomas Basin. Seepage along Percha Creek, Grayback Arroyo, Greenhorn Arroyo, and Las Animas Creek alluvial systems recharges the SFG sediments in the upper basin and the recharge pressures the stratified sediments down-dip, creating upward vertical gradients in the lower basin. Overlying clay beds create artesian conditions in the basin down-dip of recharge zones.

Artesian pressures are relatively low, generally less than 10 ft of head above land surface. A survey of artesian wells (Shomaker, unpublished) from 1993 has been updated (JSAI, 2011c), indicating reduction of artesian flow and pressure over 18 years. The history and effects of artesian discharge are discussed further below.

4.3 Hydrogeologic Conceptual Model

The hydrogeologic system described above is summarized on Figure 4.5, a map of hydrogeologic units, and on Figure 4.6, a map of the boundary conditions (inflows and outflows of water) on the system. The hydrogeologic units (Fig. 4.5) and boundary conditions (Fig. 4.6) presented form the basis of the numerical groundwater-flow model.

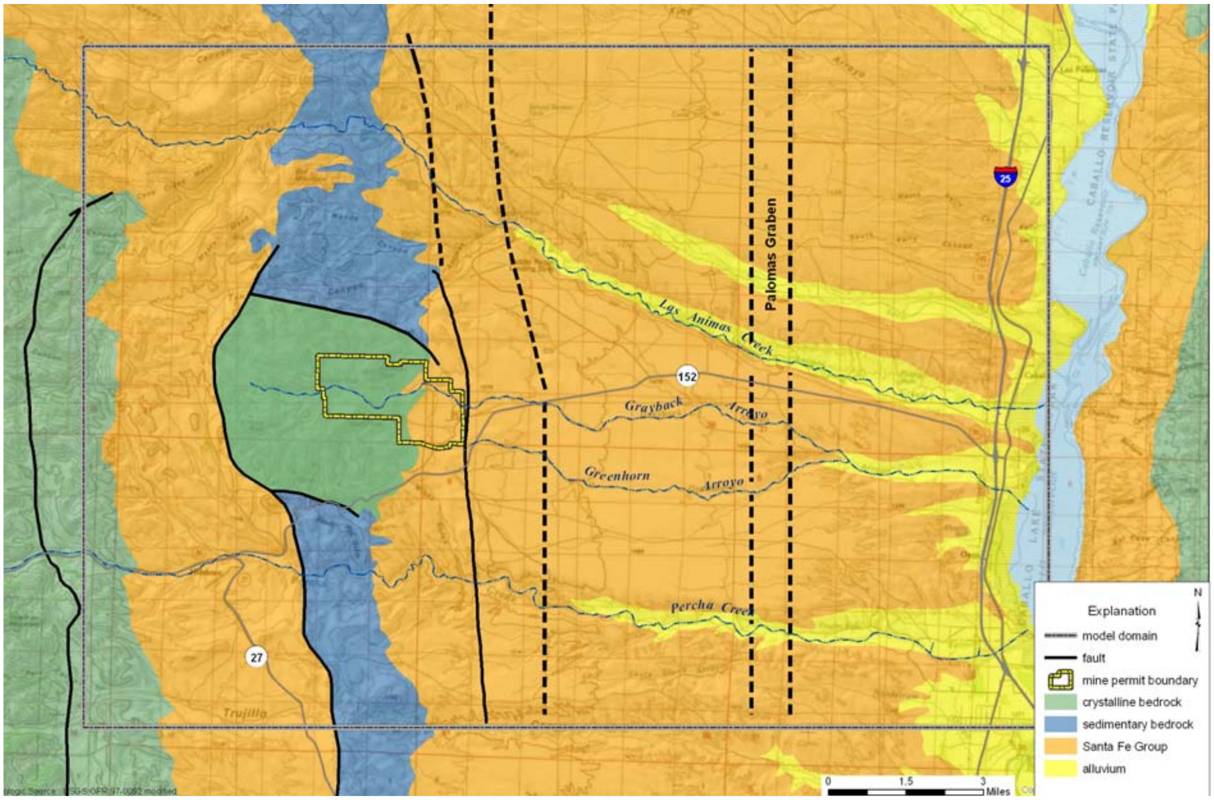


Figure 4.5. Hydrogeologic map of study area.

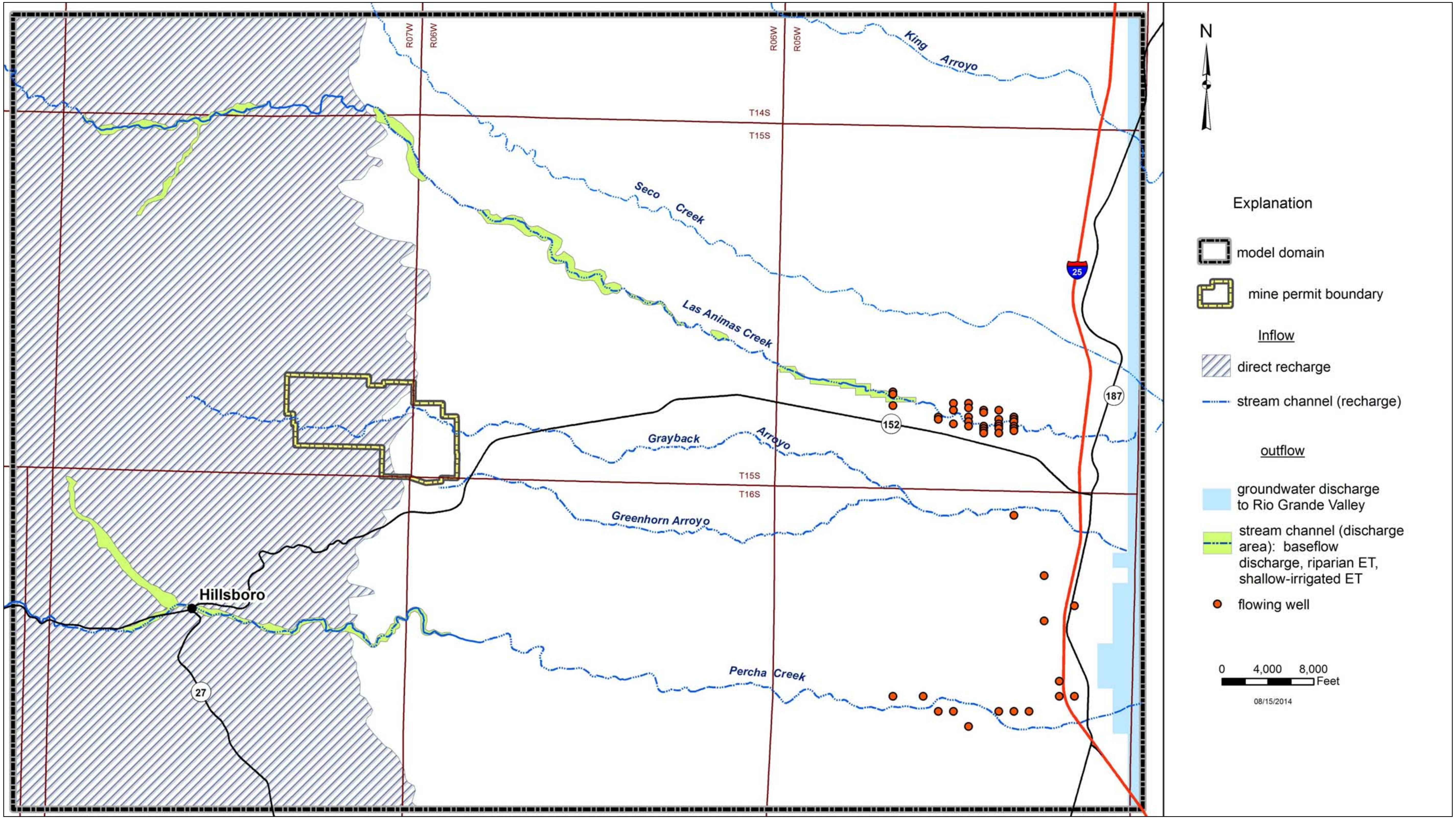


Figure 4.6. Hydrogeologic boundary conditions

5.0 CALIBRATION DATA

This section describes the data on aquifer stresses and responses available to guide the development and calibration of a numerical groundwater-flow model. These include information on (1) regional water levels, (2) the Palomas Graben and the area of the water-supply wells (well field), (3) the former tailings facility, (4) the open pit, and (5) the artesian zone in the lower Las Animas Creek and lower Percha Creek basins.

5.1 Regional Water Levels

Locations of wells and water-level measurements are presented with recent (December, 2012) potentiometric surface contours on Figure 5.1. Interpreted contours are shown for three aquifers: (1) bedrock and SFG of the Animas Uplift and Animas Graben, (2) the SFG aquifer of the Palomas Basin, and (3) the shallow alluvial aquifer along Las Animas Creek. Groundwater levels range from above 5,800 ft amsl at the western edge of the Animas graben to about 4,200 ft amsl at Caballo Lake.

Piezometers and production wells discussed below are shown on Figure 5.2. Available well construction diagrams are presented in Appendix B.

5.2 Well Field Area

The NMCC water supply wells (PW-1, PW-2, PW-3, and PW-4) were constructed and tested in 1975-80 (Green and Halpenny, 1976, 1980). Local transmissivity of the SFG aquifer is estimated below from the PW-1 and PW-2 test data. Effects of the period of well field operation, from March through June 1982, are then discussed. Next, results of a 1994 pumping test of MW-9, evaluating vertical transmission of effects, is presented. Finally, results of the 2012 aquifer test are discussed.

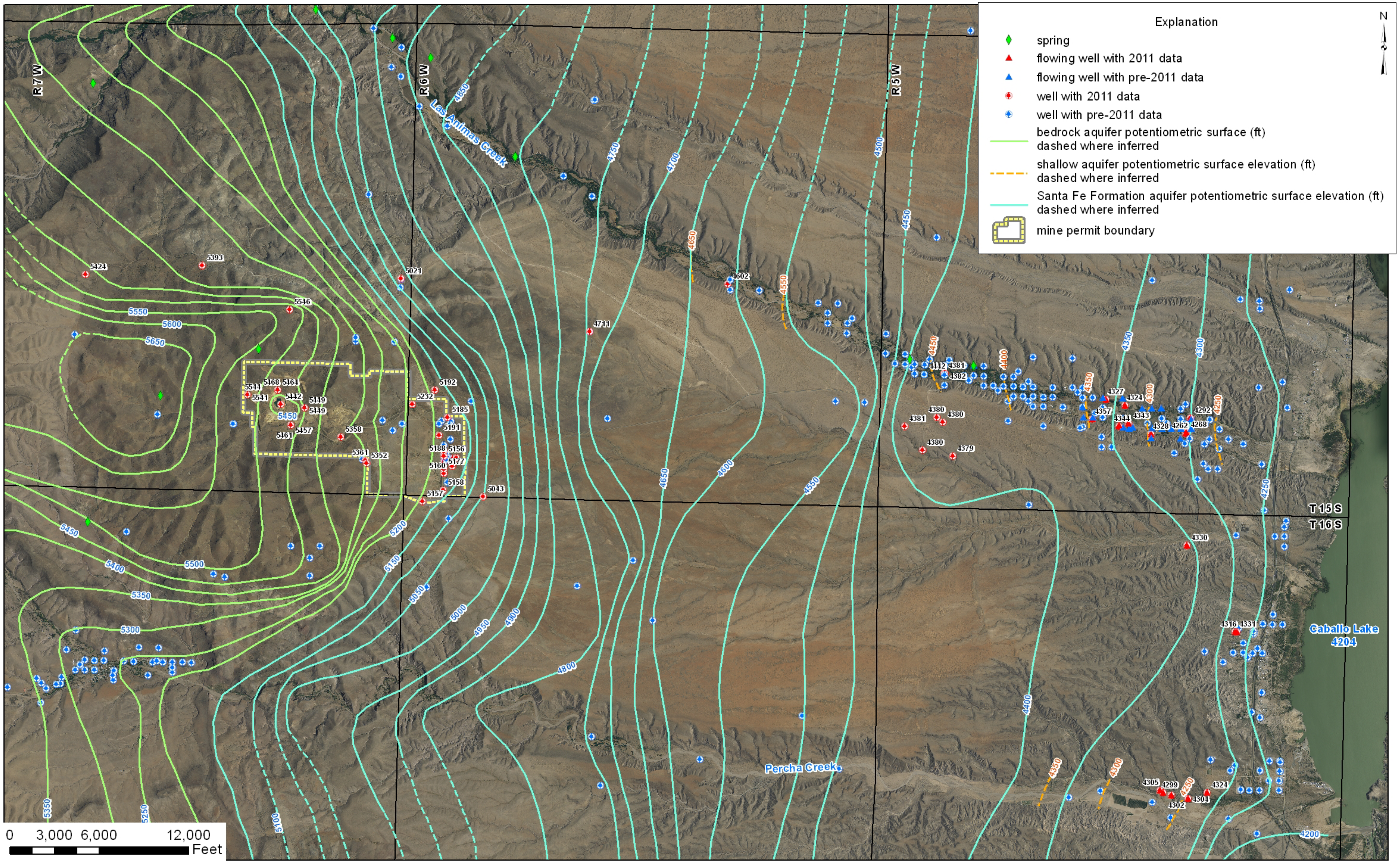


Figure 5.1. Regional water-level measurements and potentiometric surface contours.

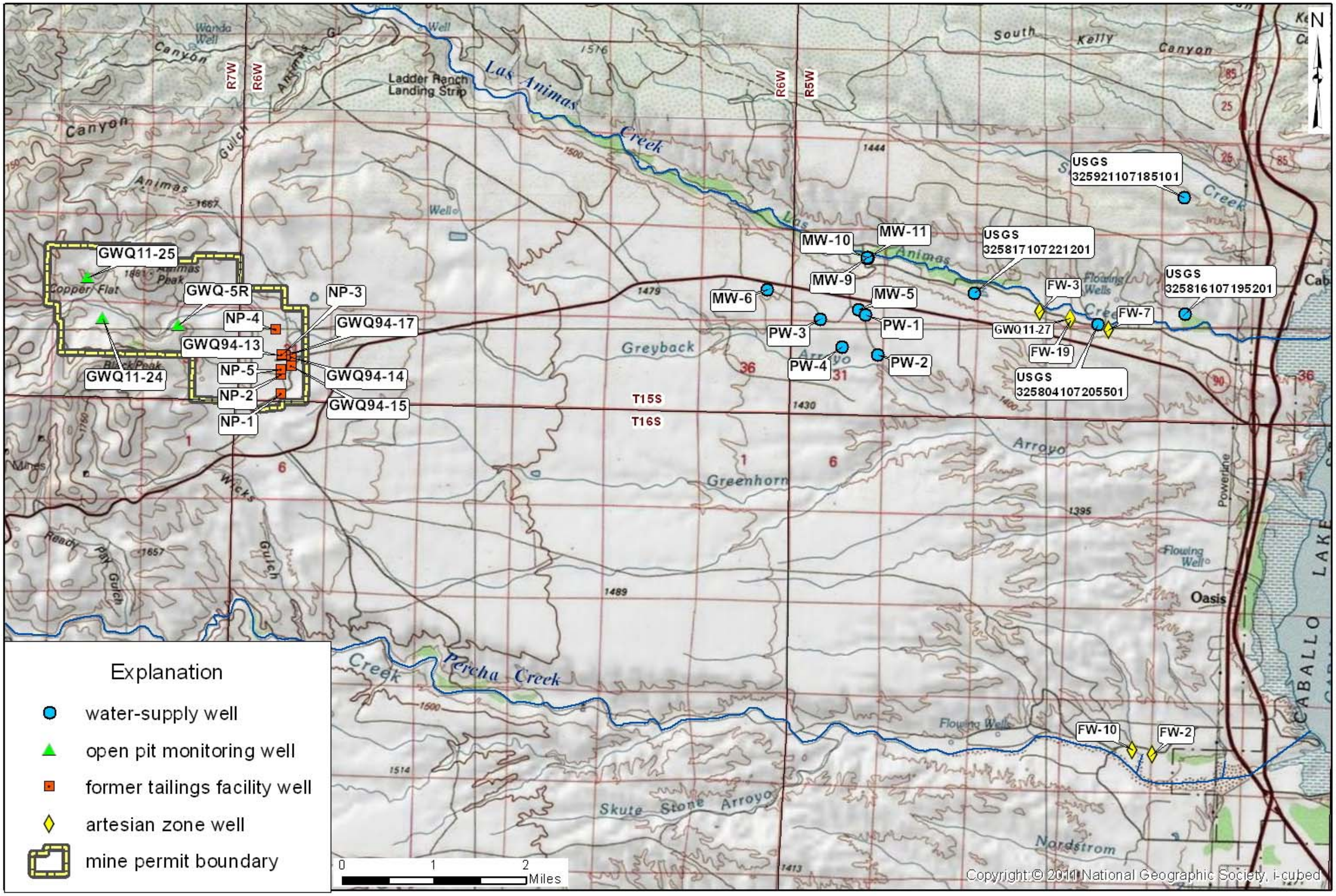


Figure 5.2. Well locations.

5.2.1 Initial Production Well Testing, 1975-1976

PW-2 was pumped at 2,020 gpm for 72 hours in January 1976 (Appendix C1). Measured drawdown and recovery at observation wells PW-1 and MW-5 are shown on Figures 5.3 and 5.4. Aquifer transmissivity is estimated at about 20,000 ft^2/day by matching the solution of Theis (1938) to measured drawdown and recovery at PW-1 and MW-5 (WDC, 1976).

Measured drawdown and recovery at the pumping well PW-2, is shown on Figure 5.5, along with the Theis solution match. In addition, because the PW-2 curves exhibit a shape characteristic of a leaky confined aquifer, the modified Theis solution of Hantush (1956) is shown as an alternate analysis.

PW-1 was pumped at 1,500 gpm for 70 hours in December 1975 (WDC, 1976). Measured drawdown and recovery at observation well MW-5 are shown on Figure 5.6. Aquifer transmissivity of about 17,000 ft^2/day is estimated by matching the solution of Theis (1938) to measured drawdown and recovery at MW-5, and to measured recovery at the pumping well PW-1, shown on Figure 5.7. In addition, the PW-1 curves exhibit a "leaky" shape and a Hantush curve match is shown as an alternate analysis.

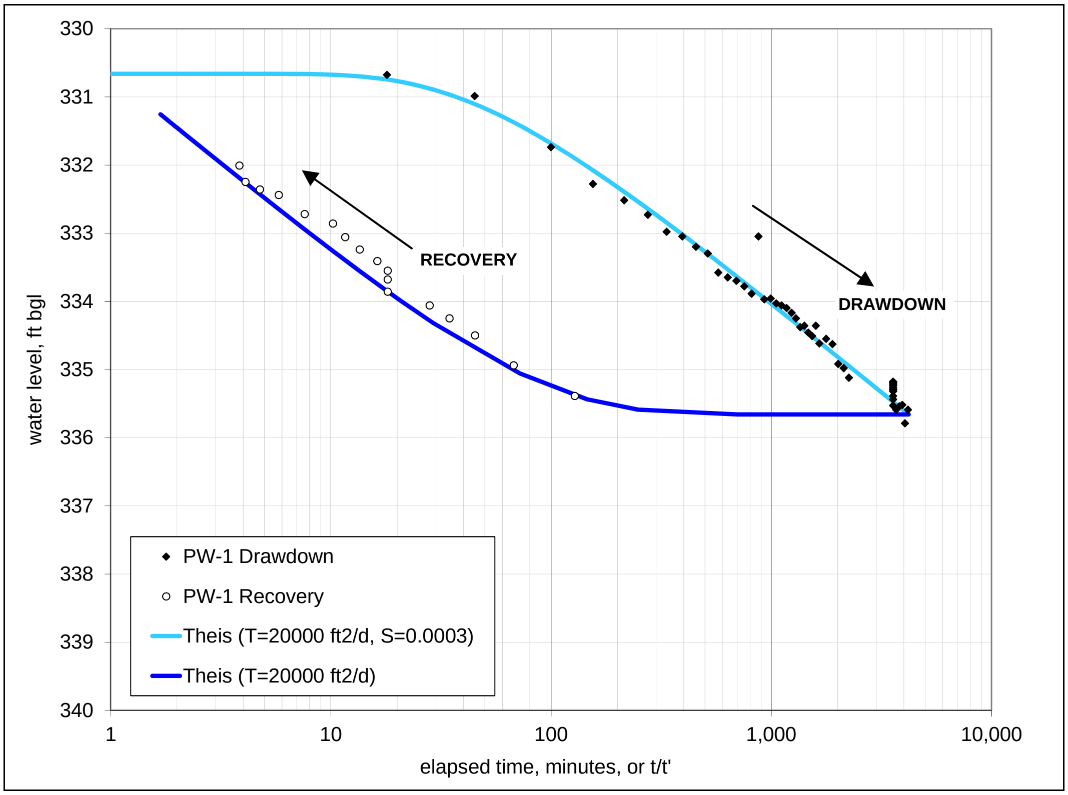


Figure 5.3. Drawdown and recovery in PW-1 during January 1976 PW-2 pumping test.

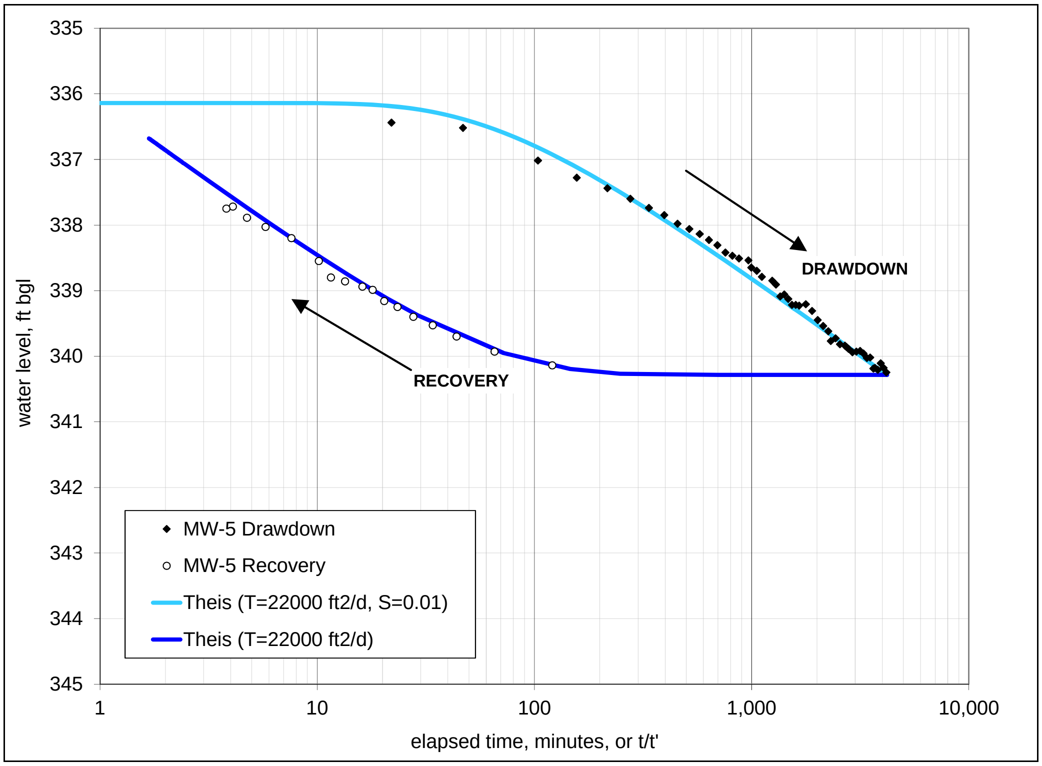


Figure 5.4. Drawdown and recovery in MW-5 during January 1976 PW-2 pumping test.

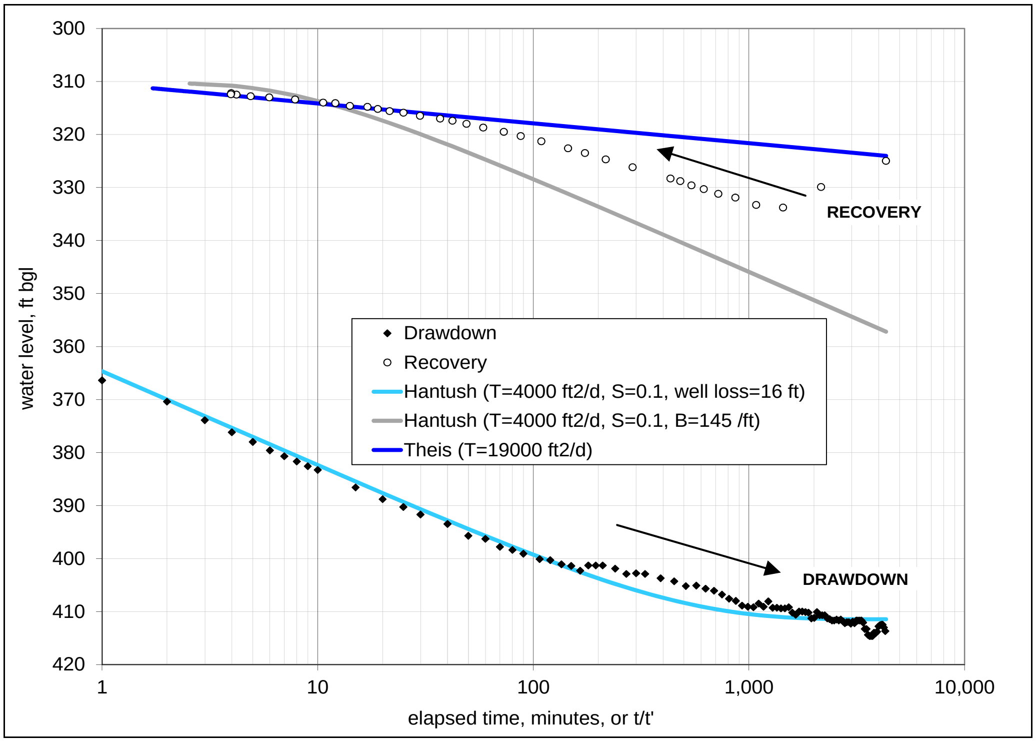


Figure 5.5. Drawdown and recovery in PW-2 during January 1976 PW-2 pumping test.

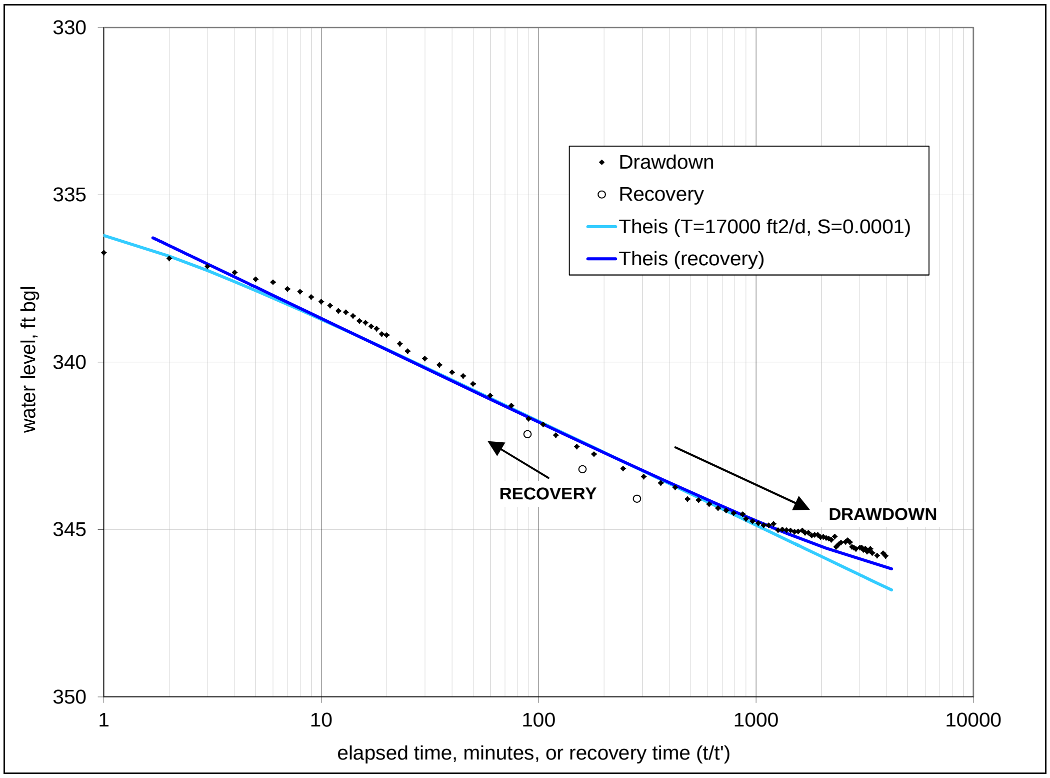


Figure 5.6. Drawdown and recovery in MW-5 during December 1975 PW-1 pumping test.

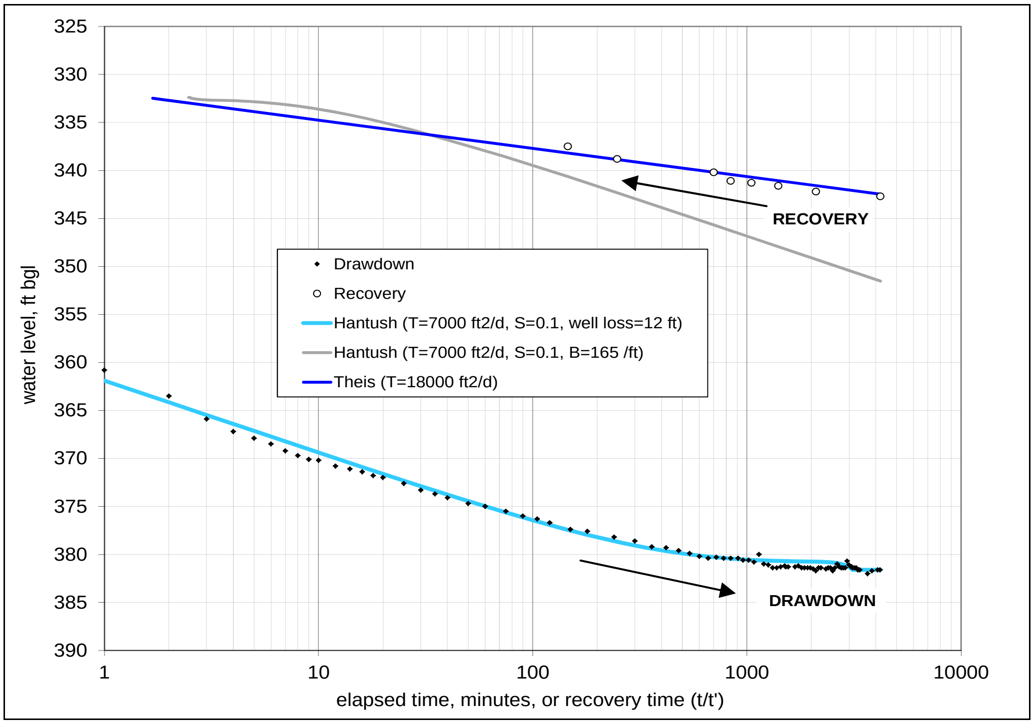


Figure 5.7. Drawdown and recovery in PW-1 during December 1975 PW-1 pumping test.

5.2.2 Period of Mine Operation, 1982

The well field was operated for 4 months from March through June 1982, at an average pumping rate of 2,272 gpm. Some pumping, averaging 40 gpm, continued for 16 months more. Average pumping rates (Bailey, 2010) are presented in Table 5.1. Total volume pumped for 1980-83 was 1,317 ac-ft.

Water levels measured in MW-5, in the immediate area of the production wells, are shown along with well field pumping on Figure 5.8, showing about 20 ft of water level drawdown due to pumping.

West of the well field, no response to pumping can be seen in water levels at MW-6, shown on Figure 5.9.

Long-term water-level trends from MW-6 show a slow rise of approximately 170 ft over 30 years. When compared to other wells in the region, water-quality data indicates groundwater from MW-6 has an anomalously high sodium chloride component. Furthermore, there are mapped north-south fault traces in the immediate vicinity of MW-6 (Seager, et al. 1982; Hawley, 2012).

Water Development Corporation (1975) reported the following: “the anomalous highs to which the water level recovered indicated that the well was being recharged by an unknown source of water (either perched water or possibly slow seepage up the well bore from the sand stringers underlying the clay layer) and that the aquifer materials were too plugged with drilling mud to allow this water to move freely into the formation.”

Over time, as MW-6 was pumped, the well slowly developed and became hydraulically connected to sodium-chloride groundwater locally upwelling along an extensional fault zone. Sodium-chloride groundwater is known to upwell along structures in the Rio Grande Rift (Witcher et al., 2004). In conclusion, the observed groundwater head and water level trend from MW-6 is not representative of the regional Santa Fe Group aquifer system.

Table 5.1. Recorded average well field pumping in gallons per minute

1980	1	Jul-82	70	Mar-83	29
1981	1	Aug-82	43	Apr-83	31
Jan-82	29	Sep-82	60	May-83	68
Feb-82	29	Oct-82	34	Jun-83	26
Mar-82	1,817	Nov-82	40	Jul-83	43
Apr-82	3,042	Dec-82	43	Aug-83	25
May-82	1,501	Jan-83	43	Sep-83	16
Jun-82	2,727	Feb-83	48	Oct-83	29

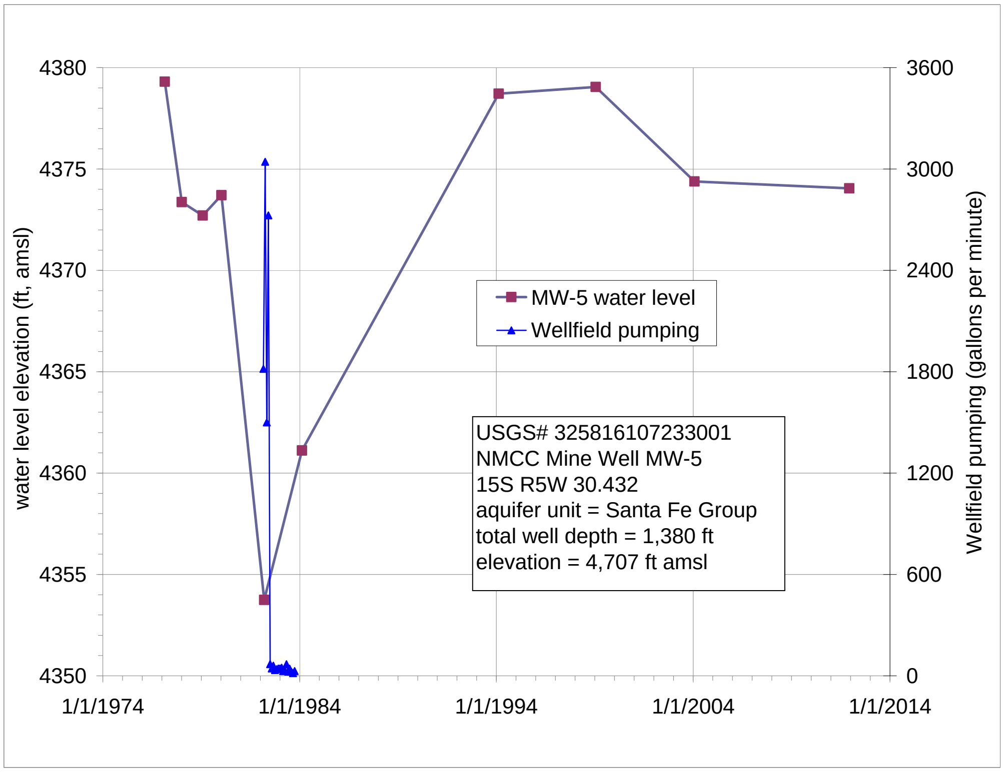


Figure 5.8. Well field pumping history and water level in MW-5.

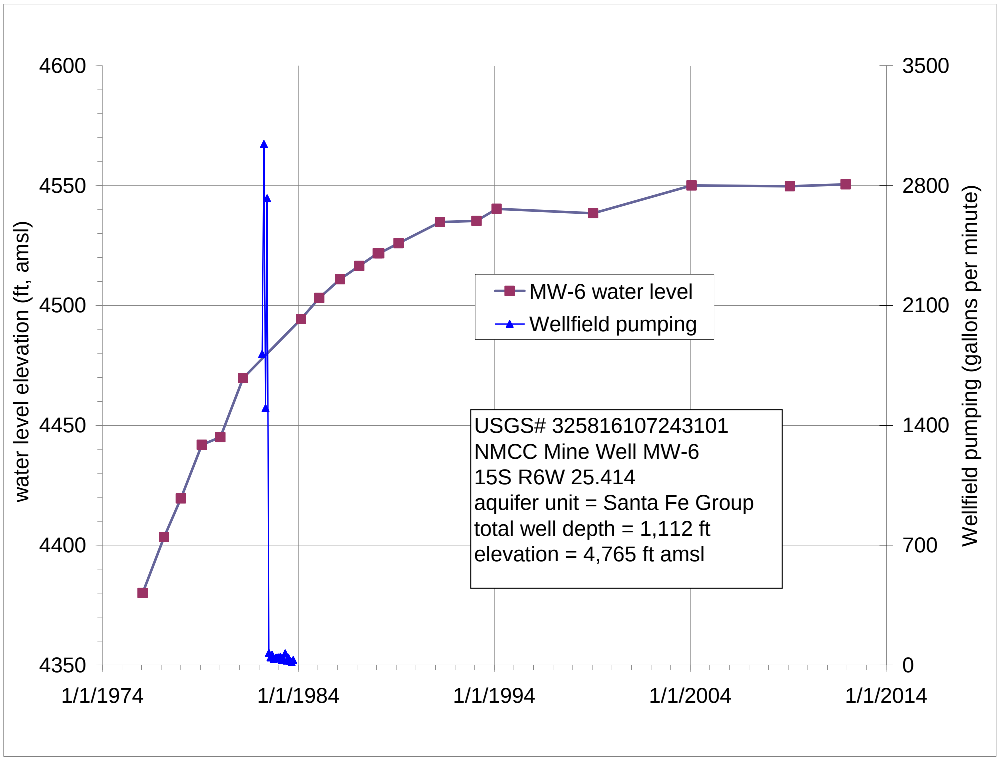


Figure 5.9. Well field pumping history and water level in MW-6.

Water levels in four wells monitored by the USGS, located east of the well field along Las Animas Creek and Seco Creek (Fig. 5.2), are shown on Figure 5.10 along with the recorded well field pumping. There is no clear response to pumping seen in any of the wells.

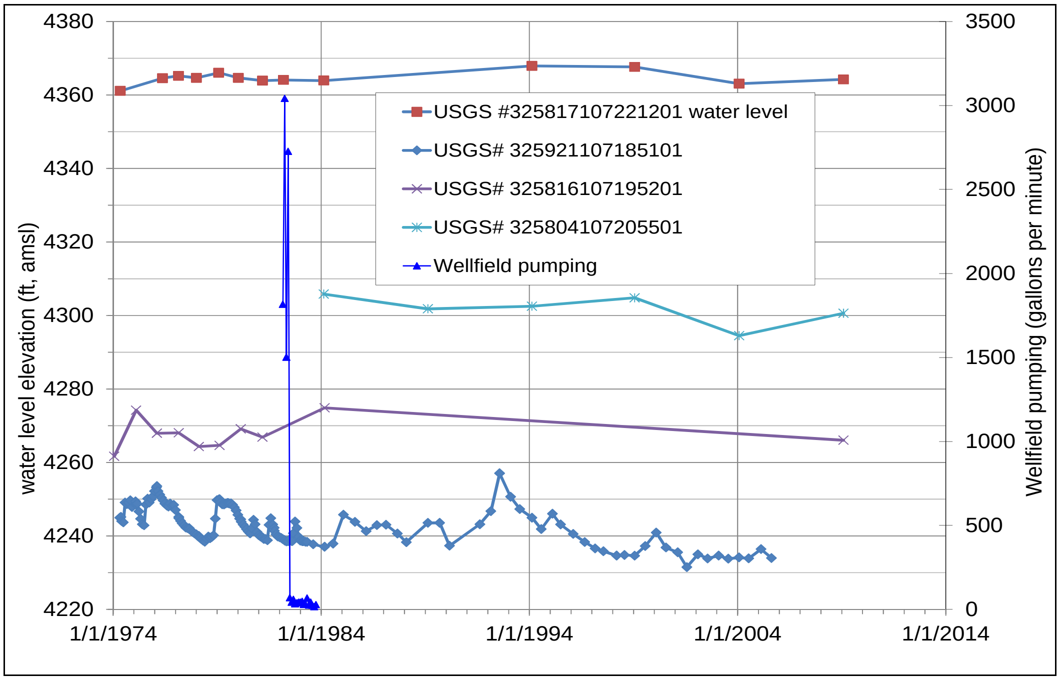


Figure 5.10. Well field pumping history and water level in USGS wells.

5.2.3 MW-9 Test, October 1994

Well MW-9, in the Palomas Graben near Las Animas Creek (Fig. 5.2.), is completed at a depth of about 250 ft. MW-10 and MW-11 are each about 50 horizontal ft from MW-9. MW-10 is completed at a depth of 125 ft and MW-11 at 37 ft. Responses at MW-10 and MW-11 to pumping at MW-9 therefore characterize the resistance to vertical flow through the SFG and alluvial aquifers.

In order to characterize vertical hydraulic communication between the SFG and alluvial aquifers (Adrian Brown Consultants, 1996), MW-9 was pumped at 90 gpm for 24 hours (Appendix C2). Drawdown and recovery at MW-9 are presented on Figure 5.11 along with a matching Hantush leaky-aquifer type-curve corresponding with transmissivity of 900 ft^2/day.

Drawdown and recovery in MW-10 are shown on Figure 5.12, showing a small response (<1 ft) to pumping, indicating possible limited vertical transmission of effects, but also showing more fluctuation due to background influences than drawdown in response to pumping. No response to pumping was detected in the shallow alluvium well MW-11; water levels rose during the test, as shown on Figure 5.13 (no analytical curves are shown on Figures 5.12 and 5.13, as the measured data show no drawdown-recovery trends to analyze).

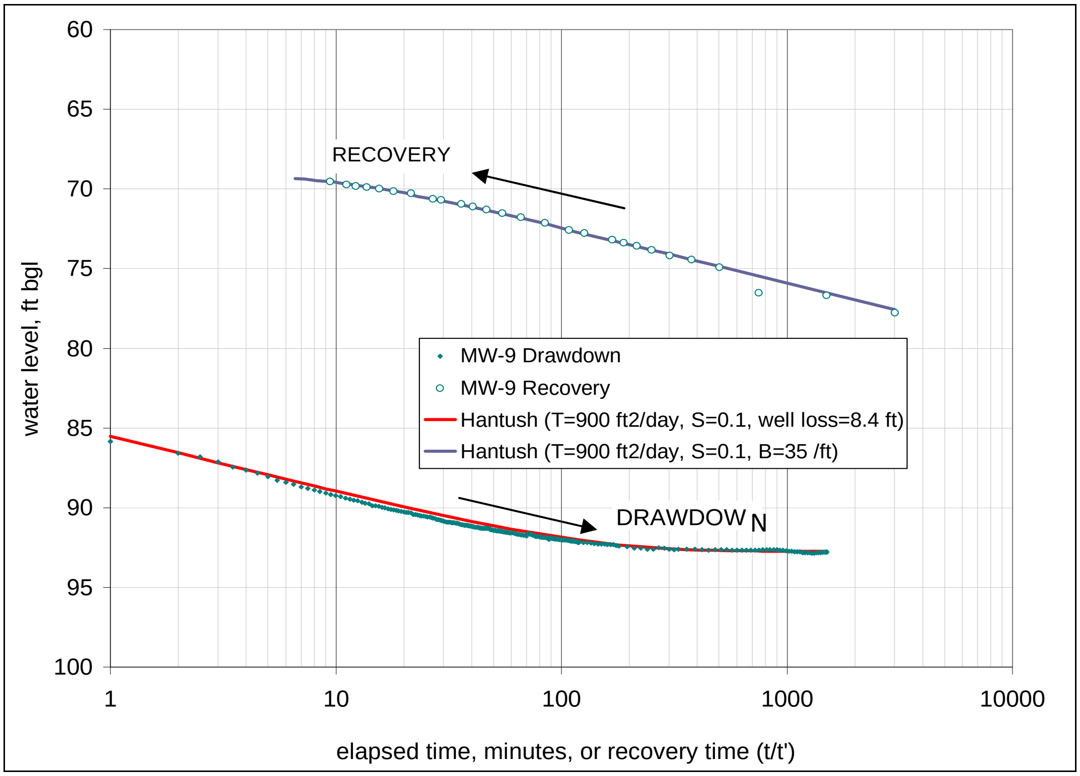


Figure 5.11. Drawdown and recovery in MW-9 during 1994 pumping test.

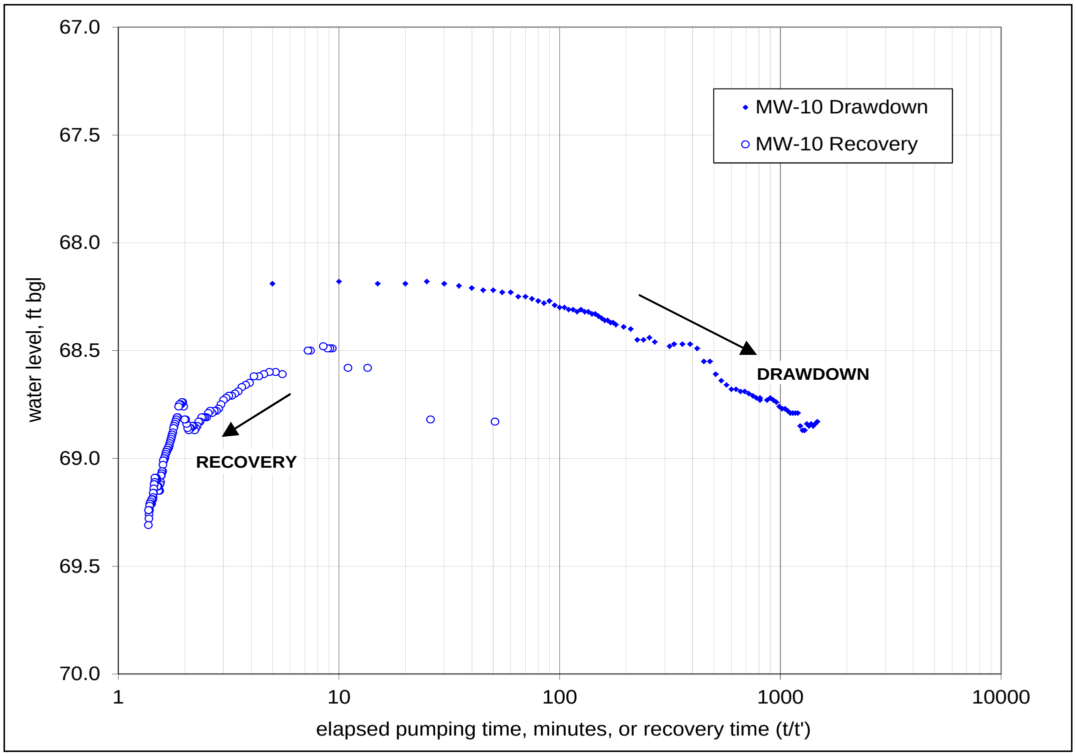


Figure 5.12. Drawdown and recovery in MW-10 during and after 1994 pumping of MW-9.

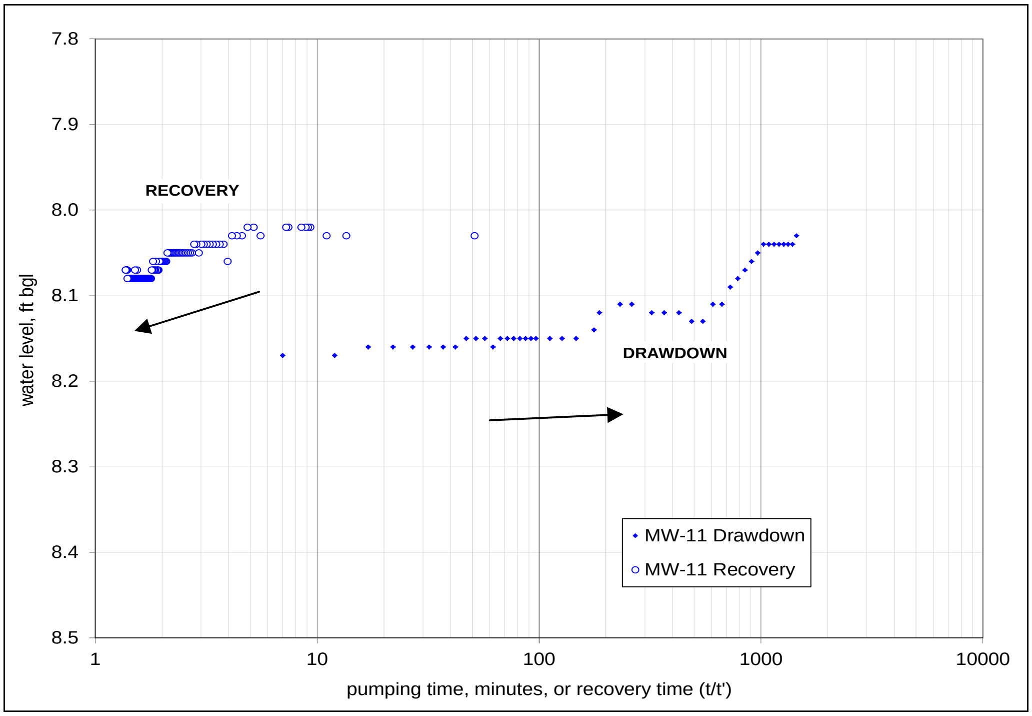


Figure 5.13. Drawdown and recovery in MW-11 during and after 1994 pumping of MW-9.

5.2.4 December, 2012 Aquifer Test

Pumping of wells PW-1 and PW-3 began on 19 November 2012 with initial testing of the pumps, circuitry and plumbing. Sustained pumping began on 3 December, was interrupted by technical difficulties on 8 December, resumed on 10 December and continued until 21 December 2012. Recorded pumping periods and rates are shown on Figure 5.14. Measured pumping-well and observation-well water levels are presented in Appendix C3. Due to the multiple pumping wells, periods and rates, the 2012 aquifer test is not easily characterized using the analytical type curves shown on Figures 5.3 through 5.7 and 5.11 above.

In addition, the analytical type curves do not reflect the particular geometry of the aquifer including the Palomas Graben. Wells within the Palomas Graben did not respond to pumping as they would in an extensive aquifer; initial drawdown was rapid and followed a semi-linear trend with time. Initial post-pumping water-level recovery was also rapid. These drawdown and recovery responses to pumping are characteristic of a high-transmissivity, semi-isolated hydrogeologic unit of finite size (the Palomas Graben).

The 2012 test is analyzed using the numerical model (Section 6.4.3 below). Measured responses in the pumping and observation wells shown on Figure 5.15 were used to calibrate the aquifer parameters for the numerical model, particularly the aquifer parameters of the Palomas Graben (Table 6.1 below) and the conductive properties of the graben-bounding faults (Table 6.2).

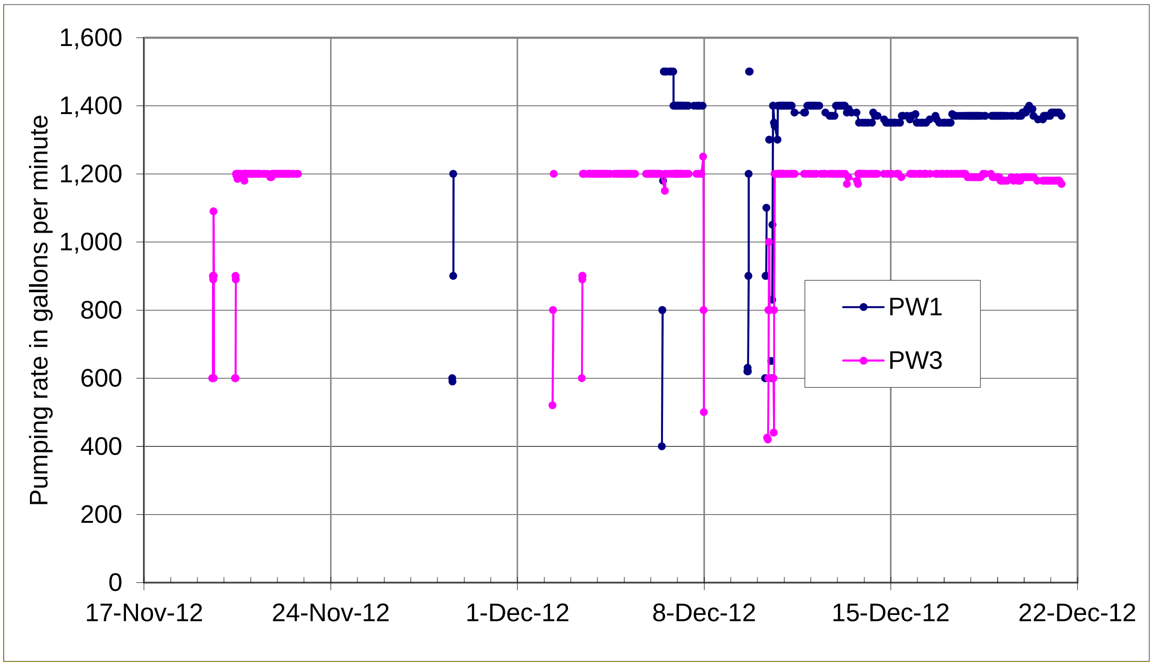


Figure 5.14. Measured aquifer test pumping rates.

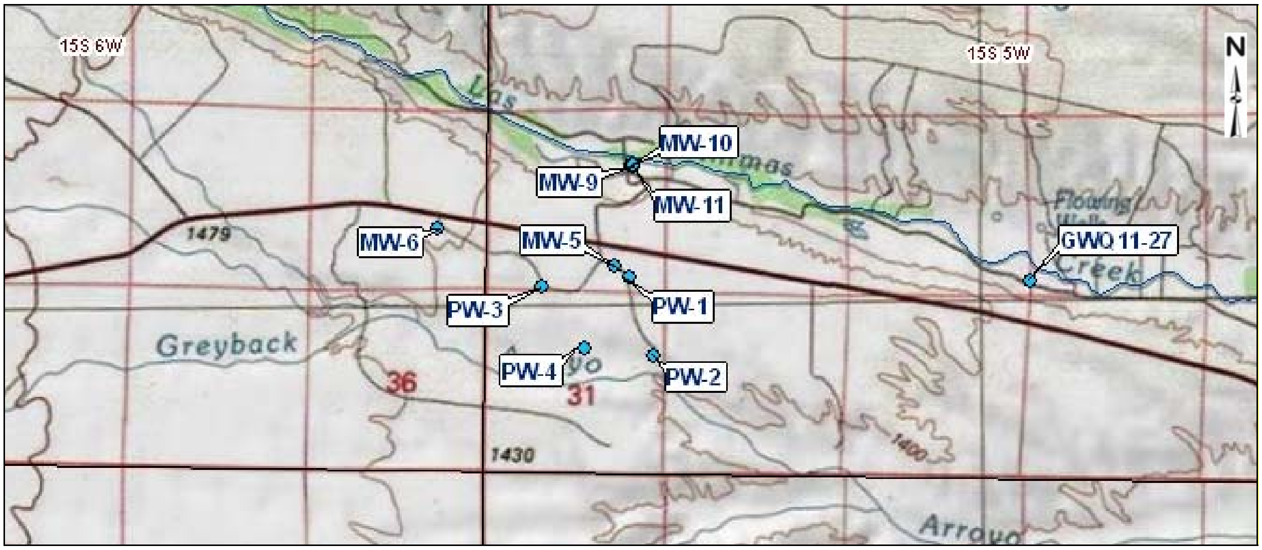


Figure 5.15. Aquifer test pumping and observation wells.

5.3 Tailings Impoundment Area

During and after the period of mine operations in 1982, the groundwater system beneath the unlined tailings facility was recharged by seepage from the tailings, in the portion of the impoundment overlying alluvium. Measured tailings-area (Fig. 5.2) water levels, shown on Figure 5.16, indicate 60 to 70 ft of water-level rise that has persisted to the present, indicating a fault, or other barrier to flow, holding the water in place.

Transmissivity in the range of 100 to 240 ft^2/day is estimated for this area at the edge of the SFG aquifer, based on the results of a 1994 aquifer test at well GWQ94-17, presented below.

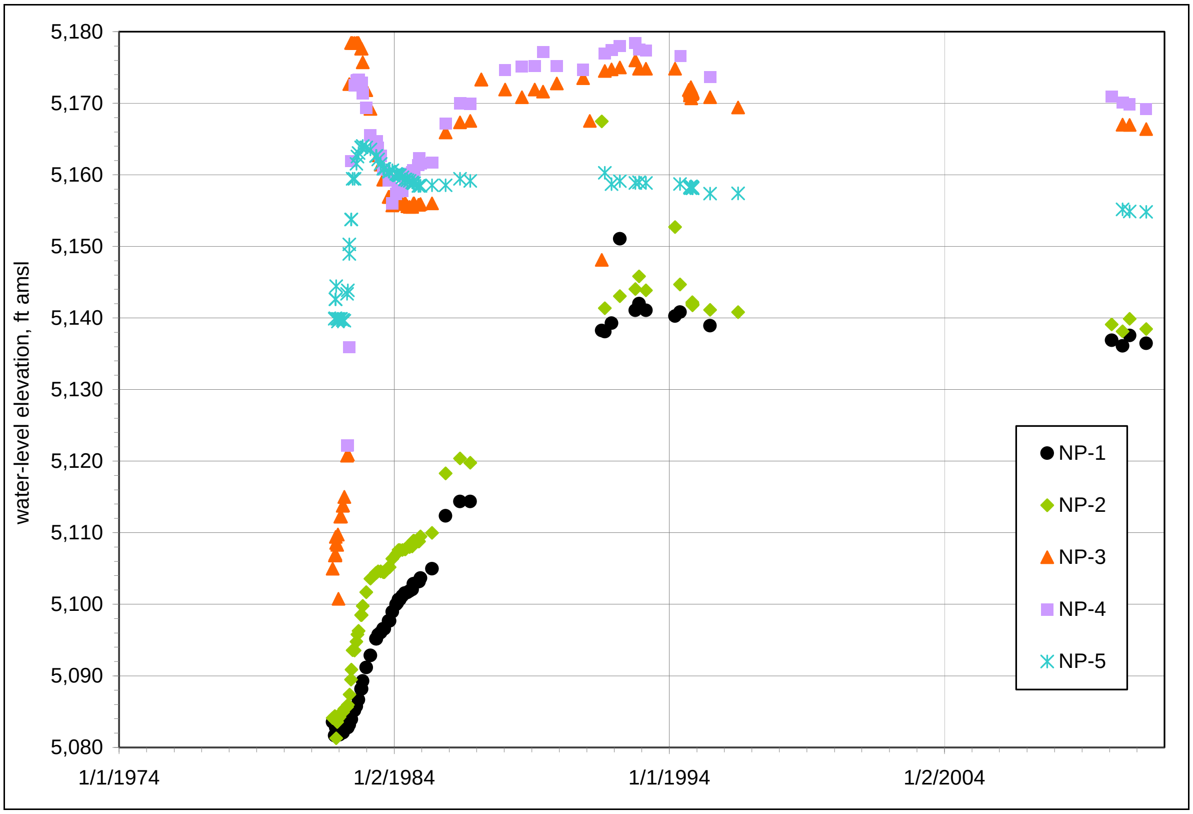


Figure 5.16. Tailings-area water levels.

5.3.1 GWQ94-17 Test, November 1994

As part of an investigation of leakage from, and groundwater flow beneath, the existing tailings impoundment (Adrian Brown Consultants, 1996), well GWQ94-17 was pumped at 23 gpm for 4,688 minutes (3.3 days), with responses measured in GWQ-13, GWQ-14 and GWQ-15 (Fig. 5.2). Complete test results are presented as Appendix C4.

Drawdown and recovery in GWQ-13 and GWQ-14 are presented on Figures 5.17 and 5.18 respectively, along with analytical (Theis, 1938) solutions. Drawdown in GWQ-15 is presented on Figure 5.19 (recovery data were unavailable) along with two Theis solutions, respectively matching distinct early and late-time trends and showing a range of possible transmissivity. Recovery in the pumping well GWQ-17 is presented on Figure 5.20 (pumping water level was constant at about 123 ft).

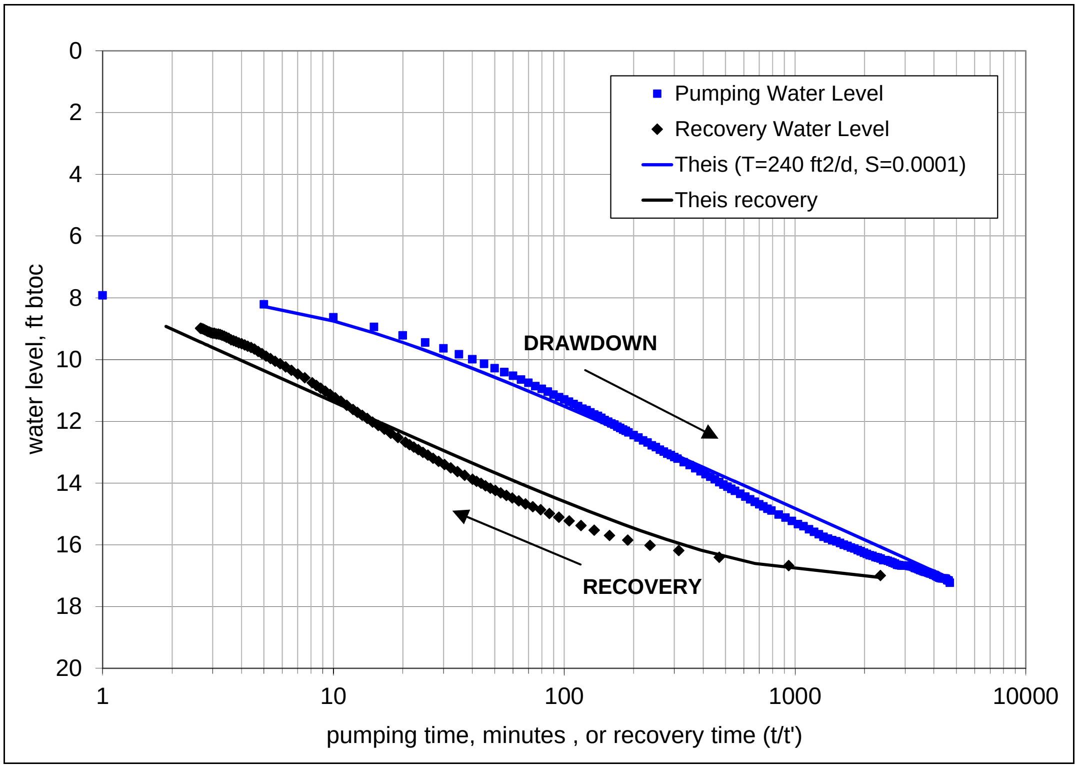


Figure 5.17. Drawdown and recovery in GWQ-13 during 1994 GWQ-17 pumping test.

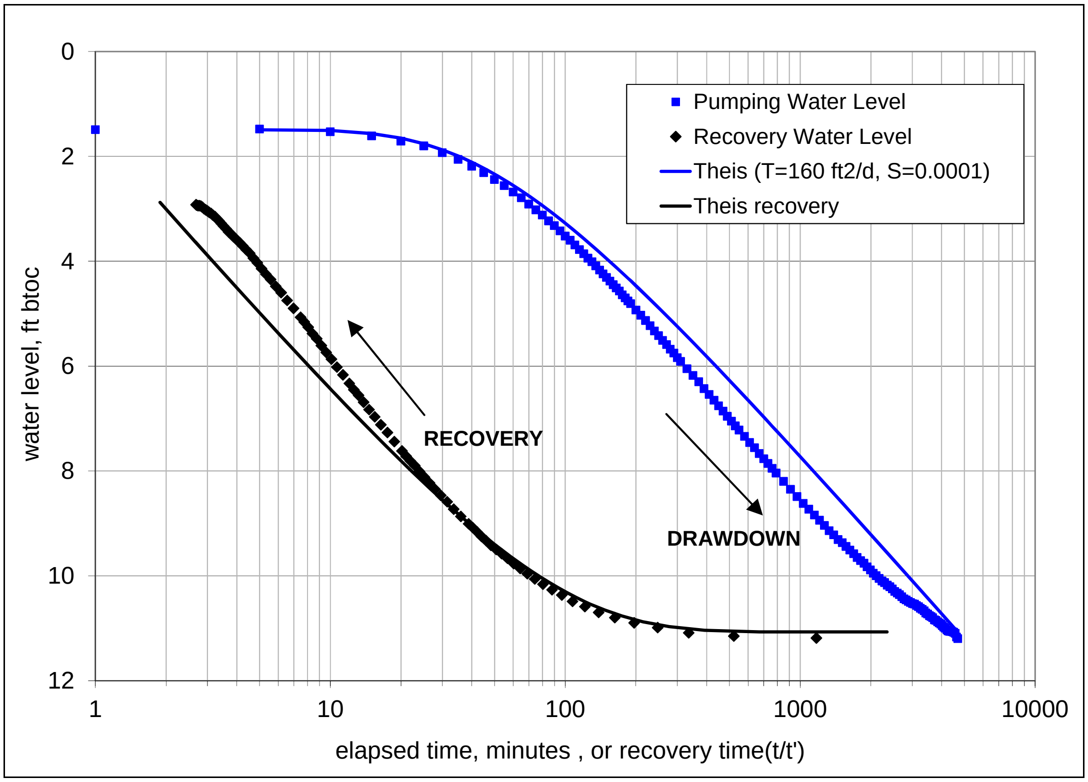


Figure 5.18. Drawdown and recovery in GWQ-14 during 1994 GWQ-17 pumping test.

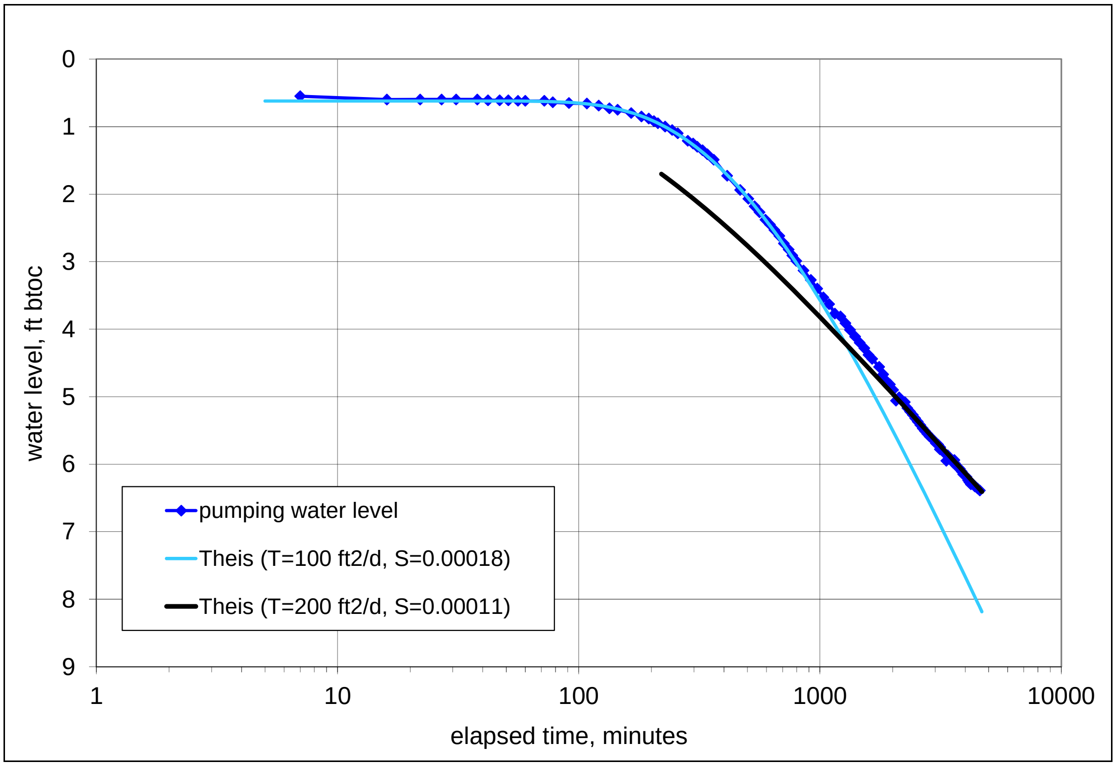


Figure 5.19. Drawdown in GWQ-15 during 1994 GWQ-17 pumping test.

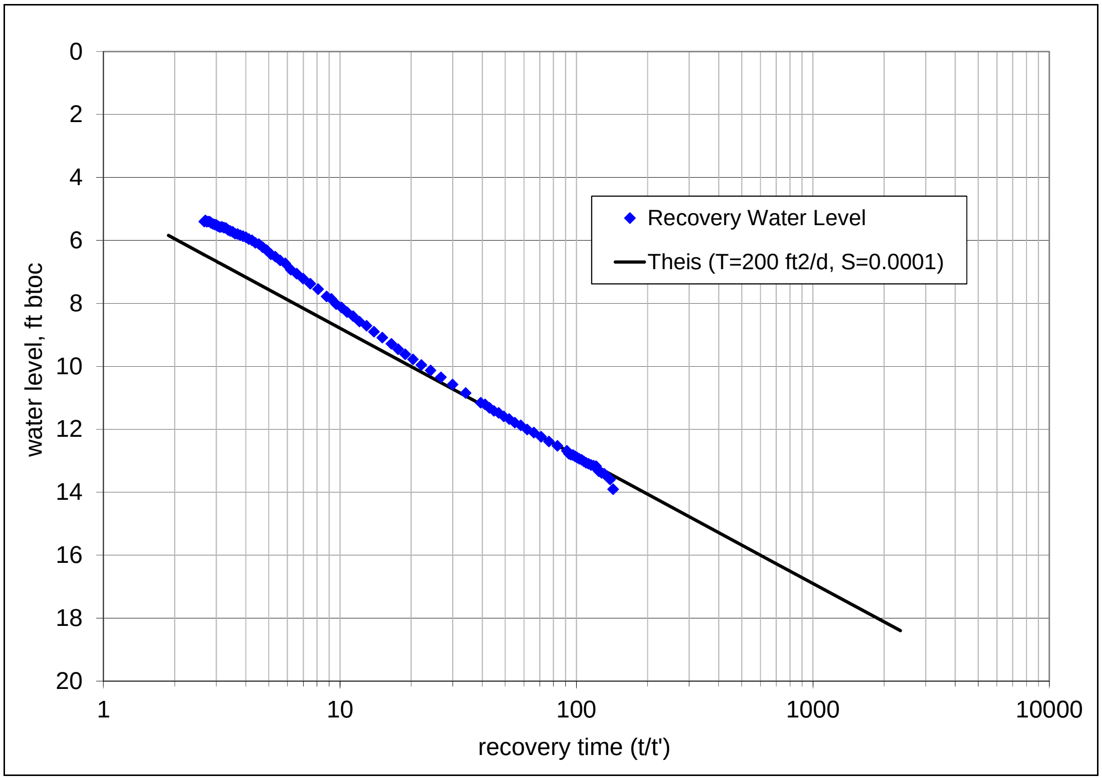


Figure 5.20. Recovery in GWQ-17 after 1994 pumping test.

5.4 Open Pit Area

The historical water level in the open pit has ranged between 5,435 and 5,450 ft amsl, corresponding to a water-surface area between 5 and 14 acres. Based on an evaporation rate of 64.6 in./yr (Table 2.1), annual open-pit evaporation has ranged from about 16 gpm to 45 gpm.

This discharge is supported by a combination of groundwater inflow, direct precipitation and runoff. Based on precipitation records it is estimated that the annual pit water balance (16 to 45 gpm of discharge by evaporation) is provided by 6 to 10 gpm of groundwater inflow and the rest (6 to 40 gpm) by precipitation and runoff.

The groundwater inflow component would increase with future pit expansion and dewatering. The post-mining open pit, larger and deeper than the existing pit, would have a larger groundwater inflow and larger evaporation.

Current pit water levels are below 5,440 ft amsl, with water balance in the low range of the estimate. The pit is a hydrologic sink, as shown on the contour map of the local piezometric surface, Figure 5.21.

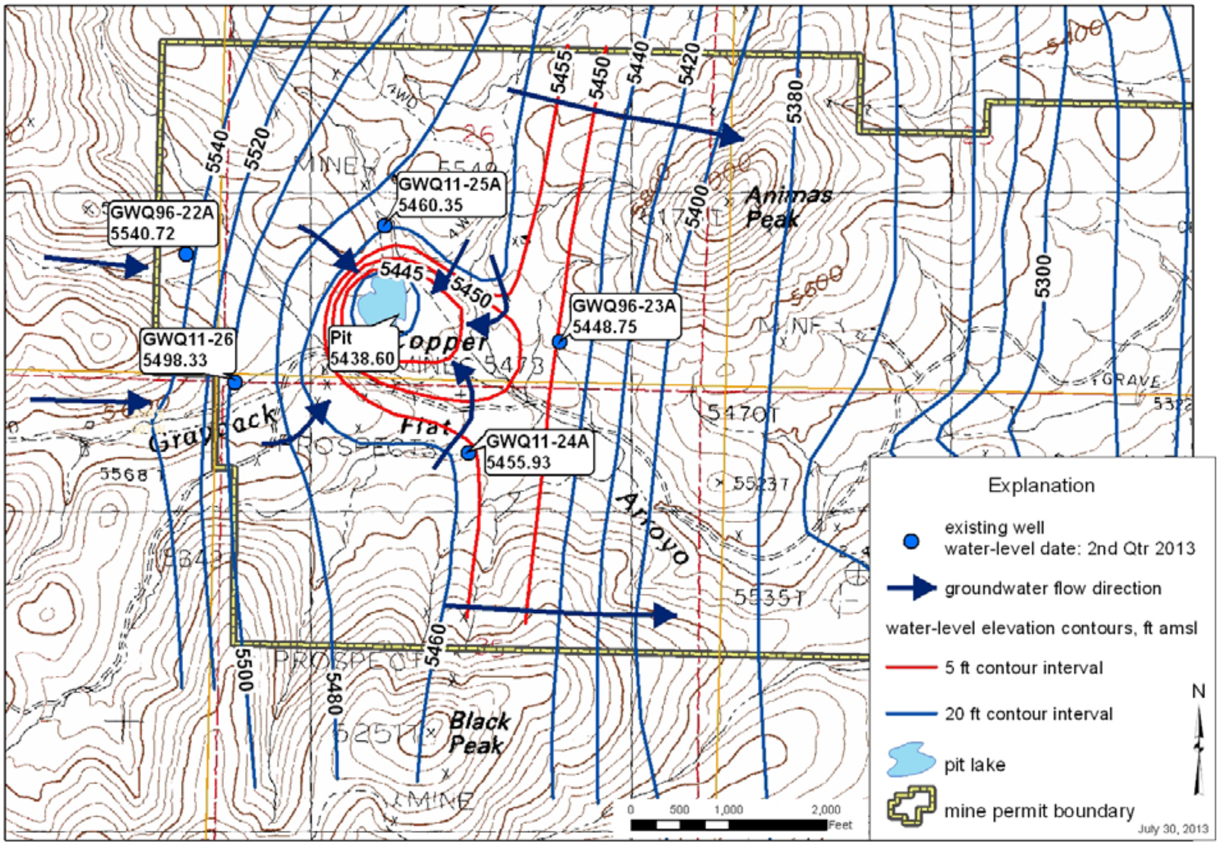


Figure 5.21. Measured pit-area groundwater levels.

5.4.1 Pit Area Pressure-Injection Tests, September 2011

Pressure-injection testing in the bedrock around the pit, in wells GWQ 5-R, GWQ 11-24, and GWQ 11-25 (Appendix C5), is summarized in Table 5.2. Apparent permeability of the bedrock ranges from near zero, to about 0.1 ft/day in the most fractured zones.

Table 5.2. Summary of pressure-injection test results

borehole and zone	depth interval (ft)	apparent permeability	
		(cm/sec)	(ft/day)
GWQ 5-R, Zone 1	64-100	~0	~0
GWQ 11-24, Zone 1	100-147	7×10^{-6}	0.02
GWQ 11-24, Zone 2	150-197	3.0×10^{-5}	0.085
GWQ 11-24, Zone 3	204-251	4.9×10^{-5}	0.14
GWQ 11-25, Zone 1	100-148	~0	~0
GWQ 11-25, Zone 2	150-198	2.9×10^{-5}	0.081
GWQ 11-25, Zone 3	207-251	2.6×10^{-5}	0.074

cm/sec - centimeters per second

5.5 Flowing Wells

The first artesian wells in the study area were drilled in the late 1930s. Most of the artesian wells were drilled prior to the New Mexico Office of the State Engineer (NMOSE) declaration of Las Animas Creek and Lower Rio Grande Underground Water Basins in 1968 and 1980, respectively.

Flow from selected artesian wells (Fig. 5.2) has been measured by Murray (1959), Davie and Spiegel (1967), JSAI (1995), and JSAI (2011c). A summary of aggregate measured artesian flow rates is presented in Table 5.3. Note that the "total artesian flow" estimates in Table 5.3 considered only a partial sample of flowing wells in the area; total artesian discharge for the study area is greater than the flows presented in Table 5.3.

Table 5.3. Summary of measured artesian flow rates

source	number of wells	year	total artesian flow (gpm)	comments
Murray (1959)	23	1946	460	included Percha, Las Animas Creek, and Oasis areas
Davie and Spiegel (1967)	29	1966	1,186	Las Animas Creek area only
JSAI (1995)	12	1995	1,319	survey limited to accessible wells with owner permission
JSAI (2011c)	21	2011	222	survey limited to accessible wells with owner permission

JSAI - John Shomaker & Associates, Inc.

gpm - gallons per minute

Construction details for the artesian wells are limited, but it appears a number of artesian wells were drilled without proper annular seals to prevent flow of water from the artesian zone into the overlying alluvium and stream channels. Furthermore, many of the artesian wells were never valved, and therefore left open to flow continuously at the land surface. Valves to regulate artesian flow, and metering, have been conditions to permits since the State Engineer declaration of the basin.

Over the last 50 years significant changes in flow rates have been observed in the few artesian wells that have time-series data. Measured artesian flow rates over time are presented in Figure 5.22, showing declines in flow rates from individual wells (except, apparently, from FW-7) along Percha and Las Animas Creeks.

There are many factors that affect artesian flow, including time of year, climatic conditions, and water level in Caballo Reservoir. Some wells may have been modified, repaired, or re-drilled. Upward leakage via artesian wells and open flow, however, appear to be mainly responsible for the long-term decline in artesian flow rates.

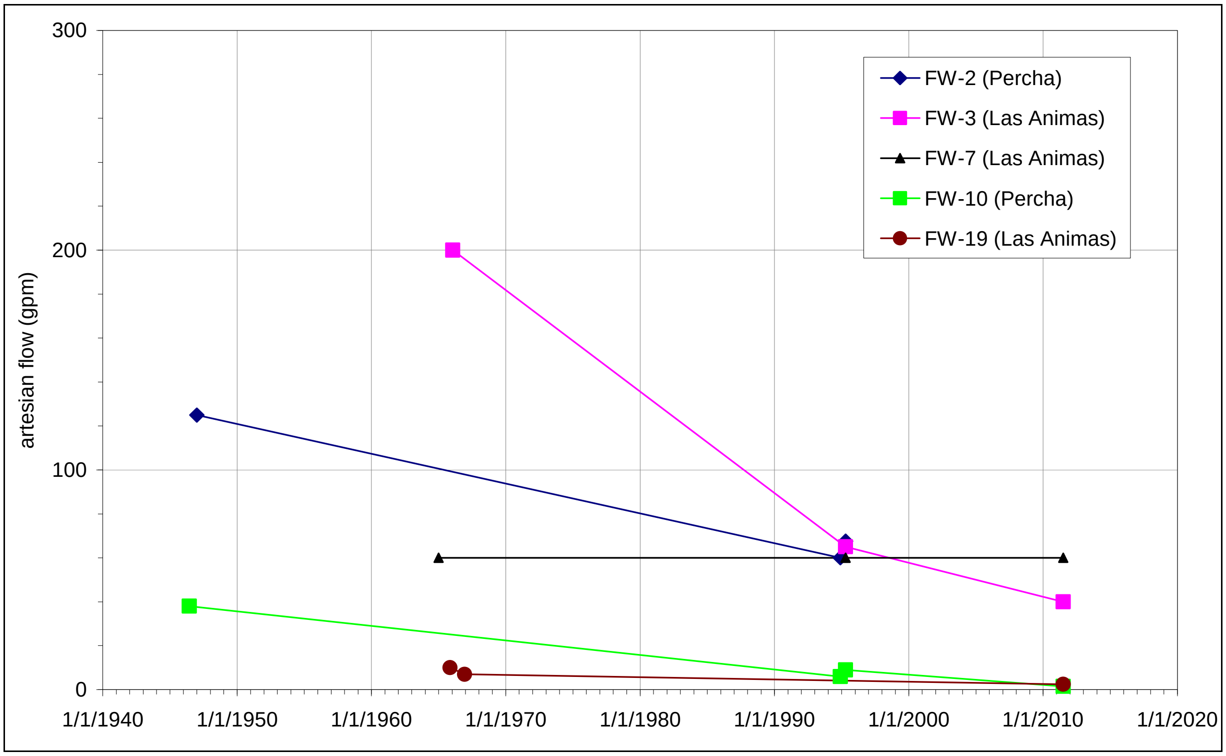


Figure 5.22. Measured artesian flow rates.

6.0 NUMERICAL MODEL

The computer program used for the hydrologic model is a version of the U.S. Geological Survey *Modular Three-Dimensional Finite Difference Ground-Water Flow Model, MODFLOW* (McDonald and Harbaugh, 1988). Modifications to the original computer program are documented in Appendix D.

Inputs to the model include (1) hydraulic parameters that control the flow of water within the model domain, and (2) boundary conditions that control the addition and removal of water to and from the model domain.

Several model simulations were developed representing different time periods and conditions:

1. **Steady-state**: Represents hypothetical pre-development steady conditions, used as starting condition for the pre-mining transient simulation.
2. **Pre-mining** (transient): Simulates the period 1940 to mid-1980, including the effect of flowing artesian wells on the system.
3. **Mining and post-mining**: Simulates the period from mid-1980 through November, 2012 including the brief period of mine operation in 1982 and the post-mining period.
4. **Aquifer test**: Simulates the period from the start of the 2012 well-field pumping test (late November, 2012), through year 2014.
5. **Future-mining scenarios**: Simulate the estimated water demand for selected scenarios. In addition, a no-mining scenario simulates continued background conditions. The effects of each mining scenario, including groundwater level drawdown and surface-discharge reduction, were evaluated by comparing results of each simulation to the equivalent results of the no-mining scenario.
6. **Future-post-mining scenarios**: Simulate the post-mining period for each future-mining (and no-mining) scenario, including continued surface-discharge effects and recovery of water levels in the SFG aquifer and in the open pit.

6.1 Model Discretization

The model grid, consisting of 87 rows, 109 columns, and 4 layers, is shown on Figure 6.1. Horizontal grid spacing ranges from 200 ft in the pit area, increasing to 1/4 mile (1,320 ft) away from the mine. Layer 1 is active only along lower Las Animas and Percha Creeks and near the axis of the Rio Grande, representing the shallow aquifer composed of alluvium and SFG sediments, with modeled thickness ranging from 100 to 200 ft. Layers 2 through 4 represent the SFG aquifer and different bedrock units, with modeled thicknesses ranging from 500 to 3,000 ft (Table 6.1).

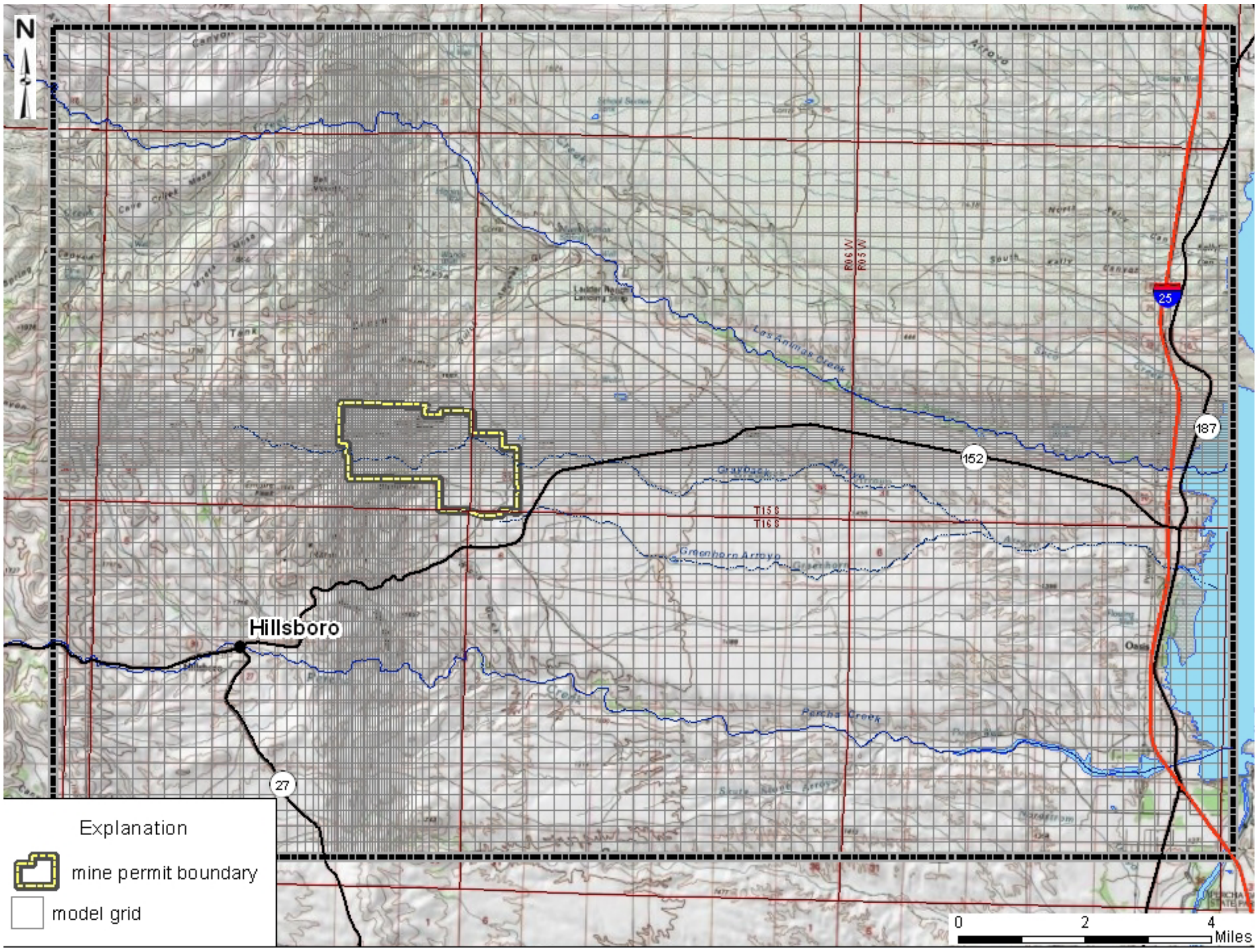


Figure 6.1. Model domain and grid.

6.2 Aquifer Parameters

Hydrogeologic units and fault barriers represented in each model layer are shown for layers 1 and 2 on Figures 6.2 and 6.3, and for layers 3 and 4 on Figures 6.4 and 6.5. Modeled aquifer parameters for each unit are shown on Table 6.1. Conductances of modeled fault barriers are shown on Table 6.2.

The layer 1 zones shown on Figure 6.2 include the shallow aquifer alluvium-SFG package along Las Animas Creek and a second, thicker zone along lower Animas, lower Percha and the Rio Grande Valley. Modeled aquifer parameters are shown on Table 6.1.

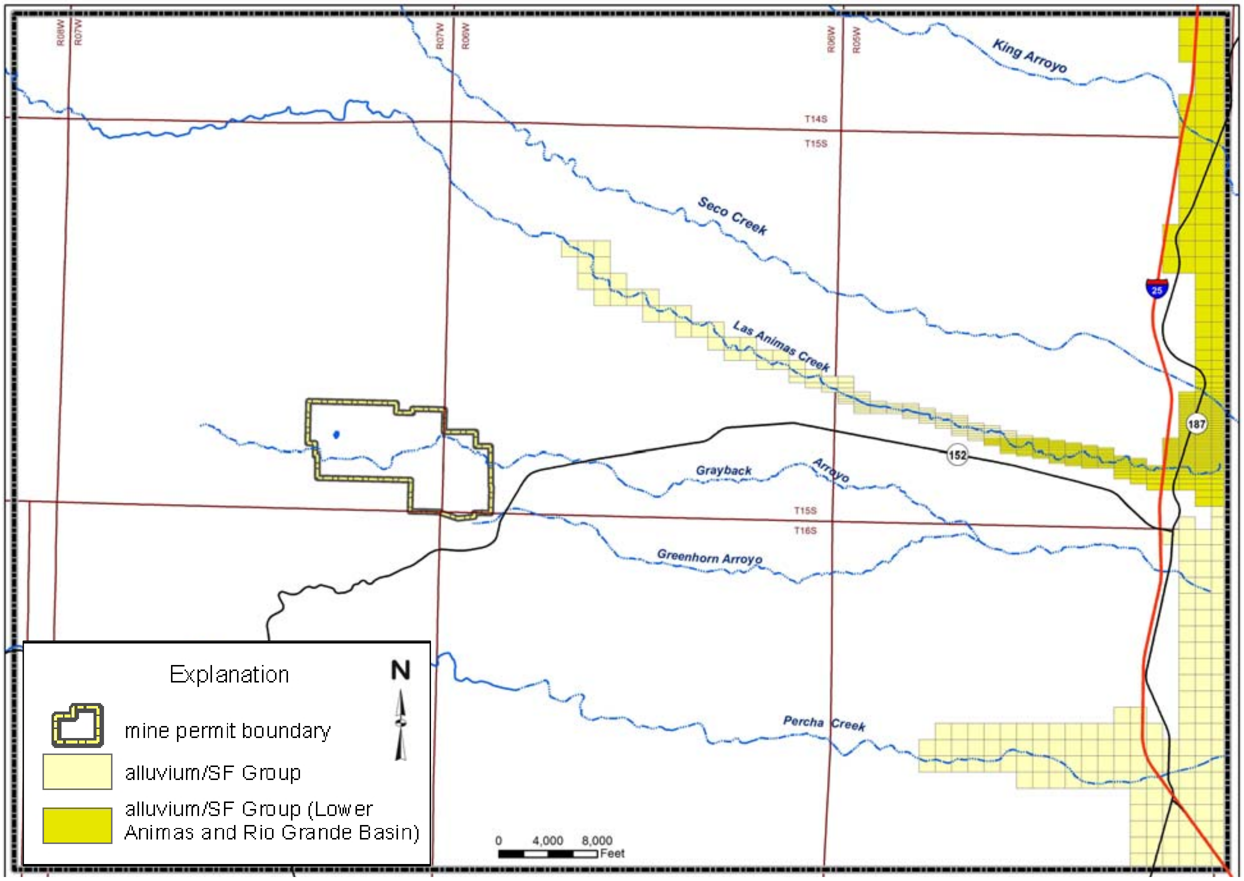


Figure 6.2. Layer 1 hydrogeologic zones

The modeled aquifer parameters (Table 6.1) include a high-transmissivity zone representing the Palomas Graben (Figs. 6.3, 6.4, and 6.5). The 2012 aquifer test results and subsequent model calibration further support the existence of the feature. Aquifer parameters of the graben (Table 6.1) and conductances of its bounding faults (Table 6.2) are based mainly on model calibration to the 2012 aquifer test results (Section 6.4.3 below).

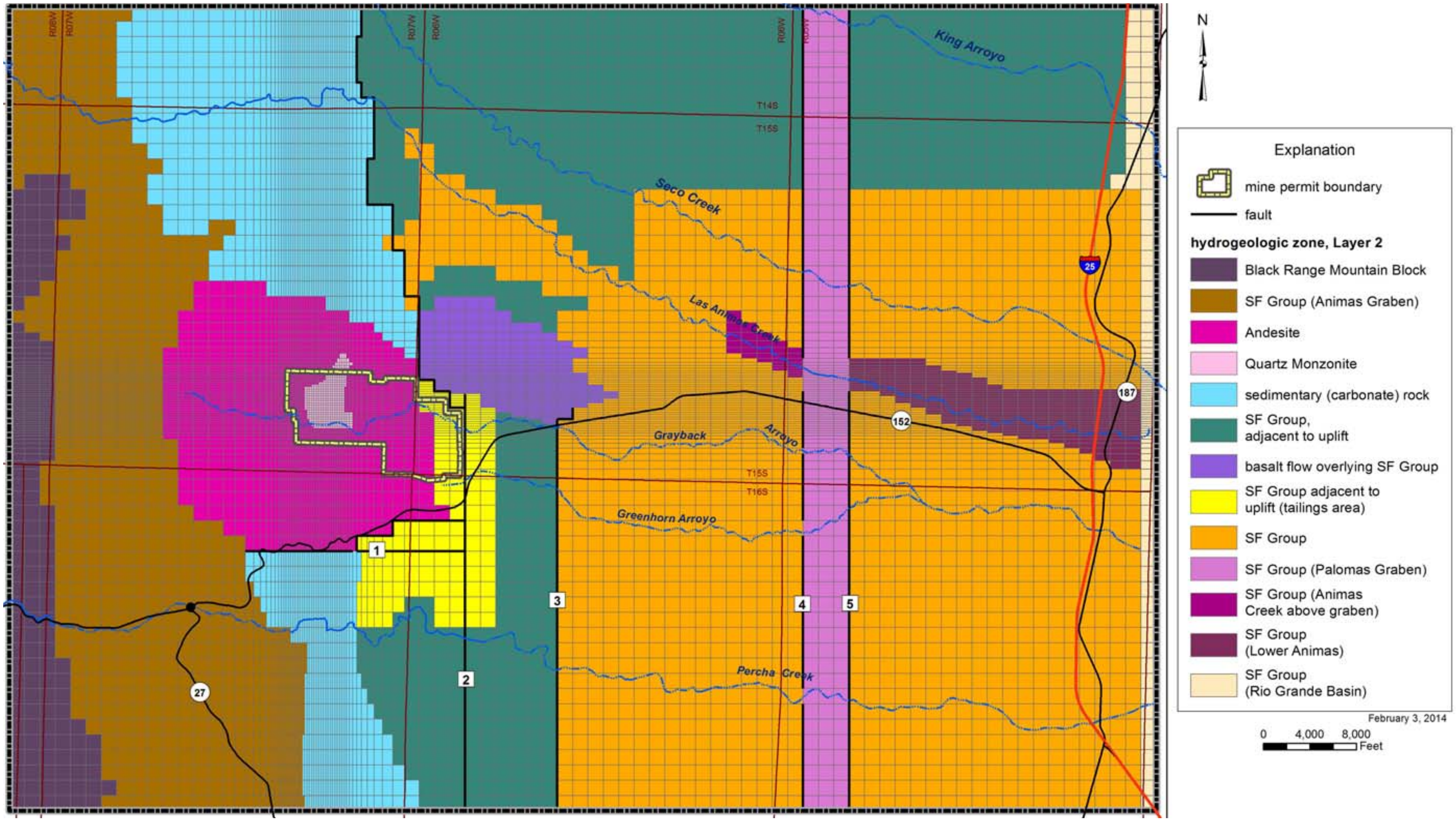


Figure 6.3. Layer 2 hydrogeologic zones.

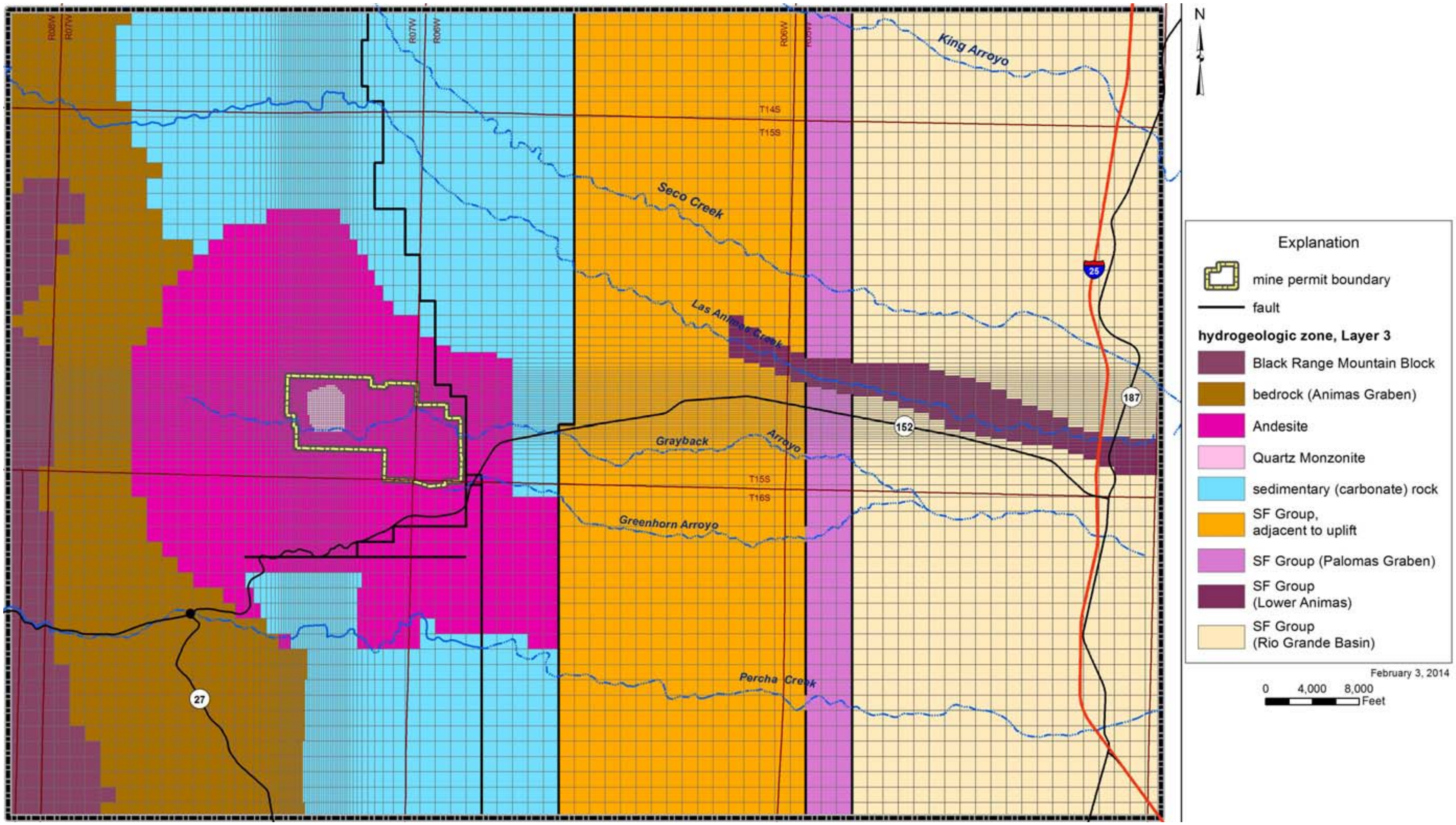


Figure 6.4. Layer 3 hydrogeologic zones.

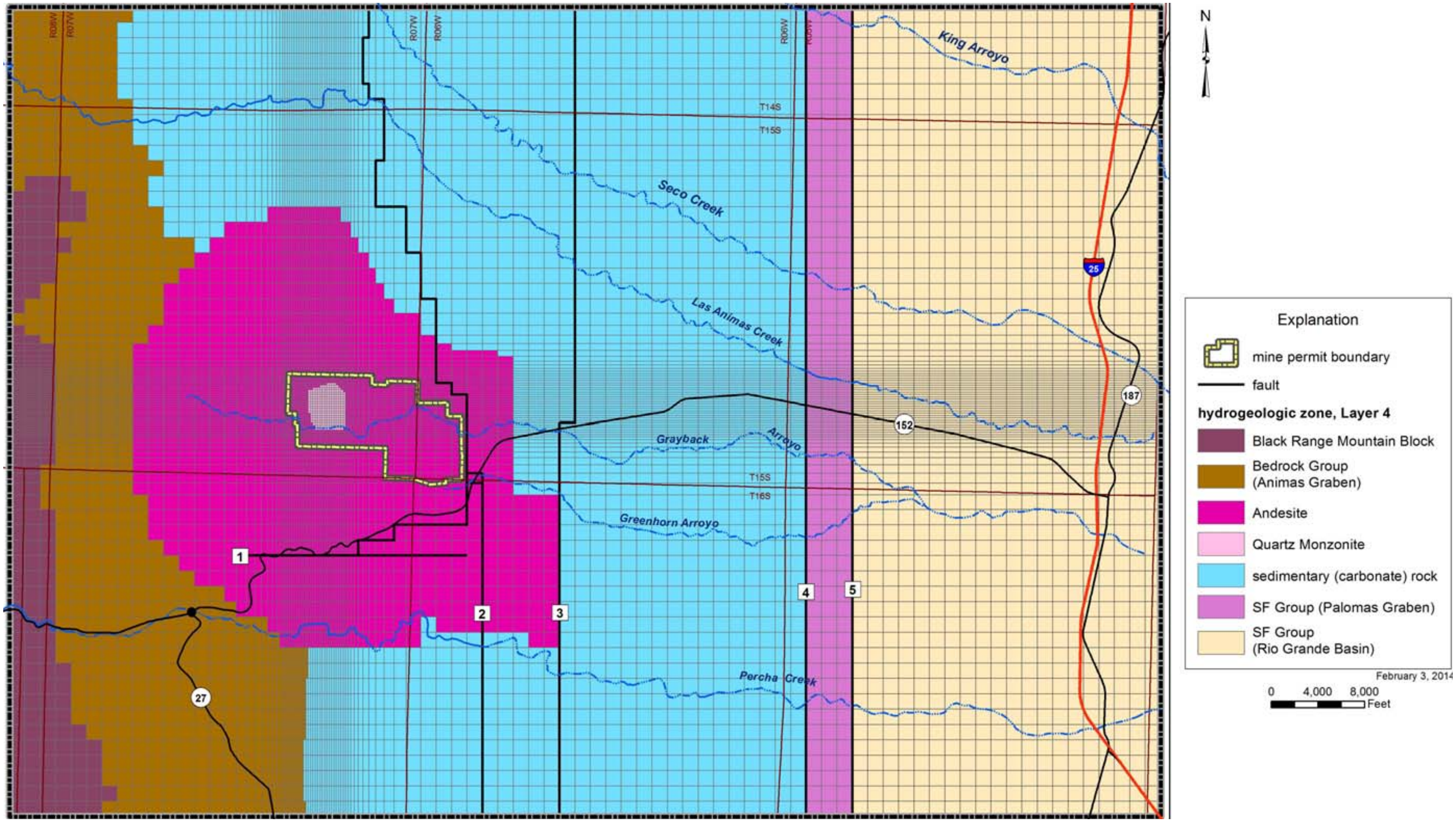


Figure 6.5. Layer 4 hydrogeologic zones.

The modeled aquifer parameters shown on Table 6.1 are based primarily on calibration of the model as a representation of the real system that is consistent with the different sources of information presented in Sections 3, 4 and 5 above. The model calibration results are presented below.

Different aquifer parameters are known with different degrees of certainty. Plausible ranges for different parameters, and the sensitivity of model results to variation of parameters within the plausible range, are discussed in Section 7 below.

Table 6.1. Modeled aquifer parameters

Hydrogeologic Unit	Transmissivity (ft^2/dy)	Saturated Thickness (ft)	Hydraulic Conductivity (ft/dy)	Vertical Anisotropy (ratio)	Specific Yield (%)	Storage Coefficient (%)
Layer 1						
Alluvium / SF Group	2,400	50	48.0	1.25E-04	10%	
Alluvium / SF Group (Lower Animas and Rio Grande Basin)	10,000	200	50.0	1.60E-04	10%	
Layer 2						
Black Range Mountain Block	2	1,000	0.002	0.01	0.1%	0.1%
SF Group (Animas Graben)	500	500	1.000	0.01	10%	10%
Andesite	2	1,000	0.002	0.01	0.1%	0.1%
Quartz Monzonite	2	1,000	0.002	0.01	0.1%	0.1%
Sedimentary (carbonate) rock	80	1,000	0.080	0.01	0.5%	0.5%
SF Group adjacent to uplift, edge of basin	200	1,000	0.200	1.0	5%	5%
SF Group adjacent to uplift (Upper Animas)	40	200	0.200	0.01	5%	5%
Basalt flow overlying SF Group	0.2	200	0.001	0.01	1%	1%
SF Group	900	1,000	0.900	0.01	10%	0.1%
SF Group (Palomas Graben)	1000	1000	10.000	1.0	10%	0.2%
SF Group (Animas Creek above graben)	2000	200	10.000	0.0001	10%	0.1%
SF Group (Lower Animas)	20000	1,000	20.000	0.01	10%	0.1%
SF Group (Rio Grande Basin)	20000	1000	20.000	1.0	10%	0.1%
Layer 3						
Black Range Mountain Block	2	2,000	0.001	0.01		0.01%
Bedrock (Graben)	700	1,000	0.700	0.01		0.01%
Andesite	2	2,000	0.001	0.01		0.01%
Quartz Monzonite	2	2,000	0.001	0.01		0.01%
Sedimentary (carbonate) rock	100	2,000	0.050	0.01		0.01%
SF Group, adjacent to uplift	400	2,000	0.200	0.01		0.4%
SF Group (Palomas Graben))	8,000	2,000	4.000	1.0		0.4%
SF Group, lower Animas	10,000	1,000	10.000	0.01		0.1%
SF Group (Rio Grande Basin)	800	2,000	0.400	0.01		0.4%
Layer 4						
Black Range Mountain Block	3	3,000	0.001	0.01		0.01%
Bedrock (Graben)	100	2,000	0.050	0.01		0.01%
Andesite	3	3,000	0.001	0.01		0.01%
Quartz Monzonite	3	3,000	0.001	0.01		0.01%
Sedimentary (carbonate) rock	150	3,000	0.050	0.01		0.01%
SF Group (Palomas Graben)	2,000	3,000	0.667	0.01		1%
SF Group (Rio Grande Basin)	2,000	3,000	0.667	0.01		0.6%

The modeled fault barriers are based on geologic interpretation and on model calibration. The barriers mainly represent a series of parallel north-south trending faults (Hawley, personal communication, 2012). The barriers shown on Figures 6.3 through 6.5 are simulated with conductance (transmissivity / fault thickness) shown on Table 6.2. The fault barriers include (Fig. 6.3):

1. A fault along the south side of the andesite cone, separating andesite from carbonate rock (Animas volcano fault system).
2. The mountain front fault (East Animas fault trend), generally following the bedrock / SFG contact, but running east of an embayment of SFG in the area of the 1982 tailings impoundment.
3. A parallel fault, east of the mountain front (Saladone Tank fault trend).
4. The west boundary of the Palomas Graben (West Palomas Graben Fault trend).
5. The east boundary of the Palomas Graben (East Palomas Graben Fault trend).

Conductance of the fault south of the andesite was based on the rapid change of water levels from the andesite to Percha Creek. Conductance of the mountain-front fault was based in part on the sustained elevated water levels in the vicinity of the tailings impoundment. The Saladone tank fault trend conductance was based on regional water-level gradient.

The Palomas graben-bounding fault conductances were based mainly on results of the 2012 aquifer test (Section 6.4.3 below). The west graben-bounding fault is simulated as a strong barrier to flow using a small conductance. The east graben-bounding fault is simulated as a weak barrier to flow using a large conductance; resistance to flow across the east edge of the graben is accomplished mostly by the simulated permeability contrast.

Table 6.2. Modeled fault barrier conductance

	fault	section	layer 2 conductance (ft/day)	layers 3-4 conductance (ft/day)
1.	andesite south boundary		1.0E-04	2.0E-05
2.	mountain-front fault	north	8.0E-02	1.2E-01
		mountain front center: andesite, TSF embayment	5.0E-03	1.0E-10
		south	5.0E-08	2.0E-07
3.	Saladone Tank trend		1.0E-03	1.0E-03
4.	Palomas Graben west		1.0E-08	1.0E-08
5.	Palomas Graben east		1.0E+00	1.0E+00

6.3 Boundary Conditions

Model boundary conditions fall under the categories of (1) natural boundary conditions including direct recharge, stream-channel runoff and infiltration, base flow discharge, evapotranspiration and groundwater discharge to the Rio Grande Basin, and (2) anthropogenic boundary conditions including flowing wells, mine water-supply wells, the current and future open pits, and infiltration from the 1982 tailings impoundment.

Anthropogenic boundary conditions in the shallow systems along Animas Creek and Percha Creek are for purposes of the model considered natural boundary conditions. The different discharges from the shallow systems, including natural ET, crop ET supplied by wells or surface diversions, pumping from wells for stock or domestic use, and discharge from flowing wells, are difficult to distinguish.

The natural boundary conditions are applied to all model simulations: steady-state, historical pre-mining, historical mining and post-mining, aquifer test, future mining, and future post-mining.

The anthropogenic boundary conditions are applied to the historical pre-mining (flowing wells only) and historical mining and post-mining (flowing wells, mine water-supply wells, open pit and tailings infiltration) simulations as described below.

Different anthropogenic boundary conditions (future water-supply pumping, future open pit) apply to the future mining and future post-mining simulations, which are reported separately.

6.3.1 Natural Boundary Conditions

Natural boundary conditions represented in the model are shown on Figure 6.6 and include the following:

- Direct recharge of precipitation to groundwater is represented as a specified-flow boundary condition, using MODFLOW module RCH. Direct recharge rates are shown on Figure 6.6.

- Stream-channel runoff, infiltration of stream flow to groundwater, and discharge of groundwater to stream channels, are represented using module RIV2. In addition to simulation of Las Animas Creek, Percha Creek, and Grayback and Greenhorn Arroyos, model calibration required consideration of runoff in Seco Creek and King Arroyo to the north of the main study area watersheds.

- ET from riparian zones along Animas and Percha Creeks is represented using module EVT. (Irrigated ET, taken from surface water or shallow wells, is simulated as part of the shallow system using the head-dependent discharge (RIV2) boundary conditions along the stream channels.)

- Groundwater discharge to the Rio Grande Basin and Caballo Reservoir is simulated with head-dependent boundary conditions using module GHB.
- Groundwater flow in the Palomas Graben, into the model domain at the north end and out at the south end, is simulated with head-dependent boundary conditions using module GHB.

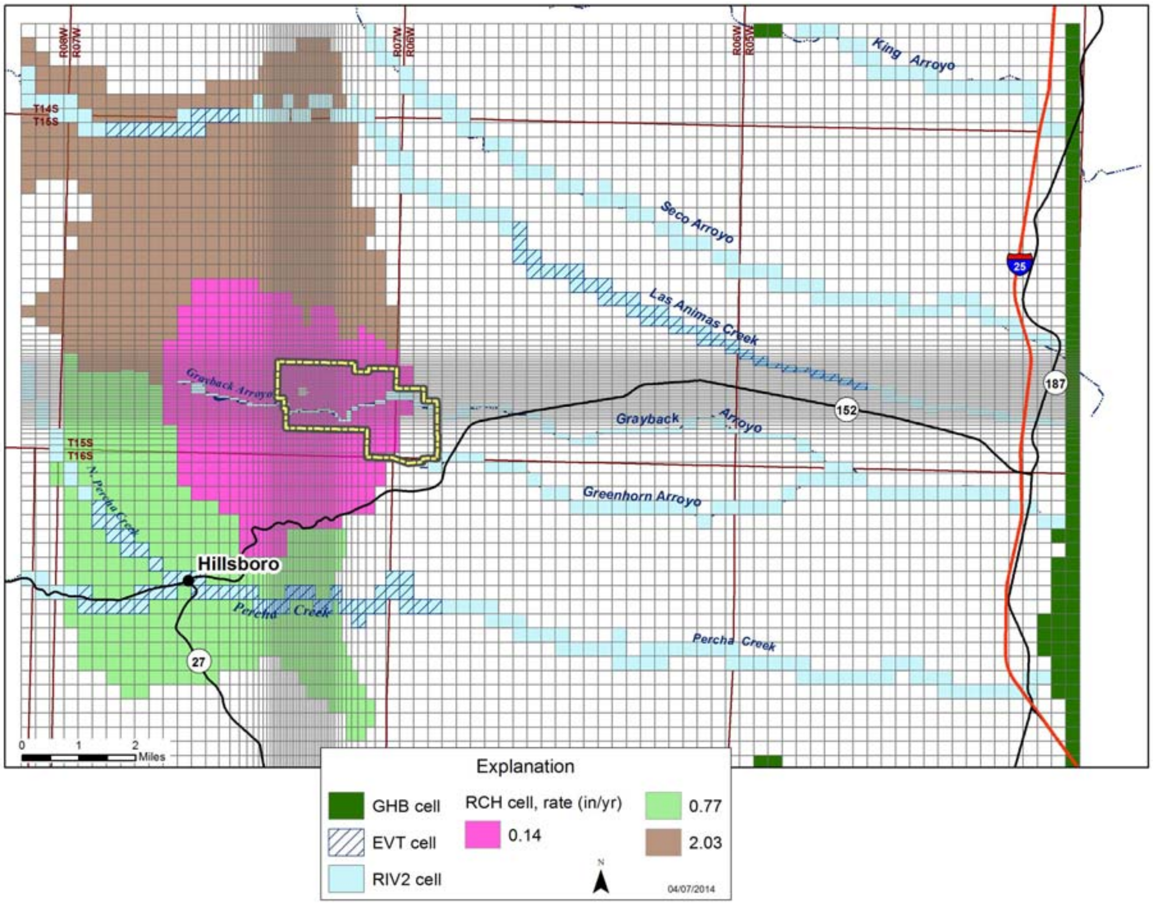


Figure 6.6. Natural boundary conditions.

RIV2 cells are grouped into reaches to define the stream network; each reach defines a length of stream, with a defined downstream reach, and total flow is tracked downstream. Infiltration to groundwater from RIV2 cells is limited to the simulated stream flow. Base flow discharge from groundwater to RIV2 cells is added to the total flow available for infiltration downstream.

Runoff is added at the upstream end of each reach. For each cell within a reach, infiltration to groundwater or discharge from groundwater is computed, and the resulting total flow, if any, is passed to the next cell downstream.

Flow between RIV2 cells and the corresponding aquifer model cell is computed based on RIV2 cell conductance, multiplied by either (1) the stream stage-aquifer head difference (aquifer in contact with stream bed) or (2) the stream stage-streambed bottom difference (aquifer below stream bed). Infiltration to the aquifer is further limited to the amount of simulated flow available in the stream.

The model reproduces the observed pattern of stream flow in the region; runoff is generated in the mountain watersheds, flows downstream until it crosses the mountain front, where it recharges the Santa Fe Group aquifer. Farther below the mountain front, streams flow only after storm events. Still further downstream, near the bottom of the basin, the streams emerge again as groundwater enters the channels as base flow.

The stream reaches defined are listed on Table 6.3, along with simulated annual runoff to each reach. RIV2 cell parameters include elevation and conductance. Conductance is computed from the length of stream in each cell and from hydraulic conductivity and thickness of the underlying material. Modeled RIV2 cell hydraulic conductivities are listed by reach and material, in downstream order, on Table 6.3. Elevation for RIV2 cells was determined from USGS topographic maps. Thickness of streambed was assumed at 1 ft.

EVT cell parameters include ET surface elevation, annual average potential ET rate of 64.6 in./yr and extinction depth of 15 ft. ET from each EVT cell is computed as the potential ET rate whenever water level is at or above the ET surface elevation (depth-to-water of zero), decreasing linearly to zero at the extinction depth. ET is zero for water levels below the extinction depth.

GHB cells simulate groundwater flow from the model area to the Rio Grande basin. GHB cell parameters include elevation, specified at 4,200 ft amsl, and conductance, calibrated at 100 ft^2/day in the north part (rows 1-60), 10,000 ft^2/day along the axis of Las Animas Creek (rows 61-73), and 1,000 ft^2/day in the south part, adjacent to Caballo Reservoir. Flow is computed as the product of GHB conductance and the difference between GHB elevation and aquifer head in the model cell.

Table 6.3. Stream reach specifications

reach No.	name	downstream reach	runoff (ac-ft/yr)	streambed hydraulic conductivity (ft/day)	underlying material
1	Upper Percha	2	5,249	0.001 1	bedrock SFG (graben)
2	Lower Percha	none	0	0.001 1 0.1 10 20	bedrock SFG (graben) carbonate bedrock (uplift) SFG alluvium
3	Las Animas	none	7,898	1 0.1 1 24	SFG (graben) carbonate bedrock (uplift) SFG alluvium
4	Grayback	6	74	0.001 1	bedrock SFG
5	Upper Greenhorn	6	66	1	SFG
6	Lower Greenhorn	none	0	10	alluvium
7	Seco Creek	none	18	0.15 0.8 20	SFG SFG (Las Animas Creek) alluvium
8	King Arroyo	none	0	0.15 20	SFG alluvium

ac-ft/yr - acre-feet per year
SFG - Santa Fe Group

6.3.2 Anthropogenic Boundary Conditions

Anthropogenic boundary conditions represented in the model include discharge from artesian wells, pumping from mine water supply wells, infiltration beneath the 1982 (historical) tailings impoundment, and the open pit. Locations of model-simulated anthropogenic boundary conditions are shown on Figure 6.7.

Flow from artesian wells was simulated as drain (head-dependent, outflow only) boundary conditions with MODFLOW module DRN. Flow from each DRN cell is computed as the product of DRN conductance (assumed at 1,000 ft^2/day, or 5.2 gpm/ft of head above the discharge elevation) and aquifer cell head minus DRN elevation. Flow is zero when aquifer cell head is below DRN elevation.

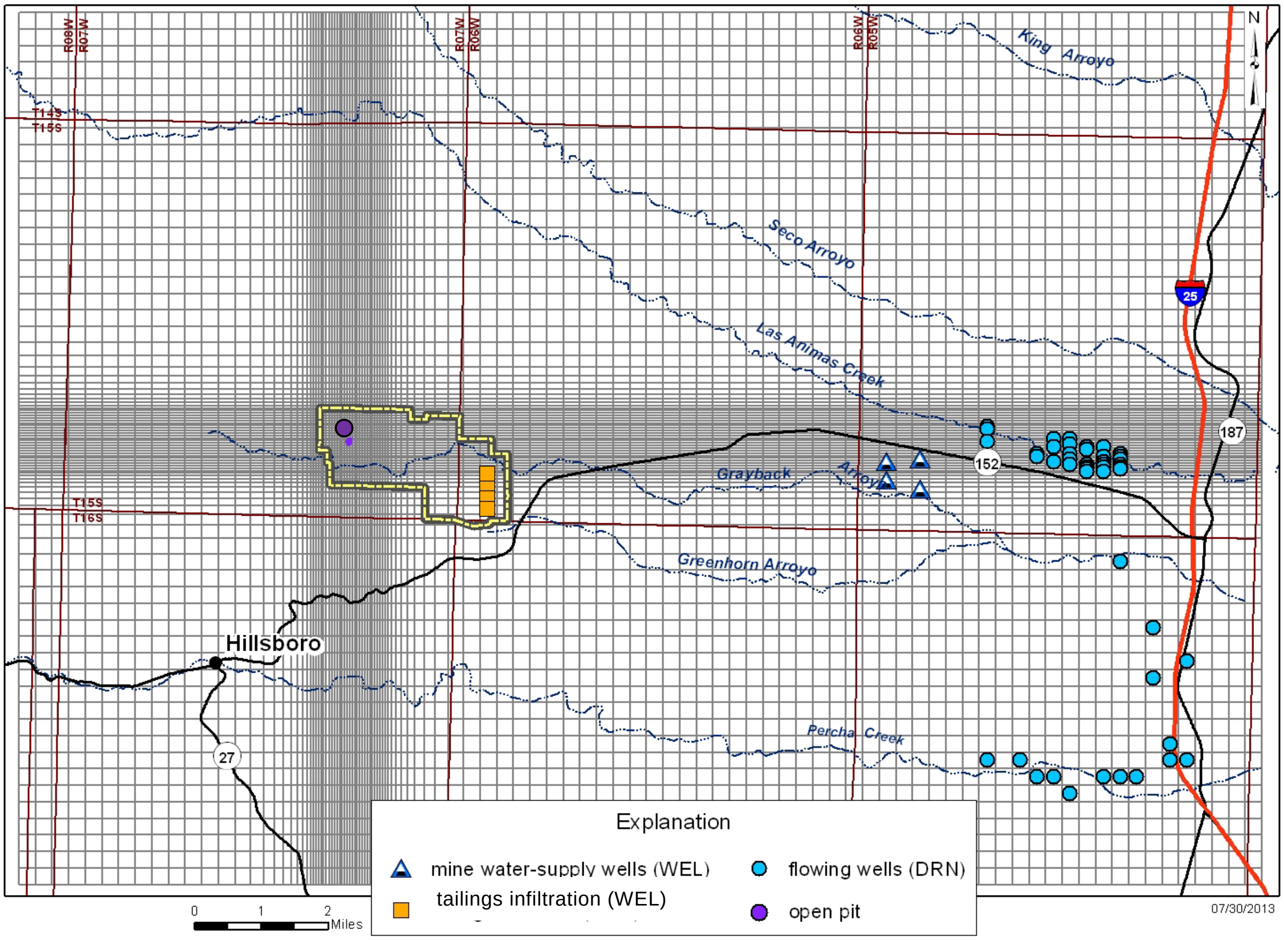


Figure 6.7. Anthropogenic boundary conditions.

Historical pumping from mine water supply wells was simulated as specified-flow boundary conditions with MODFLOW module WEL. Pumping rates were specified from Table 5.1. Pumping during the 2012 aquifer test was simulated using module LAK2, in order to simulate in-bore water levels in the pumping wells.

Infiltration from the historical tailings impoundment was also simulated as specified-flow boundary conditions using WEL. Infiltration rates were estimated based on model calibration, constrained by an upper limit based on the amount of water actually added to the impoundment (Fig. 6.8).

Water level and water balance of the open pit were simulated using MODFLOW module LAK2. The geometry of the existing pit is represented in the historical post-mining simulation, as shown by the actual and simulated pit water stage – area curves presented on Figure 6.9 (Note that Figure 6.9 does not represent model calibration; it simply verifies the accurate simulation of the current pit geometry.).

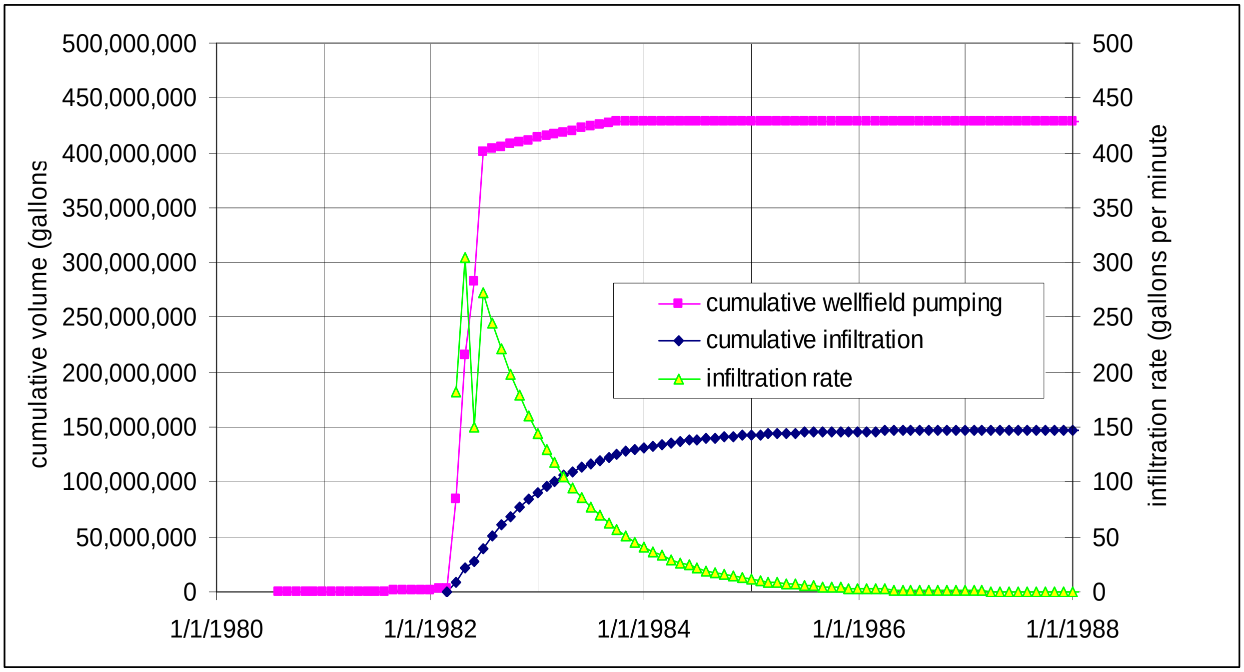


Figure 6.8. Modeled historical tailings infiltration.

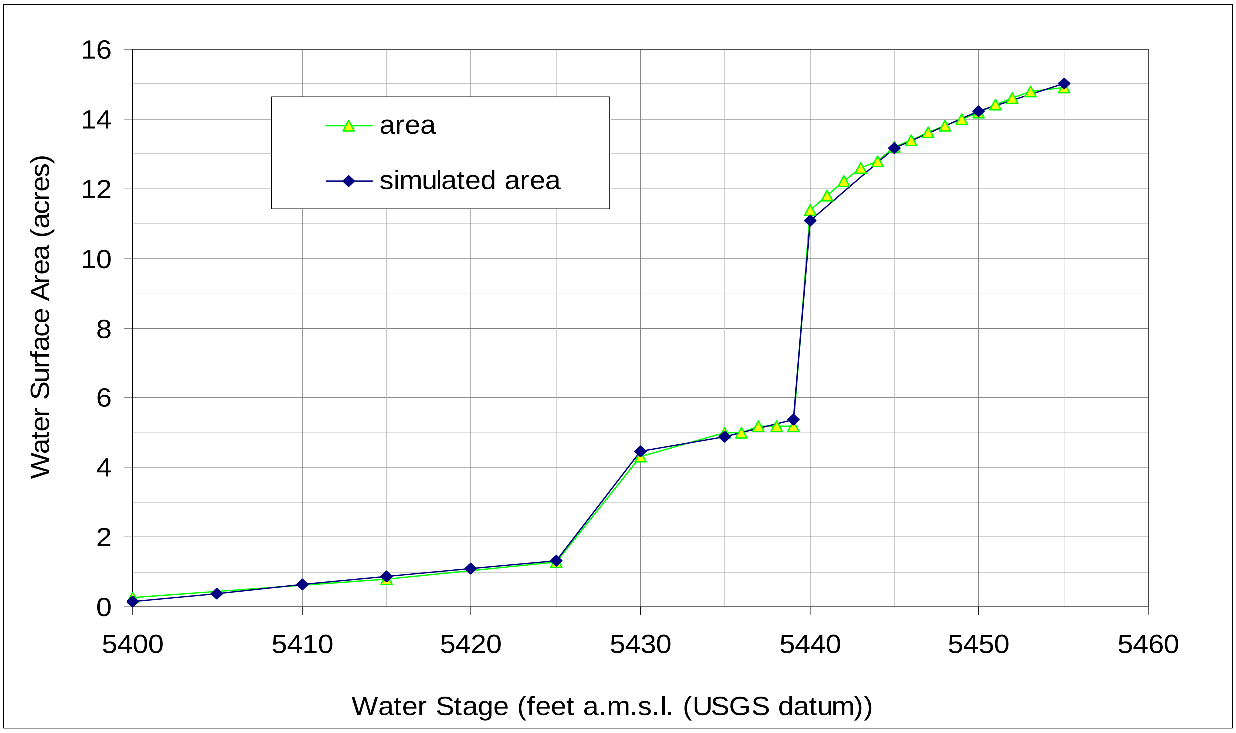


Figure 6.9. Existing open pit water elevation - water surface area relationship.

Hydrologic parameters for the open pit, including monthly average precipitation and evaporation rates, and runoff coefficients for the pit walls and for the 230-acre pit watershed, are listed on Table 6.4.

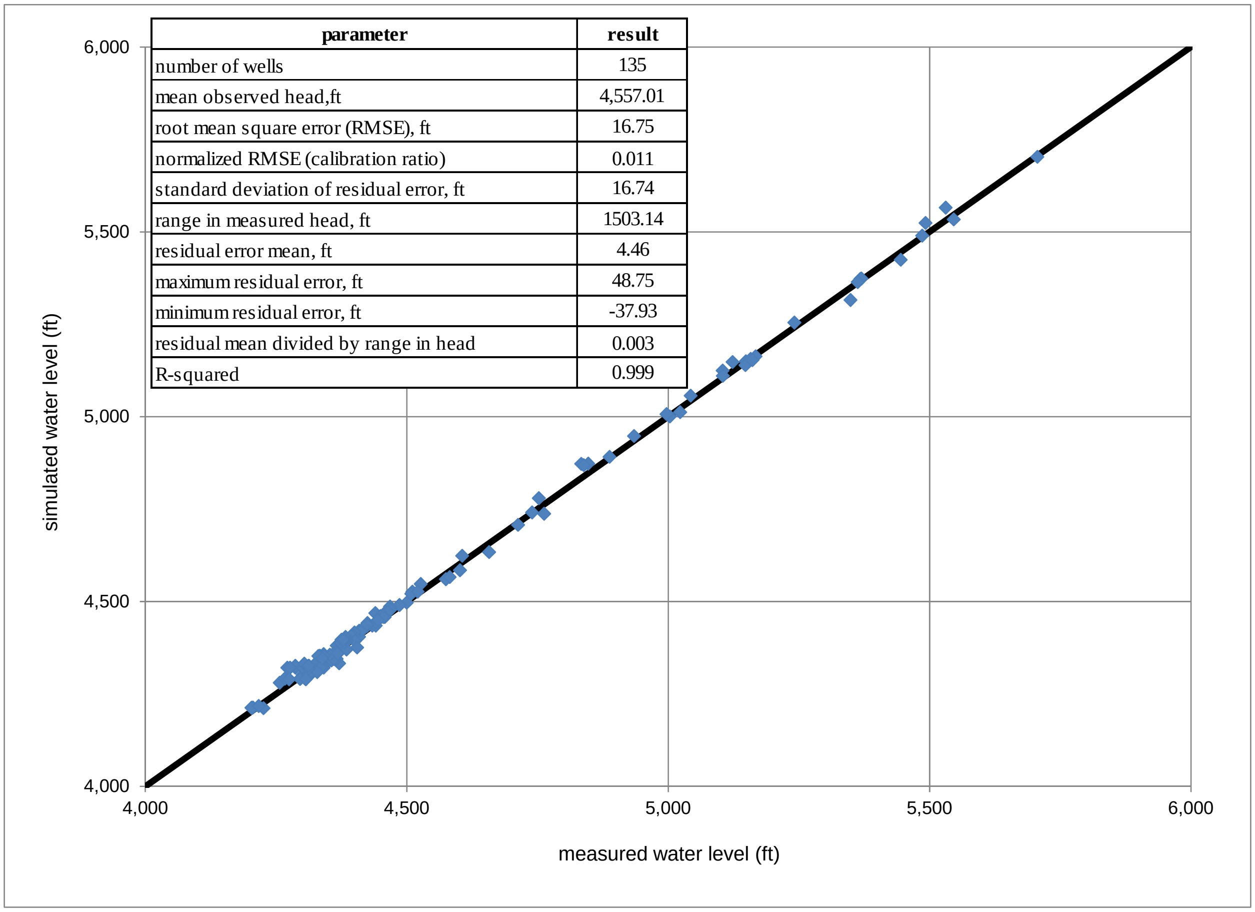
Table 6.4. Simulated open-pit hydrologic parameters

meteorological parameters		
month	**average precipitation (inches)**	**average evaporation (inches)**
Jan	0.6	3.2
Feb	0.6	4.2
Mar	0.4	6.4
Apr	0.3	7.1
May	0.5	8.4
Jun	0.7	10.7
Jul	2.3	7.8
Aug	2.5	4.5
Sep	2.1	4.6
Oct	1.2	3.0
Nov	0.6	2.8
Dec	0.8	2.1
total	12.5	64.6
runoff coefficients		**(percent of precipitation)**
pit wall		0.30
watershed		0.05

6.4 Model Results and Calibration

6.4.1 Steady-State Simulation

Estimated and simulated steady-state water levels are compared on Figure 6.10. The simulated steady-state basin water balance is shown on Table 6.5. Contours of the simulated steady-state water table are shown on Figure 6.11.



parameter	result
number of wells	135
mean observed head,ft	4,557.01
root mean square error (RMSE), ft	16.75
normalized RMSE (calibration ratio)	0.011
standard deviation of residual error, ft	16.74
range in measured head, ft	1503.14
residual error mean, ft	4.46
maximum residual error, ft	48.75
minimum residual error, ft	-37.93
residual mean divided by range in head	0.003
R-squared	0.999

Figure 6.10. Comparison of measured and simulated water levels.

Table 6.5. Simulated steady-state water balance

	watershed				**TOTAL**
	Animas	**Percha**	**Grayback / Greenhorn**	**Seco / King**	
direct recharge	2,811	825	61	0	3,697
runoff	8,720	7,052	140	18	15,931
groundwater inflow	0	0	0	1,827	1,827
TOTAL IN (ac-ft/yr)					**21,455**
Riparian ET (Palomas Basin)	1052	0	0	0	1052
Riparian ET (Animas Uplift, Animas Graben)	617	1,730	0	0	2347
Crop ET, domestic, etc.	4193	1074	0	0	5267
groundwater discharge	3589	3339	2487	3374	12789
TOTAL OUT (ac-ft/yr)					**21,455**

ac-ft/yr - acre-feet per year

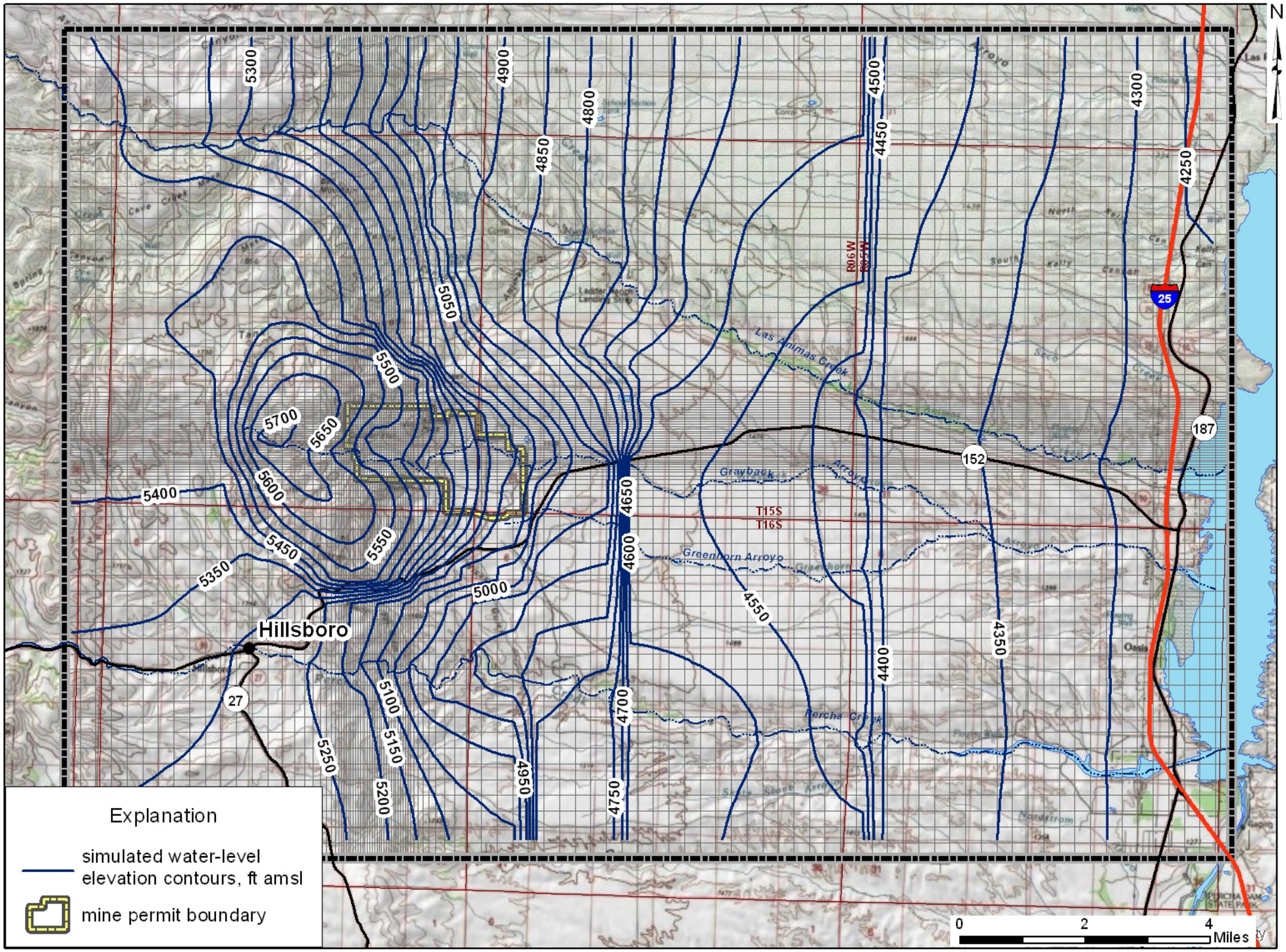


Figure 6.11. Contours of simulated 2012 groundwater levels.

6.4.2 Historical Transient Simulation

The historical transient simulations include the pre-mining (1940 to June 1980), and mining and post-mining (June 1980 to November 2012) simulations. Measured and simulated water-level hydrographs are compared for calibration well locations shown on Figure 6.12. Measured and simulated water levels are presented on Figures 6.13 through 6.27.

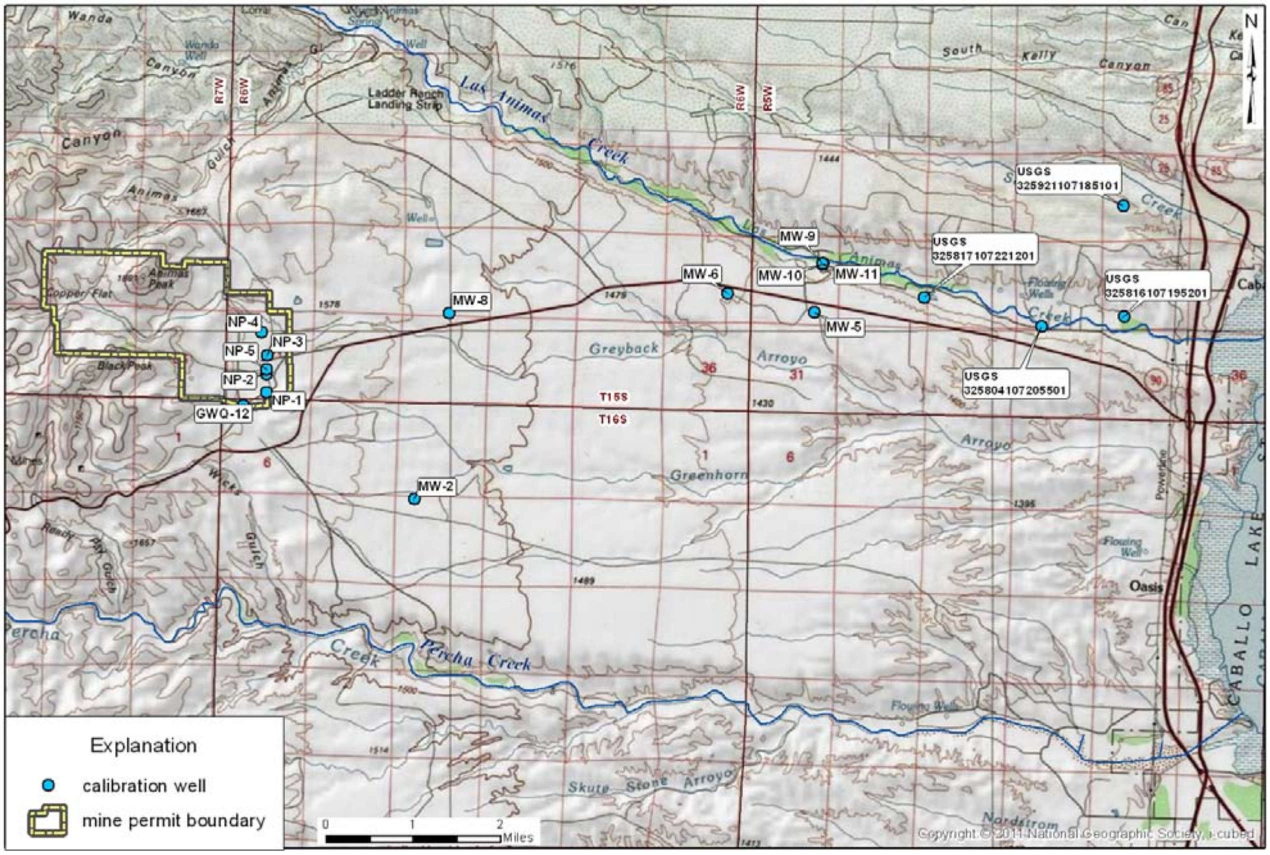


Figure 6.12. Locations of measured water-level hydrographs.

Measured and simulated water levels near the well field, at MW-5, are presented on Figure 6.13, showing drawdown and recovery in response to the period of well field operation in 1982. Measured and simulated water-level changes are in agreement. The small difference (~10 ft) between measured and simulated water-level elevations is appropriate, considering the range of water levels represented by a single model cell, and the fact that the well is not at the cell center.

Measured and simulated water levels west of the well field, at MW-6, are shown on Figure 6.14. The 35-year, 175-ft rise in the measured MW-6 water level (discussed in Section 5.2.2 above) is not simulated in the model.

Measured and simulated water levels north of the well field along Las Animas Creek, at MW-9, -10 and -11, are shown on Figure 6.15. The measured water levels include data from the mid-1990s as well as data from 2012. The vertical gradient measured between the shallow well (MW-11) and the deeper wells (MW-10 and -9) is reproduced in the model.

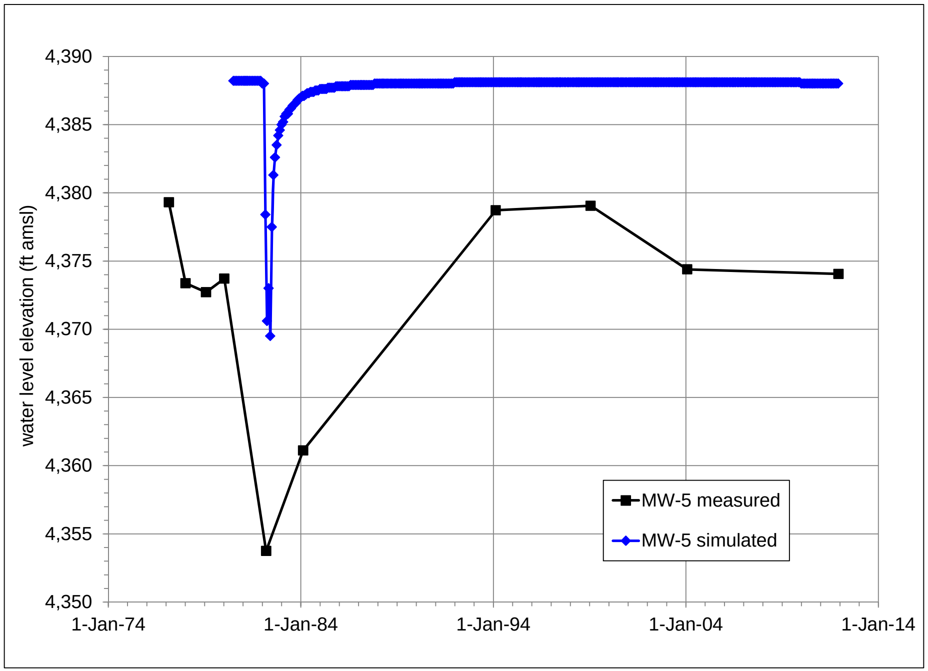


Figure 6.13. Measured and simulated water-level hydrographs in MW-5.

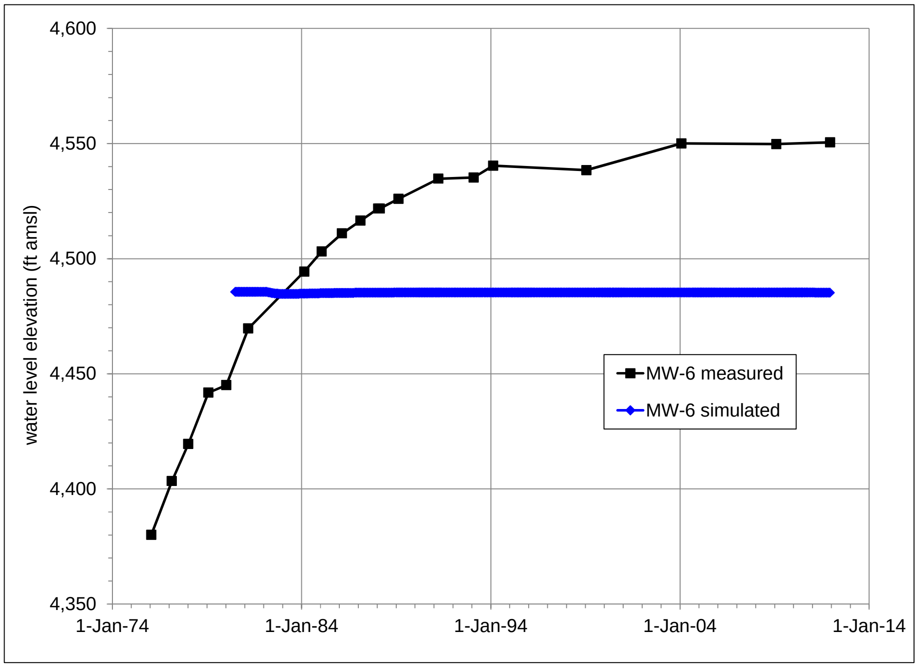


Figure 6.14. Measured and simulated water-level hydrographs in MW-6.

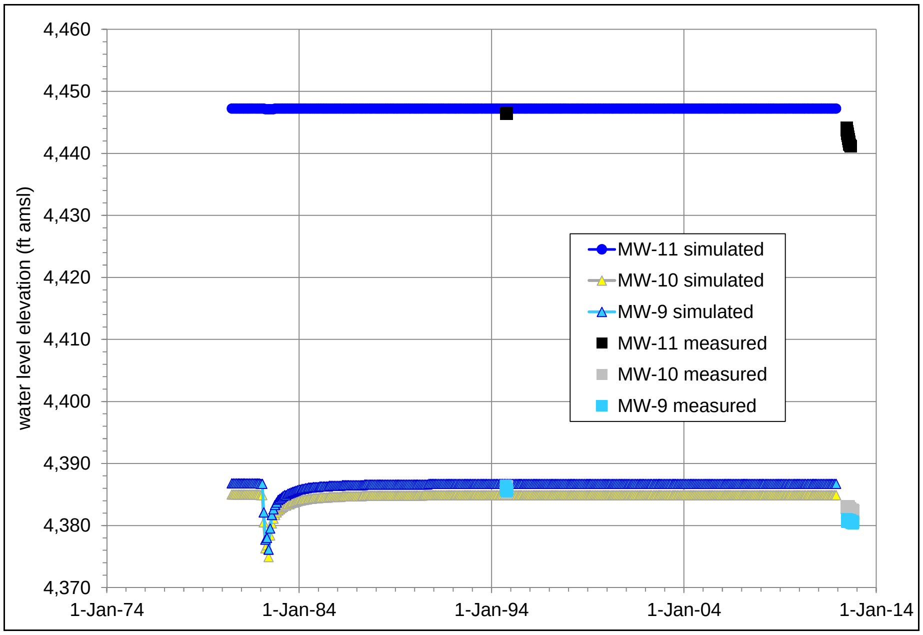


Figure 6.15. Measured and simulated water-level hydrographs in MW-9, MW-10, and MW-11.

Measured and simulated water levels farther down Las Animas Creek (Fig. 5.2) are shown on Figures 6.16 through 6.19. The background variation in the measured water levels reflects unidentified local and temporal stresses that are not simulated in the model. The model simulates the measured water levels generally within the range of water-level variation found in a single model cell in this area. The simulation is acceptably accurate considering the water-level variation within a single cell and the not-simulated local processes affecting the measured water level.

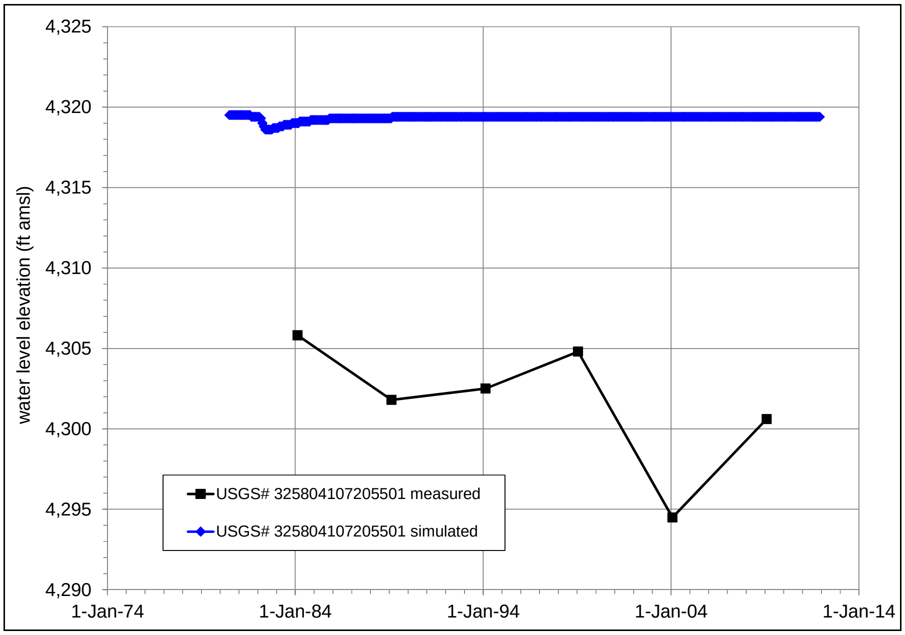


Figure 6.16. Measured and simulated water-level hydrographs in USGS No. 325804107205501.

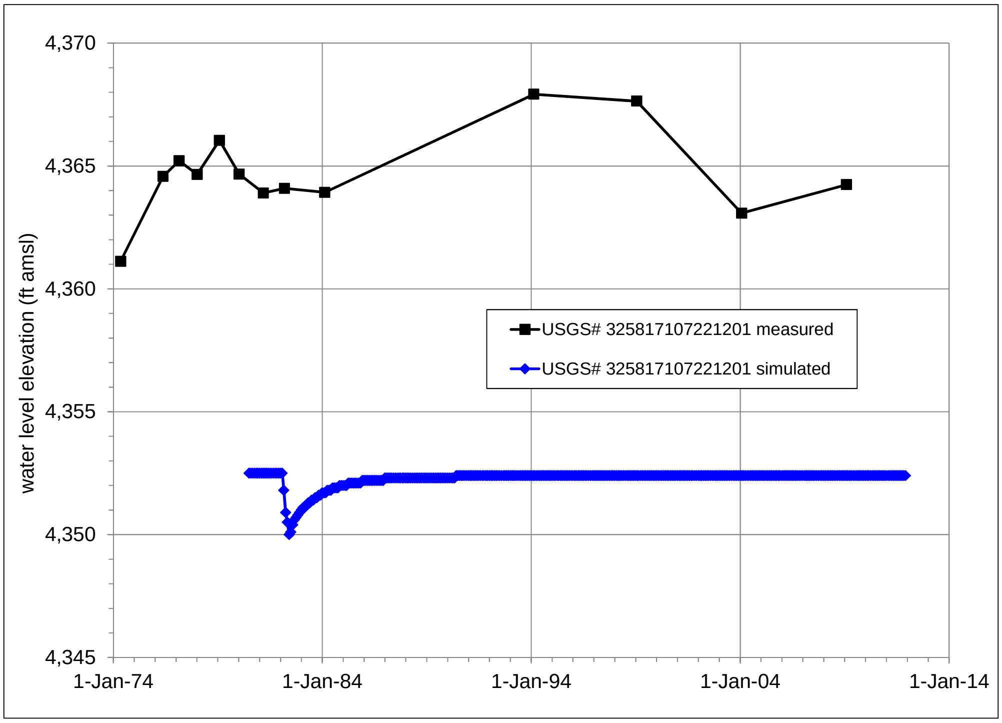


Figure 6.17. Measured and simulated water-level hydrographs in USGS No. 325817107221201.

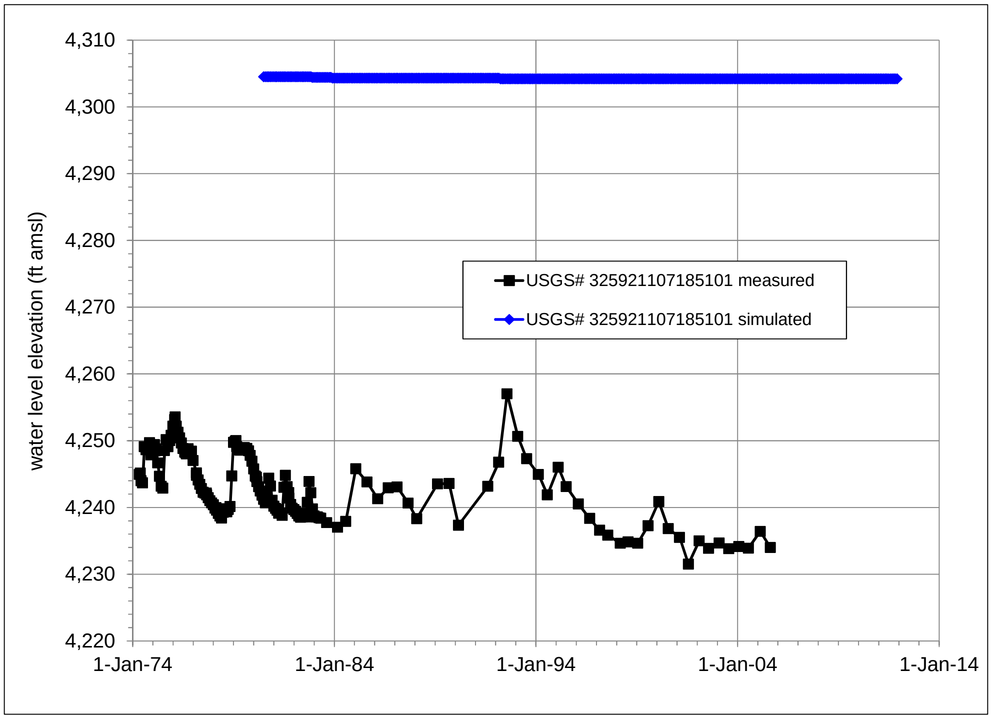


Figure 6.18. Measured and simulated water-level hydrographs in USGS No. 325921107185101.

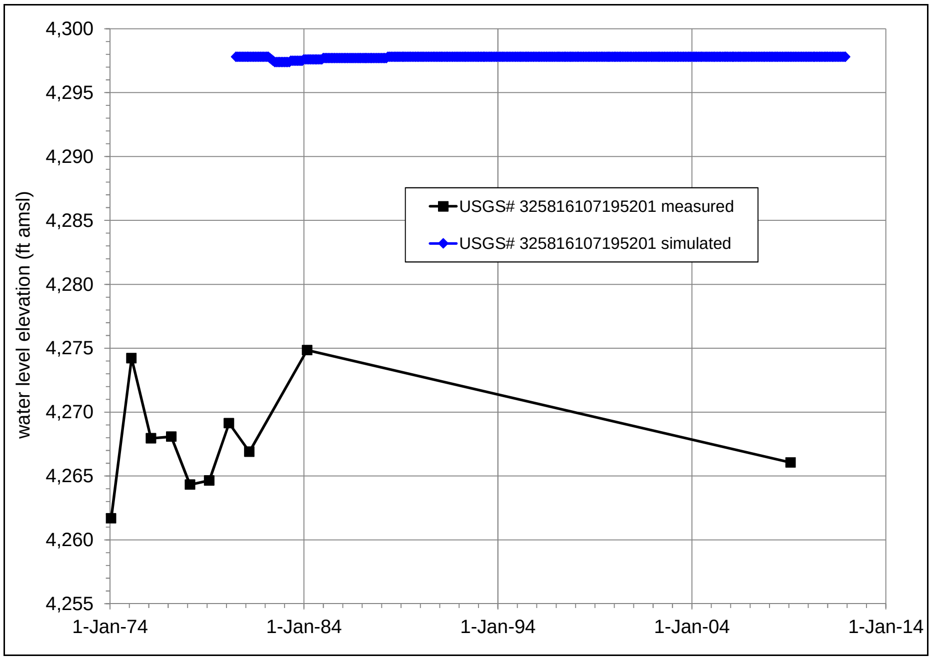


Figure 6.19. Measured and simulated water-level hydrographs in USGS No. 325816107195201.

Measured and simulated water levels downstream of the tailings impoundment (Fig. 5.2), at MW-2 and MW-8, are shown on Figures 6.20 and 6.21, also showing substantial background water-level fluctuations not simulated in the model. The simulation is acceptably accurate considering the amount of water-level variation within a single cell and the not-simulated local processes affecting the measured water level.

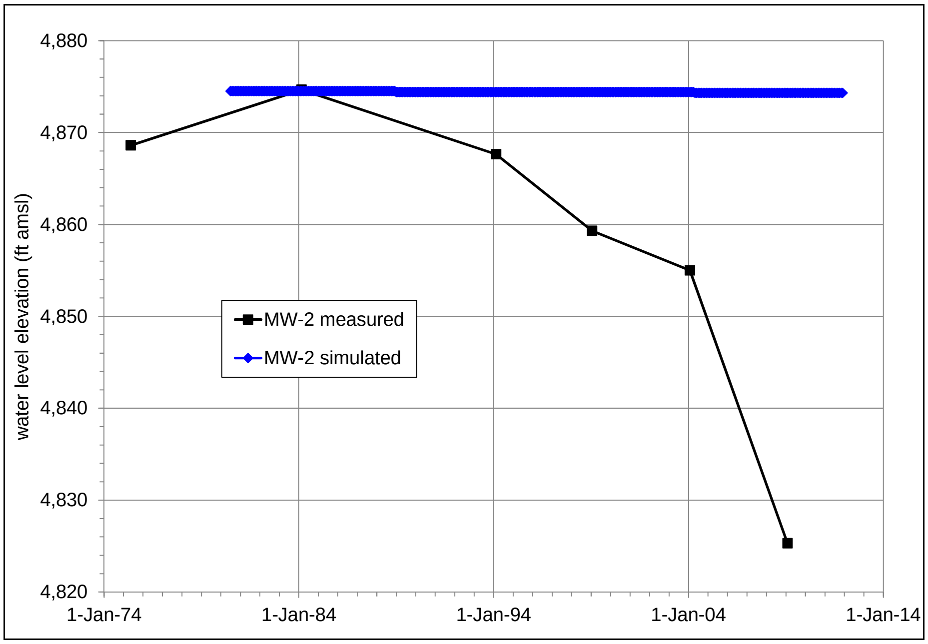


Figure 6.20. Measured and simulated water-level hydrographs in MW-2.

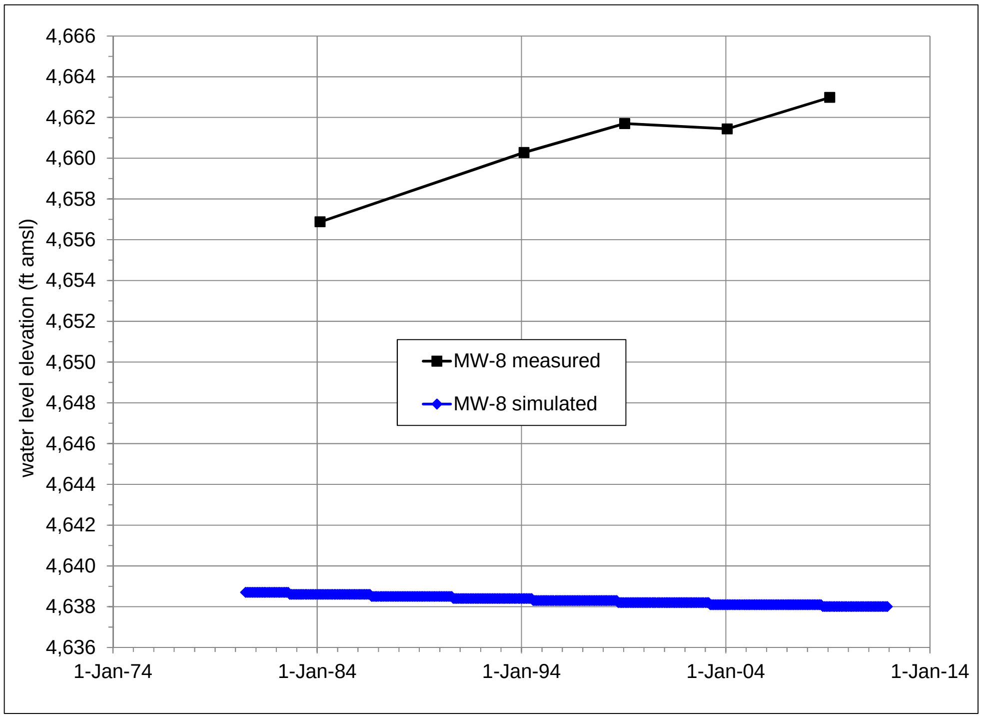


Figure 6.21. Measured and simulated water-level hydrographs in MW-8.

Measured and simulated water levels in the vicinity of the 1982 tailings impoundment (Fig. 5.2) are shown on Figures 6.22 through 6.27. The model reproduces the phenomenon of sustained elevated water levels measured in the vicinity of the impoundment, caused by a fault barrier to the east. The barrier appears to largely contain seepage from the tailings within the fault-bounded block.

Simulated water levels do not exactly match the measured, which indicate even less flow across the fault barrier than is simulated. The measured water levels also reflect unknown local processes and uncertainty in measurements taken over several periods. However the major feature, that of sustained elevated water levels caused by the dam effect of the fault barrier, is reproduced. Seepage from the tailings has mainly been contained behind the fault and has not flowed down gradient.

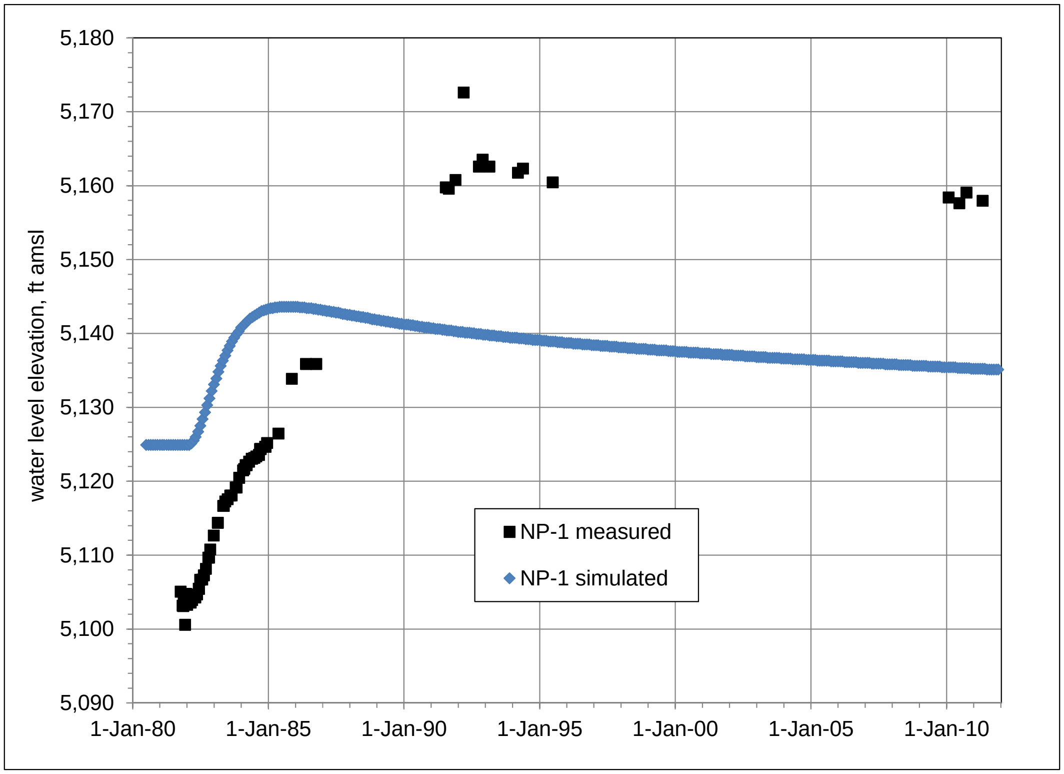


Figure 6.22. Measured and simulated water-level hydrographs in NP-1.

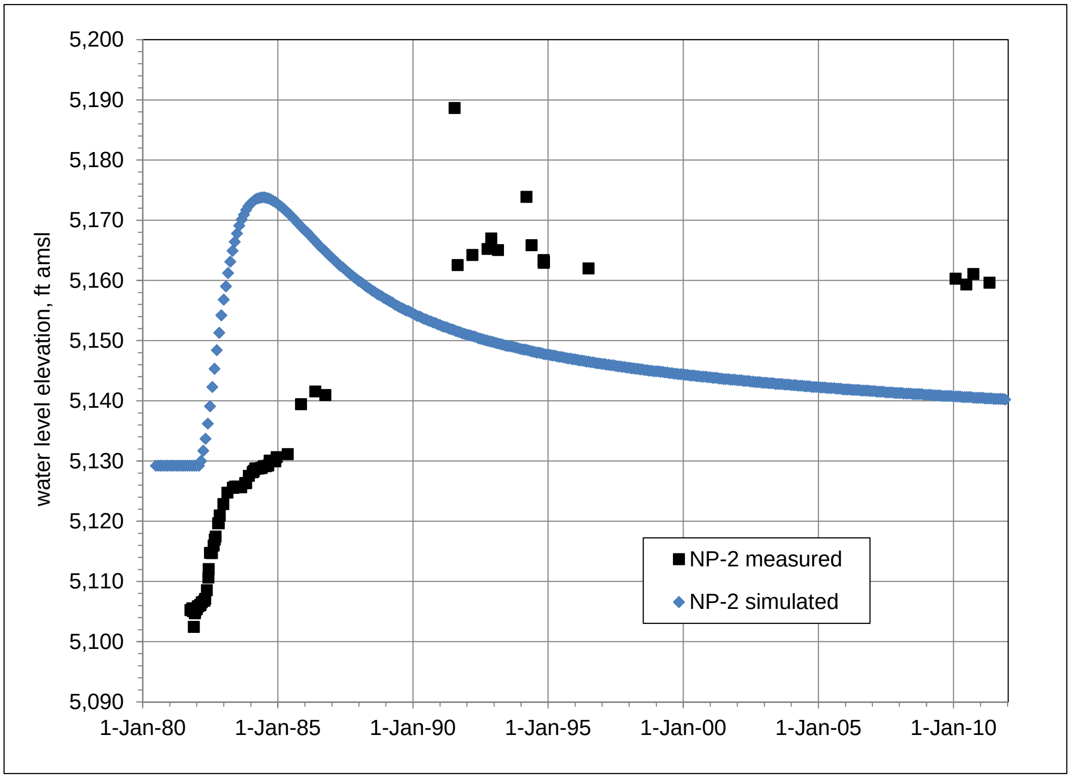


Figure 6.23. Measured and simulated water-level hydrographs in NP-2.

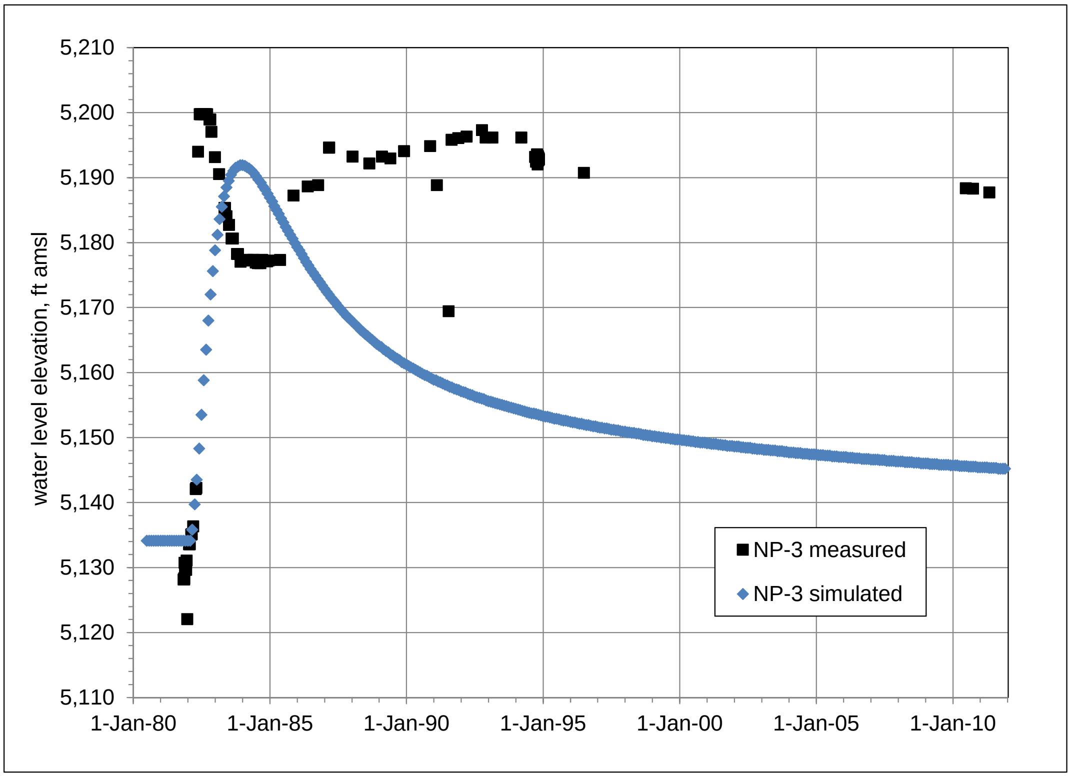


Figure 6.24. Measured and simulated water-level hydrographs in NP-3.

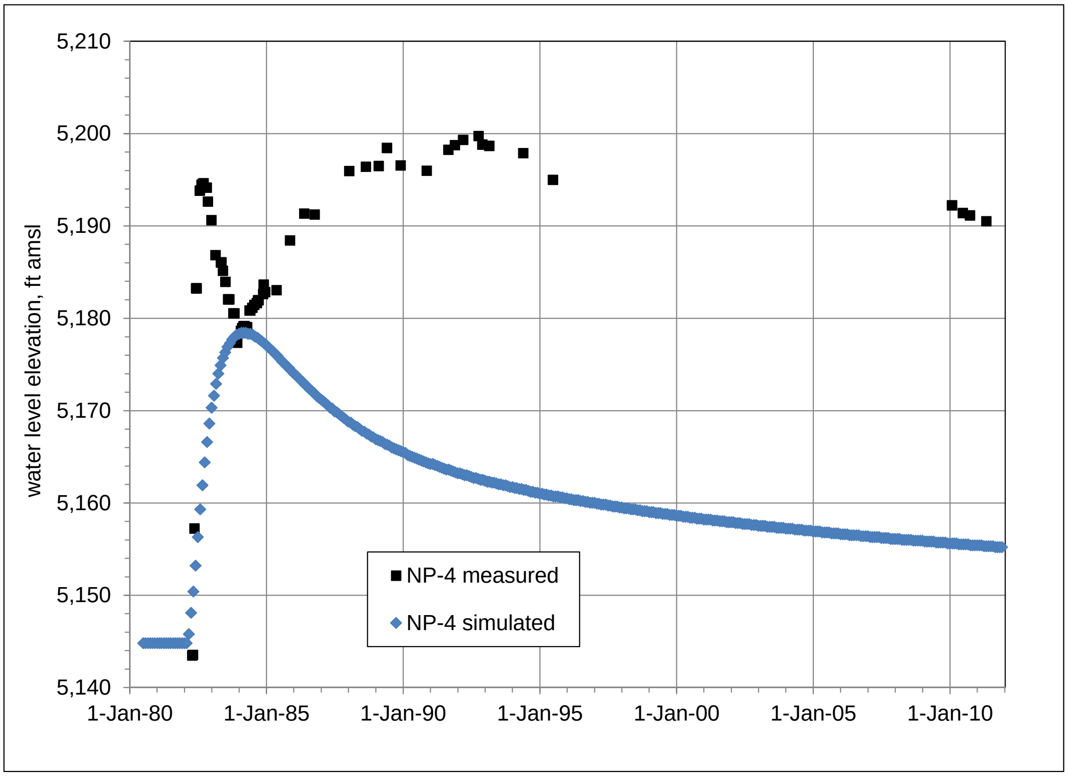


Figure 6.25. Measured and simulated water-level hydrographs in NP-4.

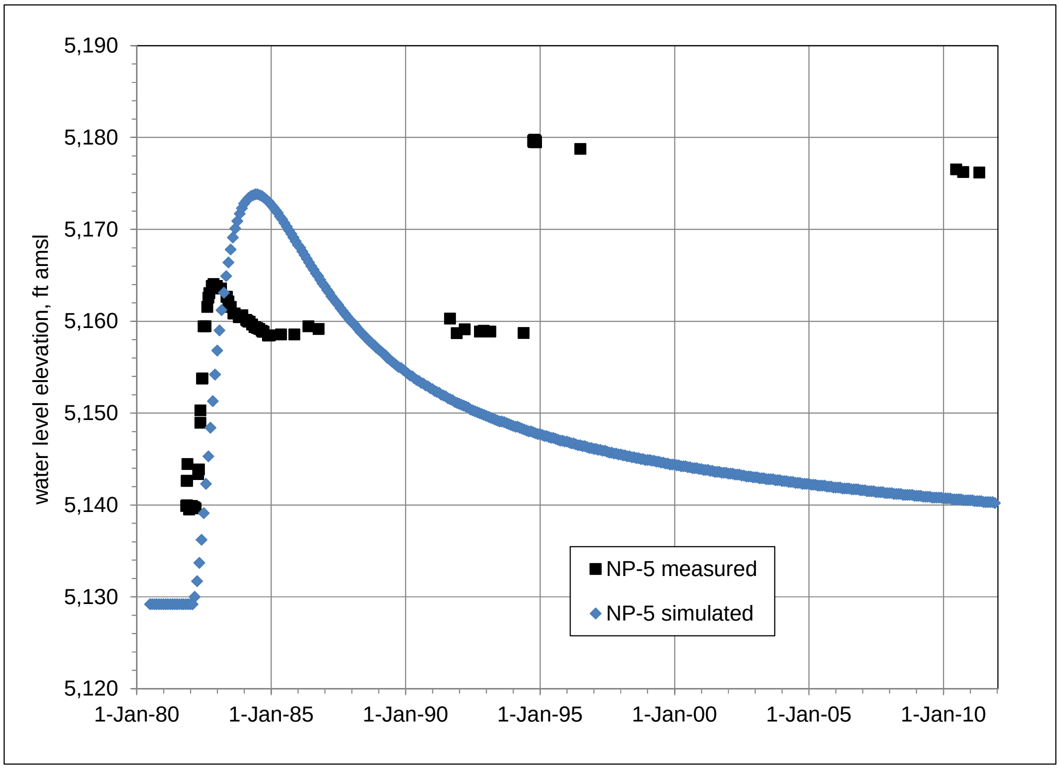


Figure 6.26. Measured and simulated water-level hydrographs in NP-5.

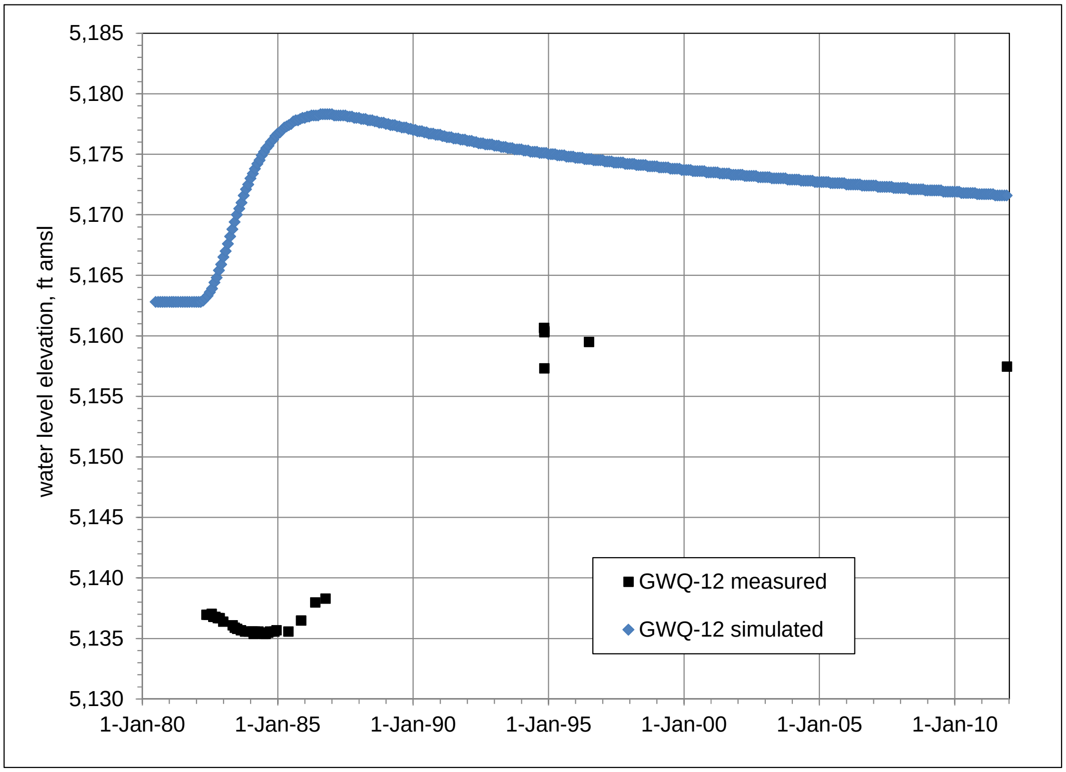


Figure 6.27. Measured and simulated water-level hydrographs in GWQ-12.

Simulated water level and water balance for the current open pit are shown on Table 6.6, indicating general agreement with current measured pit water level and estimated pit water balance. The future (larger and deeper) open pit, both during dewatering and after mining, will have more groundwater inflow with a larger water surface and more evaporation.

Table 6.6. Simulation results for current open pit

water level (ft amsl)	5,433
water surface area (acres)	4.8

simulated annual average water balance		
	ac-ft/yr	**gpm**
precipitation and runoff	18.4	11.4
groundwater inflow	6.7	4.2
TOTAL IN (ac-ft/yr)	**25.1**	**15.5**
evaporation out	25.1	15.5
TOTAL OUT (ac-ft/yr)	**25.1**	**15.5**

ac-ft/yr - acre-feet per year

The model correctly simulates the location of graining stream reaches, in the upper parts of the Animas Creek and Percha Creek watersheds over the Animas Uplift. Below the uplift, the streams generally lose flow to the SFG aquifer. However, in the alluvial aquifer along lower Animas Creek, and in the lowest parts of Percha Creek and Greenhorn Arroyo, the model simulates alternating gaining and losing river segments. This is partly an artifact of model discretization (caused by the relatively large change in river stage from cell to cell), but also reflects the reality of a water table that is close to land surface and may rise above the stream bed intermittently or seasonally, causing the stream to flow.

Simulated total flowing-well discharge over time for the study area is shown on Figure 6.28. There are no data for calibrating the total flowing-well discharge, except that the simulated flow should exceed the totals shown on Table 5.3 (and does). The model result represents the known background (independent of the Project) trend of drawdown in the model area. The model-simulated artesian well locations are shown on Figure 6.29, indicating which locations were still flowing (in the model) as of November, 2012.

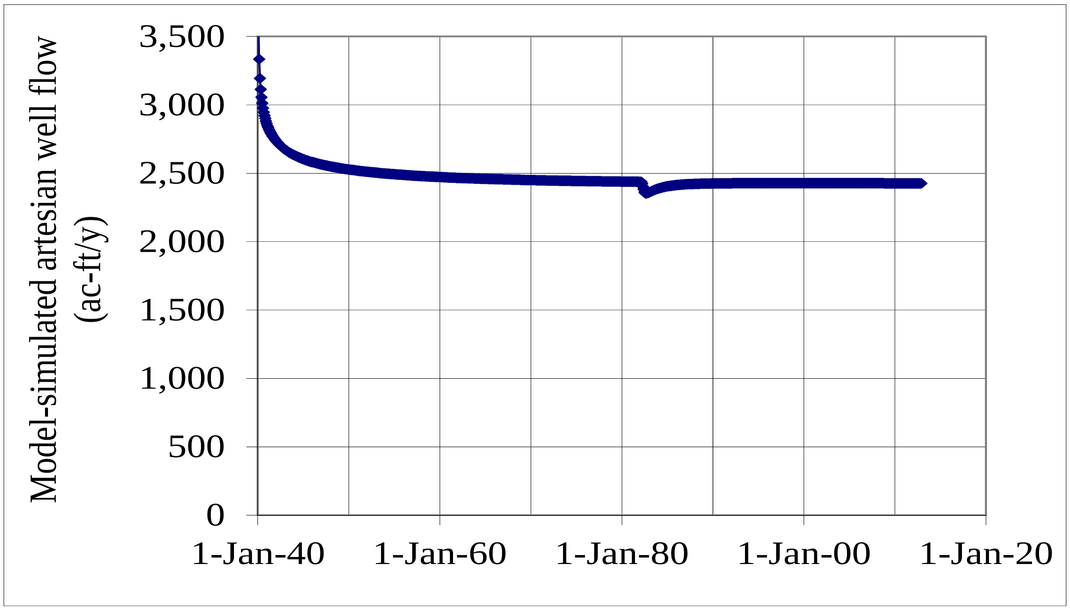


Figure 6.28. Simulated artesian well discharge.

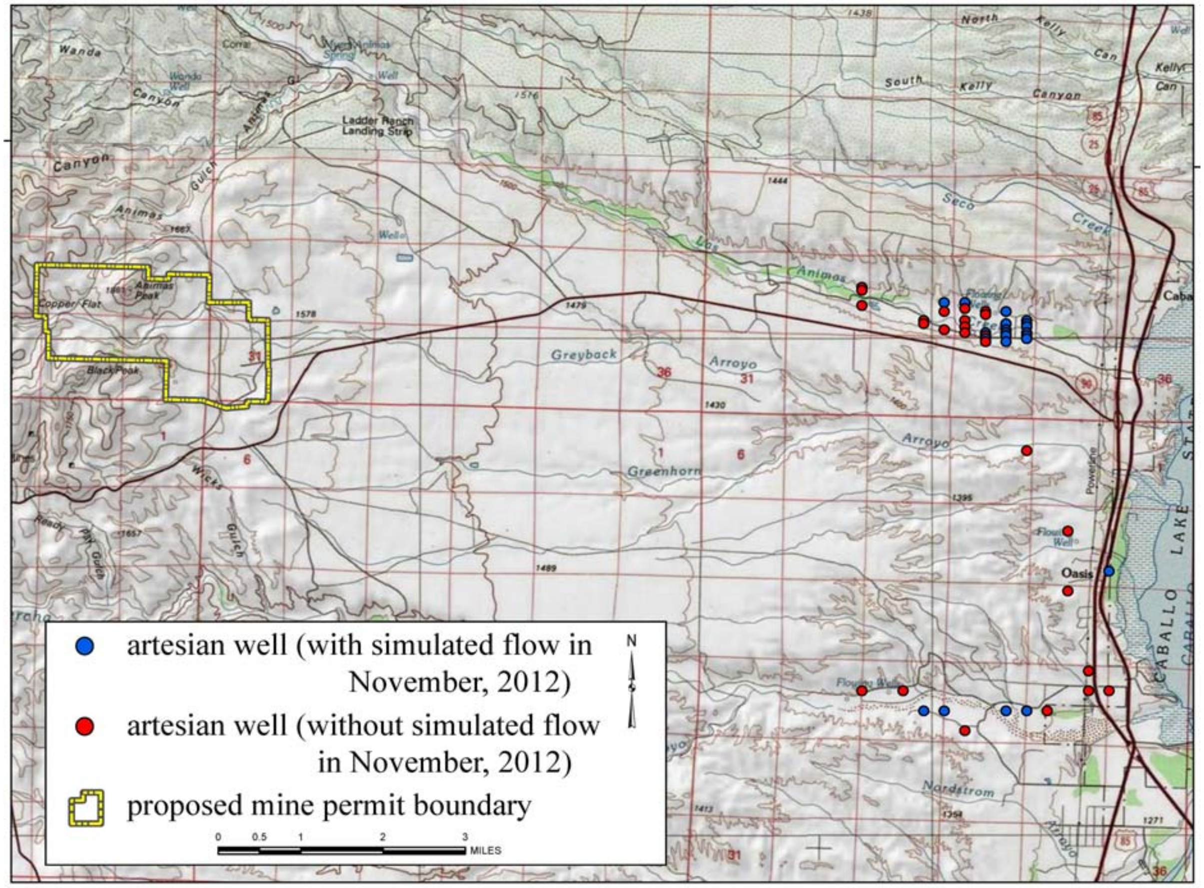


Figure 6.29. Simulated artesian wells, discharging and not discharging in November 2012.

6.4.3 Aquifer Test Simulation

Pumping of wells PW-1 and PW-3 began in late November 2012 and continued, with two stops and starts, until 21 December 2012. Recorded pumping periods and rates (Fig. 5.14) were simulated in the model using MODFLOW module LAK2 (JSAI, 2010), which simulates water level inside the pumping bores in addition to the withdrawal from the aquifer. Water-level responses were measured at locations shown on Figure 6.30. Measured and simulated aquifer test drawdown and recovery are presented on Figures 6.31 through 6.39.

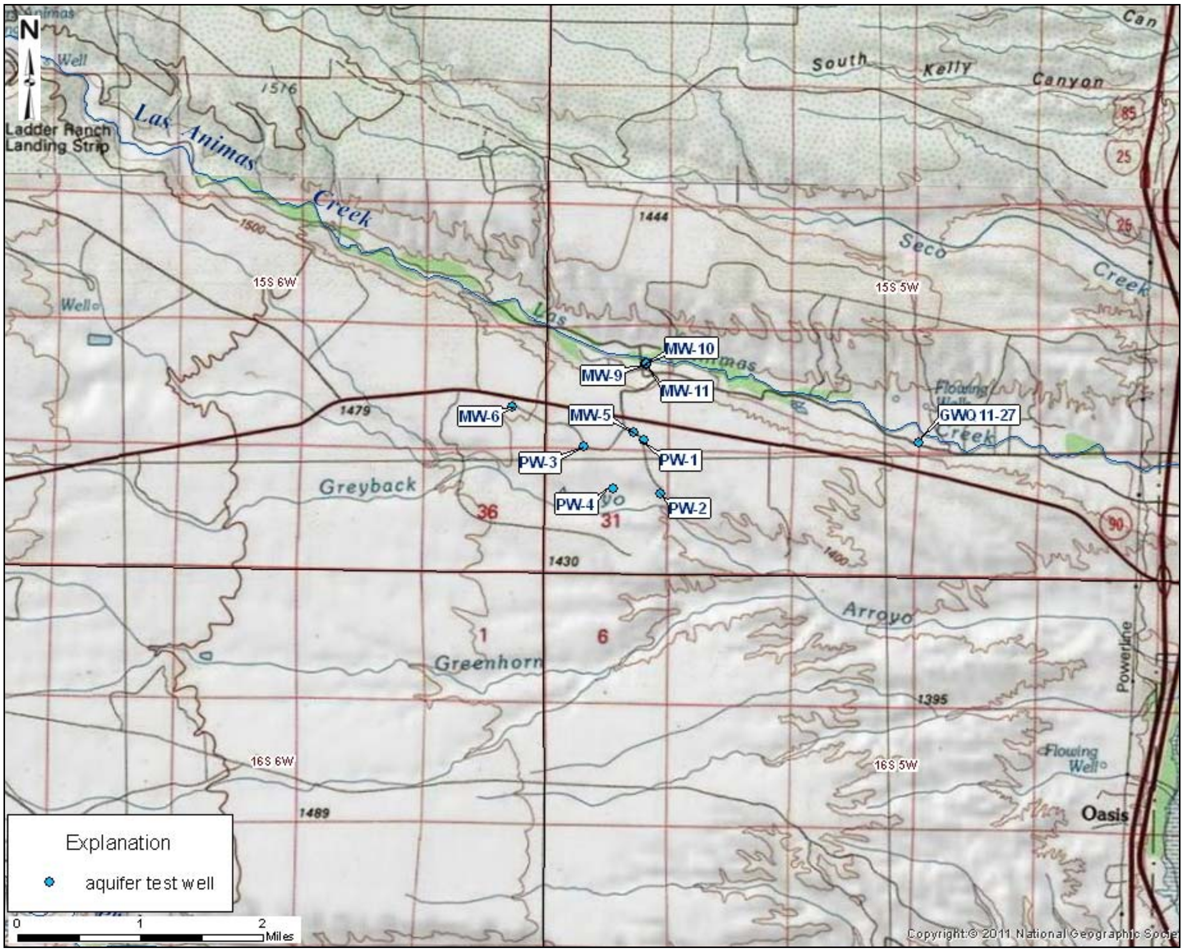


Figure 6.30. 2012 aquifer test pumping and observation locations.

Measured and simulated drawdown in the pumping wells, PW-1 and PW-3, are shown on Figures 6.31 and 6.32. Simulated water levels in the well-bore, and in the adjacent aquifer, are shown on both figures. The simulated and measured well-bore water levels agree, although the measured water level in PW-3 shows an unexplained additional decline, late in the pumping period, that is not simulated in the model. The difference between well-bore and aquifer water levels characterizes the well losses and pumping efficiency of PW-1 and PW-3.

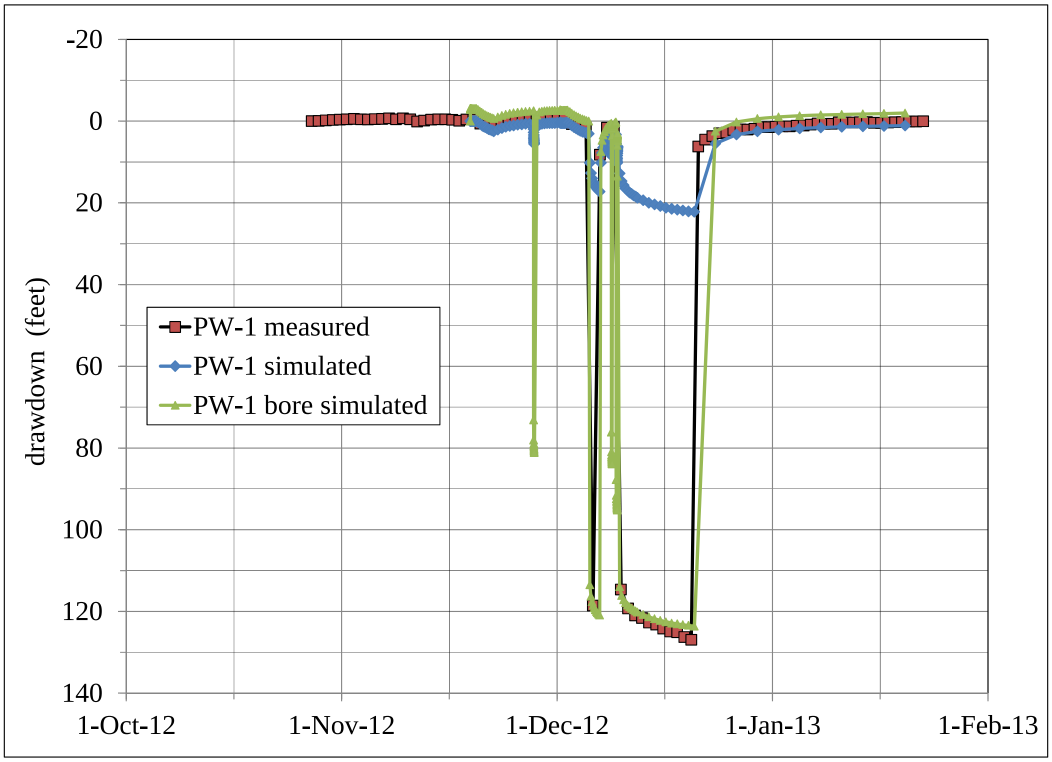


Figure 6.31. Measured and simulated water-level hydrographs in PW-1.

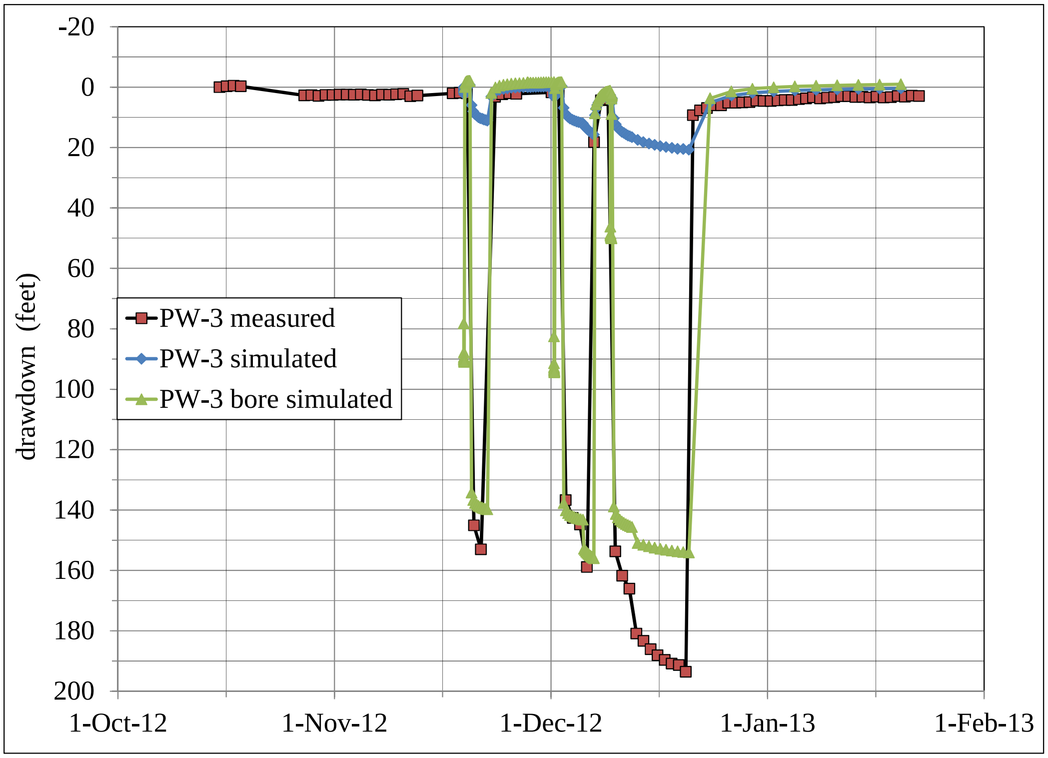


Figure 6.32. Measured and simulated water-level hydrographs in PW-3.

Measured and simulated drawdown elsewhere in the well field area, at PW-2, PW-4, and MW-5, are shown on Figures 6.33, 6.34, and 6.35. For unknown local reasons, measured drawdown in PW-2 (Fig. 6.34) is less than simulated, and less than would be expected from the results at PW-2 (Fig. 6.33) and MW-5 (Fig. 6.35).

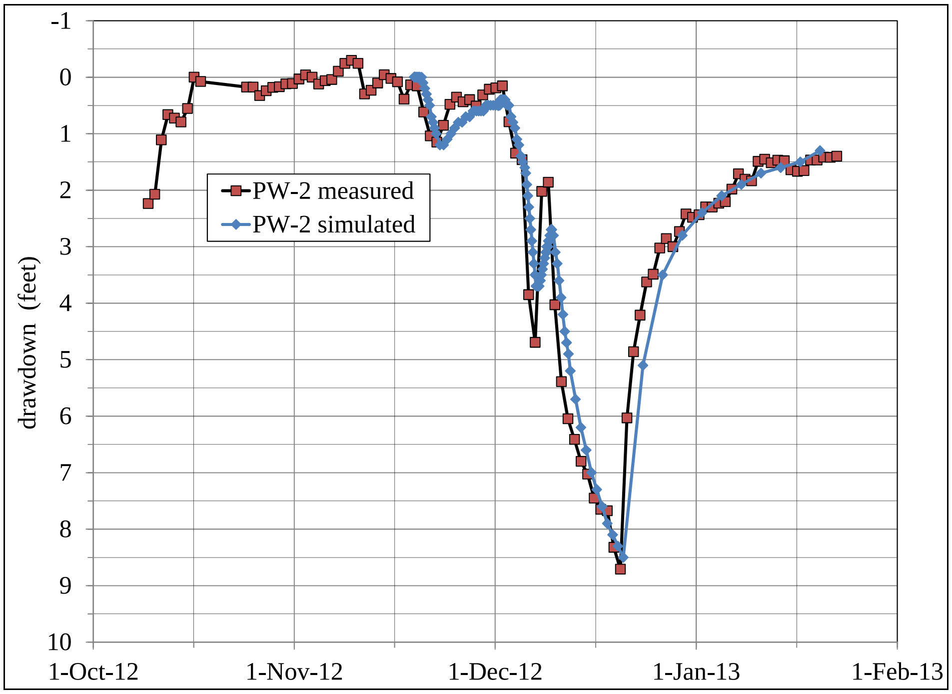


Figure 6.33. Measured and simulated water-level hydrographs in PW-2.

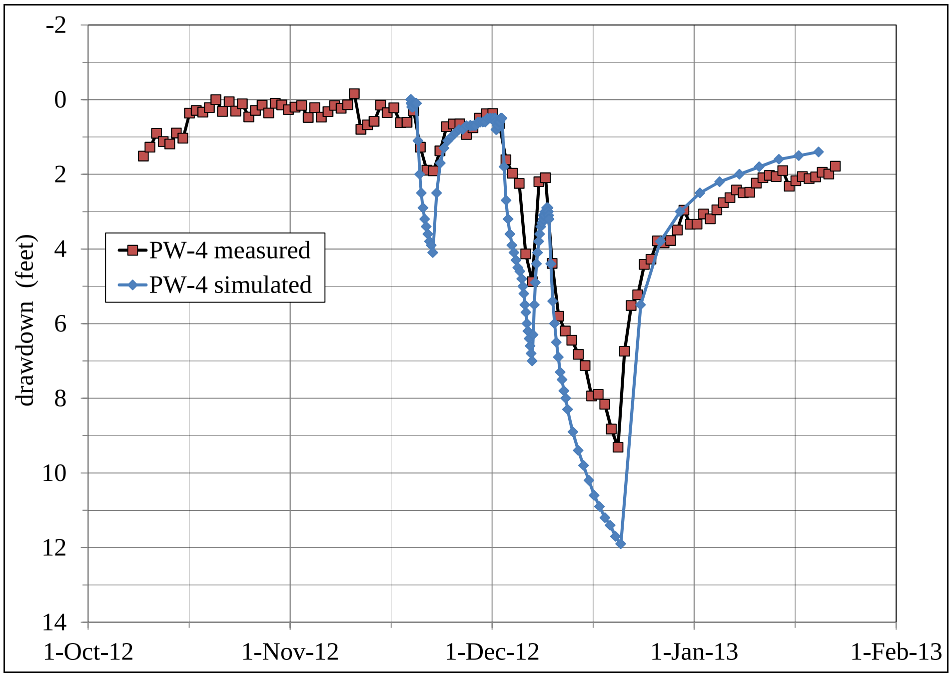


Figure 6.34. Measured and simulated water-level hydrographs in PW-4.

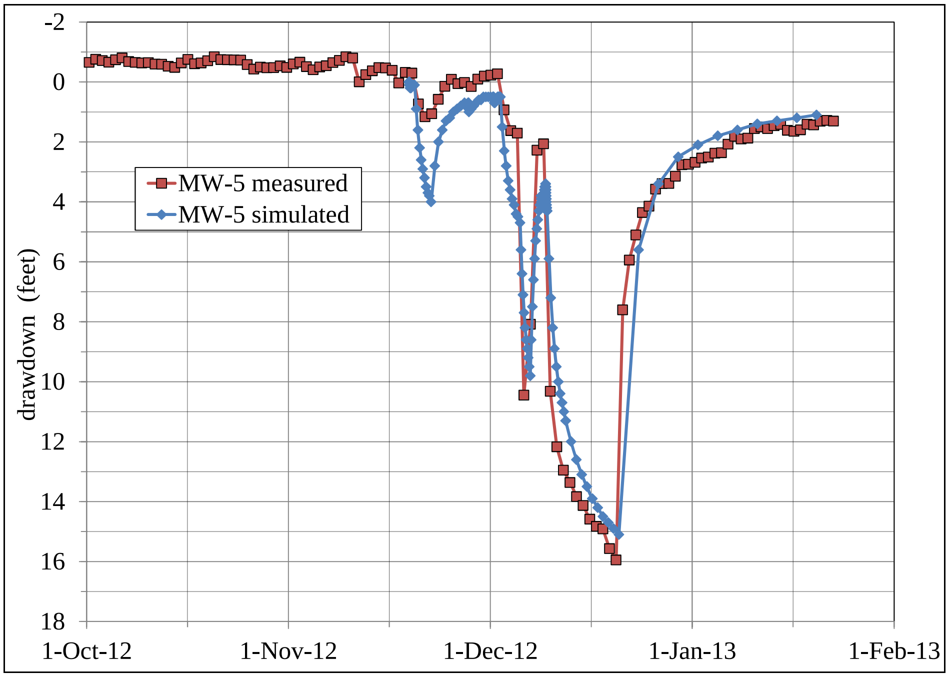


Figure 6.35. Measured and simulated water-level hydrographs in MW-5.

The rapid initial response, semi-linear drawdown trend and rapid recovery measured in the well field area is not characteristic of the response in an extensive aquifer, but in a limited-size, high-permeability unit (the Palomas graben) partly isolated from surrounding hydrogeologic units.

This response is reproduced in the model using a combination of (1) leaky fault barriers bounding the Palomas Graben, (2) high permeability within the graben and (3) lower permeability units adjacent to the graben. The combination reproduces both the aquifer test response and the overall background water levels and gradients in the basin.

Measured and simulated drawdown north of the well field along Las Animas Creek (Fig. 6.30) is shown for the SFG aquifer (wells MW-9 and MW-10) on Figure 6.36 and for the alluvium (well MW-11) on Figure 6.37.

The sharp initial drawdown and rapid recovery in the SFG aquifer is similar to that in the other Palomas Graben wells (Figs. 6.31 through 6.35). The response in the SFG aquifer (Fig. 6.36), and the lack of response in the alluvium (Fig. 6.37) are both reproduced in the model.

Instead of responding to the aquifer test, measured water levels in the very shallow (37 ft) well MW-11 (Fig. 6.37) can be seen to be rising before and throughout the test, due to some local influence, such as a neighboring well stopping pumping.

Measured and simulated drawdown east of the well field, at GWQ11-27 (Fig. 6.30), is shown on Figure 6.38. The model-simulated response is not as rapid or as large as the apparent measured response, but the figure also shows substantial background water-level fluctuation that is not part of the aquifer test response.

Measured and simulated drawdown west of the well field, at MW-6 (Fig. 6.30), is shown on Figure 6.39. The measured data shown on the figure consist of the highest water level measured each day; actual water levels in MW-6, an actively-used pumping well, fluctuate over tens of feet as the pump starts and stops. The data shown on the figure correspond to the water level measured each morning, just before the pump was started.

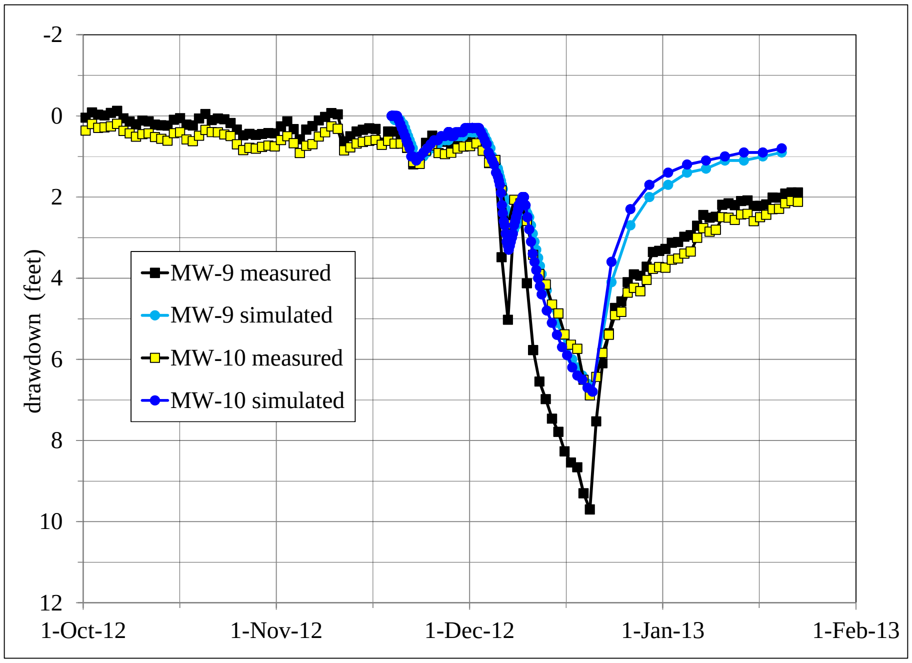


Figure 6.36. Measured and simulated water-level hydrographs in MW-9 and MW-10.

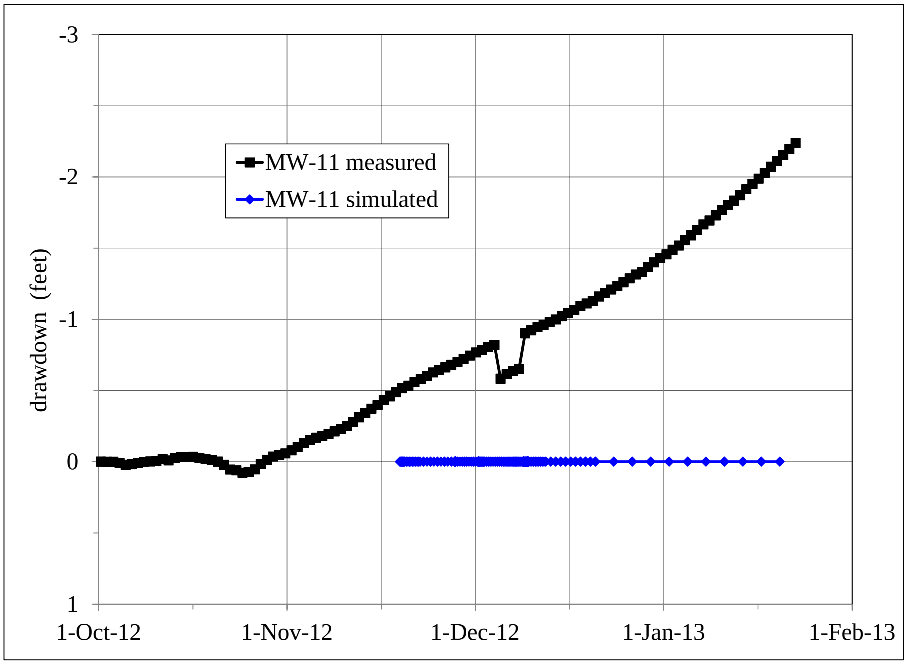


Figure 6.37. Measured and simulated water-level hydrographs in MW-11.

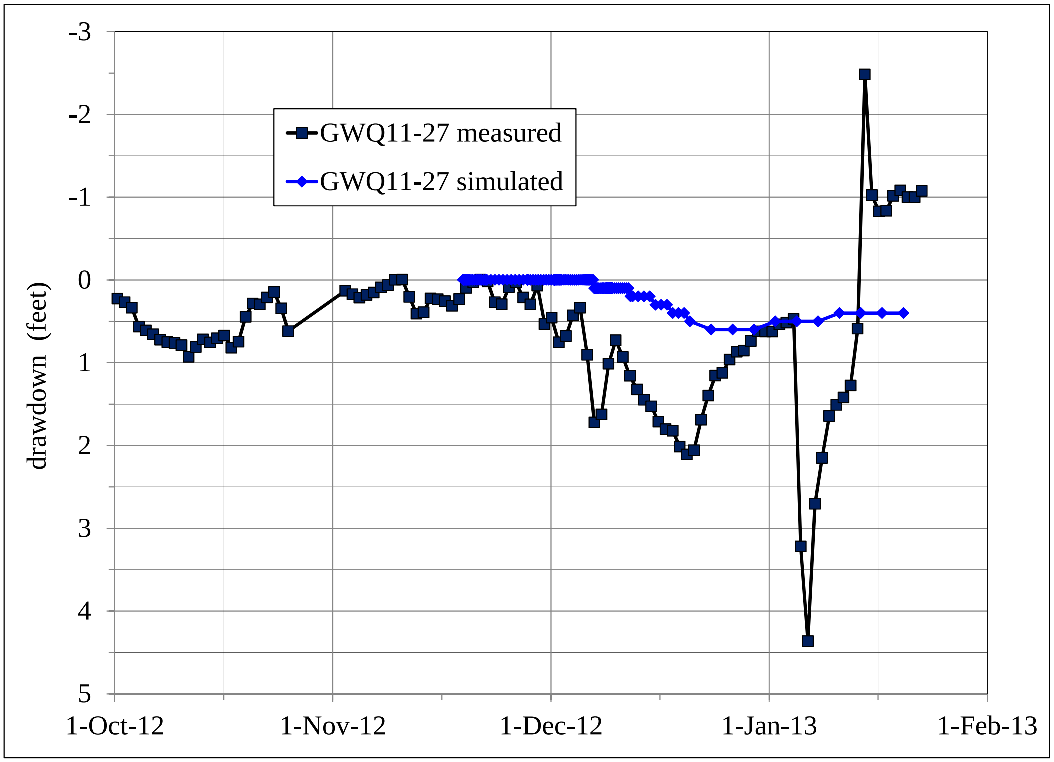


Figure 6.38. Measured and simulated water-level hydrographs in GWQ11-27.

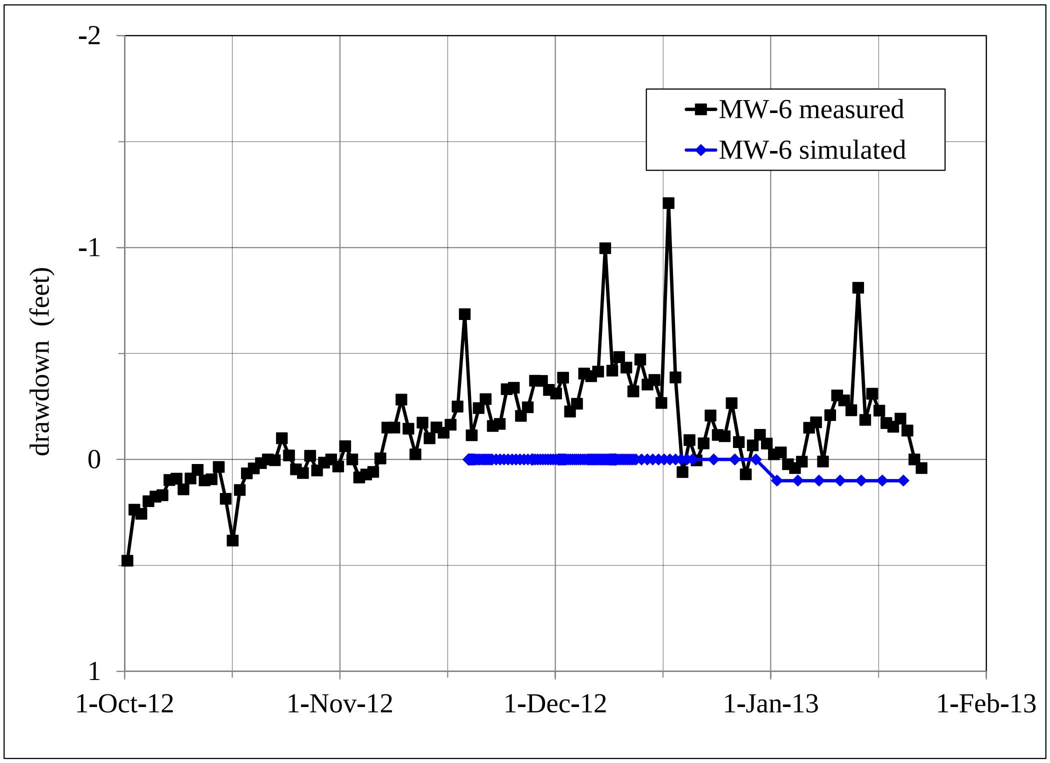


Figure 6.39. Measured and simulated water-level hydrographs in MW-6.

7.0 SENSITIVITY OF MODEL RESULTS

The sensitivity of model results to different parameters is discussed below.

First, the sensitivity of calibration results to model parameters is presented. These indicate which parameters are known with more confidence, or better constrained by data, and which are more unknown or uncertain. This helps to define a range of plausible values for each parameter.

Then the sensitivity of model projection results, within the plausible range of values for different parameters, is evaluated, to indicate a probable range of results. This quantifies the level of uncertainty in the model predictions and defines a range of likely outcomes.

7.1 Sensitivity of Calibration Results

The sensitivity of results to changes in model parameters was investigated during development of the model, in order to improve model calibration. An example of this is given on Figure 7.1, showing the simulation of the 2012 aquifer test for different modeled levels of vertical anisotropy in the Palomas Graben.

The results suggest important vertical flow upward into the strata from which the wells pump. The sediments filling the Palomas Graben are therefore modeled as an isotropic unit, with equal horizontal and vertical permeability (Table 6.1).

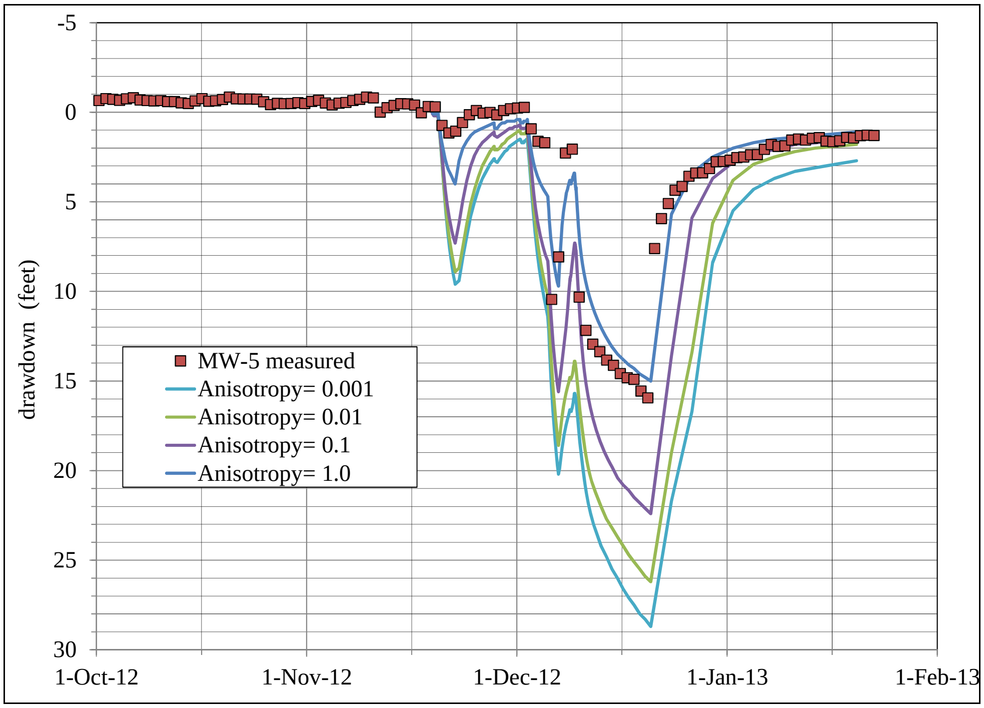


Figure 7.1. Simulated aquifer-test drawdown in well MW-5 for different vertical anisotropy values.

A related example is shown on Figure 7.2, showing the simulation of the 2012 aquifer test for different horizontal permeability of the Palomas Graben. Results show improved calibration for higher permeability. The final modeled permeability was 10 ft/d for the strata in which the well field is completed, with a total aquifer transmissivity of 20,000 ft^2/d (Table 6.1).

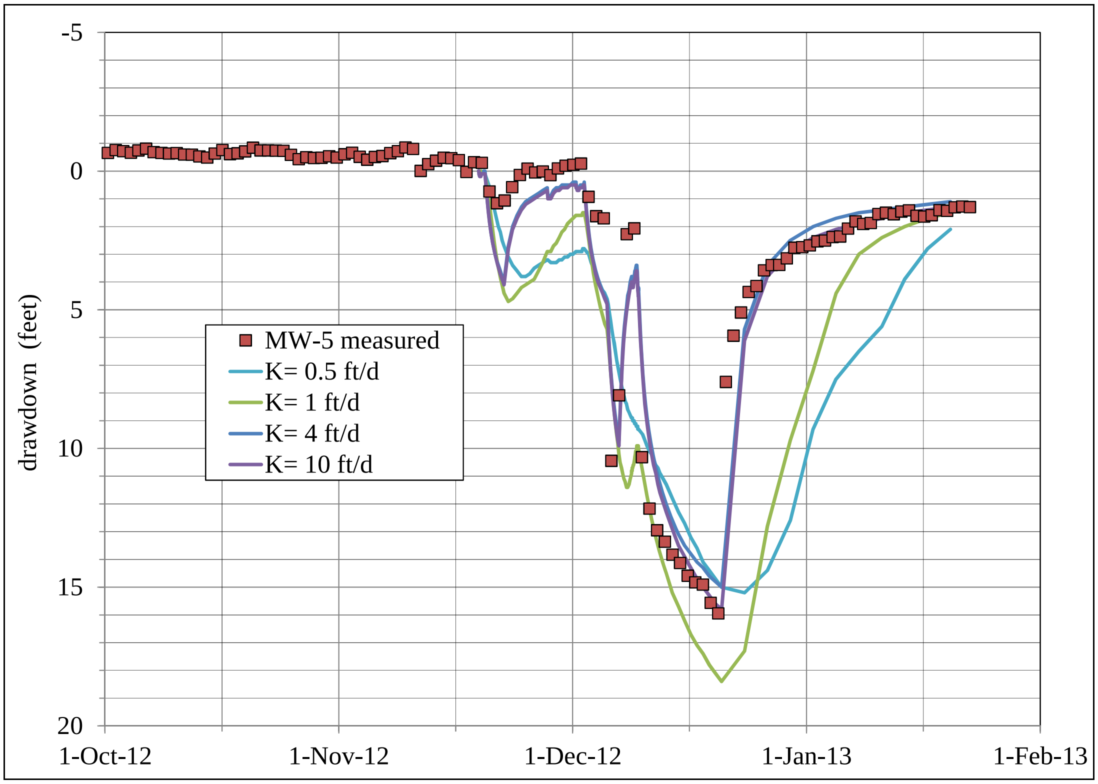


Figure 7.2. Simulated aquifer-test drawdown in well MW-5 for different hydraulic conductivity values.

Another example tests the conceptual model of a linearly extensive Palomas Graben. Figure 7.3 presents simulated 2012 aquifer test drawdown at observation well MW-5, with and without the north-south (GHB) boundary conditions in the Palomas Graben. The model calibration suggests that, if there were no significant north-south flow path in the graben, there would have been more aquifer test drawdown, with slower water-level recovery.

Based on the aquifer test results and model calibration, the Palomas Graben appears to be a linear feature of significant north-south extent; the aquifer test drawdown was characteristic of the response of a semi-infinite linear feature of finite width.

Based on the sensitivity results above, the transmissivity and vertical anisotropy of the highly-transmissive Palomas Graben are considered to be relatively well-known parameters, whose range of possible values is constrained by data.

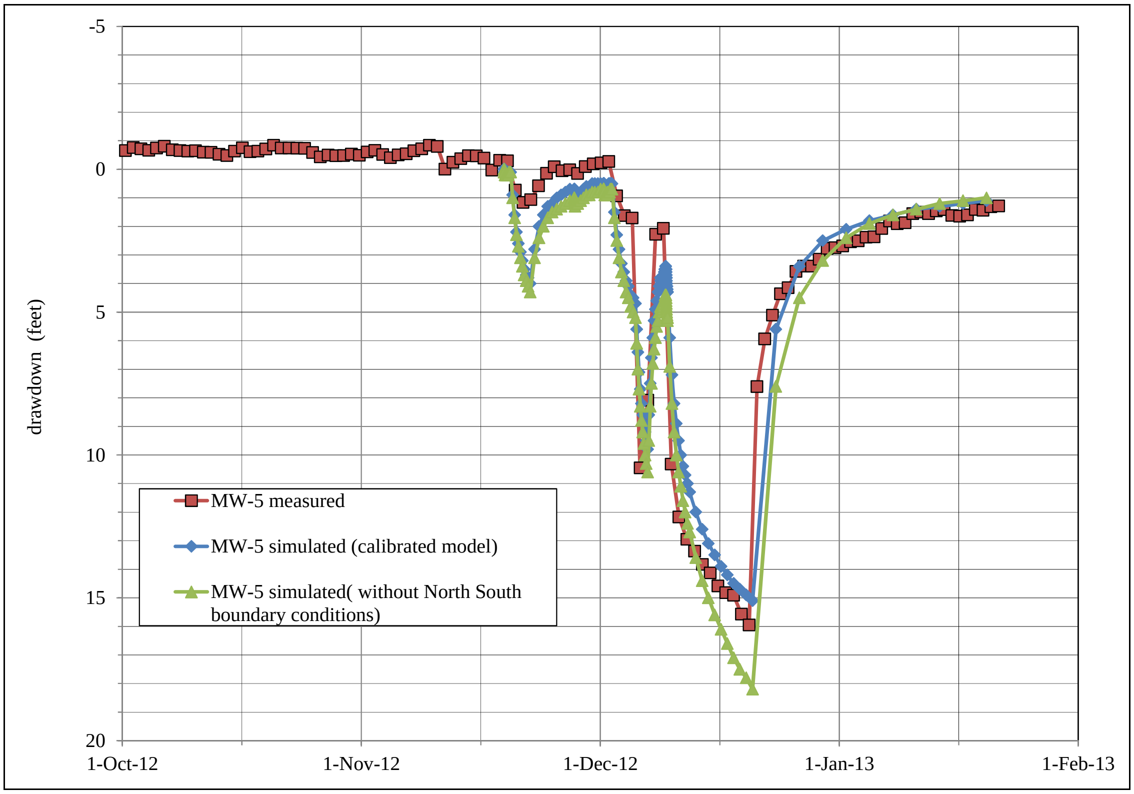


Figure 7.3. Simulated aquifer-test drawdown in well MW-5
with and without Palomas Graben boundary conditions

The hydraulic characteristics of the faults bounding the Palomas Graben are also reasonably known:

- The east bounding fault is weakly resistant to flow (Table 6.2). Based on model calibration, the resistance is not greater than simulated. The east bounding fault could be simulated with zero resistance (and compensating reduced transmissivity east of the graben), with little effect on calibration or projection results.

- The west bounding fault is strongly resistant to flow (Table 6.2). This resistance is important to overall model calibration (Fig. 6.10) and to aquifer test calibration. Simulating greater resistance (smaller conductance on Table 6.2) across the already low-permeability fault makes little difference to calibration or projection results. Simulating less resistance to the west degrades the model calibration and slightly attenuates the projected effects east of the graben.

Away from the Palomas Graben, the properties of the SFG aquifer are less well-known. However, based on aquifer test results and model calibration information the SFG aquifer along Animas Creek (Fig. 6.2) is identified to be similarly transmissive (Table 6.1).

The properties of the alluvial aquifer along Animas Creek are not known in detail, but the alluvium can be assumed to be conductive and to have substantial storage capacity. Measured historical water levels at MW-9, MW-10 and MW-11, results of the 1994 MW-9 pumping test (Fig. 5.13), and results of the 2012 well field pumping test (Fig. 6.37), all show that the alluvial aquifer does not respond readily to pumping in the underlying SFG aquifer.

To summarize the constraints on parameters:

1. Properties of the SFG sediments in the Palomas Graben are reasonably well-known based on calibration to aquifer test results. The graben aquifer is relatively transmissive both horizontally and vertically.
2. Properties of the SFG sediments along Animas Creek are somewhat known based on aquifer test results and other model calibration. The SFG aquifer along Animas Creek is also relatively transmissive.
3. Properties of the alluvial aquifer along Animas Creek are somewhat known, based on overall model calibration and on general material properties. Multiple aquifer test results (Sections 5.2.2, 5.2.3, and 5.2.4) indicate that the alluvial aquifer is substantially isolated from the SFG aquifer.

The above constraints narrow the plausible ranges of the main model result (the projection of groundwater drawdown and surface discharge reduction, resulting from proposed operation of the well field). The sensitivity of this result to variation of model parameters within plausible ranges is discussed below.

7.2 Sensitivity of Projection Results

The sensitivity of model projections to unknown parameters is of importance in evaluating the effects of the proposed project. Because model projections are reported separately, this report does not present results of specific projections. The general sensitivity of all projection scenarios to unknown parameters is discussed here.

The main effects of the project would be associated with pumping of the well field, including groundwater drawdown and surface discharge changes. The high-transmissivity features of the Palomas Graben and the SFG aquifer along Animas Creek largely control the pattern of groundwater drawdown and the effects on discharge. The projected groundwater drawdown spreads throughout the high-transmissivity features, and magnitude of drawdown is proportional to the total volume of water pumped. The discharge effects develop over the life of mine and dissipate over a similar period.

This basic result is controlled by the known high-transmissivity features. Variations of aquifer parameters for these features, within plausible ranges, do not change the basic result, and can only marginally affect the shape and size of the drawdown cone and the timing of the discharge changes. This was confirmed during model calibration by comparing the results of different preliminary projection scenarios, using different preliminary model versions.

While the basic result is insensitive to changes in aquifer parameter values, variation in the model boundary conditions controlling groundwater discharge to the Rio Grande Basin (MODFLOW module GHB) can have more effect. The conductance of the GHB boundaries (Sec. 6.3.1) were adjusted both up and down one order of magnitude, and results of a sample projection compared to results obtained using the calibrated model.

An increase in the already-large conductance does not substantially change model results; the GHB boundaries are simulated with sufficiently large conductance that they function essentially as constant-head boundary conditions, maintaining a constant water level along the east edge of the model domain.

A decrease in GHB conductance, however, reduces simulated discharge to the Rio Grande system, and increases simulated discharge to the Animas Creek and Percha Creek systems. Projected effects on discharge to the Rio Grande system are smaller, and projected effects on discharge to the Animas Creek and Percha Creek systems are larger. Total discharge and total effect on discharge are unchanged.

In summary, the aquifer properties near the well field are relatively well-known, due to the 2012 aquifer test. The aquifer properties farther away do not substantially affect the size or shape of the predicted groundwater drawdown cone, or its rate of dissipation. The identified high-transmissivity units govern the propagation of groundwater drawdown and the resulting water balance effects.

Reasonable variation in boundary condition parameters such as GHB conductance do not substantially change the overall projected effects, but can affect the predicted distribution of those effects between groundwater discharge to the Rio Grande system and discharge to the Animas Creek and Percha Creek systems.

8.0 CONCLUSIONS

A numerical model of groundwater flow in and around Copper Flat, near Hillsboro, New Mexico was developed and calibrated based on previously available information and on new studies of the system. The calibrated model will be used to project the effects, to groundwater and surface water, of the proposed development of the Copper Flat mine.

First, the climate and meteorology, hydrology and water balance, and geology and hydrogeology, of the study area were summarized. Then a conceptual model of the hydrological and hydrogeological system was presented. Important hydrogeological features are the high-transmissivity Palomas Graben and a high-transmissivity zone along the axis of Animas Creek.

Next, the data available to confirm and calibrate the model were presented. Extensive information is available, from previous studies and previous mine operations, and from new studies including the 2012 extended well field test and the 2011 pit-area pressure-injection testing. The large amount of information has allowed development of a model that can reliably project effects of future development.

Next the numerical model was presented, including model structure, inputs and calibration. The model accurately represents the conceptual model and accurately reproduces the calibration data, particularly the results of the 2012 extended well field pumping test. As a result the model is considered suitable for use in projecting the effects of future well field pumping.

Finally the sensitivity of model results to unknown parameters was evaluated. The existing information, including the 2012 aquifer test, characterizes the main SFG aquifer units and narrows the range of parameter uncertainty in the vicinity of the well field. Sensitivity of the primary model projection results, groundwater drawdown and surface discharge changes due to well field pumping, is low.

The calibrated model will be used to generate projections related to the results and effects of mine development. Projections will be generated as required and reported separately. Results of interest include the following:

- Groundwater drawdown due to water-supply pumping, for selected mine development scenarios
- Effects on surface discharge to the Las Animas Creek and Rio Grande systems
- Long-term post-mining residual groundwater drawdown and effects to surface discharge
- Potential ground subsidence due to groundwater drawdown
- Open pit dewatering rates and groundwater drawdown in bedrock
- Post-mining open-pit water level and water balance
- Down-gradient migration of potential leakage from tailings and waste rock storage facilities

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APPENDICES

Appendix A.

Geological Bibliography

Selected References on the Caballo–Copper Flat Area and Adjacent Parts of the Palomas Basin and Rincon Valley, Sierra and Doña Ana Counties, New Mexico

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Sections of specific Interest with respect to hydrology and hydrogeology: Section 7, Geology; Section 8, Surface Water and Groundwater Information; Appendix 8-B, Seepage Study (Las Animas and Percha Creeks); Appendix 8-H, List of Inventoried Wells (Updated Artesian Well Inventory)

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Appendix B.

Well Construction Diagrams

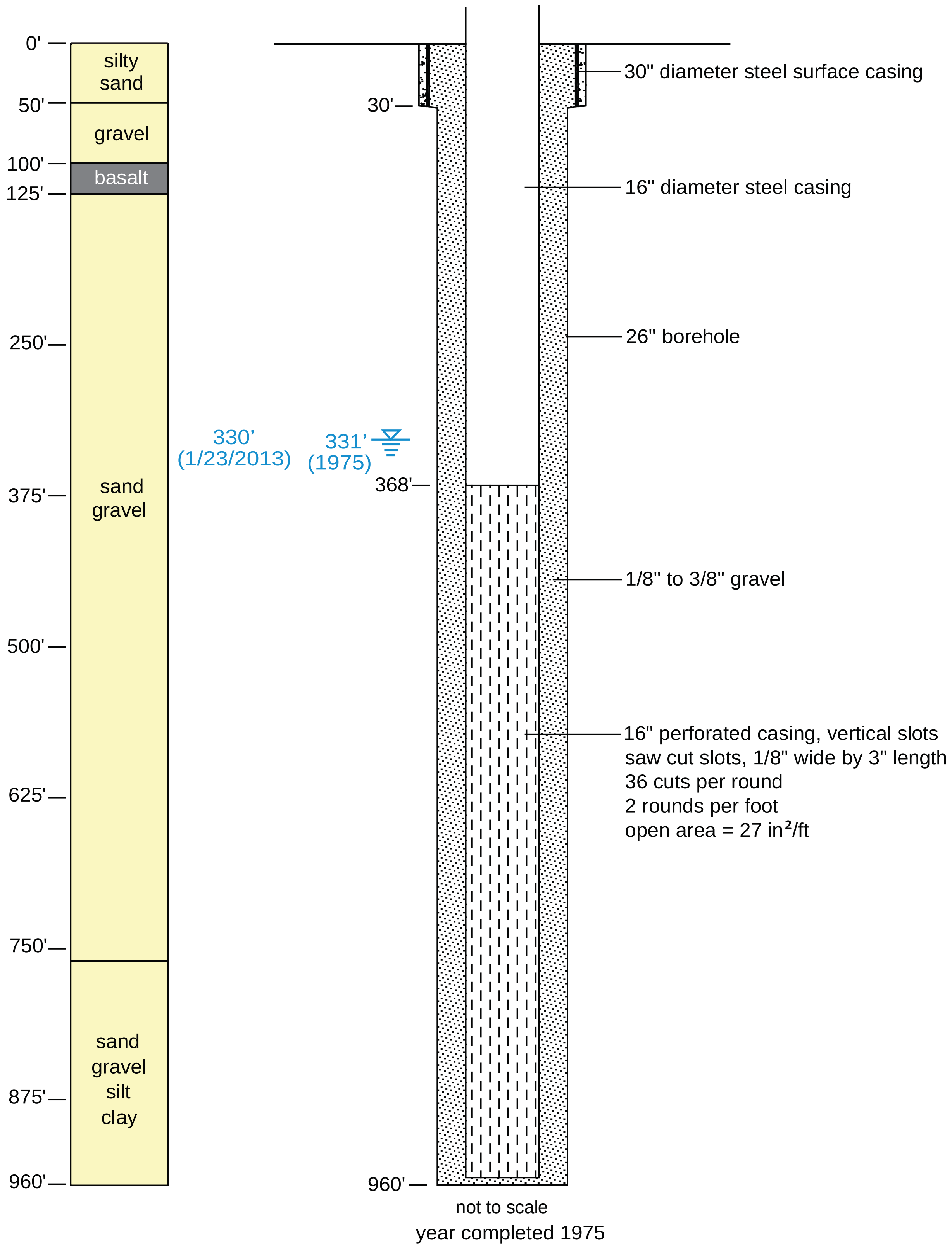


Figure B1. Well completion diagram for LRG-4652 (PW-1),
Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

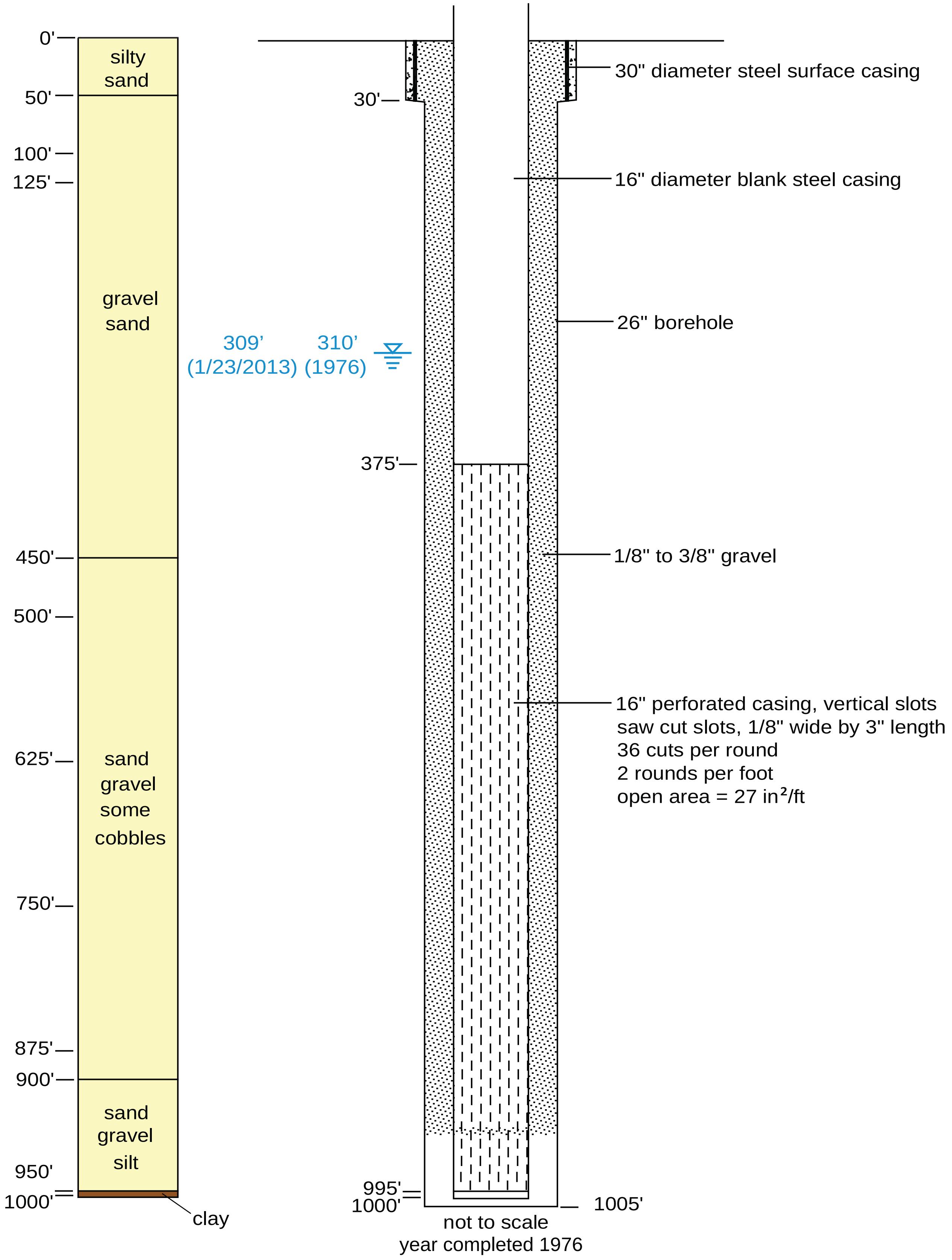


Figure B2. Well completion diagram for LRG-4652-S (PW-2), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

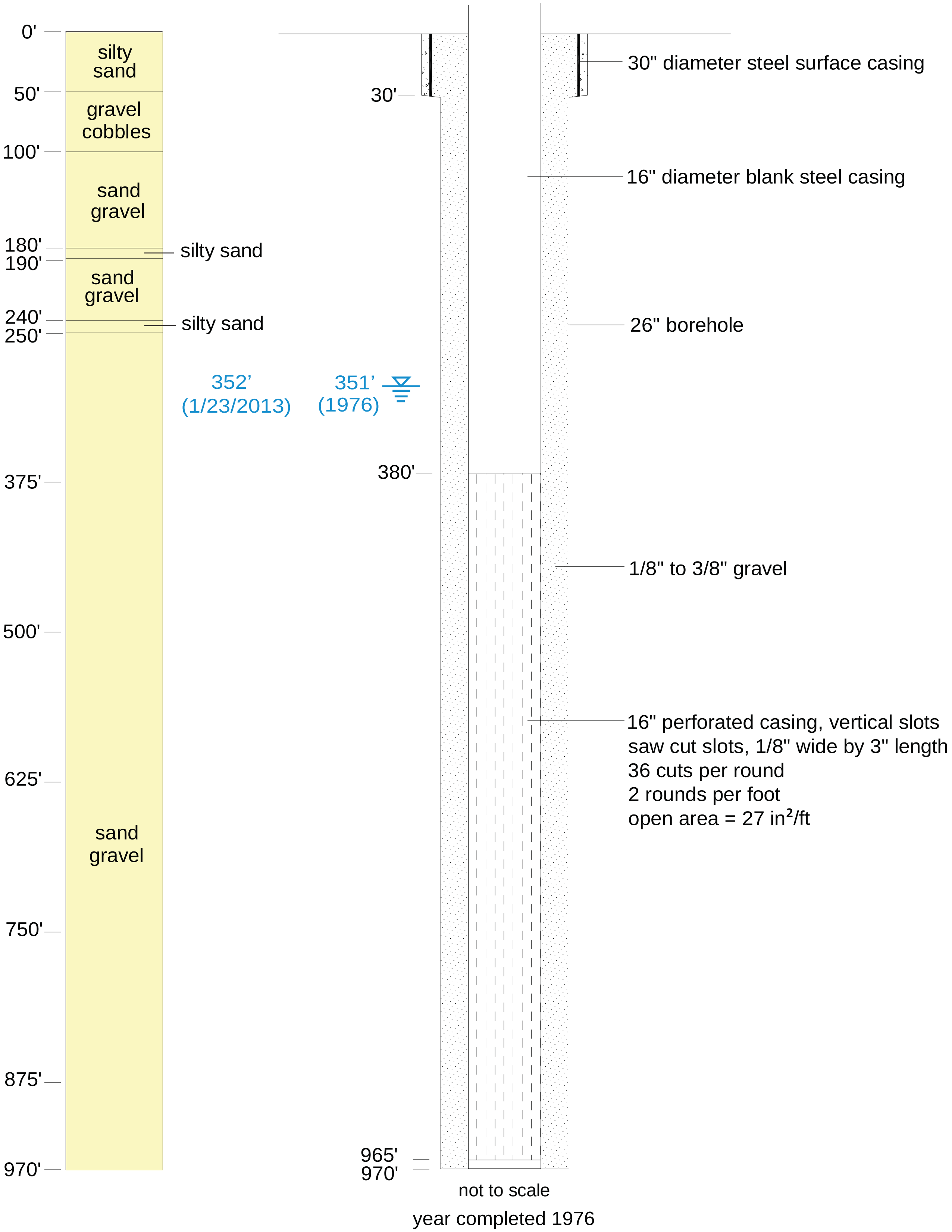
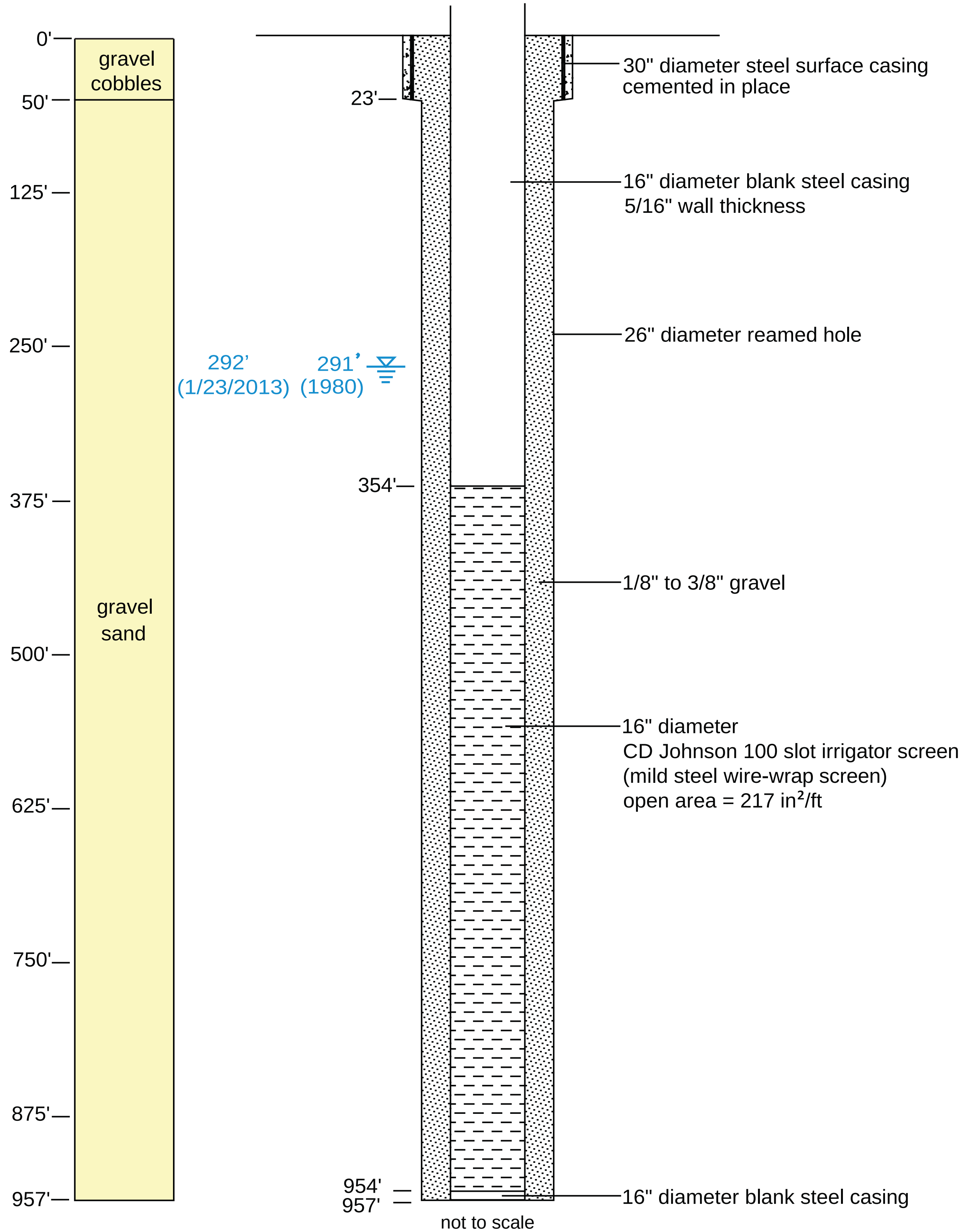


Figure B3. Well completion diagram for LRG-4652-S-2 (PW-3), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.



not to scale

year completed 1980

Figure B4. Well completion diagram for LRG-4652-S-3 (PW-4), Copper Flat Mine, Sierra County, New Mexico.

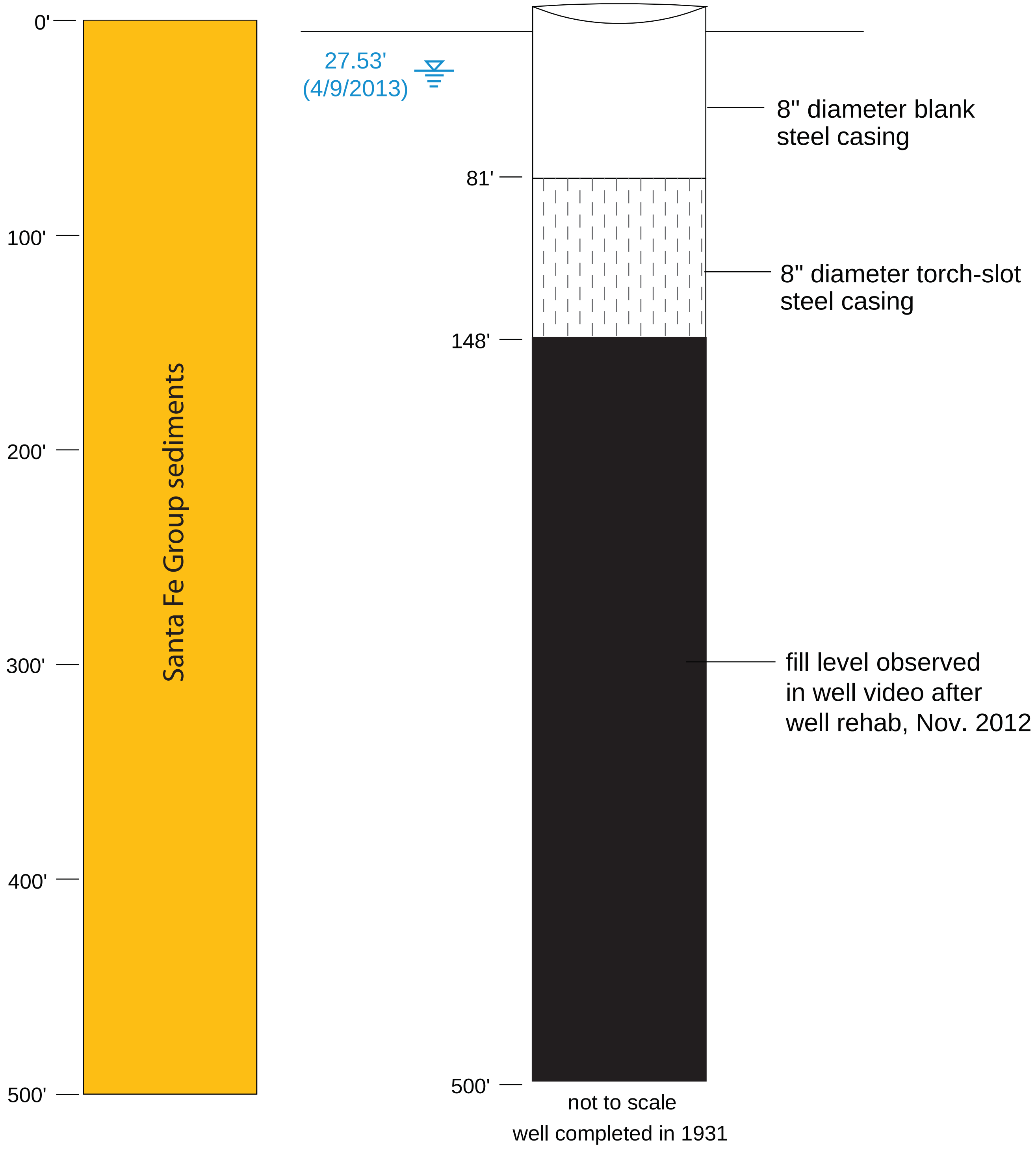


Figure B5. Well completion diagram for LRG-4652-S-4 (GWQ-8),
Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

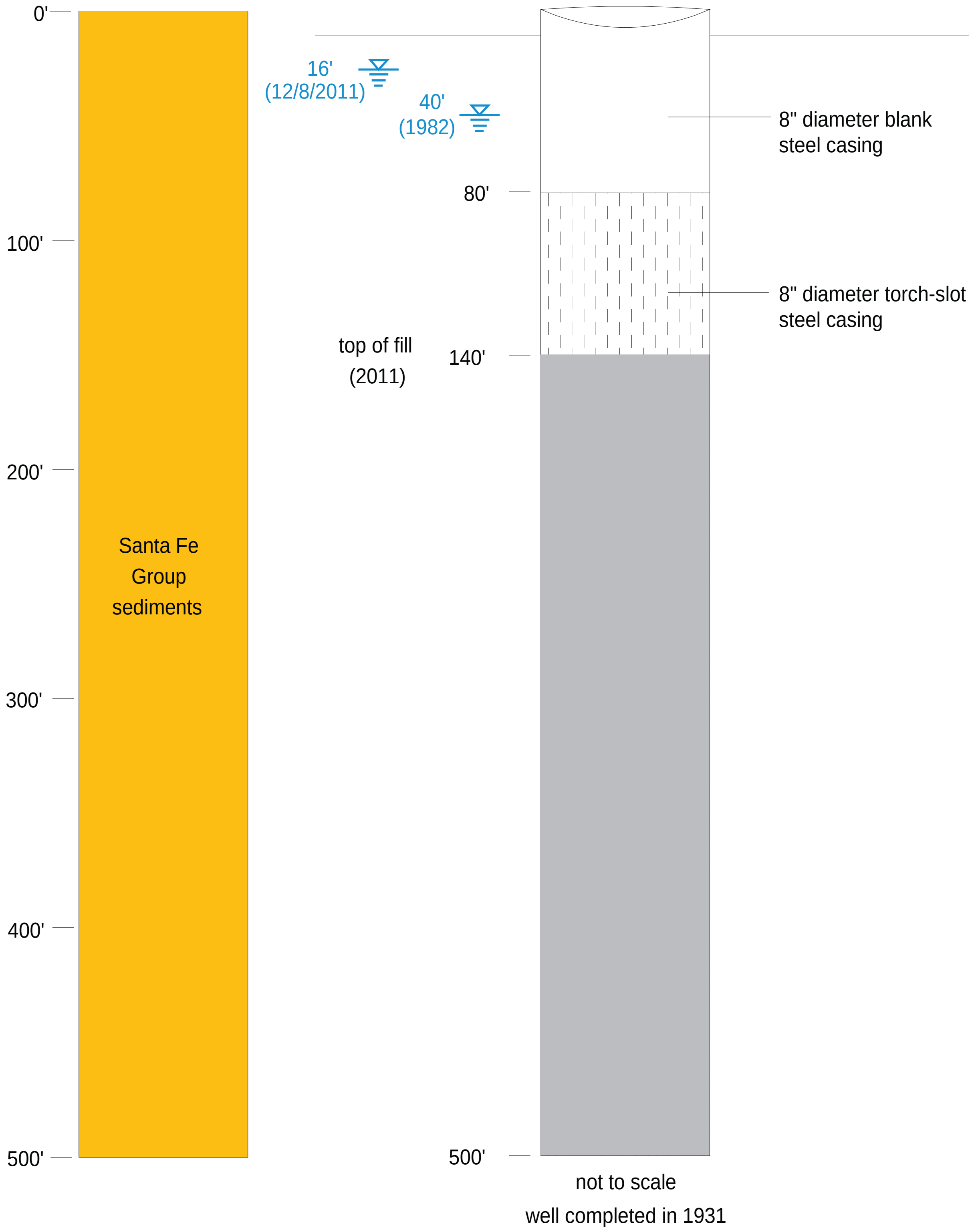


Figure B6. Well completion diagram for LRG-4652-S-5 (McCravery-Grayback), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

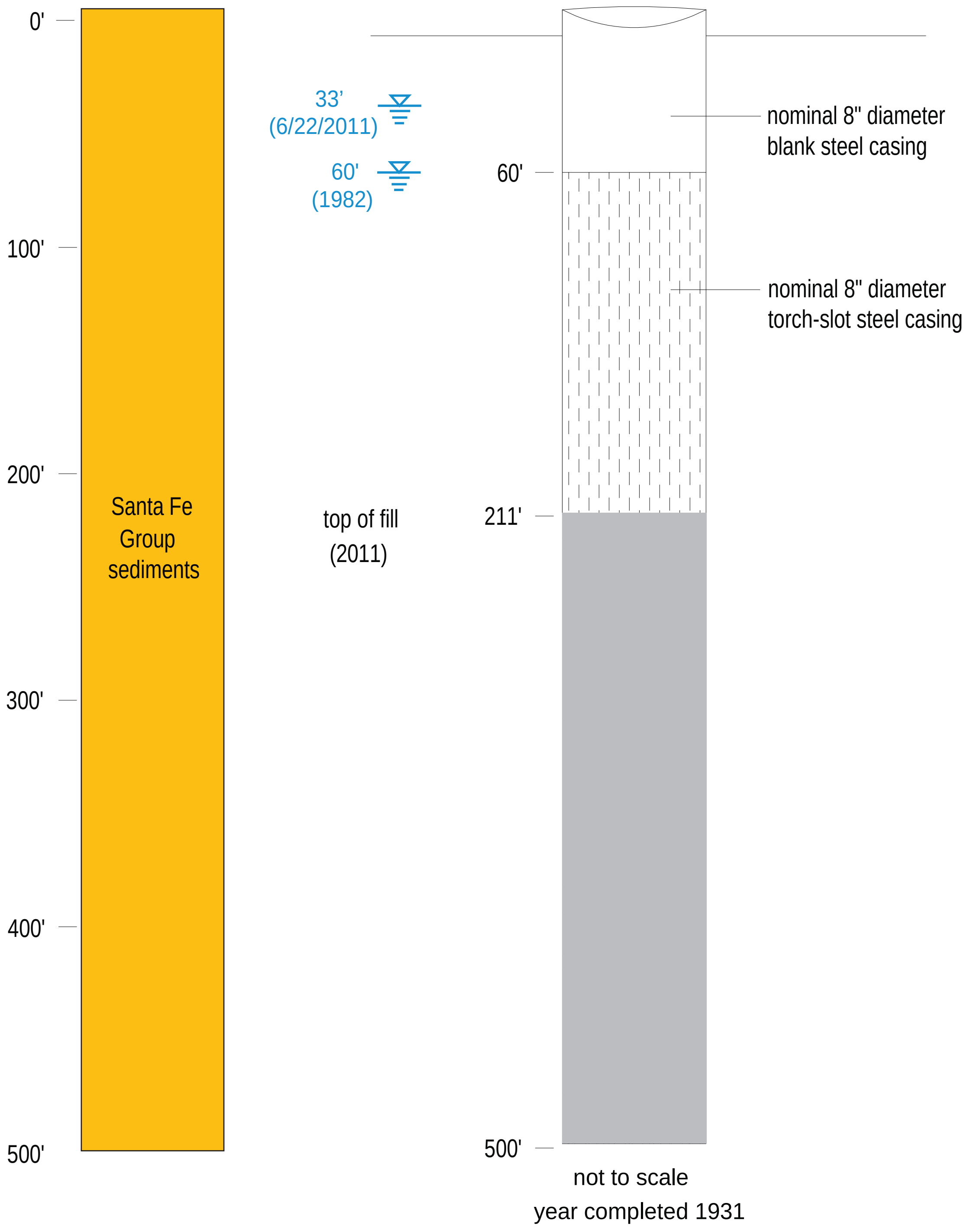


Figure B7. Well completion diagram for LRG-4652-S-6 (GWQ-2), Copper Flat Mine, Sierra County, New Mexico.

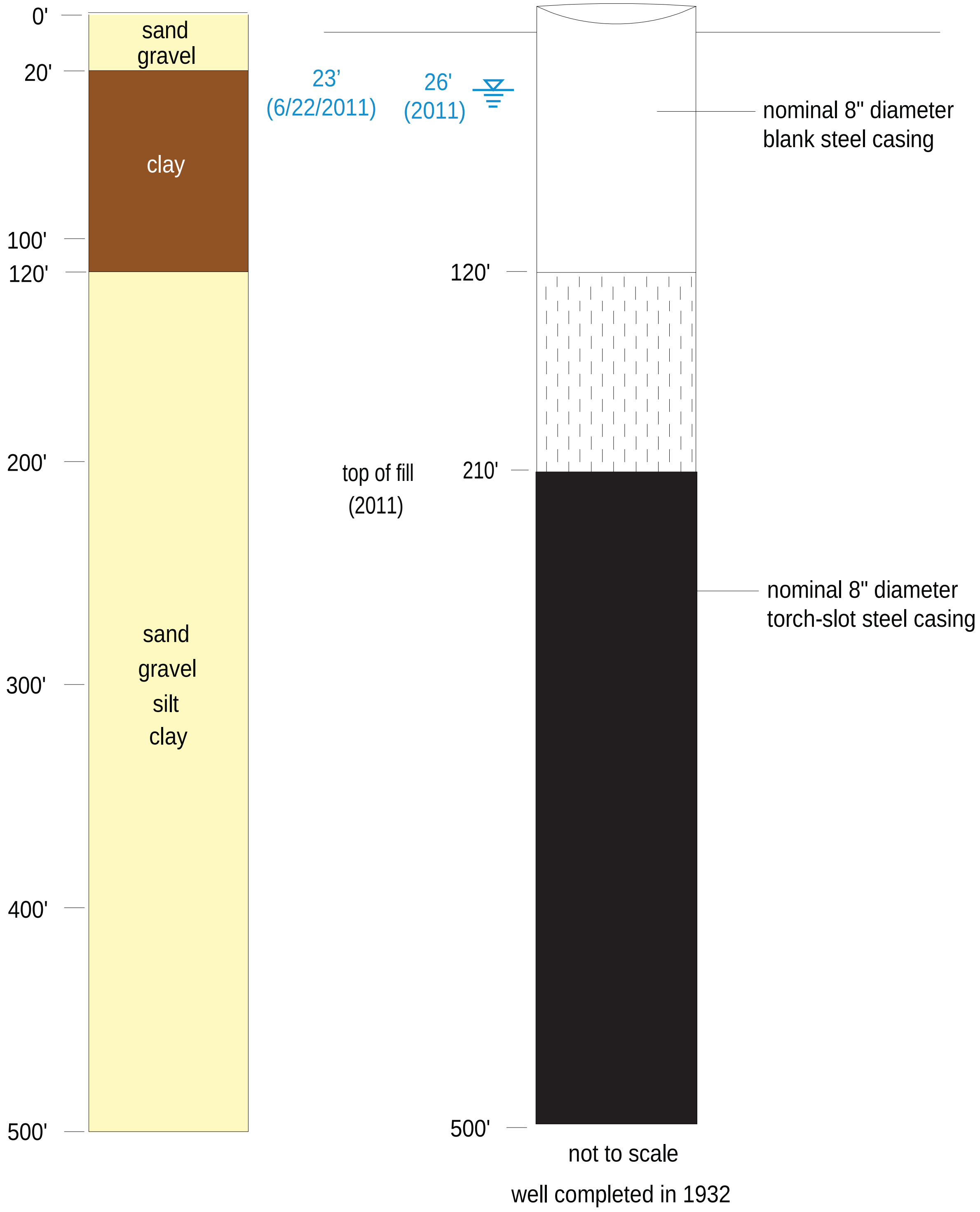


Figure B8. Well completion diagram for LRG-4652-S-7 (Irwin Well), Copper Flat Mine, Sierra County, New Mexico.

8-22-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

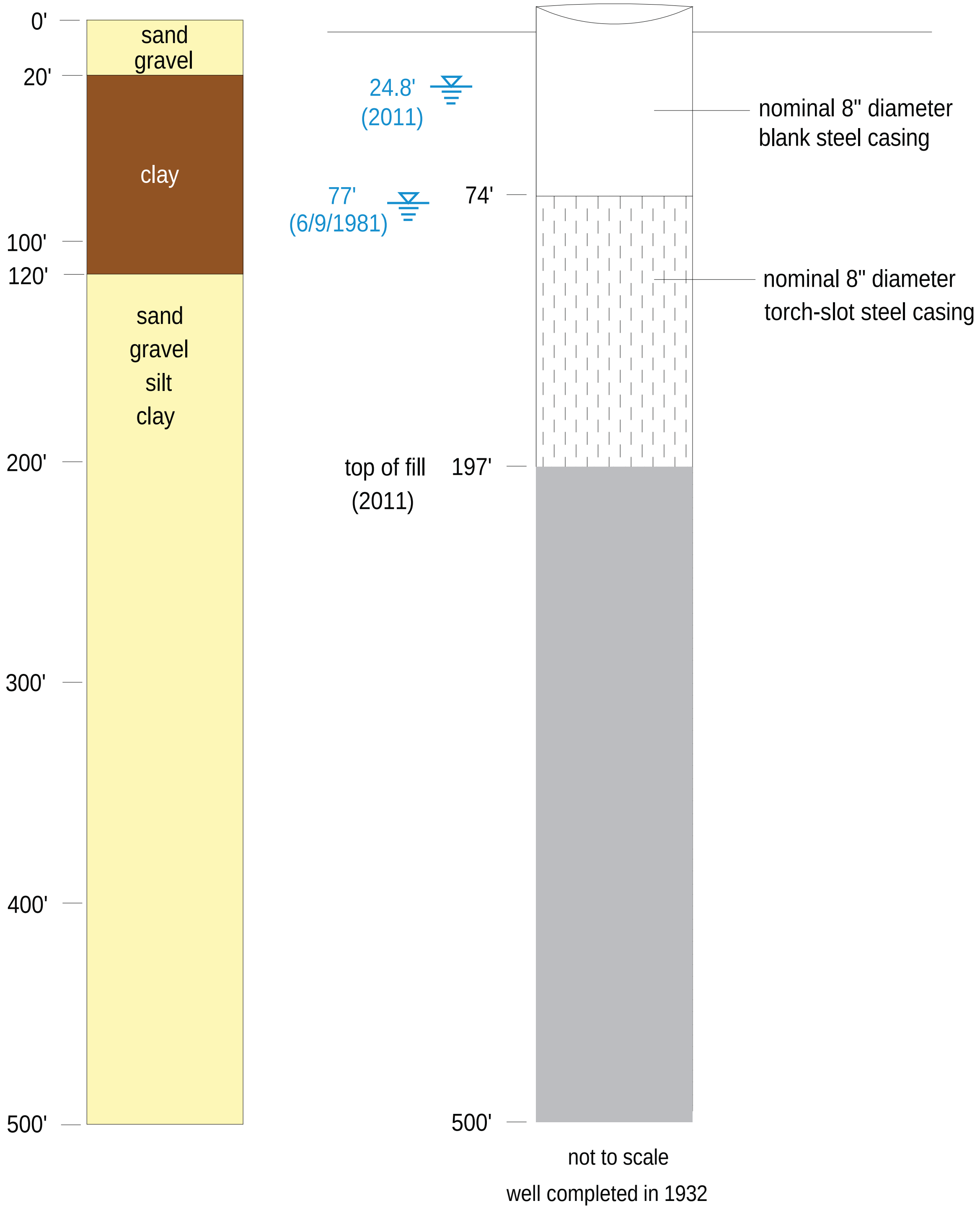


Figure B9. Well completion diagram for LRG-4652-S-8 (GWQ-7, Office Well),
Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

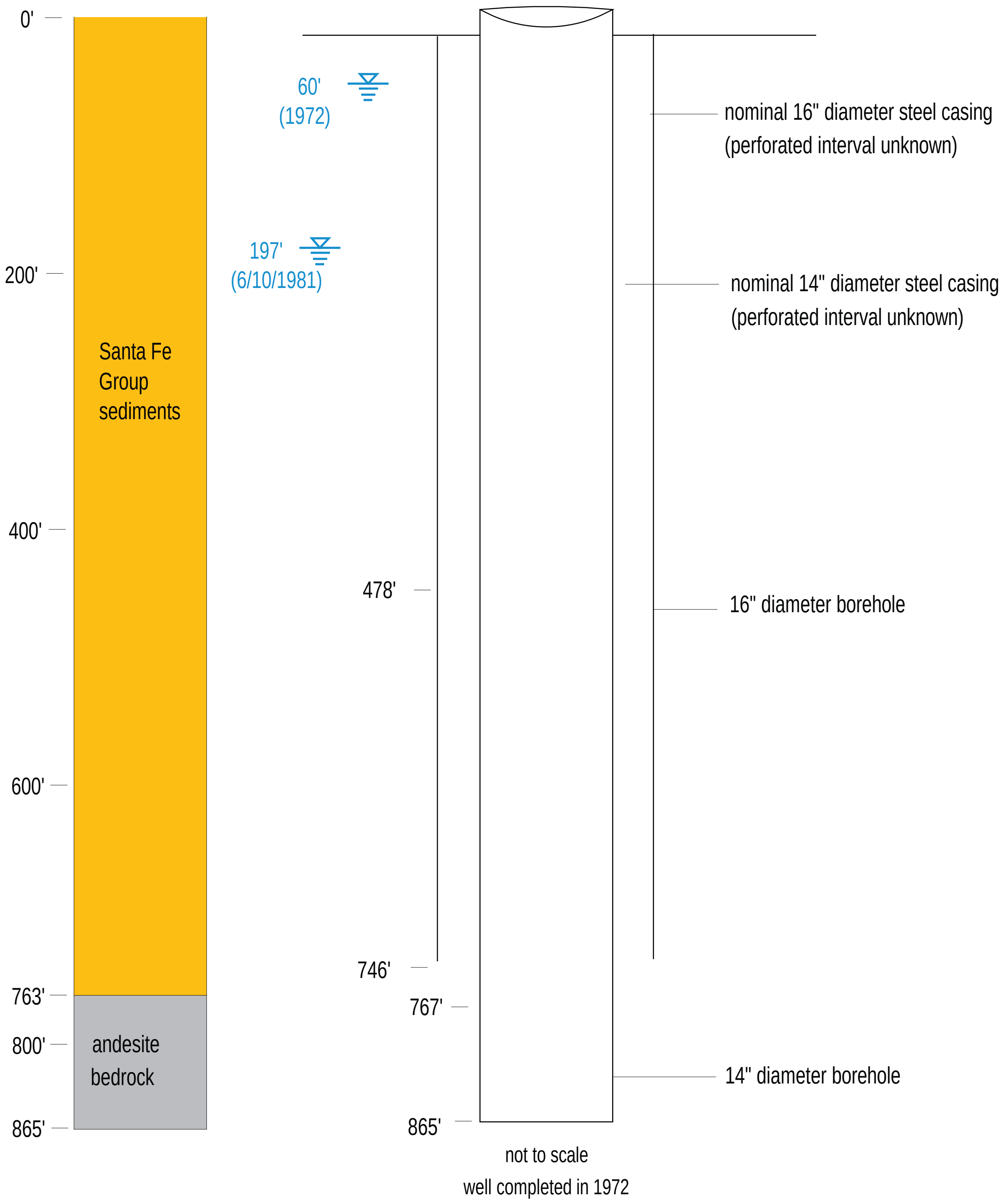


Figure B10. Well completion diagram for LRG-4652-S-9 (GWQ-9, South Inspiration, Well IDW-1), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

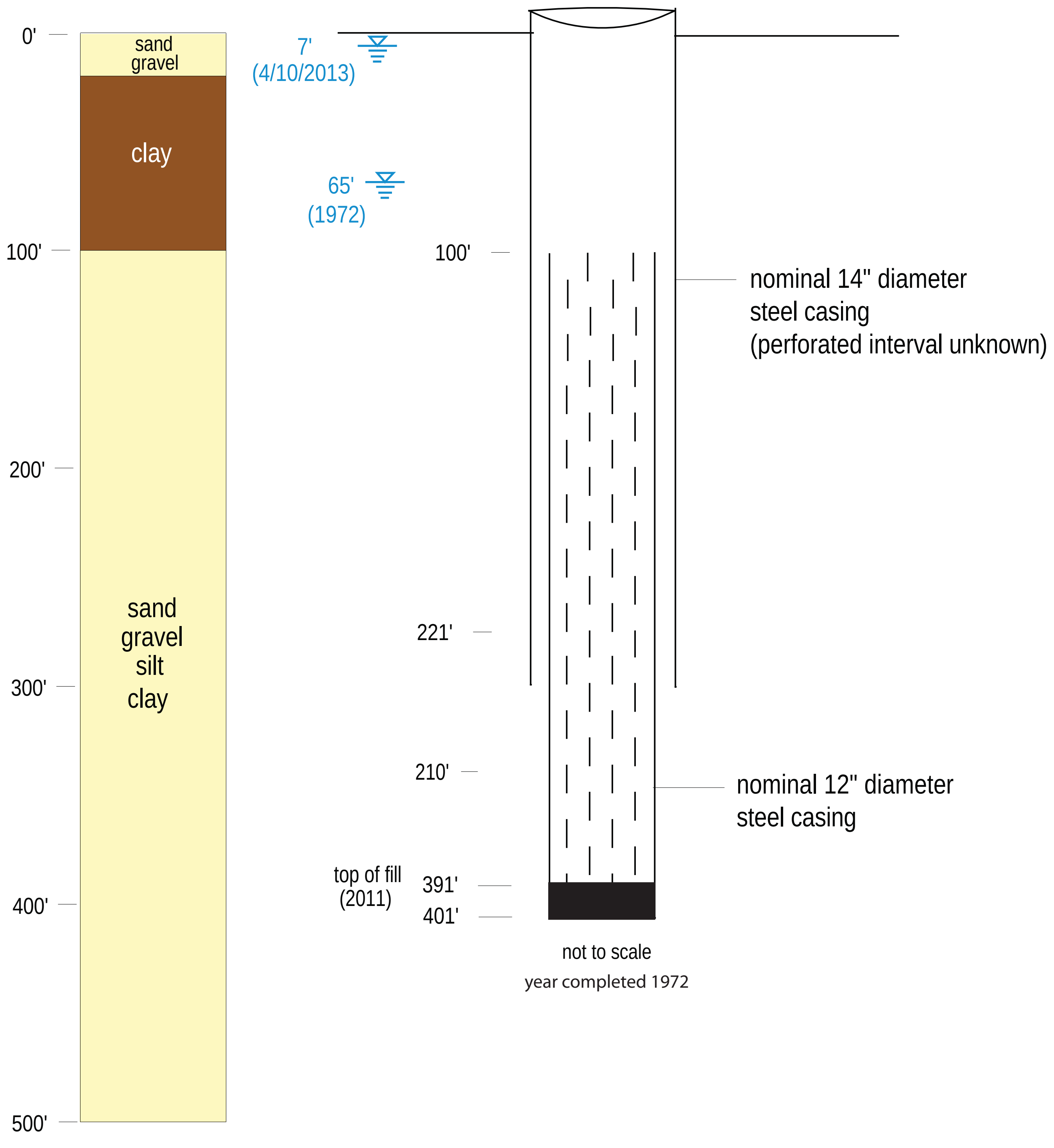


Figure B11. Well completion diagram for LRG-4652-S-10 (GWQ-1, North Inspiration, Well IDW-2, S-10), Copper Flat Mine, Sierra County, New Mexico.

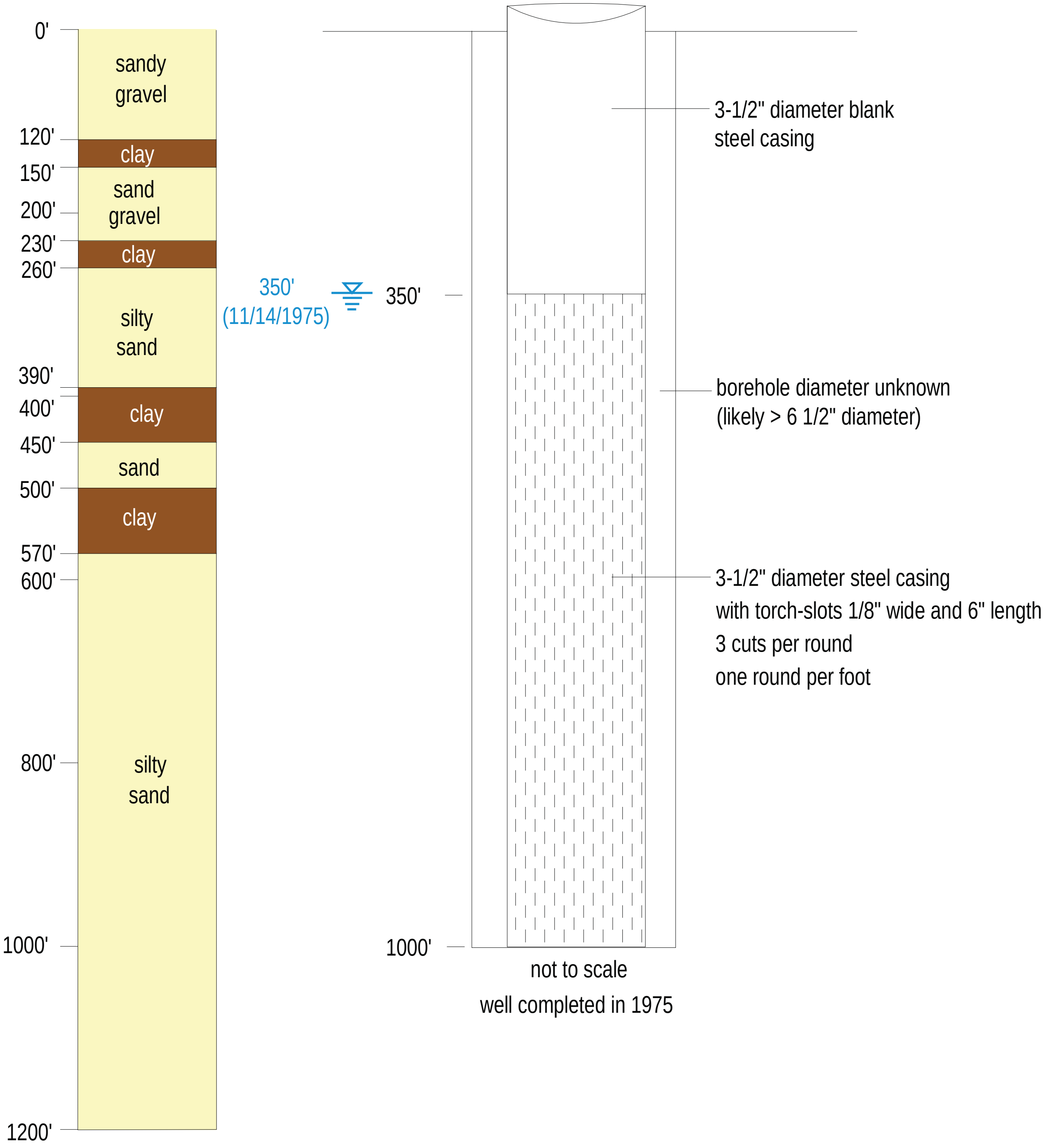


Figure B12. Well completion diagram for LRG-4652-S-11 (MW-1), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

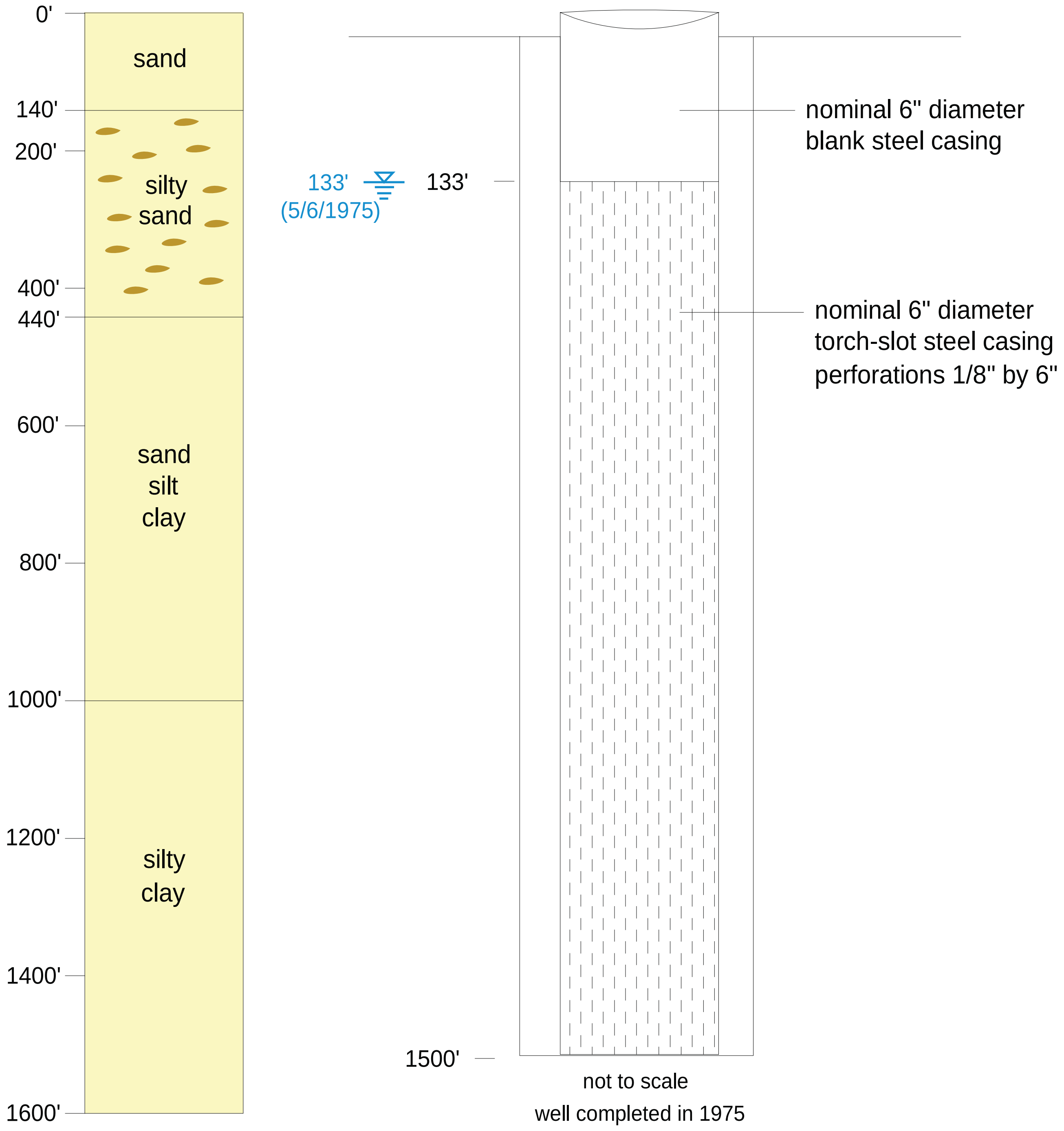


Figure B13. Well completion diagram for LRG-4652-S-12 (MW-2),
Copper Flat Mine, Sierra County, New Mexico.

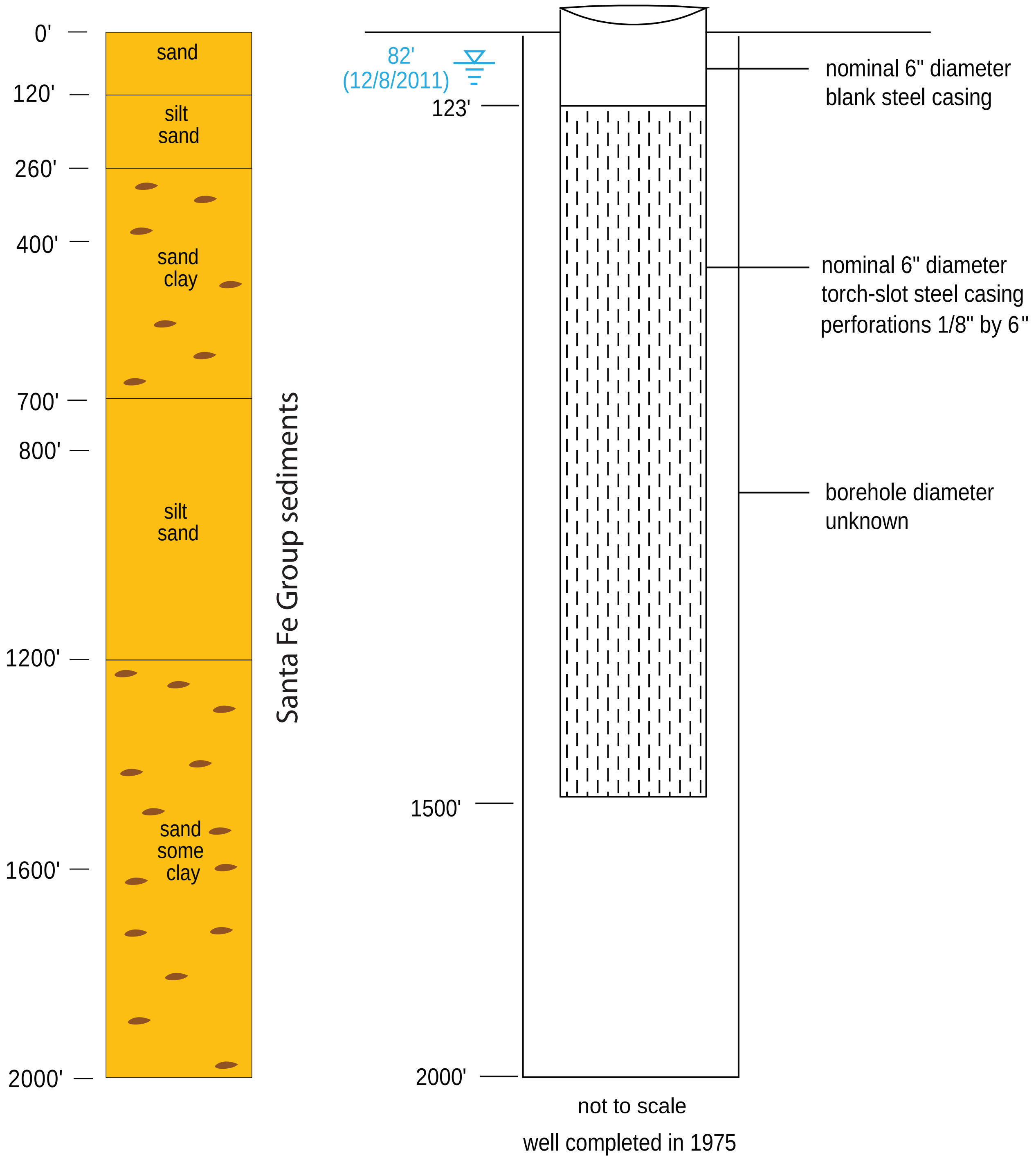


Figure B14. Well completion diagram for LRG-4652-S-13 (MW-4), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

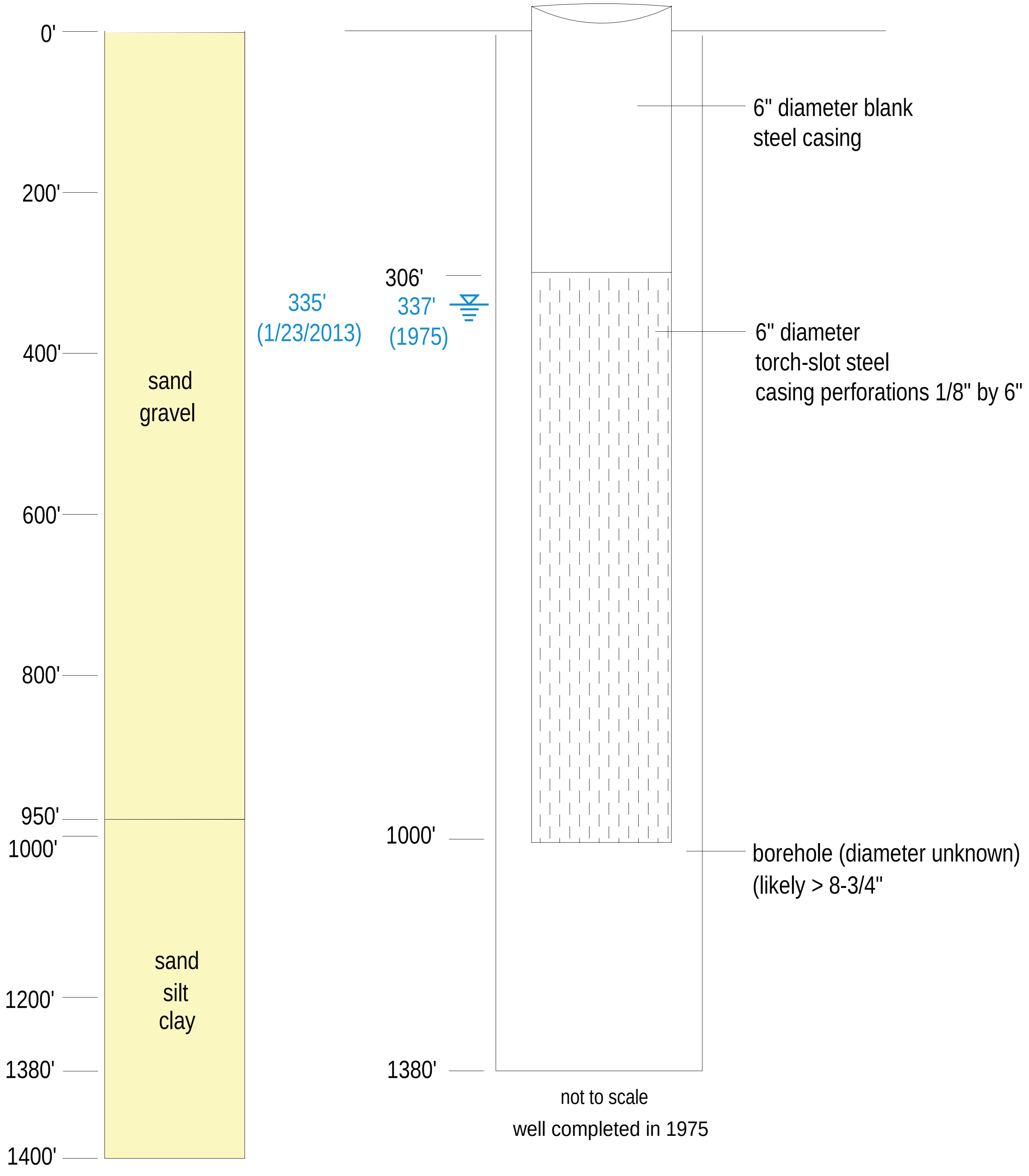


Figure B15. Well completion diagram for LRG-4652-S-14 (MW-5), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

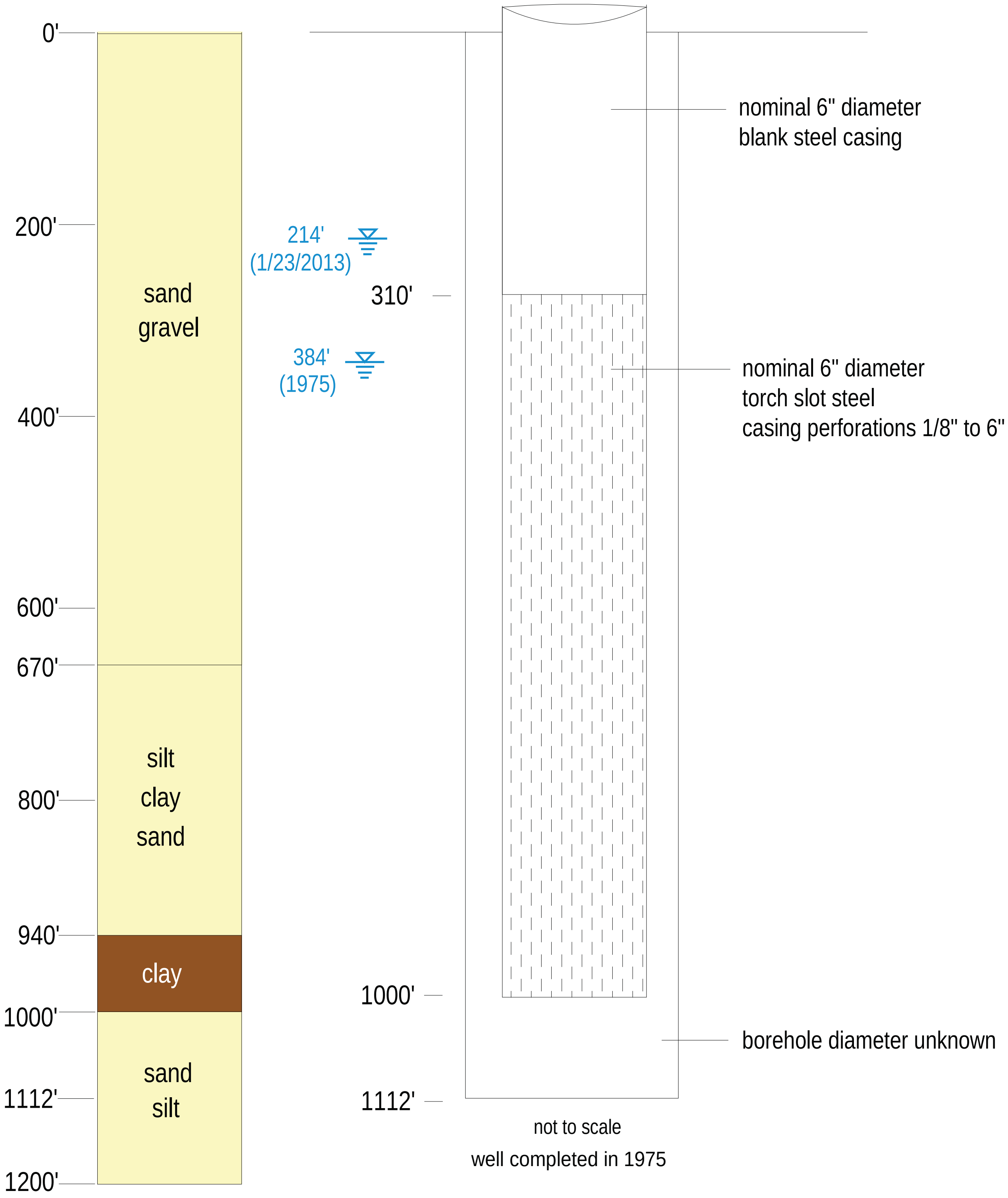


Figure B16. Well completion diagram for LRG-4652-S-15 (MW-6), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

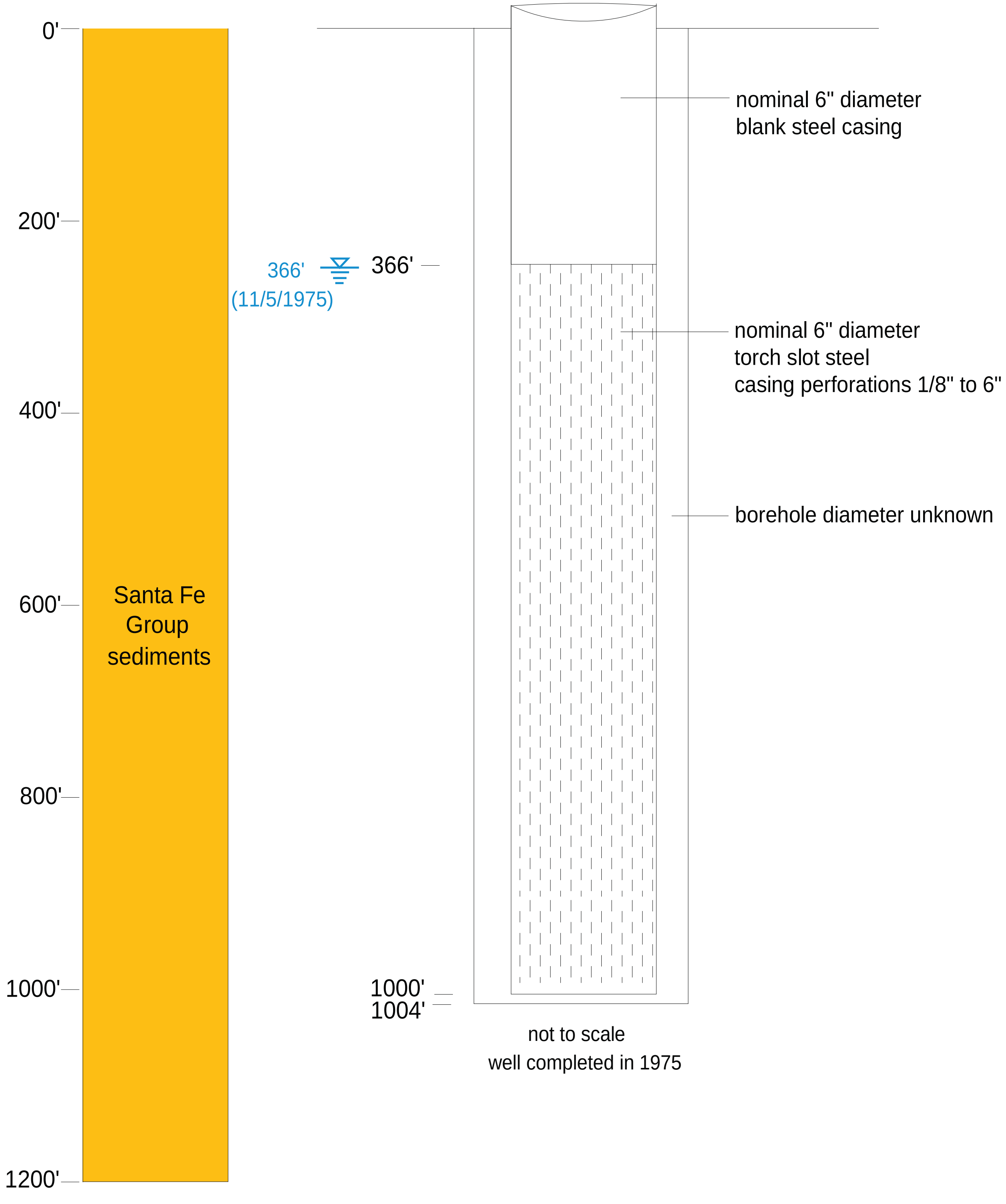


Figure B17. Well completion diagram for LRG-4652-S-16 (MW-8), Copper Flat Mine, Sierra County, New Mexico.

8-21-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

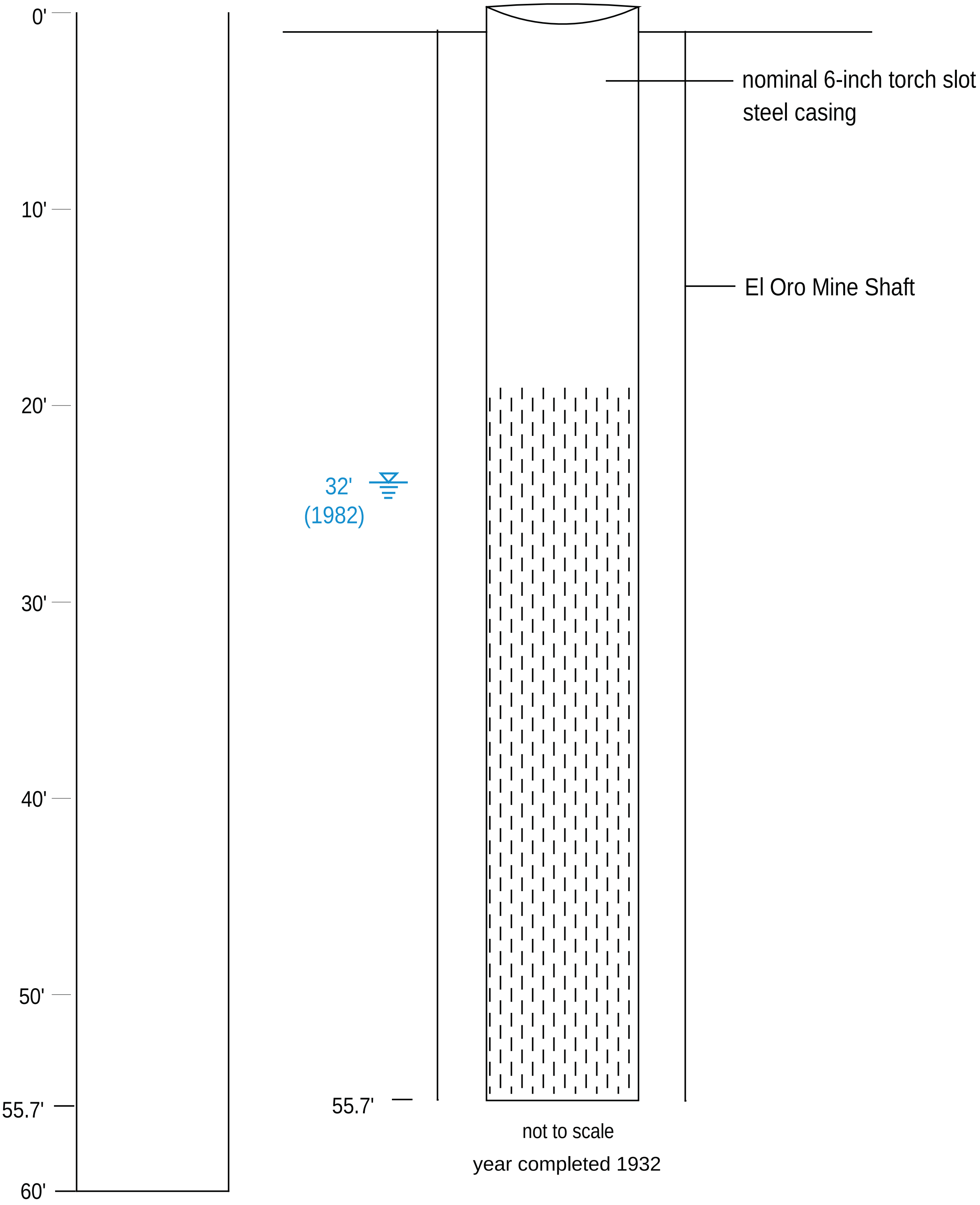
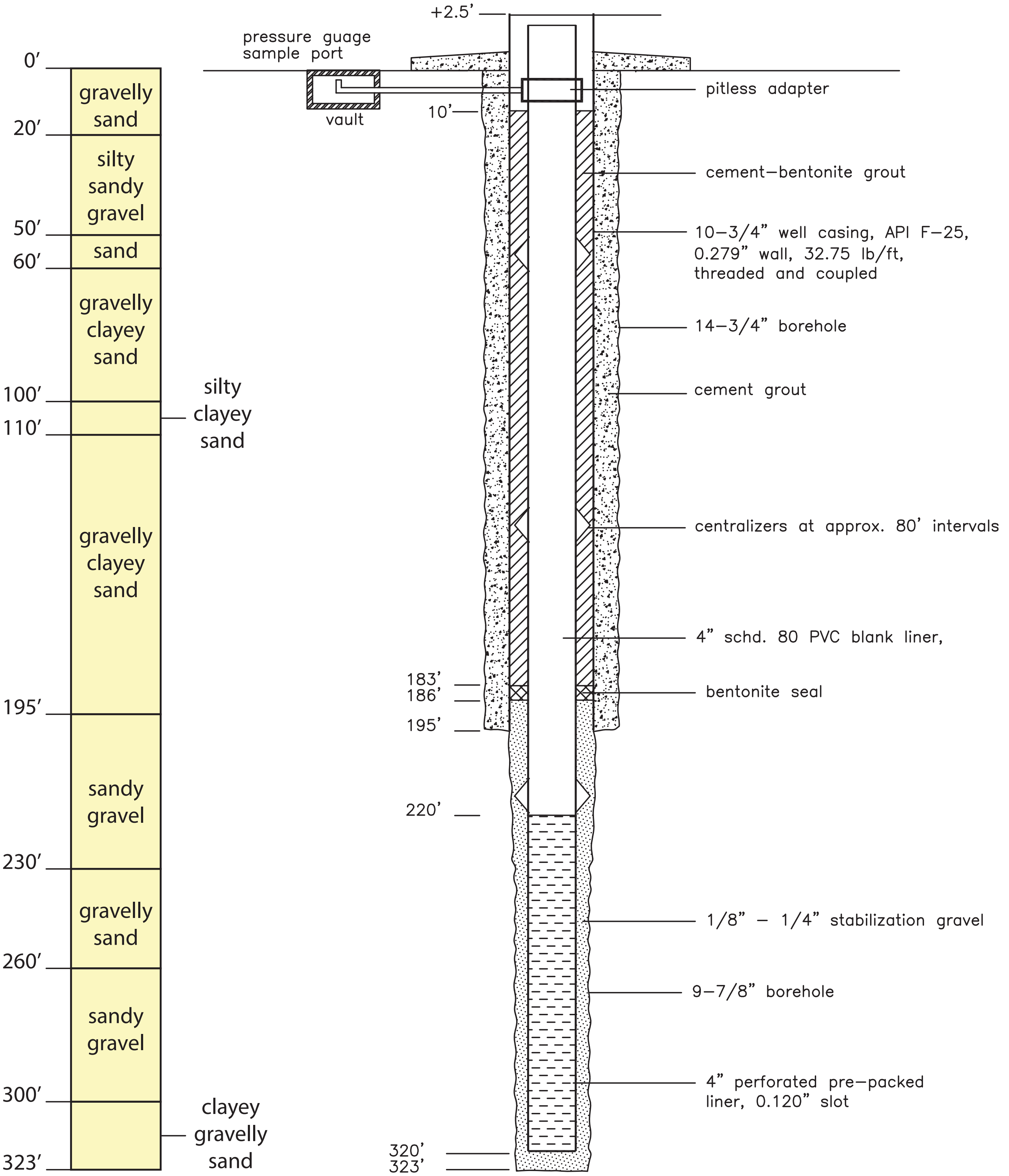


Figure B18. Well completion diagram for LRG-4654 (Old El Oro, Dolores), Copper Flat Mine, Sierra County, New Mexico.



not to scale
depths approximate
completed December 21, 2012
flowed at 19.5 gpm with a close in pressure of 15 psi

Figure B19. Well completion diagram for GWQ-11-27 (LA 00228 POD 1), Copper Flat Mine, Sierra County, New Mexico

2-21-2014

JOHN SHOMAKER & ASSOCIATES, INC.

Steffen Robertson and Kirsten
Engineering and Environmental Consultants

LOG OF MONITORING WELL MW-9

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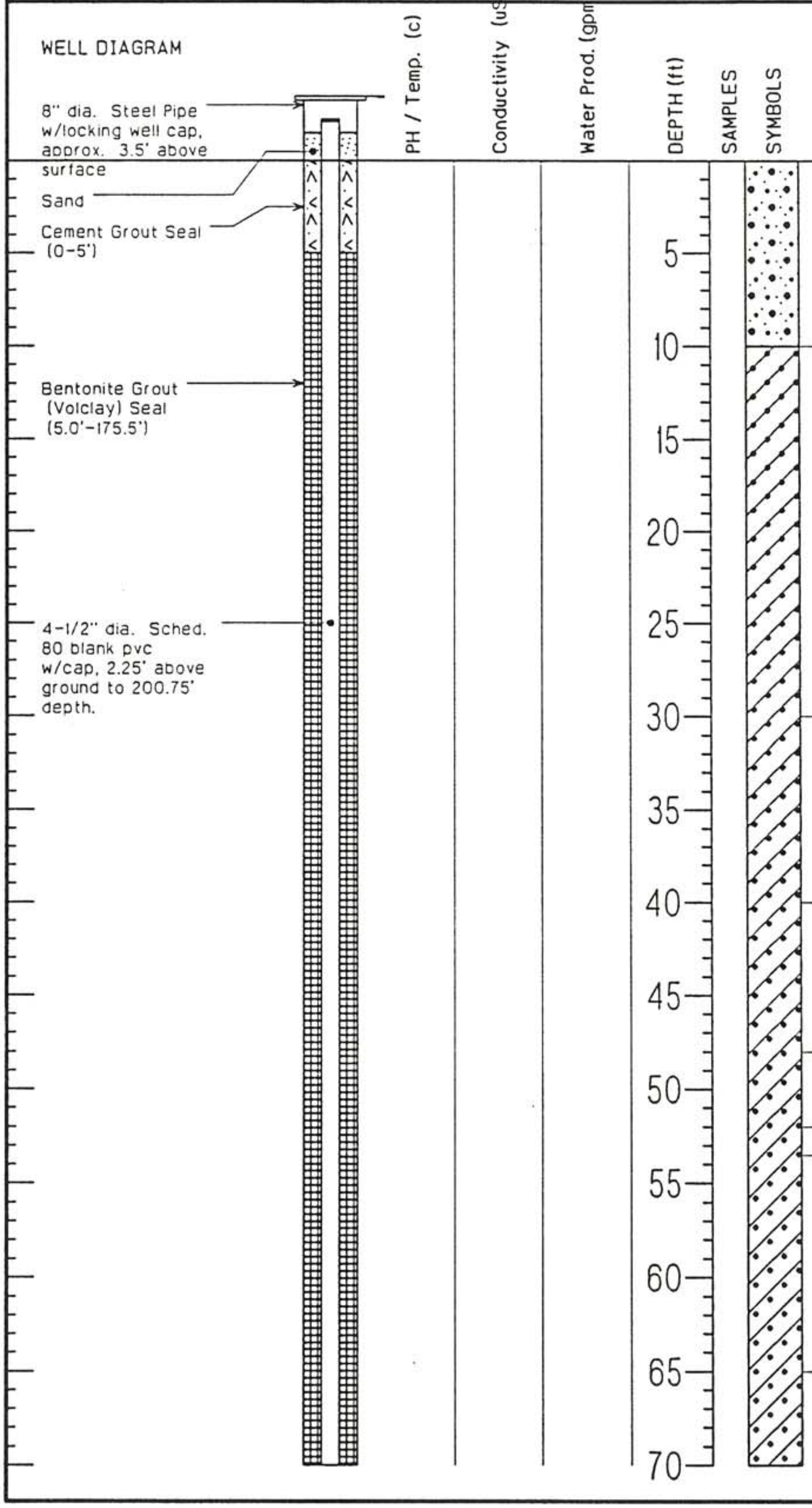


MATERIALS DESCRIPTION

0-10', Soil/gravel, dark brown, w/abundant, silt, sand, cobbles/pebbles, wet @ 8'

7.75', ENCOUNTERED GROUNDWATER

10'-30', Alluvial gravels, varying amounts of silt/clay, sand & silt, abundant pebbles/cobbles very poorly sorted, Oxidized, wet

30'-40', Gravel, brown-slightly red brown, within clayey matrix very poorly sorted, min.-mod. sand, Oxidized, wet

40'-48', Gravel, as above with less clay/silt matrix.

48'-52', Gravel, brown-red brown within clay/silt matrix, min.-mod. sand very poorly sorted, wet.

52'-53.5', Gravel, as at 40'-48', relatively clean

53.5'-65', Gravel, brown-red brown, moderate-abundant clay/silt matrix, minor sand, very poorly sorted; wet

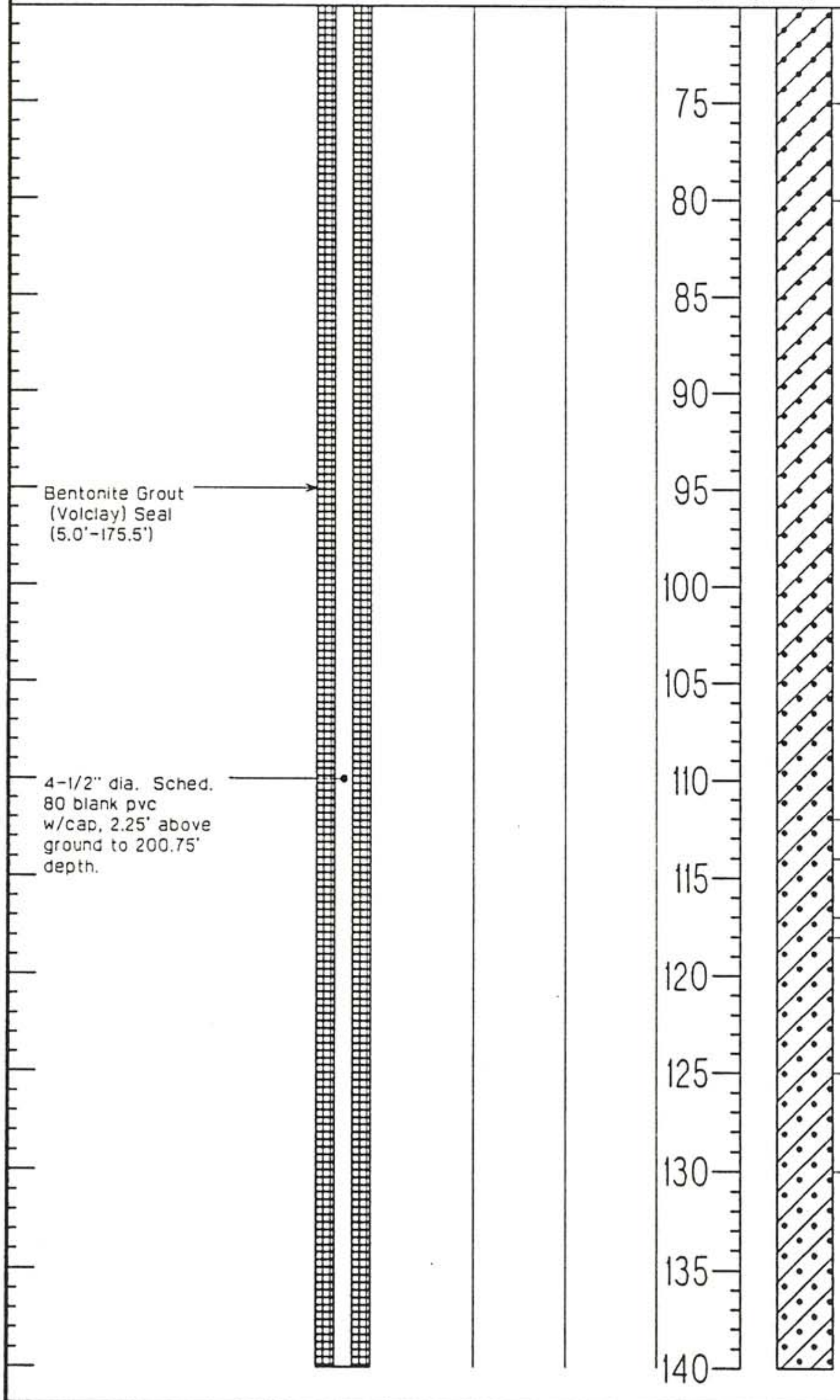
65'-75', clay, dark red-brown, w/min.-mod. sand & pebbles, no cobbles, moist-wet, very smooth drilling

PROJECT Copper Flat - Hillsboro, N.M.
LOCATION N713191.10, E603249.22 N.M. S.P.C.
JOB NUMBER 68607 (ref: 68607M9)
GEOLOGIST C.W.
DRILL RIG Air Rotary

DRILLING COMPANY Beylik Drilling
DATE DRILLED 09/20/94 - 09/26/94
SURFACE ELEVATION 4440.14
TOTAL DEPTH OF HOLE 252.50 Feet
WATER LEVEL Static, from TOC on 11/7/94: 71.05 Feet

LOG OF MONITORING WELL MW-9

WELL DIAGRAM	PH / Temp. (c)	Conductivity (uS/m)	Water Prod. (gpm)	DEPTH (ft)	SAMPLES	SYMBOLS	MATERIALS DESCRIPTION



75'-80', Gravel, very clayey/silty matrix, red-brown, trace-min. sand, very poorly sorted, wet

80'-112', Gravel, light-med brown-grey brown, min.-mod. dry/silt, min.-mod. sand, wet. Very clayey zone @ 80'-82'.

112'-114', Gravel, med. brown-red brown in clayey matrix, min.-mod. sand, wet.

114'-117', Gravel, dark brown-red brown, min.- mod. clay/silt, trace sand, wet.

117'-118', As at 114-117 with abundant clay/silt.

118'-125', Gravel, med. red brown, min.-mod. clay/silt matrix, trace-min. sand, Oxidized.

125'-130', Gravel, dark brown-red brown, abundant clay/silt matrix, min. sand, Oxidized

130'-150', Gravel, med. red brown, mod. silt/clay matrix, very poorly sorted, Oxidized.

PROJECT Copper Flat - Hillsboro, N.M.
LOCATION N713191.10, E603249.22 N.M. S.P.C.
JOB NUMBER 68607 (ref: 68607M9)
GEOLOGIST C.W.
DRILL RIG Air Rotary

DRILLING COMPANY Beylik Drilling
DATE DRILLED 09/20/94 - 09/26/94
SURFACE ELEVATION 4440.14
TOTAL DEPTH OF HOLE 252.50 Feet
WATER LEVEL Static, from TOC on 11/7/94: 71.05 Feet

Steffen Robertson and Kirsten
Engineering and Environmental Consultants

LOG OF MONITORING WELL MW-9

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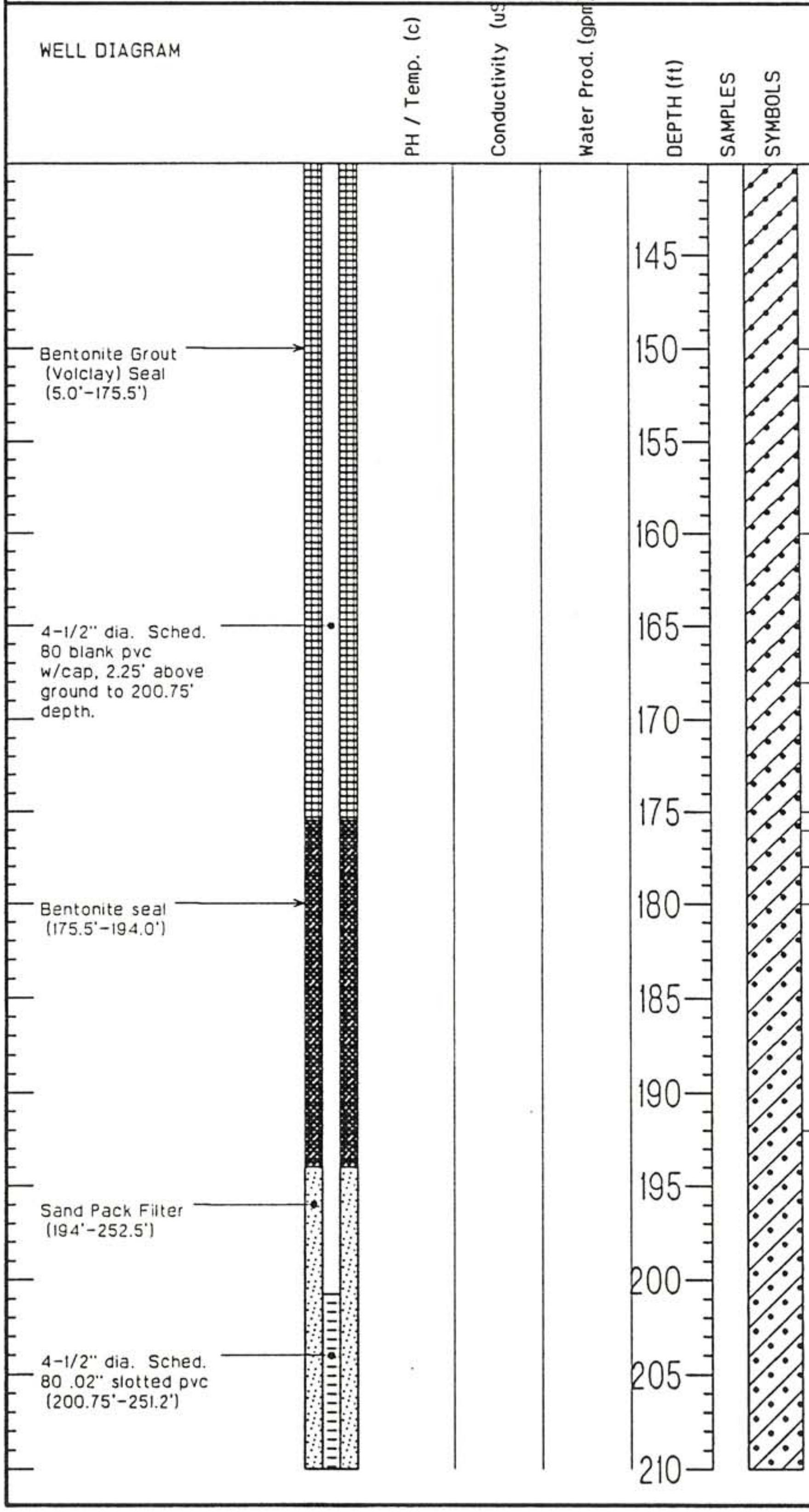


MATERIALS DESCRIPTION

130'-150', Gravel, med. red brown, mod. silt/clay matrix, very poorly sorted, Oxidized.

150'-152', Gravel as above w/abundant clay/silt matrix.

152'-160', Gravel, med. red brown, mod. clay/silt matrix material (less than @ 150-152)

160'-168', Gravel, dark red brown, abundant clay/silt matrix

168'-175', Gravel, medium brown-red brown, min.- mod. clay/silt matrix (most of matrix material washed out of cuttings)

175'-176', Sand in clay/silt matrix, med-very coarse, minor pebbles.

176'-178', Gravel, dark grey brown - red brown, w/min. - mod. clay/silt matrix, wet w/mod. sand.

178'-180', Gravel, brown-red brown, mod. sand, mod.-abundant clay/silt, Oxidized.

180'-192', Gravel, red brown, min.- mod. sand, min.- mod. clay/silt matrix, wet.

192'-202', Gravel, dark brown-red brown, mod.- abundant clay/silt matrix.

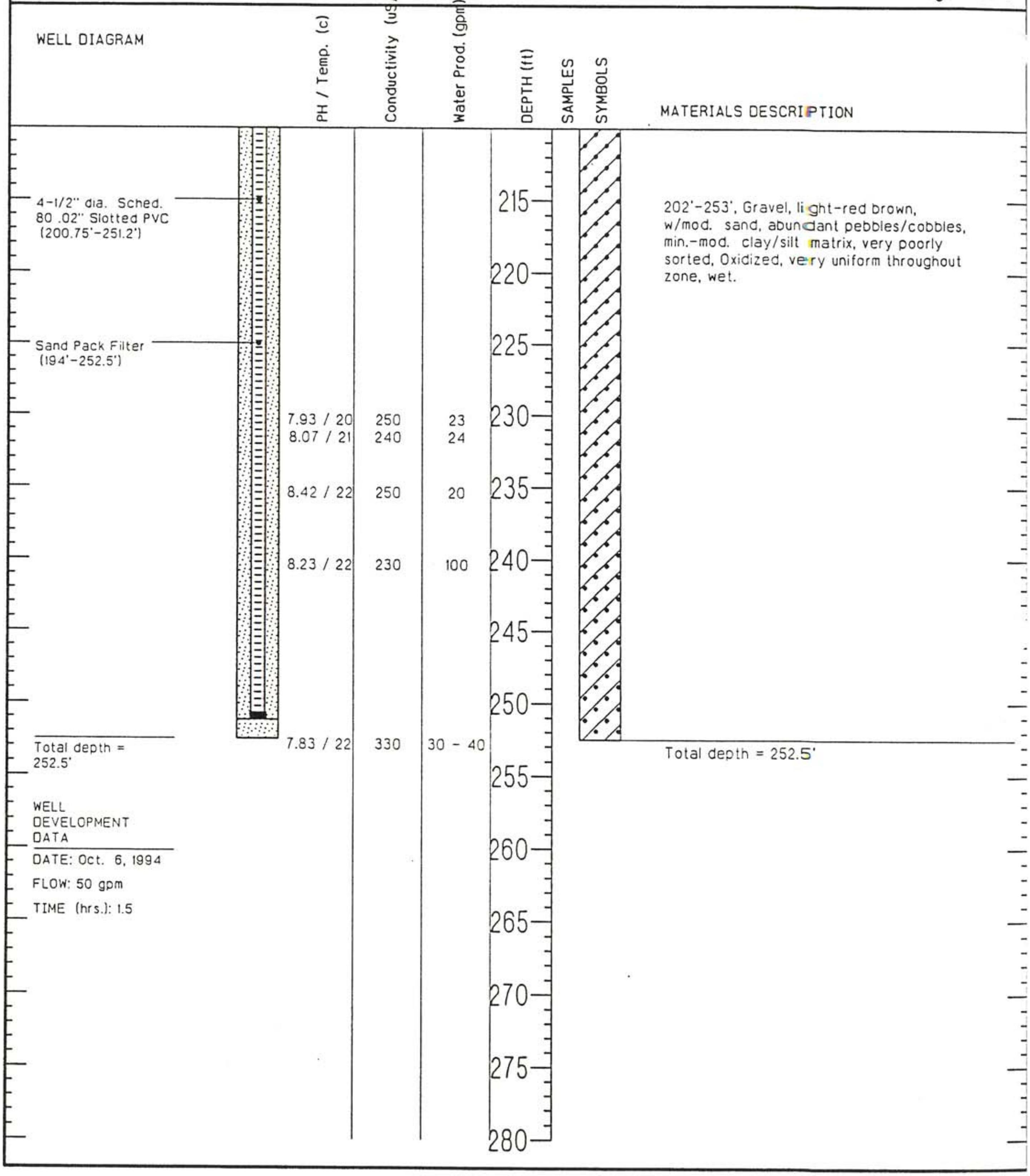
202'-253', Gravel, light-red brown, w/mod. sand, abundant pebbles/cobbles, min.- mod. clay/silt matrix, very poorly sorted, Oxidized, very uniform throughout zone, wet.

PROJECT	Copper Flat - Hillsboro, N.M.	DRILLING COMPANY	Beylik Drilling
LOCATION	N713191.10, E603249.22 N.M. S.P.C.	DATE DRILLED	09/20/94 - 09/26/94
JOB NUMBER	68607 (ref: 68607M9)	SURFACE ELEVATION	4440.14
GEOLOGIST	C.W.	TOTAL DEPTH OF HOLE	252.50 Feet
DRILL RIG	Air Rotary	WATER LEVEL	Static, from TOC on 11/7/94: 71.05 Feet

Steffen Robertson and Kirsten
Engineering and Environmental Consultants

LOG OF MONITORING WELL MW-9

Page 4 of 4



4-1/2" dia. Sched. 80 .02" Slotted PVC (200.75'-251.2')

Sand Pack Filter (194'-252.5')

PH / Temp. (c)	Conductivity (uS/m)	Water Prod. (gpm)
7.93 / 20	250	23
8.07 / 21	240	24
8.42 / 22	250	20
8.23 / 22	230	100
7.83 / 22	330	30 - 40

MATERIALS DESCRIPTION

202'-253', Gravel, light-red brown, w/mod. sand, abundant pebbles/cobbles, min.-mod. clay/silt matrix, very poorly sorted, Oxidized, very uniform throughout zone, wet.

Total depth = 252.5'

Total depth = 252.5'

WELL DEVELOPMENT DATA

DATE: Oct. 6, 1994
FLOW: 50 gpm
TIME (hrs.): 1.5

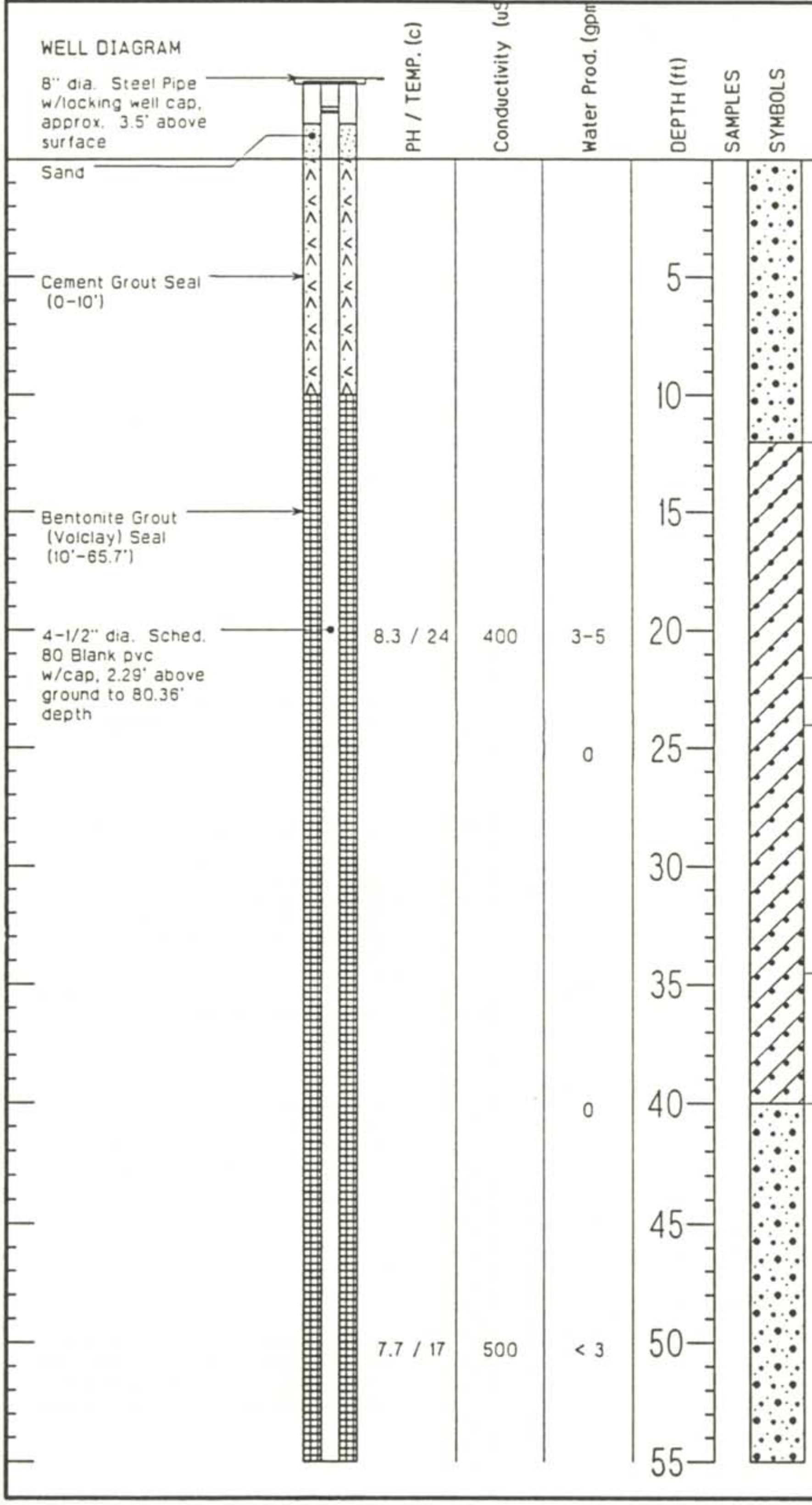
PROJECT Cooper Flat – Hillsboro, N.M.
LOCATION N713191.10, E603249.22 N.M. S.P.C.
JOB NUMBER 68607 (ref: 68607M9)
GEOLOGIST C.W.
DRILL RIG Air Rotary

DRILLING COMPANY Beylik Drilling
DATE DRILLED 09/20/94 - 09/26/94
SURFACE ELEVATION 4440.14
TOTAL DEPTH OF HOLE 252.50 Feet
WATER LEVEL Static, from TOC on 11/7/94: 71.05 Feet

Steffen Robertson and Kirsten
Engineering and Environmental Consultants

LOG OF MONITORING WELL MW-10

Page 1 of 3



DEPTH (ft)	PH / TEMP. (c)	Conductivity (uS/m)	Water Prod. (gpm)
20	8.3 / 24	400	3-5
25			0
40			0
50	7.7 / 17	500	< 3

MATERIALS DESCRIPTION

0 - 12', Gravelly soil, dark brown w/abundant cobbles & pebbles, and moderately abundant sand, silt soil, very poorly sorted, Oxidized, dry to 7.75'

Groundwater encountered @ 7.75'

12'-22', Gravel - medium brown-light red brown, min-mod clay/silt, Oxidized, wet

22'-24', Red-brown, abundant cobbles/pebbles, min-mod sand, abundant silt, Oxidized, no water

24-34.5', clay, brown-red brown, min pebbles, min-mod cobbles, "dry"

34.5-40', Gravel, grey brown, abundant brown-red brown clay/silt, Oxidized, "dry", tr-min sand

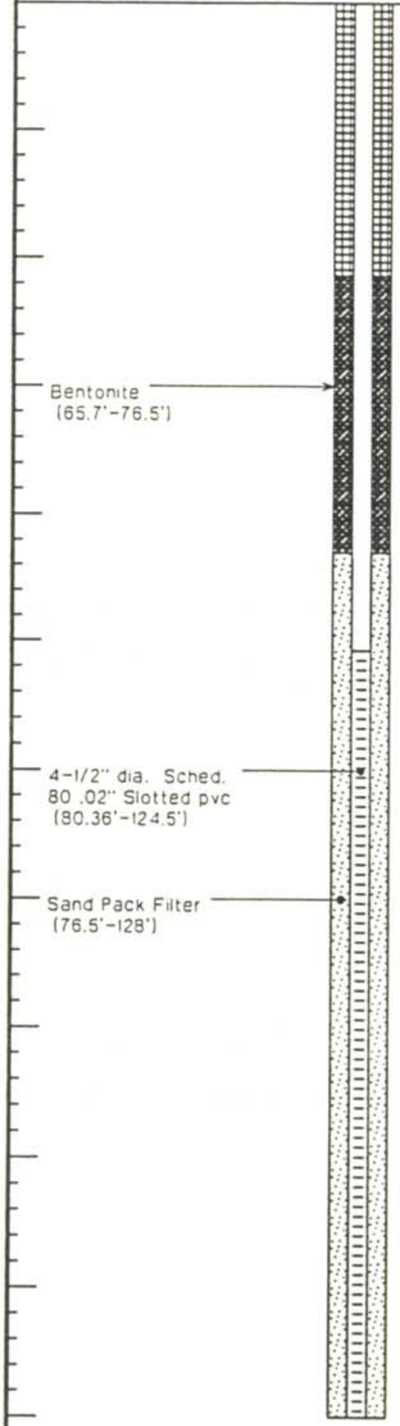
40-60', Gravel: med brown-red brown, abundant cobbles/pebbles, min-mod med-very coarse sand, "dry", Oxidized

PROJECT Copper Flat - Hillsboro, N.M.
LOCATION N719968.25, E636740.99 N.M. S.P.C.
JOB NUMBER 68607 (ref: 68607M10)
GEOLOGIST CW
DRILL RIG Air Rotary
DRILLING COMPANY Beylik Drilling
DATE DRILLED 10/94
SURFACE ELEVATION 4439.27
TOTAL DEPTH OF HOLE 128.0 Feet
WATER LEVEL Static, from TOC on 11/7/94: 70.625 Feet

LOG OF MONITORING WELL MW-10

Page 2 of 3

WELL DIAGRAM



PH / TEMP. (c)	Conductivity (uS/m)	Water Prod. (gpm)	DEPTH (ft)
		0	60
			65
			70
			75
7.6 / 19	400	< .5	80
			85
7.8 / 21	300	< 1	90
			95
7.8 / 20	300	1.5-2	100
7.6 / 20	300	2 - 2.5	
7.3 / 20	300	3 - 3.5	
			105
7.8 / 19	300	1 - 1.5	110

SAMPLES

SYMBOLS

MATERIALS DESCRIPTION

40'-60', Gravel: med brown-red brown, abundant cobbles/pebbles, min-mod med-very coarse sand, "dry", Oxidized

60-64', Gravel, med brown, within clay/silt matrix, WET (not saturated)

64-78', Clay med brown-grey brown, w/some red brown zones, min-mod sand, wet (not saturated) does not produce water on drilling

78-83', Clay, as above w/slight increase in cobbles/pebbles & trace water

83-83.5', Gravel, medium brown-grey brown w/clay/silt matrix, produces 2-3 gpm water on drilling

83.5-87', Gravel, medium brown-red brown, abundant clay/silt matrix, mod sand, Oxidized

87-95', Gravel: medium brown, abundant clay/silt matrix produces 1/2-1 gpm on drilling

95-105', Gravel - medium brown - w/abundant clay/silt, mod-abundant sand, 1 1/2-2 gpm water when blowing

105-115', Gravel - medium brown-grey brown, abundant clay/silt matrix, minor sand, produces 1 1/2-2 gpm on drilling

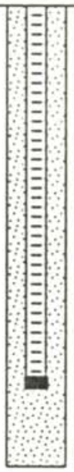
PROJECT Copper Flat - Hillsboro, N.M.
LOCATION N719968.25, E636740.99 N.M. S.P.C.
JOB NUMBER 68607 (ref: 68607M10)
GEOLOGIST CW
DRILL RIG Air Rotary

DRILLING COMPANY Beylik Drilling
DATE DRILLED 10/94
SURFACE ELEVATION 4439.27
TOTAL DEPTH OF HOLE 128.0 Feet
WATER LEVEL Static, from TOC on 11/7/94: 70.625 Feet

Steffen Robertson and Kirsten
Engineering and Environmental Consultants

LOG OF MONITORING WELL MW-10

Page 3 of 3



WELL DIAGRAM	PH / TEMP. (c)	Conductivity (uS/m)	Water Prod. (gpm)	DEPTH (ft)	SAMPLES	SYMBOLS	MATERIALS DESCRIPTION
	7.6 / 19	300	< .5				105-115', Gravel - medium brown-grey brown, abundant clay/silt matrix, minor sand, produces 1 1/2-2 gpm on drilling
4-1/2" dia. Sched. 80 .02" Slotted pvc (80.36'-124.5')				115			115-128, Gravel - medium brown-grey brown, abundant clay/silt matrix, mod-abundant sand, produces less than 1 gpm on drilling
Sand Pack Filter (76.5'-128')	7.9 / 19.5	300	< .5	120			
	7.8 / 20.5	300	< 1	125			
Total depth = 128'							Total depth = 128'
				130			
NOTE: Well developed 10/07/94 for 2.25 hrs. at 25 to 30 gpm				135			
				140			
				145			
				150			
				155			
				160			
				165			

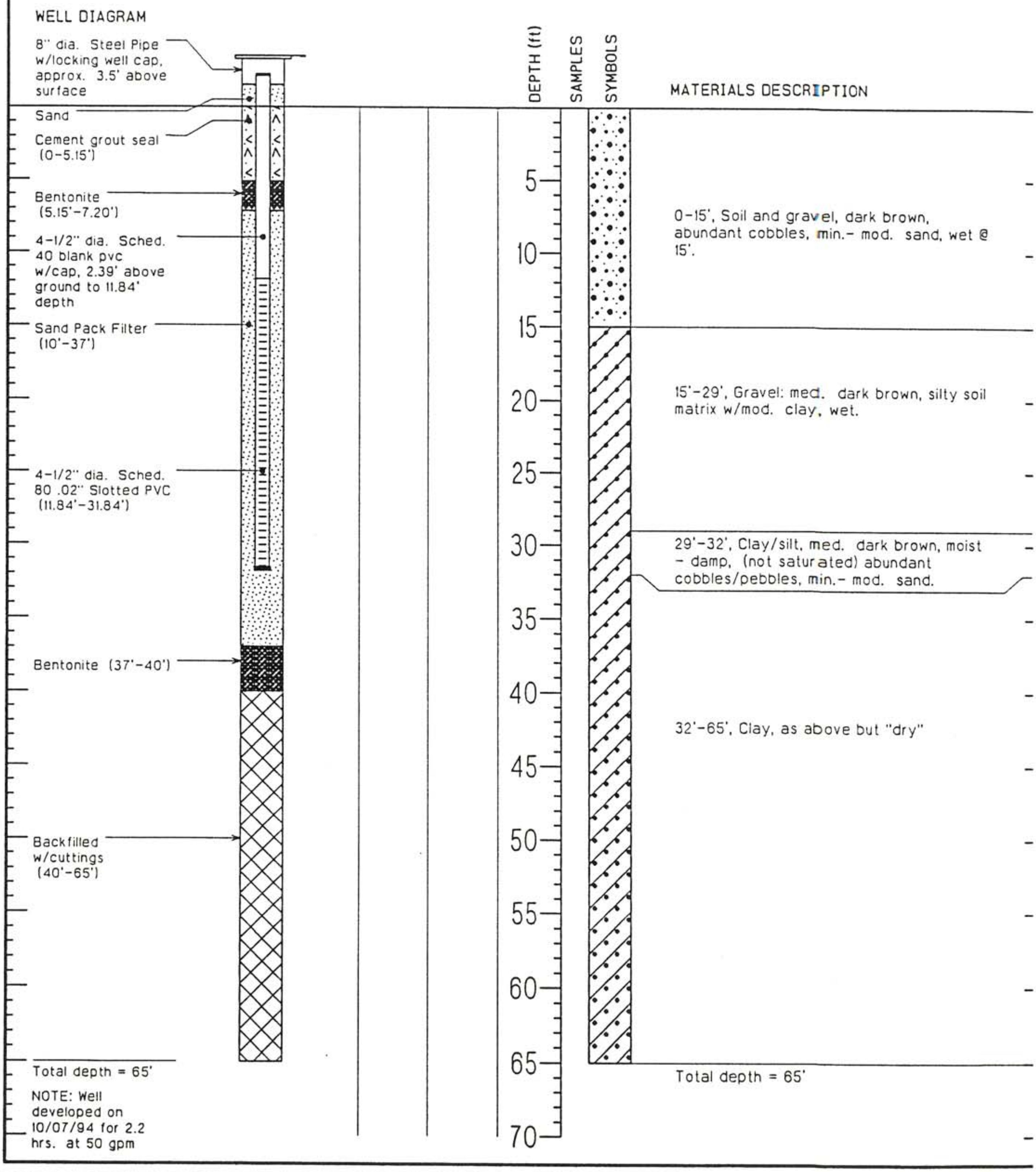
PROJECT Copper Flat - Hillsboro, N.M.
LOCATION N719968.25, E636740.99 N.M. S.P.C.
JOB NUMBER 68607 (ref: 68607M10)
GEOLOGIST CW
DRILL RIG Air Rotary

DRILLING COMPANY Beylik Drilling
DATE DRILLED 10/94
SURFACE ELEVATION 4439.27
TOTAL DEPTH OF HOLE 128.0 Feet
WATER LEVEL Static, from TOC on 11/7/94: 70.625 Feet

Steffen Robertson and Kirsten
Engineering and Environmental Consultants

LOG OF MONITORING WELL MW-11

Page 1 of 1



NOTE: Well developed on 10/07/94 for 2.2 hrs. at 50 gpm

0-15', Soil and gravel, dark brown, abundant cobbles, min.- mod. sand, wet @ 15'.

15'-29', Gravel: med. dark brown, silty soil matrix w/mod. clay, wet.

29'-32', Clay/silt, med. dark brown, moist - damp, (not saturated) abundant cobbles/pebbles, min.- mod. sand.

32'-65', Clay, as above but "dry"

Total depth = 65'

PROJECT Copper Flat - Hillsboro, N.M.
LOCATION N713751.31, E603378.24 N.M. S.P.C.
JOB NUMBER 68607 (ref: 68607M11)
GEOLOGIST CW
DRILL RIG Air Rotary
DRILLING COMPANY Beylik Drilling
DATE DRILLED 10/11/94
SURFACE ELEVATION 4439.48
TOTAL DEPTH OF HOLE 65 Feet
WATER LEVEL Static, from TOC on 11/7/94: 10.65 Feet

Appendix C1.

Initial PW- Well Pumping Tests, 1975-1980

BD - 1

P.G - 1

VB - 1

MHM - 1

RECEIVED
FEB 19 1976
QUINTANA

Water Development Corporation
CONSULTANTS IN WATER RESOURCES

3938 Santa Barbara Avenue
Tucson, Arizona 85711

Phone: 602-326-1133
Cable: WADEVCO, Tucson

February 17, 1976

W. E. S.
FEB 20 1976

Mr. W. E. Saegart , President
Quintana Minerals Corporation
2475 North Jack Rabbit Avenue
Tucson, Arizona 85705

Dear Bill:

The purpose of this letter is to give a brief summary of the test results for the three production wells drilled for Quintana's Copper Flat Project.

Production Well No. 1 was tested for 70 hours at 1,500 gpm. Initial static water level was 331.8 feet. The final pumping water level was 381.6 feet giving a drawdown of 49.8 feet and a specific capacity of 30.1 gpm per foot of drawdown. Water levels were measured in MW-5 during the test on Production Well No. 1. At the end of 70 hours of pumping the decline in MW-5 amounted to 9.10 feet.

Production Well No. 2 was tested for 72 hours at a discharge rate of 2,020 gpm. Static water level at the beginning of the test was 310.4 feet and the final pumping water level was 413.7 feet giving a drawdown of 103.3 feet and a specific capacity of 19.6 gpm per foot of drawdown. During the test on Production Well No. 2 water levels were measured in MW-5 and Production Well No. 1. During the 72 hours of pumping the decline in MW-5 amounted to 3.82 feet and the decline in Production Well No. 1 amounted to 4.93 feet.

Production Well No. 3 was tested at a rate of 1,500 gpm for 72 hours Initial static water level was 350.8 feet and the final pumping water level was 454.2 feet. Drawdown amounted to 103.4 feet giving a specific capacity of 14.5 gpm per foot of drawdown. Water levels were measured in MW-5, MW-6, and Production Wells 1 and 2 during the test on Production Well No. 3. After 72 hours of pumping the declines were 2.07 feet in Production Well No. 1, 1.46 feet in Production Well No. 2, 2.04 feet in MW-5, and 0.51 feet in MW-6. Prior to and during the early stage of the test water levels were rising in MW-6. As MW-6 had recently been used to supply water for drilling the data for MW-6 are not considered valid.

In terms of specific capacity, Production Well No. 1 is the best well and we consider that this well could be operated at a discharge in the range of 1,800 to 2,000 gpm if necessary. We could not test it at this rate due to pump limitations and for the subsequent tests a larger pump was installed. Well No. 2 is the next best well. At a discharge rate of 2,020 gpm entrained air was beginning to appear in this well and we consider that a more reasonable pumping rate for this well would be in the range of 1,600 to 1,800 gpm. Well No. 3 was producing considerable entrained air at 1,500 gpm and we recommend that, unless necessary, this well not be pumped at a rate in excess of 1,000 to 1,200 gpm. During development this well had a specific capacity of about 20 gpm per foot of drawdown at 1,000 gpm.

The source of entrained air encountered in Production Wells 2 and 3 is from cascading water coming through the perforations and falling to the pumping water level. The deeper the pumping water level is below the top of the perforations the greater the amount of entrained air. We anticipated that this would be a problem in all of the production wells but due to the excellent specific capacity of Production Well No. 1 there was no entrained air at a discharge rate of 1,500 gpm. With a higher discharge rate it is considered likely that some air will appear in the discharge of this well.

The only guaranteed way to eliminate all entrained air from a well discharge is to install blank casing to a depth greater than the anticipated pumping water level. Due to the lenticular nature of the water bearing materials and the indication from the geophysical logs that some of the more productive materials were the shallower sediments, this would result in a substantial reduction in discharge and specific capacity. Thus, if maximum quantity of water is desired, it becomes necessary to produce some entrained air also. By going to deep pump settings a portion of the entrained air can be forced out of the water before it reaches the pump intake.

We are presently preparing a basic-data report on the production wells and an interpretive report related to the effect of operating the well field for a sustained period of time using aquifer coefficients as calculated from the test data. Based on raw data from the well tests we consider at the present time that the existing well field has the following range of capacity:

62.4

Production Well No. 1	1,800 gpm to 2,000 gpm
Production Well No. 2	1,600 gpm to 1,800 gpm
Production Well No. 3	1,000 gpm to 1,200 gpm
Total	4,400 gpm to 5,000 gpm

Upon completion of our calculations related to well interference and long-term operation of the well field it may be necessary to modify the above figures. The modification, if necessary, is not considered likely to be substantial. Final selection of pumps and rates at which to operate each well should be delayed until reasonably accurate figures for mill water requirements are available.

Sincerely yours,

Don

Donald K. Greene

DKG/cm

2374

GPM x 60 x 24 x 60% = GPD

1 FT = 43,560 FT²/ACRE x 7.5 GAL/FT³

326,700 GAL/AC-FT.

6700 GPM x 60 x 24 x 60% x 3

2,112,912,000 GPY Allowed.

6467 AC-FT/YR.

5[illegible] [illegible] GPM – PW 1

PW 2

PW 3

WATER DEVELOPMENT CORPORATION

BASIC-DATA REPORT
QUINTANA MINERALS CORPORATION
COPPER FLAT PROJECT
PRODUCTION WELLS,
HILLSBORO, NEW MEXICO

By

D. K. Greene and L. C. Halpenny

Tucson, Arizona
April 1976

CONTENTS

FIGURES

BASIC-DATA REPORT

QUINTANA MINERALS CORPORATION
COPPER FLAT PROJECT PRODUCTION WELLS
HILLSBORO, NEW MEXICO

By

D. K. Greene and L. C. Halpenny

GENERAL INFORMATION

A total of three production wells have been drilled to furnish the water supply for ore processing and other uses at the Copper Flat Project. Locations of the wells are shown on Figure 1 and legal descriptions are as follows:

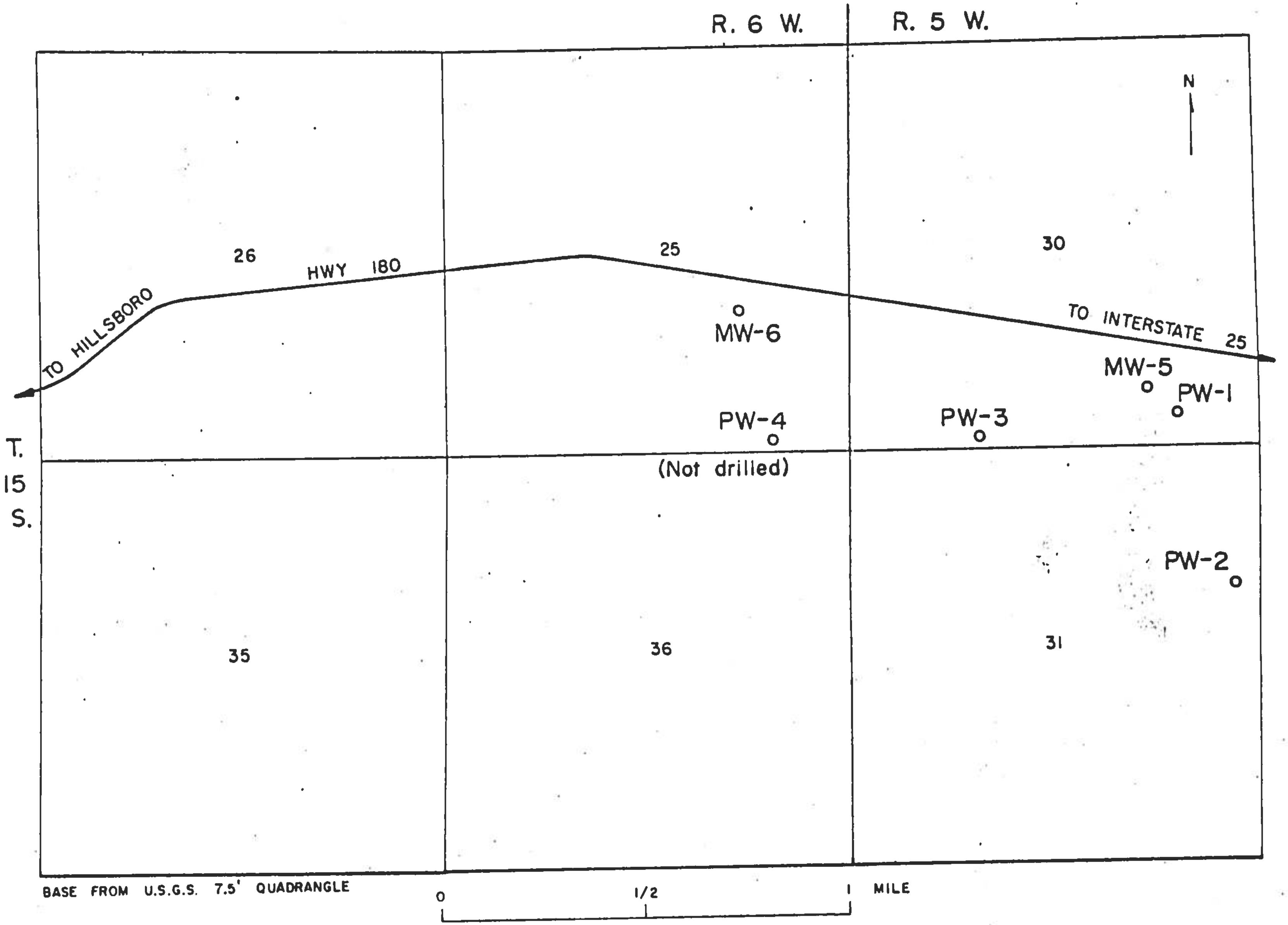


FIGURE 1.--MAP OF A PORTION OF TOWNSHIP 15 SOUTH, RANGES 5 AND 6 WEST, SIERRA COUNTY, NEW MEXICO, SHOWING LOCATIONS OF PRODUCTION WELLS AND MW-5 AND MW-6.

Production Well No. 1 (PW-1) SW¼ SE¼ SE¼, Sec. 30, T. 15 S., R. 5 W.
Production Well No. 2 (PW-2) NE¼ SE¼ NE¼, Sec. 31, T. 15 S., R. 5 W.
Production Well No. 3 (PW-3) SW¼ SE¼ SW¼, Sec. 30, T. 15 S., R. 5 W.

The well field is located approximately 7.5 miles east of the proposed concentrator site and it will be necessary to pipe water this distance.

The wells were drilled by B. C. & M. Drilling, Inc. of Mesa, Arizona using reverse air rotary equipment, during the period December 1975-January 1976. Prior to start of drilling 30 feet of 30-inch diameter, 5/16-inch wall thickness, surface pipe was installed and cemented in at each site using an auger rig. During this phase of work a site for a fourth production well (PW-4) (see Figure 1) was prepared. This site was not drilled.

The general procedure in constructing the production wells was to drill a 26-inch diameter hole in one pass, install a 16-inch, 5/16-inch wall thickness, blank and perforated casing assembly with centering guides approximately every 100 feet, gravel pack the annular space with 1/8 to 3/8-inch gravel, and develop the well with the drilling rig by jetting and washing with the compressor. The perforations were vertical saw-cut slots 1/8-inch wide by 3-inches long with 36 cuts per round and two rounds per foot. Total open area amounted to about 27 square inches per foot.

Details on depth drilled, casing installed, etc., for each of the three production wells are as follows:

Production Well No. 1

Depth drilled	960 feet
Casing installed	
Blank	0 to 368 feet
Perforated	368 to 951 feet
Gravel installed	109 yards
Rig development time	33.5 hours
Gravel slippage during rig development	41 feet

Production Well No. 2

Depth drilled	1,005 feet
Casing installed	
Blank	0 to 376 feet
Perforated	376 to 995 feet
Gravel installed	116 yards
Rig development time	28 hours
Gravel slippage during rig development	43 feet

Production Well No. 3

Depth drilled	970 feet
Casing installed	
Blank	0 to 380 feet
Perforated	380 to 965 feet
Gravel installed	116 yards
Rig development time	35.5 hours
Gravel slippage during rig development	17 feet

Following completion of rig development each well was further developed and then tested with a diesel powered turbine pump supplied by Western Pump and Supply Company of Deming, New Mexico. Data obtained during this phase of the investigation are included in the following sections of this report along with logs and water analyses for each production well.

Quintana Minerals Corporation
2475 NORTH JACK RABBIT AVENUE
TUCSON, ARIZONA 85705
602/622-4801

Bob Donegan
Property Manager

FILE MEMORANDUM

TO: W. E. Saegart
P. G. Dunn
M. W. Hood

April 26, 1976

Hillsboro-Copper Flat Water Wells

FROM: B. G. Donegan

Following are corrected elevations for the water wells given by Gordon McLain in telephone conversation today:

	PW 1	4693
	PW 2	4670
	PW 3	4717
(Proposed)	PW 4	4745
	MW 5	4700

The above are based on QMC elevation datum.

Bob Donegan

Bob Donegan

BD/ln

Hillsboro - Water
Extra file copies

Water Development Corporation
CONSULTANTS IN WATER RESOURCES

3938 Santa Barbara Avenue
Tucson Arizona 85711

Phone 602-326-1133
Cable WADEVCO Tucson

May 16, 1977

Mr. V. F. Saegart - President
Quintana Minerals Corporation
2475 North Jack Rabbit Avenue
Tucson, Arizona 85705

Re: Copper Flat Project, effect of pumping from wells

Dear Mr. Saegart:

In reply to your request for our opinion on the hydrology of the area of the Copper Flat Project water well field and the effect of pumping for 15 years from that well field, we submit the following information as an addendum to the opinions given in our April 1976 report entitled "Report on development of ground-water supply for Quintana Minerals Corporation Copper Flat Project, Hillsboro, New Mexico":

Extent of Cone of Depression

The aquifer characteristics of the Santa Fe Formation in the vicinity of the well field were developed from extended pumping of Production Wells 1, 2, and 3, and in our opinion are as follows:

Coefficient of transmissivity: 100,000 gal/day/ft
Long-term coefficient of storage: 0.10 dimensionless

The aquifer is less permeable westward toward the mountain front, based on data from test holes drilled during the exploration phase of the water well-field development program. The change toward finer-grained materials westward is gradual. No sharp barrier was found. The mathemathics of evaluating behavior of aquifers are amenable to analysis when a "negative barrier" of impermeable bedrock, or partially permeable materials occurs in one direction or more from a center of well pumping. However, for a gradational change in one or more directions it is necessary to assume the change is abrupt and is at a specified distance from the center of pumping. For this well field we have assumed that at a distance of one mile west of the center of pumping there is an abrupt change in the coefficient of transmissivity from 100,000 gpd/ft on the east side of a north-south line to 20,000 gpd/ft on the west side. The method for evaluating the effect upon water levels in an aquifer of a complete or partial line barrier is to assume the existence of an "image well" at a site on a line from the center of pumping perpendicular across the barrier, at a distance from the center of pumping equal to twice the distance from the center of pumping to the barrier.

We have made calculations of the drawdowns in water level in the Santa Fe aquifer along a north-south line through the center of pumping. These calculations are based on withdrawal of water from the well field during the first year at 6,000 gpm and for the next 14 years at 2,000 gpm. The calculations include the effect of the partial negative barrier westward. The results of the calculations are as follows:

Distance From the Center of Pumping (ft)	Decline of Water Levels in the Santa Fe Formation	
	After 1 Year (ft)	After 15 Years (ft)
5,000	13.6	18.5
10,000	5.4	13.7
20,000	.3	7.6
30,000	--	4.5
40,000	--	2.6
50,000	--	1.4
60,000	--	.6
70,000	--	.3
100,000	--	--

Decline of water levels eastward from the center of pumping would be less than the preceding tabulated figures because the effects of the assumed barrier decrease eastward.

Source of Recharge for Santa Fe Aquifer

The data given in our 1976 report include sea-level elevations of the water table (p. 18) and a discussion of the various factors affecting the water levels as determined (p. 19-21). The gradient of the water table as indicated by the water levels discussed in the report is clearly downward from west to east toward the Rio Grande, flattening eastward from about 200 feet per mile near the mountain front, decreasing to about 100 feet per mile and then to about 10 feet per mile in the vicinity of the well field. The eastward down-gradient direction of the water table indicates that ground water in the Santa Fe Formation is moving eastward, which in turn indicates that the sources of ground-water recharge are to the west. The north-south alignment of the water table contours indicates that the recharge is fairly uniform and is not concentrated in one place. In the western United States, hydrologic investigations during the past half century have indicated that ground-water recharge from rain falling directly on the desert floors is not great but that runoff in desert washes and mountain-front recharge are the major factors in replenishing the ground-water supply. In our opinion, the sources of recharge for the Santa Fe aquifer in the vicinity of the well field are infiltration of runoff from desert flood flows in Greyback Arroyo, Greenhorn Arroyo, Las Animas Creek, and Percha Creek plus mountain-front recharge.

<u>Effect Upon Water Levels Along Animas Creek</u>

Our April 1976 report discusses the fact that water levels in wells in the valley of Animas Creek are shallower than water levels in deep wells in the Santa Fe Formation by about 80 to 150 feet (p. 21-22). We consider that, although Las Animas Creek is a source of recharge to the Santa Fe Formation aquifer system, the low vertical permeability in the upper part of the Santa Fe Formation slows down the vertical percolation and permits existence of a perched shallow water table in the permeable younger sediments of the ancestral Las Animas Creek.

When water is moving vertically downward underground, the hydraulic head that is a component of that movement is 100 percent, one foot per foot. The factor that controls the downward rate of movement is the permeability of the materials through which the water is moving. If the upper portion of the Santa Fe Formation were highly permeable, all water in the younger alluvium along Las Animas Wash would readily sink, leaving the Las Animas Creek sediments dry and causing a higher water level in the underlying Santa Fe deposits.

Because of the existence of this blanket of finer-grained sediments between the coarse materials underlying Las Animas Creek and the permeable facies of the Santa Fe Formation from which the well field will produce, a water-level decline of about 18 feet in the Santa Fe Formation beneath the axis of Las Animas Creek after 15 years of pumping is not likely to lower water levels in shallow wells tapping the younger Las Animas Creek shoestring aquifer. The vertical gradient cannot increase above 100 percent and that is the gradient now, based on the data collected during the investigation in 1975-1976.

The chapter on quality of water in our 1976 report indicated a difference in chemical character exists between the shallow ground water along Las Animas Creek and the deeper ground water in the Santa Fe Formation (p. 24 and 27, Fig. 10 on p. 26). This confirms our opinion that there is not a direct connection between ground water in the two aquifer systems.

Subsurface Channels Within Santa Fe Formation

Geological field work during the course of our investigation in 1975-1976 indicated the existence of a coarser facies within the uppermost part of the Santa Fe Formation along an axis roughly from north-northwest to south-southeast visible in the canyon walls of Las Animas Creek and Lower Percha Creek. The Quintana well field is situated within this zone. The uppermost visible coarse-grained portion of the formation is underlain by a finer-grained zone which in turn is underlain by a coarser zone. The Quintana wells produce from the lower coarse zone. It is not known whether the trend of this lower coarse zone also is northwest-southeast. We have found no geological nor hydrological evidence of an "underground stream" trending in any direction. Instead the data indicate the well field is situated in a more permeable zone within the Santa Fe Formation, with ground water movement from west to east.

Were there to exist an underground stream along an axis from north-northwest to south-southeast, with recharge from a source somewhere to the north-northwest, pumping from the well field would not affect water levels upgradient beyond about 13 miles as shown in the tabulation set forth in a preceding part of this letter.

Respectfully submitted,
Water Development Corporation

By ______________________________
Leonard C. Halpenny, President

PRODUCTION WELL NO. 1
CUTTING LOG

(Prepared by B. Y. Kim, Geologist, Quintana Minerals Corporation)

Depth From (ft)	To	Pebble	Granule	Coarse Sand	Medium Sand	Fine Sand	Silt and Clay
30	50				30%	60%	10%
50	70	40%	50%	10%			
70	90	Minor	70%-80%	20%-30%	Minor	Minor	Minor
90	110	60%	30%	10%			
110	140	Minor	40%	40%	10%	5%	5%
140	160	60%	30%	10%			
160	180	20%	70%	10%			
180	200		Minor	20%	30%	30%	20%
200	220	10%	50%	40%			
220	240		Minor	20%	30%	20%	30%
240	250		60%	30%	Minor	5%	5%
250	270			Minor	10%-20%	40%	40%-50%
270	290	20%	40%	35%	Minor	Minor	5%
290	300		Minor	20%	30%	20%	30%
300	340		60%	30%	Minor	5%	5%
340	360		Minor	20%	20%	30%	30%
360	620	Minor	40%-70%	10%-30%	Minor	5%-15%	5%-15%
620	640		5%	5%	20%	30%	40%
640	660		40%	40%	Minor	10%	10%-20%
660	670	30%	40%	20%			10%
670	760	20%	40%	20%	Minor	5%	15%
760	770		5%	5%	20%	30%	40%
770	790	20%	40%	20%	Minor	5%	15%
790	800		Minor	10%	20%	40%	30%
800	960		40%-60%	10%-30%	5%	5%	20%

Well cuttings 360-620 feet generally uniform with coarse material (0.5mm) 60%-90%.

A few peanut-sized gravel at 880-890 feet with less amount of fine material; marked increase of fine material at 910-920 feet.

PRODUCTION WELL NO. 1
CUTTING LOG
(continued)

The following size ranges have been established from Wentworth Scale for classification of clastic sedimentary rock. The above log has been done by visual estimation according to the scale.

Pebble	Above 4 mm
Granule	2 mm - 4 mm
Coarse Sand	Very coarse - 1 mm - 2 mm Coarse - 0.5 mm - 1 mm (1/2 mm - 1 mm)
Medium Sand	0.25 mm - 0.5 mm (1/4 mm - 1/2 mm
Fine Sand	Fine - 0.125 mm - 0.25 mm (1/4 mm 1/8 mm) Very fine - 0.0625 mm - 0.125 mm (1/8 mm - 1/16 mm)
Silt and Clay	Less than 0.0625 mm (less than 1/16

PRODUCTION WELL NO. 1
DRILLERS LOG

Depth From (ft)	To	Sample Description
30	45	Fine silt.
45	50	Sand and silt.
50	55	Very hard rock.
55	90	Sand and rock.
90	105	Gravel and trace of clay.
105	115	Basalt, sand, little clay.
115	125	Basalt, sand.
125	135	Sand, clay, and some basalt.
135	155	Sand and rock.
155	165	Rock and some sand.
165	175	Small gravel and sand.
175	185	Clay with 5% sand.
185	195	Clay with 25% sand, some gravel.
195	206	Clay with gravel, 5% sand.
206	216	Gravel pediment with sand.
216	218	Clay.
218	222	Gravel pediment with 5% sand.
222	245	Clay.
245	255	Sand with cobbles, very hard.
255	265	Clay with 2% sand.
265	275	Sandy clay.
275	285	Sand and gravel.
285	295	Gravel and sand.
295	305	Sand and gravel with 80% clay.
305	315	Sand, gravel, and clay.
315	320	Gravel and clay.
320	325	Gravel, rock, and clay.
325	335	Basalt and rock.
335	340	Gravel and rock.
340	345	Clay and gravel.
345	355	Clay.
355	360	Clay and sand.
360	375	Sand and rock.
375	390	Sand, gravel, and clay.
390	406	Sand, rock, and clay.
406	415	Clay, sand, and gravel.
415	435	Sand and gravel.

PRODUCTION WELL NO. 1
DRILLERS LOG
(continued)

Depth From	To (ft)	Sample Description
435	445	Sand and some gravel.
445	469	Sand and little clay.
469	475	Sand and rock.
475	495	Pediment gravels, some sand.
495	505	Clay, 20% gravel.
505	525	Clay and gravel.
525	555	Sand and gravel.
555	565	Sand and 80% clay.
565	575	Sand, gravel, and some clay.
575	585	Sand and gravel.
585	590	Clay, sand, and gravel.
590	595	Sand and gravel.
595	605	Gravel and clay.
605	615	Clay, sand, and gravel.
615	620	Gravel and sand.
620	625	Sand.
625	630	Sand, gravel, 90% clay.
630	635	Clay.
635	645	Sand, 95% clay.
645	655	Sand, 35% clay.
655	665	Clay 50%, sand 50%.
665	675	Coarse sand 35%, gravel 35%, clay 30%.
675	685	Coarse sand, gravel.
685	709	Coarse sand 50%, gravel 20%, clay 30%.
709	715	Coarse sand 50%, gravel 10%, clay 40%.
715	725	Coarse sand 70%, gravel 20%, clay 10%
725	765	Gravel, clay, and sand.
765	785	Clay and gravel.
785	797	Sand, gravel, and clay.
797	805	Clay, sand, and gravel.
805	815	Sand 75%, gravel 10%, clay 15%.
815	835	Sand, gravel, and clay.
835	845	Sand 80%, gravel 15%, clay 5%.
845	850	Sand, clay, and gravel.
850	858	Sand and clay.
858	860	Clay and sand.
860	875	Sand.
875	888	Sand, some clay.

PRODUCTION WELL NO. 1
DRILLERS LOG
(continued)

Depth From - To (ft)	Sample Description
888 - 895	Sand, gravel, and clay.
895 - 905	Sand and clay.
905 - 917	Sand and gravel.
917 - 935	Clay 85%, gravel 5%, sand 10%.
935 - 947	Clay, gravel, and sand.
947 - 960	Clay, sand, and gravel.

PRODUCTION WELL NO. 1

DEVELOPMENT DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-18-75	09:48	329.3		Measuring with sounder. Measuring point top of 3/4-inch tube 1.65 feet above top of surface pipe. Surface pipe approximately 0.2 feet above land surface.
	10:00			Pump on. Eight-inch pump with bowls set at 550 feet. Discharge pipe 10-inch, orifice 6-inch.
	10:01	357.9		Decreasing RPM.
	10:02	348.9	370	Muddy, silty.
	10:03	345.3	395	
	10:04	344.4	370	Trace of sand.
	10:12	346.3	395	Clearing some.
	10:13			Increased RPM.
	10:14	350.0	500	
	10:15	350.6	500	Some mud, silt, trace of sand.
	10:20	352.1	500	
	10:27	352.4	500	
	10:44	353.1	500	Clearing.
	10:55			Surge.
	10:58			Lowering impellers.
	11:00			Pump on.
	11:05	350.3	500	Some color.
	11:12			Fairly clear, surge twice.
	11:18		760	Muddy, silty, no sand.
	11:19	358.8		
	11:25	360.8	760	Considerable color, silty.
	11:40	362.3	773	Clearing.
	11:45			T = 76° F, K = 350 micromhos.
	11:50	362.7	773	Fairly clear, surge twice.
	11:56			Silty.
	11:58		760	Clearing.
	12:00	356.9	760	

PRODUCTION WELL NO. 1

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-18-75	12:15	358.7	760	Fairly clear.
	12:22	359.0	760	T = 76° F, K = 340+ micromhos.
	12:23			Surge twice.
	12:30			Little mud and silt.
	12:33			Clearing.
	12:35	355.9	760	Fairly clear.
	12:40			Surge twice.
	12:47			Some color, no sand.
	12:50			Clearing.
	13:19	356.7	760	Surge twice.
	14:07	356 2	760	Clear, surge twice.
	14:15			Little color.
	14:18	353.1	760	Clear.
	14:20			Surge, change to 8-inch orifice.
	14:27			Pump on.
	14:29			Some color, no sand.
	14:30	358.4	1,040	
	14:35	361.6		
	14:52	363.7	1,060	Slight color.
	14:58	364.2	1,060	Surge.
	15:05			Fair amount of color, silt, no sand.
	15:08			Clearing.
	15:10	362.1	1,040	T = 76° F, K = 350 micromhos.
	15:30	363.8	1,050	Surge.
	15:35			Fair amount of color, silt.
	15:40			Clearing.
	15:58	361.8	1,030	Clear, surge twice.
	16:03			Some color, silt.
	16:28	363.5	1,060	Clear, surge twice.
	16:33			Some color, silt.
	16:37			Clearing.
	17:00	362.8	1,050	

PRODUCTION WELL NO. 1

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-18-75	17:05	378.6	1,500	Some color, no sand.
	17:10			Considerable color, silt.
	17:13	382.5	1,471	Lot of color, silt, < 0.1 cc/l sand.
	17:19	382.2	1,438	
	17:28	382.6	1,421	
	17:38	382.5	1,404	Surge.
	17:45			Some color, silt.
	18:00	387.0	1,500	Surge twice.
	18:30		1,500	Surge.
	19:00		1,500	Surge.
	19:30		1,500	Surge.
	19:50	386.0	1,500	
	20:10			Surge twice.
	20:15		1,500	Some color.
	20:38	385.1	1,500	Clear, surge.
	21:07	383.6	1,493	Clear, surge twice.
	21:12			Some color, no sand.
	21:38	382.0	1,486	T = 76° F, K = 340 micromhos, clear, surge twice.
	21:45			Some color.
	22:20	381.2	1,493	Clear, surge twice.
	22:25			Some color.
	23:04	381.2	1,507	Clear, surge twice.
	23:10			Some color, silt.
	23:35	379.9	1,500	Clear, surge twice.
	23:40			Some color.
12-19-75	00:05	378.9	1,493	Clear, surge twice.
	00:10			Little color.
	00:30	378.4	1,493	Clear, surge twice.
	00:34	375.1	1,500	
	00:55	378.9	1,500	Clear, surge twice.
	01:05	375.7	1,500	Clear.
	01:40	378.6	1,500	Clear, surge twice.
	02:10	377.8	1,500	Clear, surge twice.

PRODUCTION WELL NO. 1

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-19-75	02:40	377.4	1,493	Clear, surge twice.
	03:10	377.0	1,500	Clear, surge twice.
	03:40	376.6	1,486	Clear, surge twice.
	04:10	376.3	1,493	Clear, surge twice.
	04:45	376.3	1,500	Clear, surge twice.
	05:15	375.7	1,493	Clear, surge twice.
	05:45	376.1	1.500	Clear, surge twice.
	06:15	376.6	1,500	Clear, surge twice.
	06:45	376.6	1,500	Clear, surge twice.
	07:00	377.0	1,500	Clear, surge twice.
	07:05			Very little color.
	07:30	376.0	1,493	Clear.
	07:35			T = 76° F, K = 340 micromhos.
	08:28	376.0	1,500	Clear.
	08:29			Increase RPM.
	08:30	380.9	1,641	
	08:32			Some color.
	08:33			Clearing.
	08:45	382.1	1,641	Clear, surge.
	08:50			Some color, then clear.
	09:00	381.5	1,634	Clear.
	09:15	381.9	1,634	Clear.
	09:18			T = 76° F, K = 340 micromhos.
	09:30	382.2	1,627	
	09:50	382.5	1,627	Clear.
	10:00			Pump off.
	10:01	338.4		
	10:02	338.1		
	10:03	339.8		
	10:04	339.3		
	10:05	338.6		
	10:06	338.3		
	10:07	337.8		

PRODUCTION WELL NO. 1

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-19-75	10:08	337.5		
	10:09	337.2		
	10:10	336.8		
	10:15	335.7		
	10:20	335.0		
	10:30	334.1		
	10:38	333.4		
	12:09	330.4		
	13:18	329.8		
	14:03	329.5		
	15:40	329.1		
	15:47	332.77		Measured with chain.

PRODUCTION WELL NO. 1

TEST DATA

cofpw1.wk1

time (min) C6..c98
WL d6..d98
mw-5 WL e6..e98

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-20-75	08:00	331.82		Measured with chain. Same measuring point as for development.
	09:22	331.82		Measured with chain.
	09:32	331.8		Set sounder at 331.8.
	11:00	331.8 −1.85 = 330.0 GL		Pump on. Same setting as for development.
	11:01	360.8	1,500	
	11:02	363.5	1,500	
	11:03	365.9	1,500	
	11:04	367.2	1,500	
	11:05	367.9	1,500	
	11:06	368.5	1,500	Clear.
	11:07	369.2	1,500	
	11:08	369.7	1,500	
	11:09	370.1	1,500	
	11:10	370.2	1,500	
	11:12	370.8	1,500	
	11:14	371.1	1,500	
	11:16	371.4	1,500	
	11:18	371.8	1,500	
	11:20	372.0	1,500	
	11:25	372.6	1,500	
	11:30	373.3	1,500	
	11:35	373.7	1,500	
	11:40	374.1	1,500	
	11:50	374.7	1,500	
	12:00	375.0	1,500	
	12:15	375.5	1,500	
	12:30	376.0	1,500	
	12:45	376.3	1,500	
	13:00	376.7	1,500	
	13:30	377.4	1,500	
	14:00	377.6	1,500	
	15:00	378.2	1,500	

PRODUCTION WELL NO. 1

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-20-75	16:00	378.6	1,500	Clear.
	17:00	379.2	1,500	
	18:00	379.3	1,500	
	19:00	379.6	1,500	
	20:00	379.9	1,500	
	21:00	380.2	1,500	
	22:00	380.4	1,500 +	Decrease RPM.
	23:00	380.3	1,500	
	24:00	380.4	1,500	
12-21-75	01:00	380.4	1,500	
	01:50			T = 76° F, K = 340 micromhos.
	02:10	380.4	1,500	
	03:00	380.6	1,500	
	04:00	380.6	1,500	
	05:00	380.8	1,500	
	06:00	380.0	1,486	Increase RPM.
	06:50			T = 76° F, K = 340 micromhos.
	07:00	381.0	1,500	
	08:00	381.1	1,500	
	09:00	381.4	1,500	
	10:00	381.4	1,500 +	Decrease RPM.
	11:00	381.3	1,500	
	12:00	381.2	1,500	
	13:00	381.3	1,500	
	13:15			T = 76° F, K = 340 micromhos.
	14:20	381.3	1,500 -	Increase RPM.
	15:00	381.3	1,500	
	16:00	381.2	1,500	
	17:00	381.4	1,500	
	18:00	381.4	1,500	
	19:00	381.4	1,500	
	20:00	381.4	1,500	

PRODUCTION WELL NO. 1

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-21-75	21:00	381.5	1,500	
	22:00	381.7	1,500 +	Decrease RPM.
	23:00	381.4	1,500	
	24:00	381.4	1,500	
12-22-75	02:00	381.5	1,500	
	03:00	381.4	1,500	
	04:00	381.4	1,500	
	05:00	381.7	1,500	
	06:00	381.4	1,486	Increase RPM.
	07:00	381.0	1,500	
	08:00	381.3	1,500	
	09:00	381.4	1,500 +	Decrease RPM.
	10:00	381.4	1,500	
	11:00	381.4	1,500	
	12:00	380.7	1,500 -	Increase RPM.
	13:00	381.1	1,500	
	14:00	381.3	1,500	
	14:30	381.3	1,500	
	15:00	381.4	1,500	
	16:00	381.4	1,500	
	17:00	381.4	1,500	
	18:00	381.6	1,500	
	19:10	381.6	1,500	
	24:00	382.0	1,500	
12-23-75	03:00	381.7	1,500	
	07:00	381.6	1,500	
	08:45	381.6	1,500	T = 76° F, K = 340 micromhos. Collected water samples
	09:00			Pump off.
	09:01	340.9		
	09:02	342.7		
	09:03	342.2		
	09:04	341.6		
	09:05	341.3		
	09:06	341.1		
	09:07	340.2		
	09:18	338.8		
	09:30	337.5		

PRODUCTION WELL NO. 1

TEST DATA

(Observation Well MW-5 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
12-18-75	07:55	335.58	Measured with chain. Measuring point top of 6-inch casing approximately 1 foot above land surface.
	08:10	335.57	Measured with chain. Set sounder with tape mark at 335.57.
	10:00		PW-1 pump on for development.
	10:52	337.15	
	14:48	339.33	
12-19-75	07:40	344.03	
	09:12	344.54	
	10:00		PW-1 pump off.
	10:24	342.18	
	12:06	338.91	
	13:22	338.22	
	14:10	337.95	
	15:32	337.63	
12-20-75	07:43	336.73	Measured with chain. Set sounder with tape mark at 336.73.
	09:46	336.69	
	11:00	336-69	PW-1 pump on for test.
	11:01	336.73	
	11:02	336.90	
	11:03	337.14	
	11:04	337.32	
	11:05	337.52	
	11:06	337.61	
	11:07	337.81	
	11:08	337.89	
	11:09	338.05	
	11:10	338.19	
	11:11	338.31	
	11:12	338.47	
	11:13	338.51	
	11:14	338.62	

PRODUCTION WELL NO. 1

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-20-75	11:15	338.77	
	11:16	338.82	
	11:17	338.93	
	11:18	339.00	
	11:19	339.16	
	11:20	339.19	
	11:23	339.45	
	11:25	339.67	
	11:30	339.89	
	11:35	340.08	
	11:40	340.30	
	11:45	340.41	
	11:50	340.65	
	12:00	341.00	
	12:15	341.30	
	12:30	341.69	
	12:45	341.86	
	13:00	342.18	
	13:30	342.52	
	14:00	342.75	
	15:05	343.18	
	16:05	343.42	
	17:05	343.61	
	18:05	343.74	
	19:05	344.09	
	20:05	344.12	
	21:10	344.24	
	22:10	344.36	
	23:10	344.43	
12-21-75	00:10	344.51	
	01:30	344.54	
	02:00	344.68	
	03:05	344.75	
	04:05	344.81	

PRODUCTION WELL NO. 1

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-21-75	05:05	344.87	
	06:05	344.87	
	07:05	344.83	
	08:05	345.02	
	09:05	345.00	
	10:05	345.02	
	11:05	345.03	
	12:05	345.07	
	13:05	345.06	
	14:15	345.03	
	15:05	345.10	
	16:05	345.10	
	17:05	345.18	
	18:05	345.16	
	19:05	345.16	
	20:05	345.23	
	21:05	345.22	
	22:05	345.25	
	23:05	345.27	
12-22-75	00:05	345.31	
	01:25	345.21	
	02:00	345.52	
	03:05	345.44	
	04:05	345.39	
	06:05	345.37	
	07:05	345.32	
	08:05	345.38	
	09:05	345.52	
	10:05	345.54	
	11:05	345.58	
	13:10	345.54	
	14:10	345.54	
	15:05	345.61	
	16:05	345.57	

PRODUCTION WELL NO. 1

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-22-75	17:05	345.66	
	18:05	345.63	
	19:05	345.58	
12-23-75	00:10	345.70	
	03:10	345.78	
	07:10	345.71	
	08:50	345.79	
	09:00		PW-1 pump off.
	09:14	344.08	
	09:25	343.20	
	09:45	342.15	

BC
LABORATORIES Inc.
OIL - CORES - SOIL - WATER
3016 UNION AVENUE
BAKERSFIELD, CALIFORNIA 93305
Phone (805) 325-7475
J. J. EGLIN, Reg. Chem. Engr.

Submitted By: Water Development Corporation
3839 Santa Barbara Ave.
Tucson, Arizona 85711

Date Reported: 1/16/76
Date Received: 1/8/76
Laboratory No.: 9939

Marked: Quintana No. 1 12/23/75 08:45 T: 76° K: 340

WATER ANALYSIS

Sample Description:

pH	7.8
E.C. Micromhos/cm ($K \times 10^6$) @ 25°C (salinity)	
Resistivity, Ohm M^2/M	

Constituents, P. P. M. (parts per million)

ron, (B)	
Calcium, (Ca)	22.
Magnesium, (Mg)	2.8
Sodium, (Na)	38.
Potassium, (K)	4.5
Carbonates, (CO_3)	0.
Bicarbonates, (HCO_3)	144.6
Chlorides, (Cl)	16.3
Sulphates, (SO_4)	10.
Nitrate, (NO_3)	3.53
Fluoride, (F)	0.46
Total Iron, (Fe)	
Copper, (Cu)	
Manganese, (Mn)	
Chromium, (Cr)	
Zinc, (Zn)	
Aluminum, (Al)	
Silica, (SiO_2)	
Lithium, (Li)	
Lead, (Pb)	
Phenol	
Sulfides as H_2S	
Total Hardness as $CaCO_3$	
Oil (chloroform extractable)	
tal Dissolved Solids	217. @ 180°F.
tal Suspended Solids	

BC LABORATORIES Inc.

By J. J. Eglin

PRODUCTION WELL NO. 2
CUTTING LOG

(Prepared by B.Y. Kim, Geologist, Quintana Minerals Corporation)

Depth From (ft)	To	Pebble	Granule	Coarse Sand	Medium Sand	Fine Sand	Silt and Clay
30	40			50%	20%	10%	20%
40	100	Minor	40%-60%	30%-50%			Minor
100	110		40%	10%	10%	20%	20%
110	150		40%	40%	5%	5%	10%
150	160		10%	20%	20%	25%	25%
160	210	Minor	50%-60%	40%-50%			Minor
210	250			10%	20%	30%	40%
250	260	Minor	60%	20%	5%	5%	10%
260	270			10%	20%	40%	30%
270	290	20%	60%	20%			Minor
290	300		10%	30%	20%	20%	20%
300	310	20%	70%	10%			Minor
310	330	Minor	30%	50%	5%	5%	10%
330	370		Minor	20%	20%	30%	30%
370	440		30%	40%	10%	10%	10%
440	450			Minor	30%	50%	20%
450	900	0%-20%	20%-40%	20%-30%	0%-10%	10%-20%	10%-20%
900	910		5%	15%	20%	20%	30%
910	920	20%	50%	Minor	Minor	10%	20%
920	960	Minor	20%-30%	30%-40%	10%	10%-20%	20%
960	970	Minor	50%	30%	Minor	Minor	20%
970	990		20%	20%	10%	20%	30%
990	1005			Minor	Minor	Minor	90%

No sample from 530-540 feet; 20% pebble at 610-620 feet.

Average for the above interval 450-900 feet:

10% 30% 30% 5% 10% 15%

PRODUCTION WELL NO. 2
CUTTING LOG
(continued)

The following size ranges have been established from Wentworth Scale for classification of clastic sedimentary rock. The above log has been done by visual estimation according to the scale.

Pebble	Above 4 mm
Granule	2 mm - 4 mm
Coarse Sand	Very coarse - 1 mm - 2 mm Coarse - 0.5 mm - 1 mm (1/2 mm - 1 mm)
Medium Sand	0.25 mm - 0.5 mm (1/4 mm - 1/2 mm)
Fine Sand	Fine - 0.125 mm - 0.25 mm (1/4 mm - 1/8 mm) Very fine - 0.0625 mm - 0.125 mm (1/8 mm - 1/16 mm)
Silt and Clay	Less than 0.0625 mm (less than 1/16 mm

PRODUCTION WELL NO. 2
DRILLERS LOG

Depth From (ft)	To	Sample Description
45	65	Sand, rock, and gravel.
65	105	Sand and gravel.
105	115	Clay and sand.
115	125	Sand and gravel.
125	135	Sand, gravel, and clay.
135	145	Sand and gravel.
145	155	Sand, gravel, and clay.
155	165	Clay and gravel.
165	215	Sand and gravel.
215	225	Clay and fine sand.
225	250	Clay and sand.
250	255	Clay and gravel.
255	265	Cobbles, gravel, and sand.
265	275	Clay with 10% rock.
275	285	Gravel and sand.
285	295	Sand and gravel.
295	305	Clay and sand.
305	315	Sand and gravel.
315	325	Sand, gravel, and 2% clay.
325	335	Sand, gravel, and 15% clay.
335	345	Clay.
345	355	Clay and 5% sand.
355	365	Clay, sand, and gravel.
365	375	Clay and fine sand.
375	385	Clay, sand, and gravel.
385	415	Sand, gravel, and clay.
415	435	Sand, gravel, and trace of clay.
435	445	Sand and clay.
445	455	Clay with sand.
455	465	Clay 50%, sand 50%.
465	475	Clay and sand.
475	485	Sand 60%, gravel 35%, clay 5%.
485	495	Sand 90%, clay 10%.
495	505	Sand, clay, and gravel.
505	515	Sandy clay with caliche, gravel.
515	525	Sandy clay with caliche, some gravel.

PRODUCTION WELL NO. 2
DRILLERS LOG
(continued)

Depth From (ft)	To	Sample Description
525	540	Sand and clay.
540	550	Gravel 90%, clay 10%.
550	553	Gravel 70%, clay 30%.
553	555	Gravel 80%, clay 20%.
555	560	Gravel and clay.
560	565	Gravel 60%, clay 40%.
565	575	Sand and gravel.
575	580	Sand 80%, clay 20%.
580	583	Gravel 70%, clay 30%.
583	585	Gravel 80%, clay 20%.
585	590	Clay 70%, sand 30%.
590	600	Rock, clay, and gravel.
600	605	Rock 50%, clay 50%.
605	610	Gravel.
610	613	Gravel 10%, clay.
613	620	Sand, 20% clay.
620	625	Clay and gravel, hard.
625	635	Gravel, 5% clay.
635	640	Rock, 10% clay, and sand.
640	643	Rock, basalt, hard.
643	645	Clay and some sand.
645	675	Gravel 50%, clay 50%
675	701	Clay, sand, and gravel.
701	705	Gravel 65%, clay 35%.
705	710	Gravel 50%, clay 50%.
710	720	Clay 55%, gravel 45%.
720	725	Gravel 60%, clay 40%.
725	735	Gravel 65%, clay 35%.
735	750	Gravel 70%, clay 30%.
750	765	Sand,80%, clay 20%.
765	775	Gravel 80%, clay 20%.
775	789	Gravel 90%, clay 10%.
789	795	Clay, sand, and gravel.
795	800	Sand and clay.
800	805	Clay and sand.
805	835	Sand and gravel, clay 65%.
835	855	Clay, sand, and gravel.

PRODUCTION WELL NO. 2
DRILLERS LOG
(continued)

Depth From	To (ft)	Sample Description
855	865	Gravel.
865	885	Gravel 85%, clay 15%.
885	905	Coarse sand,85%, clay 15%.
905	915	Clay 65%, coarse sand 35%.
915	925	Gravel, sand, and clay, equal amounts.
925	935	Clay 40%, gravel 30%, sand 30%.
935	945	Clay 75%, sand 25%.
945	955	Clay 90%, sand 10%.
955	965	Gravel, sand, clay stringers.
965	975	Gravel and sand, 10% clay.
975	985	Gravel 50%, clay 50%.
985	995	Sand 60%, clay 40%.
995	1005	Clay.

PRODUCTION WELL NO. 2

DEVELOPMENT DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-10-76	12:36	309.4		Measuring with sounder. Measuring point top of 3/4-inch tube 0.95 foot above top of surface pipe. Surface pipe approximately 0.5 foot above land surface.
	12:44	309.4		
	12:45			Pump on. Ten-inch pump with bowls set at 460 feet Discharge pipe 10-inch, orifice 6-inch.
	12:47	331.8	550	Dirty.
	12:48	331.3		
	12:50	331.7		Lot of color, 0.5 cc/l, fine sand, soapy.
	12:58	332.2	550	Color decreasing, 0.1 cc/l fine sand, soapy.
	13:08	333.3	568	Color decreasing, 0.1 cc/l fine sand,
	13:09			Pump off.
	13:11	284.3		
	13:12	305.7		
	13:13	309.7		
	13:14	310.5		
	13:15	310.8		
	13:19	310.6		
	13:20			Pump on.
	13:24	333.0	550	Lot of color, 0.3 cc/l fine sand.
	13:30	333.7	550	Clearing some, 0.1 cc/l fine sand.
	13:40	334.6	559	Muddy, silty.
	14:00		550	Fairly clear, surge once.
	14:07		550	Lot of color, 0.3 cc/l fine sand.

PRODUCTION WELL NO. 2

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-10-76	14:35	332.4	520	Fairly clear, surge once, change to 8" orifice.
	14:42	374.7	1,040	
	14:45			Lot of color, less than 0.1 cc/l sand.
	15:00	351.4	1,016	Fairly clear, surge once.
	15:05			Lot of color, silt, less than 0.1 cc/l fine sand.
	15:30	352.3	1,040	Fairly clear, surge twice.
	15:37			Lot of color, silt, 0.1 cc/l fine sand.
	16:00	351.4	1,040	Fairly clear, surge twice.
	16:08			Lot of color, silt, 0.2 cc/l fine sand.
	16:30	349.8	1,040	Fairly clear, surge twice.
	16:47			Lot of color, silt, 0.3 cc/l fine sand.
	17:00	349.2	1,016	Fairly clear, surge twice.
	17:10	365.9	1,500	Lot of color, silt, 0.1 cc/l fine sand.
	17:30	373.2	1,500	Fairly clear, surge twice.
	17:38			Lot of color, silt, 0.1 cc/l fine sand. T = 74° F, K = 370 micromhos.
	18:00	372.1	1,486	Fairly clear, surge twice.
	18:07			Lot of color, silt.
	18:30	371.9	1,486	Fairly clear, surge twice.
	19:00	371.4	1,486	Surge twice.
	19:30	370.9	1,500	Surge twice.
	20:00	367.4	1,486	Surge twice.
	20:30	369.4	1,500	Fairly clear, surge twice.
	20:35			Less than 0.01 cc/l fine sand.
	21:00	369.1	1,486	Surge twice, straw color, clears quickly.
	21:30	369.0	1,486	Surge twice, slight color.

PRODUCTION WELL NO. 2

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-10-76	22:00	369.0	1,500	Surge twice, clear.
	22:30	369.0	1,486	Surge twice, straw color.
	23:00	368.4	1,486	Surge twice, clear.
	23:30	369.0	1,500	Surge twice, clear.
	24:00	368.4	1,486	Surge twice, straw color. Increase RPM.
01-11-76	00:30	394.6	1,940	Surge twice, some color.
	01:00	395.0	1,928	Surge twice, straw color, clears quickly. Entrained air showing in discharge.
	01:30	395.8	1,928	Surge twice, straw color.
	02:00	396.7	1,928	Surge twice, straw color.
	02:30	397.4	1,928	Surge twice, straw color.
	03:00	398.0	1,928	Surge twice, straw color.
	03:30	399.9	1,928	Surge twice, straw color.
	04:00	400.0	1,920	Surge twice, straw color, clears quickly.
	04:30	399.9	1,928	Surge twice, some color.
	05:00	399.8	1,928	Surge twice, some color.
	05:30	398.1	1,928	Surge twice, some color.
	06:00	397.4	1,928	Surge twice, straw color, clears quickly.
	06:30	400.0	1,970	Surge twice, some color.
	07:00	404.4	1,970	Surge twice, considerable color.
	07:30	400.9	1,940	Fairly clear, surge twice.
	07:37			Some color, silt.
	08:00	398.2	1,920	Clear, surge twice.
	08:06			Some color, clearing within 2 minutes.
	08:30	399.0	1,940	Clear, surge twice
	09:07			Some color, increase RPM.
	09:10		2,115	Clearing.
	09:15	412.0	2,212	More color showing, no sand.
	09:30	419.0	2,200	Clear, surge twice.

PRODUCTION WELL NO. 2

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-11-76	09:37			Some color, clearing in 2 minutes.
	10:00	419.0	2,200	Clear, surge twice.
	10:08			Some color, less than 0.1 cc/l sand. Clearing in 2 minutes.
	10:30	418.7	2,212	Clear.
	10:37			Some color, clearing in 2 minutes, no sand.
	10:40			T = 76° F, K = 350 micromhos.
	11:00	418.0	2,200	Clear, surge twice.
	11:07			Some color, clearing in 2 minutes, no sand.
	11:30	417.6	2,200	Clear, surge twice.
	11:37			Some color, clearing in 2 minutes, no sand.
	12:00	418.7	2,200	Clear, surge twice.
	12:07			Some color, clearing in 2 minutes, no sand.
	12:40	412.7	2,115	Clear.
	12:45			Pump off.
	12:46	321.9		
	12:47	326.5		
	12:48	330.6		
	12:49	330.0		
	12:50	328.9		
	12:51	328.0		
	12:52	327.3		
	12:53	326.5		
	12:54	325.8		
	12:55	325.2		
	13:00	322.8		
	13:05	321.3		
	13:10	320.2		
	13:15	319.3		
	13:51	316.1		
	16:06	312.8		

PRODUCTION WELL NO. 2

cufpw2.wk1

TEST DATA

time = c6..c102
Pwl = d6..d102

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-12-76	08:46	310.4 -1.45= 309.0 GL		Measuring with sounder. Same measuring point as for development.
	09:30			Pump on. Same setting as for development.
	09:31	366.4	2,020	Clear.
	09:32	370.4	2,020	
	09:33	373.9	2,020	
	09:34	376.2	2,020	
	09:35	378.0	2,020	
	09:36	379.6	2,020	
	09:37	380.7	2,020	
	09:38	381.7	2,020	
	09:39	382.6	2,020	
	09:40	383.3	2,020	
	09:45	386.6	2,020	
	09:50	388.8	2,020 +	Decrease RPM.
	09:55	390.3	2,020	
	10:00	391.7	2,020	Entrained air in discharge.
	10:10	393.5	2,020	
	10:20	395.7	2,020	
	10:30	396.3	2,020	
	10:40	397.8	2,020	
	10:50	398.4	2,020	
	11:00	399.1	2,020	
	11:17	400.1	2,020	
	11:30	400.3	2,020	
	11:45	401.1	2,020	
	12:00	401.4	2,020	
	12:15	402.3	2,040	Decrease RPM.
	12:30	401.3	2,020	
	12:45	401.3	2,020	
	13:00	401.3	2,020	
	13:17			T = 75°F, K = 335 micromhos.

PRODUCTION WELL NO. 2

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-12-76	13:30	401.9	2,020	
	14:00	402.9	2,020	
	14:30	402.8	2,020 -	Increase RPM.
	15:00	402.9	2,020	
	16:00	403.7	2,020	
	17:00	404.3	2,020 -	Increase RPM.
	18:00	405.2	2,020	
	19:00	405.1	2,020	
	20:00	405.7	2,020	
	21:00	406.1	2,020	
	22:00	406.8	2,020	
	23:00	407.6	2,020	
	24:00	408.0	2,020	
01-13-76	01:00	408.9	2,020	
	02:00	409.1	2,020	
	03:00	409.2	2,020 +	Decrease RPM.
	04:00	408.5	2,020	
	05:00	409.1	2,020	
	06:00	408.1	2,020 -	Increase RPM.
	07:00	409.3	2,020	
	08:00	409.3	2,020	
	09:00	409.4	2,020	
	10:00	409.4	2,020	
	11:00	409.2	2,020	
	12:00	410.2	2,020	
	13:00	410.6	2,020	
	13:50		2,020 +	T = 76° F, K = 350 micromhos. Decrease RPM.
	14:00	410.0	2,020	
	15:00	410.0	2,020	
	16:00	410.1	2,020	
	17:00	410.2	2,020	
	18:00	411.3	2,020	
	19:00	411.2	2,020	
	20:00	410.1	2,020	

PRODUCTION WELL NO. 2

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-13-76	21:00	410.7	2,020	
	22:00	410.7	2,020	
	23:00	410.7	2,020	
	24:00	411.3	2,020	
01-14-76	01:00	411.4	2,020	
	02:00	411.7	2,020	
	03:00	411.7	2,020	
	04:00	411.5	2,020	
	05:00	411.7	2,020	
	06:00	411.5	2,020 -	Increase RPM.
	07:15	411.9	2,020	
	08:00	412.2	2,020	
	09:00	412.0	2,020	
	10:00	412.0	2,020	
	11:00	412.3	2,020	
	12:00	411.9	2,020	
	13:00	412.2	2,020	
	14:00	411.7	2,020	
	15:00	411.7	2,020	
	16:00	411.7	2,020	
	17:00	411.7	2,020	
	18:00	412.1	2,020	
	19:00	413.3	2,020 +	Decrease RPM.
	20:00	413.3	2,020 +	Decrease RPM.
	20:05			T = 76° F, K = 350 n. hos.
	21:00	414.4	2,020	
	22:00	414.6	2,020	
	23:00	414.6	2,020 +	Decrease RPM.
	24:00	414.6	2,020	
01-15-76	01:00	414.0	2,020	
	02:00	414.1	2,020	
	03:00	413.8	2,020	
	04:00	412.8	2,020	
	05:00	412.6	2,020	

PRODUCTION WELL NO. 2

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-15-76	06:00	412.5	2,020	
	07:00	412.5	2,020	
	08:00	413.0	2,020	
	08:30			T = 76° F, K = 350 micromhos. Collected water samples.
	09:00	413.7	2,020	
	09:30			Pump off.
	09:31	325.0		
	09:32	329.9		
	09:33	333.8		
	09:34	333.3		
	09:35	331.9		
	09:36	331.2		
	09:37	330.3		
	09:38	329.6		
	09:39	328.8		
	09:40	328.3		
	09:45	326.2		
	09:50	324.7		
	09:55	323.5		
	10:00	322.6		
	10:10	321.3		
	10:20	320.3		
	10:30	319.5		
	10:45	318.7		
	11:00	318.0		
	11:15	317.4		
	11:30	317.0		
	12:00	316.5		
	12:30	315.9		
	13:00	315.6		
	13:30	315.2		
	14:00	314.8		
	15:00	314.6		

PRODUCTION WELL NO. 2

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-15-76	16:00	314.1		
	17:00	314.0		
	20:00	313.4		
	24:00	313.0		
01-16-76	04:00	312.8		
	08:00	312.5		
	09:45	312.2		
	09:50	312.42		Measured with chain.

PRODUCTION WELL NO. 2.

TEST DATA

(Observation Well PW-1 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-11-76	13:28	333.36	Measured with chain, spotty. Measuring point hole in plate 0.87 foot above top of surface pipe. Surface pipe approximately 0.2 foot above land surface.
	13:35	333.24	Measured with chain, spotty.
	16:00	332.04	Measured with chain. Water level is recovering from development of PW-2.
01-12-76	08:27	330.76	Measured with chain. Set sounder with tape mark at 330.76.
	09:11	330.66	
	09:30		PW-2 pump on for test.
	09:48	330.68	
	10:15	330.99	
	11:10	331.74	
	12:05	332.28	
	13:05	332.52	
	14:05	332.73	
	15:05	332.98	
	16:05	333.05	
	17:05	333.20	
	18:05	333.30	
	19:05	333.58	
	20:05	333.65	
	21:05	333.70	
	22:05	333.78	
	23:05	333.89	
01-13-76	00:05	334.05	
	01:00	333.97	
	02:05	333.96	
	03:05	334.03	
	04:05	334.06	
	05:05	334.10	
	06:08	334.17	
	07:05	334.25	

PRODUCTION WELL NO. 2

TEST DATA

(Observation Well PW-1 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-13-76	08:05	334.38	
	09:05	334.36	
	10:05	334.46	
	11:05	334.51	
	12:05	334.36	
	13:05	334.62	
	15:05	334.55	
	17:07	334.63	
	19:05	334.92	
	21:05	334.98	
	23:05	335.12	
01-14-76	01:05	335.19	
	03:05	335.23	
	05:05	335.27	
	07:20	335.18	
	08:05	335.21	
	09:05	335.24	
	11:05	335.29	
	13;05	335.30	
	15:05	335.29	
	17:05	335.32	
	19:05	335.39	
	21:05	335.44	
	23:05	335.53	
01-15-76	01:05	335.59	
	03:05	335.54	
	05:05	335.52	
	07:05	335.49	
	09:05	335.59	
	09:30		PW-2 pump off.
	10:03	335.39	
	10:33	334.94	
	11:05	334.50	
	11:35	334.25	

PRODUCTION WELL NO. 2

TEST DATA

(Observation Well PW-1 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-15-76	12:05	334.06	
	12:35	333.86	
	13:05	333.68	
	13:35	333:55	
	14:05	333.41	
	15:05	333.24	
	16:05	333.06	
	17:05	332.86	
	20:05	332.72	
01-16-76	00:05	332.44	
	04:05	332.36	
	08:05	332.25	
	10:04	332.01	

PRODUCTION WELL NO. 2

TEST DATA

(Observation Well MW-5 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-11-76	13:45	338.14	Measured with chain. Measuring point top of 6-inch casing approximately 1 foot above land surface.
	15:54	337.57	Measured with chain. Water level is recovering from development of PW-2.
01-12-76	08:00	336.52	Measured with chain. Set sounder with tape mark at 336.52.
	09:15	336.43	
	09:30		PW-2 pump on for test.
	09:52	336.44	
	10:17	336.52	
	11:14	337.02	
	12:07	337.28	
	13:07	337.44	
	14:07	337.60	
	15:07	337.74	
	16:07	337.85	
	17:07	337.98	
	18:07	338.06	
	19:07	338.14	
	20:07	338.23	
	21:07	338.31	
	22:08	338.42	
	23:07	338.47	
01-13-76	00:07	338.51	
	01:37	338.54	
	02:07	338.65	
	03:07	338.70	
	04:07	338.79	
	06:16	338.85	
	07:07	338.91	
	08:07	339.09	
	09:07	339.06	
	10:07	339.13	

PRODUCTION WELL NO. 2

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-13-76	11:07	339.22	
	12:07	339.22	
	13:07	339.23	
	15:07	339.21	
	17:09	339.31	
	19:07	339.45	
	21:07	339.54	
	23:07	339.62	
01-14-76	01:07	339.77	
	03:07	339.73	
	05:07	339.82	
	07:22	339.84	
	08:07	339.86	
	09:07	339.89	
	11:07	339.94	
	13:07	339.93	
	15:10	339.92	
	17:07	339.96	
	19:07	340.03	
	21:07	340.02	
	23:07	340.19	
01-15-76	01:07	340.18	
	03:07	340.21	
	05:07	340.11	
	07:07	340.18	
	09:07	340.25	
	09:30		PW-2 pump off.
	10:05	340.14	
	10:35	339.93	
	11:08	339.70	
	11:37	339.53	
	12:07	339.40	
	12:37	339.25	
	13:07	339.16	

PRODUCTION WELL NO. 2

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-15-76	13:37	338.99	
	14:07	338.94	
	15:07	338.86	
	16:07	338.80	
	17:07	338.55	
	20:05	338.20	
01-16-76	00:07	338.03	
	04:07	337.89	
	08:07	337.72	
	10:19	337.75	

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J. J. EGLIN, Reg. Chem. Engr.

ubmitted By: Water Development Corp.
3938 Santa Barbara Ave.
Tucson, Arizona 85711

Date Reported: 2/16/76
Date Received: 2/3/76
Laboratory No.: 10752

larked: Quintana #2 1/15/76 08:30 T: 76°F. K: 350

WATER ANALYSIS

ample Description:

H		8.1
.C. Micromhos/cm (K x 10^6) @ 25°C (salinity)		310.
esistivity, Ohm M^2/M		
stituents, P. P. M. (parts per million)		
.B)		-
Calcium, (Ca)		21.
Magnesium, (Mg)		3.4
Sodium, (Na)		39.
Potassium, (K)		4.3
Carbonates, (CO_3)		0.
Bicarbonates, (HCO_3)		153.1
Chlorides, (Cl)		17.0
Sulphates, (SO_4)	(-)	5.
Nitrate, (NO_3)		3.53
Fluoride, (F)		0.66
Total Iron, (Fe)		
Copper, (Cu)		
Manganese, (Mn)		
Chromium, (Cr)		
Zinc, (Zn)		
Aluminum, (Al)		
Silica, (SiO_2)		
Lithium, (Li)		
Lead, (Pb)		
Phenol		
Sulfides as H_2S		
Total Hardness as $CaCO_3$		
Oil (chloroform extractable)		
Dissolved Solids		257. @ 180°F.
spended Solids		

BC LABORATORIES Inc.

By J. J. Eglin

PRODUCTION WELL NO. 3
CUTTING LOG

(Prepared by B. Y. Kim, Geologist, Quintana Minerals Corporation)

Depth From (ft)	To	Pebble	Granule	Coarse Sand	Medium Sand	Fine Sand	Silt and Clay
30	50		30%	50%	5%	5%	10%
50	60	90%	10%				
60	80	Minor	60%	20%	Minor	5%	15%
80	100	90%	10%				
100	180	10%-30%	50%-70%	5%-15%	Minor	5%	10%
180	190			Minor	20%	40%	40%
190	210	Minor	40%	30%	5%	5%	20%
210	220			10%	20%	40%	20%
220	240	Minor	50%	40%			10%
240	250			10%	20%	40%	30%
250	260		50%	40%	Minor		10%
260	270		10%	20%	10%	20%	20%
270	330	10%-20%	50%-60%	20%	Minor	Minor	10%
330	350		10%	30%-40%	0%-10%	20%	30%
350	380	0%-10%	40%-50%	30%-40%	Minor	Minor	0%-10%
380	390		10%	30%	10%	20%	20%
390	450		30%-40%	30%-40%	0%-10%	0%-10%	10%-20%
450	460			10%	30%	30%	30%
460	760	Minor	20%-40%	20%-30%	0%-10%	10%-20%	10%-30%
(Representative Sample:		Minor	30%	30%	5%	10%	20%)
760	830		10%-20%	30%-40%	0%-10%	10%-20%	20%
830	910		20%-30%	30%-40%	10%	20%	10%
910	970		10%-20%	20%-30%	10%-20%	10%-20%	20%

Peanut-size angular pebbles at 80-100 feet, probably broken pieces from larger boulder.

Sample 120-180 missing.

Pebble-containing samples:	
670-680	(20%)
710-720	(10%)
610-620	(5%)

Toward the bottom of the hole, gradual decrease of coarse material (granule and coarse sand) has been noticed.

PRODUCTION WELL NO. 3
CUTTING LOG
(continued)

The following size ranges have been established from Wentworth Scale for classification of clastic sedimentary rock. The above log has been done by visual estimation according to the scale.

Pebble	Above 4 mm
Granule	2 mm - 4 mm
Coarse Sand	Very coarse - 1 mm - 2 mm Coarse - 0.5 mm - 1 mm (1/2 mm - 1 mm)
Medium Sand	0.25 mm - 0.5 mm (1/4 mm - 1/2 mm)
Fine Sand	Fine - 0.125 mm - 0.25 mm (1/4 mm - 1/8 mm) Very fine - 0.0625 mm - 0.125 mm (1/8 mm - 1/16 mm)
Silt and Clay	Less than 0.0625 mm (less than 1/16 mm)

PRODUCTION WELL NO. 3
DRILLERS LOG

Depth From (ft)	To	Sample Description
40	55	Sand 85%, gravel.
55	65	Gravel, 10% sand.
65	75	Gravel, 20% sand.
75	165	Sand and gravel.
165	185	Sand 70%, gravel 25%, clay 5%.
185	195	Clay.
195	200	Sand, 5% clay.
200	205	Clay.
205	215	Sand, 50%, gravel 45%, clay 5%.
215	225	Clay, 10% sand.
225	235	Sand 55%, gravel 40%, clay 5%.
235	250	Sand and gravel.
250	255	Sand, 80% clay.
255	265	Sand and gravel, 5% clay.
265	275	Sand, 70% clay.
275	339	Sand and gravel.
339	345	Clay 80%, sand 20%.
345	355	Clay 75%, sand 20%, gravel 5%.
355	369	Sand 90%, gravel 10%.
369	375	Clay 60%, gravel 30%, sand 10%.
375	385	Sand 65%, clay 25%, gravel 10%.
385	399	Clay 60%, sand 40%.
399	405	Sand 90%, clay 10%.
405	415	Sand 50%, gravel 50%.
415	425	Sand 50%, gravel 40%, clay 10%.
425	429	Sand, gravel, and clay.
429	435	Gravel 65%, sand 30%, clay 5%.
435	455	Sand, gravel, and clay.
455	465	Clay and little sand.
465	475	Clay, gravel, and sand.
475	495	Gravel 60%, sand 20%, clay 20%.
495	505	Sand and gravel.
505	525	Sand 50%, clay 50%.
525	535	Gravel 50%, sand 50%.
535	545	Sand 65%, clay 25%, gravel 10%.
545	555	Sand 50%, clay 50%.
555	565	Sand, 30% clay.

PRODUCTION WELL NO. 3
DRILLERS LOG
(continued)

Depth From (ft)	To	Sample Description
565	575	Sand and gravel.
575	590	Sand, gravel, and clay.
590	595	Sand and gravel, some clay.
595	605	Sand, gravel, and clay.
605	615	Sand and gravel, some clay.
615	625	Sand and gravel, 70% clay.
625	655	Sand and gravel.
655	665	Sand 70%, clay 30%.
665	675	Sand 85%, gravel 10%, clay 5%.
675	685	Gravel 60%, sand 20%, clay 20%.
685	699	Sand 50%, gravel 25%, clay 25%.
699	705	Sand 50%, gravel 48%, clay 2%.
705	715	Gravel 45%, coarse sand 45%, clay 10%.
715	728	Sand 80%, gravel 10%, clay 10%.
728	745	Sand, gravel, and clay.
745	756	Sand 85%, clay.
756	817	Sand, gravel, and clay.
817	835	Clay 80%, gravel 10%, sand 10%.
835	847	Sandy clay 98%, gravel 2%.
847	855	Sand 70%, gravel 30%.
855	865	Sand 80%, gravel 15%, clay 5%.
865	878	Clay 55%, gravel 35%, sand 10%.
878	895	Sand, gravel, and clay.
895	905	Sand and gravel.
905	945	Gravel 50%, sand 30%, clay 20%.
945	955	Clay 50%, sand 30%, gravel 20%.
955	965	Clay 95%, sand 5%.
965	970	Clay 90%, sand 10%.

PRODUCTION WELL NO. 3

DEVELOPMENT DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-22-76	12:54	350.6		Measuring with sounder. Measuring point top of 3/4-inch tube 0.95 feet above top of surface pipe. Surface pipe approximately 1 foot above land surface.
	13:00			Pump on. Ten-inch pump with bowls set at 500 feet. Discharge pipe 10-inch, orifice 6-inch.
	13:02	391.8	520	
	13:03	390.1		Dirty, lot of color.
	13:04	389.7	520	
	13:05	389.3		
	13:07	390.1	520	Lot of color, silt, 0.5 cc/l sand and silt.
	13:10	390.6		
	13:15	390.9	520	Clearing, less than 0.1 cc/l sand.
	13:20			Surge.
	13:25			Some color and silt, less than 0.1 cc/l fine sand.
	13:30	391.2	520	Clearing.
	13:36			Fairly clear, surge twice.
	13:44			Considerable color, 0.2 cc/l fine sand.
	13:47	386.4	520	
	13:55	388.6	520	Fairly clear, surge twice.
	14:05			Some color, silt.
	14:15	385.4	520	Fairly clear, surge twice.
	14:23			Some color, silt, less than 0.1 cc/l fine sand.
	14:30	383.3	520	Fairly clear, surge twice.
	14:37			Some color, silt, 0.1 cc/l fine sand.

PRODUCTION WELL NO. 3

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-22-76	14:45	382.0	520	Fairly clear, surge twice.
	14:58			Some color, silt, less than 0.1 cc/l fine sand.
	15:00	380.4	520	Fairly clear, silt, surge twice.
	15:08			Some color, no sand.
	15:15	379.4	520	Fairly clear, surge twice.
	15:30	378.4	520	Fairly clear, surge twice.
	15:45	377.9	520	Fairly clear, surge twice.
	16:00	377.7	520	Fairly clear, surge twice.
	16:15	377.6	520	Fairly clear, surge twice.
	16:30	377.4	520	Fairly clear, surge twice, change to 8-inch orifice.
	16:33			Pump on, increase RPM.
	16:35	402.7	1,000	Considerable color, 0.1 cc/l fine sand.
	16:40	403.0	1,000	
	16:45	403.8	1,000	Fairly clear, surge twice.
	16:53			Considerable color, silt, 0.1 cc/l fine sand.
	17:00	403.8	1,000	Fairly clear, surge twice.
	17:07			Considerable color, silt, 0.1 cc/l fine sand.
	17:10			T = 76° F, K = 370 micromhos.
	17:15	403.1	1,000	Fairly clear, surge twice.
	17:22			Considerable color, silt, 0.1 cc/l fine sand.
	17:30	402.5	1,000	Fairly clear, surge twice.
	17:37			Considerable color, silt, 0.1 cc/l fine sand.
	17:45	401.4	1,000	Fairly clear, surge twice.
	17:52			Some color, silt, 0.15 cc/l fine sand.
	18:00	402.0	1,000	Fairly clear, surge twice.
	18:07			Some color, silt, 0.15 cc/l fin sand.

PRODUCTION WELL NO. 3

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-22-76	18:15 18:22	400.6	1,000	Fairly clear, surge twice. Some color, silt, 0.1 cc/l fine sand.
	18:30 18:37	399.7	1,000	Fairly clear, surge twice. Some color, silt, 0.1 cc/l fine sand.
	18:45 18:52	399.7	1,000	Fairly clear, surge twice. Some color, silt, less than 0.1 cc/l fine sand.
	19:00 19:08	399.4	1,000	Fairly clear, surge twice. Some color, silt, less than 0.1 cc/l fine sand.
	19:15 19:22	399.2	1,000	Fairly clear, surge twice. Some color, silt, 0.1 cc/l fine sand.
	19:30 19:37	398.3	1,000	Fairly clear, surge twice. Some color, silt, 0.1 cc/l fine sand.
	19:45 19:52	398.4	1,000	Fairly clear, surge twice. Some color, silt, less than 0.1 cc/l fine sand.
	20:00	398.6	1,000	Fairly clear, surge twice, increase RPM.
	20:07	428.5	1,500	Considerable color, 0.1 cc l fine sand.
	20:09	438.7		
	20:15	446.6	1,500	Dirty, 0.1 cc/l fine sand, co siderable entrained air in charge.
	20:30 20:37	447.0	1,486	Clearing, surge twice. Lot of color, silt, 0.2 cc/l fine sand.
	20:45 20:52	443.9	1,455	Fairly clear, surge twice. Lot of color, silt, 0.2 cc.1 fine sand.

PRODUCTION WELL NO. 3

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-22-76	21:00	446.1	1,500	Fairly clear, surge twice.
	21:07			Lot of color, silt, 0.1 cc/l fine sand.
	21:15	444.8	1,500	Fairly clear, surge twice.
	21:22			Lot of color, silt, less than 0.1 cc/l fine sand.
	21:30	444.1	1,500	Fairly clear, surge twice.
	21:37			Lot of color, silt.
	21:45	441.1	1,471	Fairly clear, surge twice.
	21:53			Considerable color, silt, less than 0.1 cc/l fine sand.
	22:00	442.0	1,486	Fairly clear, surge twice.
	22:30	446.6	1,500	Fairly clear, surge twice.
	23:00	446.5	1,500	Fairly clear, surge twice.
	23:30	446.9	1,486	Fairly clear, surge twice.
	23:38			Considerable color, silt, no sand.
	24:00	446.4	1,500	Fairly clear, surge twice.
01-23-76	00:07			Lot of color, silt, no sand.
	00:30	446.9	1,500	Fairly clear, surge twice.
	00:38			Lot of color, silt, no sand.
	01:00	447.0	1,500	Fairly clear, surge twice.
	01:07			Lot of color, silt.
	01:30			Engine stopped, broken throttl linkage.
	01:36			Throttle repaired, second surg
	01:40			Lot of color, silt, no sand.
	02:00	447.1	1,500	Fairly clear, surge twice.
	02:07			Lot of color, silt, no sand.
	02:30	447.2	1,500	Fairly clear, surge twice.
	03:00	447.8	1,500	Fairly clear, surge twice.
	03:37		1,500	
	04:00	448.0	1,500	Fairly clear, surge twice.
	04:07		1,500	
	04:30	447.4	1,500	Fairly clear, surge twice.

PRODUCTION WELL NO. 3

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-23-76	04:37		1,500	
	05:00	447.2	1,500	Fairly clear, surge twice.
	05:07		1,500	
	05:30	447.3	1,500	Fairly clear, surge twice.
	05:37		1,500	
	06:00	449.3	1,500	Fairly clear, surge twice.
	06:07		1,500	
	06:30	447.4	1,500	Fairly clear, surge twice.
	06:37		1,500	Considerable color, silt, no sand.
	07:00	447.4	1,500	Clear, surge twice, increase RPM.
	07:09	463.1	1,809	Fairly dirty, 0.3 cc/l fine sand.
	07:11	470.2	1,809	Fairly dirty, lot of entrained air.
	07:15			Ohmmeter fluctuating badly. Starts at 460 feet.
	07:31		1,641	Manometer ± 1 inch, well is not surging.
	07:33			Fairly clear, surge twice.
	08:30	454.7	1,669	Clear, Ohmmeter and Manometer fluctuating, surge twice.
	08:32			Some color, silt, no sand.
	09:00	452.1	1,543	Clear, surge twice.
	09:08			Some color, silt, no sand.
	09:10			Engine stopped, broken throttl linkage.
	09:15			Throttle repaired.
	09:30	453.1	1,613	Clear, surge twice, reduce RP
	10:02			Little color, silt, no sand.
	10:04		1,500	
	10:30	448.2	1,515	Clear, reduce RPM.
	11:00	448.0	1,500	

PRODUCTION WELL NO. 3

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-23-76	11:11			T = 76° F, K = 360 micromhos.
	11:30	448.0	1,500	Clear.
	11:58	448.4	1,500	Clear.
	12:00			Pump off.
	12:01	421.1		
	12:02	396.3		
	12:03	365.2		
	12:04	354.0		
	12:05	354.2		
	12:16	352.7		
	12:15	352.1		

PRODUCTION WELL NO. 3

TEST DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-24-76	07:46	350.8		Measuring with sounder. Same measuring point as for development.
	08:59	350.8 -1.95 = 348.9 GL		
	09:00			Pump on. Same setting as for development.
	09:01	421.4	1,500	
	09:02	424.6	1,500	Some color.
	09:03	428.2	1,500	
	09:04	431.1	1,500	
	09:05	432.6	1,500	Clear.
	09:06	433.5	1,500	
	09:07	434.5	1,500	
	09:08	435.6	1,500	
	09:09	436.2	1,500	
	09:10	436.9	1,500	
	09:11	437.6	1,500	
	09:12	437.8	1,500	
	09:13	438.0	1,500	
	09:14	438.5	1,500	
	09:15	439.0	1,500	
	09:16	440.0	1,515	Decrease RPM.
	09:17	439.6	1,500	
	09:18	439.6	1,500	
	09:19	439.8	1,500	
	09:20	440.0	1,500	
	09:25	441.0	1,500	
	09:30	441.6	1,500	
	09:35	441.9	1,500	
	09:40	442.0	1,500	
	09:50	443.4	1,500	
	10:00	443.5	1,500	
	10:15	444.5	1,500 -	Increase RPM.
	10:30	445.0	1,500	Considerable entrained air in discharge.
	10:45	445.9	1,500	

PRODUCTION WELL NO. 3

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-24-76	11:00	446.0	1,500 +	Decrease RPM.
	11:30	446.6	1,500	
	12:00	446.6	1,500	
	12:03			T = 76°, K = 360 micromhos.
	12:30	448.4	1,500	
	13:00	449.5	1,500	
	13:30	449.0	1,500 -	Increase RPM.
	14:00	449.1	1,500	
	15:00	448.7	1,500 +	Decrease RPM.
	16:00	448.9	1,500	
	17:00	449.8	1,515	Decrease RPM.
	18:00	448.4	1,486	Increase RPM.
	19:00	499.4	1,500	
	20:00	450.4	1,500	
	21:00	450.9	1,500	
	22:00	451.5	1,500	
	23:00	451.8	1,500	
	24:00	452.2	1,500	
01-25-76	01:00	452.2	1,500	
	02:00	452.2	1,500	
	03:00	452.4	1,500	
	04:00	452.4	1,500	
	05:00	452.7	1,500	
	06:00	453.0	1,500	
	07:00	453.7	1,500	
	08:00	452.3	1,500	
	09:00	451.7	1,486	Increase RPM.
	10:00	452.4	1,500	
	11:00	452.4	1,500	
	12:00	453.0	1,500 -	Increase RPM.
	12:25	453.2	1,500	
	12:36	453.2	1,500	Changed sounders.
	13:00	453.86	1,500	
	14:00	454.83	1,500 +	Decrease RPM.

PRODUCTION WELL NO. 3

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-25-76	14:40			T = 76°, K = 360 microm-hos.
	15:00	452.50	1,500	
	16:00	452.59	1,500	
	17:00	453.81	1,500	
	18:00	454.26	1,500	
	19:00	453.73	1,500	
	20:00	454.16	1,500	
	21:00	455.38	1,500	
	22:00	456.12	1,500 +	Decrease RPM.
	23:00	456.36	1,500	
	24:00	456.46	1,500	
01-26-76	01:00	455.86	1,500	
	02:01	455.71	1,500	
	03:00	455.76	1,500	
	04:00	455.71	1,500	
	05:00	455.66	1,500	
	06:00	455.46	1,500	
	07:00	455.56	1,500 +	Decrease RPM.
	08:00	454.49	1,500	
	09:00	454.86	1,500	
	10:00	455.40	1,500	
	11:00	455.34	1,500	
	12:00	455.50	1,500	
	13:00	455.80	1,500	
	13:40		1,500 +	Decrease RPM.
	14:00	455.77	1,500	
	15:00	455.76	1,500	
	16:00	456.87	1,500	
	17:00	455.70	1,500	
	18:00	455.42	1,486	Increase RPM.
	19:00	456.19	1,500 -	Increase RPM.
	20:00	457.03	1,500	
	21:00	457.14	1,500	
	22:00	457.14	1,500	

PRODUCTION WELL NO. 3

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-26-76	23:00	457.31	1,500	
	24:00	457.0	1,500	
01-27-76	01:00	456.96	1,500	
	02:00	456.98	1,500	
	03:00	455.66	1,500	
	04:00	455.96	1,500	
	05:00	455.96	1,500	
	06:05	457.66	1,500	
	07:00	455.26	1,500	
	08:00	453.71	1,500	
	08:50			T = 76°, K = 360 micromhos. Collected water samples.
	08:55	454.16	1,500	
	09:00			Pump off.
	09:01	337.06		
	09:02	346.23		
	09:03	356.86		
	09:04	356.38		
	09:05	356.46		
	09:06	356.35		
	09:07	356.09		
	09:08	355.90		
	09:09	355.72		
	09:10	355.54		
	09:15	354.84		
	09:20	354.32		
	09:25	354.02		
	09:30	353.80		
	09:40	353.53		
	09:50	353.32		
	10:00	352.98		
	10:15	352.89		
	11:00	352.49		
	18:44	351.24		
01-28-76	07:42	350.66		

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well PW-1 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-22-76	11:49	330.91	Measured with chain, Measuring point hole in plate over casing 0.87 foot above top of surface pipe. Surface pipe approximately 0.2 foot above land surface.
	13:00		PW-3 pump on for development.
01-23-76	10:55	331.94	Measured with chain.
	12:00		PW-3 pump off.
01-24-76	08:13	330.77	Measured with chain. Set sounder with tape mark at 330.77.
	09:00		PW-3 pump on for test.
	09:10	330.77	
	09:30	330.87	
	09:45	330.96	
	10:00	330.98	
	10:15	331.10	
	10:35	331.10	
	11:05	331.22	
	11:55	331.33	
	13:12	331.42	
	14:15	331.45	
	15:15	331.51	
	16:15	331.55	
	17:18	331.62	
	18:23	331.67	
	20:13	331.77	
	22:13	331.85	
01-25-76	00:13	331.96	
	02:13	332.11	
	04:13	332.11	
	06:15	332.13	
	08:15	332.08	
	10:15	332.15	
	12:15	332.13	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well PW-1 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-25-76	14:15	332.11	
	16:12	332.15	
	18:15	332.21	
	20:15	332.27	
	22:50	332.36	
01-26-76	00:30	332.37	
	02:30	332.38	
	06:30	332.49	
	08:28	332.58	
	10:13	332.74	
	12:17	332.72	
	14:11	332.67	
	16:10	332.66	
	18:15	332.68	
	20:05	332.70	
01-27-76	00:10	332.74	
	02:15	332.76	
	05:55	332.78	
	08:20	332.84	
	09:00		PW-3 pump off.
	10:35	332.44	
	18:55	331.73	
01-28-76	08:06	331.47	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well PW-2 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-22-76	11:58	309.93	Measured with chain. Measuring point hole in plate above casing 0.7 foot above top of surface pipe. Surface pipe approximately 0.5 foot above land surface.
	13:00		PW-3 pump on for development.
01-23-76	10:45	310.31	Measured with chain.
	12:00		PW-3 pump off.
01-24-76	08:31	309.67	Measured with chain. Set sounder with tape mark at 309.67.
	09:00		PW-3 pump on for test.
	09:05	309.67	
	09:25	309.67	
	09:40	309.67	
	09:55	309.71	
	10:10	309.74	
	10:25	309.75	
	10:40	309.77	
	11:00	309.81	
	11:50	309.84	
	13:16	309.89	
	14:20	309.91	
	15:20	309.94	
	16:20	309.98	
	17:24	310.02	
	18:30	310.07	
	20:16	310.12	
	22:16	310.18	
01-25-76	00:16	310.22	
	02:16	310.27	
	04:18	310.31	
	06:20	310.40	
	08:20	310.42	
	10:20	310.46	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well PW-2 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-25-76	12:20	310.46	
	14:20	310.43	
	16:16	310.43	
	18:20	310.48	
	20:20	310.55	
	23:00	310.67	
01-26-76	00:35	310.65	
	02:35	310.72	
	06:35	310.83	
	08:33	310.90	
	10:17	311.01	
	12:23	311.00	
	14:15	310.92	
	16:15	310.96	
	18:20	310.99	
	20:10	311.01	
01-27-76	00:15	311.04	
	02:20	311.11	
	06:00	311.12	
	08:25	311.13	
	09:00		PW-3 pump off.
	10:40	311.04	
	19:00	310.65	
01-28-76	08:17	310.43	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well MW-5 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-22-76	11:41	336.67	Measured with chain. Measuring point top of 6-inch casing approximately 1 foot above land surface.
	13:00		PW-3 pump on for development.
01-23-76	11:03	337.68	Measured with chain.
	12:00		PW-3 pump off.
01-24-76	07:57	336.52	Measured with chain. Set sounder wit tape mark at 336.52.
	09:00		PW-3 pump on for test.
	09:13	336.52	
	09:34	336.64	
	09:50	336.70	
	10:04	336.71	
	10:24	336.77	
	10:36	336.83	
	11:07	336.91	
	11:57	337.01	
	13:10	337.07	
	14:12	337.11	
	15:12	337.14	
	16:12	337.24	
	17:15	337.29	
	18:20	337.33	
	20:08	337.42	
	22:08	337.49	
01-25-76	00:08	337.53	
	02:08	337.60	
	04:08	337.67	
	06:10	337.76	
	08:10	337.76	
	10:10	337.83	
	12:10	337.82	
	14:10	337.79	
	16:10	337.90	
	18:10	337.82	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-25-76	20:10	337.94	
	22:50	338.01	
01-26-76	00:25	338.03	
	02:25	338.06	
	06:25	338.17	
	08:25	338.26	
	10:10	338.28	
	12:12	338.29	
	14:09	338.28	
	16:08	338.30	
	18:10	338.34	
	20:00	338.39	
01-27-76	00:05	338.41	
	02:10	338.42	
	05:50	338.43	
	08:10	338.56	
	09:00		PW-3 pump off.
	10:30	338.18	
	18:50	337.41	
01-28-76	07:54	337.10	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well MW-6 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-22-76	12:22	386.84	Measuring with sounder. Inside of casing too wet to use chain. Measuring point top of 6-inch casing approximately 1 foot above land surface. MW-6 was used to supply drilling water for drilling production wells.
	13:00		PW-3 pump on for development.
01-23-76	10:14	386.67	
	12:00		PW-3 pump off.
01-24-76	07:34	386.41	
	09:00		PW-3 pump on for test.
	09:20	386.41	
	11:06	386.40	
	12:08	386.38	
	13:04	386.33	
	14:07	386.33	
	15:07	386.33	
	16:07	386.32	
	17:09	386.35	
	18:09	386.34	
	20:05	386.32	
	22:05	386.29	
01-25-76	00:05	386.32	
	02:05	386.35	
	04:05	386.39	
	06:05	386.43	
	08:05	386.49	
	10:05	386.53	
	12:05	386.50	
	14:05	386.47	
	16:05	386.41	
	18:05	386.46	
	20:05	386.54	
	22:24	386.63	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well MW-6 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-26-76	00:15	386.64	
	02:15	386.63	
	06:20	386.74	
	08:20	386.80	
	10:06	386.82	
	12:07	386.82	
	14:05	386.78	
	16:04	386.79	
	18:05	386.77	
	19:56	386.84	
	24:00	386.86	
01-27-76	02:05	386.87	
	05:45	386.88	
	08:05	386.92	
	09:00		PW-3 pump off.
	10:10	386.87	
	18:38	386.81	
01-28-76	07:29	386.77	

BC
LABORATORIES Inc.
OIL - CORES - SOIL - WATER
3016 UNION AVENUE
BAKERSFIELD, CALIFORNIA 93305
Phone (805) 325-7475
J. J. EGLIN, Reg. Chem. Engr.

Submitted By: Water Development Corp.
3938 Santa Barbara Ave.
Tucson, Arizona 85711

Date Reported: 2/16/76
Date Received: 2/3/76
Laboratory No.: 10753

Marked: Quintana #3 1/27/76 08:50 T: 76°F. K: 360

WATER ANALYSIS

Sample Description:

pH		8.0
E.C. Micromhos/cm ($K \times 10^6$) @ 25°C (salinity)		330.
Resistivity, Ohm M^2/M		

Constituents, P. P. M. (parts per million)

[illegible] (B)		
Calcium, (Ca)		22.5
Magnesium, (Mg)		2.7
Sodium, (Na)		44.
Potassium, (K)		5.1
Carbonates, (CO_3)		0.
Bicarbonates, (HCO_3)		158.0
Chlorides, (Cl)		24.1
Sulphates, (SO_4)	(-)	5
Nitrate, (NO_3)		2.60
Fluoride, (F)		0.64
Total Iron, (Fe)		
Copper, (Cu)		
Manganese, (Mn)		
Chromium, (Cr)		
Zinc, (Zn)		
Aluminum, (Al)		
Silica, (SiO_2)		
Lithium, (Li)		
Lead, (Pb)		
Phenol		
Sulfides as H_2S		
Total Hardness as $CaCO_3$		
Oil (chloroform extractable)		
[illegible] Dissolved Solids		243. @ 180°F.
[illegible] Suspended Solids		

BC LABORATORIES Inc.

By J. J. Eglin

WATER DEVELOPMENT CORPORATION

BASIC-DATA REPORT
QUINTANA MINERALS CORPORATION
COPPER FLAT PROJECT
PRODUCTION WELL NO. 4,
HILLSBORO, NEW MEXICO

By

D.K. Greene and L. C. Halpenny

Tucson, Arizona
December 1980

BASIC-DATA REPORT

QUINTANA MINERALS CORPORATION
COPPER FLAT PROJECT PRODUCTION WELL NO. 4, HILLSBORO, NEW MEXICO

By

D. K. Greene and L. C. Halpenny

GENERAL INFORMATION

A fourth production well (PW-4) has been drilled to assist in furnishing the water supply for ore processing and other uses at the Copper Flat Project. Location of PW-4 along with PW-1, PW-2, and PW-3, is shown on Figure 1. The legal description of PW-4 is as follows:

NW$\frac{1}{4}$ SW$\frac{1}{4}$ NE$\frac{1}{4}$, Sec. 31, T. 15 S., R. 5 W.

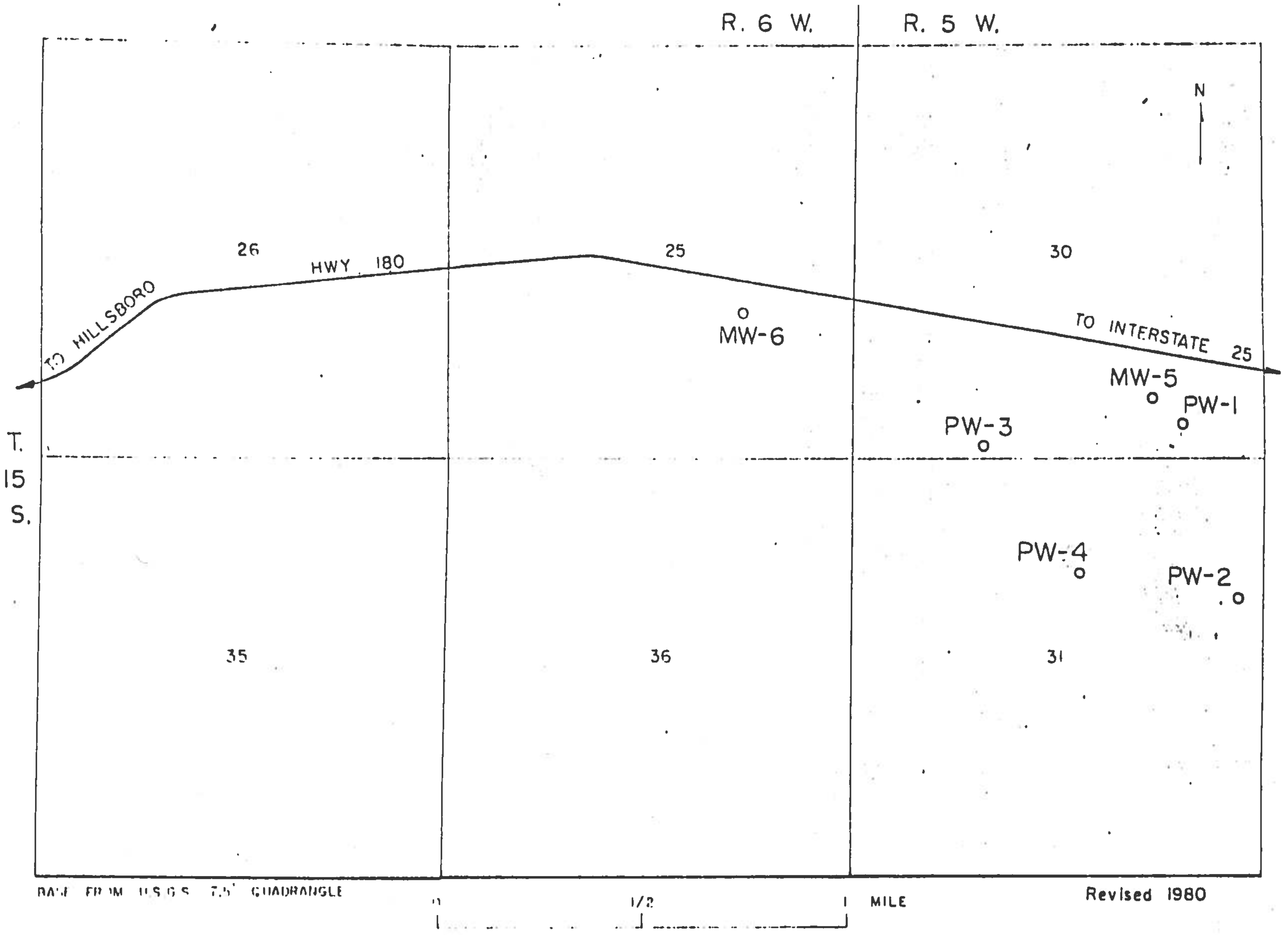

FIGURE 1.--MAP OF A PORTION OF TOWNSHIP 15 SOUTH, RANGES 5 AND 6 WEST, SIERRA COUNTY, NEW MEXICO, SHOWING LOCATIONS OF PRODUCTION WELLS AND MW-5 AND MW-6.

PW-4 was drilled by R. L. Guffey, Inc., Drilling Contractors of Las Cruces, New Mexico using rotary equipment and the conventional method of drilling. Considerable difficulty was encountered in drilling the upper 100 feet of hole due to boulders. A 12-inch pilot hole was drilled through this section and down to 400 feet. From 400 feet a 9-7/8-inch pilot hole was drilled to bottom depth of 957 feet. Following pilot hole drilling a 23-foot joint of 30-inch diameter surface pipe was set and cemented in place. The hole was then reamed to an ultimate diameter of 26 inches to a depth of 954 feet. An 18-inch pilot bit extended ahead of the 22-inch bit giving a hole diameter of 18-inches from 954 to 957 feet.

The hole was cased with 16-inch OD, 5/16-inch wall thickness, blank casing and 16-inch OD Johnson 100 slot Irrigator Screen. Open area in the Irrigator Screen amounts to 217 square inches per lineal foot. A 3-foot section of 16-inch OD, 5/16 inch wall thickness, blank casing was welded to the bottom of the Irrigator Screen.. This section of casing is tapered on the bottom end. The annular space was gravel packed with 1/8 to 3/8-inch gravel and the well was developed with the drilling rig by washing, jetting, and bailing.

Details on depth drilled, casing installed, etc., for PW-4 are as follows:

Depth drilled	957 feet
Casing installed	
Blank	0 to 354 feet
Screen	354 to 954 feet
Blank	954 to 957 feet
Gravel installed	110 yards
Rig development time	39 hours
Gravel slippage during rig development	55 feet

Upon completion of rig development the well was further developed and tested with a diesel powered turbine pump furnished by Western Pump and Supply Company of Deming, New Mexico. Data obtained during this phase of work are included in the following sections of this report along with logs for the well.

PRODUCTION WELL NO. 4
DRILLER'S LOG

(Prepared by R. L. Guffey, Inc. Drilling Contractors)

Depth From (ft)	To	Sample Description
0	23	Boulder gravel some clay
23	38	Hard black rock stks, clay
38	56	Stks. hard black rock gravel boulder some clay
56	73	Gravel some boulders and clay
73	96	Gravel and clay with boulders
96	156	Clay and gravel stks gravel
156	198	Gravel some sand with clay and clay stks.
198	233	Gravel and sand stks of red clay
233	275	Clay (red) stks gravel
275	281	Sand sandy clay
281	293	Clay stks gravel embedded in clay
293	309	Gravel some sand stks clay
309	407	Sand small gravel stks clay (sandy)
407	422	Clay stks gravel calcareous and sand
422	446	Clay some gravel embedded
446	532	Gravel and sand some clay stks
532	560	Gravel (larger) with clay
560	610	Gravel sand with some clay
610	764	Gravel some (clean) with clay stks, drilled tight
764	783	Gravel, gravel embedded in clay
783	805	Gravel some sand with clay
805	825	Gravel and clay (Bentonite)
825	835	Gravel clean with sand
835	877	Clay with gravel embedded
877	896	Gravel clean some clay lens
896	925	Gravel fine with sand (some clean)
925	957	Gravel embedded in clay

PRODUCTION WELL NO. 4

WADEVCO LOG

Depth (ft)		Sample Description
From	To	
0	20	Angular fragments of boulders which are exposed at land surface, 1/4" to 1/2" +.
20	30	Angular fragments of boulders, 1/4" to 1/2" +. Small amount of medium to coarse sand.
30	40	Angular fragments of boulders, 1/4" to 1/2" +.
40	50	Angular rock fragments, 1/8" to 1/4". Some silt and very fine sand.
50	70	Angular rock fragments, 1/4" to 1/2" +.
70	90	Angular rock fragments, 1/8" to 1/2" +. Some fine to medium sand.
90	100	Angular rock fragments, 1/8" to 1/2" +.
100	110	Angular rock fragments, 1/8" to 1/2" +. Some silt and clay.
110	120	Primarily angular rock fragments, 1/8" to 1/2". Few fragments are rounded.
120	130	Primarily angular rock fragments, 1/4" to 1/2". Several fragments of clay with embedded sand and gravel.
130	140	Angular rock fragments, ± 1/8". Some medium to very fine sand, silt, and clay.
140	160	Angular rock fragments, 1/8" to 1/4". Some medium to very fine sand, silt, and clay.
160	170	Angular rock fragments, 1/8" to 1/4". Some coarse to very fine sand.
170	180	Angular rock fragments, ± 1/8". Some coarse to very fine sand.
180	200	Medium to very coarse sand and gravel up to 1/8". Some silt.
200	220	Angular rock fragments, ± 1/8". Some coarse to very fine sand.
220	230	Angular rock fragments, 1/8" to 1/4". Some very coarse to fine sand.
230	240	Angular rock fragments, ± 1/8". Some very coarse to fine sand.
240	250	Angular rock fragments, 1/8" to 1/4". Some very coarse to fine sand.

PRODUCTION WELL NO. 4

WADEVCO LOG
(continued)

Depth From (ft)	To	Sample Description
250	260	Angular rock fragments, 1/8" to 1/4". Some very coarse to fine sand and silt. Several fragments of clay ± 1/8".
260	280	Angular rock fragments, ± 1/8". Some very coarse to fine sand.
280	300	Angular rock fragments, 1/8" to 1/4". Some very coarse to fine sand.
300	310	Angular rock fragments, 1/8" to 1/4". Some very coarse to fine sand. Several clay fragments ± 1/8".
310	330	Gravel up to ± 1/8" with fine to very coarse sand. Several rock fragments ± 1/4". Several clay fragments ± 1/8".
330	340	Medium to very coarse sand with gravel up to 1/8". Few angular rock fragments ± 1/4".
340	360	Fine to very coarse sand and gravel. Some silt.
360	390	Very coarse sand and gravel. Some fine to medium sand.
390	400	Very coarse sand and gravel. Some fine to medium sand. Few small fragments of clay.
400	420	Angular rock fragments 1/4" to 1/2". Some medium to very coarse sand and gravel.
420	450	Very coarse sand and gravel to ± 1/8". Few rock fragments ± 1/4". Some medium to coarse sand.
450	460	Very coarse sand and gravel to ± 1/8". Some medium to fine sand. Few fragments of clay. Some silt.
460	490	Very coarse sand and gravel to ± 1/8". Some medium to fine sand.
490	500	Very coarse sand and gravel to ± 1/8". Some medium to fine sand. Several fragments of black vesicular material with sand grains embedded in some vesicles.
500	530	Very coarse sand and gravel to ± 1/8". Some medium to fine sand.
530	560	Angular rock fragments, 1/8" to 1/2" with fine to very coarse sand. Some silt.

PRODUCTION WELL NO. 4

WADEVCO LOG
(continued)

Depth From (ft)	To	Sample Description
560	590	Very coarse sand and gravel to ± 1/8". Fair number of angular rock fragments in 1/4" to 1/2" range. Several fragments of clay up to 1/2". Some silt.
590	620	Very coarse sand and gravel up to ± 1/8". Some medium to very fine sand and silt.
620	700	Very coarse sand and gravel up to ± 1/8". Some medium to fine sand.
700	730	Medium to very coarse sand with some gravel up to ± 1/8". Some fine sand and silt.
730	740	Medium to very coarse sand with some gravel up to ± 1/8". Some fine sand, silt, and clay fragments.
740	750	Medium to very coarse sand with some gravel up to ± 1/8".
750	760	Coarse to very coarse sand with some gravel up to ± 1/8". Some fine to medium sand.
760	780	Coarse to very coarse sand with some gravel up to ± 1/8". Some fine to medium sand. Several fragments of clay.
780	800	Very coarse sand and gravel up to ± 1/8". Some medium to fine sand.
800	810	Coarse to very coarse sand with some gravel up to ± 1/8". Some fine to medium sand. Few fragments of clay.
810	820	Very coarse sand and gravel up to ± 1/8". Several angular rock fragments ± 1/4". Some fine to medium sand and silt.
820	840	Very coarse sand and gravel up to ± 1/8". Some fine to medium sand.
840	850	Medium to very coarse sand and gravel up to ± 1/8". Several rock fragments ± 1/4". Silt and numerous fragments of clay.
850	870	Very fine to medium sand and silt with fragments of clay. Some coarse to very coarse sand with gravel up to ± 1/8".

PRODUCTION WELL NO. 4

WADEVCO LOG
(continued)

Depth From (ft)	To	Sample Description
870	880	Coarse to very coarse sand and gravel up to ± 1/8". Some fine to medium sand.
880	900	Coarse to very coarse sand. Some fine to medium sand.
900	910	Very fine to coarse sand.
910	920	Very fine to medium sand with some coarse sand.
920	957	Samples missing. Refer to Driller's Log.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
11-30-80	16:15	290.82		Measured with chain. Measuring point top of 3/4-inch pipe 0.86 foot above top of surface pipe. Surface pipe approximately 0.5 foot above land surface.
12-01-80	07:35	290.87		Measured with chain.
	07:50	290.9		Measuring with sounder.
	09:50	290.9		
	10:15			Pump on. Ten-inch pump to 350-feet. Eight inch pump 350 to 550 feet. Top of 13.5 inch bowls set at 550 feet. Discharge pipe 10-inch. Orifice 7-inch.
	10:16	326.6		
	10:17	309.4	550	
	10:20	309.2		
	10:21	309.2	550	
	10:24		550	Lot of mud. 2.5 cc/l fine to very fine sand.
	10:25	309.5		
	10:28		550	Clearing some. 0.3 cc/l fine to very fine sand.
	10:30	309.4		
	10:38	309.4		
	10:40			Fairly clear. Slight mud color. < 0.1 cc/l very fine sand.
	10:44		550	Fairly clear. < 0.1 cc/l very fine sand.
	10:45	309.7		
	10:47			Surge once.
	10:52			Lot of mud. 1.5 cc/l medium to very fine sand.
	10:55			Lot of mud. 2.5 cc/l fine to very fine sand.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-01-80	10:56	310.6		
	11:05	310.7		Lot of mud. < 0.1 cc/l very fine sand.
	11:11		550	Clearing some. < 0.1 cc/l very fine sand.
	11:12	310.7		
	11:19			Fairly clear. < 0.1 cc/l very fine sand.
	11:20			Surge once.
	11:25		550	Lot of mud. 2.5 cc/l fine to very fine sand.
	11:27			Still lot of mud. 1.0 cc/l fine to very fine sand.
	11:29	310.5		
	11:32			Less mud. <0.1 cc/l very fine sand.
	11:38	310.6		
	11:40		550	Less mud. < 0.1 cc/l very fine sand.
	11:49			Fairly clear. Surge once.
	11:54		550	Lot of mud. 1.3 cc/l fine to very fine sand.
	11:56			Lot of mud. 0.9 cc/l fine to very fine sand.
	11:58			Lot of mud. 0.15 cc/l fine to very fine sand.
	12:00	310.9	550	
	12:11		550	Still muddy. < 0.1 cc/l very fine sand.
	12:15			Fairly clear. Surge once.
	12:19		812	Lot of mud. 1.5 cc/l medium to very fine sand.
	12:21			Lot of mud. 0.5 cc/l fine to very fine sand.
	12:23	324.1		
	12:27		812	Still muddy. < 0.1 cc/l fine to very fine sand.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-01-80	12:32	324.7		
	12:34			Fairly clear. Surge once.
	12:37			Lot of mud. 0.6 cc/l medium to very fine sand.
	12:38			Lot of mud. 1.2 cc/l fine to very fine sand.
	12:40		812	Lot of mud. 0.3 cc/l fine to very fine sand.
	12:34	324.0		
	12:52	324.4		
	12:53			Fairly clear. < 0.1 cc/l very fine sand.
	12:54			Surge twice.
	12:59			Lot of mud. 1.0 cc/l fine to very fine sand.
	13:00			Lot of mud. 0.6 cc/l fine to very fine sand.
	13:01		812	Lot of mud. 0.1 cc/l fine to very fine sand.
	13:03			Still muddy. 0.1 cc/l fine to very fine sand.
	13:12	323.8		
	13:15			Fairly clear. Surge twice.
	13:21			Lot of mud. 1.5 cc/l medium to very fine sand.
	13:23		812	Lot of mud. 0.1 cc/l fine to very fine sand.
	13:27			Still muddy. < 0.1 cc/l fine to very fine sand.
	13:29	323.1		
	13:31			Fairly clear. Surge twice.
	13:36			Lot of mud. 1.0 cc/l medium to fine sand.
	13:38			Lot of mud. 0.9 cc/l very fine sand and silt.
	13:47	322.5	812	Fairly clear. Surge twice.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-1-80	13:53		812	Lot of mud. 1.5 cc/l medium to very fine sand.
	13:55			Lot of mud. 0.15 cc/l fine to very fine sand.
	13:59		812	Still some mud. < 0.1 cc/l very fine sand.
	14:02	321.8		
	14:03			Fairly clear. Surge twice.
	14:08			Lot of mud. 0.5 cc/l medium to very fine sand.
	14:10		812	Lot of mud. 0.2 cc/l very fine sand and silt.
	14:18	321.2		
	14:20		812	Clearing some.
	14:22			Fairly clear. Surge twice.
	14:27		1,001	Lot of mud. 0.3 cc/l medium to very fine sand.
	14:28			Lot of mud. 0.3 cc/l medium to very fine sand.
	14:30			Still muddy. 0.1 cc/l very fine sand.
	14:32	329.0		
	14:40	329.8	1,001	
	14:41			Fairly clear. Surge twice.
	14:46			Lot of mud. 0.6 cc/l medium to very fine sand.
	14:48			Lot of mud. 0.1 cc/l very fine sand and silt.
	14:58	329.2	1,001	
	14:59			Fairly clear. Surge twice.
	15:04			Considerable mud and color. 0.5 cc/l medium to very fine sand.
	15:06		1,001	Considerable mud and color. 0.1 cc/l very fine sand.
	15:14	328.2	1,001	

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-01-80	15:15			Fairly clear. Surge twice.
	15:20			Considerable mud and color. 0.2 cc/l medium to fine sand.
	15:22		1,001	Considerable mud and color. 0.1 cc/l very fine sand.
	15:29	327.8	1,001	
	15:30			Fairly clear. Surge twice.
	15:35			Considerable mud and color. 0.2 cc/l fine to very fine sand.
	15:37			Considerable mud and color. < 0.1 cc/l very fine sand.
	15:44	327.2	1,001	
	15:45			Fairly clear. Surge twice.
	15:50			Considerable mud and silt. 0.2 cc/l medium to very fine sand.
	15:52			Considerable mud and silt. 0.1 cc/l very fine sand and silt.
	15:59	326.5	1,001	
	16:00			Fairly clear. Surge twice.
	16:05			Considerable mud and silt. 0.1 cc/l fine to very fine sand.
	16:07			Considerable mud and silt. 0.1 cc/l very fine sand and silt.
	16:14	326.2	1,001	
	16:15			Fairly clear. Surge twice.
	16:17			Considerable mud and silt. 0.2 cc/l fine to very fine sand.
	16:19			Considerable mud and silt. 0.1 cc/l very fine sand and silt.
	16:29	326.1	1,001	
	16:30			Fairly clear. Surge twice.
	16:35		1,251	Lot of mud and silt. 0.2 cc/l fine to very fine sand.
	16:44	335.9		
	16:45			Fairly clear. Surge twice.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-01-80	16:50			Lot of mud and color. 0.15 cc/l fine to very fine sand.
	16:52			Lot of mud and silt. < 0.1 cc/l very fine sand.
	16:59	335.9	1,251	
	17:00			Fairly clear. Surge twice.
	17:29	336.7	1,251	
	17:30			Fairly clear. Surge twice.
	17:35			Lot of color. 0.1 cc/l very fine sand.
	17:44	335.5	1,251	
	17:45			Fairly clear. Surge twice.
	17:59	335.4	1,251	Surge twice.
	18:00		1,404	Changed to 8-inch orifice.
	18:05	337.9	1,404	Fairly clear.
	19:00	341.2		Surge twice. Some color 0.1 cc/l very fine sand.
	19:15	339.9	1,370	Some color. 0.1 cc/l very fine sand.
	19:39	339.6	1,370	Surge twice. Some color.
	19:43		1,404	Some color. 0.2 cc/l very fine sand.
	20:00	339.9	1,387	Surge twice.
	20:05		1,404	Clear, then some color.
	20:30	339.5	1,370	Clearing.
	20:35		1,529	Clear, then some color.
	21:00	346.9	1,543	Some color. Surge twice.
	21:07			$T = 76^oF$; $K = 360$ micromhos. < 0.1 cc/l very fine sand.
	21:30	346.7	1,500	Clearing. Surge twice.
	21:37			Clear, then color. < 0.1 cc/l very fine sand.
	22:03	345.9	1,500	Clear. Surge twice.
	22:10		1,529	Clear, then some color. 0.1 cc/l very fine sand.
	22:30	345.2	1,529	Clearing. Very little color. Surge twice.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-01-80	23:07		1,613	Color, clearing fast. No sand.
12-02-80	01:00	348.3	1,585	Clear. Surge twice.
	01:07		1,613	Color, < 0.1 cc/l very fine sand.
	01:30	346.5	1,557	Clear. Surge twice.
	01:37	[illegible]	1,613	Some color. Clearing fast. < 0.1 cc/l very fine sand.
	02:00	345.0	1,529	Clear. Surge twice.
	02:05		1,613	Clear, then some color. < 0.1 cc/l very fine sand.
	02:35	350.2	1,627	Clear. Surge twice.
	02:40		1,697	Clear, then color. < 0.1 cc/l very fine sand.
	03:30	352.6	1,697	Clear. Surge twice.
	03:35			Color. Clearing. No sand. T = 76°F; K = 380 micromhos.
	04:00	352.7	1,711	Surge twice.
	04:07			Color. No sand.
	04:30	352.3	1,711	Surge twice.
	04:37		1,791	Clear, then some color. No sand.
	05:30	355.9	1,791	Clear. Surge twice.
	05:37		1,791	Some color. No sand.
	06:00	356.2	1,791	Clear. Surge twice.
	06:07		1,791	Color. No sand.
	06:30	356.9	1,795	
	07:10	356.2	1,791	Clear. Surge twice.
	07:15		1,865	Color. No sand.
	07:24	357.4	1,865	Clear. Surge twice.
	07:30			Color. No sand.
	07:31			Starting to clear.
	07:42	358.3	1,865	Clear. Surge twice.
	07:48			Color. No sand.
	07:52	357.2	1,865	Clear. Surge twice.
	07:57			Color. No sand.
	07:59			Clearing.
	08:05			Surge twice.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-02-80	08:11			Color. No sand.
	08:15	357.0	1,865	Surge twice.
	08:21		2,005	Color. No sand.
	08:23		1,975	Clear.
	08:25	359.2		
	08:28		1,975	Clear. Surge twice.
	08:31		1,975	Slight color.
	08:32			Clearing.
	08:34			Clear.
	08:35	359.0	1,975	
	08:36			Reduced rpm.
	08:39	355.7	1,809	Clear.
	08:48			T = 76°F; K = 380 micromhos.
	08:53	356.8		
	09:23	357.6	1,823	Clear.
	09:40	357.5	1,809	Clear. No sand.
	09:55	357.6	1,809	Clear. No sand.
	10:05	357.7	1,808	Clear. No sand.
	10:15			Pump off.
	10:16	292.2		
	10:17	299.7		
	10:18	299.4		
	10:19	298.9		
	10:20	298.4		
	10:32	295.7		
	10:45	295.2		

PRODUCTION WELL NO. 4

TEST DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-03-80	07:25	291.75		Measured with chain. Same measuring point as for development.
	07:30	291.7 -1.36 = 290.3 GL		Measuring with sounder.
	07:45	291.7		
	08:00			Pump on. Same setting as for development.
	08:01	337.8	1,711	Some color.
	08:02	341.9		Some color. Trace of sand.
	08:03	343.4	1,711	Clearing. No sand.
	08:04	344.4		
	08:05	344.9	1,711	
	08:06	345.5		Slight mud color. Few grains of sand.
	08:07	345.9		
	08:08	346.3	1,711	
	08:09	346.5		Clear. No sand.
	08:10	346.7	1,711	
	08:11	346.9		
	08:12	347.2		
	08:13	347.6		
	08:14	347.6	1,711	
	08:15	347.6		
	08:16	347.6		
	08:17	348.0		
	08:18	348.2	1,711	Clear. No sand.
	08:19	348.3		
	08:20	348.3		
	08:21	348.4		
	08:22	348.5	1,711	
	08:24	348.8		
	08:26	348.9		
	08:28	348.9		
	08:30	349.0		
	08:32	349.0		
	08:34	349.2	1,711	

PRODUCTION WELL NO. 4

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-03-80	08:36	349.6		
	08:38	349.7		
	08:40	349.7		
	08:44	349.9		Clear. No sand.
	08:46	349.9	1,711	
	08:48	350.1		T = 76°F; K = 380 micromhos.
	08:50	350.3		
	08:52	350.3		
	08:54	350.4		
	08:56	350.5	1,711	
	08:58	350.7	1,711 +	Decreased rpm slightly.
	09:00	350.6		
	09:05	350.4		
	09:10	350.6		
	09:15	351.1	1,725	Decreased rpm slightly.
	09:20	351.0	1,711 +	Decreased rpm slightly.
	09:25	351.0		
	09:30	351.1		
	09:35	351.2	1,711 +	Decreased rpm slightly.
	09:40	351.2	1,711	
	09:50	351.3	1,711	
	10:00	351.5	1,711	
	10:10	351.5	1,711	
	10:20	351.8	1,711 +	Decreased rpm slightly.
	10:30	351.7	1,711 +	Decreased rpm slightly.
	10:40	351.7	1,711	
	10:50	351.9	1,711	
	11:00	351.8	1,711 -	Increased rpm slightly.
	11:20	351.9	1,711	
	11:30	352.3	1,711	
	11:45	352.3	1,711 +	Decreased rpm slightly.
	12:00	352.3	1,711	
	12:15	352.5	1,711 +	Decreased rpm slightly.
	12:30	352.4	1,711	
	13:00	352.7	1,711	

PRODUCTION WELL NO. 4

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-03-80	13:30	352.7	1,711	
	14:00	352.8	1,711	
	14:30	352.8	1,711	
	15:00	353.0	1,711	
	15:30	353.0	1,711	
	16:00	353.2	1,711	
	16:05			T = 76°F; K = 380 micromhos.
	16:30	353.3	1,711	
	17:00	353.4	1,711	
	17:30	353.4	1,711	
	18:00	353.5	1,711	
	18:30	353.4	1,711	
	19:00	353.4	1,711	
	19:30	353.4	1,711	
	20:00	353.9	1,711 +	Decreased rpm slightly.
	20:30	353.7	1,711	
	21:00	353.4	1,697	Increased rpm slightly.
	21:30	353.6	1,711	
	22:00	353.9	1,711	
	22:30	353.8	1,711	
	23:00	353.8	1,711	T = 76°F; K = 380 micromhos.
	23:30	354.1	1,711	
12-04-80	00:00	354.5	1,711	
	00:30	354.6	1,711	
	01:00	354.9	1,711	
	01:30	355.0	1,711 +	Decreased rpm slightly.
	02:00	355.3	1,711 +	Decreased rpm slightly.
	02:30	355.5	1,725	Decreased rpm slightly.
	03:00	354.5	1,711	
	03:30	354.5	1,711 +	Decreased rpm slightly.
	04:00	354.3	1,711	
	04:30	354.3	1,711	
	04:46			Engine stopped, wire to fuel pump solenoid broke.

PRODUCTION WELL NO. 4

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-04-80	04:50	298.9		
	04:51	298.7		
	04:52	298.3		
	04:53	298.1		
	04:54	297.9		
	04:55	297.7		
	04:56	297.6		Pump back on.
	05:00	348.7	1,711	
	05:22	352.8	1,711	
	05:30	353.1	1,711	
	06:00	353.7	1,711	
	06:30	354.0	1,711 +	Decreased rpm slightly.
	07:00	353.7	1,711	
	07:30	353.9	1,711	
	07:45			T = 76°F; K = 380 micromhos. Collected samples.
	07:55	353.4	1,711	
	08:00			Pump off.
	08:01	283.1		
	08:02	299.0		
	08:03	299.8		
	08:04	299.4		
	08:05	299.1		
	08:06	298.7		
	08:07	298.5		
	08:08	298.3		
	08:09	298.0		
	08:10	297.8		
	08:11	297.6		
	08:12	297.5		
	08:13	297.4		
	08:14	297.2		
	08:15	297.2		
	08:20	296.7		
	08:25	296.2		
	08:30	296.0		

PRODUCTION WELL NO. 4

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-04-80	08:35	295.8		
	08:40	295.5		
	08:45	295.5		
	08:50	295.2		
	08:55	295.1		
	09:00	295.0		
	09:10	294.9		
	09:20	294.6		
	09:30	294.5		
	09:40	294.4		
	09:50	294.3		
	10:00	294.2		
	10:15	294.0		
	10:30	293.8		
	10:45	293.8		
	11:00	293.7		
	11:30	293.5		

PRODUCTION WELL NO. 4

TEST DATA

(Observation Well PW-1 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
11-17-80	11:35	329.04	Measured with chain. Measuring point hole in plate over casing 0.87 foot above top of surface pipe. Surface pipe approximately 0.2 foot above land surface.
11-30-80	15:08	328.76	Measured with chain.
	15:28		Set wire with tape mark at 328.76.
12-01-80	08:09	328.68	
	10:15		PW-4 on for development.
	17:18	329.24	
12-02-80	02:15	330.21	
	09:07	330.70	
	10:15		PW-4 off.
12-03-80	07:25	329.44	
	08:00		PW-4 on for test.
	08:28	329.49	
	09:00	329.71	
	09:20	329.82	
	09:35	329.90	
	09:50	329.94	
	10:10	330.02	
	10:25	330.06	
	10:45	330.13	
	11:25	330.24	
	11:40	330.26	
	12:40	330.42	
	13:40	330.51	
	14:40	330.61	
	15:40	330.68	
	16:40	330.76	
	17:40	330.86	
	19:10	330.95	
	20:10	331.06	
	21:10	331.13	
	22:10	331.43	
	23:10	331.22	

PRODUCTION WELL NO. 4

TEST DATA
(Observation Well PW-1 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-04-80	00:10	331.24	
	01:10	331.25	
	02:10	331.30	
	03:10	331.33	
	04;10	331.34	
	05:10	331.29	
	06:10	331.32	
	07:10	331.39	
	08:00		PW-4 off.
	08:45	331.21	
	09:00	331.14	
	09:15	331.07	
	09:30	331.00	
	10:15	330.85	
	10:30	330.78	
	11:10	330.67	

PRODUCTION WELL NO. 4

TEST DATA

(Observation Well PW-2 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
11-17-80	11:50	307.46	Measured with chain. Measuring point hole in plate over casing 0.90 foot above top of surface pipe. Surface pipe approximately 0.5 foot above land surface.
11-30-80	15:40	307.29	Measured with chain.
	15:55		Set wire with tape mark at 307.29.
12-01-80	08:15	307.32	
	10:15		PW-4 on for development.
	17:22	307.97	
12-02-80	02:25	309.74	
	06:50	310.40	
	09:15	310.71	
	10:15		PW-4 off.
12-03-80	07:32	308.79	
	08:00		PW-4 on for test.
	08:33	308.94	
	09:05	309.10	
	09:25	309.18	
	09:40	309.23	
	09:55	309.31	
	10:15	309.42	
	10:30	309.49	
	10:50	309.57	
	11:30	309.71	
	11:45	309.77	
	12:45	310.01	
	13:45	310.13	
	14:45	310.35	
	15:45	310.52	
	16:45	310.73	
	17:45	310.92	
	19:15	311.17	
	20:15	311.30	
	21:15	311.46	

PRODUCTION WELL NO. 4

TEST DATA
(Observation Well PW-2 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-03-80	22:15	311.58	
	23:15	311.67	
12-04-80	00:15	311.76	
	01:15	311.83	
	02:15	311.91	
	03:15	311.98	
	04:15	312.07	
	05:15	312.04	
	06:15	312.17	
	07:15	312.22	
	08:00		PW-4 off.
	08:50	312.01	
	09:05	311.93	
	09:20	311.82	
	09:35	311.74	
	10:20	311.44	
	10:35	311.33	
	11:30	311.10	

PRODUCTION WELL NO. 4

TEST DATA

(Observation Well PW-3 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
11-17-80	11:10	353.22	Measured with chain. Measuring point hole in plate over casing 1.3 feet above surface pipe. Surface pipe approximately 1 foot above land surface.
11-30-80	14:23	352.92	Measured with chain.
	14:55		Set wire with tape at 352.92.
12-01-80	08:03	352.80	
	10:15		PW-4 on for development.
	17:13	353.18	
12-02-80	02:15	353.93	
	06:44	354.20	
	09:00	354.29	
	10:15		PW-4 off.
12-03-80	07:39	353.43	
	08:00		PW-4 on for test.
	08:23	353.47	
	08:55	353.64	
	09:30	353.77	
	09:45	353.79	
	10:00	353.83	
	10:20	353.86	
	10:35	353.91	
	11:20	353.98	
	11:35	354.01	
	12:35	354.06	
	13:35	354.12	
	14:35	354.16	
	15:35	354.24	
	16:35	354.28	
	17:35	354.34	
	19:05	354.41	
	20:05	354.48	
	21:05	354.57	
	22:05	354.59	
	23:05	354.65	

PRODUCTION WELL NO. 4

TEST DATA
(Observation Well PW-3 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-04-80	00:05	354.63	
	01:05	354.65	
	02:05	354.68	
	03:05	354.69	
	04:05	354.74	
	05:05	354.67	
	06:05	354.74	
	07:05	354.78	
	08:00		PW-4 off.
	08:55	354.60	
	09:10	354.55	
	09:25	354.51	
	10:10	354.40	
	10:25	354.37	
	10:45	354.31	

Appendix C2.

MW-9 Pumping Test, 1994

APPENDIX C

LAS ANIMAS CREEK
PUMPING TEST

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September 12, 1996
Report 1356A/960912

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LIST OF ATTACHMENTS

1. INTRODUCTION

Water supply for the Copper Flat project is to be drawn from Santa Fe Formation alluvium in the valley of the Rio Grande. Water is to be removed from four wells approximately one mile north of the Las Animas Creek valley. This valley contains a shallow aquifer and an intermittent stream, which supply water for a wide range of agricultural and water supply activities, as well as support a major stand of deciduous trees.

In order to evaluate the extent to which the stream flow and the water in the shallow aquifer may be affected by the drawdown from the nearby pumping wells, a major pumping test was designed and performed in Animas Creek. This test comprised the installation of a pumping well in the main Santa Fe aquifer, located some 200 feet below the ground surface in the valley. Water was pumped from this well to create a drawdown which would simulate the drawdown expected from the production pumping. The response to this pumping was monitored in one well completed at the top of the saturated section in the Santa Fe formation, at a depth of approximately 80 feet. In addition, the response of the overlying Las Animas Creek shallow aquifer was monitored by one specially completed shallow monitor well, as well as a total of seven other shallow private wells in the area. The pumping test was performed in October, 1994. This appendix presents the test approach, test results, and an interpretation of the results.

2. APPROACH

The pumping test was performed in the Las Animas Creek Valley at the point closest to the mine's water supply wells, as shown in Figure 1. The test location geology comprises 20-60 feet of reworked gravels which form a recent alluvium layer, overlying several thousand feet of Santa Fe Group gravels, sands, and silts.

A number of nearby private wells draw water from the Las Animas Creek alluvium, most are less than 100 feet deep, tapping the recent alluvium. Water levels in these wells are typically within a few feet of ground surface, and appear to be associated with stream levels (when the stream flows). This aquifer provides groundwater for domestic and stock watering wells in the area. Several wells are completed at approximately 100 feet or greater. These wells display a chemical signature distinct from the alluvial well water and a water level about 50 feet lower than the shallow wells.

Las Animas Creek is an intermittent stream. The stream was flowing when sampled in August 1994, but was not flowing at the time of the pumping test in October 1994. Water quality is generally good.

3. TEST ARRANGEMENT

Figure 2 shows the locations of the three wells which were installed for the test. Details of each well are provided in Attachment 1. The three wells were completed as follows:

1. Pumping well MW-9. The pumping well is MW-9. This well is drilled to a depth of 252.5 feet through the Las Animas Creek alluvium into the Santa Fe Formation. It is open to the formation from 194 feet to total depth. The well was screened with 4 ½ inch Schedule 80

slotted PVC, and cased with 4 ½ inch Schedule 80 blank PVC pipe. The well was fitted with a 100 gpm submersible pump.

2. Monitor well MW-10. MW-10 is located approximately 50 feet east of MW-9. It was drilled to a depth of 125 feet, and screened between 76.5 feet and total depth in the Santa Fe alluvium.
3. Monitor well MW-11. MW-11 is located approximately 50 feet southeast of MW-9. MW-11was initially drilled to a depth of 65 feet. After logging the hole, it was backfilled to a depth of 37 feet, sealed with bentonite, and screened from 7 to 37 feet BGS with a gravel pack.

Figure 3 shows the generalized geology of the three wells. The initial water levels are shown for reference.

In addition to these three wells, the test was monitored by measuring water levels in nearby domestic, irrigation, and water supply wells. The wells used were as follows:

Well Name	Location Relative to MW-9	Drilling method	Approx. Depth (ft)
Irwin House- "Birdie"	250 feet southwest	Hand dug	40
Irwin Yard- "Concrete"	150 feet due south	Hand dug	30
Exten	1250 feet west	Hand dug	25
Nicholson	1350 feet east	Hand dug	25
Cox	2200 feet east	Drilled	112
Darling	2700 feet east	Hand dug	25
PW-1	3400 feet south	Drilled	1000

4. TEST RESULTS

4.1 Pre-test activities

Prior to the test, all wells were measured daily for 17 days, to establish a trend for groundwater levels (if any).

4.2 Pumping Test Operation

The test was operated by starting the pump generator on October 13, 1994 at 12:30 p.m. Initially water was discharged to a location approximately 200 feet from the well. It was discovered that this location was too close to the monitor wells, as the water level began to rise slightly in MW-11. The test was temporarily shut down on October 14 from 13:32 to 16:30 to change the location of the discharge, with the new discharge point being located approximately one mile from the pumping well. During operating periods, the pumped flow rate averaged 90 gpm. Flows are shown on Figure 4. The test ended at 09:00 on October 17. Water levels were measured every day for 12 days following the test.

Water levels were monitored using water level sounders, which were calibrated against each other to the nearest one hundredth foot. Reading frequency depended on the changes in the levels; pre- and post-test levels were generally read daily, while test rates ranged from hourly to once per shift. Results of water level monitoring are presented in Attachment 2.

4.3 Rainfall event

On October 14, a nearby rain gauge measured 1 inch of rain in 2.5 hours in the Las Animas Creek drainage basin. The creek began to flow, and water levels in the wells changed in response to the rain and the flow.

5. RESULTS

5.1 Flows

Flows from the pumped well (MW-09) were recorded using a flow meter. The results are presented in Figure 4. The flow fluctuated somewhat, with an average flow rate of 90 gpm.

5.2 Heads

Heads were measured in all project wells, but were measured more frequently in the three main wells installed for the project. The results are as follows:

1. MW-09. The initial water level elevation in the pumping well was approximately 4,375 feet. The response of MW-9 to pumping is indicated in Figure 5. As can be seen, drawdown was rapid and reversible, and reached approximately 24 feet at the end of the test. Specific capacity of the well was 3.75 gpm/ft.
2. MW-10. The initial water level elevation in the deeper of the two monitor wells was 4,376 feet, about the same as the pumping well. The response to the pumping is indicated in Figure 6. A drawdown of approximately 1 foot was recorded at the well, although it is possible that this value was affected by the rainfall which occurred late in the test.
3. MW-11. The initial water elevation in the shallowest well, completed in the Las Animas Creek alluvium, was 4,435 feet, approximately 60 feet higher than the two deeper wells. The response of the level in MW-11 during the test is presented in Figure 7 (note very expanded vertical scale on this graph). The rise in water level after the start of the test on October 14 is due to the local discharge of water on the ground nearby. There is no evidence that pumping in MW-9 effected a head change in MW-11 at any time during the test; the level in the well was falling prior to the test, and continued to fall after it.

In addition to monitoring the three main wells, a total of seven other wells were monitored. All were relatively shallow, and all were near the pumping well. Figure 9 presents a magnified view of the pumping test wells' head responses. The general trend of these well results is as follows:

1. a small rise for the first few days after pumping began
2. a return to the previous rate of decrease after the rise.

Prior to the pumping test, the "Birdie" shallow aquifer well was falling at 0.02 ft/day. After the discharge incident, the rate of decline remained the same. There is no identifiable evidence of any impact on these wells of the drawdown created by MW-09.

5.3 PW-1 Response

To check if there was any effect of the drawdown in the extraction wells, pumping well PW-1 was monitored. This well is located 3500 feet to the south of MW-9. The water level elevation in this well was 4375 feet for the period during which the test was run. During the test, the water level in PW-1 did not change in any way attributable to MW-9.

6. ANALYSIS OF RESPONSES

6.1 MW-09 response

The hydraulic characteristics of the aquifer tapped by MW-09 have been estimated by a variety of non-equilibrium methods, using the Aqtesolve Package (Gerahty and Miller, 1995). Three approaches were used to analyze the first 24 hour drawdown period, with the following results (Figure 10, Figure 11, and Figure 12):

Method	**Cooper-Jacob**	**Theis**	**Hantush**	**Average**
Transmissivity (ft^2/min)	0.6086	0.5779	0.5666	0.5700
Storage Coefficient	$3.3x10^{-5}$	$6.1x10^{-5}$	$7.3x10^{-5}$	$5x10^{-5}$
Horizontal hydraulic conductivity (ft/yr)	6,400	6,075	5,960	6,000
Vertical hydraulic conductivity (ft/yr)	n/a	n/a	60	60

The Hantush analysis is particularly interesting, as the fit is good between the observed and the predicted behavior. In this analysis, it is assumed that there is leaky flow through an aquitard (on the bottom or top of the aquifer, or both). The vertical hydraulic conductivity of the leaky aquitards can be estimated from the response. The value obtained is 60 ft/yr. The vertical to horizontal anisotropy ratio obtained for the test is 100:1.

In summary, it would appear that MW-09 is located in a material with a hydraulic conductivity of approximately 6,000 ft/yr, with a storage coefficient of $5x10^{-5}$, and a ratio of horizontal hydraulic conductivity to vertical hydraulic conductivity of 100:1. These values are very similar to the calibrated values which have been used in the modeling (Appendix D).

6.2 Las Animas Creek aquitard conductivity

The conductivity of the aquitard below the Las Animas Creek alluvium can be estimated by consideration of the head difference in the aquifer. The vertical head gradient between MW-11 (completed in the Las Animas Creek alluvium) and MW-10 (completed in the Santa Fe Formation) can be computed as follows: 60'?

Head difference MW-10 to MW-11 = 23 feet

Thickness of low permeability layer = 50 feet

Head gradient = 23/50 = 0.46

This is a substantial vertical gradient. From modeling, it appears that there is approximately 13 miles of Las Animas Creek bottom land, with an average width of 2,000 feet. The total flow down the valley appears to be in the order of 2,000 gpm. If half of the water were to seep from the upper alluvium to the lower through the low permeability layer between the two wells above, then the hydraulic conductivity would have to be:

evidence?

but in the lower part, it seeps up!

$$K = Q/iA$$

where: K = hydraulic conductivity (ft/yr)

Q = flow (1,000 gpm or 70×10^6 cuft/yr)

i = hydraulic gradient = 0.46

A = flow area (5 square miles or 150×10^6 square feet)

Applying the values produces a vertical hydraulic conductivity estimate of 1.0 ft/yr, or about 10^{-6} cm/sec. This is the vertical conductivity of a clayey material.

6.3 Water Chemistry

As a part of the evaluation, water chemistry was sampled from the test wells. The results are included in the data presented in Appendix E. The chemistry of the water is summarized below:

Parameter	Units	MW-9	MW-10	MW-11	PW-1
TDS	mg/L	190	310	314	217
HCO_3	mg/L	149	262	263	144
SO_4	mg/L	12	25	21	10
Ca	mg/L	12	59	63	22
Na	mg/L	54	29	23	38
Mg	mg/L	1	8	10	n/a

The chemistry of wells MW-10 and MW-11 are very similar, indicating that the water in the upper portion of the Santa Fe aquifer is provided by seepage from the overlying Las Animas Creek alluvium through a low permeability layer to the MW-10 level. Conversely, the chemistry of MW-9 differs from MW-10 and MW-11, and is very similar to PW-1. This suggests MW-9 comprises underflow beneath Las Animas Creek, not flow from it.

6.4 Conceptual Model

Based on the observations from the Las Animas Creek pump test a conceptual flow model of this system has been developed and quantified:

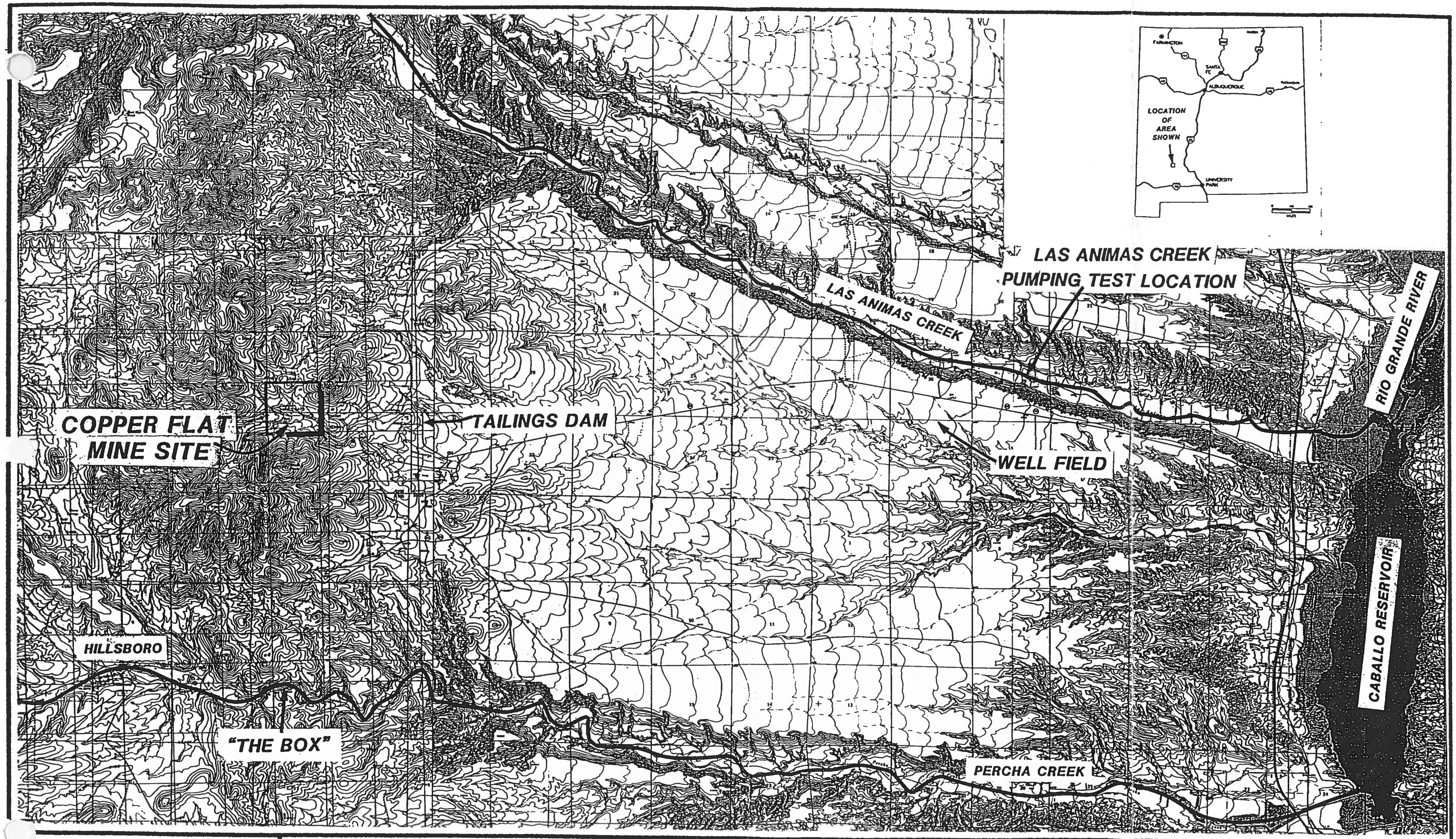
1. Water flows along Las Animas Creek, filling the associated alluvial aquifer.
2. Water leaks from the Las Animas Creek alluvial aquifer through the underlying clayey material. Analysis of this flow and the head gradient identified in the test produces a vertical hydraulic conductivity of 1 ft/yr.
3. This infiltrating water then meets with, and mixes with, water in the main Santa Fe aquifer. This aquifer is made up of relatively high permeability material, with a lateral hydraulic conductivity of about 6,000 ft/yr. The vertical permeability of this material is approximately 100 times less than its effective horizontal conductivity.

This system provides the explanation as to why the Las Animas alluvium remains saturated; the low conductivity of the underlying clayey material is sufficiently low to prevent water from leaving the alluvium, even under the strong vertical head which exists through the layer.

7. CONCLUSIONS

The Las Animas Creek alluvial system pump test has established that the creek and the associated alluvium is prevented from leaving the valley by a low permeability zone beneath the alluvial aquifer. This zone is estimated to have an hydraulic conductivity of no more than 1 ft/yr. The lower material in the Santa Fe aquifer is comprised of layers of high horizontal hydraulic conductivity materials ($K = 6,000$ ft/yr) and layers of low vertical conductivity aquitards ($K = 60$ ft/yr, or 1/100 of the horizontal conductivity).

While there is some evidence to suggest that the material between the Las Animas Creek alluvium is unsaturated (Attachment 1) the testing data does not provide a demonstration of a widespread unsaturated material beneath the creek bed.



ADRIAN BROWN CONSULTANTS, INC.

LOCATION MAP

Figure 1

Figure 2 Pump test location map

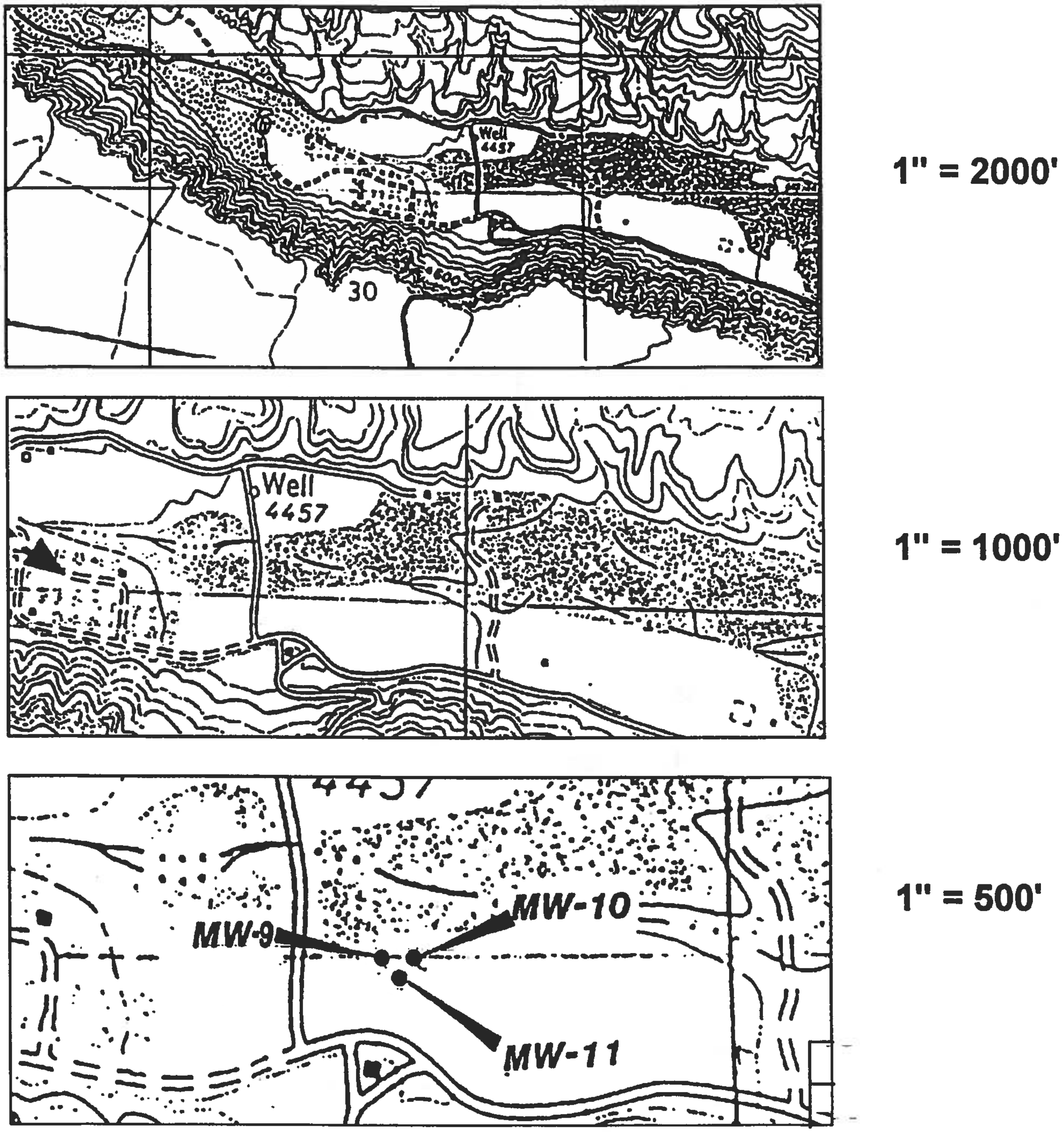


Figure 3 Generalized geology of pumping test wells

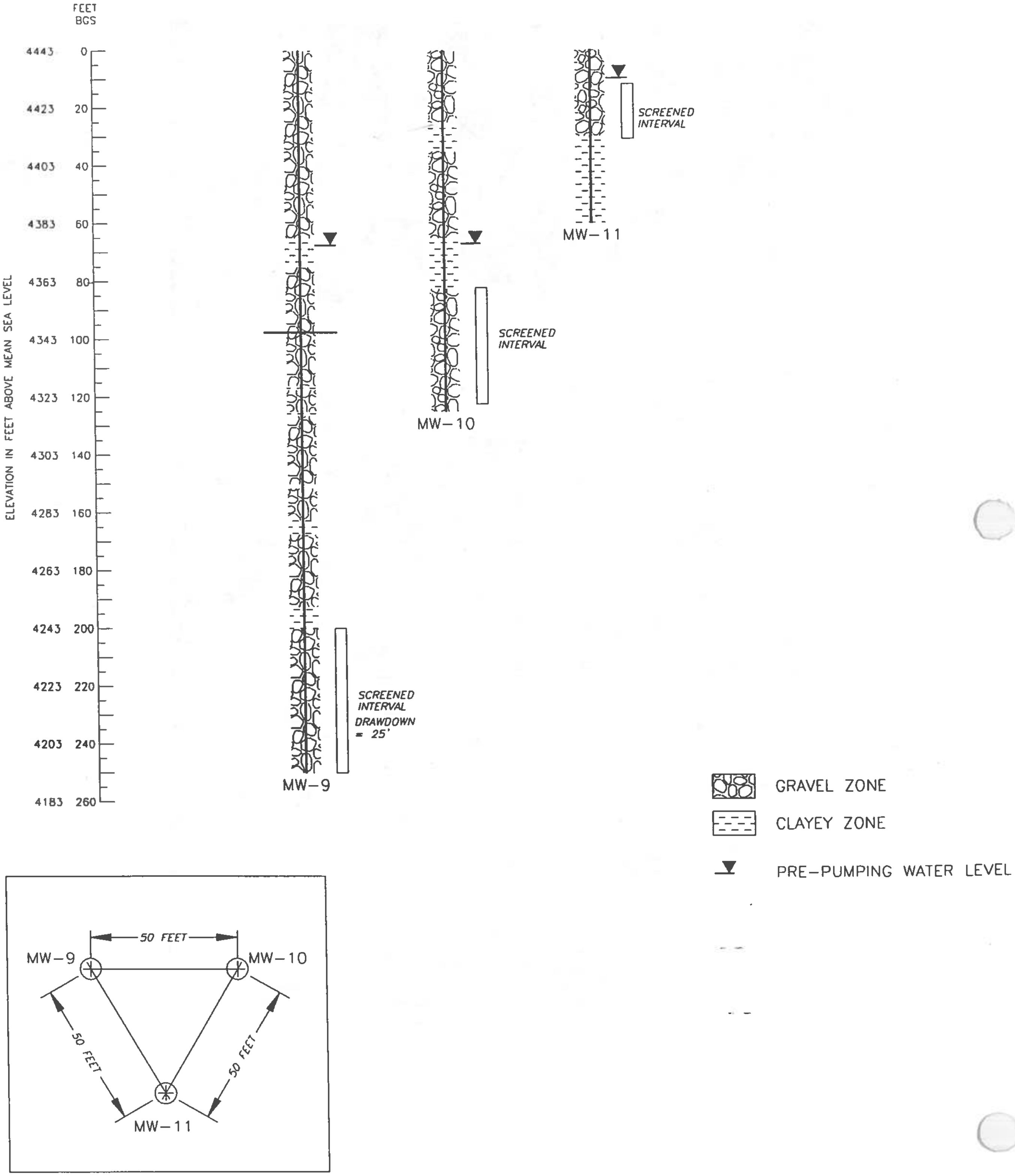


Figure 4 Flow from MW-9

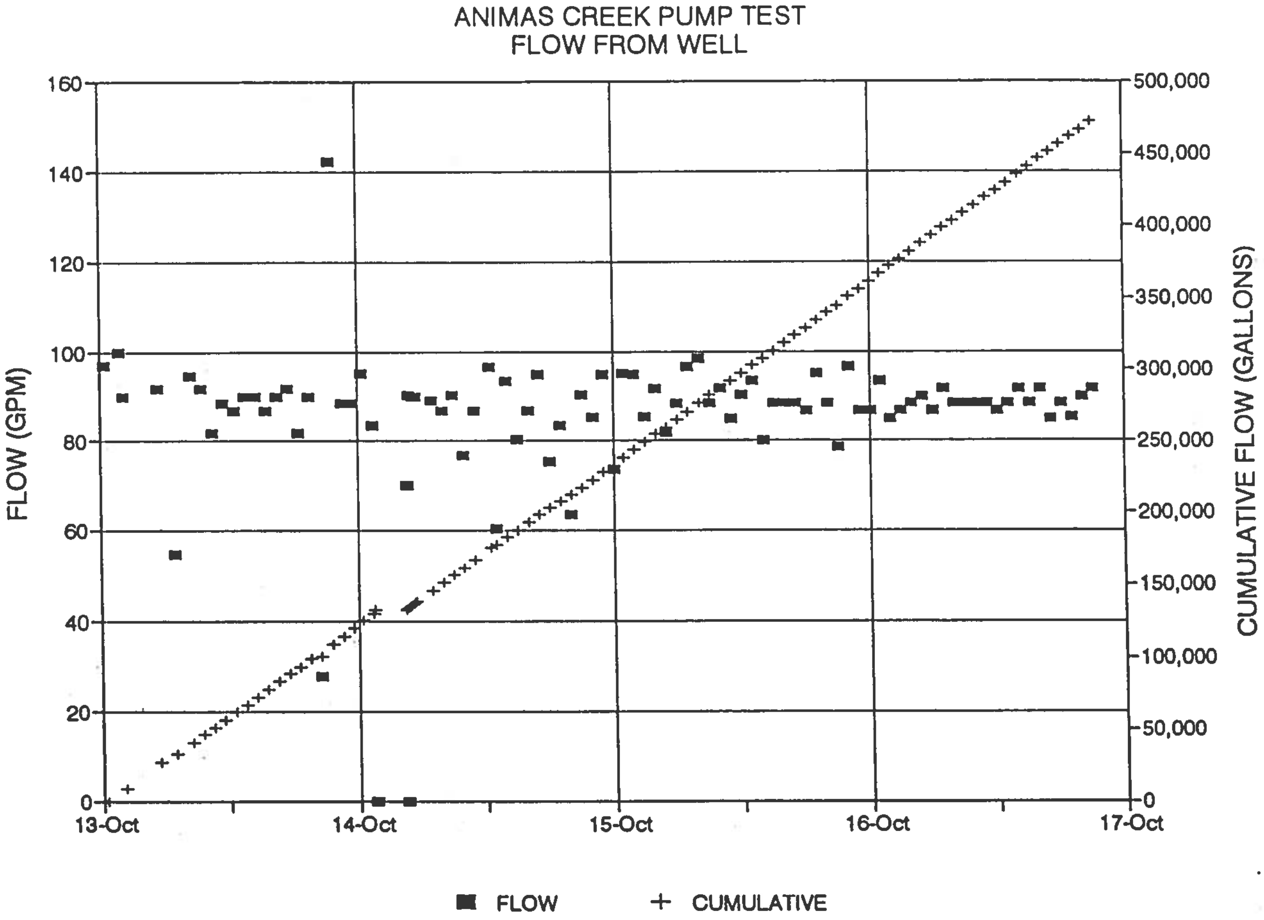


Figure 5 Drawdown in MW-9

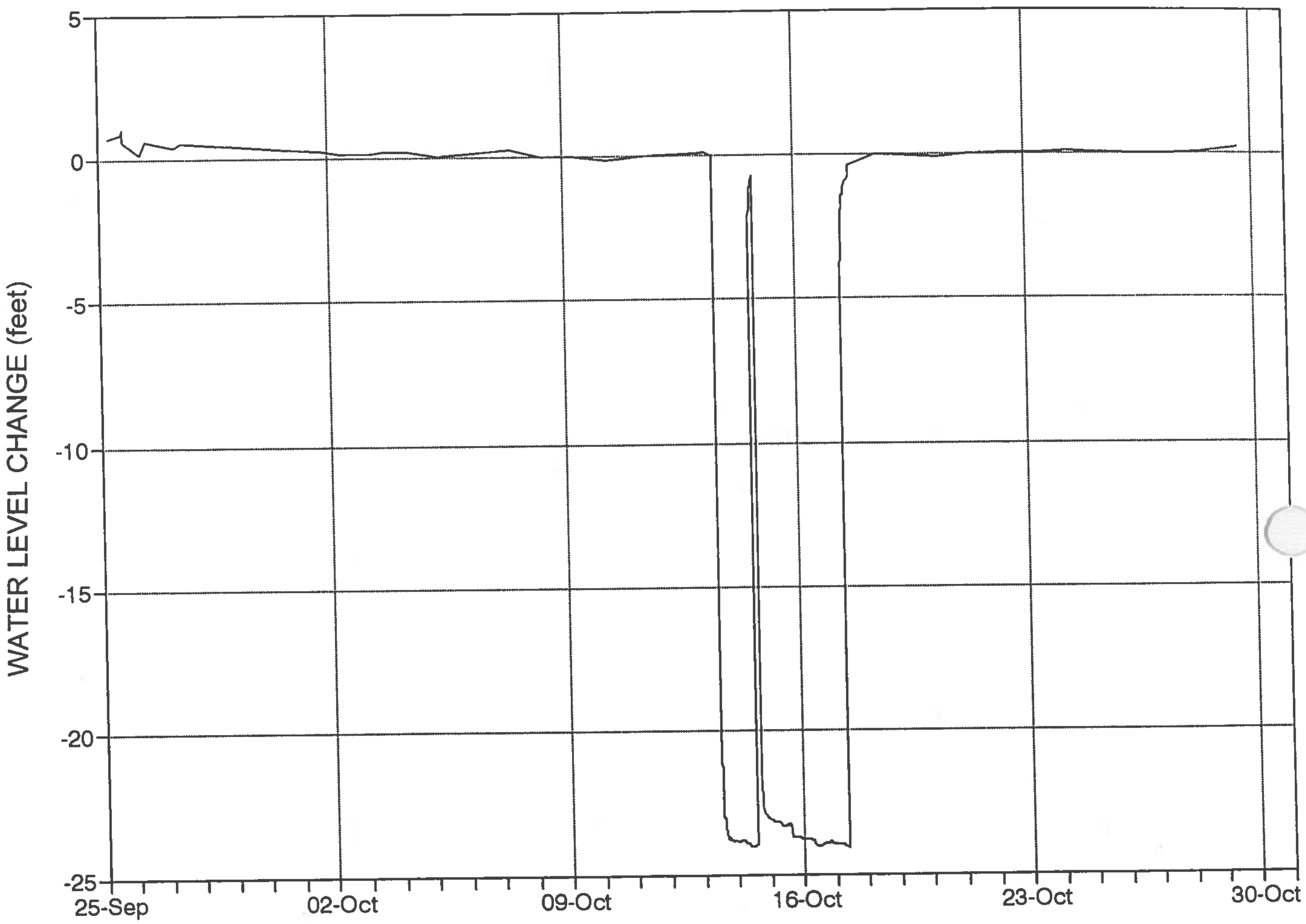


Figure 6 Drawdown in MW-10

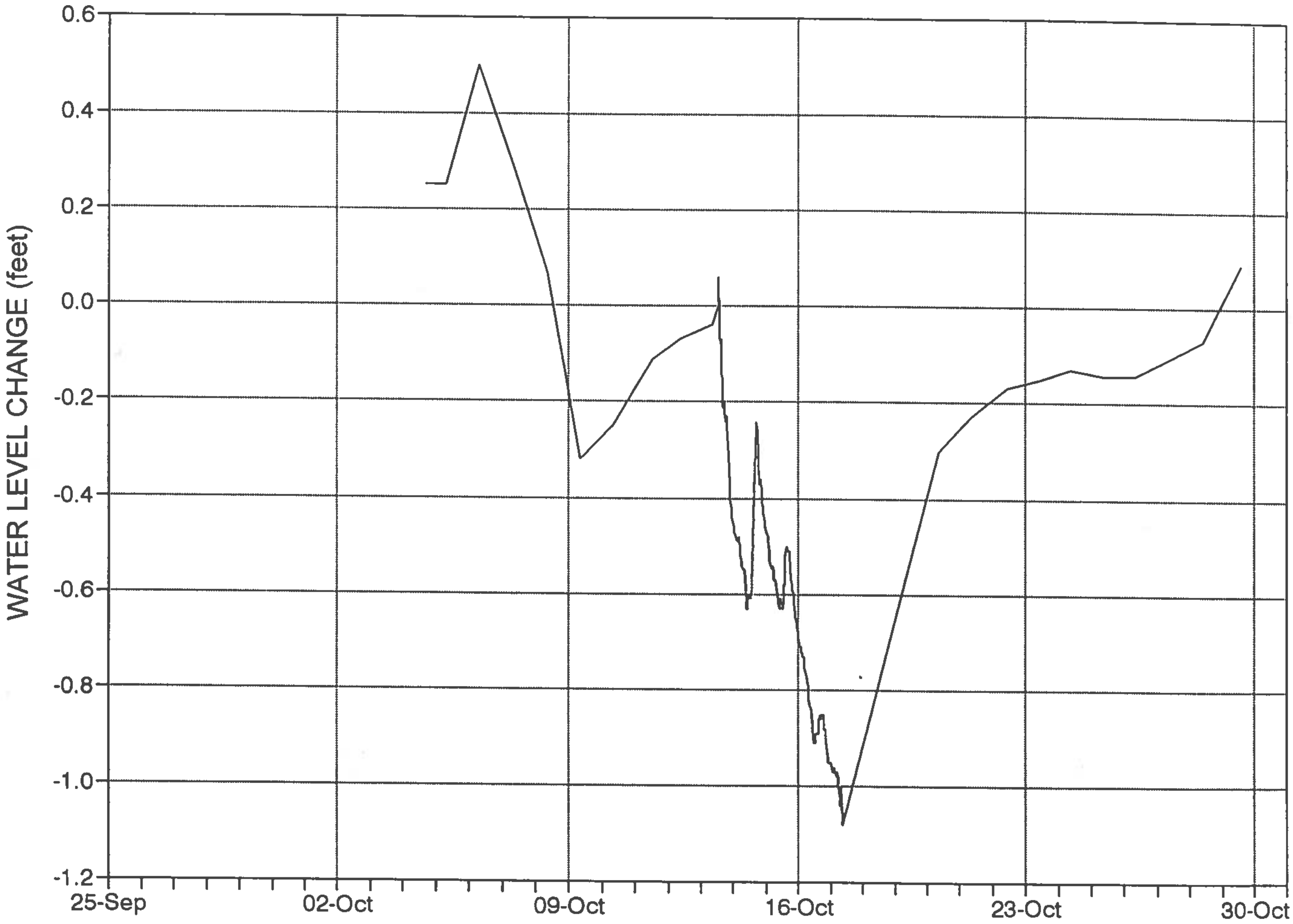


Figure 7 Drawdown in MW-11

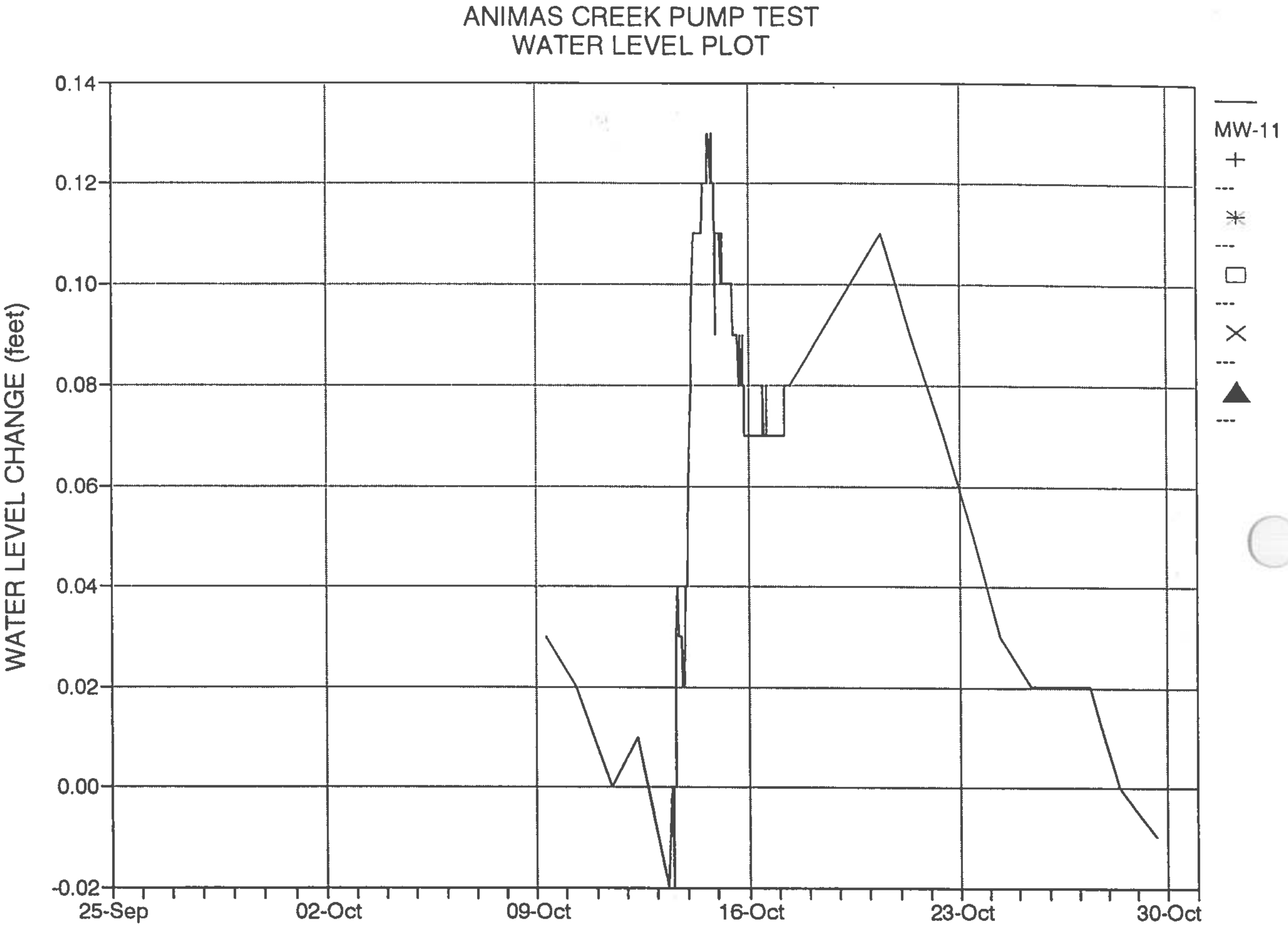
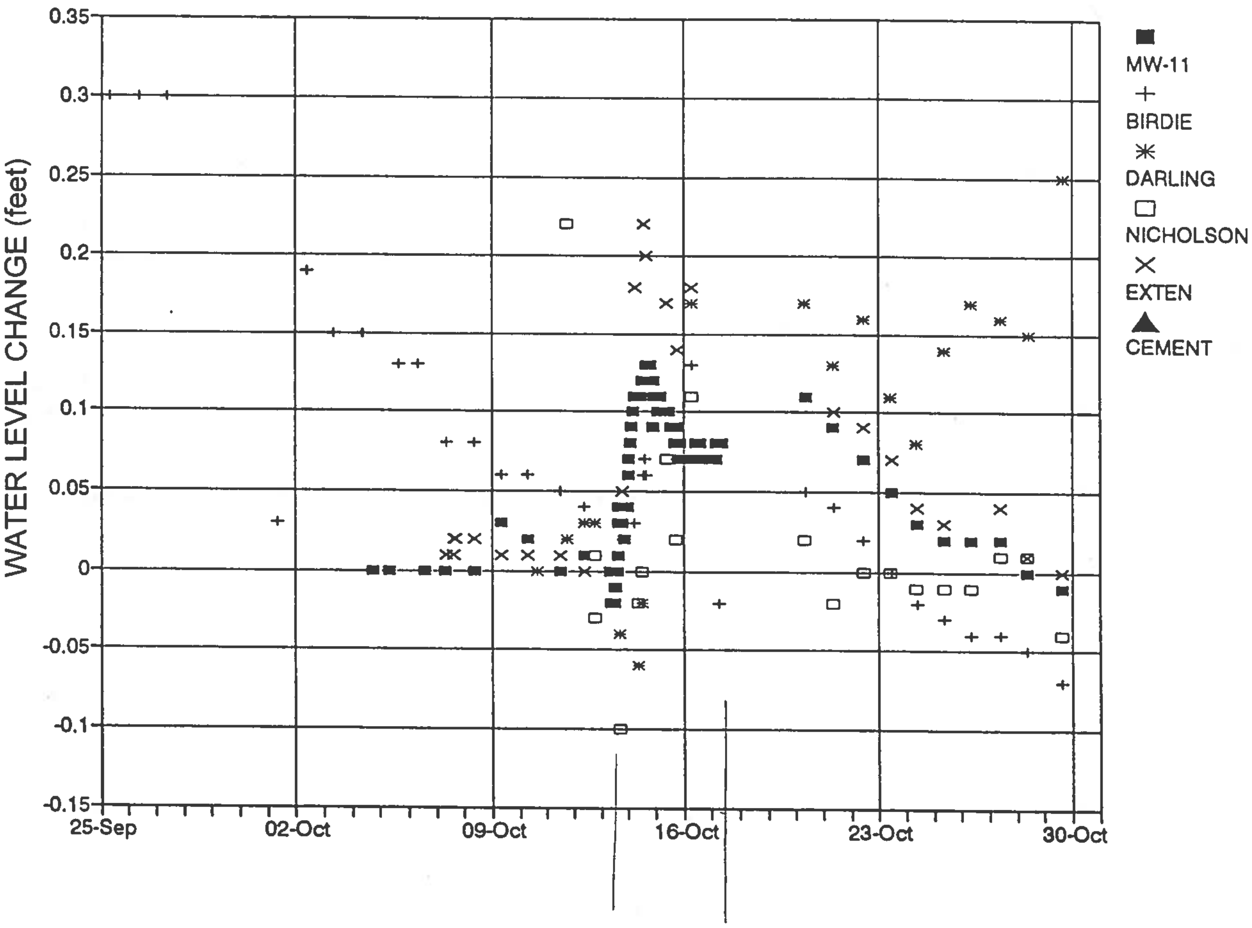


Figure 8 Water elevations in test wells



10-13-94
noon

10-17-94
09:00

Figure 9 Head changes for test wells

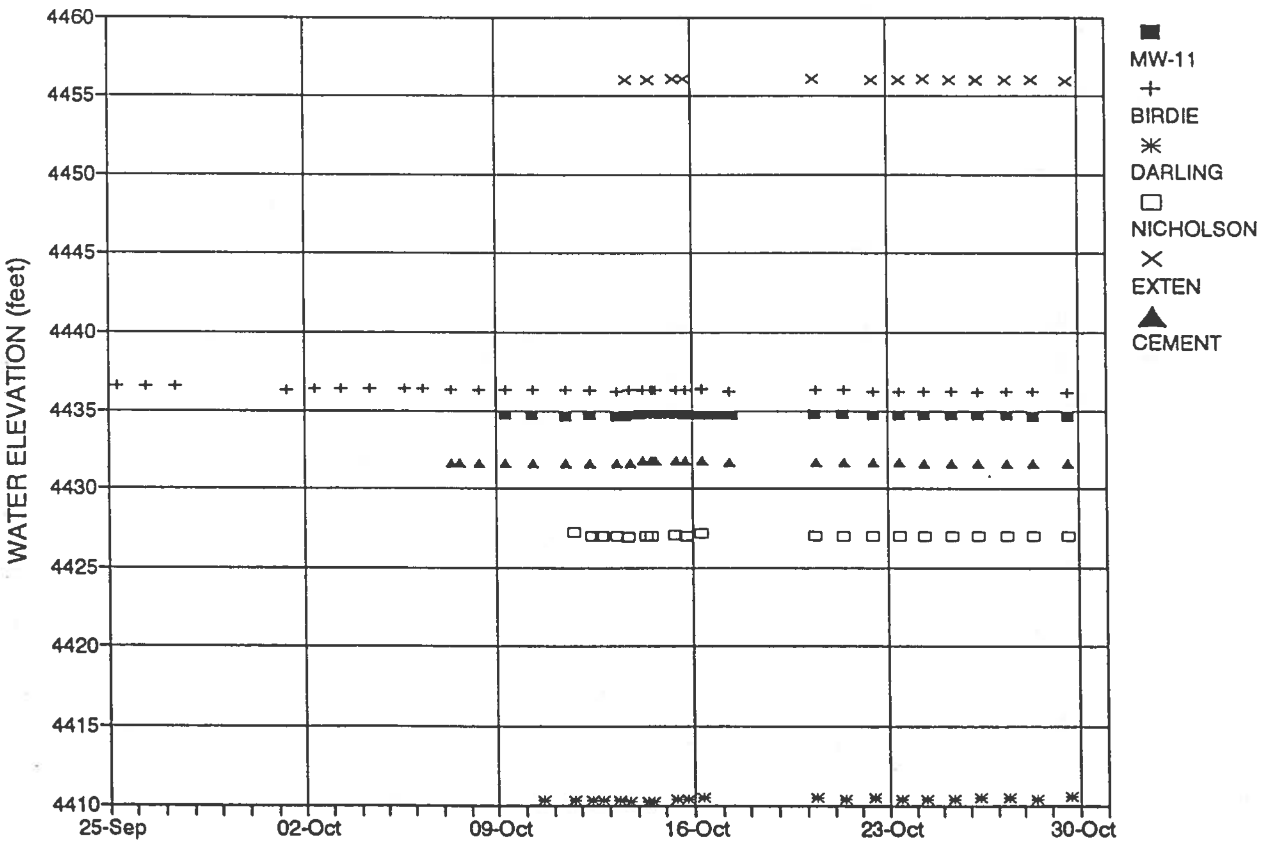
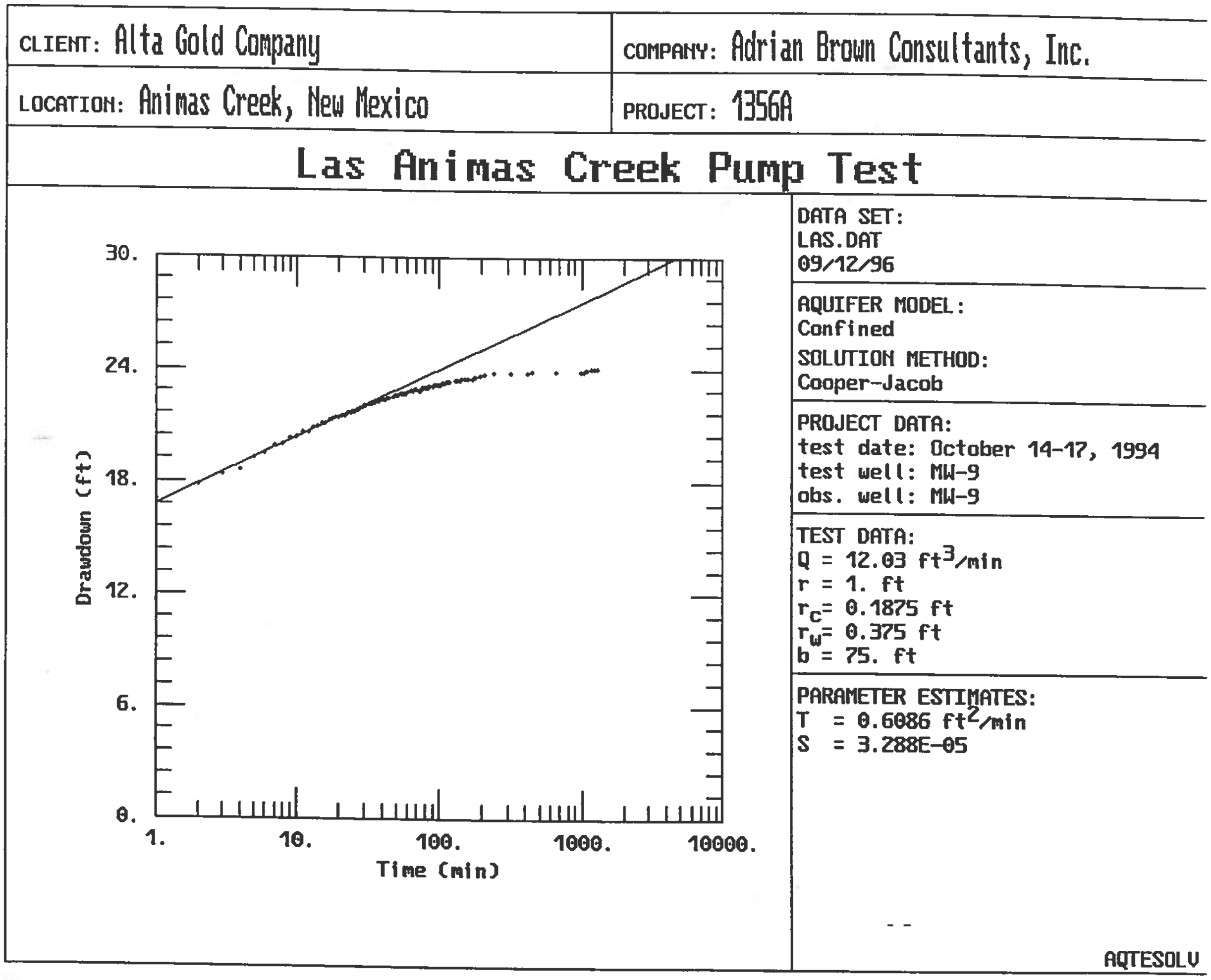


Figure 10 Cooper- Jacob drawdown analysis plot



CLIENT: Alta Gold Company

COMPANY: Adrian Brown Consultants, Inc.

LOCATION: Animas Creek, New Mexico

PROJECT: 1356A

Las Animas Creek Pump Test

DATA SET:
LAS.DAT
09/12/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper-Jacob

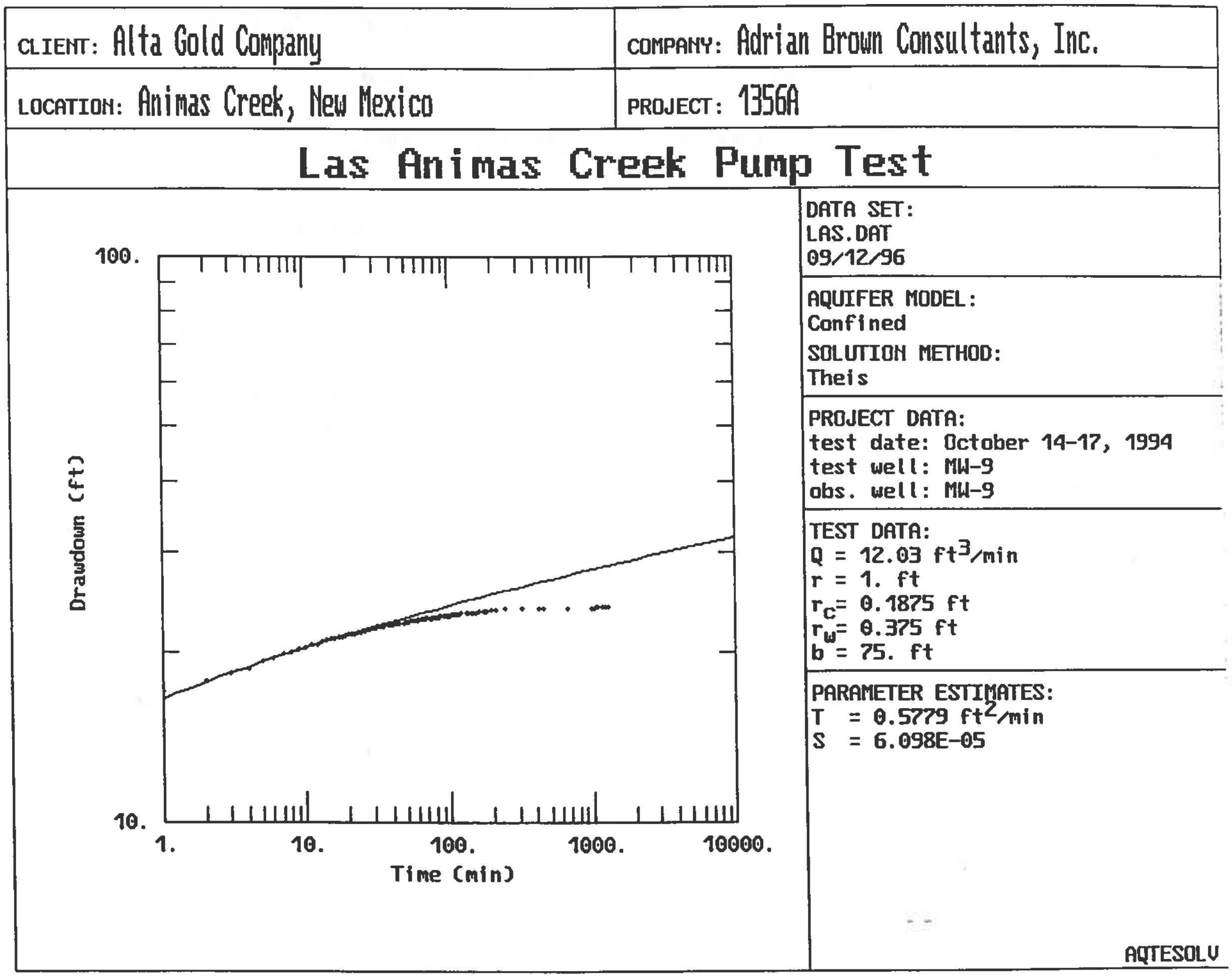
PROJECT DATA:
test date: October 14-17, 1994
test well: MW-9
obs. well: MW-9

TEST DATA:
$Q = 12.03\ ft^3/min$
$r = 1.\ ft$
$r_c = 0.1875\ ft$
$r_w = 0.375\ ft$
$b = 75.\ ft$

PARAMETER ESTIMATES:
$T = 0.6086\ ft^2/min$
$S = 3.288E-05$

AQTESOLV

Figure 11 Theis drawdown analysis plot



CLIENT: Alta Gold Company

COMPANY: Adrian Brown Consultants, Inc.

LOCATION: Animas Creek, New Mexico

PROJECT: 1356A

Las Animas Creek Pump Test

DATA SET:
LAS.DAT
09/12/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

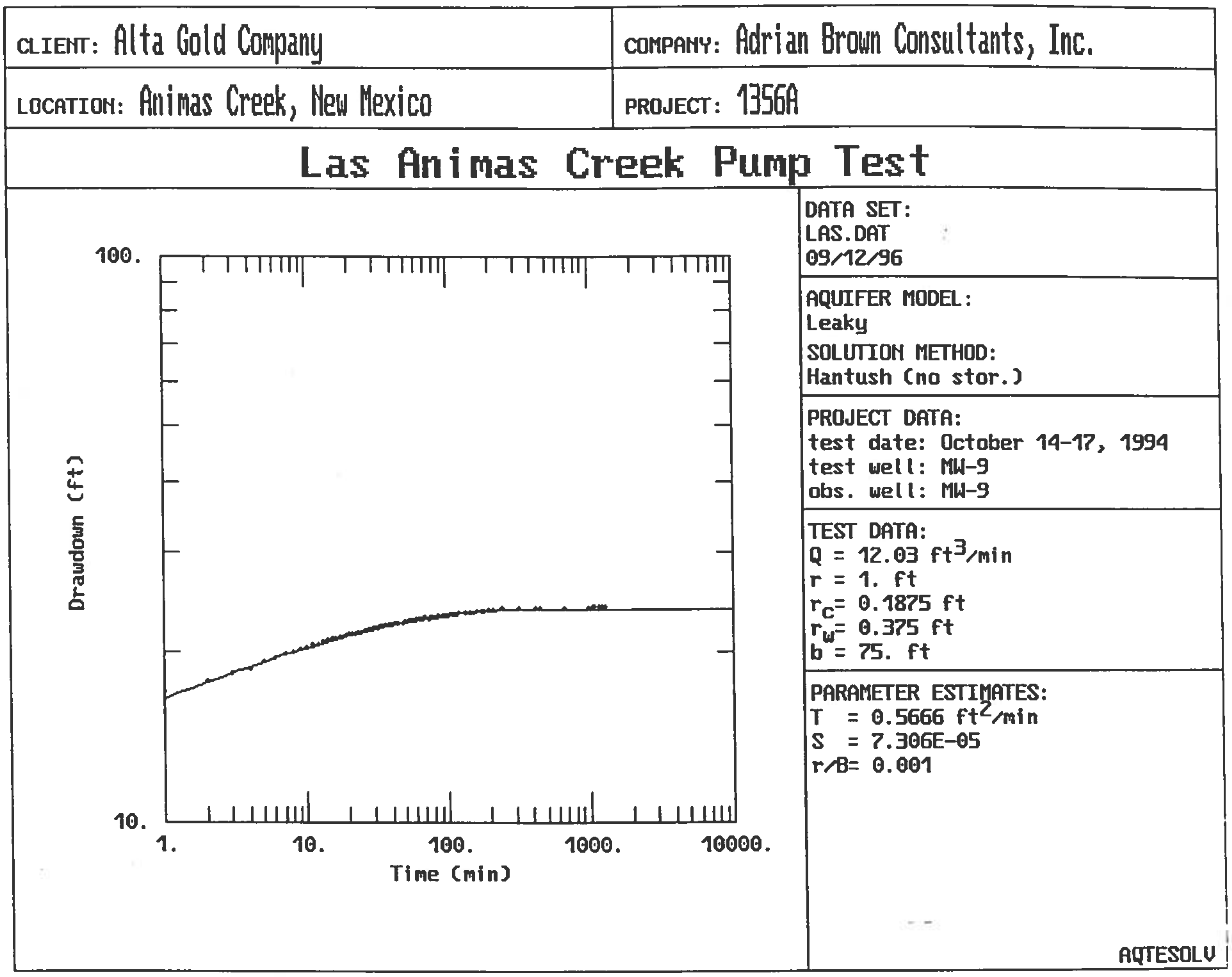
PROJECT DATA:
test date: October 14-17, 1994
test well: MW-9
obs. well: MW-9

TEST DATA:
$Q = 12.03\ ft^3/min$
$r = 1.\ ft$
$r_c = 0.1875\ ft$
$r_w = 0.375\ ft$
$b = 75.\ ft$

PARAMETER ESTIMATES:
$T = 0.5779\ ft^2/min$
$S = 6.098E-05$

AQTESOLV

Figure 12 Hantush leaky aquifer drawdown analysis plot



CLIENT: Alta Gold Company

COMPANY: Adrian Brown Consultants, Inc.

LOCATION: Animas Creek, New Mexico

PROJECT: 1356A

Las Animas Creek Pump Test

DATA SET:
LAS.DAT
09/12/96

AQUIFER MODEL:
Leaky

SOLUTION METHOD:
Hantush (no stor.)

PROJECT DATA:
test date: October 14-17, 1994
test well: MW-9
obs. well: MW-9

TEST DATA:
Q = 12.03 ft^3/min
r = 1. ft
r_c = 0.1875 ft
r_w = 0.375 ft
b = 75. ft

PARAMETER ESTIMATES:
T = 0.5666 ft^2/min
S = 7.306E-05
r/B = 0.001

AQTESOLV

Appendix C3.

TSF-Area Pumping Test, 1994

APPENDIX G
TAILINGS DAM AREA PUMPING TEST

Prepared for:

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1755 East Plumb Lane, Suite 241
Reno, Nevada 89502

Prepared by:

Adrian Brown Consultants, Inc.
155 South Madison Street, #230
Denver, Colorado 80209

September 9, 1996
Project #1356A

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ATTACHMENTS

G.1 INTRODUCTION

A seven-day aquifer test was conducted in the vicinity of the tailings dam of the Copper Flat Mine, to determine the hydraulic characteristics of the aquifer(s) in this area. This section describes the pump test activities, and includes a discussion of the selection of the pumping well and observation wells, schedule of operations, operation of the test, water discharge and water quality issues. The aquifer test analysis is summarized in Section G.4 of this report.

An understanding of the site-specific geology is critical to the interpretation of the pumping test results. The deposits in the vicinity of the tailings dam are comprised of relatively recent sands and gravel contained within a clay/silt matrix, all of which overlie the Santa Fe Group sediments, which are similar in nature. A distinctive clay/silty clay unit is found at depths ranging from approximately 10 to 30 feet below ground surface and ranges in thickness from 25 to over 100 feet. This clay/silty clay unit, characterized by a distinctive red to red-brown color and dry to slightly moist with uniform composition and consistency, provides an effective hydrologic barrier between the upper alluvial sediments and those representing the Santa Fe Group.

Volcanic rocks (basalt and/or rhyolite) were commonly encountered above the clay unit during the drilling of the project boreholes. One borehole (GWQ94-16), however, encountered basalt beneath the clay. Unlike the clay observed in other boreholes, the clay/silty clay in GWQ94-16 was uncharacteristically thinner and was accompanied by significant amounts of gravel and moisture. Based on the gravelly nature of the clay, the relative superposition in the borehole, and the eastward dip of the sediments, the relatively shallow clay/silty clay located above the basalt in borehole GWQ94-16 may actually be reworked material from an upgradient clay source which was deposited over the basalt. The stratigraphy observed in all other boreholes clearly indicates that basalt and/or rhyolite was flowed out above the thick clay unit.

The alluvial units above and below the clay unit are similar in nature, although the gravel unit below the clay contains more matrix material. Because of the abundant matrix material, the lower unit is more poorly sorted and the lower aquifer has a lower permeability in those zones where clay or silty clay predominate.

G.2 WELL SELECTION

One pumping well and 13 observation wells were employed during the aquifer test. Figure G-1 shows the well locations and Table G-1 presents pertinent information for each of the wells used for data collection.

G.2.1 Pumping Well

Well GWQ94-17 was drilled and completed in October 1994. The borehole was drilled to a total depth of 158 feet and the well is screened from 120-150 feet below ground surface. Static water level in the well is on the order of 3 feet below ground surface. Well GWQ94-17 was chosen for pumping for the following reasons:

1. Central location relative to observation wells.
2. Casing diameter (4") was sufficient for pump installation.
3. Discharge water could be easily routed to discharge point.
4. Sulfate concentrations were low enough to pump without concern of immediately exceeding discharge standards.
5. Screened in a horizon of suitable water production.
6. Screen located beneath the red clay aquitard that separates the shallow aquifer from the underlying aquifer.

Discharge water from GWQ94-17 was piped through 600 feet of 3-inch layflat vinyl pipe that passed under the county road through a corrugated-steel culvert to a concrete sump. The sump is connected by an underground concrete culvert to a concrete-lined pit, located approximately 1500 feet southwest of the pumping well. Figure G-2 shows a schematic of the system.

G.2.2 Observation Wells

Observation wells were selected based on their proximity to the pumping well, their screened intervals, and their potential to exhibit a response in water levels during the pumping test.

The nearest observation well, GWQ94-13, is located 190 feet west-southwest of the pumping well, and is screened from 75 to 105 feet below ground surface. Observation well GWQ94-14, located 390 feet east-southeast of the pumping well, is screened from 127.5 to 157.5 feet. Observation well GWQ94-15 is 713 feet southeast of the pumping well, and is screened from 112 to 142 feet. Well GWQ94-16 is among the shallowest observation wells (screened from 25 to 45 feet below ground surface) and is located 423 feet southwest of pumping well GWQ94-17. The deepest observation well, GWQ94-20, is screened from 288 to 338 feet, and is located 264 feet northwest of the pumping well. Observation well GWQ94-21 has separate completions at

213-263 feet (A) and 285-315 feet (B), and is located 621 feet east of the pumping well.

Limited completion information was available for the six observation wells installed prior to the 1994 field program. Observation well GWQ-11 is located approximately 405 feet southwest of the pumping well and is completed to a depth of 76 feet. Observation wells NP-2 and NP-5 are located approximately 1130 and 735 feet south-southwest of the pumping well, and have total depths of 110 and 41 feet, respectively. Observation well IW-1 has a total depth of 67 feet and is located 239 feet west of the pumping well. Observation well IW-2, 248 feet northwest of the pumping well, is completed to 45 feet.

Water levels in wells GWQ94-18 and GWQ94-19 were not monitored during the pumping test since both wells were dry or nearly dry.

G.3 AQUIFER TEST

G.3.1 Aquifer Pumping Test Operations

Well GWQ94-17 was pumped for a total of 78.14 hours, starting at 10:50 on Tuesday, November 8, 1994 and ending at 16:58 on Friday, November 11, 1994. The average flow rate during the test was 23 gpm. The flowrate was not sufficient to activate the inline flowmeter at the wellhead, so flowrate was measured at the concrete sump discharge point approximately hourly using a bucket and stopwatch. The flowrate remained steady throughout the test until the pump was shut off.

G.3.2 Monitoring

Water level changes during the pumping portion of the aquifer test were monitored manually for wells GWQ94-17, GWQ-11, GWQ94-15, GWQ94-16, GWQ94-21A, GWQ94-21B, NP-2, NP-3, NP-5, IW-1, and IW-2 using an electronic water level sounder. The remaining wells (GWQ94-13, GWQ94-14, and GWQ94-20) were monitored automatically, during the pumping portion of the aquifer test, using pressure transducers attached to data logging units. Manual readings were collected every 5 to 10 minutes for about the first hour, every 15 to 20 minutes for the next 3 to 4 hours, and at least hourly for the remainder of the test. Automatic pressure transducer readings were collected every minute during the pumping period.

During the recovery portion of the test, water levels were measured at 5-minute intervals in wells GWQ94-14 and GWQ94-13 using pressure transducers. The pressure transducer that was set in GWQ94-20 during the pumping period of the test was transferred to GWQ94-21A for the recovery test. Water level recovery was also monitored in the pumping well at 5-minute intervals, using a pressure transducer. Recovery was monitored for 2.5 days, from 16:58 on Friday, November 11, 1994 to approximately 16:00 on Sunday, November 13.

A summary of these monitoring activities is presented in Figure G-3. The pre-pumping static water level data and aquifer test water level data are presented in the Attachments A-5 and G-2, respectively. A major storm event occurred, in which 6.5 inches of rain were gauged at the tailings dam from the morning of November 11, 1994 to the evening of November 12, 1994 (Irwin, personal communication). This recharge event may have affected the recovery of the water levels in the observation wells.

G.3.3 Observations

G.3.3.1 Pumping Well GWQ94-17

Well GWQ94-17 was pumped at a rate of 23 gpm for a total of 78.14 hours. The steady-state drawdown of 125 feet was acheived in 31 minutes of pumping. The plot of drawdown versus time, presented in Figure G-4, indicates that the pump operated continuously during the test.

G.3.3.2 Discharge

The well discharged a total of just under 108,000 gallons into the concrete-lined pit, located approximately 1500 feet south-southwest of the pumping well. Observation well NP-2, located approximately 50 feet from the northwest corner of the pit, was monitored during the test to determine whether the concrete pit was leaking and if so, how much effect it had on the local groundwater table. The water levels in NP-2 during the test period are shown in Figure G-5, and do not exhibit effects from leakage. However, the drop in water level in the concrete pit after the pump was shut off indicated that the pit leaked approximately 5000 gallons/day.

G.3.3.3 Water Quality

The quality of the discharge water was monitored periodically during the test. Sulfate ranged from a low of 180 mg/l to a high of 360 mg/l, with concentrations peaking eight hours into the test and decreasing as the test progressed. Temperature readings were affected by the sun incidence on the discharge pipe and were not representative of the groundwater temperature. The pH of the water stabilized at approximately 7.4 and the conductivity ranged from a low of 990 μS to a high of 1110 μS. Water quality parameters measured at the discharge pipe are summarized in Table G-2.

G.3.4 Test Results

G.3.4.1 Shallow Aquifer System

The shallow aquifer system hosts numerous wells, including the shallow (<80 feet) monitoring wells near the tailings dam.

None of the shallow observation wells monitored during the pumping test showed a response to pumping at GWQ94-17, indicating that in this area there is no hydraulic connection between the upper, shallow alluvial aquifer and the lower aquifer in the Santa Fe Group. The plots of drawdown in the observation wells versus time during the pumping test are presented in Attachment G-1. The shallow observation wells are IW-1, IW-2, NP-5, GWQ-11, and GWQ94-16.

G.3.4.2 Santa Fe Group Aquifer System

Two types of response were observed in the Santa Fe Group aquifer system due to stressing by pumping at GWQ94-17. Theis type responses were demonstrated at wells GWQ94-13, GWQ94-14, GWQ94-21A, GWQ94-21B and NP-3. An attenuated response was demonstrated at observation well GWQ94-15, in the form of a slower, flatter drawdown curve.

The response in observation well GWQ94-20 was influenced by recharge of the well following development on November 3, 1994. The well is completed in a low-permeability zone and is slow to equilibrate following pumping/development. Therefore, data collected from GWQ94-20 during the pumping test are considered invalid for analysis purposes. The water level plots versus time for all other monitoring wells observed during the aquifer test are shown in the Attachment G-1.

G.3.4.3 Bedrock Flow System

Although no deep bedrock wells were installed or monitored during this study, some knowledge of the deep bedrock system is discernible through investigation of the local geology of the area. Water that enters the various limestone beds of the upper Paleozoic rocks in the north-trending Animas Uplift moves downdip along bedding plane and solution openings until it reaches the zone of saturation, then moves laterally along the strike of permeable strata toward points of discharge in the principal stream valleys, which in this case are Las Animas Creek and Seco Creek (Davies and Spiegel, 1967).

G.4 ANALYSIS AND INTERPRETATION

The transmissivity of the aquifer appears to be approximately 1400 gpd/ft with a storage coefficient of 2.5×10^{-4}, based on a Theis analysis, and is representative of a confined aquifer of moderate permeability. Plots from the Theis evaluation are presented in Figures G-6 and G-7. The estimated efficieny of the pumping well, GWQ94-17, is approximately 25% based on the drawdown in the pumping well versus the water levels in the observation wells. This suggests that the aquifer is sufficiently tight to create large head losses in the formation as the groundwater flows radially into the wellbore. Additional well losses could be caused by the well design and completion.

The aquifer test did not positively identify any fixed-head or no-flow boundaries. The test did confirm that wells that penetrate the clay layer are hydraulically connected to the pumping well. Response of those observation wells were, in general, well-modeled by a Theis-type response. Wells that are completed above the confining clay layer (shallow aquifer) were not affected by the pumping activity at GWQ94-17.

Well GWQ94-14 displayed an unusually quick response and more rapid drawdown possibly indicating the presence of a higher permeability paleo-channel that connects GWQ94-14 to GWQ94-17.

In addition to performing an integrated, detailed Theis analysis on the suite of observation wells, data from individual observation wells were analyzed using the aquifer test analysis software package, AQTESOLV (Geraghty and Miller, Inc.). Table G-3 presents the transmissivity and storativity values derived using various methods, and the plots of drawdown versus time are included in Attachment G-1.

Table G-1 Observations Wells Used During the Tailings Dam Area Aquifer Test

WELL ID	TD (feet)	ELEV. (toc) QMC[3]	r (feet)	TOP OF SCREEN (feet bgs)	BOTTOM OF SCREEN (feet bgs)	SCREEN LENGTH (feet)	PIPE DIAM. (in.)	STATIC WATER LEVEL (feet btoc) 11/7/94
GWQ-11	76	5174.87	≈405	na	na	na	3	17.04
GWQ94-13	112	5179.05	190	75	105	30	4.5	8.02
GWQ94-14	158	5171.41	390	127.5	157.5	30	4.5	1.585
GWQ94-15	148	5161.64	713	112	142	30	4	0.63
GWQ94-16	48	5176.02	423	25	45	20	4	18.23
GWQ94-17[1]	158	5176.97	0	120	150	30	4	5.32
GWQ94-20	340	5181.97	264	288	338	50	4.5	20.315
GWQ94-21A	320	5171.28	621	213	263	50	2	4.58
GWQ94-21B	320	5170.79	621	285	315	30	2	3.945
NP-2	110	5171.38	≈1130	na	na	na	2	29.46
NP-3	79.3[2]	5178.42	≈239	na	na	na	2	7.07
NP-5	41.2[2]	5177.45	≈735	na	na	na	2	19.67
IW-1	67[2]	5177.68	239	na	na	na	4	20.55
IW-2	45	5186.54	438	na	na	na	4	33.585

[1] Pumping well

[2] Measured prior to groundwater sampling

[3] Elevations relative to project datum (Quintana Minerals Corp.)

TD = total depth of borehole
r = distance to the pumping well (feet)
bgs = below ground surface
toc = top of casing
btoc = below top of casing
na = information not available

Table G-2 Summary of Water Quality during Pumping of GWQ94-17

DATE	TIME	TEMPERATURE (deg-C)	pH	CONDUCTIVITY (um/cm)	SULFATE CONCENTRATION (mg/l)
11/8/94	12:14	21	7.4	1110	225
11/8/94	13:22	21	7.4	1050	180
11/8/94	15:15	19.5	7.4	1050	210
11/8/94	17:25	19	7.4	1030	350
11/8/94	18:10	18	7.4	1030	360
11/9/94	07:18	--	7.3	1050	300
11/9/94	12:24	--	7.3	1020	240
11/9/94	14:35	--	7.3	990	250
11/9/94	13:57	--	7.3	1010	240
11/10/94	12:40	--	7.4	1030	280
11/10/94	14:35	--	7.4	1000	220

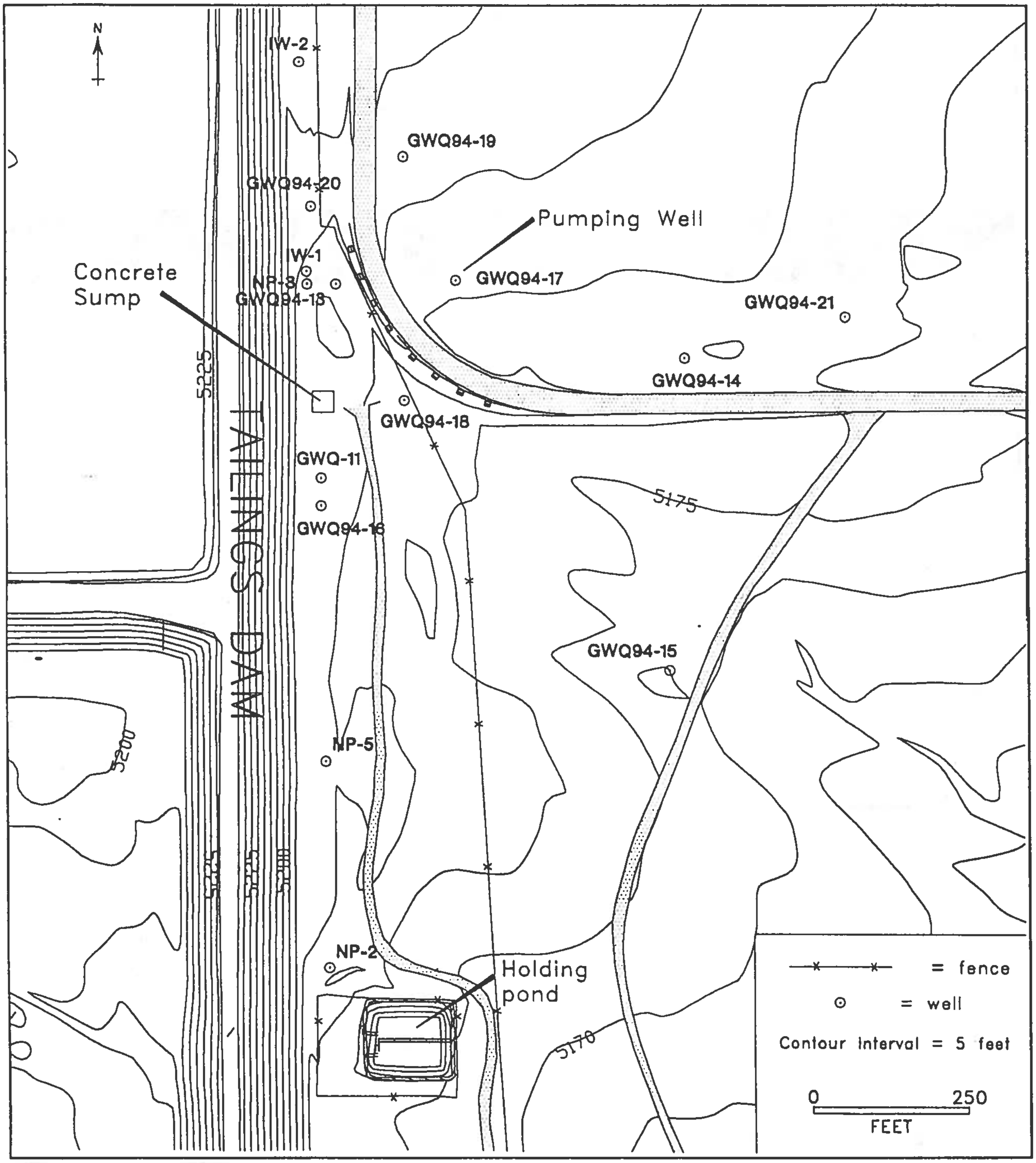


Figure G-1 Well location map for tailings dam area pumping test

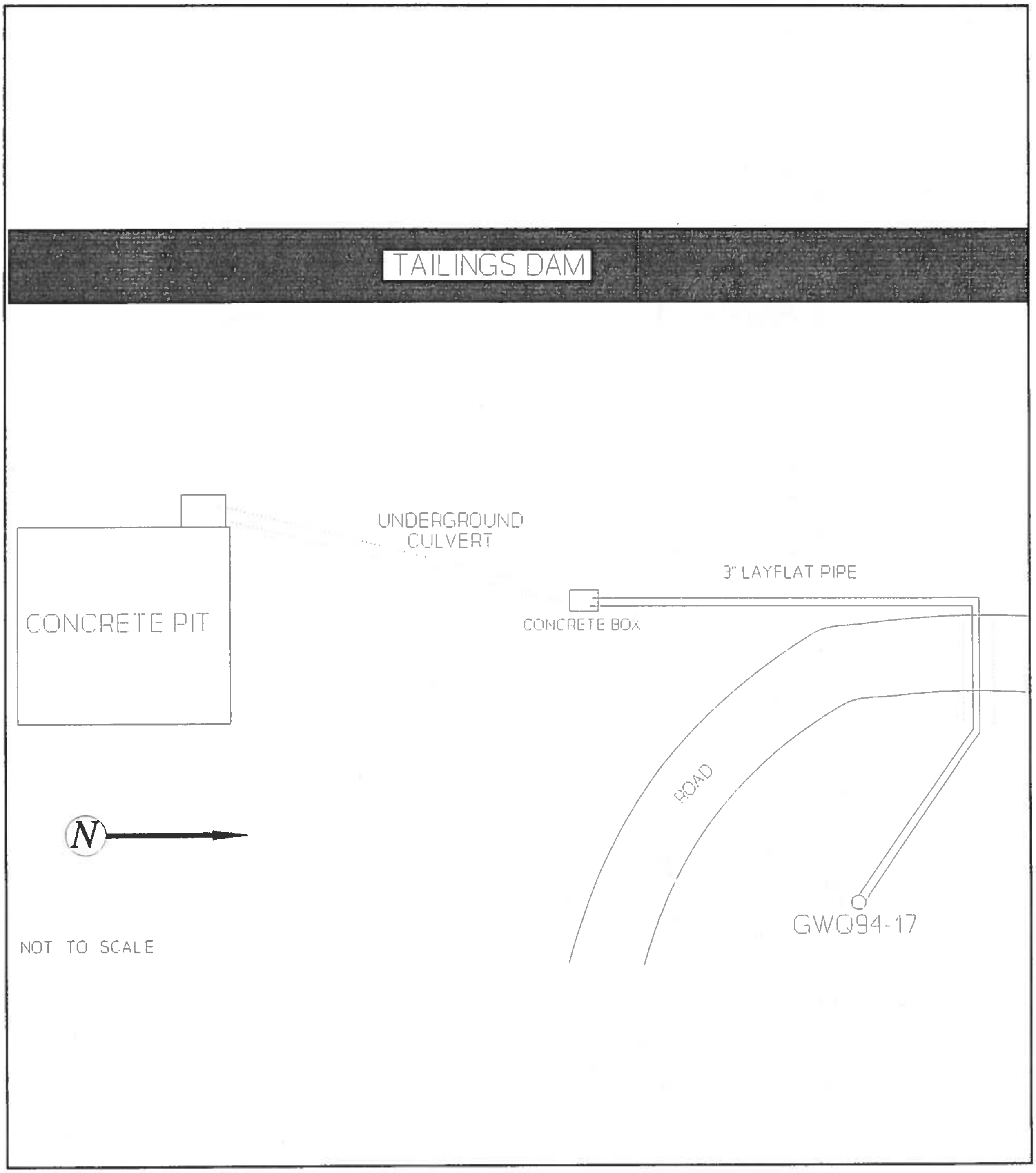


Figure G-2 Schematic of pumping test system

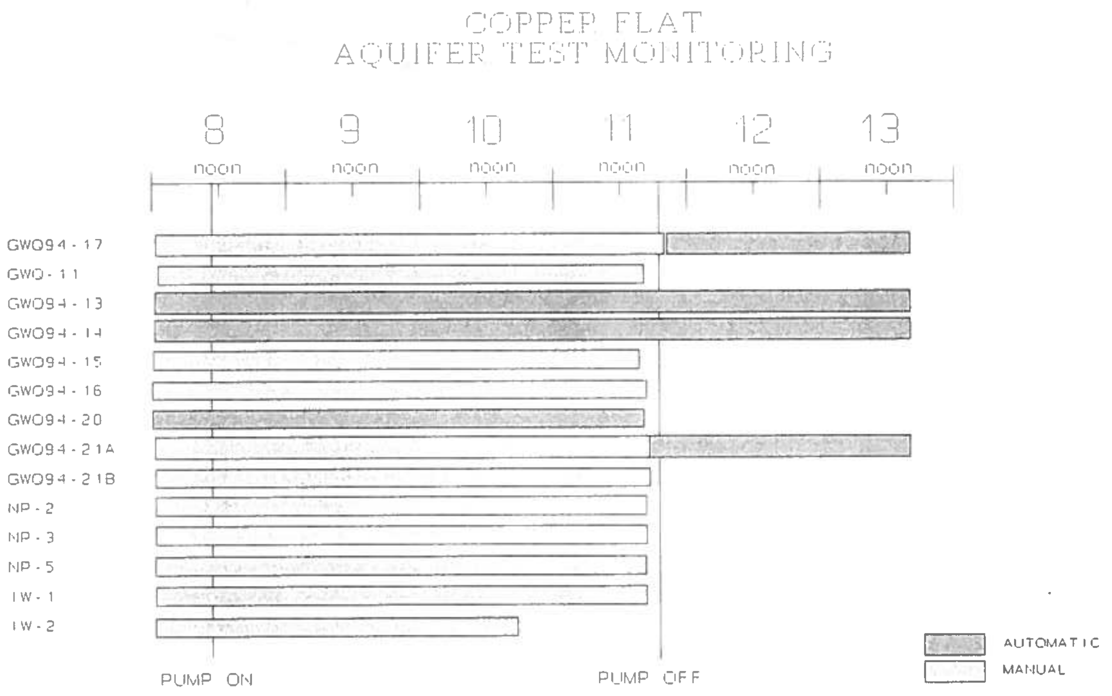
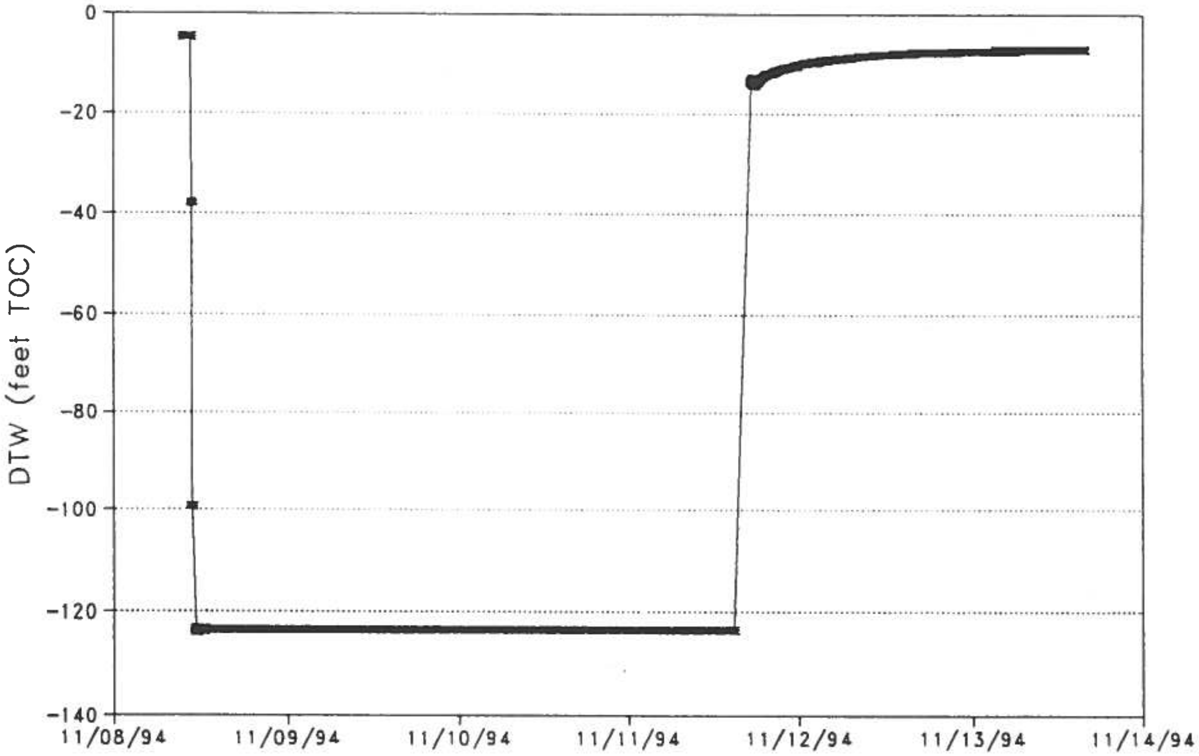


Figure G-3 Copper Flat tailings dam aquifer test monitoring

COPPER FLAT AQUIFER TEST
GWQ94-17



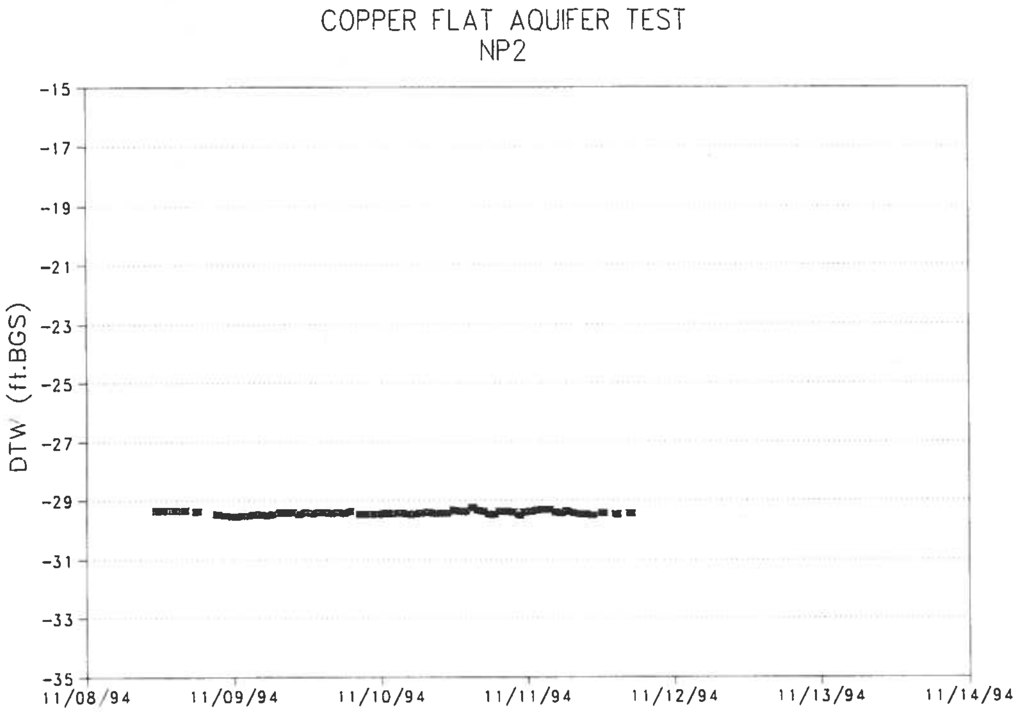


Figure G-5 Water levels in observation well NP-2

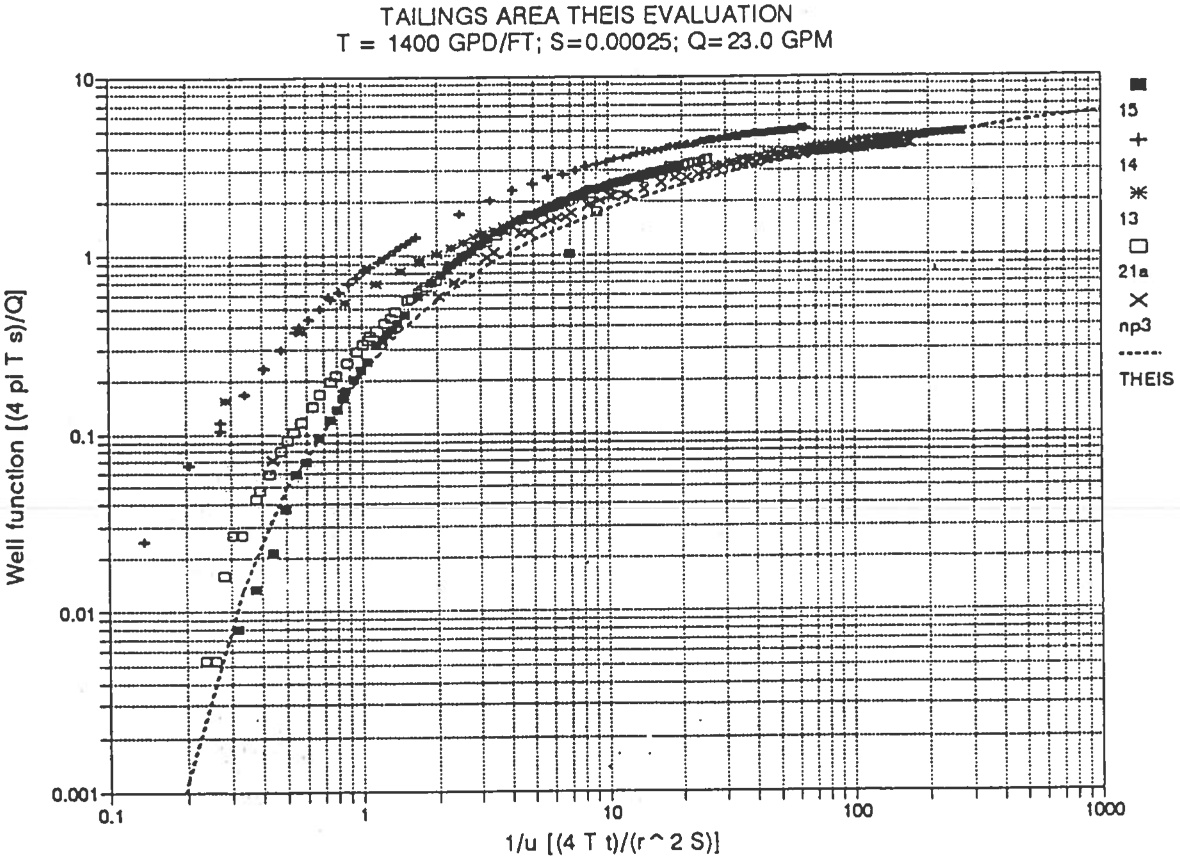


Figure G-6 Theis evaluation for tailings dam area pumping test, T=1400 gpd/ft

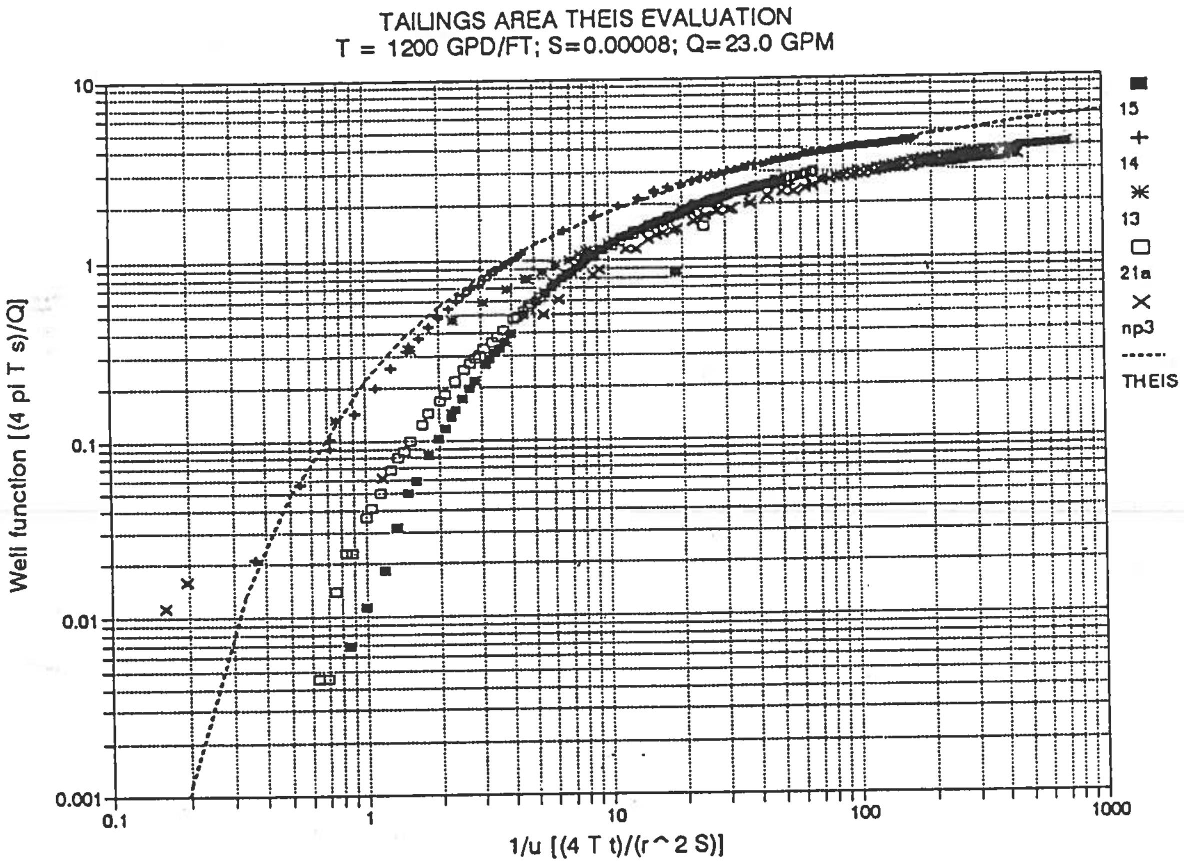


Figure G-7 Theis evaluation for tailings dam area pumping test, T=1200 gpd/ft

Table G-3 Aquifer Test Analysis Results

WELL ID	SOLUTION	TRANSMISSIVITY (gpd/ft)	STORATIVITY
GWQ94-13	Theis	1658	1.1×10^{-4}
	Jacob-Cooper straight-line	1540	1.2×10^{-4}
GWQ94-14	Theis	1148	8.1×10^{-5}
	Jacob-Cooper straight-line	1177	6.9×10^{-5}
GWQ94-15	Theis	1259	1.5×10^{-4}
	Hantush - leaky con. w/o storage	1168	1.7×10^{-4}
	Jacob-Cooper straight-line	1299	1.3×10^{-4}
GWQ94-21A	Theis	1147	1.7×10^{-4}
	Jacob-Cooper straight-line	1272	1.4×10^{-4}
GWQ94-21B	Theis	1068	2.8×10^{-4}
	Jacob-Cooper straight-line	1086	2.4×10^{-4}
Integrated Approach[1]	Theis	1400	2.5×10^{-4}

[1] See text and Figures B-6 and B-7

Appendix C4.

2012 Aquifer Test Results

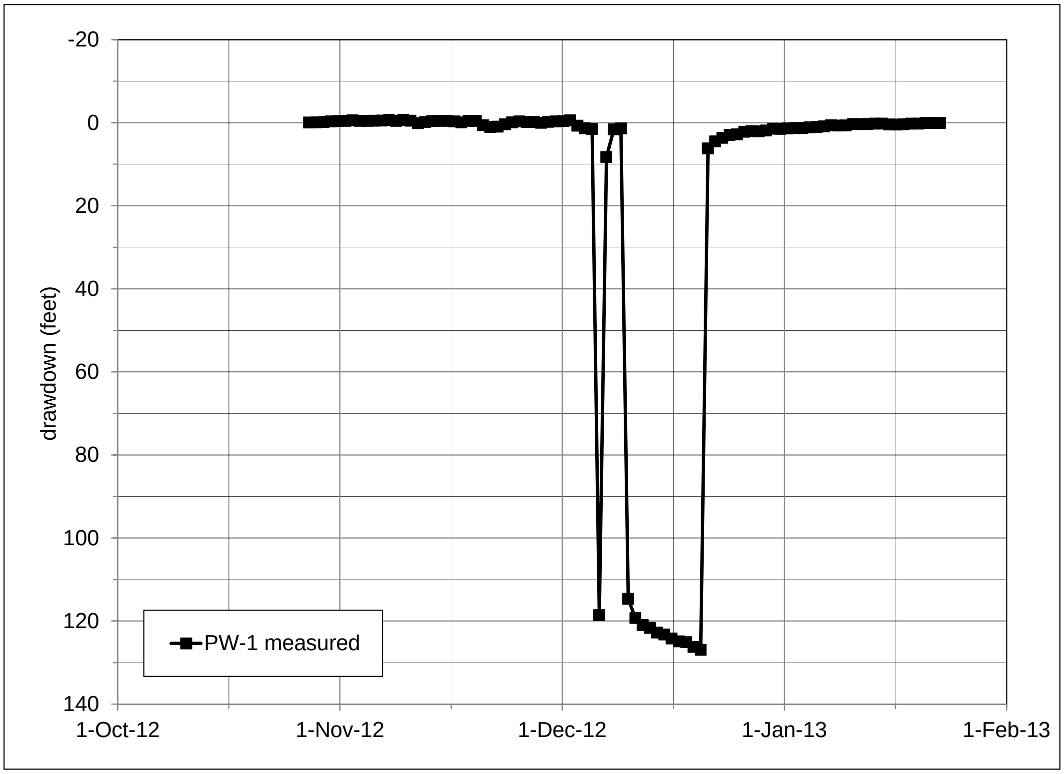


Figure C4-1. Aquifer test hydrograph PW-1.

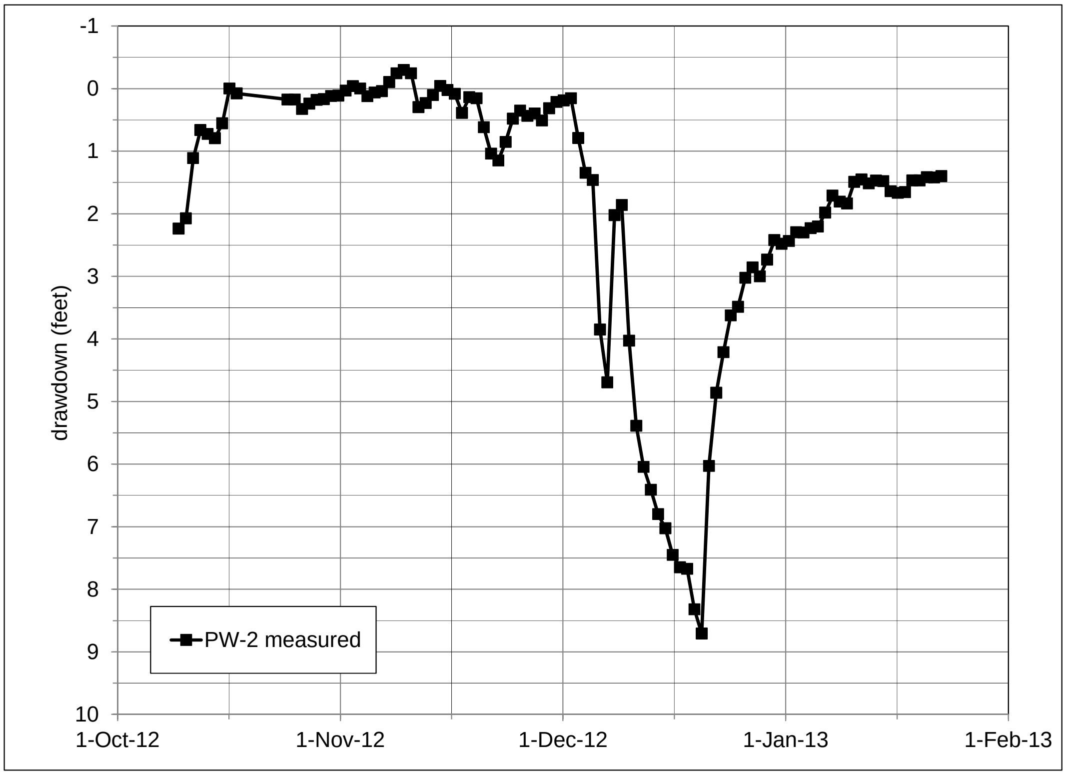


Figure C4-2. Aquifer test hydrograph PW-2.

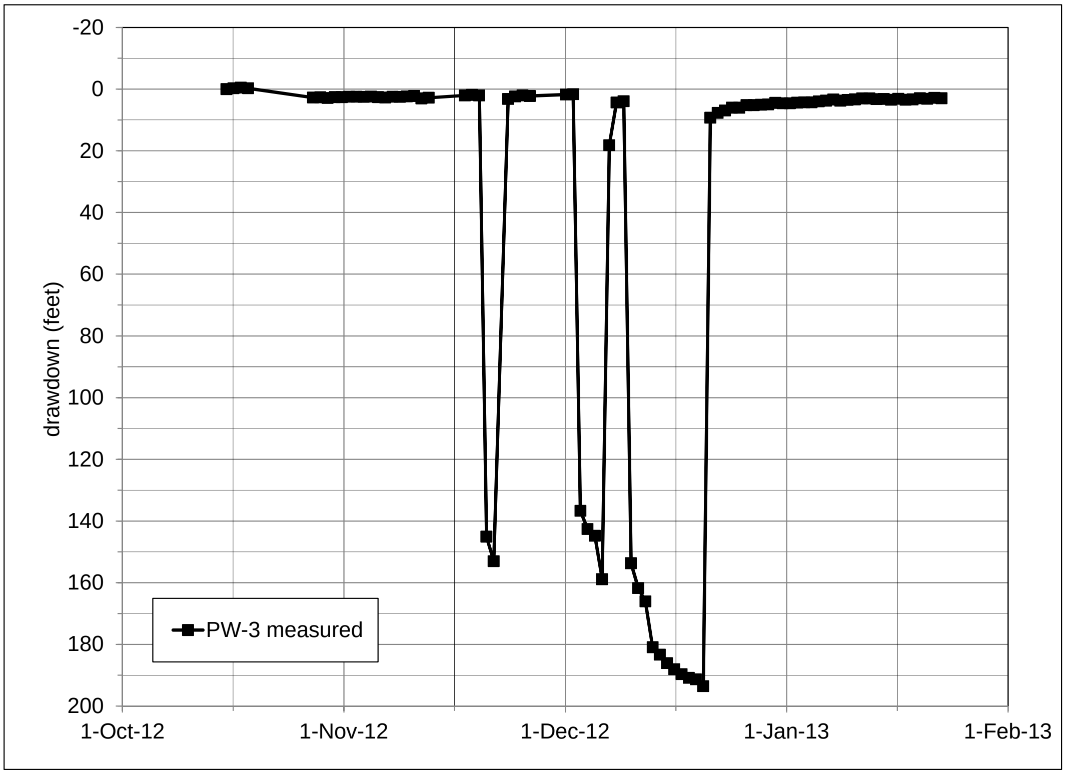


Figure C4-3. Aquifer test hydrograph PW-3.

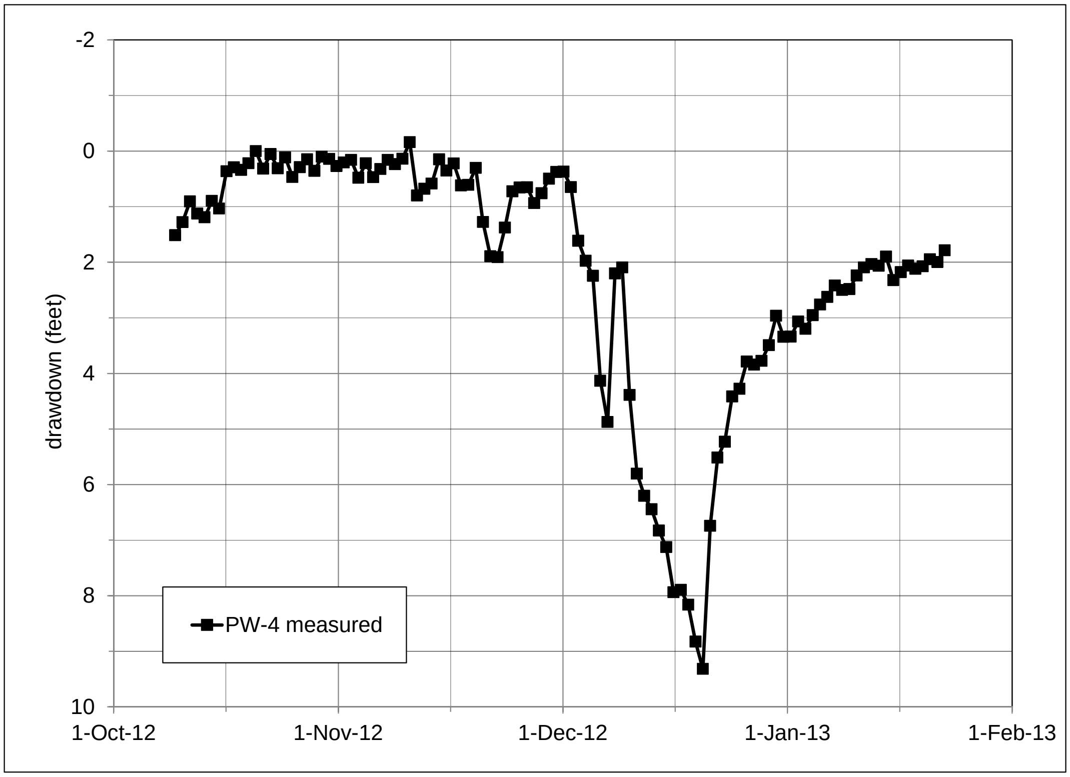


Figure C4-4. Aquifer test hydrograph PW-4.

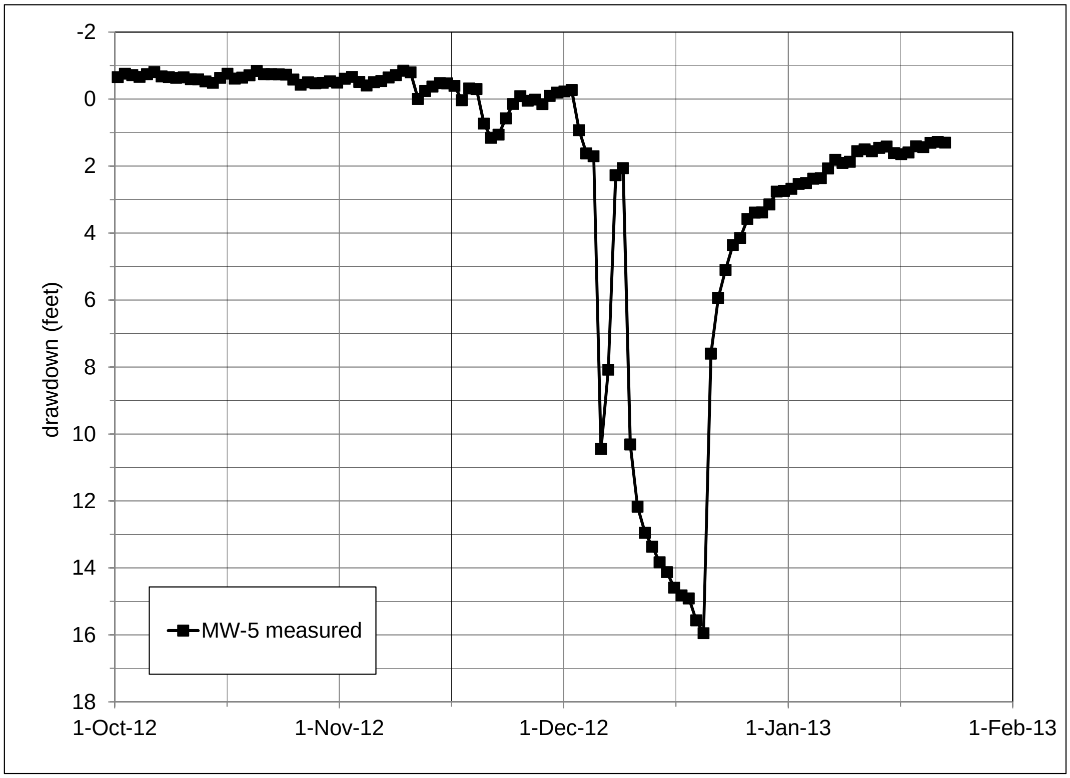


Figure C4-5. Aquifer test hydrograph MW-5.

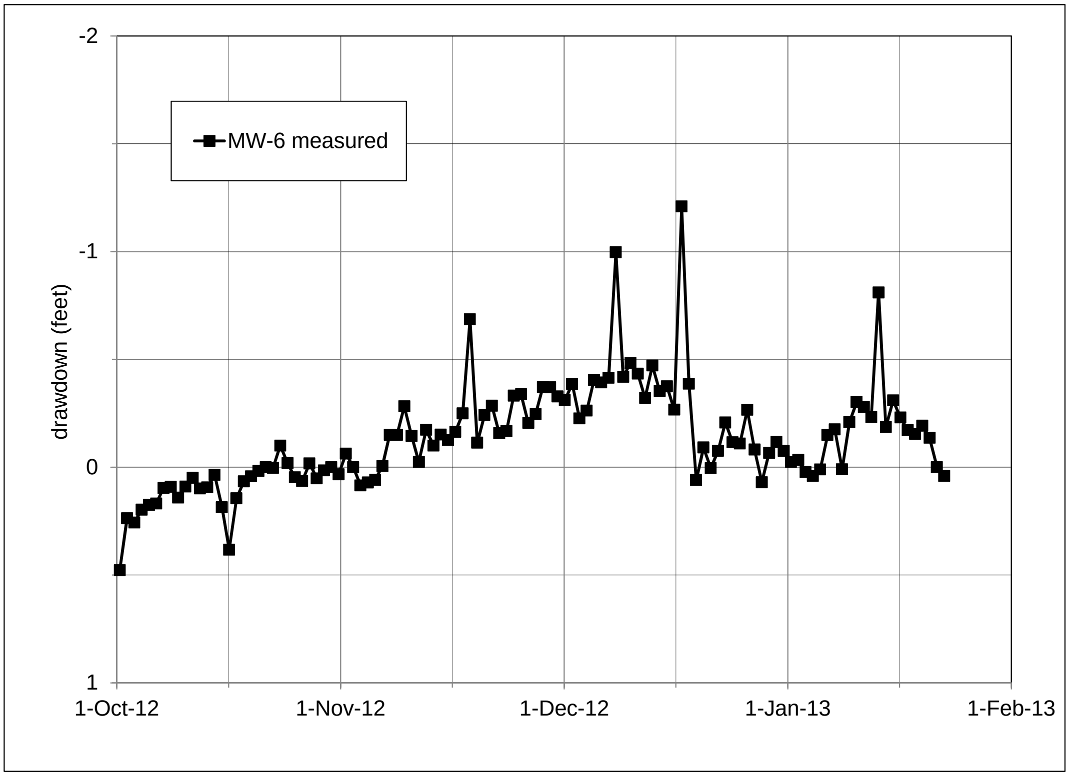


Figure C4-6. Aquifer test hydrograph MW-6.

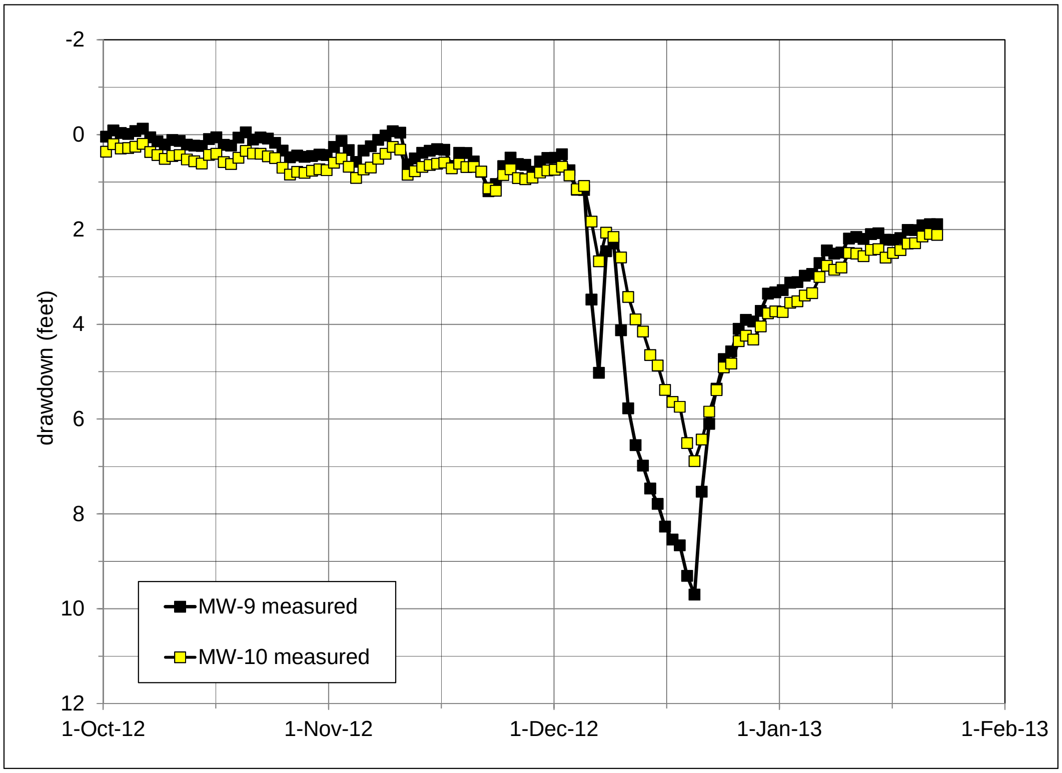


Figure C4-7. Aquifer test hydrograph MW-10.

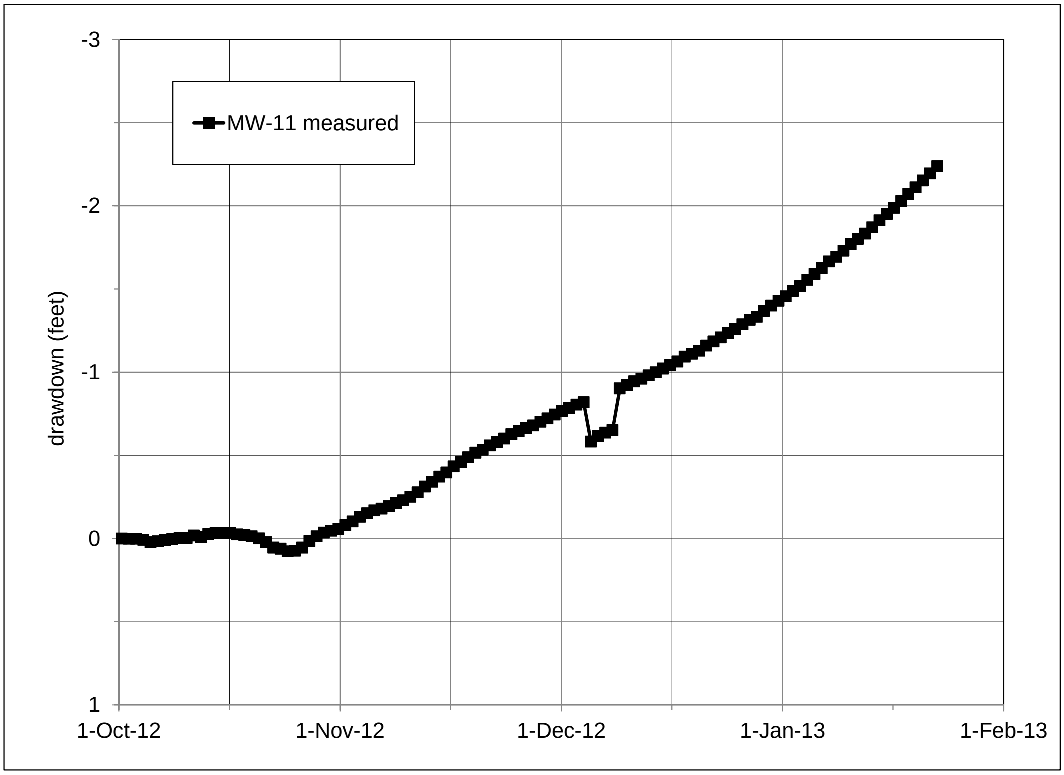


Figure C4-8. Aquifer test hydrograph MW-11.

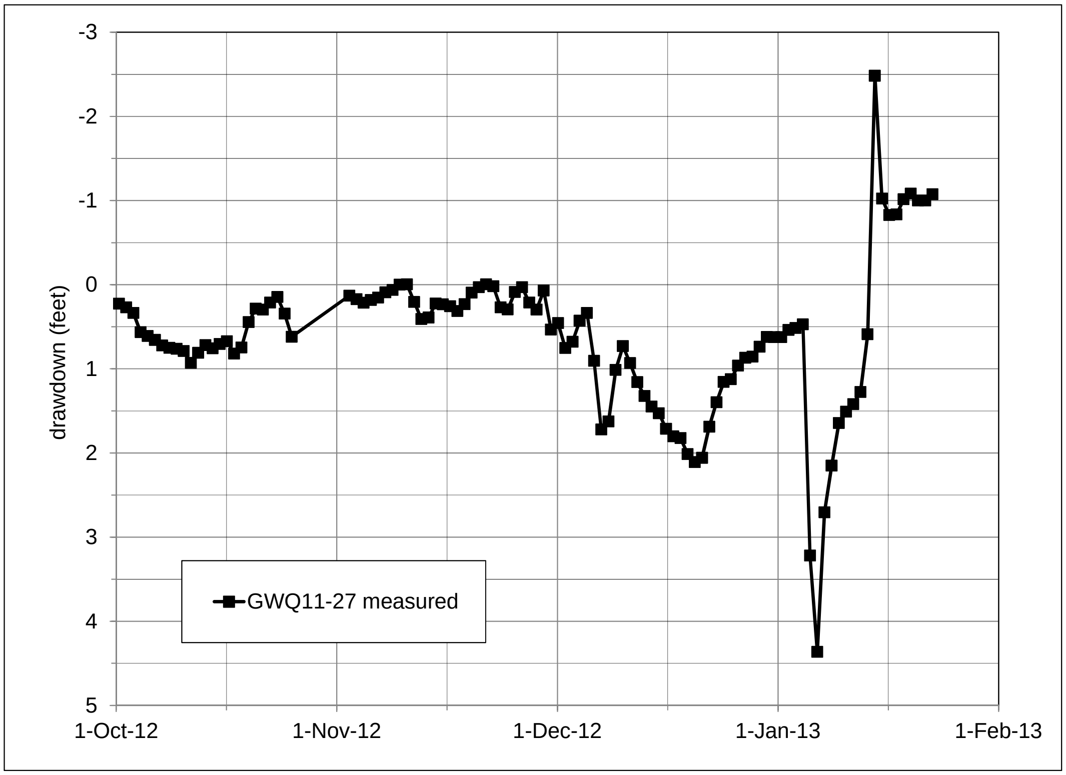


Figure C4-9. Aquifer test hydrograph GWQ11-27.

Appendix C5.

Pit Area Pressure-Injection Tests, September 2011

ESTIMATED HYDRAULIC CONDUCTIVITY OF PRESSURE-INJECTION TEST ZONES
BOREHOLES GWQ 5-R, GWQ 11-24, AND GWQ 11-25
COPPER FLAT MINE
SIERRA COUNTY, NEW MEXICO

by

John W. Shomaker, Ph.D.

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prepared for

New Mexico Copper Corporation
2425 San Pedro NE
Albuquerque, New Mexico 87110

September 2011

ESTIMATED HYDRAULIC CONDUCTIVITY OF PRESSURE-INJECTION TEST ZONES BOREHOLES GWQ 5-R, GWQ 11-24, AND GWQ 11-25 COPPER FLAT MINE SIERRA COUNTY, NEW MEXICO

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September 2011

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ESTIMATED HYDRAULIC CONDUCTIVITY OF PRESSURE-INJECTION TEST ZONES
BOREHOLES GWQ 5-R, GWQ 11-24, AND GWQ 11-25
COPPER FLAT MINE, SIERRA COUNTY, NEW MEXICO

INTRODUCTION

Pressure-injection tests were conducted during drilling of three boreholes (later reamed and completed as monitor wells), New Mexico Copper GWQ 5-R, GWQ-11-24, and GWQ-11-25. One zone was tested in GWQ 5-R, and three zones were tested in each of the other two boreholes. The tests were carried out between July 27 and August 31, 2011. Test equipment was provided and operated by the drilling contractor, WDC Exploration. Jeffrey J. Kelsch of John Shomaker & Associates recorded the data. Figure 1 is a map showing the locations.

The locations, logs and descriptions of the three monitor wells may be found in other reports. Well GWQ 5-R is completed in Cretaceous-age andesite, in the SE/4 NE/4 NW/4, Sec. 36, T. 15 S., R. 7 W. GWQ 11-24 and GWQ 11-25 are completed in Cretaceous-age intrusive rocks, in the SE/4 NE/4 NW/4 of Sec. 35, and the SW/4 NE/4 SW/4 of Sec. 26, respectively, of T. 15 S., R. 7 W.

TEST METHOD AND INTERPRETATION

The tests were conducted using a variation on the standard Lugeon test (Lugeon, 1933; Houlsby, 1976), for estimating average hydraulic conductivity of rock masses. In each of the three vertical, 3-3/4-in. boreholes, one or more zones were isolated between the bottom of the hole as it was at the time of the test, and a packer run on 1-in. standard-pipe tubing. In all but one case (GWQ 5-R), the test zone was below the water table and the rock mass was saturated at the beginning of the test.

For most of the tests, a Moyno progressing-cavity pump, reportedly rated at 10 gpm maximum flow and 350 psi maximum pressure, was used to inject water. One test employed a centrifugal pump, which was then replaced by the Moyno pump. The lengths of the test zones ranged from 36 ft to 48 ft, as indicated in Table 1 below. The injection rate was metered as clear water was pumped through the tubing into the open interval of the borehole at constant pressure, in 10-minute steps, first at increasing pressure and then at decreasing pressure. Basic data from the tests are given in the Appendix. In most cases, three series of measurements, at the same injection-pressure steps, were taken.

Injection rate was measured with a new, calibrated meter. Pressure in the tubing was measured with a 4-1/2-in.-dial, 0-300 psi, NIST certified gauge with 10-psi increments. Data were recorded each minute during each 10-minute pumping step.

The standard Lugeon test method is based on a sequence of five, 10-minute measurements of injection rate, three at increasing pressure, followed by two at decreasing pressure. The procedure for this project differed from the standard method in that many more measurements were made, with smaller increments of pressure between them, as suggested by Quiñones-Rozo (2010). This variation provides data for a more complete interpretation. In all cases, the higher pressures in the sequence of steps exceeded the fracture-gradient pressure at the depth of the open interval of the borehole, and existing fractures were dilated as water was pumped into them, or new fractures were created.

For each step, total head above the pre-test water level in the borehole was calculated as the sum of the gauge pressure in the tubing, the height of the gauge above ground level, and the depth to the static water level in the borehole, less the friction loss in the tubing at the specific injection rate. The friction loss was calculated by the standard Hazen-Williams formula with a constant for steel pipe of 100.

Hydraulic conductivity was calculated using the Lugeon relationship, which is empirically defined as the conductivity required for maintenance of an injection rate of 1 liter per minute per meter of open interval in the borehole, under a reference water pressure of 10 bars. One Lugeon unit is equivalent to 1.3 x 10^{-5} cm/sec, 0.03685 ft/day (Fell et al., 2005). For convenience, the calculations were made in terms of total added head in pounds per square inch (psi), and injection rates in gallons per minute (gpm).

Plots of injection rate versus total head above the pre-test water level in the borehole, and of apparent hydraulic conductivity (permeability) against total head, are given in Figures 1 through 12 for the tests in which the pumping rate was measurable.

RESULTS AND CONCLUSIONS

GWQ 5-R

One injection zone, from the bottom of the packer at 64 ft to the bottom of the borehole at 100 ft, was tested. Although the hole was almost full of fluid at the time of the test, later water-level measurements indicate that the natural static water level is about 48 ft. No flow was measured until the total head above the water level at the beginning of the test (5.6 ft below land surface, probably more than 40 ft above the natural water level) had reached more than 200 ft of water (87 psi; see Fig. 1). The injection rate was small, but increased rapidly, above that pressure. In a pressure step at 120 psi gauge pressure, fluid began to move up the hole above the packer, and the well began to flow, indicating that the packer seal had failed. An attempt was made to complete the test, but only very small injection rates could be maintained and it is clear from Figure 1 that any measurable fluid injected was entering dilated fractures. The test interval took no more fluid at declining pressures after the total head fell below about 340 ft of water, at about 110 psi gauge pressure.

The apparent hydraulic conductivity (permeability) was calculated at zero for the steps up to a head of about 200 ft of water, and then rose rapidly at higher pressures (Fig. 2). All of the measured injection that did occur was undoubtedly into fractures dilated by the high test pressures, and the actual hydraulic conductivity (permeability) is extremely low. This conclusion is reinforced by the fact that, at the beginning of the test, the water level in the borehole was 5.6 ft below land surface, even though later measurements in the completed well indicate that the hole would have been dry to a depth of 48 ft. No attempt was made to replicate the test.

Table 1. Summary of hydraulic conductivity (permeability) estimates

borehole and zone	depth interval, ft	apparent permeability		
		Lugeon units	cm/sec	ft/day
GWQ 5-R, Zone 1	64-100	~0	~0	~0
GWQ 11-24, Zone 1	100-147	0.5	7×10^{-6}	0.02
GWQ 11-24, Zone 2	150-197	2.3	3.0×10^{-5}	0.085
GWQ 11-24, Zone 3	204-251	3.8	4.9×10^{-5}	0.14
GWQ 11-25, Zone 1	100-148	~0	~0	~0
GWQ 11-25, Zone 2	150-198	2.2	2.9×10^{-5}	0.081
GWQ 11-25, Zone 3	207-251	2.0	2.6×10^{-5}	0.074

GWQ 11-24, Zone 1

This zone extended from the packer, at 100 ft, to 147 ft. Three series of injection tests were conducted, the first two with a centrifugal pump and the third with the Moyno positive-displacement pump. Plots of injection rate against total head are shown on Figure 3. In Series 1, the injection rates at increasing pressure were close to a line passing through the origin of the graph (Fig. 1), indicating that dilation of fractures was not significant until total head exceeded 200 ft or more, and the apparent permeability (Fig. 2) was roughly constant at around 0.5 Lugeon units (7×10^{-6} cm/sec, or 0.02 ft/day). Late in the first series, above total heads of around 210 ft of water, with about 75 psi gauge pressure, the injection rates began to increase sharply (Fig. 3), and it is probable that dilation of fractures was occurring.

In the subsequent two series of injection measurements, the rates were successively higher at corresponding pressures, and apparent permeability was greater (Fig. 4). In the third series, at the highest injection rates, the decreasing trend of apparent permeability indicates that head loss due to turbulent flow, as water flowed to and entered discrete fractures, played a significant role. The value of around 0.5 Lugeon units (7×10^{-6} cm/sec, or 0.02 ft/day), based on the first series of measurements, is likely to be most nearly representative.

GWQ 11-24, Zone 2

The packer was set at 150 ft and the bottom of the hole was at 197 ft. The injection rates in the first series of measurements were high compared with the other tests (see Fig. 5), but the plot of injection rates against total head does not extrapolate back through the origin. This may be attributable to turbulent-flow losses, or to significant dilation of fractures that occurred, and flow into the rock mass begun, even as the hole was filling and before pressure began to show on the gauge. This seems improbable at such low total heads. Although not reflected in the field notes, a more probable explanation is that some leakage around the packer was occurring.

In the second series of measurements (Fig. 5), the injection rates were directly proportional to total head, and the increasing-pressure plot extrapolates back almost through the origin, suggesting that the packer was sealing properly. Injection rates were somewhat greater during the decreasing-pressure part of the series, which may be attributable to some fracture dilation that occurred at the highest pressures during the increasing-pressure part of the test, and persisted.

The plot of apparent permeability against total head (Fig. 6) shows a steep decline with increasing injection rate for the first series of measurements, which might be indicative of large and increasing influence of turbulent flow, but is more likely a consequence of leakage around the packer as mentioned above. In the second series, in contrast, the apparent permeability is nearly constant, representing nearly laminar-flow conditions, at about 2.3 Lugeon units for increasing pressures. The representative permeability is likely to be 2.3 Lugeon units (3.0 x 10^{-5} cm/sec, or 0.085 ft/day).

GWQ 11-24, Zone 3

In this zone, the packer was set at 204 ft and the bottom of the borehole was at 251 ft. For the first four steps at increasing pressure in the first series of measurements, for total head up to about 170 ft, the injection rates plot approximately on a line that extrapolates back through the origin (Fig. 7), indicating that no fracture-dilation occurred. The apparent-permeability plot, projected back to the value at zero head (Fig. 8) suggests a value of about 0.6 Lugeon units, and a small turbulent-flow effect.

After total head exceeded about 170 ft in the first series of measurement, the injection rate increased markedly (Fig. 7), indicating that a fracture or fractures had opened under the increasing pressure, or more probably in this case, that temporary clogging of a fracture or the skin effect of drilling-fluid solids had been overcome. The pattern of injection rates as the pressures continued to increase and then decrease in the first series of measurements, and the identical pattern in the second and third series of measurements (see Fig. 7), suggest that fracture(s) did not close as the pressure was reduced, and that the initial sharp rise in injection rates during the first series was attributable to clearing of clogging or skin effect.

The plots of injection rate against total head for points representing measurements after the original breakthrough do not, however, extrapolate back through the origin. A loss of about 1.6 gpm, equivalent to about 93 ft of head differential, is indicated. The water level in the well at the beginning of the test, however, compares closely with later measurements, and it is not likely that a difference between the natural head and the head at the beginning of the test would account for the discrepancy. The most likely explanation seems to be that some water leaked around the packer, perhaps through a fracture open at both ends of the packer element.

Figure 8 shows the calculated values of permeability versus total head. Discounting the earliest measurements in Series 1, and assuming that turbulent-flow conditions account for the negative slope of the plot, and also assuming that the leakage around the packer is actually proportional to the injection rate, leads to a projection at zero total head, where no turbulence or leakage would exist, of about 3.8 Lugeon units (4.9 x 10^{-5} cm/sec, or 0.14 ft/day).

GWQ 11-25, Zone 1

A zone from 100 to 148 ft was isolated between the packer and the bottom of the borehole. No water was measured as being injected into the test zone until the gauge pressure reached 150 psi, representing a total head above the water level in the hole at the beginning of the test of about 375 ft, equivalent to 163 psi. This pressure is far in excess of any probable fracture-gradient pressure at 100 ft, and it seems clear that the hydraulic conductivity of the rock was extremely low before fractures were induced or opened by the injection pressure. The remainder of the test was not considered valid for estimation of permeability.

GWQ 11-25, Zone 2

Zone 2 extended from the packer at 150 ft to the bottom of the hole at 198 ft. Injection rates during the first series of measurements were approximately proportional to total head, except for a relative rise in injection rate at heads above about 240 ft (Fig. 9). In the second and third series of measurements, injection rates increased and became directly proportional to total head, and the plot of injection rate against total head extrapolates back through the origin, with zero flow at zero additional head. Probably this sequence reflects some clearing of clogging by drilling-fluid solids.

The apparent permeability plot (Fig. 10) appears to reflect a decrease in turbulent-flow effects from Series 1 to Series 3. Projection of the apparent permeability for Series-3 measurements back to the value at zero additional head, where no turbulent-flow effect would be seen, suggests a representative permeability of about 2.2 Lugeon units (2.9 x 10^{-5} cm/sec or 0.081 ft/sec).

GWQ 11-25, Zone 3

This zone extended from the packer at 207 ft to the bottom of the hole at 251 ft. The injection rate was approximately proportional to total head at values of head up to about 180 ft during the first series of measurements (Fig. 11), but the plot appears to project back to a rate greater than zero at zero head, suggesting some leakage. At higher pressures, the injection rate increased very sharply, indicating dilation of fractures, and the injection rates at descending values of total head fell below the rates at corresponding heads during the increasing-pressure phase of the test, suggesting that some plugging of fractures had occurred. In the second and third series of measurements, the injection-rate versus total-head plots were very similar, and in each series they were similar for increasing and decreasing rates. The sharp rise in rate indicative of fracture dilation occurred at a higher total head, and projections of the plots pass nearly through the origin.

The apparent-permeability plot (Fig. 12) shows the influence of turbulent flow in all three series. Projection of the low total-head points back to a value at zero total head, suggests that a representative permeability may be about 2.0 Lugeon units (2.6 x 10^{-5} cm/sec or 0.074 ft/day).

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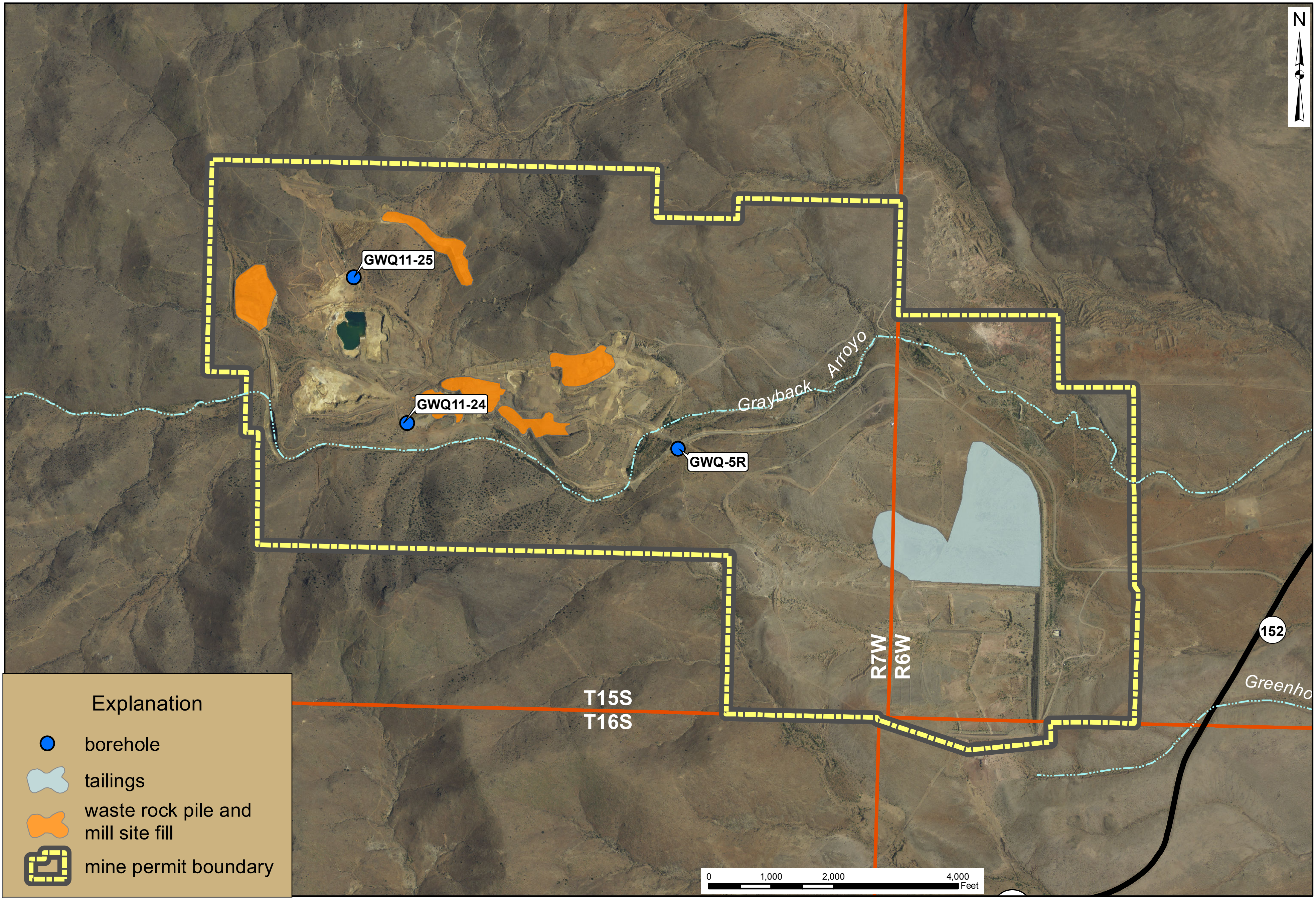
Quiñones-Rozo, C., 2010, Lugeon test interpretation, revisited: United States Society on Dams, 30th Annual Conference Proceedings, pp. 405-414.

ILLUSTRATIONS



Aerial Photograph: NAIP 2011

July 26, 2013

Figure 1. Aerial photograph showing locations of three boreholes and facilities associated with the former Copper Flat Mine operated by Quintana Minerals, Sierra County, New Mexico.

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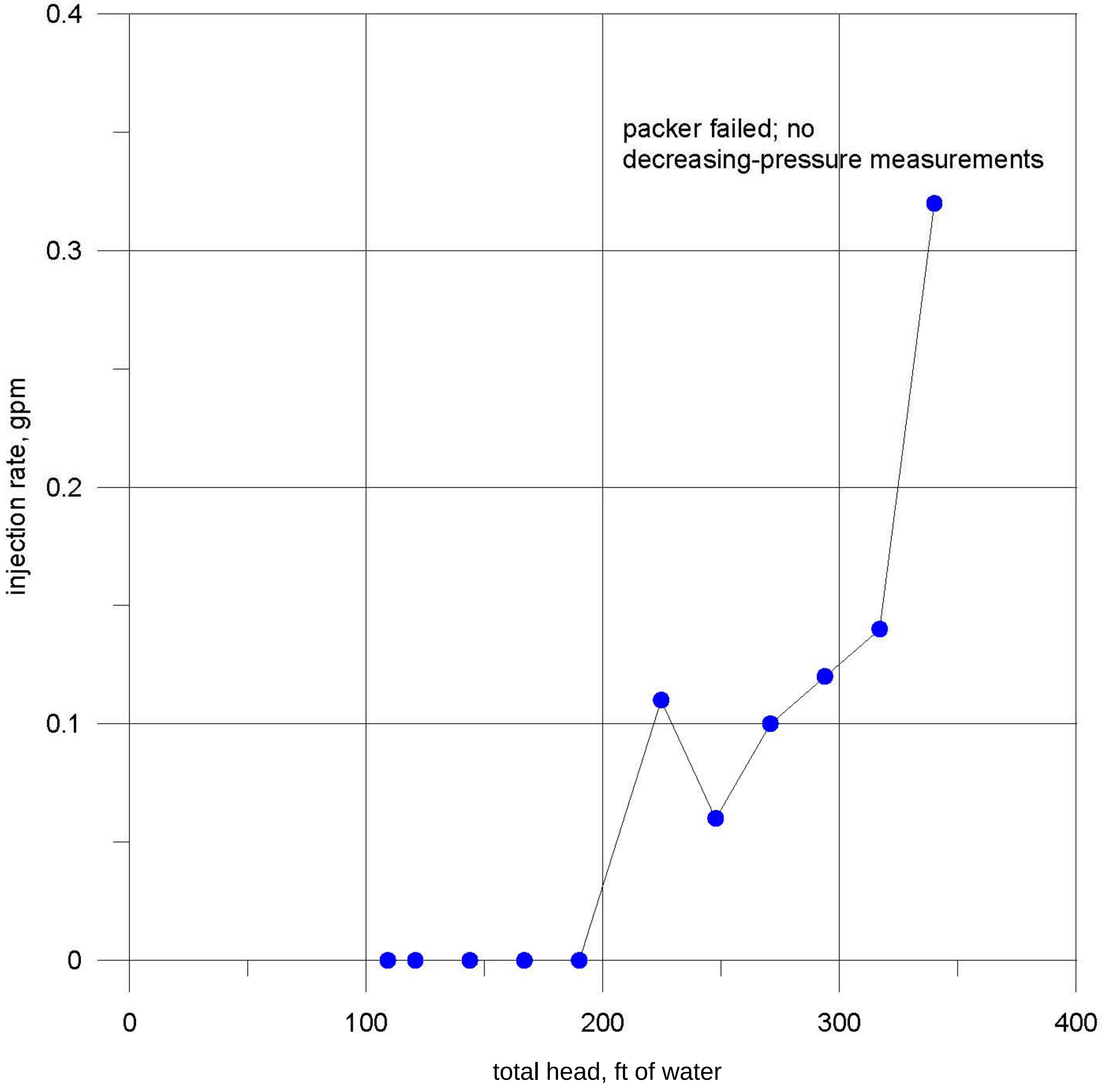

Figure 2. Pressure injection test, New Mexico Copper GWQ 5-R, Zone 1 (64-100 ft), Series 1, August 31, 2011.

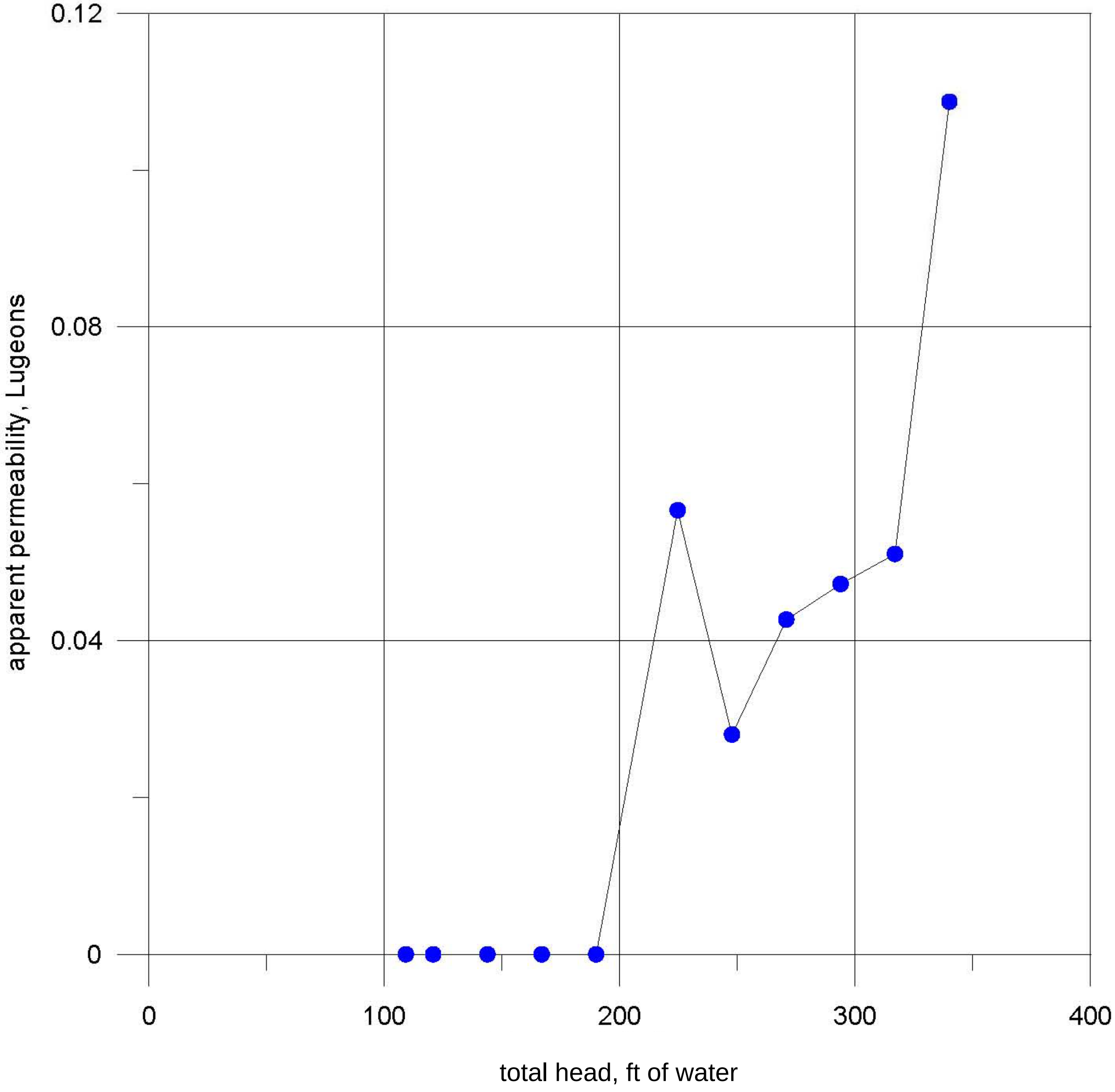

Figure 3. Apparent permeability from pressure injection test, New Mexico Copper GWQ 5-R, Zone 1 (64-100 ft), Series 1, August 31, 2011.

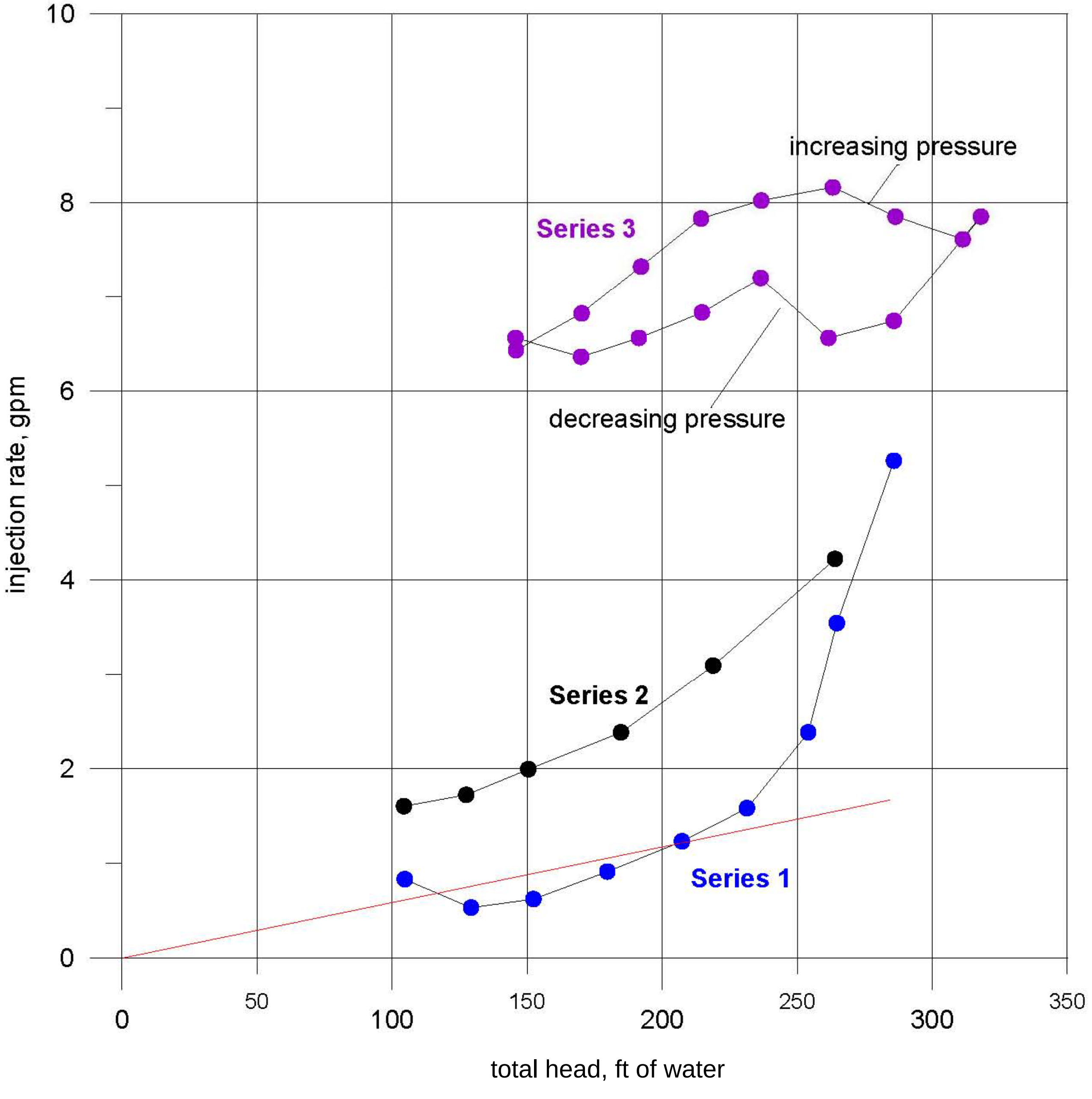

Figure 4. Pressure injection tests, New Mexico Copper GWQ 11-24, Zone 1 (100-147 ft), Series 1 and 2 (centrifugal pump), and Series 3 (positive displacement pump), July 27, 2011.

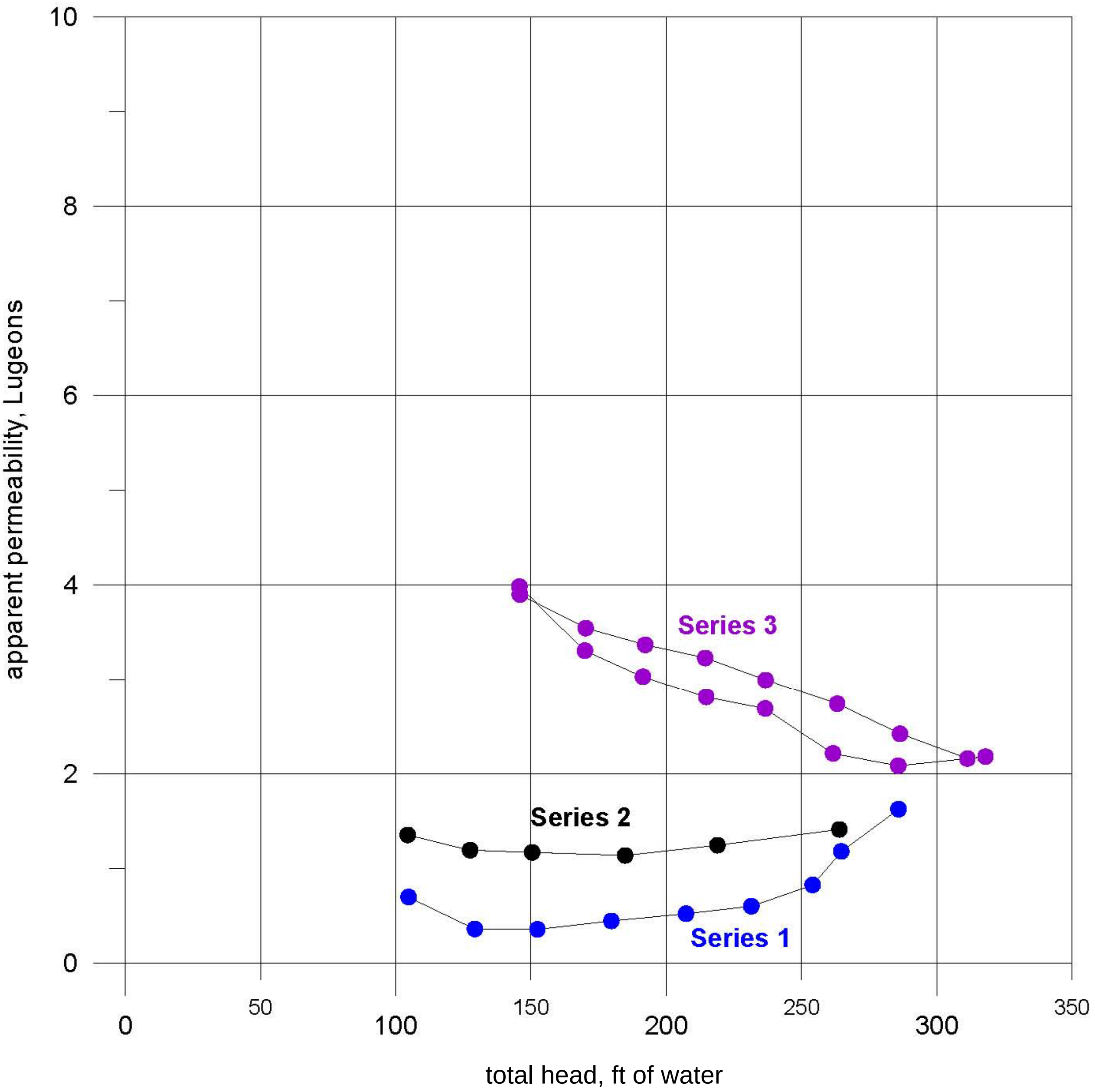

Figure 5. Apparent permeability from pressure injection tests, New Mexico Copper GWQ 11-24, Zone 1 (100-147 ft), Series 1 and 2 (centrifugal pump), and Series 3 (positive displacement pump), July 27, 2011.

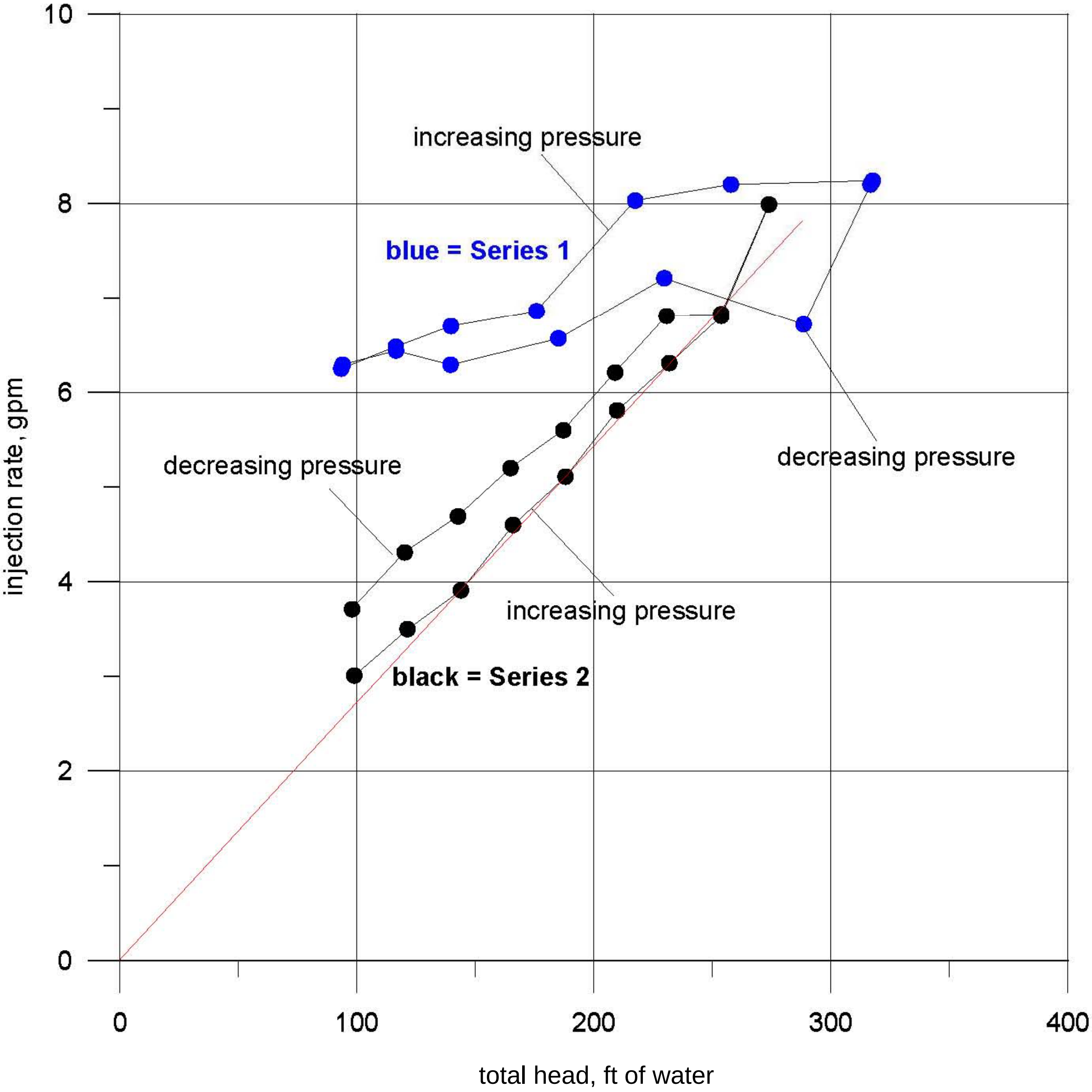

Figure 6. Pressure injection test, New Mexico Copper GWQ 11-24, Zone 2 (150-197 ft), Series 1 and 2, July 30, 2011.

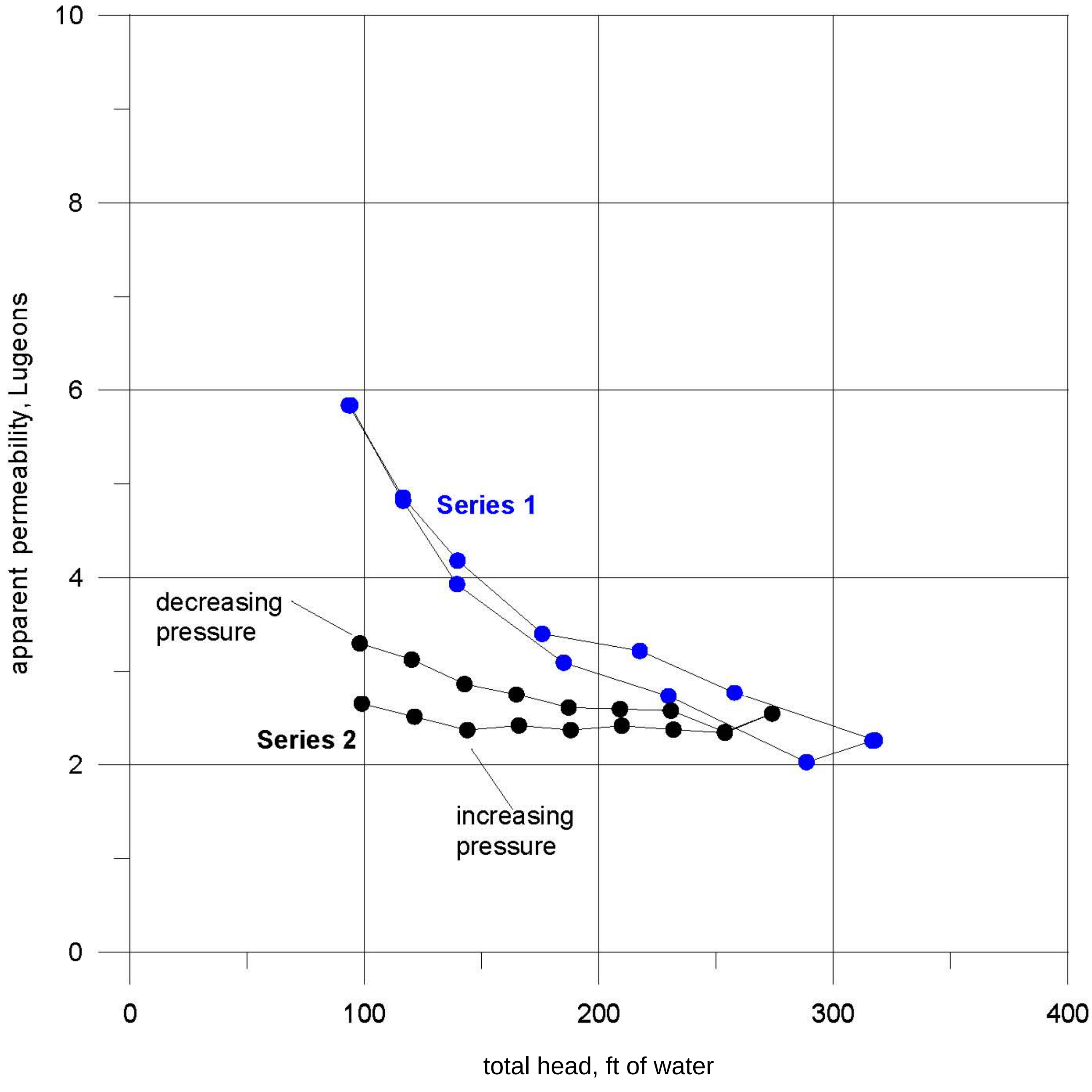

Figure 7. Apparent permeability from pressure injection test, New Mexico Copper GWQ 11-24, Zone 2 (150-197 ft), Series 1 and 2, July 30, 2011.

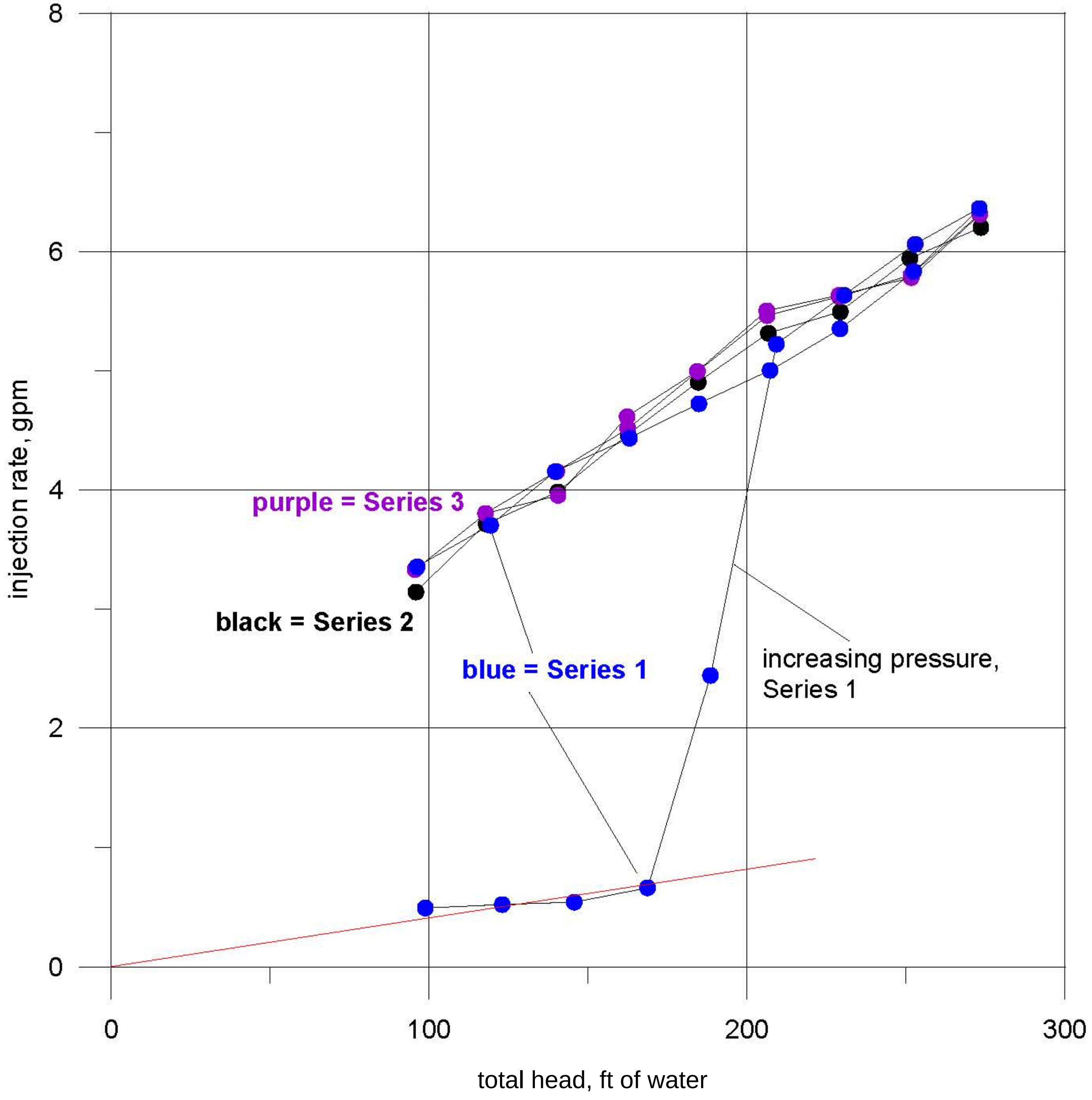

Figure 8. Pressure injection test, New Mexico Copper GWQ 11-24,
Zone 3 (204-251 ft), Series 1, 2, and 3, August 1, 2011.

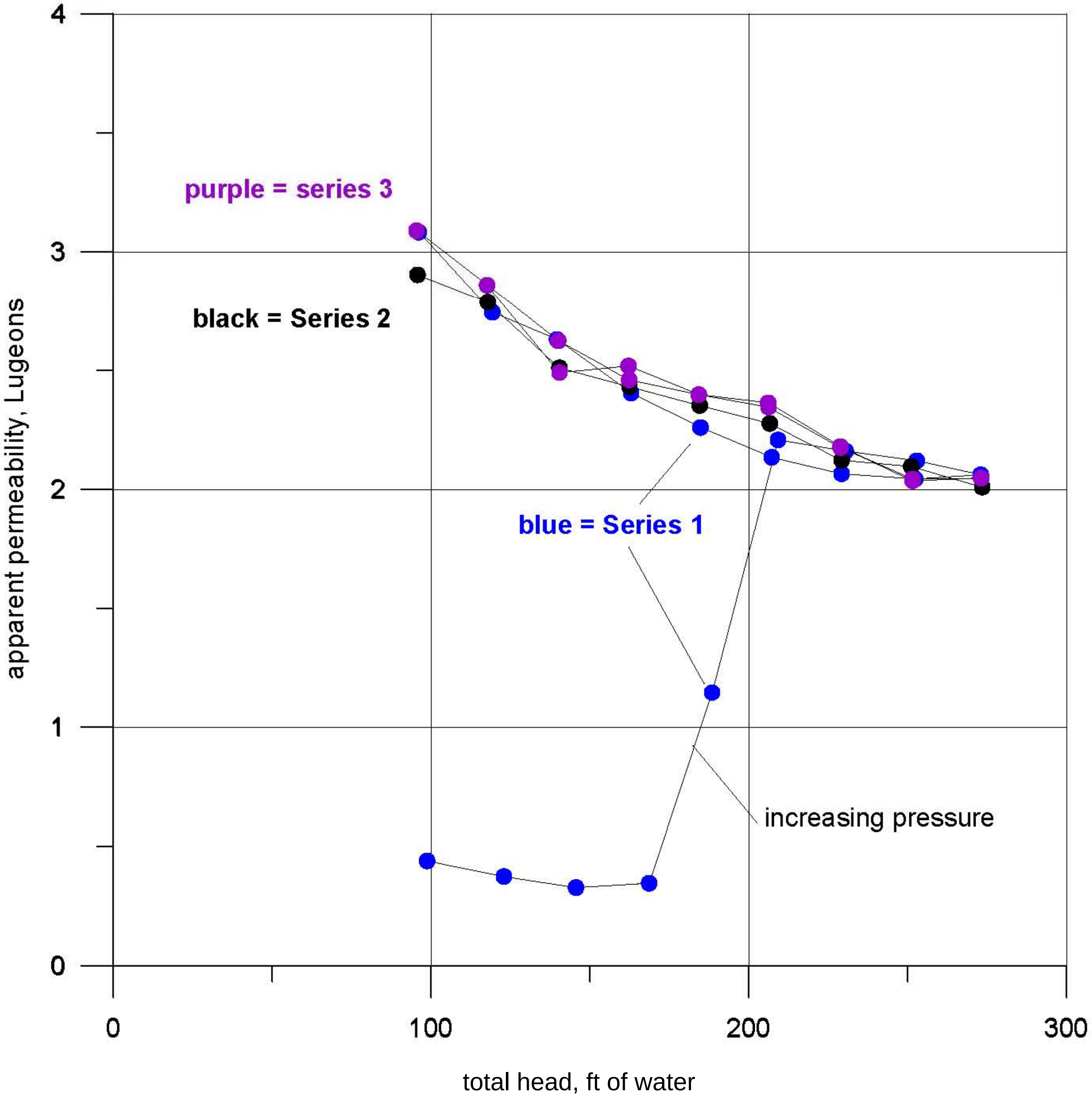

Figure 9. Apparent permeability from pressure injection test, New Mexico Copper GWQ 11-24, Zone 3 (204-251 ft), Series 1, 2, and 3, August 1, 2011.

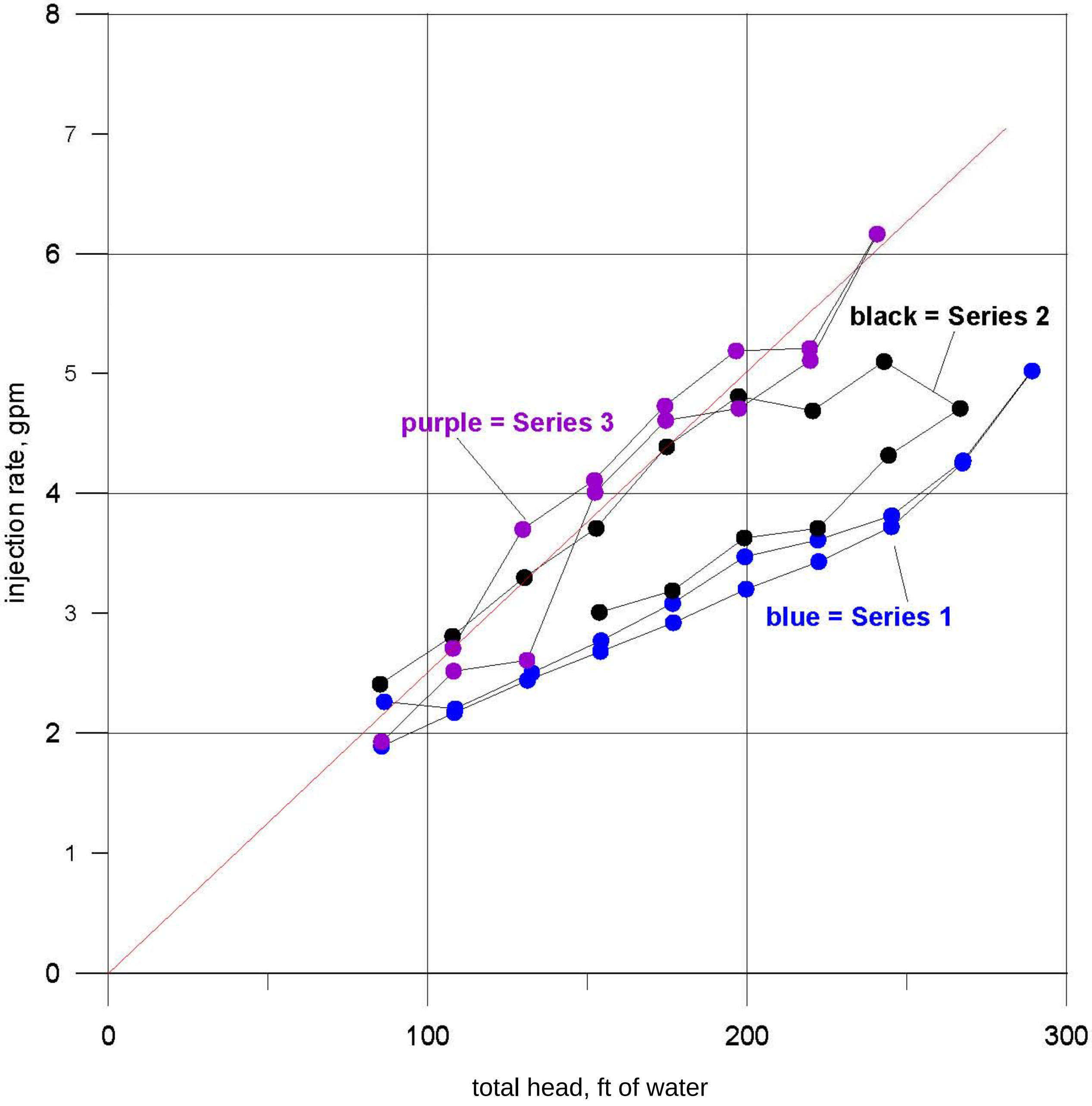

Figure 10. Pressure injection test, New Mexico Copper GWQ 11-25,
Zone 2 (150-197.7 ft), Series 1, 2, and 3, August 16, 2011.

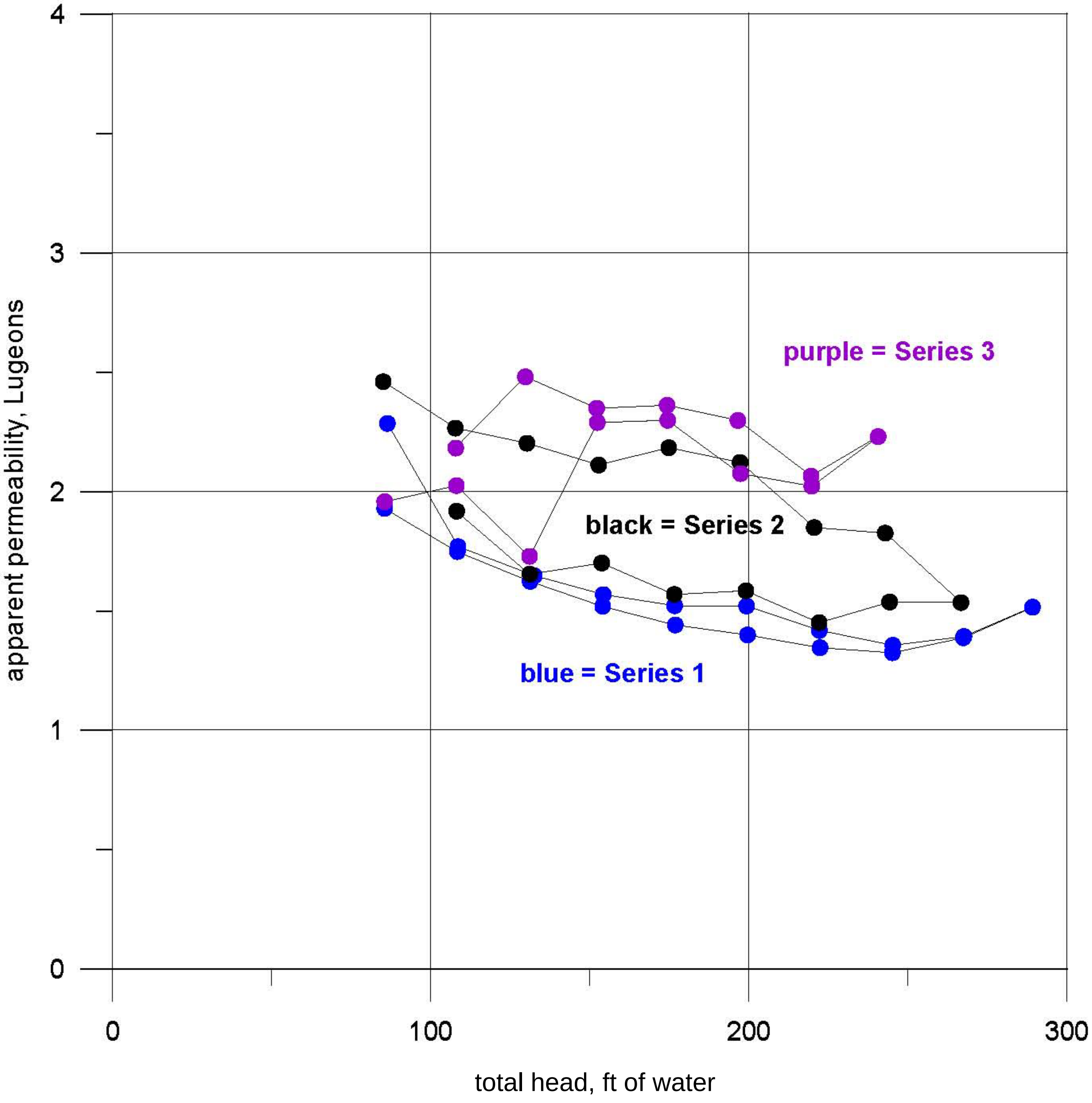

Figure 11. Apparent permeability from pressure injection test, New Mexico Copper GWQ 11-25, Zone 2 (150-197.7 ft), Series 1, 2, and 3, August 16, 2011.

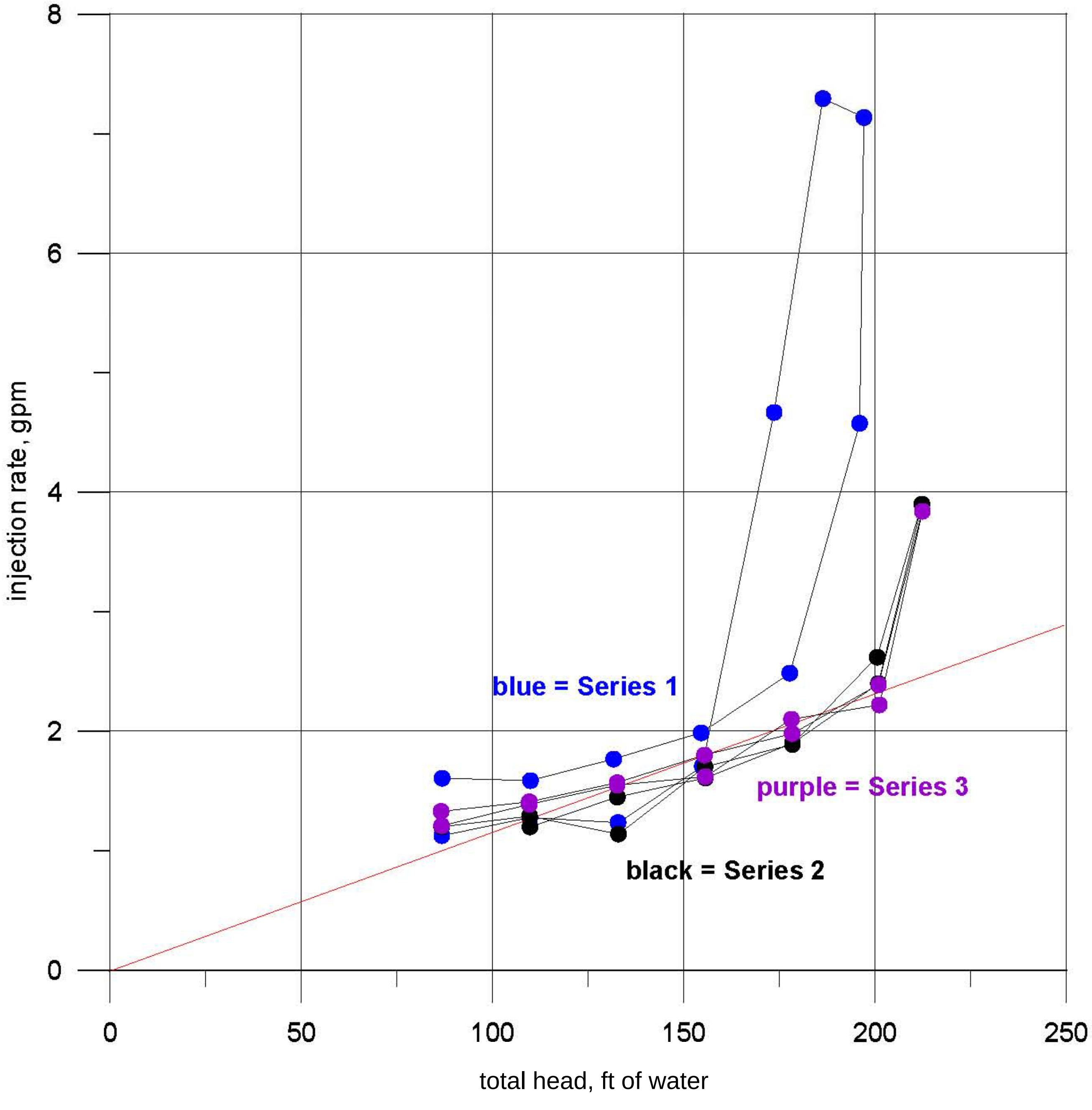

Figure 12. Pressure injection test, New Mexico Copper GWQ 11-25, Zone 3 (207-251 ft), Series 1, 2 and 3, August 24, 2011.

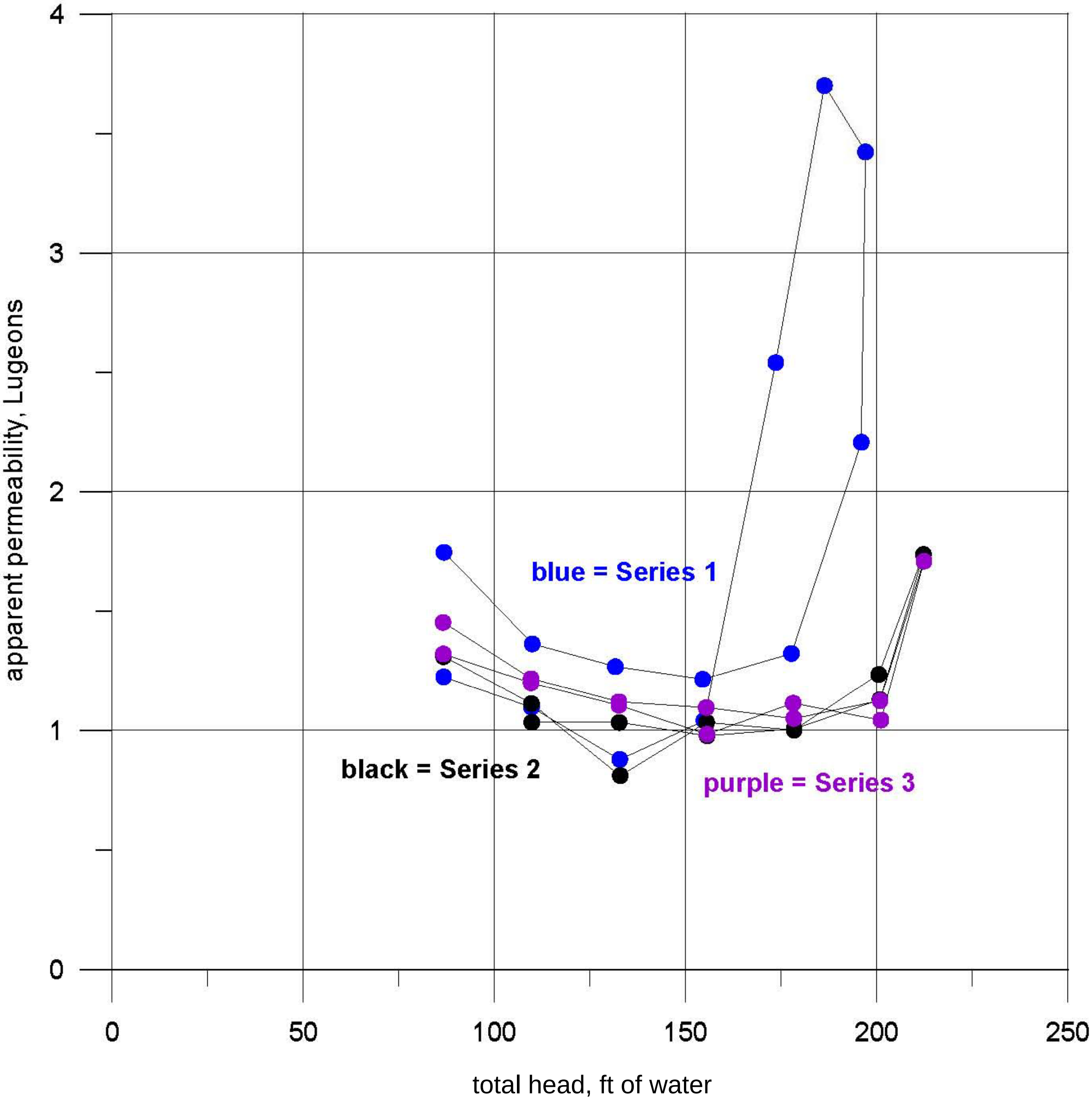

Figure 13. Apparent permeability from pressure injection test, New Mexico Copper GWQ 11-25, Zone 3 (207-251 ft), Series 1, 2, and 3, August 24, 2011.

APPENDIX

Appendix.

Basic data for pressure-injection tests

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Date 8/31/2011
Client New Mexico Copper Corp
Project Copper Flat
Well Name GWQ 5-R
Hydrologist JJK

later WLs indicate dry to 100 ft; use (64+100)/2

Starting Water Level (ft bgl) 5.6 (not representative of Static)
Elevation (ft GL)
Injection Interval (ft bgl) 64 to 100
Bore/Casing Depth (ft bgl) 100

Packer Dia 2 inch
Bore/Casing Dia 3-3/4 inch
Injection Pipe Dia 1 inch
Pressure gauge height above GL 4 ft

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
11:25	0		6000		10	0	Packer at 200 psi
11:26	1	1	6000	0.00	10	0	
11:27	2	2	6000	0.00	10	0	
11:28	3	3	6000	0.00	10	0	
11:29	4	4	6000	0.00	10	0	
11:30	5	5	6000	0.00	10	0	
11:31	6	1	6000	0.00	20	0	
11:32	7	2	6000	0.00	20	0	
11:33	8	3	6000	0.00	20	0	
11:34	9	4	6000	0.00	20	0	
11:35	10	5	6000	0.00	20	0	
11:36	11	1	6000	0.00	30	0	
11:37	12	2	6000	0.00	30	0	
11:38	13	3	6000	0.00	30	0	
11:39	14	4	6000	0.00	30	0	
11:40	15	5	6000	0.00	30	0	
11:41	16	1	6000	0.00	40	0	
11:42	17	2	6000	0.00	40	0	
11:43	18	3	6000	0.00	40	0	
11:44	19	4	6000	0.00	40	0	
11:45	20	5	6000	0.00	40	0	
11:46	21	1	6000	0.00	50	0	
11:47	22	2	6000	0.00	50	0	
11:48	23	3	6000	0.00	50	0	
11:49	24	4	6000	0.00	50	0	
11:50	25	5	6000	0.00	50	0	
11:51	26	1	6000	0.00	60	0	
11:52	27	2	6000	0.00	60	0	
11:53	28	3	6000.3	0.30	60	0.3	
11:54	29	4	6000.3	0.00	60	0.3	
11:55	30	5	6000.5	0.20	60	0.5	
11:56	31	1	6000.7	0.2	60	0.7	
11:57	32	2	6000.9	0.2	60	0.9	
11:58	33	3	6001	0.1	60	1	
11:59	34	4	6001.1	0.1	60	1.1	
12:00	35	5	6001.1	0	60	1.1	
12:01	36	1	6001.2	0.1	70	1.2	
12:02	37	2	6001.2	0	70	1.2	
12:03	38	3	6001.2	0	70	1.2	
12:04	39	4	6001.3	0.1	70	1.3	
12:05	40	5	6001.3	0	70	1.3	
12:06	41	6	6001.5	0.2	70	1.5	
12:07	42	7	6001.5	0	70	1.5	
12:08	43	8	6001.5	0	70	1.5	
12:09	44	9	6001.7	0.2	70	1.7	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
12:10	45	10	6001.7	0	70	1.7	
12:11	46	1	6001.9	0.2	80	1.9	
12:12	47	2	6002	0.1	80	2	
12:13	48	3	6002.1	0.1	80	2.1	
12:14	49	4	6002.1	0	80	2.1	
12:15	50	5	6002.1	0	80	2.1	
12:16	51	6	6002.4	0.3	80	2.4	
12:17	52	7	6002.4	0	80	2.4	
12:18	53	8	6002.5	0.1	80	2.5	
12:19	54	9	6002.7	0.2	80	2.7	
12:20	55	10	6002.7	0	80	2.7	
12:21	56	1	6002.8	0.1	90	2.8	
12:22	57	2	6003	0.2	90	3	
12:23	58	3	6003	0	90	3	
12:24	59	4	6003.2	0.2	90	3.2	
12:25	60	5	6003.2	0	90	3.2	
12:26	61	6	6003.3	0.1	90	3.3	
12:27	62	7	6003.4	0.1	90	3.4	
12:28	63	8	6003.6	0.2	90	3.6	
12:29	64	9	6003.7	0.1	90	3.7	
12:30	65	10	6003.9	0.2	90	3.9	
12:31	66	1	6004	0.10	100	4	
12:32	67	2	6004.2	0.20	100	4.2	
12:33	68	3	6004.2	0.00	100	4.2	
12:34	69	4	6004.5	0.30	100	4.5	
12:35	70	5	6004.7	0.20	100	4.7	
12:36	71	1	6004.7	0	100	4.7	
12:37	72	2	6004.9	0.2	100	4.9	
12:38	73	3	6005.1	0.2	100	5.1	
12:39	74	4	6005.1	0	100	5.1	
12:40	75	5	6005.3	0.2	100	5.3	
12:41	76	1	6005.7	0.4	110	5.7	
12:42	77	2	6006	0.3	110	6	
12:43	78	3	6006.4	0.4	110	6.4	
12:44	79	4	6006.6	0.2	110	6.6	
12:45	80	5	6006.9	0.3	110	6.9	
12:46	81	6	6007.3	0.4	110	7.3	
12:47	82	7	6007.7	0.4	110	7.7	
12:48	83	8	6007.9	0.2	110	7.9	
12:49	84	9	6008.2	0.3	110	8.2	
12:50	85	10	6008.5	0.3	110	8.5	
12:51	86	1	6011.2	2.7	120	11.2	Fluid moving up hole
12:52	87	2	6013.8	2.6	122	13.8	
12:53	88	3	6016.2	2.4	115	16.2	Fluid at top of conductor
12:54	89	4	6021.2	5	113	21.2	
12:55	90	5	6026.3	5.1	110	26.3	
12:56	91	6	6032	5.7	110	32	
12:57	92	7	6037.6	5.6	110	37.6	
12:58	93	8	6043.5	5.9	110	43.5	
12:59	94	9	6049.2	5.7	110	49.2	Approximatly 5 + gallons flowing at surface
13:00	95	10	6055	5.8	110	55	Stop pump
13:01	96		6055	0		NA	Packer pressure has dropped to 160
13:02	97		6055	0		NA	
13:03	98		6055	0		NA	
13:04	99		6055	0		NA	
13:05	100		6055	0		NA	
13:06	101		6055	0		NA	Attempt to reinflate packer and stabilize

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
13:07	102		6055	0		NA	
13:08	103		6055	0		NA	
13:09	104		6055	0		NA	
13:10	105		6055	0		NA	Unable to stabilize packer psi
13:11	106		6055	0		NA	
13:12	107		6055	0		NA	
13:13	108		6055	0		NA	
13:14	109		6055	0		NA	
13:15	110		6055	0		NA	
13:16	111		6055	0		NA	
13:17	112		6055	0		NA	
13:18	113		6055	0		NA	
13:19	114		6055	0		NA	
13:20	115		6055	0		NA	Pull and replace packer
13:21	116		6055	0		NA	
13:22	117		6055	0		NA	
13:23	118		6055	0		NA	
13:24	119		6055	0		NA	
13:25	120		6055	0		NA	
13:26	121		6055	0		NA	
13:27	122		6055	0		NA	
13:28	123		6055	0		NA	
13:29	124		6055	0		NA	
13:30	125		6055	0		NA	
13:31	126		6055	0		NA	
13:32	127		6055	0		NA	
13:33	128		6055	0		NA	
13:34	129		6055	0		NA	
13:35	130		6055	0		NA	
13:36	131		6055	0		NA	
13:37	132		6055	0		NA	
13:38	133		6055	0		NA	
13:39	134		6055	0		NA	
13:40	135		6055	0		NA	
13:41	136		6055	0		NA	
13:42	137		6055	0		NA	
13:43	138		6055	0		NA	
13:44	139		6055	0		NA	
13:45	140		6055	0		NA	
13:46	141		6055	0		NA	
13:47	142		6055	0		NA	
13:48	143		6055	0		NA	
13:49	144		6055	0		NA	
13:50	145		6055	0		NA	
13:51	146		6055	0		NA	
13:52	147		6055	0		NA	
13:53	148		6055	0		NA	
13:54	149		6055	0		NA	
13:55	150		6055	0		NA	
13:56	151		6055	0		NA	
13:57	152		6055	0		NA	
13:58	153		6055	0		NA	
13:59	154		6055	0		NA	New packer installed and inflated to 200 psi
14:00	155	1	6057	2	100	55	Filling hose and 1 inch
14:01	156	2	6057.4	0.4	110		
14:02	157	3	6057.5	0.1	110		
14:03	158	4	6057.5	0	125		
14:04	159	5	6057.5	0	123		

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
14:05	160	6	6057.5	0	120		
14:06	161	7	6057.5	0	120		Pump shear pin fails
14:07	162	8	6057.5	0	0		Stop to repair pump
14:08	163		6057.5	0	0		
14:09	164		6057.5	0	0		
14:10	165		6057.5	0	0		
14:11	166		6057.5	0	0		
14:12	167		6057.5	0	0		
14:13	168		6057.5	0	0		
14:14	169		6057.5	0	0		
14:15	170		6057.5	0	0		
14:16	171		6057.5	0	0		
14:17	172		6057.5	0	0		
14:18	173		6057.5	0	0		
14:19	174		6057.5	0	0		
14:20	175		6057.5	0	0		
14:21	176		6057.5	0	0		
14:22	177		6057.5	0	0		
14:23	178		6057.5	0	0		
14:24	179		6057.5	0	0		
14:25	180		6057.5	0	0		
14:26	181		6057.5	0	0		
14:27	182		6057.5	0	0		
14:28	183		6057.5	0	0		
14:29	184		6057.5	0	0		
14:30	185		6057.5	0	0		
14:31	186		6057.5	0	0		
14:32	187		6057.5	0	0		
14:33	188		6057.5	0	0		
14:34	189		6057.5	0	0		
14:35	190		6057.5	0	0		
14:36	191		6057.5	0	0		
14:37	192		6057.5	0	0		
14:38	193		6057.5	0	0		
14:39	194		6057.5	0	0		
14:40	195		6057.5	0	0		
14:41	196		6057.5	0	0		
14:42	197		6057.5	0	0		
14:43	198		6057.5	0	0		
14:44	199		6057.5	0	0		
14:45	200		6057.5	0	0		
14:46	201		6057.5	0	0		
14:47	202		6057.5	0	0		
14:48	203		6057.5	0	0		
14:49	204		6057.5	0	0		
14:50	205		6057.5	0	0		
14:51	206		6057.5	0	0		
14:52	207		6057.5	0	0		
14:53	208		6057.5	0	0		
14:54	209		6057.5	0	0		
14:55	210		6057.5	0	0		
14:56	211		6057.5	0	0		
14:57	212		6060	2.5	0		Test pump to ground
14:58	213		6067.5	7.5	0		
14:59	214		6075	7.5	0		
15:00	215		6082.5	7.5	0		
15:01	216		6082.5	0	0		
15:02	217		6082.5	0	0		

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
15:03	218		6082.5	0	0		
15:04	219		6082.5	0	0		
15:05	220		6082.5	0	0		
15:06	221		6082.5	0	0		
15:07	222		6082.5	0	0		
15:08	223		6082.5	0	0		
15:09	224		6082.5	0	0		
15:10	225		6082.5	0	0		
15:11	226	1	6082.7	0.2	120	55.2	
15:12	227	2	6082.9	0.2	120	55.4	
15:13	228	3	6083	0.1	120	55.5	
15:14	229	4	6083	0	120	55.5	
15:15	230	5	6083.2	0.2	120	55.7	
15:16	231	6	6083.3	0.1	120	55.8	
15:17	232	7	6083.3	0	120	55.8	
15:18	233	8	6083.3	0	120	55.8	
15:19	234	9	6083.3	0	120	55.8	
15:20	235	10	6083.3	0	120	55.8	
15:21	236	1	6083.3	0	130	28.3	
15:22	237	2	6083.3	0	130	28.3	
15:23	238	3	6083.4	0.1	130	28.4	
15:24	239	4	6083.4	0	130	28.4	
15:25	240	5	6083.4	0	130	28.4	
15:26	241	6	6083.4	0	130	28.4	
15:27	242	7	6083.4	0	130	28.4	
15:28	243	8	6083.4	0	130	28.4	
15:29	244	9	6083.5	0.1	130	28.5	
15:30	245	10	6083.5	0	130	28.5	
15:31	246	1	6083.5	0	150	28.5	
15:32	247	2	6083.5	0	150	28.5	
15:33	248	3	6083.6	0.1	150	28.6	1 inch injection pipe pushing up
15:34	249	4	6083.7	0.1	150	28.7	
15:35	250	5	6083.7	0	150	28.7	Packer pressure moving up 240
15:36	251	6	6083.7	0	150	28.7	
15:37	252	7	6083.7	0	150	28.7	Packer pressure moving up 260
15:38	253	8	6083.7	0	150	28.7	
15:39	254	9	6083.9	0.2	150	28.9	Packer pressure moving up 290
15:40	255	10	6084	0.1	150	29	
15:41	256	1	6084	0	130	29	
15:42	257	2	6084	0	130	29	
15:43	258	3	6084.2	0.2	130	29.2	
15:44	259	4	6084.2	0	130	29.2	
15:45	260	5	6084.2	0	130	29.2	Packer pressure down to 260
15:46	261	6	6084.2	0	130	29.2	
15:47	262	7	6084.3	0.1	130	29.3	
15:48	263	1	6084.3	0	120	29.3	
15:49	264	2	6084.3	0	120	29.3	
15:50	265	3	6084.3	0	120	29.3	
15:51	266	4	6084.3	0	120	29.3	
15:52	267	5	6084.3	0	120	29.3	
15:53	268	6	6084.3	0	120	29.3	
15:54	269	7	6084.3	0	120	29.3	
15:55	270	8	6084.3	0	120	29.3	
15:56	271	9	6084.3	0	120	29.3	
15:57	272	10	6084.4	0.1	120	29.4	
15:58	273	1	6084.4	0	110	29.4	
15:59	274	2	6084.4	0	110	29.4	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
16:00	275	3	6084.4	0	110	29.4	
16:01	276	4	6084.5	0.1	110	29.5	
16:02	277	5	6084.5	0	110	29.5	
16:03	278	1	6084.5	0	100	29.5	
16:04	279	2	6084.5	0	100	29.5	
16:05	280	3	6084.5	0	100	29.5	
16:06	281	4	6084.5	0	100	29.5	
16:07	282	5	6084.5	0	100	29.5	
16:08	283	1	6084.5	0	90	29.5	
16:09	284	2	6084.5	0	90	29.5	
16:10	285	3	6084.5	0	90	29.5	
16:11	286	4	6084.5	0	90	29.5	
16:12	287	5	6084.5	0	90	29.5	
16:13	288	1	6084.5	0	80	29.5	
16:14	289	2	6084.5	0	80	29.5	
16:15	290	3	6084.5	0	80	29.5	
16:16	291	4	6084.5	0	80	29.5	
16:17	292	5	6084.5	0	80	29.5	
16:18	293	1	6084.5	0	70	29.5	
16:19	294	2	6084.5	0	70	29.5	
16:20	295	3	6084.5	0	70	29.5	
16:21	296	4	6084.5	0	70	29.5	
16:22	297	5	6084.5	0	70	29.5	
16:23	298	1	6084.5	0	60	29.5	
16:24	299	2	6084.5	0	60	29.5	
16:25	300	3	6084.5	0	60	29.5	
16:26	301	4	6084.5	0	60	29.5	
16:27	302	5	6084.5	0	60	29.5	
16:28	303	1	6084.5	0	50	29.5	
16:29	304	2	6084.5	0	50	29.5	
16:30	305	3	6084.5	0	50	29.5	
16:31	306	4	6084.5	0	50	29.5	
16:32	307	5	6084.5	0	50	29.5	
16:33	308	1	6084.5	0	40	29.5	
16:34	309	2	6084.5	0	40	29.5	
16:35	310	3	6084.5	0	40	29.5	
16:36	311	4	6084.5	0	40	29.5	
16:37	312	5	6084.5	0	40	29.5	
16:38	313	1	6084.5	0	30	29.5	
16:39	314	2	6084.5	0	30	29.5	
16:40	315	3	6084.5	0	30	29.5	
16:41	316	4	6084.5	0	30	29.5	
16:42	317	5	6084.5	0	30	29.5	
16:43	318	6	6084.5	0	20	29.5	
16:44	319	7	6084.5	0	20	29.5	
16:45	320	8	6084.5	0	20	29.5	
16:46	321	9	6084.5	0	20	29.5	
16:47	322	10	6084.5	0	20	29.5	

Repeated steps summarized								
psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	
								No duplicat test performed

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Date	**7/21/2011**
Client	**New Mexico Copper Corp**
Project	**Copper Flat**
Well Name	**GWQ 11-24 Zone 1**
Hydrologist	**JJK**

Starting Water Level (ft bgl)	**54.61**	**Packer Dia**	**2 inch**
Elevation (ft GL)		**Bore/Casing Dia**	**3-3/4 inch**
Injection Interval (ft bgl)	**100 to 147**	**Injection Pipe Dia**	**1 inch**
Bore/Casing Depth (ft bgl)	**147**	**Pressure gauge height above GL**	**4 ft**

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
8:25	0		9		20	0	20 psi
8:26	1	1	9.8	0.80	20	0.8	
8:27	2	2	10.59	0.79	20	1.59	
8:28	3	3	11.4	0.81	20	2.4	
8:29	4	4	12.2	0.80	20	3.2	
8:30	5	5	13.1	0.90	20	4.1	
8:31	6	6	14	0.90	20	5	
8:32	7	7	14.8	0.80	20	5.8	
8:33	8	8	15.6	0.80	20	6.6	
8:34	9	9	16.5	0.90	20	7.5	
8:35	10	10	17.3	0.80	20	8.3	Average 0.83 gpm
8:36	11	1	17.8	0.5	30	8.8	30 psi
8:37	12	2	18.3	0.5	32	9.3	
8:38	13	3	18.9	0.6	30	9.9	
8:39	14	4	19.6	0.7	31	10.6	
8:40	15	5	20	0.4	30	11	
8:41	16	6	20.5	0.5	32	11.5	
8:42	17	7	21	0.5	31	12	
8:43	18	8	21.5	0.5	30	12.5	
8:44	19	9	22.1	0.6	30	13.1	
8:45	20	10	22.6	0.5	30	13.6	Average 0.53 gpm
8:46	21	1	23.22	0.62	40	14.22	Attempt 40 psi. Oscillating + - 5 psi
8:47	22	2	23.8	0.58	40	14.8	
8:48	23	3	24.4	0.6	40	15.4	
8:49	24	4	25	0.6	40	16	
8:50	25	5	25.6	0.6	40	16.6	
8:51	26	6	26.3	0.7	40	17.3	
8:52	27	7	26.9	0.6	40	17.9	
8:53	28	8	27.5	0.6	40	18.5	
8:54	29	9	28.1	0.6	42	19.1	
8:55	30	10	28.8	0.7	44	19.8	Average 0.62 gpm
8:56	31	1	29.7	0.9	50-55	20.7	Attempt 50 psi. Oscillating + - 5 psi
8:57	32	2	30.6	0.9	50-55	21.6	
8:58	33	3	31.5	0.9	50-55	22.5	
8:59	34	4	32.4	0.9	50-55	23.4	
9:00	35	5	33.3	0.9	50-55	24.3	
9:01	36	6	34.3	1	50-55	25.3	
9:02	37	7	35.2	0.9	50-55	26.2	
9:03	38	8	36.2	1	50-55	27.2	
9:04	39	9	37	0.8	50-55	28	
9:05	40	10	37.9	0.9	50-55	28.9	Average 0.91 gpm
9:06	41	1	39.1	1.2	60	30.1	Attempt 60 psi. Oscillating + - 8 psi
9:07	42	2	40.3	1.2	65	31.3	
9:08	43	3	41.5	1.2	65	32.5	
9:09	44	4	42.8	1.3	65	33.8	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
9:10	45	5	44	1.2	65	35	
9:11	46	6	45.3	1.3	65	36.3	
9:12	47	7	46.6	1.3	65	37.6	
9:13	48	8	47.8	1.2	65	38.8	
9:14	49	9	49	1.2	65	40	
9:15	50	10	50.2	1.2	65	41.2	Average 1.23 gpm
9:16	51	1	51.8	1.6	75	42.8	Attempt 70 psi Oscillating + - 10 to 12 psi
9:17	52	2	53.4	1.6	75	44.4	
9:18	53	3	55	1.6	75	46	
9:19	54	4	56.5	1.5	75	47.5	
9:20	55	5	58	1.5	75	49	
9:21	56	6	59.6	1.6	75	50.6	
9:22	57	7	61	1.4	75	52	
9:23	58	8	62.5	1.5	75	53.5	
9:24	59	9	64.1	1.6	75	55.1	
9:25	60	10	66	1.9	75	57	Average 1.58 gpm
9:26	61	1	68.4	2.4	85	59.4	Attempt 80 psi Oscillating + - 10 to 20 psi
9:27	62	2	70.7	2.3	85	61.7	
9:28	63	3	73	2.3	85	64	
9:29	64	4	75.5	2.5	85	66.5	
9:30	65	5	78	2.5	85	69	
9:31	66	6	80.3	2.3	85	71.3	
9:32	67	7	82.7	2.4	85	73.7	
9:33	68	8	85	2.3	85	76	
9:34	69	9	87.4	2.4	85	78.4	
9:35	70	10	89.8	2.4	85	80.8	Average 2.38 gpm
9:36	71	1	93.32	3.52	90	84.32	Attempt 90 psi Oscillating + - 20 to 30 psi
9:37	72	2	96.8	3.48	90	87.8	
9:38	73	3	100	3.2	90	91	
9:39	74	4	103.5	3.5	90	94.5	
9:40	75	5	107	3.5	90	98	
9:41	76	6	110.5	3.5	90	101.5	
9:42	77	7	114.2	3.7	90	105.2	
9:43	78	8	117.8	3.6	90	108.8	
9:44	79	9	121.4	3.6	90	112.4	
9:45	80	10	125.2	3.8	90	116.2	Average 3.54 gpm
9:46	81	1	130.4	5.2	100	121.4	Valve fully open readings on gauge 85 to 118
9:47	82	2	135.8	5.4	100	126.8	Test abandoned at 90 minutes due to excess
9:48	83	3	141	5.2	100	132	fluctuation in pressure gauge.
9:49	84	4	146.3	5.3	100	137.3	
9:50	85	5	151.5	5.2	100	142.5	
9:51	86	6	156.8	5.3	100	147.8	
9:52	87	7	162	5.2	100	153	
9:53	88	8	167.3	5.3	100	158.3	
9:54	89	9	172.5	5.2	100	163.5	
9:55	90	10	177.8	5.3	100	168.8	Average 5.26 gpm

Second attempt on 7-26-2011 with centrifugal pump

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
7:44	0		180				
7:45	1	1	181.6	3.8	20	1.6	
7:46	2	2	183.1	1.5	20	3.1	
7:47	3	3	184.7	1.6	20	4.7	
7:48	4	4	186.4	1.7	20	6.4	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
7:49	5	5	188	1.6	20	8	
7:50	6	6	189.7	1.7	20	9.7	
7:51	7	7	191.2	1.5	20	11.2	
7:52	8	8	192.8	1.6	20	12.8	
7:53	9	9	194.5	1.7	20	14.5	
7:54	10	10	196	1.5	20	16	Average 1.6 gpm
7:55	11	1	197.7	1.7	30	17.7	
7:56	12	2	199.5	1.8	30	19.5	
7:57	13	3	201.3	1.8	30	21.3	
7:58	14	4	203	1.7	30	23	
7:59	15	5	204.6	1.6	30	24.6	
8:00	16	6	206.4	1.8	30	26.4	
8:01	17	7	208	1.6	30	28	
8:02	18	8	209.7	1.7	30	29.7	
8:03	19	9	211.5	1.8	30	31.5	
8:04	20	10	213.2	1.7	30	33.2	Average 1.72 gpm
8:05	21	1	215.2	2	40	35.2	
8:06	22	2	217.3	2.1	40	37.3	
8:07	23	3	219.2	1.9	40	39.2	
8:08	24	4	221	1.8	40	41	
8:09	25	5	223	2	40	43	
8:10	26	6	225.1	2.1	40	45.1	
8:11	27	7	227.2	2.1	40	47.2	
8:12	28	8	229.3	2.1	40	49.3	
8:13	29	9	231.1	1.8	40	51.1	
8:14	30	10	233.1	2	40	53.1	Average 1.99 gpm
8:15	31	1	235.5	2.4	50 - 60	55.5	Gauge reading from 45 to 65 psi
8:16	32	2	237.9	2.4	50 - 60	57.9	
8:17	33	3	240	2.1	50 - 60	60	
8:18	34	4	242.4	2.4	50 - 60	62.4	
8:19	35	5	244.9	2.5	50 - 60	64.9	
8:20	36	6	247.2	2.3	50 - 60	67.2	
8:21	37	7	249.6	2.4	50 - 60	69.6	
8:22	38	8	252	2.4	50 - 60	72	
8:23	39	9	254.5	2.5	50 - 60	74.5	
8:24	40	10	256.9	2.4	50 - 60	76.9	Average 2.38 gpm
8:25	41	1	260	3.1	65 - 75	80	Gauge reading from 60 to 80 psi
8:26	42	2	263.1	3.1	65 - 75	83.1	
8:27	43	3	266.3	3.2	65 - 75	86.3	
8:28	44	4	269.3	3.1	65 - 75	89.3	
8:29	45	5	272.3	3	65 - 75	92.3	
8:30	46	6	275.4	3.1	65 - 75	95.4	
8:31	47	7	278.4	3	65 - 75	98.4	
8:32	48	8	281.5	3.1	65 - 75	101.5	
8:33	49	9	284.7	3.2	65 - 75	104.7	
8:34	50	10	287.8	3.1	65 - 75	107.8	Average 3.09 gpm
8:35	51	1	292	4.2	80 - 100	112	Gauge reading from 65 to 115
8:36	52	2	296.1	4.1	80 - 100	116.1	Test abandoned at 60 minutes due to excess
8:37	53	3	300	3.9	80 - 100	120	fluctuation in pressure gauge
8:38	54	4	304.2	4.2	80 - 100	124.2	
8:39	55	5	308.5	4.3	80 - 100	128.5	
8:40	56	6	312.9	4.4	80 - 100	132.9	
8:41	57	7	317.2	4.3	80 - 100	137.2	
8:42	58	8	321.5	4.3	80 - 100	141.5	
8:43	59	9	325.8	4.3	80 - 100	145.8	
8:44	60	10	330	4.2	80 - 100	150	Average 4.22 gpm

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks

Third attempt on 7-27-2011 with screw pump

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
11:20	0	0	350		40	0	
11:21	1	1	356.2	6.2	40	6.2	
11:22	2	2	362.73	6.53	40	12.73	
11:23	3	3	369.3	6.57	40	19.3	
11:24	4	4	375.8	6.5	40	25.8	
11:25	5	5	382.3	6.5	40	32.3	
11:26	6	6	388.6	6.3	40	38.6	
11:27	7	7	395.1	6.5	40	45.1	
11:28	8	8	401.6	6.5	40	51.6	
11:29	9	9	408	6.4	40	58	
11:30	10	10	414.3	6.3	41	64.3	6.43 average gpm
11:31	11	1	421.1	6.8	50	71.1	Gauge oscillating + - 3 psi
11:32	12	2	427.9	6.8	50	77.9	
11:33	13	3	434.8	6.9	51	84.8	
11:34	14	4	441.7	6.9	51	91.7	
11:35	15	5	448.6	6.9	52	98.6	
11:36	16	6	455.4	6.8	50	105.4	
11:37	17	7	462.2	6.8	52	112.2	
11:38	18	8	469	6.8	51	119	
11:39	19	9	475.8	6.8	50	125.8	
11:40	20	10	482.5	6.7	52	132.5	6.82 average gpm
11:41	21	1	489.9	7.4	60	139.9	Gauge oscillating + - 3 psi
11:42	22	2	497.2	7.3	61	147.2	
11:43	23	3	504.4	7.2	61	154.4	
11:44	24	4	511.8	7.4	62	161.8	
11:45	25	5	519.2	7.4	62	169.2	
11:46	26	6	526.4	7.2	61	176.4	
11:47	27	7	533.7	7.3	60	183.7	
11:48	28	8	541	7.3	60	191	
11:49	29	9	548.3	7.3	60	198.3	
11:50	30	10	555.7	7.4	61	205.7	7.32 average gpm
11:51	31	1	563.6	7.9	70	213.6	Gauge oscillating + - 3 psi
11:52	32	2	571.4	7.8	71	221.4	
11:53	33	3	579.1	7.7	70	229.1	
11:54	34	4	587	7.9	70	237	
11:55	35	5	594.9	7.9	71	244.9	
11:56	36	6	602.9	8	72	252.9	
11:57	37	7	610.7	7.8	72	260.7	
11:58	38	8	618.5	7.8	70	268.5	
11:59	39	9	626.3	7.8	70	276.3	
12:00	40	10	634	7.7	72	284	7.83 average gpm
12:01	41	1	642	8	81	292	Gauge oscillating + - 3 psi
12:02	42	2	650.1	8.1	81	300.1	
12:03	43	3	658.2	8.1	80	308.2	
12:04	44	4	666	7.8	80	316	
12:05	45	5	674	8	80	324	
12:06	46	6	682.2	8.2	80	332.2	
12:07	47	7	690.3	8.1	81	340.3	
12:08	48	8	698.2	7.9	82	348.2	
12:09	49	9	706.1	7.9	80	356.1	
12:10	50	10	714.2	8.1	81	364.2	8.02 average gpm

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
12:11	51	1	722.4	8.2	90	372.4	Gauge oscillating + - 4 psi
12:12	52	2	730.5	8.1	92	380.5	
12:13	53	3	738.5	8	94	388.5	
12:14	54	4	746.8	8.3	95	396.8	
12:15	55	5	755	8.2	92	405	
12:16	56	6	763.1	8.1	92	413.1	
12:17	57	7	771.3	8.2	91	421.3	
12:18	58	8	779.3	8	92	429.3	
12:19	59	9	787.5	8.2	93	437.5	
12:20	60	10	795.8	8.3	91	445.8	8.16 average gpm
12:21	61	1	803.7	7.9	100	453.7	Gauge oscillating + - 5 psi
12:22	62	2	811.4	7.7	101	461.4	
12:23	63	3	819.2	7.8	102	469.2	
12:24	64	4	827	7.8	101	477	
12:25	65	5	834.9	7.9	103	484.9	
12:26	66	6	842.8	7.9	104	492.8	
12:27	67	7	850.9	8.1	102	500.9	
12:28	68	8	858.6	7.7	104	508.6	
12:29	69	9	866.5	7.9	102	516.5	
12:30	70	10	874.3	7.8	101	524.3	7.85 average gpm
12:31	71	1	881.9	7.6	110	531.9	Gauge oscillating + - 5 psi
12:32	72	2	889.3	7.4	112	539.3	
12:33	73	3	896.9	7.6	114	546.9	
12:34	74	4	904.7	7.8	112	554.7	
12:35	75	5	912.3	7.6	115	562.3	
12:36	76	6	919.9	7.6	112	569.9	
12:37	77	7	927.6	7.7	112	577.6	
12:38	78	8	935	7.4	112	585	
12:39	79	9	942.7	7.7	113	592.7	
12:40	80	10	950.4	7.7	114	600.4	7.61 average gpm
12:41	81	1	958.3	7.9	115	608.3	Gauge oscillating + - 5 psi
12:42	82	2	966	7.7	116	616	
12:43	83	3	973.9	7.9	115	623.9	
12:44	84	4	981.8	7.9	116	631.8	
12:45	85	5	989.6	7.8	117	639.6	
12:46	86	6	997.7	8.1	115	647.7	
12:47	87	7	1005.4	7.7	115	655.4	
12:48	88	8	1013.1	7.7	117	663.1	
12:49	89	9	1021	7.9	115	671	
12:50	90	10	1028.9	7.9	116	678.9	7.85 average gpm
12:51	91	1	1035.6	6.7	101	685.6	Gauge oscillating + - 5 psi
12:52	92	2	1042.4	6.8	100	692.4	
12:53	93	3	1049	6.6	102	699	
12:54	94	4	1055.8	6.8	101	705.8	
12:55	95	5	1062.6	6.8	100	712.6	
12:56	96	6	1069.4	6.8	102	719.4	
12:57	97	7	1076.2	6.8	100	726.2	
12:58	98	8	1083	6.8	101	733	
12:59	99	9	1089.7	6.7	102	739.7	
13:00	100	10	1096.3	6.6	100	746.3	6.74 average gpm
13:01	101	1	1102.9	6.6	90	752.9	Gauge oscillating + - 4 psi
13:02	102	2	1109.5	6.6	89	759.5	
13:03	103	3	1116	6.5	90	766	
13:04	104	4	1122.6	6.6	89	772.6	
13:05	105	5	1129	6.4	90	779	
13:06	106	6	1135.5	6.5	91	785.5	
13:07	107	7	1142	6.5	90	792	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
13:08	108	8	1148.6	6.6	92	798.6	
13:09	109	9	1155.2	6.6	91	805.2	
13:10	110	10	1161.9	6.7	91	811.9	6.56 average gpm
13:11	111	1	1169	7.1	80	819	Gauge oscillating + - 4 psi
13:12	112	2	1176.2	7.2	79	826.2	
13:13	113	3	1183.4	7.2	80	833.4	
13:14	114	4	1190.5	7.1	81	840.5	
13:15	115	5	1197.8	7.3	81	847.8	
13:16	116	6	1205	7.2	80	855	
13:17	117	7	1212.3	7.3	78	862.3	
13:18	118	8	1219.6	7.3	80	869.6	
13:19	119	9	1226.7	7.1	79	876.7	
13:20	120	10	1233.9	7.2	81	883.9	7.2 average gpm
13:21	121	1	1240.9	7	68	890.9	Gauge oscillating + - 3 psi
13:22	122	2	1247.8	6.9	69	897.8	
13:23	123	3	1254.6	6.8	70	904.6	
13:24	124	4	1261.3	6.7	71	911.3	
13:25	125	5	1268	6.7	70	918	
13:26	126	6	1274.9	6.9	71	924.9	
13:27	127	7	1281.9	7	70	931.9	
13:28	128	8	1288.7	6.8	70	938.7	
13:29	129	9	1295.5	6.8	71	945.5	
13:30	130	10	1302.2	6.7	72	952.2	6.86 average gpm
13:31	131	1	1308.9	6.7	60	958.9	Gauge oscillating + - 3 psi
13:32	132	2	1315.5	6.6	60	965.5	
13:33	133	3	1322	6.5	59	972	
13:34	134	4	1328.5	6.5	60	978.5	
13:35	135	5	1335.1	6.6	60	985.1	
13:36	136	6	1341.6	6.5	60	991.6	
13:37	137	7	1348	6.4	59	998	
13:38	138	8	1354.7	6.7	61	1004.7	
13:39	139	9	1361.2	6.5	60	1011.2	
13:40	140	10	1367.8	6.6	60	1017.8	6.56 average gpm
13:41	141	1	1374.2	6.4	50	1024.2	
13:42	142	2	1380.9	6.7	50	1030.9	
13:43	143	3	1387	6.1	50	1037	
13:44	144	4	1393.2	6.2	50	1043.2	
13:45	145	5	1399.6	6.4	51	1049.6	
13:46	146	6	1406	6.4	50	1056	
13:47	147	7	1412	6	50	1062	
13:48	148	8	1418.5	6.5	51	1068.5	
13:49	149	9	1424.9	6.4	52	1074.9	
13:50	150	10	1431.4	6.5	51	1081.4	6.36 average gpm
13:51	151	1	1438	6.6	40	1088	
13:52	152	2	1444.5	6.5	40	1094.5	
13:53	153	3	1451	6.5	40	1101	
13:54	154	4	1457.7	6.7	39	1107.7	
13:55	155	5	1464.2	6.5	40	1114.2	
13:56	156	6	1470.8	6.6	40	1120.8	
13:57	157	7	1477.3	6.5	41	1127.3	
13:58	158	8	1483.9	6.6	41	1133.9	
13:59	159	9	1490.4	6.5	40	1140.4	
14:00	160	10	1497	6.6	40	1147	6.56 average gpm

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Date	**7/30/2011**
Client	**New Mexico Copper Corp**
Project	**Copper Flat**
Well Name	**GWQ 11-24 Zone 2**
Hydrologist	**JJK**

Starting Water Level (ft bgl)	**53.5**
Elevation (ft GL)	
Injection Interval (ft bgl)	**150 to 197**
Bore/Casing Depth (ft bgl)	**197**

Packer Dia	**2 inch**
Bore/Casing Dia	**3-3/4 inch**
Injection Pipe Dia	**1 inch**
Pressure gauge height above GL	**1 ft**

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
11:00	0		70				New meter
11:01	1	1	76.2	6.2	20	6.2	
11:02	2	2	82.3	6.1	20	12.3	
11:03	3	3	88.5	6.2	20	18.5	
11:04	4	4	94.7	6.2	20	24.7	
11:05	5	5	100.8	6.1	20	30.8	
11:06	6	6	107.2	6.4	20	37.2	
11:07	7	7	113.4	6.2	20	43.4	
11:08	8	8	119.6	6.2	20	49.6	
11:09	9	9	126	6.4	20	56	
11:10	10	10	132.5	6.5	20	62.5	6.25 gpm average for 20 psi
11:11	11	1	139	6.5	30	69	Up to approximately 30 psi
11:12	12	2	145.5	6.5	30	75.5	
11:13	13	3	152.1	6.6	30	82.1	
11:14	14	4	158.4	6.3	30	88.4	
11:15	15	5	164.9	6.5	30	94.9	
11:16	16	6	171.2	6.3	30	101.2	
11:17	17	7	177.7	6.5	30	107.7	
11:18	18	8	184	6.3	30	114	
11:19	19	9	190.5	6.5	32	120.5	
11:20	20	10	197.3	6.8	30	127.3	6.48 gpm average for 30 psi
11:21	21	1	204	6.70	40	134	Up to approximately 40 psi
11:22	22	2	210.6	6.60	40	140.6	
11:23	23	3	217.3	6.70	41	147.3	
11:24	24	4	224	6.70	40	154	
11:25	25	5	230.4	6.40	40	160.4	
11:26	26	6	237.1	6.70	41	167.1	
11:27	27	7	243.9	6.80	42	173.9	
11:28	28	8	250.6	6.70	41	180.6	
11:29	29	9	257.4	6.80	40	187.4	
11:30	30	10	264.3	6.90	40	194.3	6.70 gpm average for 40 psi
11:31	31	1	271.2	6.9	55	201.2	Up to approximately 55 psi
11:32	32	2	278.1	6.9	55	208.1	
11:33	33	3	285.0	6.9	55	215	
11:34	34	4	291.8	6.8	55	221.8	
11:35	35	5	298.5	6.7	56	228.5	
11:36	36	6	305.4	6.9	55	235.4	
11:37	37	7	312.4	7	56	242.4	
11:38	38	8	319.3	6.9	59	249.3	
11:39	39	9	326	6.7	59	256	
11:40	40	10	332.9	6.9	58	262.9	6.86 gpm average for 55 psi
11:41	41	1	340.4	7.5	70	270.4	Up to approximately 75 psi
11:42	42	2	348.5	8.1	75	278.5	
11:43	43	3	356.7	8.2	76	286.7	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
11:44	44	4	364.6	7.9	76	294.6	
11:45	45	5	372.8	8.2	76	302.8	
11:46	46	6	380.7	7.9	76	310.7	
11:47	47	7	388.9	8.2	76	318.9	
11:48	48	8	397	8.1	77	327	
11:49	49	9	405	8	77	335	
11:50	50	10	413.2	8.2	77	343.2	8.03 gpm average for 75 psi
11:51	51	1	421.5	8.3	90	351.5	Up to approximately 95 psi
11:52	52	2	429.8	8.3	90	359.8	
11:53	53	3	438	8.2	91	368	
11:54	54	4	446.1	8.1	93	376.1	
11:55	55	5	454.3	8.2	94	384.3	
11:56	56	6	462.6	8.3	95	392.6	
11:57	57	7	470.6	8	95	400.6	
11:58	58	8	478.8	8.2	96	408.8	
11:59	59	9	486.9	8.1	95	416.9	
12:00	60	10	495.2	8.3	94	425.2	8.2 gpm average for 95 psi
12:01	61	1	503.4	8.2	115	433.4	Up to approximately 120 psi
12:02	62	2	511.7	8.3	118	441.7	
12:03	63	3	520	8.3	120	450	
12:04	64	4	528.3	8.3	120	458.3	
12:05	65	5	536.7	8.4	120	466.7	
12:06	66	6	545	8.3	120	475	
12:07	67	7	553.2	8.2	120	483.2	
12:08	68	8	561.5	8.3	120	491.5	
12:09	69	9	569.5	8	120	499.5	
12:10	70	10	577.6	8.1	120	507.6	8.24 gpm average for 120 psi
12:11	71	1	585.8	8.2	120 to 123	515.8	Valve fully open.
12:12	72	2	594	8.2	120 to 123	524	
12:13	73	3	602.2	8.2	120 to 124	532.2	
12:14	74	4	610.4	8.2	120 to 122	540.4	
12:15	75	5	618.7	8.3	119 to 121	548.7	
12:16	76	6	626.8	8.1	119	556.8	
12:17	77	7	635	8.2	118	565	
12:18	78	8	643.2	8.2	118	573.2	
12:19	79	9	651.5	8.3	119	581.5	
12:20	80	10	659.6	8.1	120	589.6	8.2 gpm average for 120 psi
12:21	81	1	666.3	6.7	105	596.3	Down to approximately 100 psi
12:22	82	2	673.1	6.8	100 to 105	603.1	
12:23	83	3	679.8	6.7	100 to 105	609.8	
12:24	84	4	686.4	6.6	100 to 105	616.4	
12:25	85	5	693.2	6.8	100 to 105	623.2	
12:26	86	6	700	6.8	100 to 105	630	
12:27	87	7	706.7	6.7	100 to 105	636.7	
12:28	88	8	713.5	6.8	100 to 105	643.5	
12:29	89	9	720.1	6.6	100 to 105	650.1	
12:30	90	10	726.8	6.7	100 to 105	656.8	6.72 gpm average for 100 psi
12:31	91	1	734	7.2	80	664	Down to approximately 80 psi
12:32	92	2	741.2	7.2	80	671.2	
12:33	93	3	748.3	7.1	75 to 80	678.3	
12:34	94	4	755.6	7.3	75 to 80	685.6	
12:35	95	5	762.9	7.3	75 to 80	692.9	
12:36	96	6	770.1	7.2	75 to 80	700.1	
12:37	97	7	777.4	7.3	75 to 80	707.4	
12:38	98	8	784.6	7.2	75 to 80	714.6	
12:39	99	9	791.7	7.1	75 to 80	721.7	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
12:40	100	10	798.9	7.2	75 to 80	728.9	7.21 gpm average for 80 psi
12:41	101	1	805.5	6.6	60	735.5	Down to approximately 60 psi
12:42	102	2	812.1	6.6	55 to 60	742.1	
12:43	103	3	818.9	6.8	55 to 60	748.9	
12:44	104	4	825.3	6.4	55 to 60	755.3	
12:45	105	5	831.9	6.6	55 to 60	761.9	
12:46	106	6	838.4	6.5	55 to 60	768.4	
12:47	107	7	845	6.6	55 to 60	775	
12:48	108	8	851.5	6.5	55 to 60	781.5	
12:49	109	9	858.2	6.7	55 to 60	788.2	
12:50	110	10	864.6	6.4	55 to 60	794.6	6.57 gpm average for 60 psi
12:51	111	1	871	6.4	40	801	Down to approximately 40 psi
12:52	112	2	877.3	6.3	40	807.3	
12:53	113	3	883.6	6.3	40	813.6	
12:54	114	4	890	6.4	40	820	
12:55	115	5	896.3	6.3	40	826.3	
12:56	116	6	902.3	6	40	832.3	
12:57	117	7	908.5	6.2	40	838.5	
12:58	118	8	914.8	6.3	40	844.8	
12:59	119	9	921.1	6.3	40	851.1	
13:00	120	10	927.5	6.4	40	857.5	6.29 gpm average for 40 psi
13:01	121	1	933.92	6.42	30	863.92	Down to approximately 30 psi
13:02	122	2	940.4	6.48	30	870.4	
13:03	123	3	946.8	6.4	30	876.8	
13:04	124	4	953.2	6.4	31	883.2	
13:05	125	5	959.6	6.4	30	889.6	
13:06	126	6	966	6.4	30	896	
13:07	127	7	972.5	6.5	31	902.5	
13:08	128	8	979	6.5	30	909	
13:09	129	9	985.4	6.4	30	915.4	
13:10	130	10	991.9	6.5	30	921.9	6.44 gpm average for 30 psi
13:11	131	1	998.3	6.4	20	928.3	Down to approximately 20 psi
13:12	132	2	1004.6	6.3	20	934.6	
13:13	133	3	1010.9	6.3	20	940.9	
13:14	134	4	1017.3	6.4	21	947.3	
13:15	135	5	1023.5	6.2	22	953.5	
13:16	136	6	1029.8	6.3	20	959.8	
13:17	137	7	1036.1	6.3	20	966.1	
13:18	138	8	1042.3	6.2	20	972.3	
13:19	139	9	1048.5	6.2	20	978.5	
13:20	140	10	1054.8	6.3	20	984.8	6.29 gpm average for 20 psi

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	
3.00	20.0	6.82	90.0					Set pressure. Wait 1 minute
3.49	30.0	6.80	80.0					average over 2 minutes. Repeat
3.90	40.0	6.20	70.0					
4.59	50.0	5.59	60.0					
5.10	60.0	5.19	50.0					
5.80	70.0	4.68	40.0					
6.30	80.0	4.30	30.0					
6.80	90.0	3.70	20.0					
7.98	100.0							

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Date	**8/1/2011**
Client	**New Mexico Copper Corp**
Project	**Copper Flat**
Well Name	**GWQ 11-24 Zone 3**
Hydrologist	**JJK**

Starting Water Level (ft bgl)	**51.42**	**Packer Dia**	**2 inch**
Elevation (ft GL)		**Bore/Casing Dia**	**3-3/4 inch**
Injection Interval (ft bgl)	**204 to 251**	**Injection Pipe Dia**	**1 inch**
Bore/Casing Depth (ft bgl)	**251**	**Pressure gauge height above GL**	**1 ft**

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
11:50	0		2910		20	0	
11:51	1	1	2911	1.00	20	1	
11:52	2	2	2912.1	1.10	20	2.1	
11:53	3	3	2913	0.90	20	3	
11:54	4	4	2913.3	0.30	20	3.3	
11:55	5	5	2913.5	0.20	20	3.5	
11:56	6	6	2913.8	0.30	20	3.8	
11:57	7	7	2914.1	0.30	20	4.1	
11:58	8	8	2914.4	0.30	20	4.4	
11:59	9	9	2914.7	0.30	21	4.7	
12:00	10	10	2914.9	0.20	20	4.9	0.49 gpm average for 20 psi
12:01	11	1	2915.4	0.5	30	5.4	Up to approximately 30 psi
12:02	12	2	2915.9	0.5	31	5.9	
12:03	13	3	2916.4	0.5	30	6.4	
12:04	14	4	2917.1	0.7	31	7.1	
12:05	15	5	2917.6	0.5	31	7.6	
12:06	16	6	2918.1	0.5	31	8.1	
12:07	17	7	2918.7	0.6	31	8.7	
12:08	18	8	2919.2	0.5	30	9.2	
12:09	19	9	2919.6	0.4	31	9.6	
12:10	20	10	2920.1	0.5	30	10.1	0.52 gpm average for 30 psi
12:11	21	1	2920.8	0.7	38	10.8	Up to approximately 40 psi
12:12	22	2	2921.4	0.6	40	11.4	
12:13	23	3	2921.9	0.5	40	11.9	
12:14	24	4	2922.3	0.4	40	12.3	
12:15	25	5	2922.8	0.5	39	12.8	
12:16	26	6	2923.3	0.5	41	13.3	
12:17	27	7	2923.8	0.5	40	13.8	
12:18	28	8	2924.4	0.6	43	14.4	
12:19	29	9	2924.9	0.5	41	14.9	
12:20	30	10	2925.5	0.6	42	15.5	0.54 gpm average for 40 psi
12:21	31	1	2926.3	0.8	50	16.3	Up to approximately 50 psi
12:22	32	2	2927.2	0.9	51	17.2	
12:23	33	3	2928	0.8	52	18	
12:24	34	4	2928.6	0.6	50	18.6	
12:25	35	5	2929.2	0.6	50	19.2	
12:26	36	6	2929.8	0.6	50	19.8	
12:27	37	7	2930.4	0.6	50	20.4	
12:28	38	8	2931	0.6	50	21	
12:29	39	9	2931.5	0.5	51	21.5	
12:30	40	10	2932.1	0.6	50	22.1	0.66 gpm average for 50 psi
12:31	41	1	2932.6	0.5	59	22.6	
12:32	42	2	2933.4	0.8	60	23.4	
12:33	43	3	2934	0.6	60	24	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
12:34	44	4	2934.8	0.8	60 to 25	24.8	psi drops to 25
12:35	45	5	2935.5	0.7	25 to 60	25.5	adjust valves to maintain 60 psi
12:36	46	6	2940	4.5	60	30	
12:37	47	7	2943.5	3.5	50 to 60	33.5	adjust valves to maintain 60 psi
12:38	48	8	2947.2	3.7	50 to 60	37.2	adjust valves to maintain 60 psi
12:39	49	9	2952	4.8	60	42	
12:40	50	10	2956.5	4.5	59	46.5	2.44 gpm average for 60 psi
12:41	51	1	2961.5	5	70	51.5	
12:42	52	2	2968.8	7.3	71	58.8	
12:43	53	3	2971	2.2	72	61	
12:44	54	4	2973.9	2.9	70 to 60	63.9	psi drops to 60
12:45	55	5	2981.5	7.6	60 to 70	71.5	adjust valves to maintain 70 psi
12:46	56	6	2987	5.5	70	77	
12:47	57	7	2992.5	5.5	72	82.5	
12:48	58	8	2998	5.5	72	88	
12:49	59	9	3003.5	5.5	70	93.5	
12:50	60	10	3008.7	5.2	71	98.7	5.22 gpm average for 70 psi
12:51	61	1	3015	6.3	81	105	
12:52	62	2	3020.5	5.5	82	110.5	
12:53	63	3	3026	5.5	82	116	
12:54	64	4	3032	6	81	122	
12:55	65	5	3037.5	5.5	82	127.5	
12:56	66	6	3042.9	5.4	82	132.9	
12:57	67	7	3048.8	5.9	80	138.8	
12:58	68	8	3054	5.2	79	144	
12:59	69	9	3059.5	5.5	79	149.5	
13:00	70	10	3065	5.5	79	155	5.63 gpm average for 80 psi
13:01	71	1	3071	6	92	161	Gauge is oscillating + or - 3 psi
13:02	72	2	3077.5	6.5	90	167.5	
13:03	73	3	3083.6	6.1	92	173.6	
13:04	74	4	3090	6.4	92	180	
13:05	75	5	3095.9	5.9	92	185.9	
13:06	76	6	3102	6.1	90	192	
13:07	77	7	3108.7	6.7	90	198.7	
13:08	78	8	3113.8	5.1	90	203.8	
13:09	79	9	3119.9	6.1	90	209.9	
13:10	80	10	3125.6	5.7	91	215.6	6.06 gpm average for 90 psi
13:11	81	1	3132	6.4	100	222	Gauge is oscillating + or - 5 psi
13:12	82	2	3138.5	6.5	100	228.5	
13:13	83	3	3145	6.5	100	235	
13:14	84	4	3151.4	6.4	100	241.4	
13:15	85	5	3157.5	6.1	100	247.5	
13:16	86	6	3163.7	6.2	100	253.7	
13:17	87	7	3170.3	6.6	100	260.3	
13:18	88	8	3176.3	6	100	266.3	
13:19	89	9	3182.8	6.5	100	272.8	
13:20	90	10	3189.2	6.4	100	279.2	6.36 gpm average for 100 psi
13:21	91	1	3195	5.8	91	285	Gauge is oscillating + or - 3 psi
13:22	92	2	3201	6	90	291	
13:23	93	3	3206.6	5.6	90	296.6	
13:24	94	4	3212.5	5.9	91	302.5	
13:25	95	5	3218.5	6	89	308.5	
13:26	96	6	3224	5.5	90	314	
13:27	97	7	3229.8	5.8	91	319.8	
13:28	98	8	3235.5	5.7	91	325.5	
13:29	99	9	3241.4	5.9	91	331.4	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
13:30	100	10	3247.5	6.1	90	337.5	5.83 gpm average for 90 psi
13:31	101	1	3252.5	5	80	342.5	psi down to 80
13:32	102	2	3257.8	5.3	80	347.8	
13:33	103	3	3263	5.2	80	353	
13:34	104	4	3268.5	5.5	81	358.5	
13:35	105	5	3273.8	5.3	80	363.8	
13:36	106	6	3279.4	5.6	80	369.4	
13:37	107	7	3284.5	5.1	79	374.5	
13:38	108	8	3290	5.5	79	380	
13:39	109	9	3295.1	5.1	80	385.1	
13:40	110	10	3301	5.9	79	391	5.35 gpm average for 80 psi
13:41	111	1	3305.5	4.5	70	395.5	psi down to 70
13:42	112	2	3310.9	5.4	70	400.9	
13:43	113	3	3315.7	4.8	71	405.7	
13:44	114	4	3321	5.3	70	411	
13:45	115	5	3325.7	4.7	69	415.7	
13:46	116	6	3331	5.3	69	421	
13:47	117	7	3335.7	4.7	70	425.7	
13:48	118	8	3340.9	5.2	70	430.9	
13:49	119	9	3345.7	4.8	70	435.7	
13:50	120	10	3351	5.3	70	441	5.0 gpm average for 70 psi
13:51	121	1	3355.5	4.5	60	445.5	psi down to 60
13:52	122	2	3360.2	4.7	58	450.2	
13:53	123	3	3364.9	4.7	60	454.9	
13:54	124	4	3369.7	4.8	60	459.7	
13:55	125	5	3374.4	4.7	60	464.4	
13:56	126	6	3379.2	4.8	60	469.2	
13:57	127	7	3383.9	4.7	61	473.9	
13:58	128	8	3389	5.1	60	479	
13:59	129	9	3393.5	4.5	60	483.5	
14:00	130	10	3398.2	4.7	60	488.2	4.72 gpm average for 60 psi
14:01	131	1	3402.6	4.4	51 to 52	492.6	psi to 50
14:02	132	2	3407.5	4.9	52 to 50	497.5	
14:03	133	3	missed		52 to 50		
14:04	134	4	3416	4.25	50	506	
14:05	135	5	3420.7	4.7	50	510.7	
14:06	136	6	3425	4.3	50	515	
14:07	137	7	3429.4	4.4	48 to 50	519.4	
14:08	138	8	3433.7	4.3	51	523.7	
14:09	139	9	3438.2	4.5	50	528.2	
14:10	140	10	3442.5	4.3	50	532.5	4.43 gpm average for 50 psi
14:11	141	1	3447	4.5	40	537	psi to 40
14:12	142	2	3451.1	4.1	40	541.1	
14:13	143	3	3454.8	3.7	40	544.8	
14:14	144	4	3459	4.2	40	549	
14:15	145	5	3463	4	40	553	
14:16	146	6	3467.1	4.1	40	557.1	
14:17	147	7	3471.3	4.2	41	561.3	
14:18	148	8	3475.4	4.1	39	565.4	
14:19	149	9	3479.7	4.3	38	569.7	
14:20	150	10	3484	4.3	40	574	4.15 gpm average for 40 psi
14:21	151	1	3487.4	3.4	34	577.4	psi to 30
14:22	152	2	3491.2	3.8	30	581.2	
14:23	153	3	3494.8	3.6	30	584.8	
14:24	154	4	3498.7	3.9	29	588.7	
14:25	155	5	3502.3	3.6	30	592.3	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
14:26	156	6	3506	3.7	30	596	
14:27	157	7	3509.8	3.8	29	599.8	
14:28	158	8	3513.3	3.5	31	603.3	
14:29	159	9	3517	3.7	31	607	
14:30	160	10	3521	4	32	611	3.7 gpm average for 30 psi
14:31	161	1	3524.2	3.2	20	614.2	psi to 20
14:32	162	2	3527.6	3.4	20	617.6	
14:33	163	3	3531.1	3.5	21	621.1	
14:34	164	4	3534.3	3.2	21	624.3	
14:35	165	5	3538	3.7	20	628	
14:36	166	6	3541.4	3.4	20	631.4	
14:37	167	7	3544.6	3.2	20	634.6	
14:38	168	8	3548	3.4	20	638	
14:39	169	9	3551.4	3.4	20	641.4	
14:40	170	10	3554.5	3.1	21	644.5	3.35 gpm average for 20 psi

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	
3.14	20.0	3.14	20.0	3.80	30.0	5.78	90.0	Set pressure. Wait 1 minute
3.71	30.0	3.71	30.0	3.95	40.0	5.63	80.0	average over 2 minutes. Repeat
3.98	40.0	3.98	40.0	4.61	50.0	5.50	70.0	
4.46	50.0	4.46	50.0	4.99	60.0	4.99	60.0	
4.90	60.0	4.90	60.0	5.46	70.0	4.51	50.0	
5.31	70.0	5.31	70.0	5.62	80.0	4.15	40.0	
5.49	80.0	5.49	80.0	5.80	90.0	3.80	30.0	
5.94	90.0	5.94	90.0	6.31	100.0	3.33	20.0	
6.20	100.0	6.20	100.0					

same data as "increase" series

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Date 8/13/2011
Client New Mexico Copper Corp
Project Copper Flat
Well Name GWQ 11-25 Zone 1
Hydrologist JJK

Starting Water Level (ft bgl) 29.0 (not representative of Static)
Elevation (ft GL)
Injection Interval (ft bgl) 100 to 147.7
Bore/Casing Depth (ft bgl) 147.7

Packer Dia 2 inch
Bore/Casing Dia 3-3/4 inch
Injection Pipe Dia 1 inch
Pressure gauge height above GL 3 ft

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
15:00	0		4400		10	0	
15:01	1	1	4400	0.00	10	0	
15:02	2	2	4400	0.00	10	0	
15:03	3	3	4400	0.00	10	0	
15:04	4	4	4400	0.00	10	0	
15:05	5	5	4400	0.00	10	0	
15:06	6	6	4400	0.00	10	0	
15:07	7	7	4400	0.00	10	0	
15:08	8	8	4400	0.00	10	0	
15:09	9	9	4400	0.00	10	0	
15:10	10	10	4400	0.00	10	0	
15:11	11	1	4400	0.00	20	0	
15:12	12	2	4400	0.00	20	0	
15:13	13	3	4400	0.00	20	0	
15:14	14	4	4400	0.00	20	0	
15:15	15	5	4400	0.00	20	0	
15:16	16	6	4400	0.00	20	0	
15:17	17	7	4400	0.00	20	0	
15:18	18			0.00		0	Break out meter to verify operation of same
15:19	19			0.00		0	
15:20	20			0.00		0	Operating to spec
15:21	21	1	4410	0.00	30	0	
15:22	22	2	4410	0.00	30	0	
15:23	23	3	4410	0.00	30	0	
15:24	24	4	4410	0.00	30	0	
15:25	25	5	4410	0.00	30	0	
15:26	26	1	4410	0.00	40	0	
15:27	27	2	4410	0.00	40	0	
15:28	28	3	4410	0.00	40	0	
15:29	29	4	4410	0.00	40	0	
15:30	30	5	4410	0.00	40	0	
15:31	31	1	4410	0	50	0	
15:32	32	2	4410	0	50	0	
15:33	33	3	4410	0	50	0	
15:34	34	4	4410	0	50	0	
15:35	35	5	4410	0	50	0	
15:36	36	1	4410	0	60	0	
15:37	37	2	4410	0	60	0	
15:38	38	3	4410	0	60	0	
15:39	39	4	4410	0	60	0	
15:40	40	5	4410	0	60	0	
15:41	41	1	4410	0	70	0	
15:42	42	2	4410	0	70	0	
15:43	43	3	4410	0	70	0	
15:44	44	4	4410	0	70	0	
15:45	45	5	4410	0	70	0	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
15:46	46	1	4410	0	80	0	
15:47	47	2	4410	0	80	0	
15:48	48	3	4410	0	80	0	
15:49	49	4	4410	0	80	0	
15:50	50	5	4410	0	80	0	
15:51	51	1	4410	0	90	0	
15:52	52	2	4410	0	90	0	
15:53	53	3	4410	0	90	0	
15:54	54	4	4410	0	90	0	
15:55	55	5	4410	0	90	0	
15:56	56	1	4410	0	100	0	
15:57	57	2	4410	0	100	0	
15:58	58	3	4410	0	100	0	
15:59	59	4	4410	0	100	0	
16:00	60	5	4410	0	100	0	
16:01	61	1	4410	0	110	0	
16:02	62	2	4410	0	110	0	
16:03	63	3	4410	0	110	0	
16:04	64	4	4410	0	110	0	
16:05	65	5	4410	0	110	0	
16:06	66	6	4410	0.00	110	0	
16:07	67	7	4410	0.00	110	0	
16:08	68	8	4410	0.00	110	0	
16:09	69	9	4410	0.00	110	0	
16:10	70	10	4410	0.00	110	0	
16:11	71	1	4410	0	120	0	
16:12	72	2	4410	0	120	0	
16:13	73	3	4410	0	120	0	
16:14	74	4	4410	0	120	0	
16:15	75	5	4410	0	120	0	
16:16	76	6	4410	0	120	0	
16:17	77	7	4410	0	120	0	
16:18	78	8	4410	0	120	0	
16:19	79	9	4410	0	120	0	
16:20	80	10	4410	0	120	0	
16:21	81	1	4410	0	130	0	
16:22	82	2	4410	0	130	0	
16:23	83	3	4410	0	130	0	
16:24	84	4	4410	0	130	0	
16:25	85	5	4410	0	130	0	
16:26	86	6	4410	0	130	0	
16:27	87	7	4410	0	130	0	
16:28	88	8	4410	0	130	0	
16:29	89	9	4410	0	130	0	
16:30	90	10	4410	0	130	0	
16:31	91	1	4410	0	140	0	
16:32	92	2	4410	0	140	0	
16:33	93	3	4410	0	140	0	
16:34	94	4	4410	0	140	0	
16:35	95	5	4410	0	140	0	
16:36	96	6	4410	0	140	0	
16:37	97	7	4410	0	140	0	
16:38	98	8	4410	0	140	0	
16:39	99	9	4410	0	140	0	
16:40	100	10	4410	0	140	0	Lightning on site forces suspension of test
Resume test on 8-14-2011							
6:00	101	1	4420	0	0	0	Slow repeat of previous ramp up
6:01	102	2	4420	0	40	0	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
6:02	103	3	4420	0	40	0	
6:03	104	4	4420	0	40	0	
6:04	105	5	4420	0	40	0	
6:05	106	1	4420	0	50	0	
6:06	107	2	4420	0	50	0	
6:07	108	3	4420	0	50	0	
6:08	109	4	4420	0	50	0	
6:09	110	5	4420	0	50	0	
6:10	111	1	4420	0	60	0	
6:11	112	2	4420	0	60	0	
6:12	113	3	4420	0	60	0	
6:13	114	4	4420	0	60	0	
6:14	115	5	4420	0	60	0	
6:15	116	1	4420	0	70	0	
6:16	117	2	4420	0	70	0	
6:17	118	3	4420	0	70	0	
6:18	119	4	4420	0	70	0	
6:19	120	5	4420	0	70	0	
6:20	121	1	4420	0	80	0	
6:21	122	2	4420	0	80	0	
6:22	123	3	4420	0	80	0	
6:23	124	4	4420	0	80	0	
6:24	125	5	4420	0	80	0	
6:25	126	1	4420	0	90	0	
6:26	127	2	4420	0	90	0	
6:27	128	3	4420	0	90	0	
6:28	129	4	4420	0	90	0	
6:29	130	5	4420	0	90	0	
6:30	131	1	4420	0	100	0	
6:31	132	2	4420	0	100	0	
6:32	133	3	4420	0	100	0	
6:33	134	4	4420	0	100	0	
6:34	135	5	4420	0	100	0	
6:35	136	1	4420	0	110	0	
6:36	137	2	4420	0	110	0	
6:37	138	3	4420	0	110	0	
6:38	139	4	4420	0	110	0	
6:39	140	5	4420	0	110	0	
6:40	141	1	4420	0	120	0	
6:41	142	2	4420	0	120	0	
6:42	143	3	4420	0	120	0	
6:43	144	4	4420	0	120	0	
6:44	145	5	4420	0	120	0	
6:45	146	1	4420	0	130	0	
6:46	147	2	4420	0	130	0	
6:47	148	3	4420	0	130	0	
6:48	149	4	4420	0	130	0	
6:49	150	5	4420	0	130	0	
6:50	151	1	4420	0	140	0	
6:51	152	2	4420	0	140	0	
6:52	153	3	4420	0	140	0	
6:53	154	4	4420	0	140	0	
6:54	155	5	4420	0	140	0	
6:55	156	1	4420	0	150	0	
6:56	157	2	4420	0	150	0	
6:57	158	3	4420	0	146	0	First injection
6:58	159	4	4422.9	2.9	150	2.9	All 150 psi readings are approximate.
6:59	160	5	4425.9	3	150	5.9	Gauge oscillating from 140 to 158

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
7:00	161	6	4428.7	2.8	150	8.7	
7:01	162	7	4431.5	2.8	150	11.5	
7:02	163	8	4434.5	3	150	14.5	
7:03	164	9	4437.4	2.9	150	17.4	
7:04	165	10	4440.3	2.9	150	20.3	
7:05	166	11	4443.1	2.8	150	23.1	
7:06	167	12	4444	0.9	150	24	
7:07	168	13	4447.2	3.2	150	27.2	
7:08	169	14	4450.1	2.9	150	30.1	
7:09	170	15	4452.8	2.7	150	32.8	2.73 average for 150 psi
7:10	171	0	4457.1	4.3	130	37.1	Attempt to stabilize at 140 psi. abandon
7:11	172	1	4459.3	2.2	130	39.3	All 130 psi readings are approximate.
7:12	173	2	4461.2	1.9	130	41.2	Gauge oscillating from 125 to 137
7:13	174	3	4464.1	2.9	130	44.1	
7:14	175	4	4466.3	2.2	130	46.3	
7:15	176	5	4468.1	1.8	130	48.1	
7:16	177	6	4470.9	2.8	130	50.9	
7:17	178	7	4473.2	2.3	130	53.2	
7:18	179	8	4475.2	2	130	55.2	
7:19	180	9	4477.1	1.9	130	57.1	
7:20	181	10	4478.9	1.8	130	58.9	2.18 average for 130 psi
7:21	182	1	4480.9	2	100	60.9	
7:22	183	2	4482.7	1.8	100	62.7	
7:23	184	3	4484.6	1.9	100	64.6	
7:24	185	4	4486.4	1.8	100	66.4	
7:25	186	5	4488.2	1.8	100	68.2	
7:26	187	6	4490.1	1.9	100	70.1	
7:27	188	7	4491.9	1.8	100	71.9	
7:28	189	8	4493.9	2	100	73.9	
7:29	190	9	4495.7	1.8	100	75.7	
7:30	191	10	4497.6	1.9	100	77.6	1.87 average for 100 psi
7:31	192	1	4499.5	1.9	90	79.5	
7:32	193	2	4500.7	1.2	90	80.7	
7:33	194	3	4502.7	2	90	82.7	
7:34	195	4	4504.7	2	90	84.7	
7:35	196	5	4506.5	1.8	90	86.5	
7:36	197	6	4508.2	1.7	90	88.2	
7:37	198	7	4510	1.8	90	90	
7:38	199	8	4511.6	1.6	90	91.6	
7:39	200	9	4513.5	1.9	90	93.5	
7:40	201	10	4515.2	1.7	90	95.2	1.76 average for 90 psi
7:41	202	1	4516.6	1.4	80	96.6	
7:42	203	2	4518.2	1.6	80	98.2	
7:43	204	3	4519.9	1.7	80	99.9	
7:44	205	4	4521.3	1.4	80	101.3	
7:45	206	5	4523	1.7	80	103	
7:46	207	6	4524.7	1.7	80	104.7	
7:47	208	7	4526.4	1.7	80	106.4	
7:48	209	8	4528.2	1.8	80	108.2	
7:49	210	9	4530.1	1.9	80	110.1	
7:50	211	10	4531.9	1.8	80	111.9	1.67 average for 80 psi
7:51	212	1	4533.5	1.6	70	113.5	
7:52	213	2	4535.2	1.7	70	115.2	
7:53	214	3	4536.7	1.5	70	116.7	
7:54	215	4	4538.5	1.8	70	118.5	
7:55	216	5	4540.2	1.7	70	120.2	
7:56	217	6	4541.1	0.9	70	121.1	
7:57	218	7	4542.4	1.3	70	122.4	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
7:58	219	8	4544.3	1.9	70	124.3	
7:59	220	9	4545.9	1.6	70	125.9	
8:00	221	10	4547.5	1.6	70	127.5	1.56 average for 70 psi
8:01	222	1	4548.9	1.4	60	128.9	
8:02	223	2	4550.5	1.6	60	130.5	
8:03	224	3	4552.1	1.6	60	132.1	
8:04	225	4	4553.8	1.7	60	133.8	
8:05	226	5	4555.3	1.5	60	135.3	
8:06	227	6	4556.9	1.6	60	136.9	
8:07	228	7	4558.5	1.6	60	138.5	
8:08	229	8	4560	1.5	60	140	
8:09	230	9	4561.6	1.6	60	141.6	
8:10	231	10	4563.3	1.7	60	143.3	1.58 average for 60 psi
8:11	232	1	4564.7	1.4	50	144.7	
8:12	233	2	4566	1.3	50	146	
8:13	234	3	4567.3	1.3	50	147.3	
8:14	235	4	4568.6	1.3	50	148.6	
8:15	236	5	4570	1.4	50	150	
8:16	237	6	4571.4	1.4	50	151.4	
8:17	238	7	4572.8	1.4	50	152.8	
8:18	239	8	4574.2	1.4	50	154.2	
8:19	240	9	4575.3	1.1	50	155.3	
8:20	241	10	4576.5	1.2	50	156.5	1.32 average for 50 psi
8:21	242	1	4577.6	1.1	40	157.6	
8:22	243	2	4578.9	1.3	40	158.9	
8:23	244	3	4580.2	1.3	40	160.2	
8:24	245	4	4581.5	1.3	40	161.5	
8:25	246	5	4582.8	1.3	40	162.8	
8:26	247	6	4584.1	1.3	40	164.1	
8:27	248	7	4585.4	1.3	40	165.4	
8:28	249	8	4586.5	1.1	40	166.5	
8:29	250	9	4587.6	1.1	40	167.6	
8:30	251	10	4588.9	1.3	40	168.9	1.24 average for 40 psi
8:31	252	1	4590	1.1	30	170	
8:32	253	2	4591.2	1.2	30	171.2	
8:33	254	3	4592.3	1.1	30	172.3	
8:34	255	4	4593.2	0.9	30	173.2	
8:35	256	5	4594.6	1.4	30	174.6	
8:36	257	6	4595.7	1.1	30	175.7	
8:37	258	7	4596.8	1.1	30	176.8	
8:38	259	8	4597.9	1.1	30	177.9	
8:39	260	9	4599	1.1	30	179	
8:40	261	10	4600.1	1.1	30	180.1	1.12 average for 30 psi
8:41	262	1	4601.2	1.1	20	181.2	
8:42	263	2	4602.1	0.9	20	182.1	
8:43	264	3	4603.3	1.2	20	183.3	
8:44	265	4	4604.4	1.1	20	184.4	
8:45	266	5	4605.4	1	20	185.4	
8:46	267	6	4606.3	0.9	20	186.3	
8:47	268	7	4607.4	1.1	20	187.4	
8:48	269	8	4608.4	1	20	188.4	
8:49	270	9	4609.4	1	20	189.4	
8:50	271	10	4610.5	1.1	20	190.5	1.04 average for 20 psi
8:51	272	1	4611.4	0.9	10	191.4	
8:52	273	2	4612.4	1	10	192.4	
8:53	274	3	4613.3	0.9	10	193.3	
8:54	275	4	4614.2	0.9	10	194.2	
8:55	276	5	4615.1	0.9	10	195.1	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
8:56	277	6	4616	0.9	10	196	
8:57	278	7	4617	1	10	197	
8:58	279	8	4617.9	0.9	10	197.9	
8:59	280	9	4618.7	0.8	10	198.7	
9:00	281	10	4619.6	0.9	10	199.6	0.91 average for 10 psi

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	
0.98	10	2.31	130	1.02	10	2.45	130	Set pressure. Wait 1 minute
1.12	20	2.24	100	1.18	20	2.23	100	average over 2 minutes. Repeat
1.15	30	2.05	90	1.18	30	2.1	90	
1.26	40	1.8	80	1.29	40	1.82	80	
1.55	50	1.81	70	1.56	50	1.8	70	
1.78	60	1.78	60	1.8	60	1.83	60	
1.81	70	1.56	50	1.83	70	1.54	50	
1.81	80	1.31	40	1.82	80	1.33	40	
2.02	90	1.21	30	2.01	90	1.2	30	
2.20	100	1.13	20	2.19	100	1.14	20	
2.21	130	1	10	2.23	130	1.02	10	
2.98	150			3.12	150			
0.00	1	4	6084.5	0	60	1664.5		
0.00	2	5	6084.5	0	60	1664.5		
0.69	303	1	6084.5	0	50	1664.5		
0.69	304	2	6084.5	0	50	1664.5		
0.69	305	3	6084.5	0	50	1664.5		
0.69	306	4	6084.5	0	50	1664.5		
0.69	307	5	6084.5	0	50	1664.5		
0.69	308	1	6084.5	0	40	1664.5		
0.69	309	2	6084.5	0	40	1664.5		
0.69	310	3	6084.5	0	40	1664.5		
0.69	311	4	6084.5	0	40	1664.5		
0.69	312	5	6084.5	0	40	1664.5		
0.69	313	1	6084.5	0	30	1664.5		
0.69	314	2	6084.5	0	30	1664.5		
0.69	315	3	6084.5	0	30	1664.5		
0.70	316	4	6084.5	0	30	1664.5		
0.70	317	5	6084.5	0	30	1664.5		
0.70	318	6	6084.5	0	20	1664.5		
0.70	319	7	6084.5	0	20	1664.5		
0.70	320	8	6084.5	0	20	1664.5		
0.70	321	9	6084.5	0	20	1664.5		
0.70	322	10	6084.5	0	20	1664.5		

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	
								No duplicat test performed

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Date	**8/16/2011**
Client	**New Mexico Copper Corp**
Project	**Copper Flat**
Well Name	**GWQ 11-25 Zone 2**
Hydrologist	**JJK**

Starting Water Level (ft bgl)	**60.2**
Elevation (ft GL)	
Injection Interval (ft bgl)	**150 to 197.7**
Bore/Casing Depth (ft bgl)	**197.7**

Packer Dia	**2 inch**
Bore/Casing Dia	**3-3/4 inch**
Injection Pipe Dia	**1 inch**
Pressure gauge height above GL	**3 ft**

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
7:25	0		4700		10	0	
7:26	1	1	4704.5	4.50	12	4.5	
7:27	2	2	4707	2.50	10	7	
7:28	3	3	4709	2.00	10	9	
7:29	4	4	4711	2.00	12	11	
7:30	5	5	4712.9	1.90	10	12.9	
7:31	6	6	4714.9	2.00	10	14.9	
7:32	7	7	4717	2.10	11	17	
7:33	8	8	4718.8	1.80	10	18.8	
7:34	9	9	4720.7	1.90	10	20.7	
7:35	10	10	4722.6	1.90	10	22.6	2.26 gpm average for 10 psi
7:36	11	1	4724.8	2.2	20	24.8	
7:37	12	2	4727.1	2.3	20	27.1	
7:38	13	3	4729.2	2.1	21	29.2	
7:39	14	4	4731.4	2.2	20	31.4	
7:40	15	5	4733.6	2.2	19	33.6	
7:41	16	6	4735.8	2.2	20	35.8	
7:42	17	7	4738	2.2	20	38	
7:43	18	8	4740.2	2.2	21	40.2	
7:44	19	9	4742.4	2.2	20	42.4	
7:45	20	10	4744.6	2.2	20	44.6	2.20 gpm average for 20 psi
7:46	21	1	4747.1	2.5	30	47.1	
7:47	22	2	4749.6	2.5	31	49.6	
7:48	23	3	4752.3	2.7	31	52.3	
7:49	24	4	4754.8	2.5	32	54.8	
7:50	25	5	4757.2	2.4	31	57.2	
7:51	26	6	4759.7	2.5	30	59.7	
7:52	27	7	4762.3	2.6	30	62.3	
7:53	28	8	4764.7	2.4	31	64.7	
7:54	29	9	4767.2	2.5	30	67.2	
7:55	30	10	4769.6	2.4	30	69.6	2.50 gpm average for 30 psi
7:56	31	1	4772.4	2.8	38	72.4	
7:57	32	2	4775.3	2.9	40	75.3	
7:58	33	3	4778.2	2.9	41	78.2	
7:59	34	4	4781	2.8	40	81	
8:00	35	5	4783.8	2.8	40	83.8	
8:01	36	6	4786.4	2.6	40	86.4	
8:02	37	7	4789.1	2.7	40	89.1	
8:03	38	8	4791.9	2.8	41	91.9	
8:04	39	9	4794.2	2.3	40	94.2	
8:05	40	10	4797.3	3.1	41	97.3	2.77 gpm average for 40 psi
8:06	41	1	4800.5	3.2	50	100.5	Oscilating = or - 3 to 4 psi
8:07	42	2	4803.6	3.1	50	103.6	
8:08	43	3	4806.6	3	50	106.6	
8:09	44	4	4809.7	3.1	50	109.7	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
8:10	45	5	4812.8	3.1	50	112.8	
8:11	46	6	4815.8	3	50	115.8	
8:12	47	7	4818.9	3.1	50	118.9	
8:13	48	8	4822	3.1	50	122	
8:14	49	9	4825	3	50	125	
8:15	50	10	4828.1	3.1	50	128.1	3.08 gpm average for 50 psi
8:16	51	1	4831.6	3.5	60	131.6	Oscilating = or - 3 to 4 psi
8:17	52	2	4834.9	3.3	60	134.9	
8:18	53	3	4838	3.1	60	138	
8:19	54	4	4841.8	3.8	60	141.8	
8:20	55	5	4844.9	3.1	60	144.9	
8:21	56	6	4848.3	3.4	60	148.3	
8:22	57	7	4851.9	3.6	60	151.9	
8:23	58	8	4855.5	3.6	60	155.5	
8:24	59	9	4859.1	3.6	60	159.1	
8:25	60	10	4862.8	3.7	60	162.8	3.47 gpm average for 60 psi
8:26	61	1	4866.4	3.6	70	166.4	Oscilating = or - 3 to 4 psi
8:27	62	2	4870.2	3.8	70	170.2	
8:28	63	3	4874	3.8	70	174	
8:29	64	4	4877.5	3.5	70	177.5	
8:30	65	5	4881	3.5	70	181	
8:31	66	6	4884.6	3.6	70	184.6	
8:32	67	7	4888.1	3.5	70	188.1	
8:33	68	8	4891.7	3.6	70	191.7	
8:34	69	9	4895.5	3.8	70	195.5	
8:35	70	10	4898.9	3.4	70	198.9	3.61 gpm average for 70 psi
8:36	71	1	4903	4.1	80	203	Oscilating = or - 3 to 4 psi
8:37	72	2	4906.8	3.8	80	206.8	
8:38	73	3	4910.4	3.6	80	210.4	
8:39	74	4	4914.2	3.8	81	214.2	
8:40	75	5	4918	3.8	80	218	
8:41	76	6	4921.9	3.9	80	221.9	
8:42	77	7	4925.6	3.7	80	225.6	
8:43	78	8	4929.3	3.7	80	229.3	
8:44	79	9	4933.1	3.8	80	233.1	
8:45	80	10	4937	3.9	80	237	3.81 gpm average for 80 psi
8:46	81	1	4941.1	4.1	90	241.1	Oscilating = or - 5 psi
8:47	82	2	4945.4	4.3	90	245.4	
8:48	83	3	4949.6	4.2	90	249.6	
8:49	84	4	4954	4.4	91	254	
8:50	85	5	4958.1	4.1	90	258.1	
8:51	86	6	4962.3	4.2	90	262.3	
8:52	87	7	4966.6	4.3	90	266.6	
8:53	88	8	4971.2	4.6	90	271.2	
8:54	89	9	4975.3	4.1	90	275.3	
8:55	90	10	4979.7	4.4	90	279.7	4.27 gpm average for 90 psi
8:56	91	1	4984.8	5.1	100	284.8	Oscilating = or - 6 psi
8:57	92	2	4989.9	5.1	100	289.9	
8:58	93	3	4995	5.1	100	295	
8:59	94	4	5000	5	100	300	
9:00	95	5	5005.1	5.1	100	305.1	
9:01	96	6	5010	4.9	100	310	
9:02	97	7	5015.1	5.1	100	315.1	
9:03	98	8	5020	4.9	100	320	
9:04	99	9	5025	5	100	325	
9:05	100	10	5029.9	4.9	100	329.9	5.02 gpm average for 100 psi
9:06	101	1	5034	4.1	90	334	Oscilating = or - 5 psi

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
9:07	102	2	5038	4	90	338	
9:08	103	3	5042.1	4.1	90	342.1	
9:09	104	4	5046.5	4.4	90	346.5	
9:10	105	5	5050.7	4.2	90	350.7	
9:11	106	6	5055	4.3	90	355	
9:12	107	7	5059.2	4.2	90	359.2	
9:13	108	8	5063.4	4.2	90	363.4	
9:14	109	9	5067.7	4.3	90	367.7	
9:15	110	10	5072.4	4.7	90	372.4	4.25 gpm average for 90 psi
9:16	111	1	5076.2	3.8	80	376.2	Oscilating = or - 5 psi
9:17	112	2	5079.9	3.7	80	379.9	
9:18	113	3	5083.5	3.6	80	383.5	
9:19	114	4	5087.1	3.6	80	387.1	
9:20	115	5	5090.5	3.4	80	390.5	
9:21	116	6	5094.3	3.8	80	394.3	
9:22	117	7	5098	3.7	80	398	
9:23	118	8	5101.8	3.8	80	401.8	
9:24	119	9	5105.6	3.8	80	405.6	
9:25	120	10	5109.6	4	80	409.6	3.72 gpm average for 80 psi
9:26	121	1	5113	3.4	70	413	Oscilating = or - 3 to 4 psi
9:27	122	2	5116.2	3.2	70	416.2	
9:28	123	3	5119.8	3.6	70	419.8	
9:29	124	4	5123	3.2	70	423	
9:30	125	5	5126.5	3.5	70	426.5	
9:31	126	6	5130.2	3.7	70	430.2	
9:32	127	7	5133.7	3.5	70	433.7	
9:33	128	8	5137.2	3.5	70	437.2	
9:34	129	9	5140.4	3.2	70	440.4	
9:35	130	10	5143.9	3.5	70	443.9	3.43 gpm average for 70 psi
9:36	131	1	5147	3.1	60	447	Oscilating = or - 3 to 4 psi
9:37	132	2	5150.1	3.1	60	450.1	
9:38	133	3	5153.5	3.4	60	453.5	
9:39	134	4	5156.5	3	60	456.5	
9:40	135	5	5159.7	3.2	60	459.7	
9:41	136	6	5163	3.3	60	463	
9:42	137	7	5166.2	3.2	60	466.2	
9:43	138	8	5169.4	3.2	60	469.4	
9:44	139	9	5172.7	3.3	60	472.7	
9:45	140	10	5175.9	3.2	60	475.9	3.20 gpm average for 60 psi
9:46	141	1	5178.7	2.8	50	478.7	Oscilating = or - 3 to 4 psi
9:47	142	2	5181.6	2.9	50	481.6	
9:48	143	3	5184.7	3.1	50	484.7	
9:49	144	4	5187.5	2.8	50	487.5	
9:50	145	5	5190.3	2.8	50	490.3	
9:51	146	6	5193.3	3	50	493.3	
9:52	147	7	5196.1	2.8	50	496.1	
9:53	148	8	5199	2.9	50	499	
9:54	149	9	5202.1	3.1	50	502.1	
9:55	150	10	5205.1	3	50	505.1	2.92 gpm average for 50 psi
9:56	151	1	5207.8	2.7	40	507.8	
9:57	152	2	5210.1	2.3	40	510.1	
9:58	153	3	5212.8	2.7	40	512.8	
9:59	154	4	5215.6	2.8	40	515.6	
10:00	155	5	5218.1	2.5	40	518.1	
10:01	156	6	5221	2.9	40	521	
10:02	157	7	5223.8	2.8	40	523.8	
10:03	158	8	5226.4	2.6	40	526.4	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
10:04	159	9	5229	2.6	40	529	
10:05	160	10	5231.9	2.9	40	531.9	2.68 gpm average for 40 psi
10:06	161	1	5234.2	2.3	30	534.2	
10:07	162	2	5236.5	2.3	30	536.5	
10:08	163	3	5238.9	2.4	30	538.9	
10:09	164	4	5241.4	2.5	30	541.4	
10:10	165	5	5244	2.6	30	544	
10:11	166	6	5246.3	2.3	30	546.3	
10:12	167	7	5248.7	2.4	30	548.7	
10:13	168	8	5251.2	2.5	30	551.2	
10:14	169	9	5253.7	2.5	30	553.7	
10:15	170	10	5256.3	2.6	30	556.3	2.44 gpm average for 30 psi
10:16	171	1	5258.2	1.9	20	558.2	
10:17	172	2	5260.2	2	20	560.2	
10:18	173	3	5262.6	2.4	20	562.6	
10:19	174	4	5264.8	2.2	20	564.8	
10:20	175	5	5267	2.2	20	567	
10:21	176	6	5269.1	2.1	20	569.1	
10:22	177	7	5271.3	2.2	20	571.3	
10:23	178	8	5273.6	2.3	20	573.6	
10:24	179	9	5275.9	2.3	20	575.9	
10:25	180	10	5278	2.1	20	578	2.17 gpm average for 20 psi
10:26	181	1	5279.7	1.7	10	579.7	
10:27	182	2	5281.6	1.9	10	581.6	
10:28	183	3	5283.5	1.9	10	583.5	
10:29	184	4	5285.4	1.9	10	585.4	
10:30	185	5	5287.2	1.8	10	587.2	
10:31	186	6	5289.1	1.9	10	589.1	
10:32	187	7	5291	1.9	10	591	
10:33	188	8	5293	2	10	593	
10:34	189	9	5295	2	10	595	
10:35	190	10	5296.9	1.9	10	596.9	1.89 gpm average for 10 psi

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	
NA	10.0	(*)	90.0	2.70	20.0	(*)	90.0	Set pressure. Wait 1 minute
2.38	20.0	5.09	80.0	3.69	30.0	(*)	80.0	average over 2 minutes. Repeat
2.49	30.0	4.68	70.0	4.10	40.0	5.10	70.0	
3.00	40.0	4.80	60.0	4.72	50.0	4.70	60.0	
3.18	50.0	4.38	50.0	5.18	60.0	4.60	50.0	
3.62	60.0	3.70	40.0	5.20	70.0	4.00	40.0	
3.70	70.0	3.29	30.0	6.16	80.0	2.60	30.0	
4.31	80.0	2.80	20.0	(*)	90.0	2.51	20.0	
4.70	90.0	2.40	10.0	(*)	100.0	1.92	10.0	
(*)	100.0							
(*) unable to maintain pressure								

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Date	8/24/2011
Client	New Mexico Copper Corp
Project	Copper Flat
Well Name	GWQ 11-25, Zone 3
Hydrologist	JJK

Starting Water Level (ft bgl)	60.00
Elevation (ft GL)	
Injection Interval (ft bgl)	207 to 251
Bore/Casing Depth (ft bgl)	251

Packer Dia	2 inch
Bore/Casing Dia	3-3/4 inch
Injection Pipe Dia	1 inch
Pressure gauge height above GL	4 ft

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
8:10	0		5463		11	0	
8:11	1	1	5465	2.00	10	2	
8:12	2	2	5465.7	0.70	11	2.7	
8:13	3	3	5468.3	2.60	11	5.3	
8:14	4	4	5470	1.70	10	7	
8:15	5	5	5471.4	1.40	10	8.4	
8:16	6	6	5472.8	1.40	10	9.8	
8:17	7	7	5474.4	1.60	10	11.4	
8:18	8	8	5475.9	1.50	10	12.9	
8:19	9	9	5477.4	1.50	10	14.4	
8:20	10	10	5479	1.60	10	16	1.6 gpm average for 10 psi
8:21	11	1	5480.5	1.5	20	17.5	
8:22	12	2	5482.2	1.7	20	19.2	
8:23	13	3	5483.5	1.3	20	20.5	
8:24	14	4	5485.2	1.7	20	22.2	
8:25	15	5	5486.7	1.5	21	23.7	
8:26	16	6	5488.4	1.7	20	25.4	
8:27	17	7	5490	1.6	20	27	
8:28	18	8	5491.6	0	20	28.6	
8:29	19	9	5493.1	1.5	20	30.1	
8:30	20	10	5494.8	1.7	21	31.8	1.58 gpm average for 20 psi
8:31	21	1	5496.5	1.7	30	33.5	
8:32	22	2	5498.1	1.6	29	35.1	
8:33	23	3	5499.9	1.8	30	36.9	
8:34	24	4	5501.5	1.6	30	38.5	
8:35	25	5	5503.1	1.6	30	40.1	
8:36	26	6	5505	1.9	30	42	
8:37	27	7	5506.6	1.6	30	43.6	
8:38	28	8	5508.6	2	30	45.6	
8:39	29	9	5510.4	1.8	29	47.4	
8:40	30	10	5512.4	2	29	49.4	1.76 gpm average for 30 psi
8:41	31	1	5514.3	1.9	40	51.3	
8:42	32	2	5516.2	1.9	40	53.2	
8:43	33	3	5518.3	2.1	40	55.3	
8:44	34	4	5520.4	2.1	40	57.4	
8:45	35	5	5522.3	1.9	40	59.3	
8:46	36	6	5524.3	2	40	61.3	
8:47	37	7	5526.3	2	40	63.3	
8:48	38	8	5528.2	1.9	39	65.2	
8:49	39	9	5530.2	2	39	67.2	
8:50	40	10	5532.2	2	39	69.2	1.98 gpm average for 40 psi
8:51	41	1	5534.4	2.2	50	71.4	All 50 psi readings are approximate
8:52	42	2	5536.6	2.2	50	73.6	pressure gauge is oscillating + - 3 to 4 psi
8:53	43	3	5539.1	2.5	50	76.1	
8:54	44	4	5541.6	2.5	50	78.6	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
8:55	45	5	5544.1	2.5	50	81.1	
8:56	46	6	5546.6	2.5	50	83.6	
8:57	47	7	5549.2	2.6	50	86.2	
8:58	48	8	5551.7	2.5	50	88.7	
8:59	49	9	5554.3	2.6	50	91.3	
9:00	50	10	5557	2.7	50	94	2.48 gpm average for 50 psi
9:01	51	1	0	-5557	60	-5463	All 60 psi readings are approximate
9:02	52	2	5565.1	5565.1	60	102.1	pressure gauge is oscillating + - 3 to 4 psi
9:03	53	3	5569.7	4.6	60	106.7	
9:04	54	4	5573.9	4.2	60	110.9	
9:05	55	5	5578.5	4.6	60	115.5	
9:06	56	6	5583.4	4.9	60	120.4	
9:07	57	7	5587.4	4	58	124.4	
9:08	58	8	5592.2	4.8	58	129.2	
9:09	59	9	5597.4	5.2	60	134.4	
9:10	60	10	5602.7	5.3	60	139.7	4.57 gpm average for 60 psi
9:11	61	1	5609	6.3	65	146	Valve fully open. Water moving past packer
9:12	62	2	5616.1	7.1	65	153.1	
9:13	63	3	5623.1	7	65	160.1	
9:14	64	4	5630.3	7.2	65	167.3	
9:15	65	5	5637.6	7.3	65	174.6	
9:16	66	6	5645.1	7.5	63	182.1	Water at surface
9:17	67	7	5652.3	7.2	62	189.3	
9:18	68	8	5659.8	7.5	62	196.8	
9:19	69	9	5666.9	7.1	60	203.9	
9:20	70	10	5674	7.1	60	211	7.13 gpm average for 65 psi
9:21	71	1	5681.4	7.4	60	218.4	
9:22	72	2	5688.6	7.2	60	225.6	
9:23	73	3	5696	7.4	59	233	
9:24	74	4	5703.2	7.2	59	240.2	
9:25	75	5	5710.6	7.4	58	247.6	
9:26	76	6	5717.8	7.2	58	254.8	
9:27	77	7	5725	7.2	58	262	
9:28	78	8	5732.3	7.3	58	269.3	
9:29	79	9	5739.5	7.2	59	276.5	
9:30	80	10	5746.9	7.4	59	283.9	7.29 gpm average for 60 psi
9:31	81	1	5752.3	5.4	50	289.3	Water now moving down casing
9:32	82	2	5757	4.7	50	294	
9:33	83	3	5761.3	4.3	50	298.3	
9:34	84	4	5766	4.7	50	303	
9:35	85	5	5770.5	4.5	50	307.5	
9:36	86	6	5775	4.5	50	312	
9:37	87	7	5779.7	4.7	50	316.7	
9:38	88	8	5784.3	4.6	50	321.3	
9:39	89	9	5788.8	4.5	50	325.8	
9:40	90	10	5793.5	4.7	50	330.5	4.66 average for 50 psi
9:41	91	1	5796.5	3	40	333.5	
9:42	92	2	5798	1.5	40	335	
9:43	93	3	5799.9	1.9	40	336.9	
9:44	94	4	5801.2	1.3	39	338.2	
9:45	95	5	5802.8	1.6	40	339.8	
9:46	96	6	5804.4	1.6	39	341.4	
9:47	97	7	5806	1.6	40	343	
9:48	98	8	5807.5	1.5	40	344.5	
9:49	99	9	5809.2	1.7	40	346.2	
9:50	100	10	5810.5	1.3	39	347.5	1.7 average for 40 psi
9:51	101	1	5812.1	1.6	30	0	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
9:52	102	2	5813.4	1.3	30	1.3	
9:53	103	3	5814.8	1.4	30	2.7	
9:54	104	4	5816.3	1.5	30	4.2	
9:55	105	5	5817.6	1.3	30	5.5	
9:56	106	6	5818.9	1.3	30	6.8	
9:57	107	7	5820.3	1.4	30	8.2	
9:58	108	8	5821.8	1.5	30	9.7	
9:59	109	9	5823	1.2	30	10.9	
10:00	110	10	5824.4	1.4	30	12.3	1.39 average for 30 psi
10:01	111	1	5825.7	1.3	20	13.6	
10:02	112	2	5827	1.3	20	14.9	
10:03	113	3	5828.3	1.3	20	16.2	
10:04	114	4	5829.5	1.2	20	17.4	
10:05	115	5	5830.8	1.3	20	18.7	
10:06	116	6	5832.1	1.3	20	20	
10:07	117	7	5833.3	1.2	20	21.2	
10:08	118	8	5834.6	1.3	20	22.5	
10:09	119	9	5835.9	1.3	20	23.8	
10:10	120	10	5837.1	1.2	20	25	1.27 average for 20 psi
10:11	121	1	5838.2	1.1	10	26.1	
10:12	122	2	5839.3	1.1	10	27.2	
10:13	123	3	5840.3	1	10	28.2	
10:14	124	4	5841.8	1.5	10	29.7	
10:15	125	5	5842.7	0.9	10	30.6	
10:16	126	6	5843.8	1.1	10	31.7	
10:17	127	7	5845	1.2	10	32.9	
10:18	128	8	5846.1	1.1	10	34	
10:19	129	9	5847.2	1.1	10	35.1	
10:20	130	10	5848.3	1.1	10	36.2	1.12 average for 10 psi

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	
NA	10.0	NA	65.0	1.21	10.0	NA	65.0	Set pressure. Wait 1 minute
1.20	20.0	2.62	60.0	1.39	20.0	2.39	60.0	average over 2 minutes. Repeat
1.45	30.0	1.89	50.0	1.55	30.0	1.98	50.0	
1.61	40.0	1.70	40.0	1.62	40.0	1.80	40.0	
1.90	50.0	1.14	30.0	2.10	50.0	1.57	30.0	
2.40	60.0	1.29	20.0	2.22	60.0	1.41	20.0	
3.90	66.0	1.20	10.0	3.84	66.0	1.33	10.0	

Appendix D.

MODFLOW Code Documentation

DOCUMENTATION FOR MODFLOW CODE VERSION

The following report first presents general details and documentation for the MODFLOW version titled maj10_12mar10. Documentation for LAK2 is presented as an Appendix.

DOCUMENTATION FOR MODFLOW CODE VERSION

page

DOCUMENTATION FOR MODFLOW CODE VERSION

INTRODUCTION

This report documents a version of the US Geological Survey modular ground-water flow model, or MODFLOW (McDonald and Harbaugh, 1988). Major non-standard features include:

- Modifications to module BCF2 and other modules involving the treatment of perched aquifers, dry cells and cell rewetting. These modifications preserve continuity of the governing equations of flow and also preserve mass balance accounting.
- Module RIV2 (adapted from Miller, 1988). The original program has been revised to improve the surface water mass balance accounting, to improve I/O options and to accommodate the sub-module DIV1.
- RIV2 sub-module DIV1. This module simulates the diversion of surface water and the optional re-injection of diverted water into the groundwater system.
- Module LAK2. This module is used to simulate lakes, well bores and other open water bodies connected to groundwater systems.
- Module OUT1 manages output control.
- Module ZON1 computes and outputs zone-by-zone budgets

Minor features include:

- Additional options for the formatting of input arrays (from Zheng, 1989, Appendix B)
- The Drain Package, DRN1, has been modified to also perform the functions of the WEL module, in addition to the DRN function. In addition, a second copy of the DRN module has been implemented in the code. These modifications are useful in simulating complex, multi-component and highly variable pumping regimes.
- The Well Package, WEL1, has been modified to optionally transfer pumping to the next layer down when a pumping cell goes dry.
- The Output Control (OC1) sub-module of the Basic Package, BAS has been modified to include the output of hydrographs and to allow the output of volumetric budget terms to a separate file
- Addition of a repeating seasonal input option to the Evapotranspiration (EVT1) and Recharge (RCH1) modules.

GENERAL DOCUMENTATION

Modules

MODFLOW packages are invoked using the IUNIT array (McDonald and Harbaugh, 1988, ch. 4). This particular version contains the following selection of modules:

IUNIT#	PACKAGE	TYPE	
1	BCF2	G	Block-Centered Flow Package BCF2 (McDonald et al., 1991) modified
2	WEL	B	Well Package modified
3	DRN	B	Drain Package modified
4	RIV	B	River Package
5	EVT	B	Evapotranspiration Package, modified
6	RIV2	S	River Package 2 (adapted from Miller, 1988)
7	GHB	B	General Head Boundary Package
8	RCH	B	Recharge Package, modified
9	SIP	M	Strongly Implicit Procedure solver Package
10	PCG	M	Preconditioned Conjugate Gradient solver Package (Hill, 1990)
11	SOR1	M	Slice-successive OverRelaxation solver Package
12	OC	O	Output Control Option, modified
13	LAK2	S	Lake Package
14	DRN	B	Drain Package modified (second entry)
15	NCF1	G	Node-Centered Flow Package (Jones, 1997)
16	SOL1	M	ITPACK2C matrix solvers (Kincaid et al., 1992)
17	CHD1	B	Time-variant Constant HeaD Package (Leake and Prudic, 1988, Appendix C)
18	OUT1	O	Output Control Package
19	HFB	G	Horizontal Flow Barrier Package (Hsieh and Freckleton, 1992)
20	ZON1	O	Zone Budget Package
21	(unused)		
2	LKMT	O	Package creates interface files to MT3D, modified
23	LKMP1	O	Package creates interface files to MODPATH
24	(unused)		

Types
G: Groundwater flow domain / Aquifer properties
B: Boundary conditions to Groundwater domain
S: Surface water flow / Boundary conditions to Groundwater domain
O: Output control
M: Matrix inversion/ solution

Name file

MODFLOW has been modified to run from a single input file (the Name file) containing a list of input and output file names and unit numbers. The file is equivalent to the ".NAM" file of MODFLOW96 and later, though with different format. In addition to providing instructions to the program, the Name file serves to define the simulation and is a useful file for record keeping. File names needed include

the BAS input file (unit 1),
the main output file (unit 2),
all input file units specified in the IUNIT array,
all output units specified in individual input files (including modules OC1, OUT1, ZON1, LAK2, etc.)

When MODFLOW.EXE is run, the program first reads the console for the name of the Name file. The Name file consists of one line for each file to be used during the simulation, in the following format:

Input Records

RECORD1 : read once for each file to be opened during simulation.

variable:	**KUNIT**	**FNAME**	**UNFC**
format:	I5	A20	A1

Explanation of Variables

KUNIT : Unit number of file to be opened.
FNAME : Name of file to be opened.
UNFC : Format flag.
If UNFC = 'U' or 'u', the file is opened as unformatted.
Otherwise the file is opened as formatted.

Array Readers

Input instructions throughout MODFLOW refer to the input formats U2DREL , U1DREL , and U2DINT. These "formats" are utility package array reading subroutines. Options for the format of input arrays have been added to the original MODFLOW routines, following Zheng (1989). One option not in Zheng (1989) has also been added.

Options for the format of input arrays are characterized here by the value of an input variable, LOCAT (see below). The options available with 1988 MODFLOW are

LOCAT<0
LOCAT>0

The options added by (Zheng, 1989) are

LOCAT = 100
LOCAT = 101
LOCAT = 102
LOCAT = 103

one more option has been added:

LOCAT<-100

The file opening aspects of the (Zheng, 1989) subroutines have not been utilized.

Input Records

When called to read a data array from an input file, the array readers first read an array control record. The data array may then be read in various formats from the same file or from a different file, depending on specifications in the array control record

For the real array readers (U2DREL, U1DREL)
Array control record

variable:	**LOCAT**	**CNSTNT**	**FMTIN**	**IPRN**
format:	I10	F10.0	5A4	I10

For the integer array readers (U2DINT)
Array control record

variable:	**LOCAT**	**ICONST**	**FMTIN**	**IPRN**
format:	I10	F10.0	5A4	I10

The data array may or may not follow the input control record, depending on the value of LOCAT.

Explanation of Variables

LOCAT : Data location and format style.

if LOCAT<-100, the array is read from unit (-LOCAT-100) using format FMTIN. The array input unit is then rewound, so that the same array may be used later.

if -100<LOCAT<0, the array is read unformatted from unit -LOCAT.

if LOCAT=0, the array is set to the constant CNSTNT/ICONST.

if LOCAT>0, but LOCAT does not take the values 100, 101, 102 or 103, the array is read from unit LOCAT using format FMTIN.

if LOCAT=100, the array is read from the current unit (the file from which the array control record was read) using format FMTIN.

if LOCAT=101, the array is read from the current unit using a block format (Zheng, 1989).

if LOCAT=102, the array is read from the current unit using a zone format (Zheng, 1989).

if LOCAT=103, the array is read from the current unit using a list-directed or free format (Zheng, 1989).

CNSTNT/ICONST : constant.

if LOCAT=0, each element of the array is set to CNSTNT/ICONST.

if LOCAT≠0, each element of the array is multiplied by CNSTNT/ICONST.

FMTIN : Input format, enclosed in parenthesis.

IPRN : Printout flag and format.

If IPRN<0, the array is not printed.

Otherwise, the array is printed in the main output file, using a format determined by the value of IPRN:

IPRN	U1/2DREL	U2DINT
0	10G11.4	10I11
1	11G10.3	60I1
2	9G13.6	40I2
3	15F7.1	30I3
4	15F7.2	25I4
5	15F7.3	20I5
6	15F7.4	
7	20F5.0	
8	20F5.1	
9	20F5.2	
10	20F5.3	
11	20F5.4	
12	10G11.4	

OUTPUT CONTROL MODULES

The modifications and new modules described below perform output control functions and are not directly related to the numerical computations of water levels and flows. They are, however valuable for viewing, evaluating and presenting model results.

Modifications to module BAS1/OC1

The Basic Package has been modified from its original version (McDonald and Harbaugh, 1988). The Output Control Option has been modified to output hydrographs and to output volumetric budget information to a separate file. The modified option is referred to here as OC2. OC2 will not correctly read unmodified OC1 input files. OC2 capabilities are identical to those of OC1, with the following exceptions:

(1) OC2 allows the specification of a number of cells/nodes as observed head locations: For each time step the user may specify a list of cells/nodes whose hydraulic head will be printed to the file number JHEDUN.

(2) OC2 allows output of the volumetric budget to file number IBUD, as well as to the main output file.

To work correctly with the modified model, input files created for OC1 must be modified. To convert an older file, insert input record 1, with a value of zero, at the beginning of the file:

sample OC1 input file

```
4    4    81   82
0    1    1    0
0    0    1    0
```

modified input file

```
0
4    4    81   82
0    1    1    0
0    0    1    0
```

Input Records

Record 1 is read by module OC1AL and *is read once for a simulation*.

record 1: Maximum number of individual head values (observed heads) to be printed to unit JHEDUN in any one time step.

variable: MXHEADS

format: I10

Record 2 is read by module BAS1RP and *is read once for a simulation*.

record 2: Print formats for head and drawdown, unit numbers for head, drawdown, observed heads and volumetric budget.

variable:	IHEDFM	IDDNFM	IHEDUN	IDDNUN	JHEDUN	IBUD
format:	I10	I10	I10	I10	I10	I10

Records 3, 4 and 5 are read by module BAS1OC and *are read once for each time step*.

record 3: Flag for layer-by-layer head and drawdown output requests, flags for head/drawdown, volumetric budget and cell-by-cell or node-by-node flow components, number of observed heads for this time step.

variable:	INCODE	IHDDFL	IBUDFL	ICBCFL	NHEADS
format:	I10	I10	I10	I10	I10

record 4: Layer, row and column of observed heads. Read NHEADS times when NHEADS is greater than zero.

variable:	LAYER	ROW	COLUMN
format:	I10	I10	I10

record 5: Layer-by-layer output specifications for head and drawdown. Read zero, one or NLAY times, depending on the value of INCODE.

variable:	HDPR	DDPR	HDSV	DDSV
format:	I10	I10	I10	I10

Explanation of Variables

Record 1

MXHEADS : Maximum number of individual head values, or observed heads, to be written to unit JHEDUN in any one time step.

Record 2

IHEDFM : Format code for printing heads.
IDDNFM : Format code for printing drawdowns.

Format codes have the same meaning for head and drawdown. A positive entry indicates wrap format, a negative entry strip format. The absolute value of IDDNFM specifies the printout format as follows:

0 - 10G11.4
1 - 11G10.3
2 - 9G13.6
3 - 15F7.1
4 - 15F7.2
5 - 15F7.3
6 - 15F7.4
7 - 20F5.0
8 - 20F5.1
9 - 20F5.2
10 - 20F5.3
11 - 20F5.4
12 - 10G11.4

IHEDUN : Unit number to which heads are written, if they are saved.
IDDNUN : Unit number to which drawdowns are written, if they are saved.
JHEDUN : Unit number to which observed head values are to be written.
IBUD : Unit number to which volumetric budget is to be written when flag IBUDFL is set. A value of zero indicates the budget is written to the main output file.

Record 3

INCODE : Head/drawdown output code. Determines the number of times record 5 is read. If INCODE is:

< 0 : layer-by-layer specifications from last time step are used. Record 5 is not read.
= 0 : all layers are treated the same way. Record 5 is read once.
> 0 : Input record 5 is read for each layer.

IHDDFL : Head/drawdown output flag. If IHDDFL is nonzero, heads and drawdowns will be printed or saved according to the flags for each layer specified in input record 5.
IBUDFL : Budget print flag. If IBUDFL is nonzero, overall volumetric budget is printed. Exception: The budget is always printed at the end of a stress period.
ICBCFL : node-by-node flow-term flag. If ICBCFL is nonzero, node-by-node flow terms are printed or saved according to flags set in the individual packages.
NHEADS : Number of individual head values to be written to unit JHEDUN for current time step. If NHEADS<0, the list of individual heads from the previous time step is reused.

Record 4

LAYER, ROW, COLUMN : Layer, row, and column of individual head to be written to unit JHEDUN. (Read NHEADS times, when NHEADS>0).

Record 5

HDPR : Flag for head printing. Head is printed if HDPR is nonzero.
DDPR : Flag for drawdown printing. Drawdown is printed if DDPR is nonzero.
HDSV : Flag for head saving to disk. Head is saved if HDSV is nonzero.
DDSV : Flag for drawdown saving to disk. Drawdown is saved if DDSV is nonzero.

Changes to BAS1 Code

Changes to the BAS1 code are listed below by BAS1 module subroutine.

OC1AL

OC1AL is a new subroutine added to allocate array space for hydrograph output using the Output Control package.

BAS1RP

Subroutine BAS1RP has been modified to reserve values of IBOUND and to accommodate hydrograph and budget output. The parameters JHEDUN and IBUD, unit numbers for hydrograph and budget output, have been added. Special IBOUND values (currently 30000 and 99) are reserved in bold text following comment **C5a**. The call statement to subroutine SBAS1I is indicated in bold text following comment **C8**.

BAS1ST

BAS1ST has been modified to include the stress period length (variable PERLEN) as a subroutine argument. This makes this variable available for use by other subroutines.

SBAS1I

Subroutine SBAS1I has been modified to read unit numbers for hydrograph output (JHEDUN) and budget output (IBUD). The parameters JHEDUN and IBUD have been added. The unit numbers are read in the bold text following comment **C2**.

BAS1OC

Subroutine BAS1OC has been modified to read output hydrograph data. The parameters MXHEDS and NHEADS and the array XHEDMT have been added. Hydrograph cell locations are read from the output control input file in the bold text following comments **C3** and **C3a**.

BAS1OT

Subroutine BAS1OT has been modified to accommodate hydrograph and budget output. The parameters JHEDUN, IBUD, MXHEDS and NHEADS and the array XHEDMT have been added. The call statement to subroutine SBAS1H has been modified in the bold text following comment **C3**. A call statement to subroutine SBAS1B has been added in the bold text following comment **C4**.

SBAS1H

Subroutine SBAS1H has been modified to output hydrograph data. The parameters JHEDUN, MXHEDS and NHEADS and the array XHEDMT have been added. Hydrograph data are output in the bold text following comment **C0**.

SBAS1B

SBAS1B is a new subroutine added to print the volumetric budget to a separate output file.

DOCUMENTATION FOR OUT1

OUT1 is an output control package for MODFLOW that generates a user-specified set of output. OUT1 is activated in IUNIT(18) of the BAS input file in MODFLOW version **maj6x5**. Output is specified in a format similar to MODAFT. OUT1 performs the functions of MODAFT and STARTHED.

Input Records

Record 1 is read by module OUT1AL and *is read once for a simulation*.

variable:	KOUTOP	MXOTRC
format:	I10	I10

Record 2 is read by module OUT1OT and is read:

once for each time step when KOUTOP=0.
once for each stress period when KOUTOP>0.

variable:	ITMP
format:	I10

Records 3 and 4 are read by module OUT1OT a combined total of ITMP times when ITMP>0.

record 3 Read up to ITMP times when ITMP>0. Not read when ITMP≤0.

variable:	KCOM	KSUB	KNDX	KFRM	KFIL
format:	I10	I10	I10	I10	I10

record 4 Read KNDX times when KSUB=4. Not read otherwise.

variable:	KLAY	KROW	KCOL
format:	I10	I10	I10

Explanation of Variables

1. KOUTOP : Output control option.

If KOUTOP=0, output control specifications are read for each time step.
Output is generated for each time step.
If KOUTOP=1, output control specifications are read for each stress period.
Output is generated for each time step.
If KOUTOP=2, output control specifications are read for each stress period.
Output is generated for the last time step of each stress period.

MOTRC: Maximum number of output control records. Must be greater than or equal to the largest value of ITMP (Record 2) within a simulation.

2. ITMP: Number of output control records.

If ITMP <0, output control specifications from the previous time step or stress period are re-used.
If ITMP>0, ITMP output control records (combined total of records 3 and 4) are read.
If ITMP=0, no output is generated for the current time step or stress period.

3. KCOM: Component of output desired:

If KCOM =0, **hydraulic head** is output.
=1, "**storage**" flow is output.
=2, "**constant head**" flow is output.
=3, "**flow right face**" is output.
=4, "**flow front face**" is output.
=5, "**flow lower face**" is output.
=6, "**wells**" (WEL1) flow is output.
=7, "**drains**" flow (DRN1, copy 1, IUNIT 3) is output.
=8, "**recharge**" (RCH1) flow is output.
=9, "**ET**" (EVT1) flow is output.
=10, "**river leakage**" (RIV1 flow) is output.
=11, "**head dependent bounds**" (GHB) flow is output.
=12, "**river 2 leakage**" (RIV2 flow to groundwater) is output.
=13, "**lake seepage**" (LAK2 flow to groundwater) is output.
=14, "**drains**" flow (DRN1, copy 2, IUNIT 14) is output.
=15, "**river 2 downstream flow**" (RIV2 surface flow) is output.
=16, **hydraulic head** is output (same as KCOM=0).
=17, (inactive, reserved for NCF1 "diagonal flow")
=18, "**river 2 reinjection**" (DIV1 injection of diverted surface flow) is output
=19, (inactive, reserved for "drawdown")

KSUB: Subset of output desired:

If KSUB=0, the entire array is output
=1, a layer of the array is output
=2, a row of the array is output
=3, a column of the array is output
=4, a selection of points from the array is output

KNDX: Index number for KSUB:

If KSUB=0, KNDX is not used.
If KSUB=1, KNDX is the layer number output
If KSUB=2, KNDX is the row number output
If KSUB=3, KNDX is the column number output
If KSUB=4, KNDX is the number of points to be output (read in Record 4)

KFRM: format of output. KFRM is discussed below.

KFIL: Unit number for output file. Output described by KCOM, KSUB, KNDX and KFRM is output to unit KFIL.

4. KLAY KROW KCOL

The layer, row, column indices of specific points to be output.
Read KNDX times when KSUB=4.

Explanation of KFRM

KFRM is the format of output. Its meaning is dependent on the value of KSUB.

If KSUB=0 (entire array output):

If KFRM=0, the array is output as a list of records in the form of *layer, row, column, value*

=1, the array is output in UBUDSV format (3 dimensional unformatted output, used in MODFLOW for unformatted cell-by-cell flow output).

=2, the array is output in ULASAV format (layer by layer unformatted output, used in MODFLOW for unformatted head output). Use this format to generate starting head files.

=3, the array is output as a list of records in the form of *row, column, period, step, time, value*

If KSUB=1 (one layer output):

If KFRM=0, the layer is output as a list of records in the form of l*ayer, row, column, value*

=1, the layer is output as a list of records in the form of *row, column, value*

=2, the layer is output in ULASAV format (layer by layer unformatted MODFLOW output).

=3, the layer is output as a list of records in the form of *row, column, period, step, time, value*

>11, the layer is output in wrap/strip format (ULAPRW and ULAPRS, used by mudflow to print heads). The format number used is determined by computing KFRM1=KFRM-24: If KFRM1<0, strip format (ULAPRS) is used, with format number –KFRM1. Otherwise, wrap format (ULAPRW) is used, with format number KFRM1:

KFRM1	U1/2DREL	U2DINT
0	10G11.4	10I11
1	11G10.3	60I1
2	9G13.6	40I2
3	15F7.1	30I3
4	15F7.2	25I4
5	15F7.3	20I5
6	15F7.4	
7	20F5.0	
8	20F5.1	
9	20F5.2	
10	20F5.3	
11	20F5.4	
12	10G11.4	

If KSUB=2 (one row output):

If KFRM=0, the row is output as a list of records in the form of *layer, row, column, value*

=1, the row is output as a list of records in the form of *layer, column, value*

=2, the row is output as a list of records in the form of *layer, column, period, step, value*

=3, the row is output as a list of records in the form of *layer, column, period, step, time, value*

=4, the row is output as a list of records in the form of *layer, column, time, value*

If KSUB=3 (one column output):

If KFRM=0, the column is output as a list of records in the form of *layer, row, column, value*

=1, the column is output as a list of records in the form of *layer, row, value*

=2, the column is output as a list of records in the form of *layer, row, time, value*

=3, the column is output as a list of records in the form of *layer, row, period, step, value*

=4, the column is output as a list of records in the form of *layer, row, period, step, time, value*

If KSUB=4 (list of points output):

If KFRM=0, output is generated in hydrograph format: Each line of the output file contains stress period and time step numbers and a value for each point. The header of the file contains the layer, row and column location of each point.

=1, output is generated in list format: Each line of the output file contains information in the form of *period, step, layer, row, column, value*

DOCUMENTATION FOR ZON1

ZON1 is an output control package for MODFLOW that generates zone budgets. ZON1 is activated in IUNIT(20) of the BAS input file in MODFLOW version **maj6x5**. ZON1 uses the memory allocated by OUT1 (IUNIT(18)), and will not run if OUT1 is not also activated.

Input Records

Record 1 is read by module ZON1AL and *is read once for a simulation*.

variable:	NZONES	KZONOP	KZONOT
format:	I10	I10	I10

Record 2 is read by module ZON1OT and *is read once for each layer*.

variable:	IZON (NCOL,NROW)
format:	(U2DINT)

Record 3 is read by module ZON1OT and *is read* *once for each stress period if KZONOP>0*,
once for each time step if KZONOP=0

variable:	ITMP
format:	(I10)

Record 4 is read by module ZON1OT when ITMP > 0

variable:	ICODES (NZONES)
format:	(50I2)

Explanation of Variables

1. NZONES: The number of zones in the model grid. Set NZONES equal to the highest number in the zone array, IZON.

   KZONOP: Options for zone budget output
   If KZONOP=0 Record 3 is read each time step. Output is generated each time step.
   =1 Record 3 is read each stress period. Output is generated each time step.
   =2 Record 3 is read each stress period. Output is generated on the last time step of each stress period.

   KZONOT: Unit number for zone budget output.

2. IZON: Zone designation for each cell. One array is read for each layer

3. ITMP: Flag for reading output specifications (Record 4)
   If ITMP>0 Record 4 is read. Output is generated based on flags set in Record 4.
   =0 Record 4 is not read. No output is generated.
   <0 Record 4 is not read. Output is generated based on the previous reading of Record 4.

4. ICODES: Output flag for each zone. If ICODES(K) is not zero, output is generated for zone K.

MODIFICATIONS TO LKMT

The LKMT package has been added to enable use of MT3D (Zheng, 1996). The LKMT package saves MODFLOW output in the format used for MT3D input.

Modifications

(a) the LKMT package has been made into a subroutine; (b) the LKMT package is distributed as an included block in the main MODFLOW program; (c) subroutine LKMT contains the code from the included block; (d) subroutines LAK2MT and RIV2MT have been added to the LKMT package to allow MT3D interfaces for the LAK2 and RIV2 packages.

DOCUMENTATION FOR LKMP1

The LKMP1 package has been added to facilitate the use of MODPATH (Pollock, 1994), a particle tracking program. The LKMP1 package saves MODFLOW output in the format used for MODPATH input. LKMP1 generates a MODPATH input file, the Composite Budget File (*.cbf),

LKMP1 is activated by setting IUNIT(23) in the .BAS file to a non-zero unit number, then listing a file (*.cbf) with the same unit number in the master input file (".NAM" file). The CBF file will be saved to the unit number (IUNIT[23]) and filename specified.

PERCHED WATER, DRY CELLS, AND REWETTING

This group of modifications to MODFLOW was inspired by conditions encountered along the Carlin Trend of Northern Nevada. A highly-transmissive carbonate rock aquifer (the carbonate aquifer) has been dewatered for mining. The carbonate aquifer is represented using multiple model layers, with some cells becoming dry during the course of dewatering. These cells are rewet during the simulation of post-mining water level recovery.

The Carlin Formation overlies the carbonate aquifer in parts of the model area. It is composed of Tertiary-aged alluvial deposits with much lower permeability than the carbonate aquifer. Over the course of dewatering the carbonate water level has dropped below the bottom of the Carlin Formation and created a perched Carlin water table overlying a zone of desaturated carbonate rock.

Water drains through the dewatered but highly transmissive carbonate rock. Components of recharge to the carbonate aquifer that pass through the dewatered part of the aquifer include:

a) Recharge from the Carlin formation. Water drains from the Carlin Formation downward, through the dewatered carbonate rock, to the carbonate water table below.

b) Recharge from stream networks. Stream channels including Brush Creek, Rodeo Creek, Boulder Creek, and Bell Creek directly recharge the carbonate in outcrop areas.

c) Areal recharge. Direct infiltration of precipitation occurs over carbonate outcrops.

In order to properly represent the above conditions, the following modifications were made to the MODFLOW code.

Vertical Leakage Transfer

The BCF2 package (McDonald et al., 1991) has been modified to (optionally) transmit vertical leakage from above a dry cell to a lower, active layer. Thus the Carlin formation in Layer 1, initially leaking water to the carbonate aquifer in Layer 2, will leak water to the carbonate in Layer 3 after Layer 2 is dry.

Without modifications, MODFLOW already simulates perched aquifer units: Under non-perched conditions, vertical flow between two layers is calculated based on the difference in head between the two layers. As water level in the lower layer drops below the bottom of the upper layer, MODFLOW switches to calculating a flow based on water head in the upper layer only, assuming gravity drainage through the unsaturated zone to the water table below in the lower layer.

A problem arises as the Layer 2 carbonate aquifer cells become dry. Without modification, MODFLOW stops simulating drainage from the perched Carlin Formation to the carbonate water table below. This discontinuity in the equations used to calculate flow produced unrealistic results in the simulated carbonate aquifer water balance and in the simulated Carlin Formation water level trends and water balance.

With the modification, water continues draining at the same rate it was before the Layer 2 carbonate aquifer cells became dry. This restores continuity to the equations used to simulate groundwater flow.

The transfer of vertical leakage is appropriate to apply to the situation along the Carlin Trend, where a lower permeability unit is perched above a higher permeability unit. In some cases, the use of the unmodified algorithm, in which drainage stops as Layer 2 becomes dry, would be more appropriate. In other cases, the use of an unsaturated flow algorithm to represent Layer 2 may be most appropriate.

Vertical Transfer of Recharge and River Leakage

The RCH1 package (McDonald and Harbaugh, 1988) was already equipped with an option (NRCHOP=3) to add areal recharge to the uppermost active layer; therefore, no modifications were necessary to simulate recharge to a lower layer when the uppermost carbonate layers are dry.

The RIV2 package was similarly equipped with a feature that adds stream infiltration to the uppermost active layer. Thus rivers initially recharging the carbonate aquifer in Layer 1 will recharge the Layer 2 carbonate when Layer 1 is dry (and Layer 3 when Layer 2 is dry).

Vertical Transfer of Pumping

Historical pumping rates are modeled as specified flows using the module WEL1. Without modifications, MODFLOW removes pumping from the model when a pumping cell becomes dry. The WEL1 package has been modified to (optionally) shift pumping to the next layer down when a pumping cell becomes dry. This option preserves specified pumping rates.

The approach can be appropriate for representing dewatering wells that are completed in multiple layers, or wells that are assumed to be replaced when pumping levels become too low, and it eliminates the need to re-partition pumping between layers and re-specify WEL package input every time a cell becomes dry.

Transfer of Residual Storage

In a model time step in which a cell becomes dry, MODFLOW normally ignores the water stored in the cell at the beginning of the time step. This volume of water is lost to the model mass balance accounting. In the carbonate aquifer, however, this volume of water would percolate to the water table below. The BCF2 package has been modified to (optionally) transfer the residual storage volume from a dry cell to a lower, active cell, thus preserving the mass-balance accounting of aquifer storage.

Cell Rewetting

A simplified rewetting method allows dry cells to be rewet with a zero rewetting threshold, resulting in smoother rewetting and better continuity of groundwater flow equations. Dry cells are rewet when head in an underlying or adjacent cell is above the bottom of a dry cell. Cells may be rewet with a zero saturated thickness and cells can remain wet with a small saturated thickness.

MODIFICATIONS TO MODULE BCF2

The BCF2 package (McDonald et al., 1991) has been modified from its original version for the purpose of simulating conditions of drawdown and recovery of a high-permeability formation underlying a low-permeability formation. The modifications allow the simulation of a perched leaky aquifer by allowing the vertical flow of water through inactive high-permeability cells to a water table in the underlying active cells.

Modifications

The modifications to BCF2 provide an option for vertical transfer of flow, including:

The transfer of vertical flow from an active cell, goes through the underlying inactive cells to the uppermost active cell below. The transfer of vertical flow allows the simulation of a perched water table.

The transfer of storage flow from of a cell, in the time step in which it goes dry, to the uppermost active cell below. The vertical transfer of storage improves computation of cumulative mass balance.

The input parameter IWETIT, previously not used for rewetting simulations with vertical transfer, now is a cutoff iteration for rewetting. When IWETIT is greater than zero, cells are not rewet after iteration IWETIT.

The vertical transfer option may be used with or without rewetting. Vertical transfer simulations use a simplified rewetting algorithm appropriate to high-permeability material: A dry cell is rewet at the beginning of any iteration in which the cell below has a head higher than the bottom of the dry cell. The initial head of the rewet cell is set equal to the cell bottom.

Input Records

Input records for the modified BCF2 are unchanged from the original BCF2. Explanations of input parameters are unchanged except for the following:

IWDFLG rewetting/flux transfer flag.
if IWDFLG=0, cell rewetting and transfer of BCF2 flux components are not enabled.
if IWDFLG>0, BCF2 cell rewetting is enabled.
if IWDFLG<0, vertical transfer of BCF2 flux components is enabled.
if IWDFLG=-2, cell rewetting and vertical transfer of BCF2 flux components are enabled.

WETDRY rewetting array.
When IWDFLG=0 or -1, WETDRY is not read.
When IWDFLG>0 WETDRY is the rewetting array as originally used in BCF2.
When IWDFLG<-1 WETDRY is a rewetting flag: A cell may be rewet if WETDRY for the cell is not equal to zero.

Changes to BCF2 Code

BCF2AL

Subroutine BCF2AL has been modified to reflect vertical transfer of flow. The vertical transfer option is identified in bold text following comment **C2a**. The condition for allocation of array WETDRY is changed in the bold text following comment **C7a**.

BCF2RP

Changes to subroutine BCF2RP accommodating the vertical transfer option are indicated in bold text following comment **C2H**.

SBCF2N

Changes to subroutine SBCF2N accommodating the vertical transfer option are indicated in bold text following comments **C4B1** and **C4B4**.

BCF2AD

Subroutine BCF2AD has been modified to initialize HOLD for inactive cells during simulations using vertical transfer. The parameters KPER and KSTP have been added. New code is indicated in bold text following comment **C1**. Modified code is indicated in bold text following comment **C1a**.

BCF2FM

Transfer of Flux Components

BCF2 has been modified to transfer storage from dry cells to lower layers. Storage is transferred in subroutine BCF2FM in the bold text following comments **C4a**, **C4b** and **C5d**. BCF2 has also been modified to transfer vertical leakage from above to a lower layer from cells that desaturate. Vertical leakage is transferred in subroutine BCF2FM in the bold text following comments **C6** and **C6a**.

Secondary Modifications

Transfer of storage and vertical leakage is invoked in subroutine BCF2FM by an IBOUND value of 99, set in SBCF2H. Cells with an IBOUND value of 99 are deactivated in subroutine BCF2FM in the bold text following comment **C8d**.

SBCF2H

Rewetting

In transient simulations, vertical transfer of flux components from dry cells maintains the head in dry cells at the layer bottom. Dry cells may be rewet with a zero saturated thickness by ending transfer of flux components and restoring vertical conductance values. No wetting threshold is required, allowing cells to remain wet with a small saturated thickness. Dry cells are rewet when head in the layer below is above the bottom of the dry cell. The rewetting criteria are therefore equivalent to the bottom wetting option in BCF2 (WETDRY<0) with a rewetting interval of 1 (IWETIT=1) and a zero wetting threshold (WETFCT=0 and WETDRY=0). Cells are rewet in the bold text following comment **C2c**.

Secondary Modifications

Transfer of storage and vertical leakage is invoked in subroutine BCF2FM by an IBOUND value of 99. SBCF2H sets the IBOUND value of dry cells to 99 when the flux transfer option is invoked. Head in dry cells is set at the layer bottom elevation to allow computation of storage in dry cells. Dry cells entering SBCF2H are assigned IBOUND values of 99 in the bold text following comment **C2b**. As in the unmodified BCF2, horizontal and vertical conductance terms are set to zero. Unlike unmodified BCF2, vertical conductance from above is not set to zero (bold text following comment **C2d**), enabling the transfer of vertical leakage to lower layers. IBOUND values and heads are assigned to cells that become dry in the bold text following comment **C6c**.

BCF1BD

Subroutine BCF1BD has been modified to recognize the vertical transfer of storage from dry cells to lower layers. Flag IWDFLG and array CVWD have been added to the subroutine parameters. Modifications are contained in bold text in the subroutine header and in bold text following comments **C6** and **C6aa** and in the call statement to subroutine SBCF1F

SBCF1F

Subroutine SBCF1F has been modified to recognize the transfer of vertical flow through dry cells during computation of constant head flows. Flag IWDFLG and array CVWD have been added to the subroutine parameters. Modifications are contained in bold text following comments **C6E1** and **C6F1**.

Verification of Changes Made to BCF2

The modifications to BCF2 were verified using the example problems described in the BCF2 Package documentation (McDonald, Harbaugh, Orr, and Ackerman, 1991). Following is a brief description of the example problems and a comparison of the model results using both BCF2 and modified BCF2:

Problem 1 A steady-state problem, referred to as Problem 1 in the BCF2 Package documentation, was run. First the original problem was duplicated employing the modified BCF2 Package, with IWDFLG>0. The problem was then run with the flux transfer/rewetting option (IWDFLG=-2). Results closely matched the published Problem 1 results, computing the same number and location of active cells and a maximum head difference between simulations of .02 feet.

Problem 2a A steady-state problem, referred to as Problem 2a in the BCF2 Package documentation, was run. First the original problem was run, with IWDFLG>0. Results were confirmed to be identical to the published BCF2 results.

In a second simulation the problem was modified by the specification of absolute values of .0001 for WETDRY and WETFCT. The small wetting values approximate the zero wetting values of the flux transfer/rewetting option (IWDFLG=-2). Results were close to the published 2A results, with 2 more active cells in Layer 2, 3 more active cells in Layer 5 and head differences of up to .1 feet.

In a third simulation the problem was run with the flux-transfer/rewetting option (IWDFLG=-2). Results were identical to those of the second simulation.

Problem 2d A transient problem, 2d, was run. First the original problem was run, with IWDFLG>0. Results were confirmed to be identical to the published BCF2 results.

Second the problem was modified by the specification of absolute values of .0001 for WETDRY and WETFCT. The small wetting values approximate the zero wetting values of the flux transfer/rewetting option (IWDFLG=-2). The results of changing WETDRY and WETFCT for problem 2d resembled the results of changing WETDRY and WETFCT for problem 2a, with several more active nodes and head differences of up to .1 feet.

Third the problem was run with the flux-transfer/rewetting option (IWDFLG=-2). Results were identical to those of the second simulation.

Fourth, the problem was modified to test the transfer of vertical leakage. The recharge package was turned off and replaced with an initially wet Layer 1. The flux transfer option without rewetting (IWDFLG=-1) was enabled. Layer 1 was specified as active, with an initial head of 70 feet and a bottom of 65 feet. The last row and the last column of Layer 1 were de-activated to avoid vertical transfer of flow directly into constant head cells. Layers 2-9 were specified as inactive, unable to be rewet. Layers 10-14 were specified as active, with an initial head of 25 feet. Layer 1 is thus separated from the rest of the grid by inactive layers. The problem was run for 50 1-day time steps. As a perched aquifer, Layer 1 should drain according to the equation

$$Sy\frac{\partial h}{\partial t} = Vc(h-b),$$

where,

h is hydraulic head
Sy=0.2 is specific yield
Vc=0.05/dy is vertical conductance
b=65 ft is layer bottom,

with a solution of $h = 65\,ft + (5\,ft)e^{-t/4dy}$

A comparison of numerical and analytical solutions is shown on the figure below:

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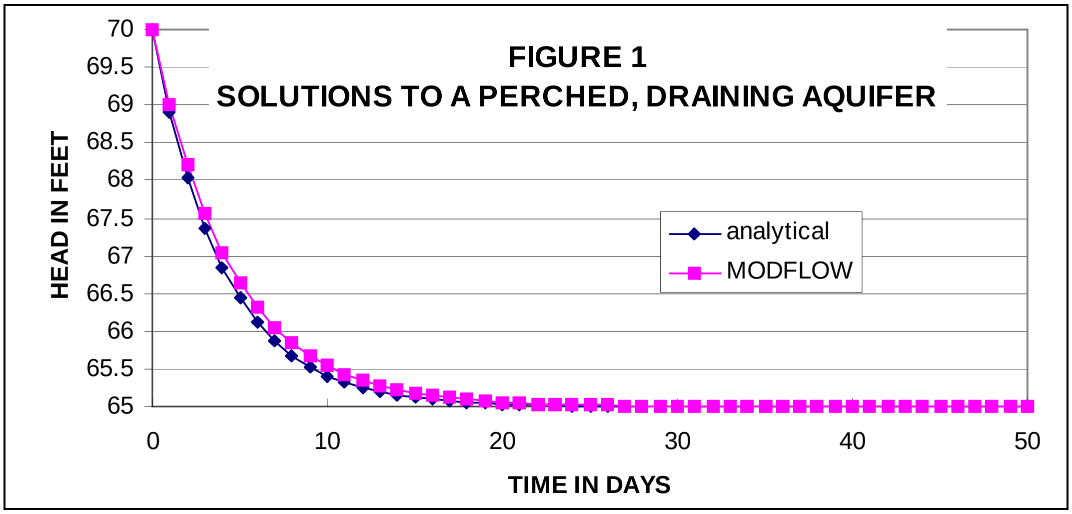

Figure 1 shows that the isolated layer drains as expected, with a reasonable match of the analytical solution. Furthermore, a 1-point implicit finite difference spreadsheet solution exactly matched the MODFLOW solution. Inspection of the mass balance table in the simulation output also shows that the water from Layer 1 enters aquifer storage or exits through constant heads in the active Layers 10-14.

Fifth, the problem was modified to test the transfer of storage. The bottom of Layer 1 is re-specified at 69.1 feet. The simulation is run for a 1 day time step, during which Layer 1 goes dry. Inspection of the mass balance table in the simulation output shows that the correct volume of storage flows from Layer 1:

$$(39 \text{ rows}) \times (39 \text{ columns}) \times (125 \text{ ft})^2 \times (0.9 \text{ ft}) \times (0.2) = 4.2778\times 10^6 \text{ft}^3$$

The Layer 1 storage entering the model exits the model as storage or constant head flow in the active Layers 10-14.

MODIFICATIONS TO BOUNDARY CONDITION MODULES

The following sections describe mostly minor modifications that are used to specify boundary conditions to a groundwater flow domain, including modules RCH1, EVT1, WEL1 and DRN1.

Modifications to Module WEL1

The original WEL package (McDonald and Harbaugh, 1988) has been modified to shift pumping down to the uppermost active layer when the assigned cell for a well is dry. This vertical flux transfer serves to maintain the total specified pumping flow for a simulated well that is completed in several layers. Prior to modification, MODFLOW removes pumping from the simulation when a cell goes dry; vertical flux transfer therefore eliminates the need to re-partition pumping between layers and re-specify WEL package input every time a cell goes dry. Vertical flux transfer is accomplished by means of an extra variable in the WELL array that serves as a flag indicating whether vertical transfer is to be used for a given well. Modifications to WEL1AL, WEL1RP, WEL1FM and WEL1BD are indicated in bold text.

Modifications

In subroutine WEL1AL the dimensioning of array WELL is 5* MXWEL instead of 4* MXWEL. Modified code is indicated by bold text in the line following comment **C4**. The new dimension of WELL is also indicated by bold text in the DIMENSION statements of WEL1RP, WEL1FM and WEL1BD.

In subroutine WEL1RP the READ statement in the fifth line following comment **C5** has been modified to also read a vertical transfer flag. Modified code is indicated by bold text.

In subroutine WEL1FM, vertical transfer is performed in the bold text following comment **C2aa**.

In subroutine WEL1BD, vertical transfer is performed in the bold text following comment **C5aa**.

Input Records

Record 1 is read by module WEL1AL and *is read once for a simulation*.

record 1 variable: MXWEL IWELCB
format: I10 I10

Records 2 and 3 are read by module WEL1RP and *are read once for each stress period*.

record 2 variable: ITMP
format: I10

record 3 Read ITMP times when ITMP>0. Not read when ITMP≤0.
variable: LAYER ROW COLUMN RATE IVTF
format: I10 I10 I10 F10.0 I10

Explanation of Variables

1. MXWEL : Maximum number of wells in any stress period.
   IWELCB : Flag and unit number for node-by-node WEL output.
      If IWELB>0, well flows are saved unformatted on unit number IWELCB whenever the flag ICBCFL from the OC Package is nonzero.
      If IWELCB<0, well flows are printed to the main output file. In the future they will be printed to unit number -IWELCB.
      If IWELCB=0, well flows are not printed or saved.
2. ITMP : If ITMP≥0, ITMP is the number of wells used in the current stress period.
      If ITMP<0, the well list from the previous stress period is reused.
3. LAYER : Layer of well cell/node.
   ROW : Row of well cell/node.
   COLUMN : Column of well cell/node.
   RATE : Pumping rate of well.
   IVTF : Vertical transfer flag for well.
      If IVTF is not equal to zero, vertical transfer is performed.
      If IVTF is equal to zero, vertical transfer is not used.

Modifications to Module DRN1

The Drain Package has been modified from its original version (McDonald and Harbaugh, 1988). The function of the Well Package has been incorporated into the Drain Package. The modification allows a convenient representation of pumping wells, in which a well may pump a specified rate or a head-dependent rate. Vertical flow transfer may be used with the Well package function of DRN.

Modifications

In subroutine DRN1AL a vertical transfer is read following comment **C2**. The dimension of array DRAI is 6* MXDRN instead of 5* MXDRN. Modified code is indicated by bold text in the line following comment **C4**. The new dimension of DRAI is also indicated by bold text in the DIMENSION statements of DRN1RP, DRN1FM and DRN1BD.

In subroutine DRN1RP the READ statement in the fifth line following comment **C7** has been modified to also read a pumping rate. Modified code is indicated by bold text.

In subroutine DRN1FM the function of the Well Package is performed in the bold text following comment **C3b**. Vertical transfer for the Well package function is performed in the bold text following comment **C3a**.

In subroutine DRN1BD the function of the Well Package is performed in the bold text following comment **C5c** and indicated by bold text in the lines following comments **C5a** and **C9**. Vertical transfer for the Well package function is performed in the bold text following comment **C5b**.

Input Records

Record 1 is read by module DRN1AL and *is read once for a simulation*.

record 1	variable:	MXDRN	IDRNCB	ID1VT			
	format:	I10	I10	I10			

Records 2 and 3 are read by module DRN1RP and *are read once for each stress period*.

record 2	variable:	ITMP					
	format:	I10					
record 3	Read ITMP times when ITMP>0. Not read when ITMP≤0.						
	variable:	LAYER	ROW	COLUMN	HEAD	COND	RATE
	format:	I10	I10	I10	(3F10.0)		

Explanation of Variables

1. MXDRN : Maximum number of drains in any stress period.
IDRNCB : flag and unit number for node-by-node DRN output.
If IDRNCB>0, drain flows are saved unformatted on unit number IDRNCB whenever the flag ICBCFL from the OC Package is nonzero.
If IDRNCB<0, drain flows are printed to the main output file. In the future they will be printed to unit number -IDRNCB.
If IDRNCB=0, drain flows are not printed or saved.
ID1VT : Vertical transfer flag. If ID1VT is not zero, vertical transfer is used for the well function part of DRN : Pumping (RATE in record 3) is placed in the uppermost active layer.

2. ITMP : If ITMP≥0, ITMP is the number of drains used in the current stress period.
If ITMP<0, the drain list from the previous stress period is reused.

3. LAYER : Layer of drain cell/node.
ROW : Row of drain cell/node.
COLUMN : Column of drain cell/node.
HEAD : Elevation of drain.
COND : Conductance of drain.
RATE : Pumping rate of well

Modifications to Module RCH1

The areal Recharge Package, version 1, RCH1 (McDonald and Harbaugh, 1988), has been modified to include a seasonal input option. When the seasonal option is invoked, the RCH1 input file is rewound and recharge data from the first stress period are used. The seasonal option may be seen in subroutine RCH1RP in the bold text following comment **C2**. Following are revised input instructions. The seasonal input option is described in Record 2 (INRECH).

Input Records

Record 1 is read by module RCH1AL and *is read once for a simulation.*

record 1.

variable:	NRCHOP	IRCHCB
format:	I10	I10

Records 2-4 are read by module RCH1RP and *are read once for each stress period.*

record 2.

variable:	INRECH	INIRCH
format:	I10	I10

record 3. Read if INRECH is greater than or equal to 0.
variable: RECH(NCOL,NROW)
format: U2DREL

record 4. Read if NRCHOP=2 and INIRCH is greater than or equal to 0.
variable: IRCH(NCOL,NROW)
format: U2DINT

Explanation of Variables

record 1

NRCHOP : RCH option.
If NRCHOP=1, recharge is specified for the top layer.
If NRCHOP=2, the user specifies the recharge layer at each horizontal location using array IRCH.
If NRCHOP=3, recharge is applied to the top-most active layer. If the top-most active layer at a given horizontal location is a constant head cell/node, recharge is not applied to that location.

IRCHCB : flag and unit number for node-by-node RCH output.
When IRCHCB>0, node-by-node terms are recorded on unit IRCHCB.

record 2

INRECH : recharge rate (RECH) read flag.
If INRECH is greater than or equal to 0, RECH is read.
If INRECH=-1, RECH from the previous stress period is used.
If INRECH<-1, the input file is rewound and RCH input for the first stress period is read.

INIRCH : Layer indicator (IRCH) read flag.
If NRCHOP=2 and INIRCH is greater than or equal to 0, IRCH is read. Otherwise (if NRCHOP=2), IRCH from the previous stress period is used.

record 3

RECH : recharge rate (L/t).

record 4

IRCH : Layer indicator array. Used if NRCHOP=2. At each horizontal location, IRCH indicates the layer to which recharge is applied.

Modifications to Module EVT1

The Evapotranspiration Package, version 1, EVT1 (McDonald and Harbaugh, 1988), has been modified to include a seasonal input option. When the seasonal option is invoked, the EVT1 input file is rewound and recharge data from the first stress period are used. The seasonal option may be seen in subroutine EVT1RP in the bold text following comment **C2**. Following are revised input instructions. The seasonal input option is described in Record 2 (INSURF).

Input Records

Record 1 is read by module EVT1AL and *is read once for a simulation.*

record 1.

variable:	NEVTOP	IEVTCB
format:	I10	I10

Records 2-6 are read by module EVT1RP and *are read once for each stress period.*

record 2.

variable:	INSURF	INEVTR	INEXDP	INIEVT
format:	I10	I10	I10	I10

record 3. Read if INSURF greater than or equal to 0.
variable: SURF(NCOL,NROW)
format: U2DREL

record 4. Read if INEVTR greater than or equal to 0.
variable: EVTR(NCOL,NROW)
format: U2DREL

record 5. Read if INEXDP greater than or equal to 0.
variable: EXDP(NCOL,NROW)
format: U2DREL

record 6. Read if NEVTOP=2 and INIEVT greater than or equal to 0.
variable: IEVT(NCOL,NROW)
format: U2DINT

Explanation of Variables:

record 1.

NEVTOP : ET option.
1 - ET is calculated for the top layer.
2 - the user specifies the ET layer at each horizontal location using array IEVT.

IEVTCB : flag and unit number for node-by-node EVT output.
When IEVTCB>0, node-by-node terms are recorded on unit IEVTCB.

record 2.

INSURF : ET surface (SURF) read flag.

If INSURF greater than or equal to 0, SURF is read.

If INSURF=-1, SURF from the previous stress period is used.

If INSURF<-1, the input file is rewound and EVT input for the first stress period is read and used.

INEVTR : Maximum ET rate (EVTR) read flag. If INEVTR is greater than or equal to 0, EVTR is read.

Otherwise, EVTR from the previous stress period is used.

INEXDP : Extinction depth (EXDP) read flag. If INEXDP is greater than or equal to 0, EXDP is read.

Otherwise, EXDP from the previous stress period is used.

INIEVT : Layer indicator (IEVT) read flag. If NEVTOP=2 and INIEVT greater than or equal to 0, IEVT is read. Otherwise (if NEVTOP=2), IEVT from the previous stress period is used.

record 3: SURF : ET surface elevation.

record 4: EVTR : Maximum ET rate.

record 5: EXDP : Extinction depth.

record 6: IEVT : Layer indicator array. Used if NEVTOP=2.

At each horizontal location, IEVT indicates the layer from which ET is taken.

DOCUMENTATION FOR RIV2

The River Package, version 2 (RIV2), developed by the USGS (Miller, 1988) is a FORTRAN package for the U.S. Geological Survey Modular Groundwater Flow Model, MODFLOW (McDonald and Harbaugh, 1988). RIV2 has been modified to allow unformatted output of streamflow, to include a seasonal input option, to allow input of new river reach data while repeating river node data and to allow input of new river node data while repeating river reach data. In addition, river recharge is now placed in the uppermost active layer. The capability to simulate diversion of river flow and optional transfer and re-injection of diverted flow to a new location has also been added. This diversion capability was added through a set of subroutines that all include the characters “DIV1” in their names. Input data for the diversion capability is in a file that is separate from the RIV2 input file.

RIV2 Narrative (from Miller, 1988)

The main features of RIV2 are:

1. The river system is divided into reaches and simulated river discharge is routed from one reach to another in a specified sequence. Within a reach, river discharge is routed from one node to the next.
2. Inflow (river discharge) entering the upstream end of a reach can be specified.
3. More than one river can be represented at one node and rivers can cross, as when representing a siphon.
4. The quantity of leakage to or from the aquifer at a given node is proportional to the hydraulic-head difference between that specified for the river and that calculated for the aquifer. Also, the quantity of leakage to the aquifer at any node can be limited by the user and, within this limit, the maximum leakage to the aquifer is the discharge available in the river. This feature allows for the simulation of intermittent rivers and drains that have no discharge routed to their upstream reaches.
5. An accounting of river discharge is maintained.

Neither stage-discharge relations nor storage in the river or river banks is simulated.

The modeling concepts necessary for the operation of RIV2 differ little from those for RIV1. The differences are largely due to features adapted from the modeling code of Posson et al. (1980) and Hearne (1982). The RIV2 code represents a number of nodes that simulate leakage from or to an overlying river. Certain features of a river that would be essential in a surface-water model, such as storage in the channel or banks, are not represented because RIV2, like RIV1, is considered to be a boundary condition in a ground-water model, not a surface-water model.

The rate of leakage at each node is directly proportional to the difference between the hydraulic head in the aquifer and the stage of the river, but is limited to the lesser of either a user-specified maximum or the intermittent and ephemeral rivers. Leakage from the aquifer to the river is not limited in RIV2.

The user needs to supply the hydraulic-connection coefficient, the limiting maximum rate of leakage to the aquifer, and the river stage for each node. It is possible for the user to re-specify the river characteristics (stage, hydraulic-connection coefficient, and limiting maximum rate of leakage to the aquifer and river stage) for each stress period. They hydraulic-connection coefficient, CRIV, may be defined as the conductance of the reach of the riverbed with units of length squared per unit time:

$$CRIV = K' A'/b$$

where K’ = vertical hydraulic conductivity of the riverbed material
A’ = area of the river channel; and
b = thickness of the riverbed material

The river discharge for a node is equal to the river discharge into the node minus the leakage to the aquifer or plus the leakage from the aquifer. The river stage, the wetted perimeter of the river channel, and the conductance of the riverbed material in a river vary with the discharge of the river. The constant values used in RIV2 limit its accuracy, but the error probably is not as great as it would be if the aquifer were allowed to gain more water from the river than the river contained.

The river-discharge-routing procedure in RIV2 uses a higher order structure that is not used in RIV1. A river, as represented in the framework of the model, consists of one or more reaches, and each reach consists of one or more nodes. (This definition of the term “reach” is distinctly different from that of RIV1.) A node may be part of more than one river reach. The river discharge at the upstream end of a reach consists of the river discharge from upstream reaches plus any user-specified tributary inflow. The river discharge from the downstream end of a reach may be routed to any downstream reach. The structure allows representation of tributaries.

RIV2, like RIV1, separates the leakage term into explicit and implicit parts. The explicit part of the leakage term is added to the variable RHS. (RHS is the right side of a finite-difference equation and is an accumulation of the terms that are independent of hydraulic head at the current time step. Terms in RHS are defined by various model packages.) The term added to RHS may have either of two forms. If the hydraulic head computed for the aquifer during the previous iteration was greater that the hydraulic head required to produce the limiting value of leakage to the aquifer, then the following FORTRAN assignment is made:

$$RHS = CRIV * HRIV$$

where, HRIV is the river stage, and other terms are as previously defined. If the hydraulic head computed for the aquifer during the previous iteration was less than or equal to the hydraulic head required to produce the limiting value of leakage to the aquifer, then the assignment is:

$$RHS = RHS - CRIV * (HRIV - HMIN)$$

where, HMIN is the hydraulic head required to produce the limiting value of leakage to the aquifer, and other terms are as previously defined.

The implicit part of the leakage term is added to the variable HCOF. (HCOF) is the coefficient of hydraulic head for the node (J, I, K) in the finite-difference equation.) The implicit term may, like the explicit term, have either of two forms. If the hydraulic head computed for the aquifer during the previous iteration was greater than the hydraulic head required to produce the limiting value of leakage to the aquifer, then the following FORTRAN assignment is made:

$$HCOF = HCOF - CRIV$$

where, all terms are as previously defined. The implicit term is zero when the hydraulic head computed for the aquifer during the previous iteration was less than or equal to the hydraulic head necessary to produce the limiting value of leakage to the aquifer. In this instance, the leakage term included in the solution algorithm is explicit.

Modifications

The following are modifications to the original RIV2 Package:

The River Package, version 2, RIV2, has been modified to allow unformatted output of streamflow. Streamflow for each river node is saved when the flag IDQ (record 1) is set.

RIV2 has been modified to include a seasonal input option. The RIV2 input file is rewound, and river data from the first stress period re-read, when the flag ITMP (record 3) is less than -1.

RIV2 has been modified to allow input of new river reach data while repeating river node data. River reach data will be read, and river node data repeated, when the flag IREAC (record 3) is set.

RIV2 has been modified to allow river leakage to be placed in the uppermost active model layer. The flux transfer option is invoked by the flag IR2VT in record 1 below.

DIV1**,** which is a subpackage to RIV2, has been developed to expand the capabilities of the River Package. DIV1 permits a portion of existing river flow to be diverted and routed to another location in the model. Streamflow is subtracted from a user specified river node. All or part of the flow is added directly to the RHS vector of a user specified model cell.

Input Records

Records 1 and 2 are read by module RIV2AL and are *read once for a simulation*:

<u>record 1</u>

Data:	MXRIVR	IRIVCB	IDQ	IDIV	IR2VT
Format:	I10	I10	I10	I10	I10

<u>record 2</u>

Data:	MXREAC
Format:	I10

Records 3, 4, 5 and 6 are read by module RIV2RP and are *read each stress period*.

<u>record 3</u>

Data:	ITMP	IREAC
Format:	I10	I10

<u>record 4</u>

Data:	NR
Format:	I10

<u>record 5</u> read NR times.

Data:	NREA	NNRE	RQIN	NADD
Format:	I10	I10	F1O.0	I10

(record 5 consists of one record for each river reach active during the current stress period. The reaches need to be specified in downstream order.)

<u>record 6</u> read ITMP times, when ITMP>0.

Data:	Layer	Row	Column	STAGE	COND	QMAX
Format:	I10	I10	I10	F10.0	F10.0	F10.0

(record 6 consists of one record for each river node active during the current stress period. The nodes need to be specified in downstream order, consistent with the specification of the river reaches.)

Explanation of Variables

record 1
MXRIVR is the maximum number of river nodes active at one time.
IRIVCB is a flag and a unit number.
If IRIVCB > 0, then node-by-node flow terms will be recorded on unit IRIVCB whenever ICBCFL (see Output Control) is set.
If IRIVCB = 0, then node-by-node flow terms will be neither printed nor recorded.
If IRIVCB < 0, then river leakage for each reach will be printed whenever ICBCFL is set.

IDQ is a flag indicating whether downstream flows are to be saved.
If IDQ ≠ 0, then streamflow for each river node will be recorded on unit IRIVCB whenever ICBCFL (see Output Control) is set.
If IDQ = 0, then streamflow will not be recorded.

IDIV is a flag and a unit number activating the DIV1 subpackage for river diversions.
If IDIV > 0 then DIVI is unit number from which DIV1 input is read (see input instructions below).

IR2VT is a flag for vertical transfer of river leakage.
If IR2VT=0, vertical transfer is not used: River leakage is placed in the specified layer, if active.
If IR2VT≠ 0, vertical transfer is used: River leakage is placed in the uppermost active layer.

record 2 MXREAC is the maximum number of river reaches active at one time.

record 3
ITMP is a flag and a counter.
If ITMP <-1, the input file is rewound. River node data and river reach data from the first stress period are used.
If ITMP =-1, then river node data from last stress period will be re-used.
If ITMP ≥ 0, ITMP is the number of river nodes active during the current stress period.
IREAC is a flag for reading river reach data when ITMP=-1.
If IREAC = 0 and ITMP=-1, river reach data and river node data from the previous stress period are re-used. Records 4, 5 and 6 are not read.
If IREAC ≠ 0 and ITMP=-1, river reach data is read, but river node data from the previous stress period are re-used. Records 4 and 5 are read, and record 6 is not read.

record 4 NR if NR<0, river reach data from the previous stress period are re-used.
if NR>0, NR is the number of river reaches active in the current stress period.

record 5 **river reach data**
NREA is the river-reach number.
NNRE is the number of river nodes in the reach.
RQIN is the river discharge added at the upstream end of the reach.
NADD is the number of the downstream reach (zero, if none).

record 6 **river node data**
LAYER is the layer number of the river node.
ROW is the row number of the river node.
COLUMN is the column number of the river node.
STAGE is the hydraulic head in the river.
COND is the riverbed hydraulic conductance.
QMAX is the maximum allowable leakage to the aquifer.

DOCUMENTATION FOR DIV1

DIV1 enables water to be diverted from a river channel and permits the optional transfer of the diverted water to another location within the model. This feature allows the simulation of processes such as the extraction of river water for application to agricultural lands, direct recharge of a reservoir or unspecified municipal/industrial use. Multiple diversions may be made, each being extracted from a single river node and re-injected into a single model cell. Each diversion is specified using the following variables:

NODE = RIV2 node from which water is to be diverted. NODE$\in$(1,MXRIVR)

Qd = maximum rate of water to be diverted. The actual flow diverted by DIV1 is the minimum of Qd and available river flow.

Qa = That portion of Qd assumed to be accounted for elsewhere, not to be re-injected by DIV1. Qa may represent water put into the model by other MODFLOW packages or water removed from the simulation. The amount of water diverted over Qa is re-injected.

ILAY, IROW, ICOL = The layer, row and column indices of the cell into which diverted water is re-injected.

For each RIV2 node (node number) to be diverted from, subroutine DIV1RP sets a flag in MXRIVR(7,NODE) to indicate the diversion. As subroutine RIV2FM is looping through river nodes it checks the flag for diversions. When diversions are found, RIV2FM calls subroutine DIV1FM to perform the diversion.

The amount of water diverted is computed as the minimum of Qd and available river flow:

Qdiverted = min(Qd,Q(NODE))

where, Q(NODE) is the streamflow at the river node.

The amount of water re-injected is the difference between the amount diverted and Qa:

Qreinjected = max (0, Qdiverted-Qa)

Input Records

Records 1 is read by module DIV1AL and is read *once for a simulation*:

record 1

Data:	MXDIV	IDIVOT
Format:	I10	I10

Records 2, and 3 are read by module RIV2RP and are read *each stress period*

record 2

Data:	ITMP
Format:	I10

record 3

Read ITMP times when ITMP ≥ 0

Data:	NODE	ILAY	IROW	ICOL	QD	QA
Format:	I10	I10	I10	I10	F10.0	F10.0

Explanation of Variables

record 1
MXDIV is the maximum number of river diversions occurring during the simulation.
IDIVOT is a flag and a unit number.
    If IDIVOT > 0, then node-by-node flow terms will be recorded on unit IDIVOT whenever ICBCFL (see Output Control) is set.
    If IDIVOT = 0, then node-by-node flow terms will be neither printed nor recorded.

record 2
ITMP is a flag and a counter.
    If ITMP <0, information from the previous stress period is repeated. River reach data from the first stress period is used.
    If ITMP ≥ 0, ITMP is the number of river nodes active during the current stress period.

record 3
NODE is the river node number as defined in RIV2 (from 1 to MXRIVR) from which water is to be diverted.
ILAY is the layer number of the location for the re-injection of diverted water
IROW is the row number of the location for the re-injection of diverted water
ICOL is the column number of the location for the re-injection of diverted water
QD is the volume of water diverted from the river
QA is the volume of water re-injected into the modeled system

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APPENDIX: DOCUMENTATION FOR MODULE LAK2

DOCUMENTATION OF LAK2: A COMPUTER PROGRAM TO SIMULATE THE PRESENCE OF LAKES AND OTHER OPEN WATER BODIES WITHIN A GROUNDWATER FLOW SYSTEM USING THE MODFLOW GROUNDWATER FLOW MODEL

ABSTRACT

LAK2 is a module for the U.S. Geological Survey Modular Groundwater Flow Model (MODFLOW) that simulates the interconnection between a groundwater system and an adjacent open water body such as a lake, an open pit or a well bore.

The module has been in use since 1998. Although other modules have subsequently been published (lake package, USGS OFR 00-4167 and Multi-Node Well Package, USGS OFR 02-293) that perform some of the same functions, these only provide stable and accurate solutions for a limited range of problems, and break down under strongly transient or nonlinear conditions, when aquifer water level and “lake” water level are each sensitive to the other.

The main difference between LAK2 and other modules is the method used to solve two parallel but interdependent (coupled) sets of equations governing (1) groundwater levels and flows and (2) “lake” water levels and flows. Other modules solve partially decoupled forms of the equations with good results for a limited range of problems, but with slow convergence, instability and mass balance errors for other applications. LAK2 solves the fully coupled system of equations and provides efficient, stable, convergent solutions without mass balance errors.

LAK2 was first reviewed and accepted for use in the state of Nevada for simulation of post-mining water level recovery in an open pit (BLM, 2000). LAK2 has since been applied to pit-filling simulations for sites in Nevada, New Mexico, Canada, Chile, and Tanzania. Other applications have involved modeling borehole hydraulics and wells intersecting multiple model cells. Further applications potentially include the representation of natural lakes, caverns or other open spaces linked to a groundwater system.

This report presents LAK2 documentation and selected applications including:

- Module documentation: Presentation of algorithm, input instructions and simple test case.
- Archimedes pit: Demonstration of the representation of lake (pit) geometry and water balance, projection of future water level and water balance.
- Ortiz pit: Calibration of a groundwater flow model to historical pit water levels, post-audit of water level projections.
- Belen municipal well: Representation of a well pumping from multiple layers, correcting the erratic numerical solution previously obtained.
- Fan Sediments aquifer test: Simulation of borehole water levels for analysis of aquifer test results and projection of future pumping water levels.

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DOCUMENTATION OF LAK2: A COMPUTER PROGRAM TO SIMULATE THE PRESENCE OF LAKES AND OTHER OPEN WATER BODIES WITHIN A GROUNDWATER FLOW SYSTEM USING THE MODFLOW GROUNDWATER FLOW MODEL

INTRODUCTION

This report describes a module that has been used since 1998 to solve the fully coupled system of equations describing groundwater flow and lake/water body mass balance. The module applies to both larger-scale water bodies such as open pits and smaller-scale bodies such as well bores.

Previous Work

Software for modeling of lakes in conjunction with surrounding groundwater systems, using the U.S. Geological Survey Modular Groundwater Flow Model (MODFLOW), dates back to at least 1993 (Cheng and Anderson, 1993). Other lake modules developed for MODFLOW include those by HSI Geotrans (Council, 1999) and most recently by USGS (Merritt and Konikow, 2000). Another module was developed to represent well bores intersecting multiple model cells (Halford and Hanson, 2002).

All of these modules utilize an algorithm that treats the mass balance equation governing lake stage as if it were decoupled from the equations governing the groundwater system. They have been successfully used to represent natural lakes with little change, or slow change, in water level and they work acceptably well for a range of applications where lake stage does not strongly influence groundwater heads and where simulation time steps are sufficiently small so that the lake stage does not change too much in a single time step.

The decoupling of equations is done as follows: MODFLOW iteratively solves the system of equations governing groundwater head. The equation governing lake stage is then solved, after the iterative process has finished. Because groundwater head and lake stage are mutually dependent variables, errors result in both groundwater and lake solutions.

The decoupled solution algorithms break down for strongly transient problems, such as recovery of water level in an open pit after mining has ceased, or for highly sensitive problems where lake stage strongly influences groundwater levels. Mass balance errors become large and stability or convergence limits require impractically short time step lengths with long model run times.

The module described here solves the fully coupled system of equations describing groundwater flow and lake mass balance. The equations governing lake stage are solved at each iterative step of the groundwater flow solution process, thus simultaneously solving for lake stage and groundwater head. The algorithm produces stable, efficient and convergent solutions without mass balance error.

Structure of Report

This report includes the following chapters:

1. Module documentation: Presentation of algorithm, input instructions and simple test case.
2. Application: Archimedes pit. Representation of lake (pit) geometry and water balance, projection of future water level and water balance.
3. Application: Ortiz pit. Calibration of a groundwater flow model to historical pit water levels, post-audit of water level projections.
4. Application: Belen municipal well. Representation of a well pumping from multiple layers, correcting the erratic numerical solution previously obtained.
5. Application: Fan Sediments aquifer test. Simulation of borehole water levels for analysis of aquifer test results and projection of future pumping water levels.

1.0 DOCUMENTATION

1.1 LAKE WATER BALANCE

Groundwater flow systems can be influenced by stationary surface water features (lakes) including natural lakes, constructed reservoirs, retired mine pits and wetlands. Lakes can function as hydraulic sinks with groundwater inflow, as hydraulic sources of groundwater recharge or as flow-through lakes with both groundwater inflow and groundwater outflow. A lake may serve to connect distinct parts of a groundwater flow system.

Lake water balance components are illustrated on Figure 1.1 and can include:

- direct precipitation and runoff from surface catchment
- evaporation of water from lake surface
- groundwater inflow
- inflow from surface streams
- groundwater outflow
- surface water outflow

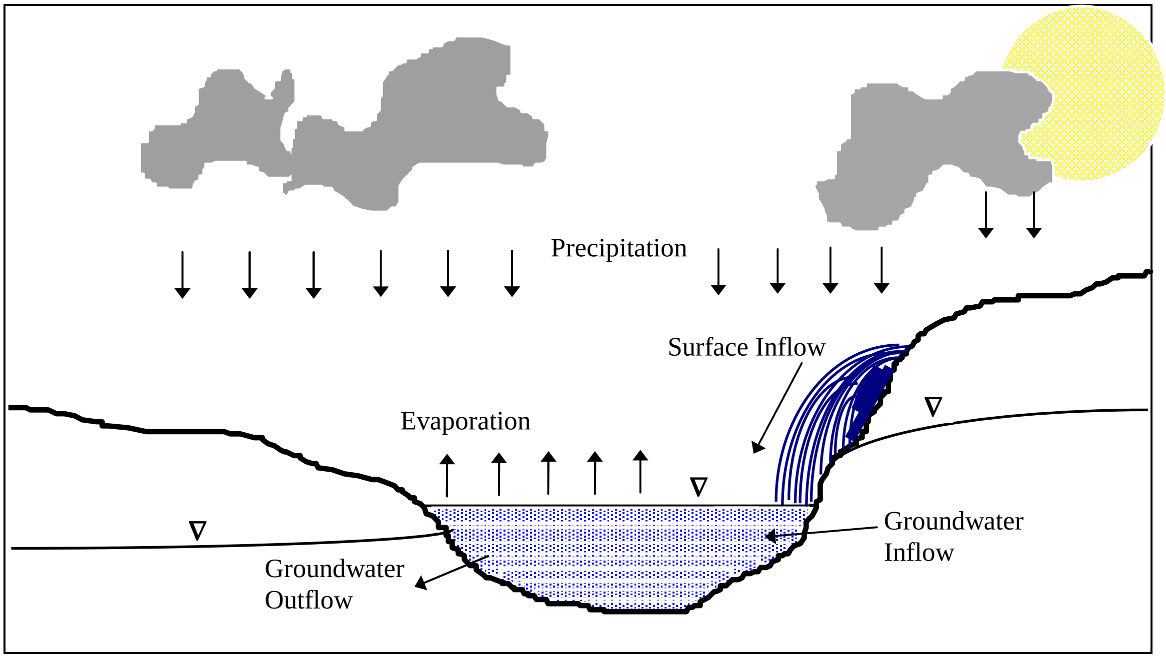

Figure 1.1 Components of lake water balance.

The governing equation for lake stage used by LAK2 is

$$\frac{\partial H_{LAKE}}{\partial t} = \frac{1}{A_{LAKE}} \{ Q_{str\,in} - Q_{str\,out} + P - E + Q_{gw} - W \} \qquad (1)$$

where:

H_{LAKE} is the lake water surface elevation (L).
A_{LAKE} is the water surface area of the lake at stage HLAKE (L^2).
Q_{strin} is the rate of streamflow into the lake (L^3/t).
Q_{strout} is the rate of streamflow out of the lake (L^3/t).
P is the rate of precipitation inflow to the lake (L^3/t).
E is the rate of evaporation from the lake (L^3/t).
Q_{gw} is the net rate of groundwater flow to the lake (L^3/t).
W is the rate of pumping or other diversion out of or into the lake (L^3/t).

1.1.1 Geometric Representation of Lake

A lake is defined by a list of cells (lake cells) in the groundwater flow domain that are connected to the lake. A conceptual view is shown on Figure 1.2, indicating lake cells (groundwater cells connected to the lake) and inactive cells (not part of the groundwater domain).

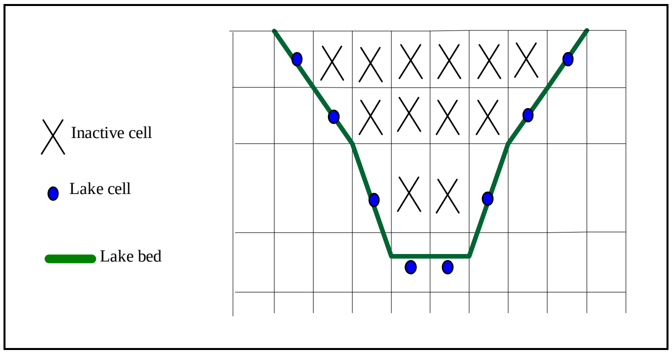

Figure 1.2. Cross-sectional view of a lake in a MODFLOW grid.

Each lake cell is specified with a lakebed minimum elevation, lakebed maximum elevation and maximum water surface area.

Water surface area of the lake is computed by summing the contribution of each cell to the total water surface. The contribution for a cell is equal to zero when lake water level is at or below the lakebed minimum elevation, increasing linearly with lake water level to the maximum water surface area when lake water level is at or above the lakebed maximum elevation.

The bottom of a lake is the lowest lakebed minimum elevation among the lake nodes. Two options exist for representation of the lake bottom:

1. A flat bottom lake is defined when the lakebed minimum elevation is equal to lakebed maximum elevation for the lowermost cell(s) of the lake.
2. A non-flat bottom lake is defined when the lakebed minimum elevation is lower than the lakebed maximum elevation for the lowermost cell(s) of the lake.

The two types of lake bottom have different implications for Equation (1) above when water level is near the lake bottom elevation. For a non-flat bottom, the water surface area A_{LAKE} approaches zero as water level approaches bottom elevation. For a flat bottom, the water surface area A_{LAKE} approaches a nonzero constant as water level approaches bottom elevation. For both types, A_{LAKE} is zero when the lake is dry (water level equal to bottom elevation) and Equation (1) is undefined. Lake bottom type is considered in the computation of the components of Equation (1) and in the handling and rewetting of dry lakes.

1.1.2 Stream Connections

LAK2 is configured to recognize surface water inflows and outflows simulated using the streamflow routing package RIV2 (Miller, 1988, Jones, 2010). RIV2 has been developed to provide the streamflow routing function in an efficient and simple way without surface water mass balance errors. Other streamflow routing modules for Modflow could readily be utilized by LAK2 with minor code changes.

A list of RIV2 reaches may be specified to flow into a LAK2 lake. The simulated streamflow at the bottom node of each inflowing reach is added to Q_{strin} in Equation (1).

A single RIV2 reach may be specified to flow out of a lake at a specified spill elevation. Spill from the lake, Q_{strout} in Equation (1), is computed by setting water level equal to spill elevation and then computing the resulting water surplus. The simulated inflow at the top node of the outflowing reach is set equal to spill from the lake.

Note: Other lake modules including (Merritt and Konikow, 2000) have used a Manning equation to estimate a spill rating curve and thus compute spill as a function of water level above spill elevation. To date, the models to which LAK2 has been applied have not been concerned with the small margin of water level above spill elevation. A Manning equation-based spill computation could be readily implemented into LAK2 with minor code changes.

1.1.3 Precipitation

Total precipitation inflow to a lake consists of direct precipitation on the water surface as well as runoff from the surface catchment above the lake water level. A runoff coefficient for each lake cell is specified to define the portion of precipitation that runs off to the lake from areas above the lake water level.

Total precipitation inflow to the lake is computed as precipitation multiplied by water surface area, plus precipitation multiplied by runoff coefficient multiplied by catchment area above the lake water level, or

$$P=p[\ \alpha\ A_{MAX} + (1-\ \alpha)\ A_{LAKE}] \qquad (2)$$

where

p is precipitation rate over the lake (L/t).
α is runoff coefficient for the lake cell.
A_{MAX} is the maximum water surface area of the lake cell (L^2).
A_{LAKE} is the actual water surface area of the lake cell (L^2).

Note that the right-hand side of equation (2) represents a summation over the individual lake cells defining a lake, each cell having its own α, A_{MAX} and contribution to A_{LAKE}.

1.1.4 Evaporation

Lake evaporation is computed as

$$E = eA_{LAKE} \qquad (3)$$

where

e is evaporation rate over the lake (L/t).

<u>Evaporation/Evapotranspiration from ephemeral, flat-bottom lakes</u>

If groundwater level is close to a flat lake bottom, groundwater evapotranspiration (ET) may occur when the lake is dry. LAK2 recognizes this condition and adds boundary conditions to each lake cell on a dry lake bottom equivalent to those added by the EVT1 module (McDonald and Harbaugh, 1988). An extinction depth is specified for each flat bottom lake to define the reduction of ET with depth. ET is zero if the lake is not dry. ET rate is equal to e when groundwater head is at the lakebed elevation, decreasing linearly to zero when groundwater head drops to extinction depth below the lake bottom. Simulated ET is included as part of the “groundwater inflow” and “evaporation” components of the lake water balance.

Other considerations arise in the computation of evaporation over a discrete time step in which a flat bottom lake is dry or becomes dry. Evaporation in this case is reduced from the maximum rate by limiting evaporation to lake inflow, reflecting the evaporation of all available water in only part of the time step. If, in addition, groundwater levels are close to the lake bottom, maximum ET rate is specified such that the sum of lake evaporation and maximum ET rate is equal to the evaporation rate e, reflecting evaporation for one part of the time step and ET for the other part.

1.1.5 Groundwater Flow

Groundwater flow into and out of the lake is computed based on the difference between lake water level and groundwater head at each lake cell, multiplied by lake cell conductance. The conductance of each lake cell is specified as described in Numerical Implementation below.

Conductance for each lake cell is adjusted based on water levels. Conductance is equal to the specified (maximum) conductance when either lake water level or groundwater level is above the lakebed maximum elevation. Conductance is equal to zero when water level is below the lakebed minimum elevation. Conductance decreases linearly for water levels between the lakebed maximum and lakebed minimum elevations.

Groundwater flow to or from lake cell n is computed as

$$Q_n = - C_n (\max[H_{LAKE}, BOTLK_n] - \max[H_n, BOTLK_n])$$

where

Q_n is the groundwater flux into the lake at lake cell n (L3/t).
C_n is the conductance of lake cell n (L2/t).
H_n is the groundwater head in lake cell n (L).
$BOTLK_n$ is the lakebed minimum elevation in lake cell n (L): If HLAKE > $BOTLK_n$, the lake is wet at lake cell n. If HLAKE < $BOTLK_n$, the lake is dry at lake cell n.

Total groundwater inflow and outflow to the lake are equal to the respective sum of inflows and outflows from each lake cell. Net rate of groundwater flow to the lake is computed as $Q_{gw} = \sum_n Q_n$.

1.2 NUMERICAL IMPLEMENTATION

1.2.1 Discrete Equation

The discrete equation for lake stage used by LAK2 for a MODFLOW time step may be written as

(1)
$$\frac{\Delta S}{\Delta t} = P - E + Q_{gw} + Q_{strin} - Q_{strout}$$

where

$\Delta S = \int_{t0}^{t0+\Delta t} A_{LAKE} \frac{\partial H_{LAKE}}{\partial t} dt$ is the change in lake storage during the time step
t_0 is the beginning of the time step
Δt is the length of the time step

1.2.2 Change in Lake Storage

Change in lake storage is computed as

$$\Delta S = \sum_{n=1}^{N} \left[\int_{h1_n}^{h2_n} A_n dh \right]$$

where

$Hnew_{LAKE}$ is lake stage at the end of the time step
$Hold_{LAKE}$ is lake stage at the beginning of the time step

$h1_n = \max[Hold_{LAKE}, BOTLK_n]$

$h2_n = \max[Hnew_{LAKE}, BOTLK_n$

The above equation can be written in the form

(2)
$$\Delta \mathrm{S} = \mathrm{D}_0 + \mathrm{D}_1 \mathrm{Hnew}_{\mathrm{LAKE}} + \mathrm{D}_2\ \mathrm{Hold}_{\mathrm{LAKE}}$$

where

$$\mathrm{D}_0 = \sum_{\{n\in[1,N]|Hnew_{LAKE}<BOTLK_n\}} \mathrm{A}_{\mathrm{n}} BOTLK_n - \sum_{\{n\in[1,N]|Hold_{LAKE}<BOTLK_n\}} \mathrm{A}_{\mathrm{n}} BOTLK_n$$

$$\mathrm{D}_1 = \sum_{\{n\in[1,N]|Hnew_{LAKE}>BOTLK_n\}} \mathrm{A}_{\mathrm{n}}$$

$$\mathrm{D}_2 = -\sum_{\{n\in[1,N]|Hold_{LAKE}>BOTLK_n\}} \mathrm{A}_{\mathrm{n}}$$

1.2.3 Precipitation

As above, lake precipitation is computed as

(3)
$$P = p\alpha A_{MAX} + p(1-\alpha)A_{LAKE}$$

1.2.4 Evaporation

As above, lake evaporation is computed as

(4)
$$E = eA_{LAKE}$$

1.2.5 Groundwater Flow

Groundwater flow to a lake is defined to be the sum of groundwater flow to each lake node:

(i)
$$Q_{\mathrm{gw}} = \sum_{n=1}^{N} \mathrm{Q}_{\mathrm{n}}$$

where

Q_{n} is the groundwater flux to lake node n (L^3/t).

(ii)
$$\mathrm{Q}_{\mathrm{n}} = -\mathrm{C}_{\mathrm{n}}(\max[\mathrm{H}_{\mathrm{LAKE}}, \mathrm{BOTLK}_{\mathrm{n}}] - \max[\mathrm{H}_{\mathrm{n}}, \mathrm{BOTLK}_{\mathrm{n}}])$$

where

H_{n} is the groundwater head in lake node n

C_{n} is the lake bed conductance at lake node n (L^2/t).

Equation (ii) may be written in the form

(iv)
$$Q_{\mathrm{n}} = \mathrm{R}_n + \gamma_{\mathrm{n}}\mathrm{H}_{\mathrm{LAKE}} + \beta_{\mathrm{n}}\mathrm{H}_{\mathrm{n}}$$

where

βn	=Cn	if	Hn>BOTLKn		
	=0	if	Hn<BOTLKn		
γn	= -Cn	if	HLAKE>BOTLKn		
	=0	if	HLAKE<BOTLKn		
Rn	=CnBOTLKn	if	Hn<BOTLKn	and	HLAKE>BOTLKn
	= -CnBOTLKn	if	Hn>BOTLKn	and	HLAKE<BOTLKn
	=0	if	Hn,HLAKE<BOTLKn	or	H_{n},$\mathrm{H}_{\mathrm{LAKE}}$>$\mathrm{BOTLK}_{\mathrm{n}}$

Combining equations (i) and (iv) yields an equation of the form

$$Q_{gw} = \alpha + \beta_0 H_{LAKE} + \sum_{n=1}^{N} \beta_n H_n \qquad (5)$$

where

$$\beta_0 = \sum_{n=1}^{N} \gamma_n$$

$$\alpha = \sum_{n=1}^{N} R_n$$

1.2.6 Lakebed Conductance

Lakebed conductance is specified by the LAK2 user. Conductance may be computed externally to the simulation as

C_n = (lakebed area)x(hydraulic conductivity)/(bed thickness).

Three models of lakebed conductance are shown on Figures 1.3a, b and c.

Lakebed area: If the lakebed is horizontal, then lakebed area is equal to lake cell surface area. Lakebed area may also be computed as lake cell surface area divided by the cosine of the average angle of lakebed inclination.

Hydraulic conductivity: Effective hydraulic conductivity for the zone crossed by the bold line in Figures 1.3a, b or c may be specified to compute conductance. If the lakebed is horizontal, a vertical hydraulic conductivity should be used. If the lakebed is vertical, a horizontal hydraulic conductivity should be used.

Bed thickness: Bed thickness for each of the three conductance models is indicated by the bold line in Figures 1.3a, b and c.

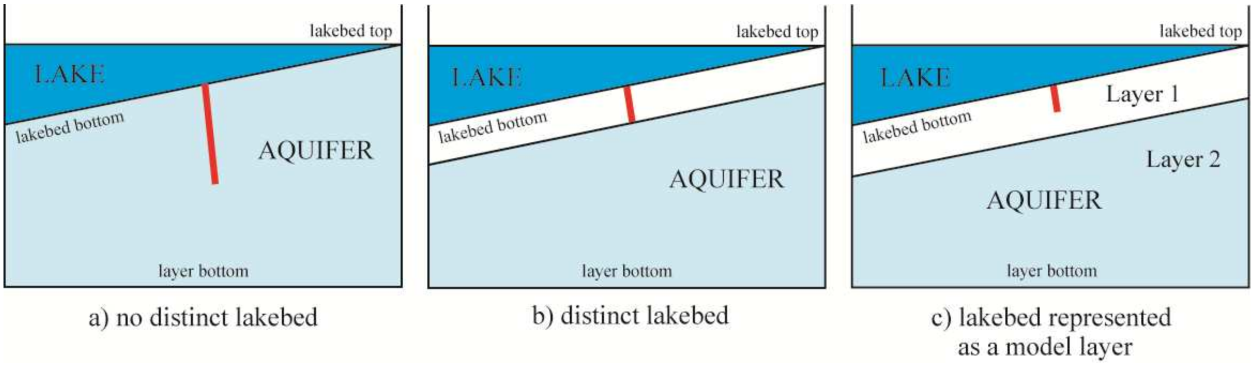

Figure 1.3. Models of lakebed conductance.

LAK2 adjusts conductance for each node to reflect partial saturation:

Let X= max (H_n,H_{LAKE}). Let $TOPLK_n$ = lakebed max elevation in lake cell n

1. If $X \geq TOPLK_n$, C_n is set to the user-specified conductance.
2. If $BOTLK_n < X < TOPLK_n$, C_n is set equal to the user-specified conductance times the factor

$$\left[\frac{X - BOTLK_n}{TOPLK_n - BOTLK_n}\right]$$

3. If $X \leq BOTLK_n$, C_n is set equal to zero

1.2.7 Interpolation of HLAKE

The lake stage used for computing Qgw in equations (3), (4) and (5) is defined by

(6) $$\mathrm{H}_{\mathrm{LAKE}} = \theta Hnew_{LAKE} + (1-\theta)Hold_{LAKE} \quad ,$$

where

θ is a specified explicit/implicit parameter, with 0≤θ≤1.

θ=0 is the explicit formulation of lake stage,
θ =1 is the implicit formulation of lake stage and
0<θ<1 is an intermediate formulation of lake stage.

In the explicit formulation, lake stage at the beginning of a time step is used to compute flow between the lake and the aquifer. Lake stage is updated at the end of each time step. The explicit formulation converges most easily, but is unstable for large time steps.

In the implicit formulation, lake stage at the end of a time step is used to compute flow between the lake and the aquifer. Lake stage is updated at the end of each iteration of the groundwater flow equation.

In an intermediate formulation, an intermediate stage is used to compute flow between the lake and the aquifer. Lake stage is updated at the end of each iteration of the groundwater flow equation.

The implicit formulation is used for all of the applications presented here, matching the implicit formulation of groundwater flow equations used by the Modflow module BCF.

1.2.8 Numerical Equation

The LAK2 code substitutes equations (2), (3), (4), (5) and (6) into equation (1) to get an equation for lake stage in the following form:

$$\alpha_0 Hnew_{LAKE} + \sum_{\mathrm{n}=1}^{\mathrm{N}} \beta_{\mathrm{n}} \mathrm{H}_{\mathrm{n}} = RHS_{LAKE}$$

(7)

where

$$\alpha_0 = \frac{D_1}{\Delta \mathrm{t}} + \theta\beta_0$$

$$R\mathrm{HS}_{\mathrm{LAKE}} = \frac{D_0}{\Delta \mathrm{t}} + \frac{D_2}{\Delta \mathrm{t}} Hold_{\mathrm{LAKE}} + P - E + Q_{strin} - Q_{strout} + \alpha + (1-\theta)\beta_0 Hold_{\mathrm{LAKE}}$$

equation (7) may be solved as

$$Hnew_{LAKE} = \frac{1}{\alpha_0}\{RHS_{LAKE} - \sum_{\mathrm{n}=1}^{\mathrm{N}} \beta_{\mathrm{n}} \mathrm{H}_{\mathrm{n}}\}$$

.

Because the equations for lake stage are nonlinear, equation (7) is formulated iteratively. Equation (7) is formulated and solved until computed lake stage in successive iterations changes by less than a specified tolerance, or until the specified maximum number of iterations are performed.

After completing iteration of equation (7), LAK2 modifies the groundwater flow equation for each lake node to reflect flow between aquifer and lake. Inserting equation (6) into equation (iv) above yields a modified form of equation (iv):

(iv’)

$$Q_{\mathrm{n}} = \mathrm{R}'_n + \gamma'_{\mathrm{n}} \mathrm{Hnew}_{\mathrm{LAKE}} + \beta_n \mathrm{H}_{\mathrm{n}}$$

where

$\gamma'_n = \gamma_n \theta$

$R'_n = R_n + \gamma_n (1-\theta) Hold_{LAKE}$

LAK2 modifies the MODFLOW equation for each lake node according to equation (iv’) by adding boundary conditions to the HCOF and RHS arrays of the MODFLOW equation:

β_n is added to the HCOF entry for lake node n.

The term $R'_n + \gamma'_n Hnew_{LAKE}$ is added to the RHS array entry for lake node n.

On the subsequent iteration of the main MODFLOW equation, the iterative formulation and solution of lake stage is repeated and the MODFLOW equation is again modified.

1.3 Input Instructions

Input consists of parameters for the entire simulation, parameters for each lake, parameters for each lake and stress period and parameters for each lake node.

Parameters for the entire simulation include the following:

1. Total number of lake cells.
2. Number of lakes.
3. Unit number for main lake output file.
4. Unit number for cell by cell output.
5. Unit number for lakebed zone budget output.
6. Explicit/implicit parameter THETA.
7. Head change convergence criteria used in lake stage computation.
8. Maximum number of iterations allowed in lake stage computation.
9. Flow change convergence criteria, used when lake stage is at spill elevation.
10. Total number of river reaches flowing into lakes

Parameters for each lake include the following:

1. Number of lake cells
2. Initial water stage
3. Listing of inflowing river reaches, if any
4. Identification of outflowing river reach, if any
5. Spill elevation (lakes with outflowing river reaches only)
6. ET extinction depth (flat bottomed lakes only).

Parameters for each lake and stress period include the following:

1. Precipitation (L),
2. Evaporation (L) and
3. Pumping to/from the lake(L^3/t)

The following are input for each lake cell:

1. Lakebed maximum elevation (L),
2. Lakebed minimum elevation (L),
3. Water surface area (L^2),
4. Conductance (L^2/t)
5. Runoff coefficient ()
6. Zone number, for groundwater zone budgets. Groundwater flow to and from lake nodes may be broken down by zones. This allows, for example, computation of pit lake chemical balances based on groundwater flow from different rock types. Each lake node is assigned a zone number. Flow totals into and out of each zone are computed.

1.3.1 Input Records

For Each Simulation:
Record 1.

variable:	MXLKND	NLAKES	ILKC1	ILKC2	ILKC3	THETA	TOL	MXITER	TOL2	MXRIVIN
format:	I10	I10	I10	I10	I10	F10.0	F10.0	I10	F10.0	I10

For Each Lake:
Record 2. Read NLAKES times.

variable:	NODES	STAGE0	NRVIN	KRVOT	XSPIL	EXDP
format:	I10	F10.0	I10	I10	F10.0	F10.0

Record 3: Read when NRVIN > 0.

variable:	IRI(NRVIN)
format:	*

For Each Lake Node:
Record 4. Read MXLKND times.

variable:	ILAY	IROW	ICOL	COND	BOT	TOP	XAREA	IBZON	RUNCOF
format:	I10	I10	I10	F10.0	F10.0	F10.0	F10.0	I10	

For Each Stress Period:
Record 5.

variable:	ITMP
format:	I10

Record 6. Read NLAKES times.

variable:	XEVAP	XPREC	Q
format:	F10.0	F10.0	F10.0

1.3.2 Explanation of Variables

Record 1. Read once for a simulation/
MXLKND: total number of lake nodes.
NLAKES: number of lakes.
ILKC1: unit number for main lake output file.
ILKC2: flag and unit number for cell by cell output.
ILKC3: flag and unit number for lakebed zone budget output.
THETA: explicit/implicit parameter.
TOL: head change convergence criteria used in lake stage computation.
MXITER: maximum number of iterations allowed in lake stage computation.
TOL2: flow change convergence criteria, used when lake stage equals spill elevation.
MXRIVIN: total number of river reaches flowing into lakes

Record 2. Read NLAKES times.
NODES: number of nodes representing lake.
STAGE0: initial lake stage.
NRVIN: number of RIV2 reaches flowing into lake.
KRVOT: reach number of RIV2 reach flowing out of lake.
XSPIL: spill elevation for lake (L).
EXDP: extinction depth for playa surface.

Record 3. Read when NRVIN > 0.
IRI(NRVIN): reach numbers of RIV2 reaches flowing into lake.

Record 4. Read MXLKND times.
ILAY: layer of lake node.
IROW: row of lake node.
ICOL: column of lake node.
COND: maximum conductance of lake node (L2/t)
BOT: lowest lake bed elevation within lake node.
TOP: highest lake bed elevation within lake node.
XAREA: maximum area of horizontal water surface for node.
IBZON: zone number of lake node, used in computation of lakebed zone budget.
RUNCOF: runoff coefficient for lake node, defined to be the fraction of precipitation falling draining directly to lake ().

Record 5. Read once for each stress period.
ITMP: flag for reading evaporation rate, precipitation rate, and spill elevatiion.
If ITMP>0, record 7 is read.
If ITMP<0, values from the previous stress period are used.

Record 6. Read NLAKES times when ITMP>0.
EVAP: lake evaporation rate for stress period (L/t)
PRECIP: lake precipitation rate for stress period (L/t)
Q: pumping/withdrawal rate from lake (L3/t). A negative value signifies addition of water to the lake.

1.4 CODE VERIFICATION

1.4.1 Example 0: Large-diameter well recovery

The LAK2 stage computation is tested using a pair of MODFLOW simulations. Water level recovery in a large diameter well is simulated in two different ways, with and without LAK2. Results are then compared to confirm the basic functioning of the code.

1.4.2 Example 0a: Without LAK2

A sample grid is constructed with 100 rows, 100 columns and 2 layers. Each column and row has a width of 1000 units. A confined layer type (type 0) is specified. Initial head is specified as 0, except for a group of four layer 1 cells in the center of the grid (Fig. 1.4). The initial head at these cells is specified as -100. Storage coefficient is specified as 1 at the four cells and .001 everywhere else, Transmissivity for each layer is specified everywhere as .001 square units per second. Vertical conductance is specified as 10-9 /second. A 100 year recovery is simulated. By symmetry, head in each of the group of four cells is the same.

1.4.3 Example 0b: With LAK2

The model grid and aquifer parameters from the large diameter well recovery are retained. The four cells are specified as inactive cells. A lake is specified using twelve LAK2 cells as shown in Figure 1.4. An implicit lake stage computation is selected. Initial lake stage is specified as -100. Lake evaporation and precipitation are specified as 0. The four lake cells in the center are placed in layer 2 and are considered to lie underneath a horizontal lake bed. The eight cells on the perimeter are placed in layer 1 and are considered to lie next to a vertical lake bed.

Area of each of the four lake cells in the center is specified as row width times column width, or 10^6 square units. Area of the eight remaining lake cells is specified as zero.

Conductance of each of the four lake cells in the center is specified as vertical conductance times cell area, or 10^{-3} square units per second. Conductance of the eight lake cells on the perimeter is specified as transmissivity times row width divided by column width, also 10^{-3} square units per second. Lakebed minimum and maximum for each lake cell are specified at a level below initial stage, leading to constant conductance for each lake cell throughout the simulation.

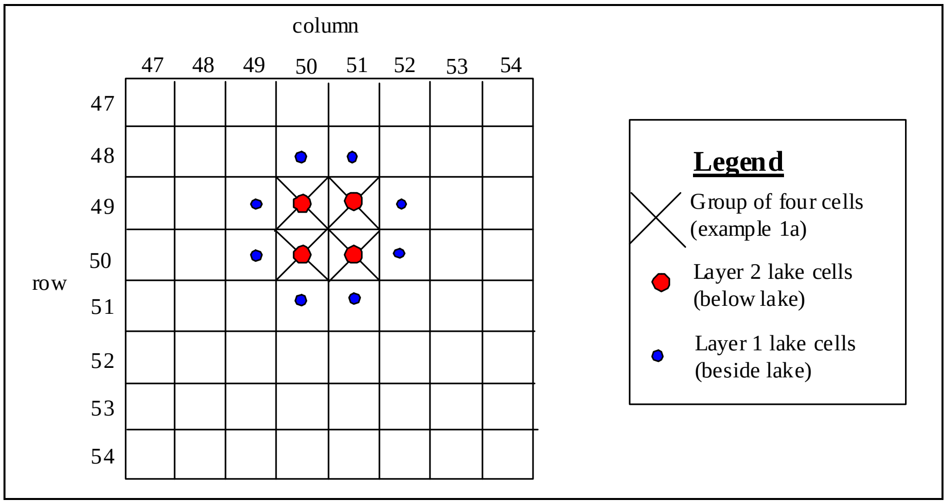

Figure 1.4. Layout of examples 0a and 0b.

1.4.4 Comparison of Results

The results of example 0a and example 0b are expected to be identical because

1. The specified area of the lake cells in example 0b matches the specified area of the group of four cells in example 0a. The storage coefficient of the group of four cells is specified as 1. The storage capacity of the lake is therefore identical to that of the group of four cells.
2. The specified conductances of the lake nodes match the specified horizontal and vertical conductances of Example 0a. In addition the lake node conductances are constant because lakebed elevations are specified below lake stage. Water is therefore transmitted to the lake at the same rate as to the group of four cells.
3. Heads in the group of four cells in example 0a are symmetric. The group of four cells is therefore represented by a single head, analogous to lake stage.
4. An implicit lake stage computation is used in example 0b. Example 0a, like most MODFLOW simulations, uses an implicit computation.

Head in the group of four cells of example 0a and stage in the lake of example 0b, both shown on Figure 1.5, are identical. Further inspection confirms that budget terms for the two simulations are also identical.

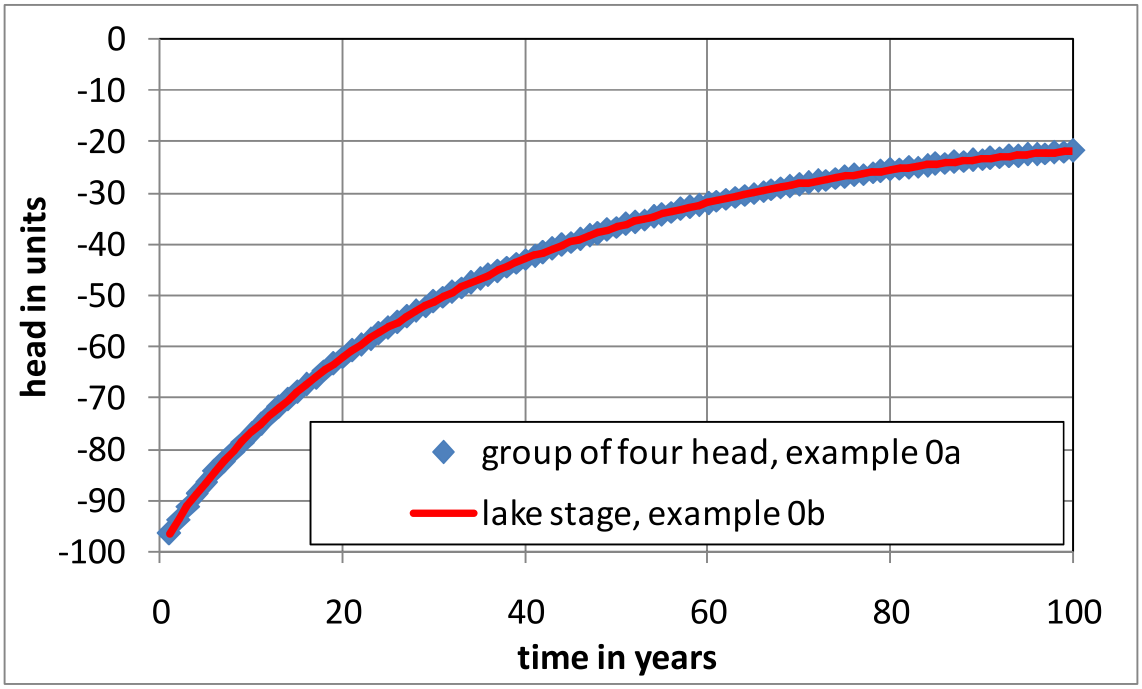

Figure 1.5. Comparison of water levels in examples 1a and 1b.

2.0 APPLICATION: ARCHIMEDES PIT

LAK2 was used to project the post-mining recovery of water level in the Archimedes pit near Eureka, Nevada. The pit bottom topography and pit surface catchment area are shown on Figure 2.1.

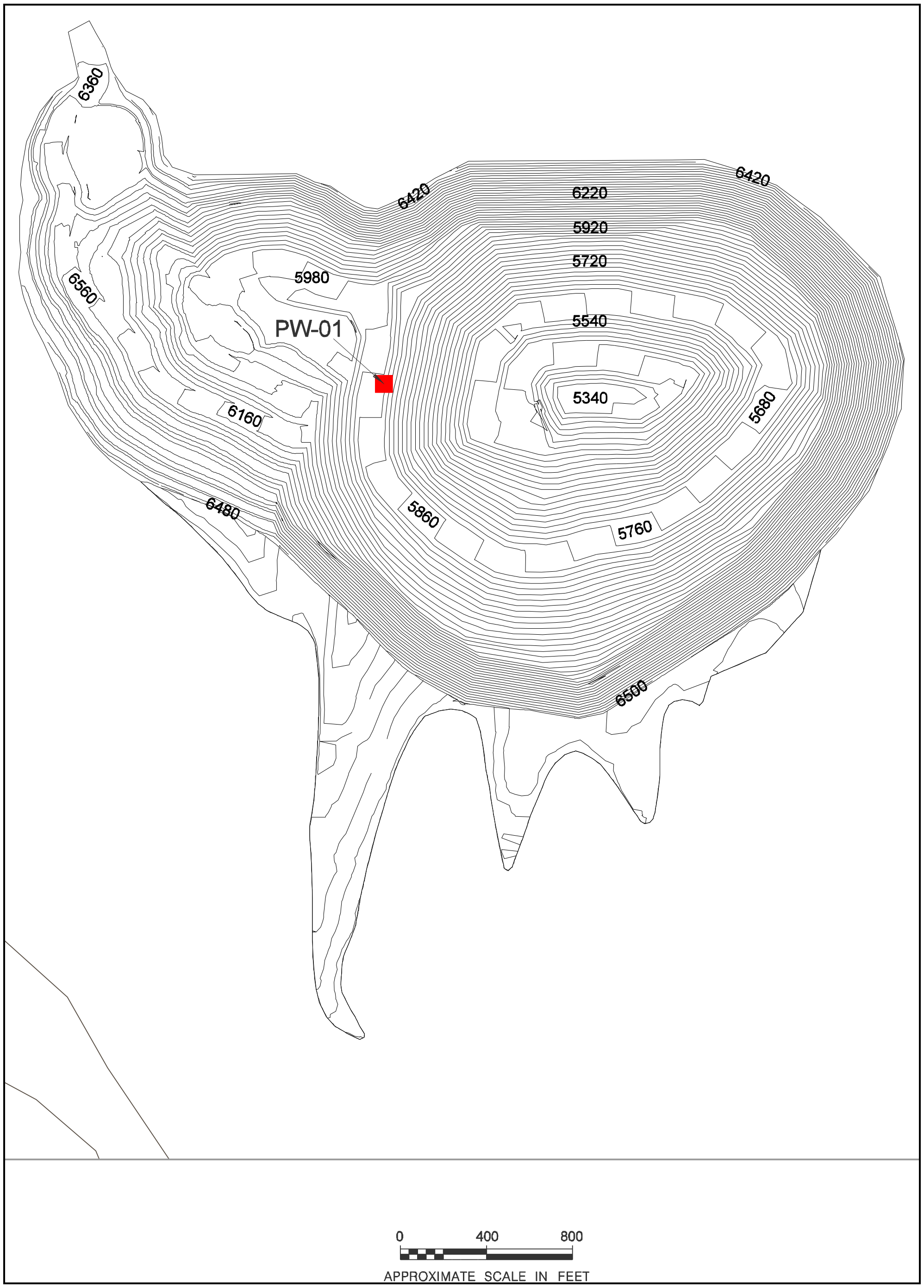

Figure 2.1. Ultimate pit contours.

The pit geometry was represented using LAK2 as described in Section 1 above, as a list of model cell locations. For each cell location, the following geometric parameters are spedified:

- Lowest pit bottom elevation within cell
- Highest pit bottom elevation within cell
- Maximum water surface area of each cell

The contribution of each cell to total open water surface area increases linearly from zero at the lowest pit bottom elevation, to the maximum area at the highest pit bottom elevation. Total water surface is computed as the sum of the area contributed by each cell.

The lowest and highest pit bottom elevations were initially assigned based on the contour map. Maximum open water surface was initially assigned to be the plan area of the MODFLOW finite difference grid cell.

The geometric parameters were then calibrated. The simulated lake bed elevations were adjusted to best reflect the actual increase of area with elevation for the portion of pit bottom within each cell. The measured and modeled pit stage-area-volume relationship is shown on Figure 2.2.

In addition to the pit geometry, the following inputs were required to simulate pit filling:

- Annual precipitation was estimated at 11.72 inches, based on records from the Eureka weather station (Western Regional Climate Center, 2004).
- A runoff coefficient of 0.15 was assumed for the pit catchment of about 210 acres.
- Annual lake evaporation was estimated at 45 inches (NOAA, 2004).

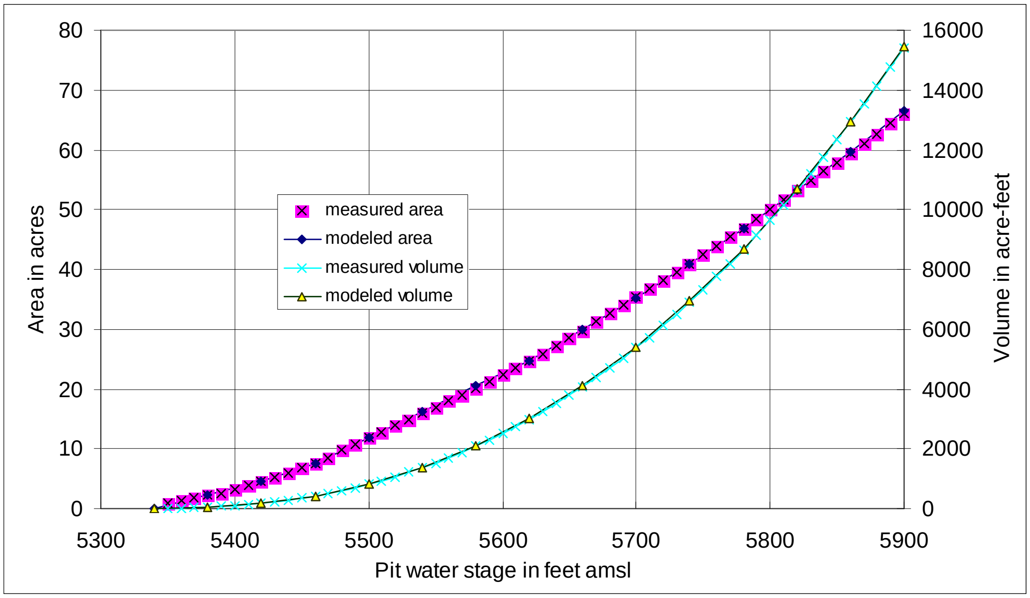

Figure 2.2. Measured and modeled pit stage-area-volume.

2.1 Changes to Original Groundwater Flow Model

Changes were also made to the specifications of aquifer geometry in MODFLOW module BCF, to reflect the presence of the pit: The layer top elevation, at which water level the layer becomes confined, was set equal to the mean of the low and high pit bottom elevations for each LAK2 cell.

2.2 Pit Filling

Recovery of water level after the end of active dewatering was simulated as described above. The projected pit water level is presented on Figure 2.3. The final equilibrium pit elevation is predicted to be 5861 feet amsl. The pit is projected to fill to 95% of recovery (elevation 5835 feet amsl) about 39 years after the end of active dewatering.

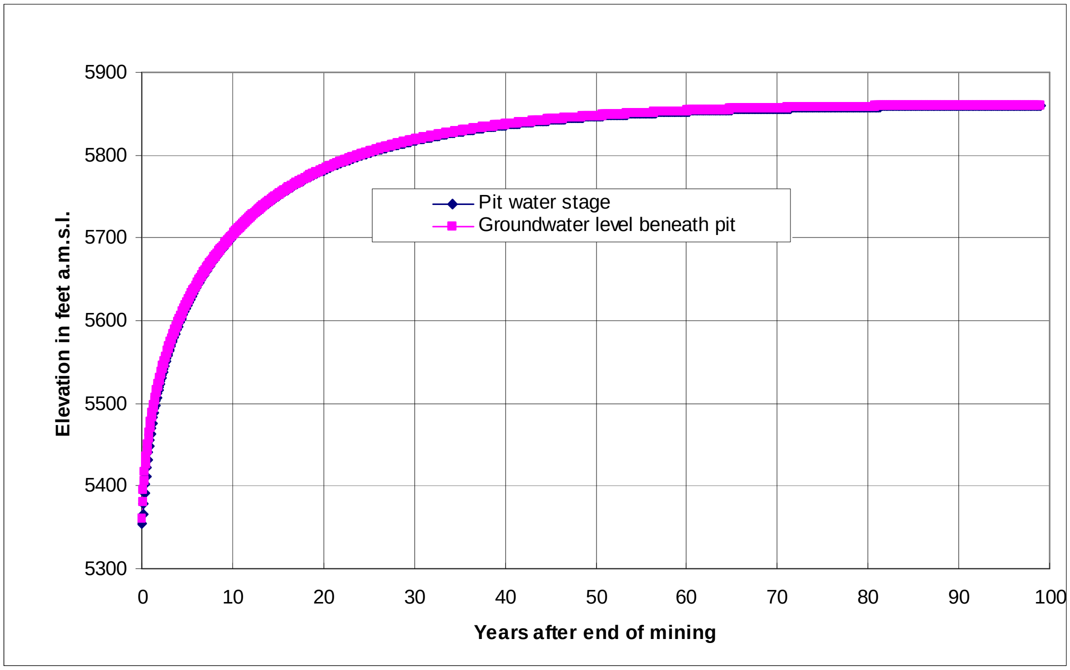

Figure 2.3. Projected pit water stage.

The projected pit water surface area and volume are presented on Figure 2.4. The final pit water surface area is predicted to be 60 acres. The final pit water volume is predicted to be 13,000 acre-feet.

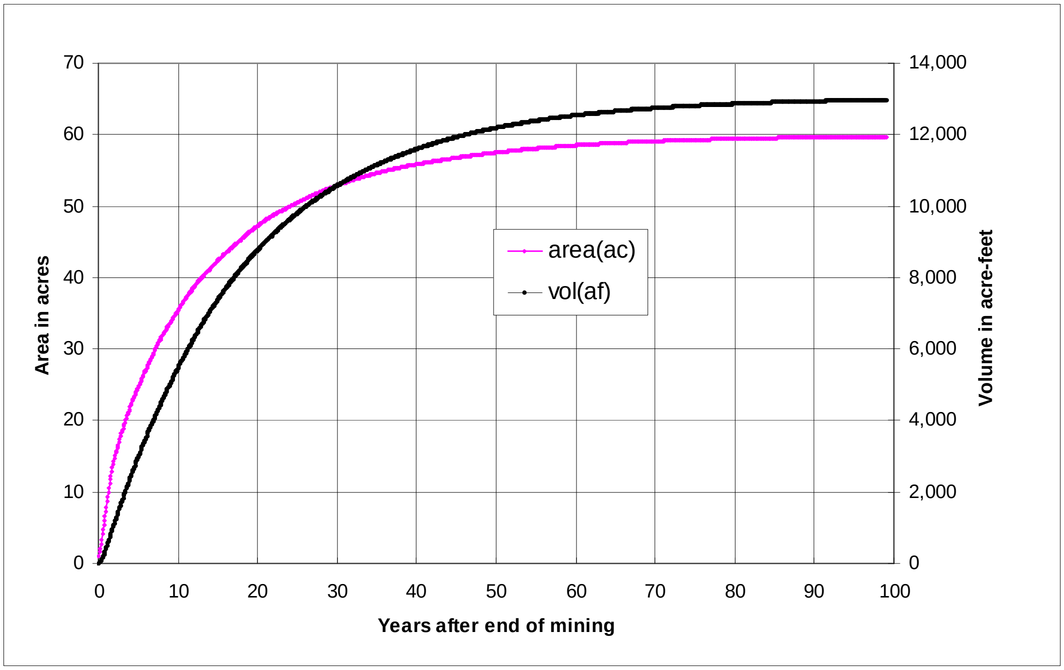

Figure 2.4. Projected pit water surface area and volume.

The projected pit water budget components are presented on Figure 2.5. The final average annual pit evaporation is predicted to be about 140 gpm. Groundwater outflow is predicted to be zero.

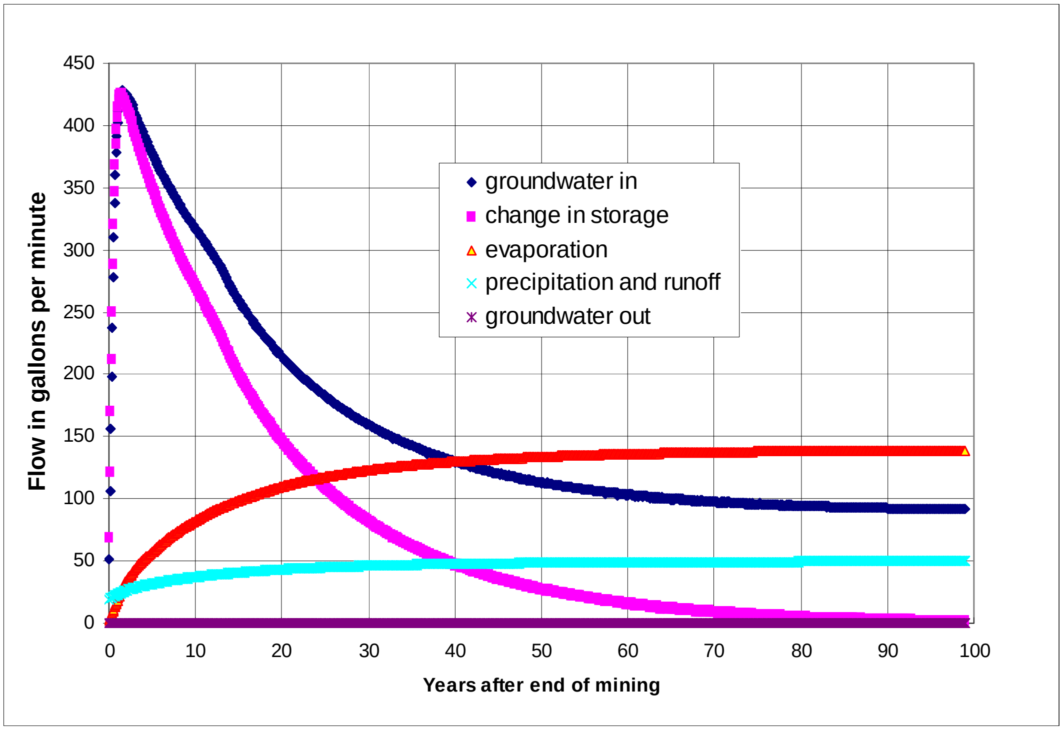

Figure 2.5. Projected pit water budget.

A map of the geochemical types exposed in the pit was provided. The units include:

- Oxide limestone (OgO)
- Oxide intrusive (KgO)
- Sulfide limestone (OgS)
- Sulfide intrusive (KgS)
- Alluvium (Qtal)
- Volcanic Tuff

The map of geochemical types was used to estimate the portions of pit inflow attributable to each unit, for use in projections of pit water chemistry. Groundwater inflow from each geochemical type is shown on Figure 2.6. Inflow from direct precipitation and from runoff over each geochemical type is shown on Figure 2.7.

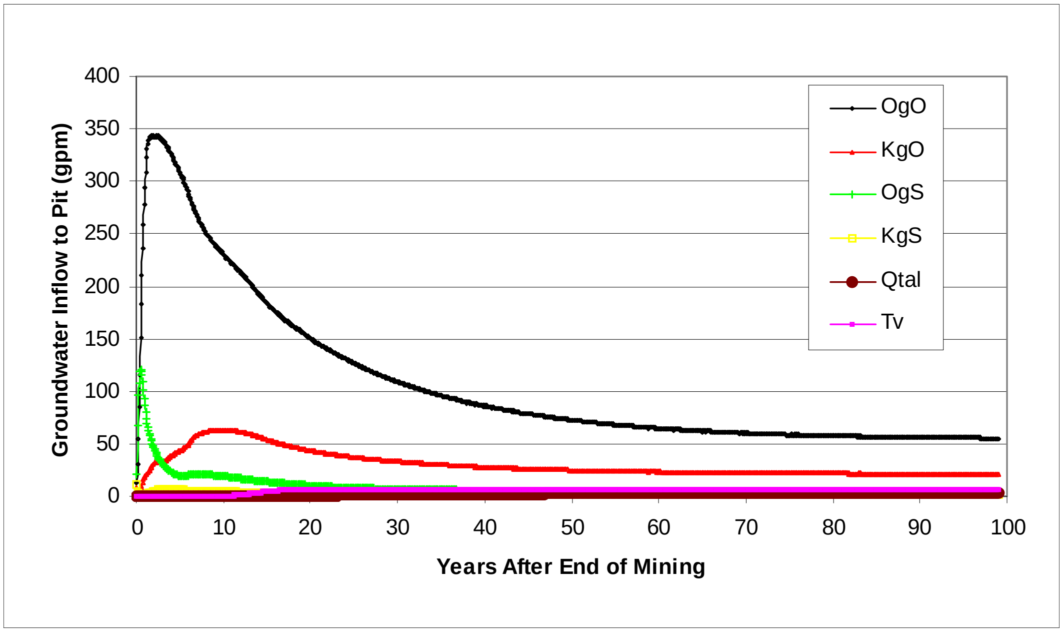

Figure 2.6. Groundwater inflow to pit by geochemical type.

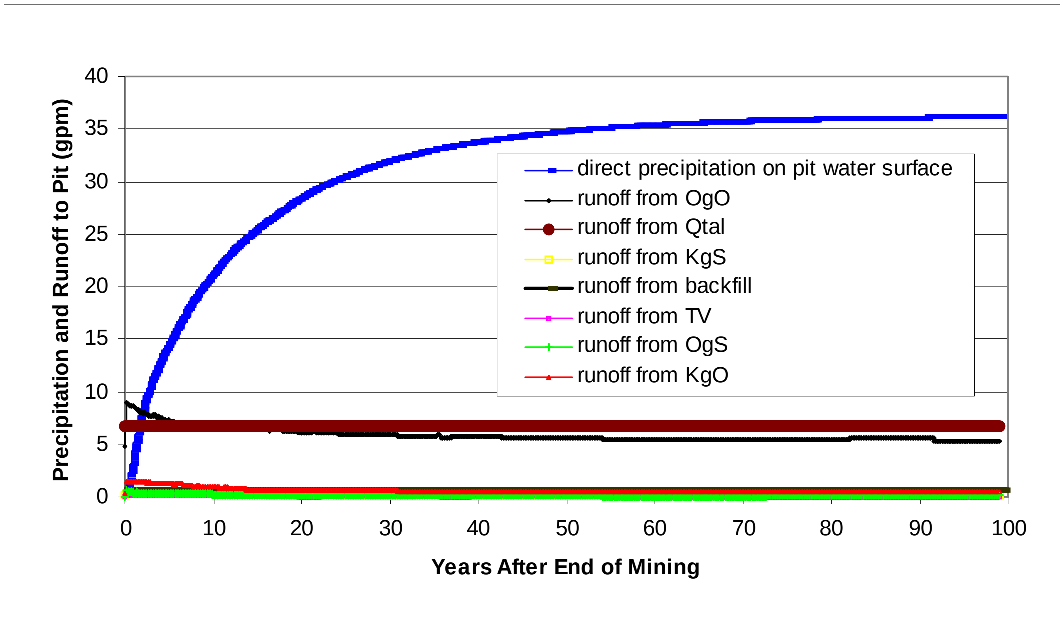

Figure 2.7. Precipitation and runoff to pit by geochemical type.

3.0 APPLICATION: ORTIZ PIT

LAK2 was used to calibrate a groundwater flow model to the measured history of mine dewatering and post-mining water level recovery in the Ortiz pit, near Cerrillos, New Mexico. Measured and simulated groundwater levels during mine dewatering, and measured and simulated post-mining pit water levels, are shown on Figure 3.1.

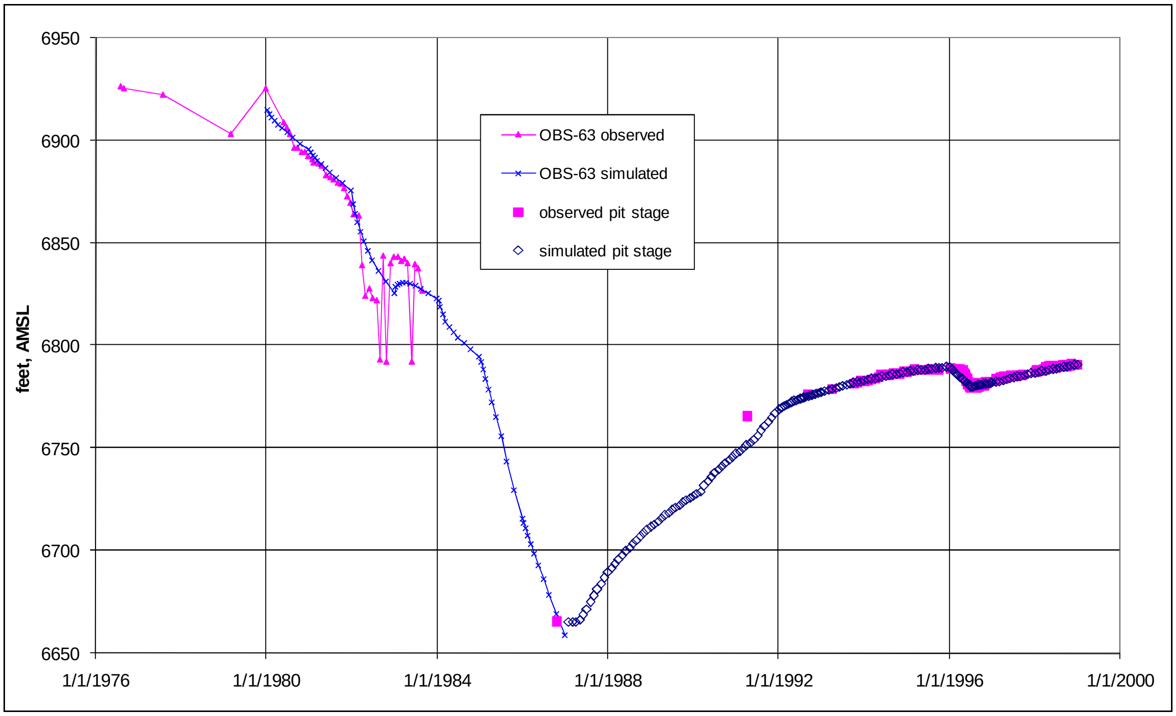

Figure 3.1. Measured and simulated historical water levels (JSAI, 1999).

The model was then used to project long-term water levels and the effect of diverting runoff from the up-gradient watershed into the pit, in order to submerge the acid seeps on the pit wall, which were adversely impacting pit water quality. Runoff from the watershed was estimated using the SCS curve number method. A series of projections of water level was developed, including, “normal”, “wet” and “dry” scenarios

4.0 APPLICATION: BELEN MUNICIPAL WELL

This section describes a problem that occurred with an application of the Middle Rio Grande Administrative (MRGA) model (Barroll, 2001), used to administer water rights in the Middle Rio Grande basin of New Mexico. The problem and its cause are analyzed and a solution is presented that utilizes LAK2 to more accurately represent pumping from a well.

4.1 The Problem

The Middle Rio Grande Administrative model (Barroll, 2001) has been employed in an attempt to evaluate the depletion effects of an additional 325 afy of groundwater pumping from the Belen municipal wells.

The results of the exercise are shown on Figure 4.1 which presents the simulated depletion, computed as the sum of the differences in total streamflow gain, streamflow loss and evapotranspiration between the base case model simulation and a simulation including the additional 325 afy of groundwater pumping. Also shown on Figure 4.1 is the portion of the additional pumping supplied by groundwater storage, rather than by depletion.

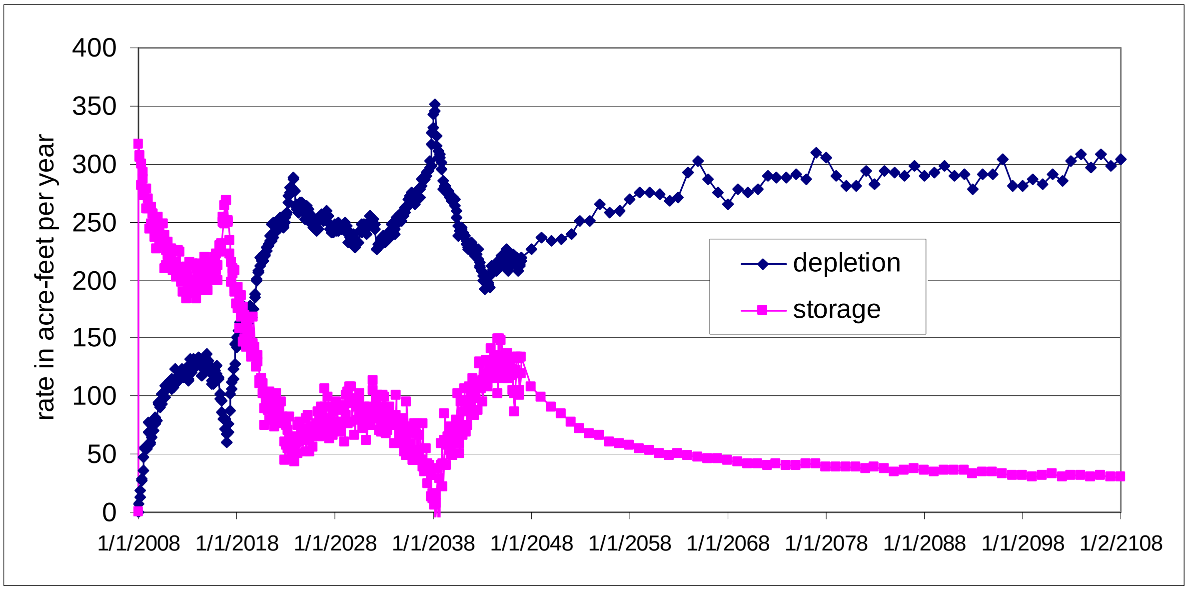

Figure 4.1. Model simulated depletion resulting from 325 afy additional pumping from belen municipal wells.

As can be seen in Figure 4.1, the results are suspicious. Instead of a steady increase in depletion from zero to 325 afy, with a corresponding decrease in the storage component from 325 afy to zero, the graph includes periods of increasing and decreasing depletion, with minima and maxima in between.

4.2 The Cause

The unexpected features of the graph shown on Figure 4.2 are the result of a dry cell in layer 2, row 100, column 37 of the model grid (corresponding to City of Belen Well 1). The cell becomes dry in both the base case simulation, in April 2038, and in the simulation with 325 afy additional pumping, in January 2017.

Simulated water levels for the cell that becomes dry, and for the cells immediately above and below, are presented for the base case ("without") and for the simulation with additional pumping ("with") in Figure 4.2.

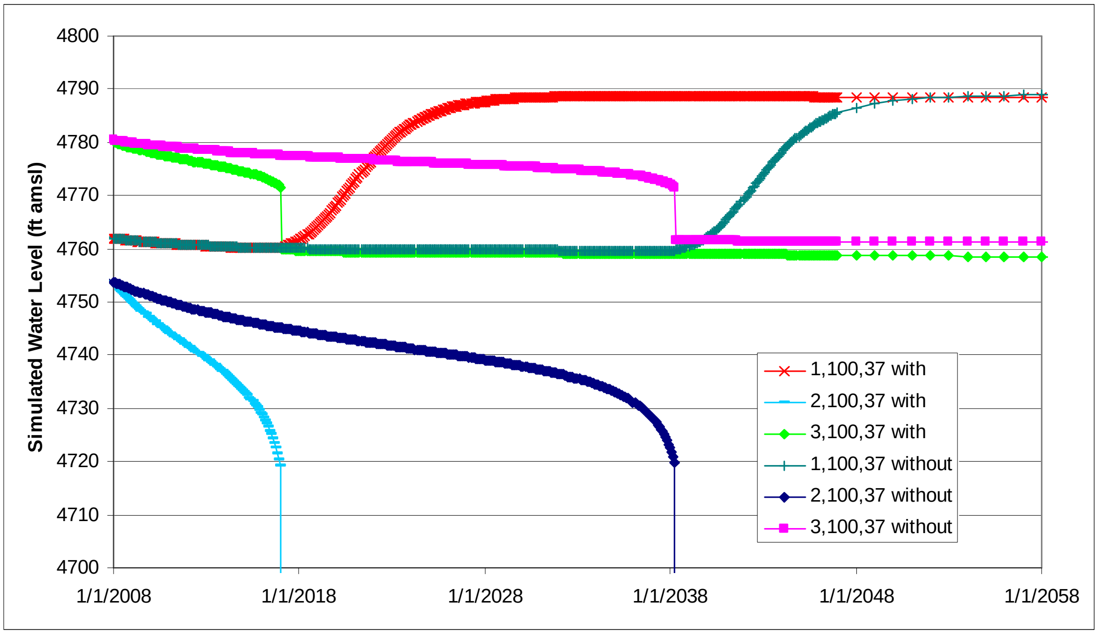

Figure 4.2. Simulated water levels in model cells in row 100, column 37.

In order to preserve simulated pumping rates, the convention adopted with the MRGA model is to shift pumping down a layer whenever a cell becomes dry (Barroll, 2001). Consequently a sharp drop in the layer 3 water level is shown on Figure 2 at the point when layer 2 becomes dry. In addition, the removal of the connection to layer 2 causes water level in layer 1 to begin to rise at the same time.

The correlation between the simulated depletion curve on Figure 4.1 and the simulated water levels on Figure 4.2 is shown graphically on Figure 4.3. Essentially, the dry cell causes discontinuities in the equations used to describe the groundwater flow system. The discontinuities occur at different times in the two simulations, impacting the depletion calculation (the difference between the two simulations) at both times.

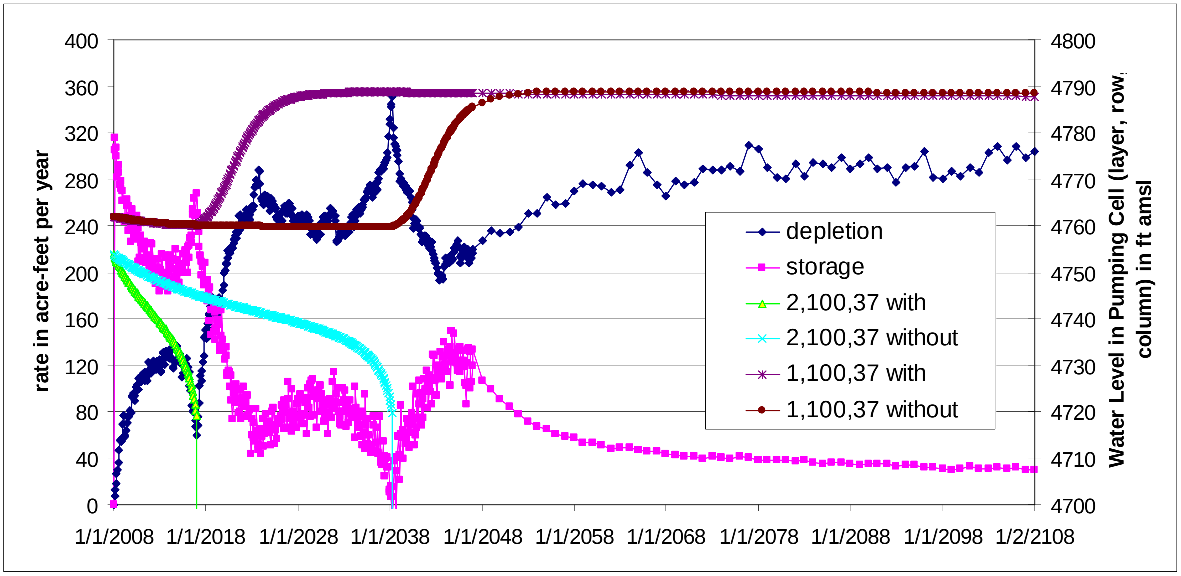

Figure 4.3. Simulated depletion and water levels.

4.3 A Solution

The problem can be addressed by restoring continuity to the equations describing the groundwater flow system. One way to do this is to represent the pumping in both layers 2 and 3. A difficulty with this approach is that results can be sensitive to the division of pumping between the layers. Proper division of pumping should be proportional to the conductivity of each layer, to the saturated screened interval and, if pumping water level is above the bottom of the screened interval, the difference between groundwater level in each cell and water level in the well bore.

The two model simulations were repeated representing the pumping in both layer 2 and layer 3. In order to properly partition the pumping, the well bore was explicitly represented in the model using LAK2 as a generic tool to represent open spaces, including well bores, connecting multiple model cells. Flows between model cells and the well are computed based on conductance terms, groundwater level in the cell, water level in the open space and elevation of the interface between the cell and the open space. The mass balance equation for the well considers the geometry of the space (a function of bore radius) and source/sink terms (pumping rate).

Results are presented in Figure 4.4.

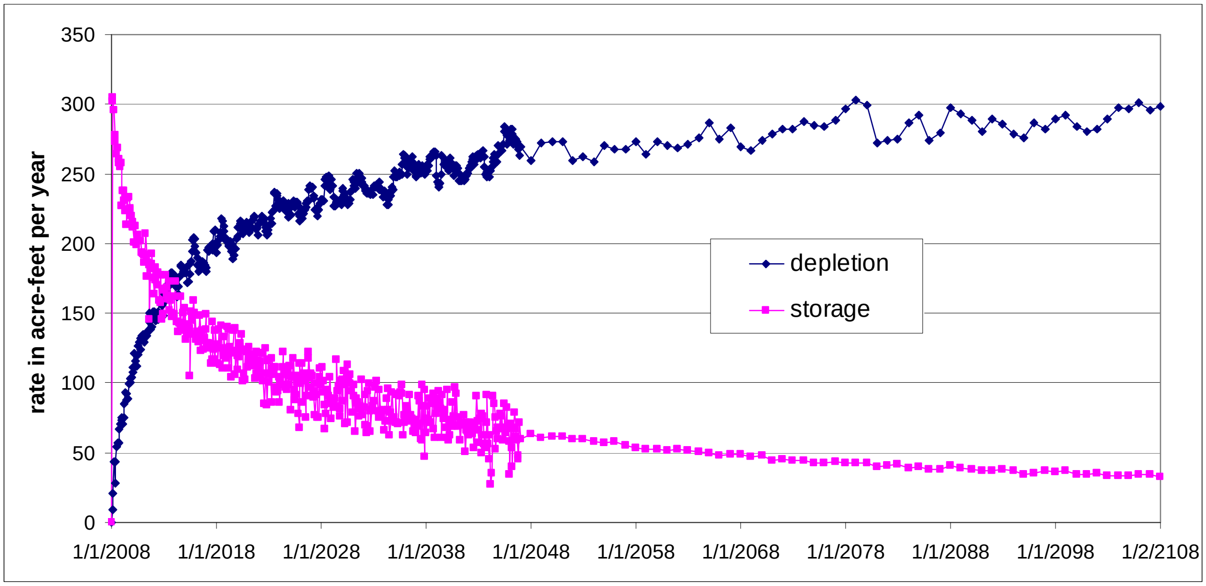

Figure 4.4. Model simulated depletion resulting from 325 afy additional pumping from Belen municipal wells, with pumping from two layers.

The oscillations remaining in the simulated depletion curve are a result of the small mass balance errors in the underlying groundwater flow simulation. These can be reduced through tighter convergence criteria, more iterations and longer run times.

5.0 APPLICATION: FAN SEDIMENTS AQUIFER TEST

LAK2 was used to simulate in-bore water levels in the analysis of aquifer test results. A numerical model was prepared to characterize the “Fan Sediments” colluvial aquifer .

A 21-day aquifer test was conducted. Three production bores, FSWW004-PB, FSWW013-PB, and FSWW020-PB, were pumped simultaneously at an average rate of about 35 liters per second each. Drawdown and recovery were measured in a total of 24 bores including:

- three pumping bores
- an observation bore located near each pumping bore, completed at a similar depth
- an observation bore located near each pumping bore, completed at a shallow depth
- a shallow observation bore located about 1 km from each pumping bore, in the area of the infiltration of pumped water
- regional observation bores, with deeper completions

A numerical model was developed to analyze the aquifer test in detail, considering saturated units above and below the production zone and responses measured in shallow, intermediate, and deep piezometers.

An observation bore is located near each pumping bore, within the same model cell, completed at a similar depth as the pumping bore. The drawdown at each model cell with a pumping bore was calibrated to match drawdown at the nearby observation bore.

In addition, water level in the pumping bore was represented directly using LAK2, in order to characterize the bore efficiency component of drawdown and to characterize the potential range of in-bore head losses that may be encountered in future production bores. The conductivity of each bore skin (the resistance to flow between aquifer and bore hole) was calibrated to match the measured pumping bore drawdown.

The water levels in observation bores FSWW012-MB and FSWW022-MB were also represented with the LAK2 module. Response in both bores to aquifer test pumping was found to be impacted by borehole problems, the first with an apparently blocked annulus and the second with apparent borehole leakage from a deeper formation. The LAK2 results help to confirm the explanation of borehole processes as the cause of each bore’s anomalous response.

Measured and simulated drawdown in pumping bore FSWW004-PB and in nearby monitoring bore FSWW003-MB are shown in Figures 5.1 and 5.2.

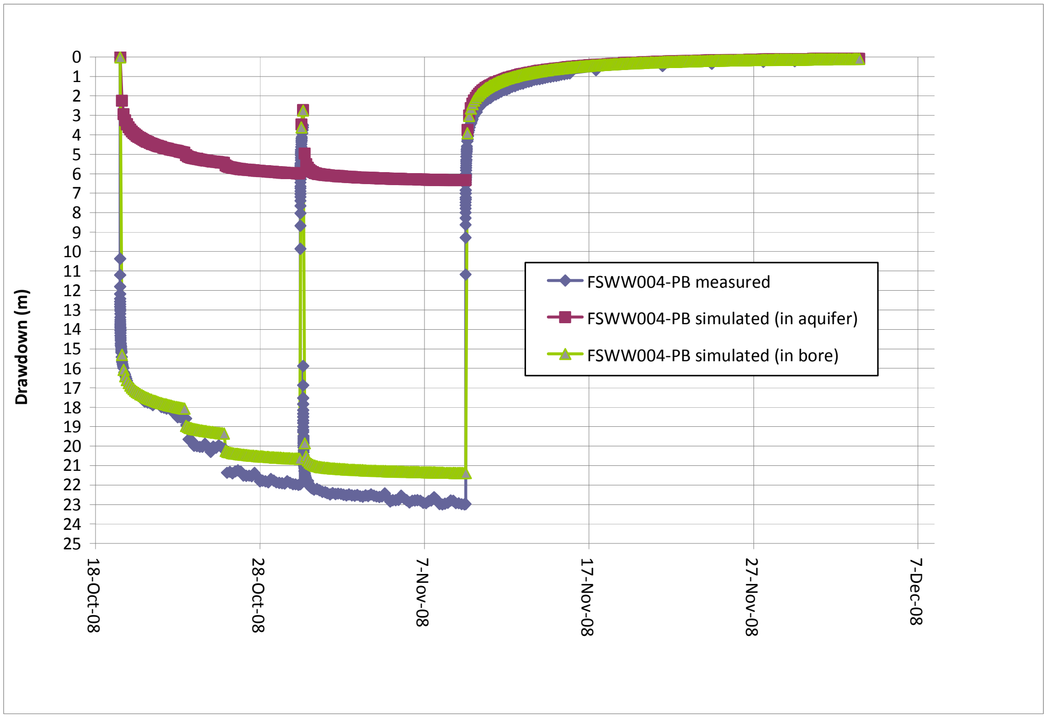

Figure 5.1. Measured and simulated aquifer test drawdown, FSWW004-PB.

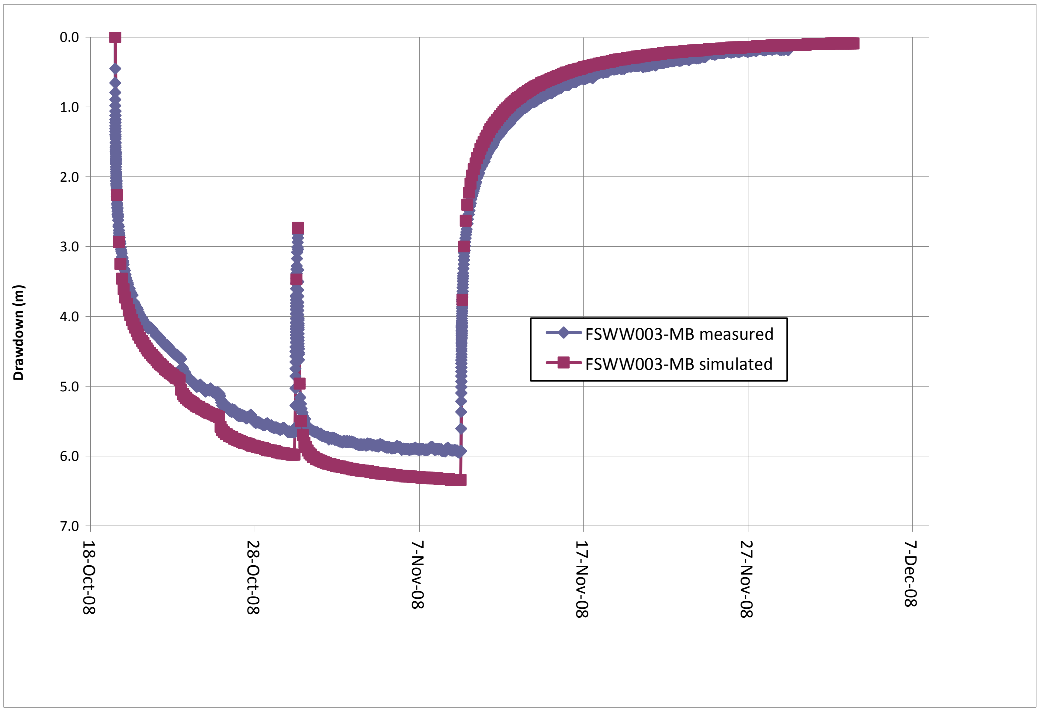

Figure 5.2. Measured and simulated aquifer test drawdown, FSWW003-MB.

Measured and simulated drawdown in pumping bore FSWW013-PB and in nearby monitoring bore FSWW010-MB are shown in Figures 5.3 and 5.4.

Measured and simulated drawdown in shallow observation bore FSWW022-MB is shown in Figure 5.5. The rapid and sharp response is characteristic of borehole leakage rather than water table drawdown. The apparent vertical connection observed in FSWW022-PB is likely a local borehole phenomenon. This was verified using LAK2 to simulate a bore in hydraulic communication with both Layers 1 and 2, resulting in a reasonably close reproduction of measured water levels.

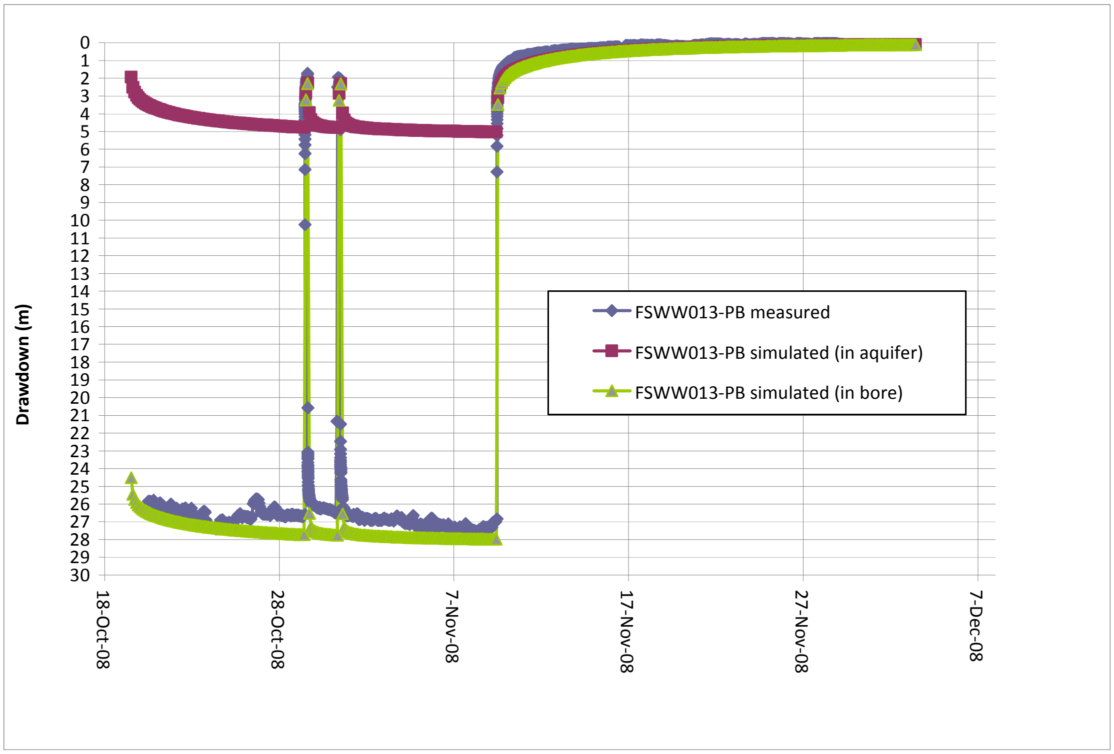

Figure 5.3. Measured and simulated aquifer test drawdown, FSWW013-PB.

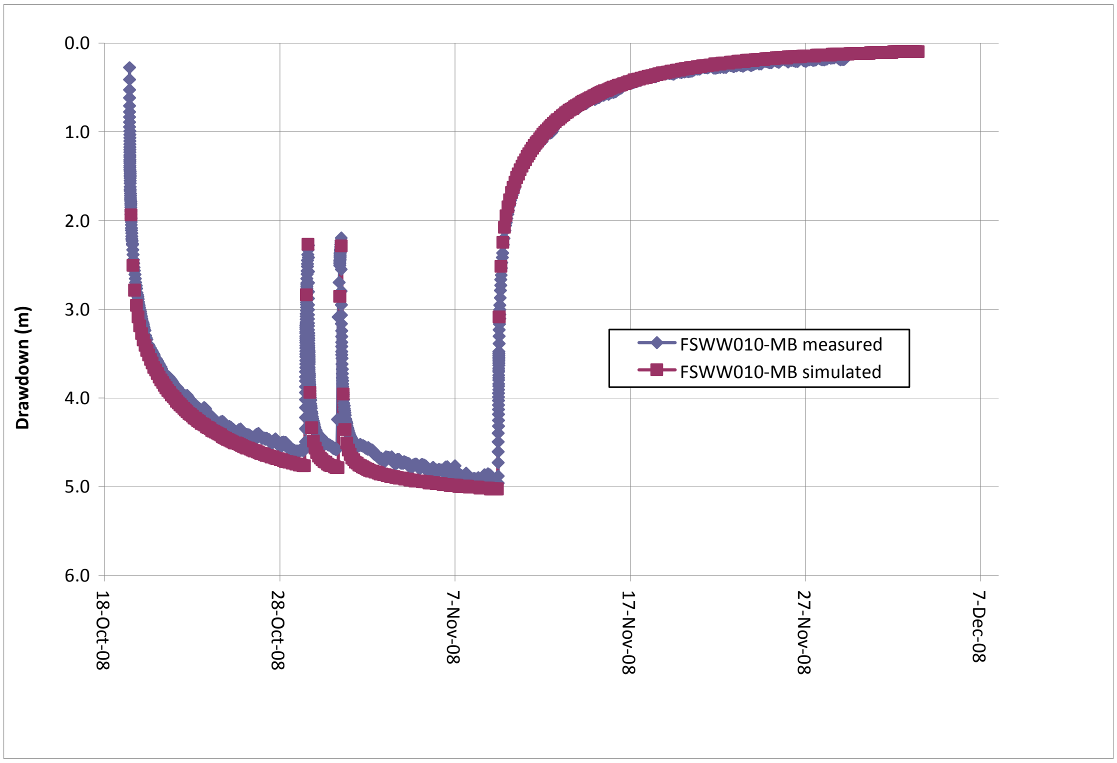

Figure 5.4. Measured and simulated aquifer test drawdown, FSWW010-MB.

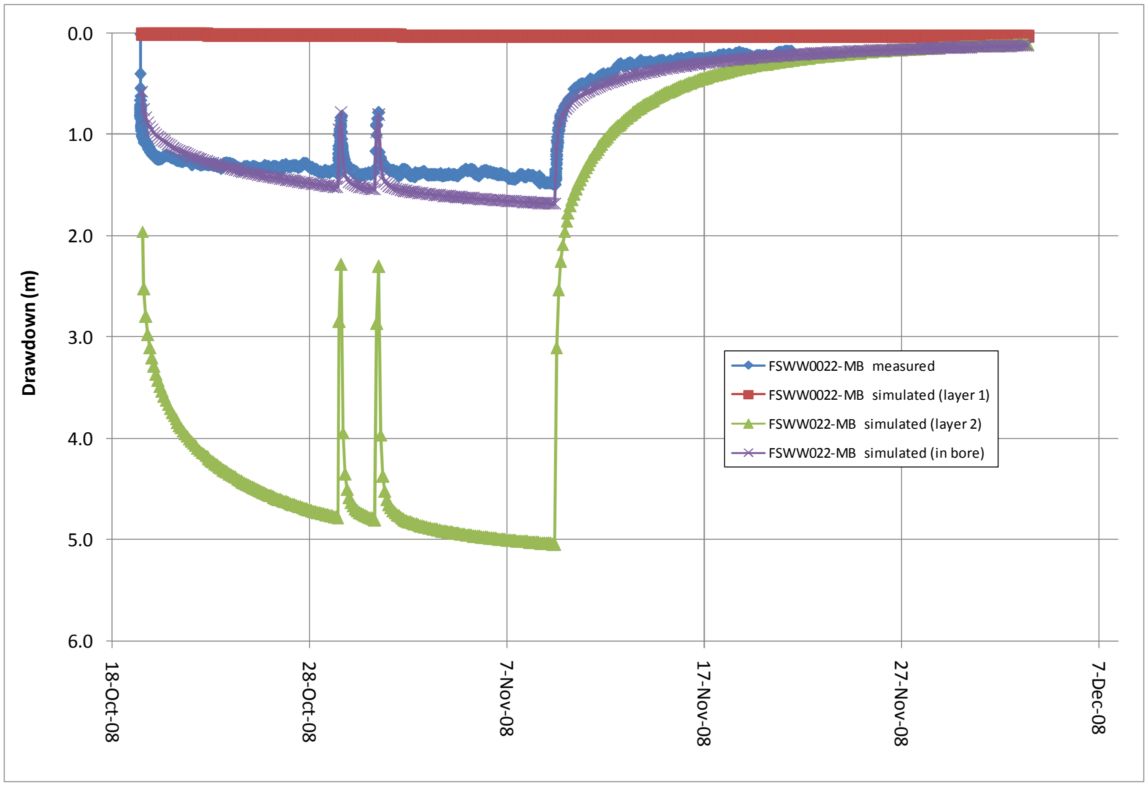

Figure 5.5. Measured and simulated aquifer test drawdown, FSWW022-MB.

Measured and simulated drawdown in pumping bore FSWW020-PB and in nearby monitoring bore FSWW018-MB are shown in Figures 5.6 and 5.7.

Farther away, water level in FSWW012-MB did not respond to pumping, as would be expected from the aquifer parameters indicated by the other observation bore responses. It was concluded, based on drilling results , that FSWW012-MB is isolated from the neighboring aquifer due to difficulties encountered during well construction and development. The lack of response at FSWW012-MB was simulated using the LAK2 module to represent an inefficient bore. Measured and simulated aquifer test drawdown at FSWW012-MB is shown on Figure 5.8.

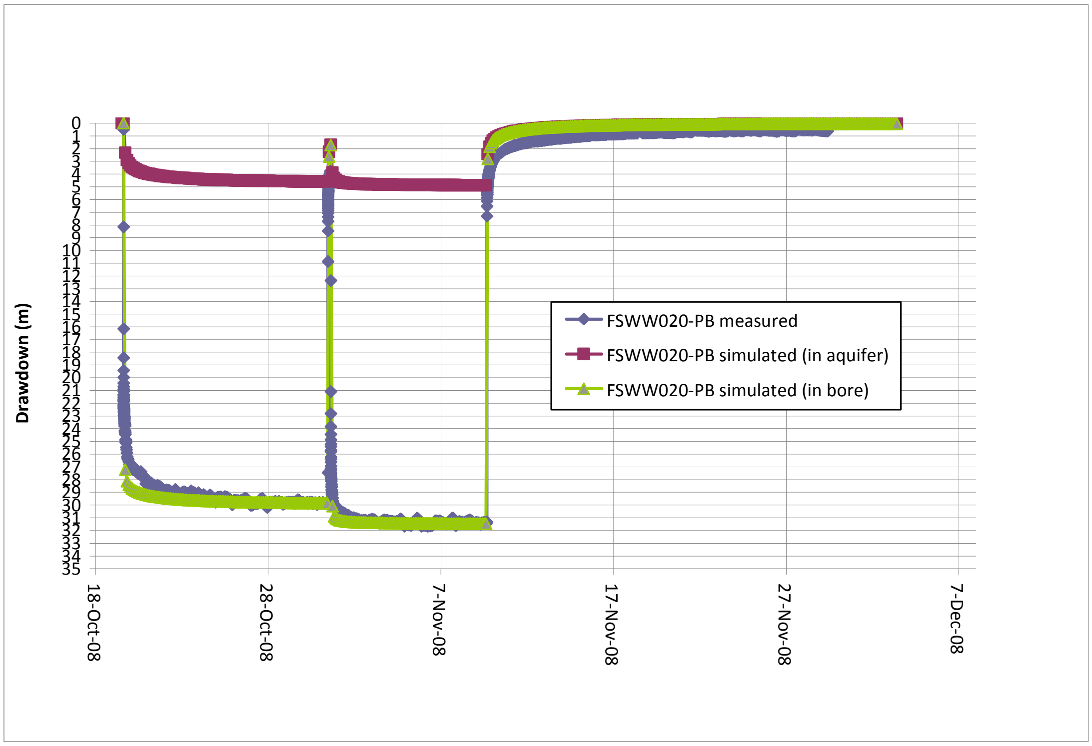

Figure 5.6. Measured and simulated aquifer test drawdown, FSWW020-PB.

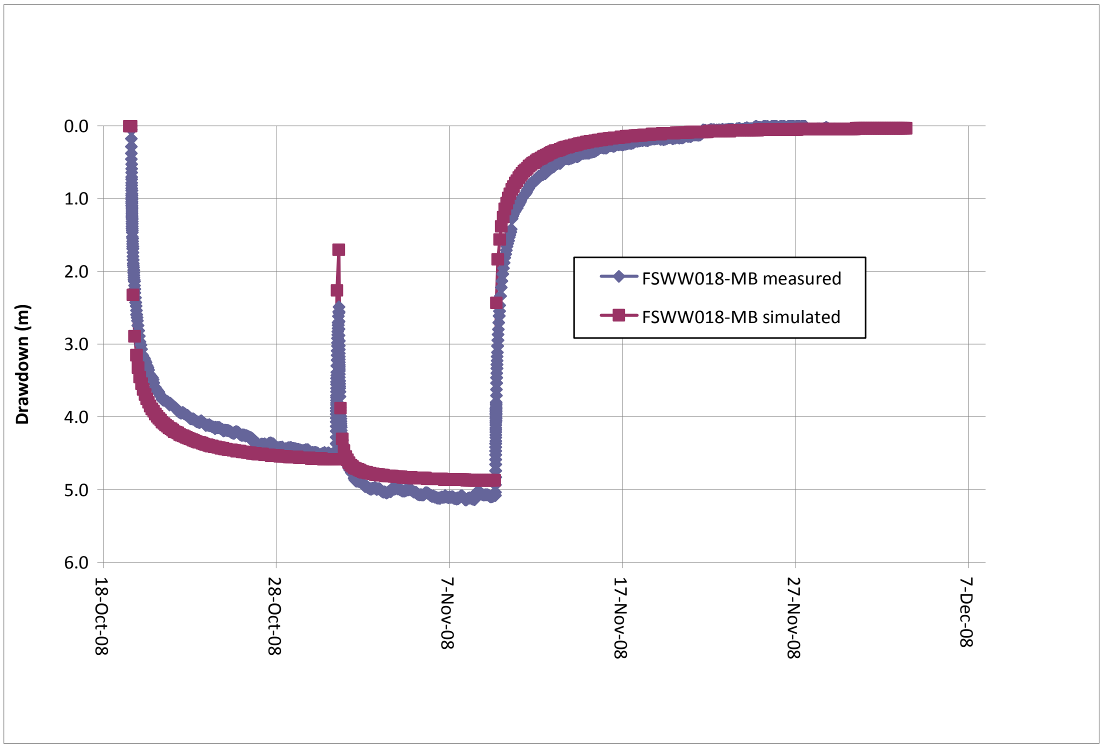

Figure 5.7. Measured and simulated aquifer test drawdown, FSWW018-MB.

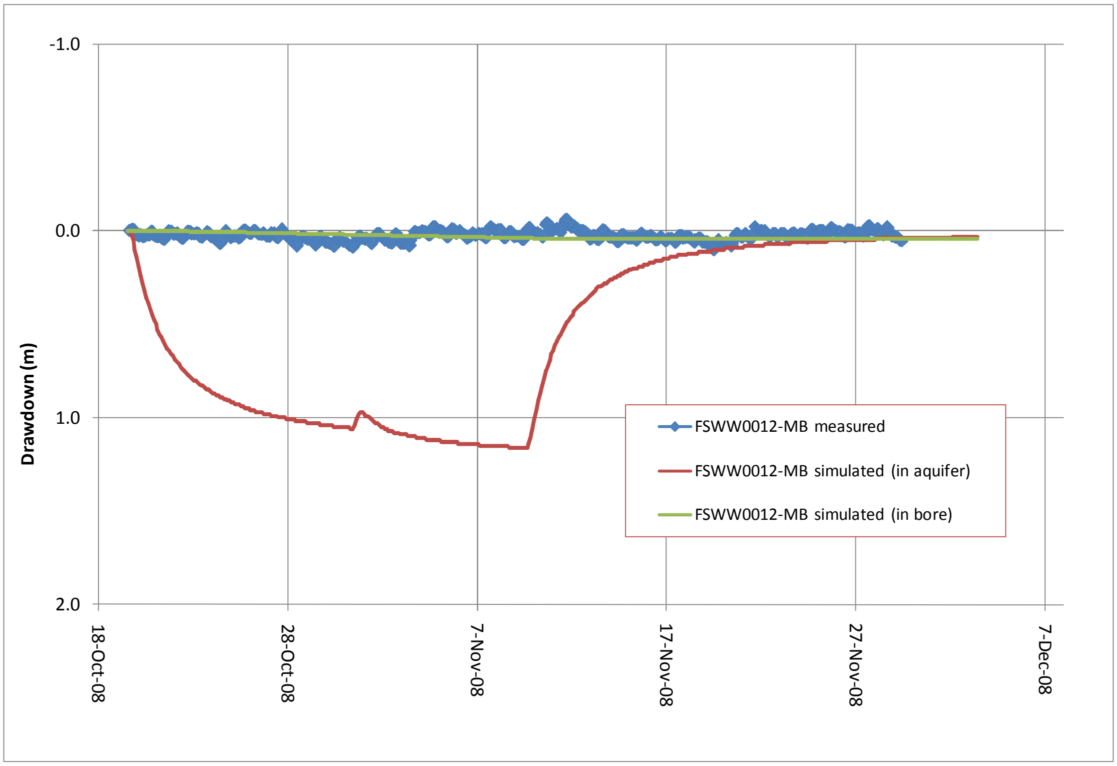

Figure 5.8. Measured and simulated aquifer test drawdown, FSWW012-MB.

6.0 REFERENCES

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THEMAC
RESOURCES

PROPOSED COPPER FLAT OPEN-PIT MINE RECLAMATION PLAN FOR DISCUSSION
August 19, 2014

MMD regulations and key definitions regarding mine reclamation

NMAC 19.10.6.603: The permit area will be reclaimed to achieve a **self-sustaining ecosystem** appropriate for the life zone of the surrounding areas following closure unless conflicting with the approved post-mining land use. Each **reclamation** plan must be developed to meet the site-specific characteristics of the mining operation and the site.

NMAC 19.10.7 R1

"**Reclamation**" means the employment during and after a mining operation of measures designed to mitigate the disturbance of affected areas and permit areas and to the extent practicable, provide for the stabilization of a permit area following closure that will minimize future impact to the environment from the mining operation and protect air and water resources.

NMAC 19.10.7 S2

"**Self-sustaining ecosystem**" means reclaimed land that is self-renewing without augmented seeding, amendments, or other assistance which is capable of supporting communities of living organisms and their environment. A self-sustaining ecosystem includes hydrologic and nutrient cycles functioning at levels of productivity sufficient to support biological diversity.

Copper Flat pit reclamation plans will be designed to meet these goals, per MMD regulations:

1. A self-sustaining ecosystem appropriate for the life zone of the surrounding areas following closure for the proposed post mining land use of wildlife.
2. Use of the most appropriate technology and best management practices.
3. Contemporaneous reclamation shall be implemented to the maximum extent practicable.
4. Appropriate and required measures will be taken to assure protection of human health and safety, the environment, wildlife, and domestic animals by:
    a. Taking measure to safeguard the public from unauthorized entry into shafts, adits, and tunnels and to prevent falls from highwalls or pit edges,
    b. Taking measures to minimize adverse impacts on wildlife and important habitat,
    c. Protecting cultural resources as appropriate and required,

  - d. Minimizing changes to the hydrologic balance in both the permit and potentially affected areas,
  - e. Taking appropriate and required steps to ensure stream diversions, if any, meet performance standards for floods and are certified by a NM professional engineer.
  - f. Designing, constructing and maintaining impoundments, if any, to minimize adverse impacts to the hydrologic balance and adjoin property and to assure the safety of the public.

5. Construct all man-made piles such as waste dumps, topsoil stockpiles and ore piles to minimize mass movement.
6. Minimize disturbance to riparian and wetland areas during mining and mitigate adverse effects to riparian and wetland areas, if needed after mining.
7. Construct and maintain roads to control erosion.
8. Plan and conduct mining activities to prevent subsidence which may cause material damage to structures of property not owned by the operator.
9. Conduct blasting to prevent injury to persons and damage to property.
10. Stabilize the permit area, to the extent practicable, to minimize future impact to the environment and protect air and water resources. The final surface configuration of the disturbed area shall be suitable for achieving a self-sustaining ecosystem or approved post-mining land use.
11. Where sufficient topsoil is present, measures will be taken to preserve it from erosion or contamination and assure that it is in a usable condition for sustaining vegetation when needed.
12. Reclamation of disturbed lands will result in a condition that controls erosion.
13. Re-vegetation success for a self-sustaining ecosystem as required for cover, diversity, woody plant or tree or shrub density, as required.
14. Meet, without perpetual care all applicable environmental requirements of the Mining Act, 19.10 NMAC and other applicable laws following closure.

Copper Flat pit reclamation plans will be designed to meet these goals, practically, through:

- A. The final pit would be 2,800 ft x 2,800 ft across with an ultimate depth of 900 ft.
- B. Stable pit walls at an average 1V:1H slope, safety benches would remain at 80-ft intervals and the overall pit slope would be stable and about 1.1H:1.0V, for a post mining land use of wildlife habitat. At pit closure unstable pit walls would be stabilized by blasting or other safe methods.
- C. Potentially installing source controls (such as pressure grouting fractures) on areas of the pit bench where the down slope wall is deemed to be high sulfide content during mining. Locally pressure-grouting mineralized fractured areas will also assist with pit wall stability.
- D. Rapid fill of the pit water with fresh (low TDS and high alkalinity) water to achieve a hydrologic balance equilibrium. This will inundate the bottom of the pit quickly, limit inflow of poorer quality groundwater, and maintain the hydrologic sink while meeting NMWQCC surface water standards for wildlife.

E. The final pit water body would be about 75 acres with a depth of about 200 ft. The reclamation plans would be designed to keep the quality in the pit water body within applicable surface water standards for wildlife and livestock. Evaporation will exceed precipitation and groundwater inflows over most of the year.
F. Potentially reclaiming the haul road to create a conveyance system for storm water to advance to the pit water body as quickly as possible to preserve water quality and limit contact with the pit walls.
G. Cover materials may be placed on benches above the projected water level and seeded, where feasible; particularly around the upper rim of the open pit.
H. Safety benches and the haul road, as appropriate, would be ripped and water barred to control and convey surface water runoff.
I. Where practicable, disturbed areas around and adjacent to the projected shoreline of the pit would be covered with topdressing material and re-vegetated.
J. Access to the pit water body would be controlled via the reclaimed haul road to allow escape routes for wildlife. Access to the pit area would be limited by fencing and locked gates and the access road blocked with a physical barricade.
K. The pit area and highwalls would be appropriately barricaded with physical barriers or fences and posted according to MSHA and New Mexico regulations.
L. The pit crest perimeter will be bermed to control surface water run-on and fenced to limit public access. A water diversion and vehicle exclusion berm will be constructed around the circumference of the pit. The berm will be constructed from local rock and soils, will be a minimum of 10-ft wide and 5- to 10-ft high with side slopes angled at 1.5H:1V.
M. Site access will be controlled at the private property lines to prevent public access to the pit area.

The proposed open pit reclamation is developed and designed using the most appropriate technology to meet the requirements for a self-sustaining ecosystem applicable to the post mining land use for wildlife. The goals of the open pit reclamation measures and source controls are to meet NMWQCC standards for wildlife in the open pit water, thereby meeting the requirements for a self sustaining ecosystem, and to meet without perpetual care all applicable environmental requirements of the Mining Act.

Subject: FW: Second Discussion for Copper Flat Pit Lake Model

-----Original Message-----
From: Dail, Bryan, NMENV
Sent: Friday, September 19, 2014 10:42 AM
To: Vollbrecht, Kurt, NMENV; Reid, Brad, NMENV
Cc: Pintado, Kristine, NMENV
Subject: RE: Second Discussion for Copper Flat Pit Lake Model

Dear Kurt:

The consensus here is that in the absence of it being feasible to optimize the model for all constituents listed in 20.6.4.900 NMAC that the model parameterization should optimize Se, Hg, Cu and Cl.

It is important to note that all constituents applicable to the uses are those that apply to 20.6.4.99 NMAC.

I would also like to point out that the latest draft Se criterion document is also available at:

http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/selenium/upload/seleniumdraft2014.pdf

-Bryan

From: Vollbrecht, Kurt, NMENV
Sent: Wednesday, September 17, 2014 4:15 PM
To: Dail, Bryan, NMENV
Subject: RE: Second Discussion for Copper Flat Pit Lake Model

Hi Bryan,

Pat would like to get the COC list as soon as possible so that he can put together his geochem questions accordingly. Can you get them to him in the not so distant future?

Let me know...thanks.

Kurt Vollbrecht, Program Manager
Mining Environmental Compliance Section
Ground Water Quality Bureau
New Mexico Environment Department
(505) 827-0195

Reid, Brad, NMENV

From:	Dail, Bryan, NMENV
Sent:	Friday, September 19, 2014 4:25 PM
To:	Steve Finch; Pintado, Kristine, NMENV
Cc:	Katie Emmer; paulcassidy@aquaticconsultants.com; Hogan, James, NMENV; Reid, Brad, NMENV; Scarano, Jeff, NMENV; Dail, Bryan, NMENV
Subject:	RE: UAA Workplan for New Mexico Copper Corporation Copper Flat open pit water body
Attachments:	NMED comments NMCC UAA Workplan_09192014.pdf

Dear Mr. Finch:

Attached is the New Mexico Environment Department, Surface Water Quality Bureau's comments on the Copper Flat Use Attainability Analysis Workplan provided to us on August 29, 2014.

The Bureau appreciates the opportunity to comment and provides suggestions on revising the workplan. Please feel free to contact me if you have any questions.

Sincerely,

-Bryan

From: Steve Finch [mailto:sfinch@shomaker.com]
Sent: Friday, August 29, 2014 3:43 PM
To: Pintado, Kristine, NMENV
Cc: Katie Emmer; paulcassidy@aquaticconsultants.com; Hogan, James, NMENV; Dail, Bryan, NMENV
Subject: UAA Workplan for New Mexico Copper Corporation Copper Flat open pit water body

Kristine:

Attached is the proposed UAA workplan for New Mexico Copper Corporation open pit water body. We have addressed your comments on the draft outline, and added a biological assessment component. Please review and let us know if you have comments and if the workplan is acceptable. Upon acceptance from the NMED SWQB, We would like to complete the field work within the next two months.

Have a good Labor Day weekend.

Steven T. Finch, Jr., CPG
V.P., Principal Hydrogeologist-Geochemist
JOHN SHOMAKER & ASSOCIATES, INC
Water-Resource and Environmental Consultants
2611 Broadbent Parkway NE
Albuquerque, New Mexico 87107
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SUSANA MARTINEZ
Governor
JOHN A. SANCHEZ
Lieutenant Governor

RYAN FLYNN
Cabinet Secretary
BUTCH TONGATE
Deputy Secretary

September 17, 2014

Steven T. Finch, Jr.
Vice President, Principal Hydrogeologist-Geochemist
John Shomaker and Associates, Inc.
2611 Broadbent Parkway NE
Albuquerque, New Mexico 87107

Re: Comments on New Mexico Copper Corporation Use Attainability Workplan for Copper Flats Pit Mine Lake

Dear Mr. Finch:

Thank you for the opportunity to provide comments on the above-referenced workplan which was submitted to the Surface Water Quality Bureau (SWQB).

On August 29, 2014 the New Mexico Department of the Environment, Surface Water Quality Bureau received the document entitled, *"Copper Flat open pit aquatic life and recreational Use Attainability Analysis (UAA) workplan"* from John Shomaker & Associates, Inc., on behalf of New Mexico Copper Corporation (NMCC). The New Mexico Environment Department (NMED) Surface Water Quality Bureau (SWQB) staff was requested to provide review of this draft UAA workplan.

The NMCC's Copper Flat open pit mine, currently inactive, is considered an unclassified perennial water of the state subject to surface water quality standards under 20.6.4.99 NMAC with the designated uses of primary contact, warmwater aquatic life, livestock watering, and wildlife habitat. Livestock watering and wildlife habitat are known existing uses. New mining activity is planned which will drain the current lake; however, upon closure, ground water will likely fill the enlarged pit much in the same way as presently existing thereby recreating the surface water.

The NMCC is proposing to conduct a UAA study to determine if the currently designated uses are existing or attainable. The UAA is the appropriate scientific assessment tool to make such determinations pursuant to 40 CFR 131.10(g) and 20.6.4.15.D NMAC. Previously, in a letter dated June 2, 2014, the NMED-SWQB provided feedback on NMCC's Preliminary

Aquatic Life and Recreational Use UAA Outline, or "Pre-UAA" and it was suggested the NMCC provide a UAA work plan. In accordance with 20.6.4.15.D NMAC:

> *"The work plan shall identify the scope of data currently available and the scope of data to be gathered, the factors affecting use attainment that will be analyzed and provisions for public notice and consultation with appropriate state and federal agencies."*

In general, there are two main issues in the workplan that require further explanation. First, a couple of the 40 CFR 131.10(g) factors suggested in the workplan may be difficult to demonstrate as a justification for conducting the UAA. For example, the factor under 40 CFR 131.10(g)(1) which is applicable to "natural sources" is underlined as a potential UAA demonstration for the open pit lake. Because the current pit lake chemistry is a result of previous mining modifications, the determination that naturally occurring pollutant concentrations prevent use attainment may be difficult to demonstrate. Second, it is not clear in the workplan how the data will be used to determine attainable or existing uses, or how it will be used to support a demonstration under the applicable 40 CFR 131.10(g) factor(s). For example, how will the nutrient data be analyzed and which UAA factor does the analysis confirm? How would the data described in the draft workplan be used to determine existing and attainable uses?

Additionally, we hope the comments below provide assistance and we encourage you to make the suggested revisions. Also, in accordance with 20.6.4.15.D NMAC, a revised workplan should be submitted to the Department and the EPA Region 6 for review and comment.

Comments and Suggestions:

1) Page 1, Paragraph 1. The first sentence should be corrected by replacing the word 'if' with 'what' - in front of "aquatic life". There are designated and existing uses and criteria applicable to the mine pit as a water of the state. However, these are proposed to be identified and/or refined as part of the UAA process.
2) Pages 1-2 list the reasons (40 CFR 131.10(g) 1-6) under which states may remove designated uses (if they are not existing uses). Reason 1 is listed as "naturally occurring pollutant prevents attainment of use" and underlined as a potential reason to conduct a UAA for the pit mine. This factor would need to be demonstrated through either pre-mining survey(s) (e.g., prior to 1982), proving natural exceedances *preexisted* before the mine. As mining activities initiated since 1982 exposed pollutants to the environment, including the water in the pit lake, this may be difficult to determine.
3) Page 2. The 40 CFR 131.10(g)(4) factor, "Dams and Diversions or other types of hydrologic modifications prevent attainment" would likely not be an appropriate factor for the pit mine lake aquatic life use determination. However, as the pit lake is not a dam or diversion, but a hydrologic modification of natural surface waters, this may be an appropriate factor applicable to recreational uses.

4) Page 2. Process section. The purpose of the UAA is to determine what aquatic life or recreational (i.e., CWA Section 101(a)(2)) uses are existing and attainable in the pit mine lake.
5) Page 2, Process section. In number 3, change the sentence to read, "What are the causes of impairments to the existing and designated uses?"
6) Page 2, Process section. In number 4, add the word 'highest' in front of 'attainable uses'.
7) Page 2, Process section. Change "do not apply" to "are not attainable".
8) Page 2, Process section. Instead of defaulting to the designated uses and criteria in the ephemeral category (20.6.4.97 NMAC) as suggested in the draft, by process of the UAA this water body will become a classified water body with established (proposed) designated uses and associated criteria. Also, as this is a perennial water body, the HP process is not applicable to this site; the applicable UAA process is as indicated under 20.6.4.15.D NMAC.
9) Page 3, Paragraph1. The exposed substrate (mine pit wall) was naturally mineralized by the atmosphere, but the exposure was not due to natural conditions; therefore, a demonstration under factor 40 CFR 131.10(g)(1) is not appropriate. Likewise, the low flow conditions in number 2 do not fit under the 40 CFR 131.10(g) factor (see previous comment 2). It is suggested that the human-caused conditions factor under 40 CFR 131.10(g)(3) is a more appropriate approach for this site.
10) Page 3, Paragraph1; change "can be obtained" to "are attainable".
11) Page 3, Paragraph1. A demonstration of the factor under 40 CFR 131.10(g)(1) and listed as a potential case for the UAA (under number 1) based on "naturally occurring" conditions is not appropriate. Please see comment 2.
12) Page 3, Table 1. While it is not appropriate to apply the factor of "naturally occurring" conditions to the pit mine lake, a reference stream approach requires an explanation of how such streams are identified, characterized and comparable to the UAA water body. This requires considerable effort and data.
13) Page 3. The potential case factor of low flow conditions (listed under number 2) were not previously discussed as a factor or reason to conduct a UAA for this site. The HP process is not applicable here (please refer to Comment 8); this factor is not appropriate.
14) Page 3. How do the components for the UAA listed under the 'Proposed Outline of Analysis Report' relate to the UAA questions on page 2? Outlining these links would also help identify primary data needs.
15) Page 5, Table 2. Chemical factors include nutrients and other constituents. While this information may represent a current data inventory, it is not clear how these would be used in the UAA process.

16) Page 5, Paragraph2. Use of the nutrient data for the UAA should be explained more fully. For example, explain how it is linked to the aquatic life designations.
17) In general, components on pages 4-6 (under "Scope of Data") should be aligned with the UAA questions in a way that is aimed at answering the UAA questions on page 2. There is not much discussion on how data gaps will be filled once the data is inventoried and gaps identified, i.e., no description of sample sites (or how they will be selected), numbers of samples to be collected, timing of collection, etc.
18) Page 6. The SWQB uses a biomonitoring index period defined as August 15 to October 15 for Mountain sites and August 15 to November 15 for Foothills and Xeric sites. (See page 2, Physical Habitat Measurements SOP; http://www.nmenv.state.nm.us/swqb/documents/swqbdocs/MAS/SOP/5.0SOP-PhysicalHabitat_10-02-2013.pdf)
19) Page 6. The fish sampling protocol should be reviewed by a fish biologist for gear sampling efficiency and appropriateness in this habitat.
20) Aquatic life use determinations should be as representative as possible, meaning the UAA should be designed in such a way as to reasonably capture uses that may only be seasonal, e.g., migratory uses, aquatic species with brief life cycles, etc.

Other general edits to the terminology on page 1, in paragraph 2:

1) Replace "a non-classified" with "an unclassified" as per usage in 20.6.4 NMAC;
2) Add "20.6.4 NMAC" after "water quality standards";
3) Change "aquatic life use" to "warmwater aquatic life use";
4) Change "livestock" to "livestock watering" and "wildlife" to "wildlife habitat";
5) Change "should apply" to "are attainable".

We appreciate the efforts by NMCC on the development of the draft workplan for the UAA for the Copper Flats pit mine. While the plan is not approved, we hope these comments are helpful and look forward to receiving a revised workplan. If you have questions about the comments or suggestions in this letter, please contact Bryan Dail at (505) 476-3799 (Bryan.Dail@state.nm.us) or me at (505) 827-2822 (Kristine.Pintado@state.nm.us).

Sincerely,

Kristine L. Pintado

Kristine L. Pintado
Water Quality Standards Team Leader
Surface Water Quality Bureau

Copy via email:
Katie Emmer, Permitting and Environmental Compliance Manager, New Mexico Copper Corporation
Jeff Scarano, Manager, Assessment and Standards Section, NMED SWQB
Bryan Dail, Environmental Specialist, Standards, Planning and Reporting Team, NMED SWQB
James Hogan, Bureau Chief, NMED SWQB
Brad Reid, NMED GWQB
Paul Cassidy, Aquatic Consultants, Inc.

From:	Hogan, James, NMENV
Sent:	Friday, August 29, 2014 3:44 PM
To:	Vollbrecht, Kurt, NMENV; Reid, Brad, NMENV
Subject:	FW: UAA Workplan for New Mexico Copper Corporation Copper Flat open pit water body
Attachments:	NMCC_UAA_workplan_29Aug2014v2.pdf

FYI

From: Steve Finch [mailto:sfinch@shomaker.com]
Sent: Friday, August 29, 2014 3:43 PM
To: Pintado, Kristine, NMENV
Cc: Katie Emmer; paulcassidy@aquaticconsultants.com; Hogan, James, NMENV; Dail, Bryan, NMENV
Subject: UAA Workplan for New Mexico Copper Corporation Copper Flat open pit water body

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August 29, 2014

Kristine Pintado, Water Quality Standards Coordinator
Surface Water Quality Bureau
New Mexico Environment Department
Harold Runnel Building
1190 St. Francis Dr.
P.O. Box 5469
Santa Fe, New Mexico 87502

Re: Copper Flat open pit aquatic life and recreational Use Attainability Analysis workplan

Dear Ms. Pintado:

On behalf of New Mexico Copper Corporation, John Shomaker & Associates, Inc. (JSAI) has prepared this Use Attainability Analysis (UAA) workplan for determining if aquatic life and recreational uses and associated New Mexico Water Quality Control Commission (NMWQCC) surface water quality standards (NMAC 20.6.4) apply to the Copper Flat open pit.

The Copper Flat open pit currently contains water that is considered a non-classified perennial water of the state subject to surface water quality standards for the default uses related to primary contact, aquatic life, livestock, and wildlife. Livestock and wildlife are existing uses. It is uncertain if primary contact and aquatic life designated uses should apply to the Copper Flat open pit water because it is man-made, disconnected from adjacent water courses, and is a hydrologic sink.

A UAA is a structured scientific assessment of the factors affecting the attainment of uses specified in Section 101(a)(2) of the Clean Water Act (aquatic life and primary contact recreation uses). The factors to be considered in such an analysis include the physical, chemical, biological, and economic use removal criteria described in EPA' s water quality standards regulation (40 CFR 131.10(g)(1)-(6)).

Under 40 CFR 131.10(g) regulation states one may remove a designated use which is not an existing use, as defined in § 131.3, or establish sub-categories of a use if the State can demonstrate that attaining the designated use is not feasible because:

1. Naturally occurring pollutant concentrations prevent the attainment of the use; or
2. Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by

the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or

3. Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or
4. Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use; or
5. Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or
6. Controls more stringent than those required by sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact.

Underlined items 1, 3, 4, and 5 likely apply to the Copper Flat open pit water body.

Process

The purpose of the proposed UAA analysis is to determine if the Copper Flat Open Pit does or does not support aquatic life or recreational uses; either it is or is not feasible to achieve the Clean Water Act §101(a)(2) goals. The following questions will be addressed:

1. What are the existing aquatic life and recreational uses for the Copper Flat open pit water?
2. What evidence and records are provided to described the existing uses as defined in Subsection E of 20.6.4.5.E NMAC?
3. What are the causes of any impairment of the uses?
4. What are the attainable uses based on the physical, chemical and biological characteristics of the water body?

If the data show that primary contact and aquatic life uses do not apply, then the appropriate water quality standards designations are §20.6.4.97 NMAC (livestock and wildlife uses). It is our understanding the Department will proceed, as indicated in §20.6.4.15.D NMAC, to post the UAA on the Department's Surface Water Quality Bureau website, and notify interested parties of a 30-day public comment period. Depending on the comments received, the Department may then submit this UAA and responses to comments to EPA Region 6 for technical approval. If EPA grants technical approval, the waters listed in this UAA will be subject to §20.6.4.97 NMAC.

Copper Flat UAA Approach (Water Body Survey and Assessment)

Copper Flat Open Pit is a manmade feature created in 1982, and is a hydrologic sink disconnected from adjacent water courses. A dam was created in 1982 to divert Grayback Arroyo around the Open Pit. The Open Pit area is naturally mineralized, and it is believed that only livestock and wildlife uses can be obtained through reclamation efforts. The UAA would be performed to evaluate the applicability of aquatic life and recreational uses. The potential cases that apply to Copper Flat Open Pit are:

1. Naturally occurring pollution concentrations (source of water is groundwater inflow and storm water runoff from mineralized ore body),
2. Low flow conditions (the Open Pit is a hydraulic sink not connected to a water course), and
3. Human caused conditions prevent attainment and cannot be remedied (the open pit is secured and not accessible to the public thereby preventing recreational uses).

It is possible that if more than one factor occur, aquatic communities could be more limited than if only a single stressor occurred. These factors are evaluated in Table 1.

Table 1. Potentially applicable use attainability factors and evidence evaluated in the UAA

case	attainability factor	evidence evaluated
1	naturally occurring concentrations	water concentrations reported from historical pre-mining conditions, and recent concentrations from nearby reference streams
2	low flow conditions	seasonal conditions related to physical habitat
3	irremediable human caused conditions	recent data on the effectiveness of proposed reclamation and projected results of implementing alternative additional actions

Proposed Outline of Analysis Report

- Watershed Description and History
- Hydrologic Conditions
- Surface Water Chemistry
- Physical Habitat Conditions
- Biological Conditions
- Recreational Uses
- Feasibility of Remedying Pollution Sources
- Conclusions and Recommendations

PROPOSED WORKPLAN

This UAA workplan was prepared according to 20.6.4.15 NMAC and guidance provided in the EPA's *Water Quality Handbook - Chapter 2: Designation of Uses (40 CFR 131.10), Section 2.9 Use Attainability Analyses - 40 CFR 131.10(j) and (k).* EPA indicates that the specific analyses included in their handbook are optional, but "represent the type of analyses EPA believes are sufficient for States to justify changes in uses designated in a water quality standard and to determine uses that are attainable. States may use alternative analyses as long as they are scientifically and technically supportable."

Preparation of Water Body Survey and Assessment

The primary component of the UAA would be a Water Body Survey and Assessment. The Water Body Survey and Assessment would consider selected physical, chemical, and biological factors for the existing pit water body that is located at the site of the proposed pit water body in order to identify any existing uses and determine attainable uses for the proposed pit. Selected physical and chemical factors would also be considered for the proposed pit, based on the mine plan and predictive geochemical modeling results, to determine attainable uses for the proposed pit. Economic limitations on attaining uses for the proposed pit would also be considered.

Table 1 presents physical, chemical, and biological factors to be considered for the existing pit, and Table 2 presents factors to be considered for the proposed pit, when conducting the UAA for the proposed open pit water body at Copper Flat Mine.

Preparation of the assessment would be guided by 40 CFR 131.10(g), which lists the conditions that may result in a designated use not being feasible, EPA's *Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analysis* (1983; volume III, 1984), and EPA's *Interim Economic Guidance for Water Quality Standards Workbook* (1995). Data collection and analysis methods would follow standard practices recommended by the EPA and other described in Wetzel (2001).

Scope of Data

EPA indicates that "States are encouraged to use existing data to perform the physical, chemical, and biological evaluations presented in this guidance document. The Water Body Survey and Assessment would include selected physical and chemical factors for which data have already been collected for the existing pit. Table 2 presents data available for the open pit from previous studies.

If physical limitations are identified in the assessment, the assessment would also explain why the physical limits would not be "reversible," and identify limitations on the ability to restore the physical integrity of the water body.

Table 2. Summary of existing physical and chemical data to be considered for Water Body Survey and Assessment for Copper Flat open pit water body

physical factors	chemical factors
characteristics	toxicants (B, Cd, Hg, Mn, Mo, Ni, Se, V, Zn)
size (dimensions, depth-area relationship, depth-volume relationship, bathymetry)	nutrients (nitrogen)
annual hydrology (water balance)	alkalinity
substrate composition and characteristics	pH
hydrologic sink	dissolved solids

Because the study will be carried out over a limited time period, no modeling will be attempted. However, sufficient short-term data will be generated to demonstrate whether or not the open pit water can reasonably achieve each of its designated uses.

Physical Conditions

In situ measurements to determine the thermal characteristics, water clarity, and light attenuation of the water body as they deal with stratification, nutrient cycling, and plankton growth have already been collected as part of the Baseline Data collection required for a new mining permit with the New Mexico Mines and Minerals Division. Past investigations have also characterized sediment depth and composition. Substrate type, has also been evaluated across the open pit bottom. The existing data on the physical conditions will be used to determine if sufficient habitat is available for a diverse macroinvertebrate population.

Nutrient Conditions

There is a substantial database of historical chemical data that includes most inorganic parameters. The existing inorganic water quality data will be used as part of the analysis.

Nutrients are important to sustain phytoplankton and zooplankton as part of the aquatic food web. Ammonia, can also be a toxic chemical to many species. Accordingly, the following analytes will be measure in the epilimnion, or for the upper 1/3 of the water column if an epilmnion does not exist. The sample will consist of a three location composite.

- Nitrate
- Nitrite
- Phosphorus, total
- Phosphorus, dissolved

- Ammonia
- Total Kjeldahl N
- Total organic and inorganic carbon
- Chlorophyll-a
- pH
- N:P:C ratio

Biological Conditions

The current community structure of the water body needs to be established to determine if a food web exists. A composite sample will be created from three locations. The composite will be examined to identify the number and genera of primary producers (algae) and the various forms of zooplankton that provide food for higher life forms (fish):

- Algae identification, count, and percent composition by genus; tolerance indicators
- Zooplankton forms, count, and percent composition (cladocera, rotifers, copepods, etc)
- Benthic macroinverebrate forms, count and percent composition; tolerance indicators, oligochaete/chironomid ratio (Weiderholm), and Trophic Condition Index
- Aquatic macrophyte distribution and identification

Fish

The effort to collect fish will be both electro-fishing and experimental mesh gill nets. The experimental mess gill nets are 150 ft long and range in mesh size from ½ inch to 3 inches. One net night will be set with three nets (8 hour sample overnight). Any fish collected with be identified, weighed, measured, and returned to the water. If fish are caught, a representative sample will also be photographed. The electro-fishing survey will utilize an 18ft Smith-Root electro-fishing boat with two netters, an observer, and a boat driver. The electro-fishing effort will be 3,600 seconds (measured by the boat meter of actual electro-fishing time). The sample will be split into two with 1,800 seconds during daylight and 1,800 seconds after dark. If any fish are collected, a representative sample will also be photographed. Any fish collected with be identified, weighed, measured, and returned to the water. Population estimates will be conducted on all species where the sample size is large enough.

Integrated Conditions

The following section will integrate the data and make final qualitative and quantitative descriptions and analyses of the water body biological integrity. The analysis will include, but not be limited to:

- Descriptive Classification of Biological Health
- Quantitative Descriptive Score (EPA 1983)
- Carlson Trophic Status Index
- Nygaard Trophic Index
- Palmer Organic Pollution Index
- USEPA Phytoplankton Index of Trophic Status

The proposed assessment will be performed by JSAI and Aquatic Consultants, Inc. in cooperation with New Mexico Copper Corporation.

NMED Review of Draft Water Body Survey and Assessment

The Water Body Survey and Assessment would be submitted in draft form to NMED for review and comment prior to finalizing the UAA, public notice, and consultation with other appropriate state and/or federal agencies. After addressing NMED comments, the UAA for the proposed open pit water body at Copper Flat Mine would be finalized and submitted to NMED.

Sincerely,

JOHN SHOMAKER & ASSOCIATES, INC.

Steven T. Finch, Jr.
V.P., Principal Hydrogeologist-Geochemist

STF:sf

CC: Katie Emmer, New Mexico Copper Corporation
Bryan Dail, Environmental Specialist, Standards Planning and Reporting Team, NMED SWQB
James Hogan, Chief, NMED SWQB
Paul Cassidy, Aquatic Consultants, Inc.

THEMAC RESOURCES GROUP LIMITED

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TSXV: MAC

THEMAC Announces Offers of Judgment from the New Mexico Office of the State Engineer for the Copper Flat Mine

Vancouver, British Columbia – September 12, 2014 – THEMAC Resources Group Limited (TSXV:MAC) ("THEMAC" or the "Company") announces its Offer of Judgment from the New Mexico Office of the State Engineer (NMOSE) for the Copper Flat Mine in Hillsboro, New Mexico, USA.

New Mexico Copper Corporation (NMCC), wholly-owned subsidiary of THEMAC, received two Offers of Judgment this past month from the NMOSE. The Offers of Judgment award NMCC a total of 896.29 acre feet per annum. The recognized amount is an increase from the previous amount of 888.873 acre feet per annum.

The amount of water rights recognized by NMOSE is below the Company's declared water rights of 7,481 acre-feet per annum. The Company will pursue an expedited *inter se* proceeding to defend its declared water rights.

The Offers of Judgment issued did not address the Mendenhall claims that were submitted by the Company in February 2014. The Mendenhall Doctrine is a legal argument in the State of New Mexico regarding pre-water basin claims. The Company submitted Mendenhall claims to NMOSE's hydrographic survey experts to support the Company's declared water rights.

As the Company progresses its expedited *inter se* proceeding, the appropriate disclosures will be made.

About THEMAC Resources Group Limited

THEMAC is a copper development company with a strong management team which acquired the Copper Flat copper-molybdenum-gold-silver project in New Mexico, USA in May 2011. The Company is committed to bringing the closed copper mine, Copper Flat, in Sierra County, New Mexico back into production with innovation and a sustainable approach to mining development and production, local economic opportunities and the best reclamation practices for our unique environment. The Company is listed on the TSX Venture Exchange (ticker: MAC) and has issued share capital of 76,492,122 common shares (fully diluted share capital 139,938,359).

For more information please visit www.themacresourcesgroup.com or review the Company's filings on SEDAR (www.sedar.com).

For further information contact:

THEMAC Resources Group Limited
Andrew Maloney

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Ms. Katie Emmer
Permitting & Environment
New Mexico Copper Corp
2424 Louisiana Blvd NE,
Albuquerque, NM 87110

PS Form 3800, August 2006

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

September 19, 2014

Katie Emmer, Permitting & Environmental Compliance Manager
New Mexico Copper Corporation
2424 Louisiana Blvd NE, Suite 301
Albuquerque, NM 87110

RE: Comments on the Geochemical Characterization Report and associated documents for the Copper Flat Project, Copper Flat Mine, DP-1

Dear Ms. Emmer,

The New Mexico Environment Department (NMED) Ground Water Quality Bureau received the document titled, "Geochemical Characterization Report for the Copper Flat Project, New Mexico," ("Characterization Report") on June 13, 2013. This report was prepared by SRK Consulting on behalf of the New Mexico Copper Corporation (NMCC). On January 14, 2014, representatives from NMED, Mining and Minerals Division (MMD), SRK Consulting, and the NMCC held a joint conference call to discuss the above mentioned report. On February 26, 2014, NMED received two additional documents associated with the geochemical characterization report titled "Humidity Cell Termination Report for the Copper Flat Project, New Mexico" ("Humidity Cell Termination Report") and "Copper Flat PFS and DFS Gap Analysis" ("Gap Analysis Report"). These reports were prepared by SRK Consulting on behalf of the NMCC, and in part addressed some of the issues discussed during the January 14, 2014 conference call.

Evaluation of these reports and associated documents is critical to development of the draft Ground Water Discharge Permit and NMED may have additional comments during drafting of the Ground Water Discharge Permit. Following are comments, to date, prepared by NMED and the Mining and Minerals Division (MMD) ("Agencies") for consideration.

Characterization Report - General Comments

1) The geochemical characterization report considers potential impacts to ground and surface water from the Tailings Storage Facility (TSF) and Waste Rock Disposal Facility (WRDF). It will be necessary to address and/or comment on potential impacts to ground and surface water from any proposed Low Grade Ore Stockpile(s) based on the location and design of such stockpiles.

2) The report describes that, due to many factors (e.g., encapsulation of sulfides within the silicate minerals, higher surface to volume ratios of pyrite), the proposed WRDF will not pose a threat to ground or surface water during the operational/closure phase of the mine life primarily due to slow reaction rates. Please discuss how existing waste rock piles will be managed to minimize impacts to ground and surface water.

3) A table showing results of mass transfer (precipitation-dissolution) calculations of equilibrated mineral phases would be useful in the discussion on simulated water chemistries. This table is anticipated to help further understand and quantify precipitation-dissolution processes influencing simulated, experimental, and measured solute concentrations at sampling stations associated with the different contaminant sources at Copper Flat.

Characterization Report - Specific Comments

5) Table 5-3. It appears that the acid neutralization classification of material type in the legend for potentially acid forming (PAF) and non-acid forming (NAF) provided in Table 5-3 (Summary of Waste Rock Acid Base Accounting Results) (pg. 37) of the Geochemical Characterization Report are switched.

6) Section 8.1.1 – One of the assumptions used in the conceptual model for the WRDF is that it will be situated atop low permeability andesite, thereby limiting infiltration of leachate into ground water. Assuming this assumption to be correct, please discuss the fate of and transport of leachate that may flow along the underlying topography at the waste rock/bedrock interface and out of the downslope toe of the WRDF and how this seepage will be captured and contained to prevent a potential impact to ground or surface water quality.

7) Table 8-9 - The text in Section 8.11.1 describes that background concentrations of fluoride, iron, and manganese in the andesite aquifer beneath the WRDF naturally exceed Water Quality Control Commission (WQCC) standards. The modeling predicts that seepage from the WRDF will not affect the existing "baseline" concentrations. NMCC will be required to provide a statistically defensible demonstration to establish background standards for any constituent elevated above 20.6.2.3103 NMAC ground water standards.

8) <u>Section 8.8</u> – The sensitivity analyses for the WRDF and TSF appear to only account for varying groundwater mixing zones (10 ft., 30 ft., and 50 ft. mixing zones for the WRDF and 50 ft., 75 ft., and 100 ft. for the TSF). The predicted results using the various mixing zones are nearly identical, suggesting this parameter is not sensitive to the model output. Please provide a discussion of additional parameters considered, if any, for the sensitivity analyses and why sensitivity analyses were not conducted for other parameters.

Humidity Cell Termination Report - General Comment

9) Analytical results for total dissolved Fe, Fe (II), and Fe (III) from the waste rock/ore HCT are provided in Figures 3-4, 3-5, and 3-6 of the Humidity Cell Termination Report. The units (mg/L) for Fe(II) and Fe(III) need to be consistent with total dissolved Fe (mg/kg/week) for the HCT results. Concentrations of Fe (III) in sample SRK 0858 exceed total dissolved Fe, which needs to be addressed and corrected.

Humidity Cell Termination Report - Specific Comments

10) <u>Section 2.1 Sample Selection</u> – It is stated that "The results of static geochemical test work were used to select a sub-set of 23 waste rock and ore samples for kinetic testing." Please provide a brief description of the criteria used to select the HCT samples or the rational/justification for sample selection. For example, more sulfide ore samples (12 samples) were run for HCT compared to sulfide waste samples (3 samples). Considering that ore is run through the mill and waste rock is stockpiled, it would seem that the HCT results for sulfide waste rock samples are more important for characterization than sulfide ore samples.

11) <u>Presence of Buffering Silicate Minerals, page 29</u> – statement: "Despite the limited presence of carbonate minerals in the samples, the silicate minerals phlogopite and/or clinochlore were observed in all eight samples submitted for testing. These minerals are known to offer some buffering capacity and may be one of the reasons why acidic conditions were not achieved in the majority of the Copper Flat humidity cells." Please describe and/or provide published references for the mechanism by which phlogopite and clinochlore provide buffering capacity.

12) <u>Presence of Buffering Silicate Minerals, Table 4-1</u> – Each occurrence of phlogopite in the mineralogy is described in Table 4-1 as trace (<1% by area), and clinochlore is either a trace (2 occurrences) or minor (<10% by area; 4 occurrences). Given that page 3 of the Geochemical Characterization Report states "even for minerals in the intermediate and fast minerals weathering groups, they will not be practical neutralizing materials unless they occur in excess of ~10% (Sverdrup, 1990)," it appears that the presence of phlogopite and clinochlore likely provide negligible buffering capacity. Please discuss.

Gap Analysis Report - Specific Comment

13) Table 1: Summary of PFS and DFS Design Criteria Pertinent to Geochemical Characterization Program. It is stated in the Cu cut-off grade (wt%) row, Implications for Geochemical Characterization Study column – "The numerical predictions undertaken for the WRDF as part of the PFS are based (on) the higher cut-off grade and therefore represent a conservative estimate of future water quality." In this table, the PFS cutoff is 0.164 and the DFS cutoff is 0.168, and therefore it appears the PSF has a slightly lower cut-off grade than the DFS. As such, use of the DFS cutoff value in the numerical model would be the more conservative value since it is slightly higher. Please comment on the effect(s), if any, this has on the numerical predictions undertaken for the WRDF.

NMED recommends a meeting to discuss a schedule and format for addressing these comments. Please contact Brad Reid at (505) 827-2963 to arrange a meeting to determine a schedule and path forward.

Sincerely,

Kurt Vollbrecht, Program Manager
Mining Environmental Compliance Section
Ground Water Quality Bureau

KV:BR

cc: Steve Raugust, Resource Development Manager, NMCC (signed PDF copy via electronic mail: sraugust@themacresourcesgroup.com)
Steven T. Finch, Jr., John Shomaker & Associates, Inc. (signed PDF copy via electronic mail: sfinch@shomaker.com)
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Bryan Dail, SWQB
Mark Nelson,

THEMAC
RESOURCES

Handouts from
Mtg on 9/23/14
to discuss Post Mining
Plans as they pertain to
Regulation
MMD

DRAFT COPPER FLAT OPEN-PIT RECLAMATION PLAN

For Discussion

23 September 2014

The Copper Flat open pit will be reclaimed to achieve a self-sustaining ecosystem appropriate for the life zone of the surrounding areas following closure unless conflicting with the approved post-mining land use. The reclamation plan must be developed to meet the site-specific characteristics of the mining operation and the site (NMAC 19.10.6.603).

New Mexico Copper Corporation understands **"Reclamation"** to mean the employment during and after a mining operation of measures designed to mitigate the disturbance of affected areas and permit areas and to the extent practicable, provide for the stabilization of the open pit following closure that will minimize future impact to the environment from the mining operation and protect air and water resources (NMAC 19.10.1.7(R)1).

"Self-sustaining ecosystem" means reclaimed land that is self-renewing without augmented seeding, amendments, or other assistance which is capable of supporting communities of living organisms and their environment. A self-sustaining ecosystem includes hydrologic and nutrient cycles functioning at levels of productivity sufficient to support biological diversity (NMAC 19.10.1.7(S)2).

Post-Mining Land Use

The post-mining land use means a beneficial use or multiple uses which will be established on the permit area after completion of a mining project (NMAC 19.10.1.P.(5)). The use shall be selected by the owner of the land and approved by the Director. The most logical post-mining land uses for NMCC proposed Copper Flat Open mine pit include:

1. Wildlife habitat
2. Developed water resources (open pit water body for wildlife habitat)

The Baseline Data Report (BDR) has defined the area outside of the historical mining areas, as Chihuahuan Desert Scrub and Grasslands. Cover characteristics are summarized in the table below.

Cover	percent area
Bedrock and rock	5.1
Cobbles and gravel	28.6

Bare soil	20.8
Vegetation	45.5

Proposed Copper Flat open pit

The final open mine pit would be 2,800 ft in diameter at the top with an ultimate depth of 1,000 ft. The open pit facility will encompass an area of about 160 acres. The final post-mining open pit water body would be about 22 acres with a depth of about 200 ft. The haul road will compose about 21 acre area within the open pit facility. The remaining pit walls and benches between the water body and pit rim will include about an 85 acre area. The pit rim area is about 32 acres. See attached map showing areas within open pit facility. The table below summarizes the open pit areas and post-mining land use characteristics.

Component	**area (acres)**	**% total area**	**post-mining land use**
Open pit facility	160	100	Wildlife habitat and developed water resources
Reclaimed pit rim	32	20	Chihuahuan Desert Grasslands
Reclaimed haul road	21	13	Chihuahuan Desert Grasslands
Reclaimed benches and walls	85	53	Chihuahuan Desert wildlife habitat
Water body	22	14	Developed water resources for wildlife habitat

Chihuahuan Desert scrubland has 37 to 42 % cover (sotol, cacti, hackberry, juniper, etc)
Chihuahuan Desert Grassland has 55 and 64 % cover
Type and percent cover varies between north and south facing slopes
Source: Baseline Data Reports

Proposed Copper Flat open pit reclamation plan

MMD Requirement 1 (NMAC 19.10.6.603): The reclaimed pit should support a self-sustaining ecosystem appropriate for the life zone of the surrounding areas following closure for the proposed post mining land use of wildlife.

Proposed Plan: The open pit will be reclaimed to the extent practicable to meet NMWQCC surface water standards in water body for wildlife. The self-sustaining ecosystem appropriate for the life zone of the surrounding areas includes those found in various environments identified around the mine area, such as scree slopes, cliffs, with limited vegetative cover (refer to BDR). Abiotic factors for self sustaining ecosystem include atmosphere, radiation from sun, sediment (geologic substrate), and water (open pit water body). Biotic factors include Chihuahuan Desert plants and animals. Wildlife sustained in these environments includes large mammals, small mammals, reptiles and amphibians, birds, bats, etc. These proposed reclamation measures take into consideration the provisions and standards outlined in the New Mexico Mining Act; particularly Section 69-36-7(H). Establishing a water source (open pit water body) for wildlife will be a critical component of the self sustaining ecosystem.

MMD Requirement 2 (NMAC 19.10.6.603(A)): Use of the most appropriate technology and best management practices.

Proposed Plan: The open pit will be reclaimed to the extent practicable, which will include reclaimed haul road and pit rim perimeter, sources controls for maintaining surface water standards in water body, and slope stability measures for pit benches and walls. The proposed reclamation plan is more robust than those required for open pit copper mines in Arizona and Nevada, which do not require in-pit reclamation. The proposed pit reclamation plan must balance and take into account all applicable regulations. Rapid fill with fresh water may be a more appropriate technology than backfilling or partial backfilling, primarily because New Mexico Water Quality Control Commission standards for surface water and groundwater will be maintained and because establishing a water source will be critical for wildlife, for establishing a self sustaining ecosystem, and for meeting all applicable environmental requirements without perpetual care.

MMD Requirement 3 (NMAC 19.10.6.603(B)): Contemporaneous reclamation shall be implemented to the maximum extent practicable and in a manner that is consistent with the approved reclamation plan.

Proposed Plan: It is difficult to perform contemporaneous reclamation when the area mined will be mined as part of a later phase of mining as common for open pit copper mines. However, mineralized and fractured areas of benches and walls will be reclaimed to the extent practicable, which may include localized pressure grouting and slope stability measures where feasible. In pit storm-water management will be an integral part of the mining operations so that erosion of the benches and walls is prevented, and stability is maintained.

MMD Requirement 4 (NMAC 19.10.6.603(C)): Appropriate and required measures will be taken to assure protection of human health and safety, the environment, wildlife, and domestic animals.

Proposed Plan: These reclamation measures will include:

a. Taking measure to safeguard the public from unauthorized entry and to prevent falls from highwalls or pit edges. In cooperation with the BLM, access to the pit area would be limited by fencing and locked gates and the access road blocked with a physical barricade. The pit area and highwalls would be appropriately barricaded with physical barriers or fences and posted according to MSHA and New Mexico regulations. Site access will be controlled at the private property lines to prevent public access to the pit area.

b. Wildlife protection, such as reclaiming areas of wildlife habitat. Access to the pit water body would be controlled via the reclaimed haul road to allow escape routes for wildlife.
c. Minimizing changes to the hydrologic balance in both the permit and potentially affected areas. Rapid fill of the pit water with fresh (low TDS and high alkalinity) water to achieve a hydrologic balance equilibrium. This will inundate the bottom of the pit quickly, limit inflow of poorer quality groundwater, and maintain the hydrologic sink while meeting NMWQCC surface water standards for wildlife. Rapid filling to create the open pit water body will also reclaim the hydrologic balance.
d. In pit source controls will protect water quality and prevent erosion.
e. All diversion designs will accommodate low-flow conditions as well as peak runoff from a 10-year 24-hr event.
f. After mining, the haul road will be reclaimed to accomplish in pit stormwater conveyance and management, to prevent erosion, and to promote self-sustaining ecosystem. Features may include diversion berms, stormwater drains, erosion resistant substrate for anchoring vegetation, and re-vegetated surfaces. The reclaimed haul road will be designed to control and convey storm water runoff to the water body. Drainage control structures will be used to minimize erosion, sedimentation, and flooding. Furthermore, the reclaimed haul road will be designed to prevent runon to the pit benches and high walls, thereby protecting slope stability.

<u>MMD Requirement 5 (NMAC 19.10.6.603(D)):</u> Stabilize the permit area, to the extent practicable, to minimize future impact to the environment and protect air and water resources. The final surface configuration of the disturbed area shall be suitable for achieving a self-sustaining ecosystem or approved post-mining land use.

<u>Proposed Plan</u>: Open pit reclamation will include the following steps 1) stabilize pit walls and safety benches, 2) reclaim haul road, 3) create water body that meets surface water quality standards by rapid fill, 4) reclaim pit rim area, 5) establish native vegetation where possible. These steps will stabilize the permit area, minimize future impact to the environment and protect air and water resources.

The inter-ramp pit slopes would be stable and about 1.1H:1.0V, for a post mining land use of wildlife habitat. At pit closure unstable pit walls would be stabilized by blasting or other safe methods. Potentially installing source controls (such as pressure grouting fractures) on areas of the pit bench where the down slope wall is deemed to be fractured and containing high sulfide content during mining. Locally pressure-grouting mineralized fractured areas will also assist with pit wall stability.

Rapid filling with fresh groundwater (low TDS and high alkalinity) from the Production Wells will establish a water body that can maintain NMWQCC standards, and provide a water source critical for the post-mining land use and self sustaining ecosystem. The pit will be filled to the 4,900 ft elevation level, and flood out the lower 200 ft of the open pit. The rapid-fill water body will prevent inflow of poorer quality post-mining groundwater seepage, reclaim the lower 200 ft of open pit. Detailed analysis using a calibrated groundwater flow model has shown that the open pit water body will remain a hydrologic sink, and that the long-term equilibrium water level will be in the 4,860 to 4,900 ft elevation range. Evaporation will exceed precipitation and groundwater inflows over most of the year.

The final surface configuration of the disturbed area will create a water source for wildlife endemic to the area. The pit walls and benches will provide habitat for raptors, bats, small mammals, birds, reptiles, and amphibian representative of the post-mining land use.

All reconstructed slopes, embankments, and roads will be designed and constructed, and maintained to minimize mass movement. Stabilization of open pit benches and walls and storm water controls will also minimize mass movement and protect the quality of the water body so NMWQCC standards are maintained.

Not proposed: Backfilling (which would include and a store and release cover) is technically infeasible for the following reasons:

1. The open pit would need to be backfilled to the 5,300 ft elevation (600 ft above pit bottom) to create a surface capable of maintain store and release cover and a hydraulic sink. A completely backfilled pit would create a flow-through system that would not meet groundwater discharge standards.
2. There is not enough material suitable to backfill the pit and infill over the remaining benches and walls, and a new mining operation would need to be permitted to achieve reclamation goals with backfilling.
3. A partial backfill open pit would have steep slopes subject to perpetual erosion of required store and release cover.
4. Backfilling would remove the water body, and reduce biodiversity of the post-mining land use.

MMD Requirement 6 (NMAC 19.10.6.603(E)): Where sufficient topsoil is present, measures will be taken to preserve it from erosion or contamination and assure that it is in a usable condition for sustaining vegetation when needed.

Proposed Plan: Cover materials may be placed, where feasible around the upper rim of the open pit.

As practicable, the haul road would be covered with topdressing material and re-vegetated where it touches projected shoreline of the pit.

MMD Requirement 7 (NMAC 19.10.6.603(F)): Reclamation of disturbed lands will result in a condition that controls erosion.

Proposed Plan: The pit crest perimeter will be bermed to control surface water run-on and fenced to limit public access. A water diversion and vehicle exclusion berm will be constructed around the circumference of the pit. The berm will be constructed from local rock and soils, will be a minimum of 10-ft wide and 5- to 10-ft high with side slopes angled at 1.5H:1V.

The haul road will be reclaimed to control and convey surface water runoff.

MMD Requirement 8 (NMAC 19.10.6.603(G)): Re-vegetation success for a self-sustaining ecosystem as required for cover, diversity, woody plant or tree or shrub density, as required.

Proposed Plan: Re-vegetation will be appropriate to the topography, substrate (ground cover), exposure to solar radiation (north versus south slopes). The open pit facility area less the water body equals about 138 acres, in which varying degrees of percent vegetative cover will be established. The goal will be to re-established, where feasible, the same vegetative diversity for Chihuahuan Desert shrubs and grasslands defined in the BDR.

The pit perimeter (rim), where feasible, will be reclaimed and where appropriate cover material can be placed and seeded with native Chihauhuan Desert grasses.

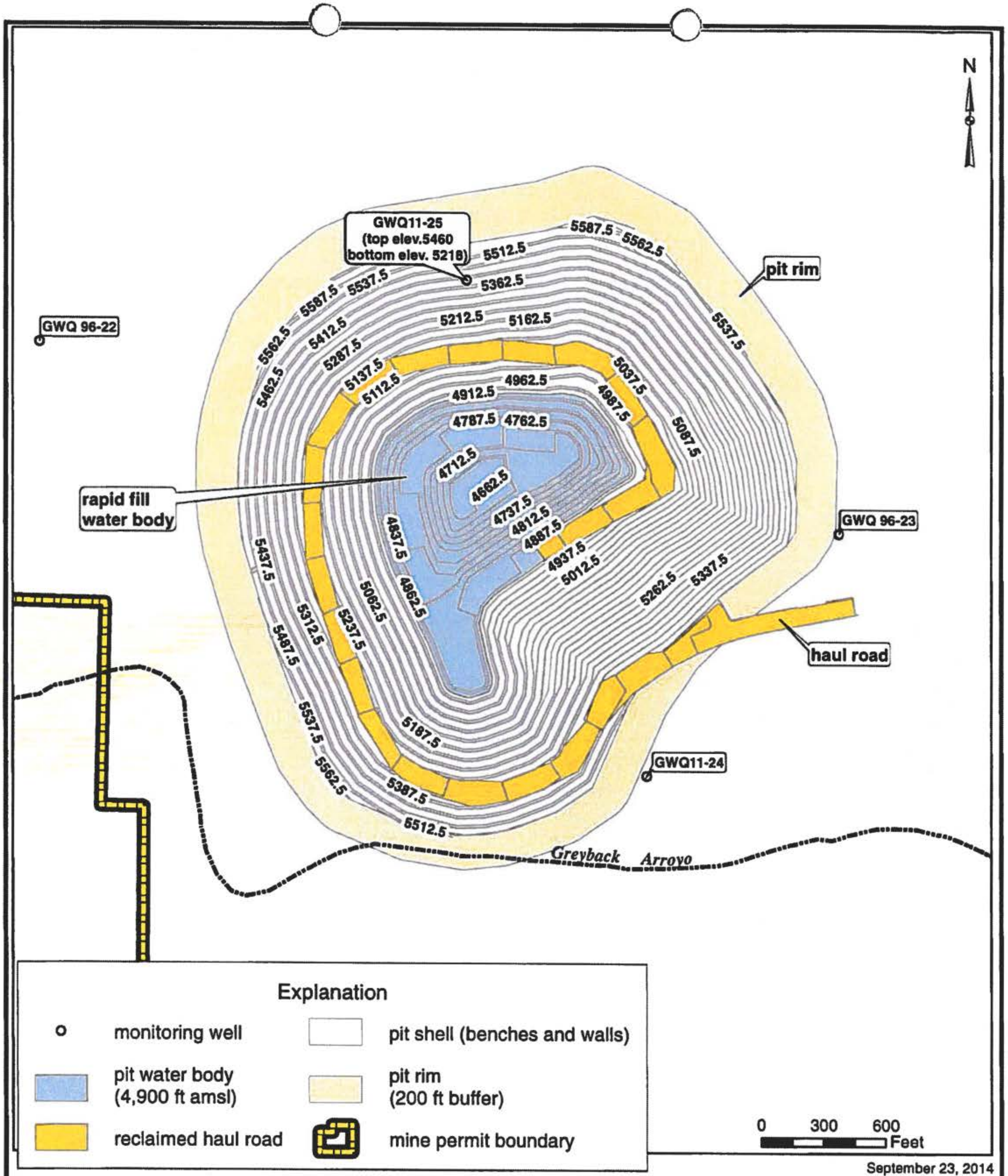
Pit benches and walls between water body and pit rim will range from barren rock to native vegetation where it develops naturally.

Haul road will be re-vegetated with grasses. The grasses will also help with erosion control.

MMD Requirement 9 (NMAC 19.10.6.603(H)): Meet, without perpetual care all applicable environmental requirements of the Mining Act, 19.10 NMAC and other applicable laws following closure.

The proposed open pit reclamation is developed and designed using the most appropriate technology to meet the requirements for a self-sustaining ecosystem applicable to the post mining land use for wildlife and developed water resources for wildlife. The goals of the open pit reclamation measures and source controls are to meet NMWQCC standards for wildlife in the open pit water, thereby meeting the requirements for a self sustaining ecosystem.

Geochemical waste characterization of wall rock, geochemical modeling of the open pit water body, and detailed groundwater flow modeling analysis were used to determine if the water body would meet the surface water standards for the long term. The proposed reclamation plan is most viable option for meeting the environmental requirements and for removing the liability associated with perpetual care.



September 23, 2014

DRAFT

Map of proposed NMCC Copper Flat Open Pit facility.

Comparison of Part 6 requirements in the Act vs. Rules

__ACT:__

69-36-7 Commission; duties:

H. establish by regulation permit and reclamation requirements for new mining operations that incorporate site-specific characteristics. These requirements shall, at a minimum:

(1) require that new mining operations be designed and operated using the most appropriate technology and the best management practices;

RULES:

19.10.6.603

A. Most Appropriate Technology and Best Management Practices The mining operation and the reclamation plan shall be designed and operated using the most appropriate technology and the best management practices.

F. Erosion Control Reclamation of disturbed lands must result in a condition that controls erosion. Revegetated lands must not contribute suspended solids above background levels, or where applicable the Water Quality Control Commission's standards, to streamflow of intermittent and perennial streams. Acceptable practices to control erosion include but are not limited to the following:

(1) stabilizing disturbed areas through land shaping, berming, or grading to final contour;
(2) minimizing reconstructed slope lengths and gradients;
(3) diverting runoff;
(4) establishing vegetation;
(5) regulating channel velocity of water;
(6) lining drainage channels with rock, vegetation or other geotechnical materials; and
(7) mulching.

__ACT:__

H.(2) assure protection of human health and safety, the environment, wildlife and domestic animals;

RULES:

C. Assure Protection The mining operation and completed reclamation shall meet the following requirements established to assure protection of human health and safety, the environment, wildlife and domestic animals.

(1) Signs, Markers and Safeguarding Measures will be taken to safeguard the public from unauthorized entry into shafts, adits, and tunnels and to prevent falls from highwalls or pit edges. Depending on site specific characteristics, the following measures shall be required:

(a) closing shafts, adits or tunnels to prevent entry;
(b) posting warning signs in locations near hazardous areas;
(c) restricting access to hazardous areas;
(d) marking the permit area boundaries;
(e) posting a sign at the main entrances giving a telephone number of a person to call in the event of emergencies related to the mine; or
(f) other measures as needed to protect human safety.

(2) Wildlife Protection Measures shall be taken to minimize adverse impacts on wildlife and important habitat. Based on site-specific characteristics, the following measures will be required:

(a) restricting access of wildlife and domestic animals to toxic chemicals or otherwise harmful materials;
(b) minimizing harm to wildlife habitat during mining; and
(c) reclaiming areas of wildlife habitat if not in conflict with the approved post-mining land use.

(3) Cultural Resources Cultural resources listed on or eligible for listing on the National Register of Historic Places or the State Register of Cultural Properties, and any cemeteries or burial grounds shall be protected until clearance has been granted by the State Historic Preservation Office or other appropriate authority.

(4) Hydrologic Balance Operations shall be planned and conducted to minimize change to the hydrologic balance in both the permit and potentially affected areas. If not in conflict with the approved post-mining land use, reclamation shall result in a hydrologic balance similar to pre-mining conditions unless non-mining impacts have substantially changed the hydrologic balance.

(a) Operations shall be designed so that non-point source surface releases of acid or other toxic substances shall be contained within the permit area, and that all other surface flows from the disturbed area are treated to meet all applicable state and federal regulations.

(b) The disturbed areas shall not contribute suspended solids above background levels, or where applicable the Water Quality Control Commission's standards, to intermittent and perennial streams.

(c) To provide data to determine background levels for surface water entering the permit area, appropriate monitoring shall be conducted on drainages leading into the permit area.

(d) All diversions of overland flow shall be designed, constructed and maintained to minimize adverse impacts to the hydrologic balance and to assure the safety of the public.

(i) No diversion shall be located so as to increase the potential for landslides.

(ii) Unless site-specific characteristics require a different standard which is included in the approved permit, diversions which have watersheds larger than 10 acres shall be designed, constructed and maintained to safely pass the peak runoff from a 10-year, 24-hour precipitation event.

(iii) All diversion designs which have watersheds larger than 10 acres shall be certified by a professional engineer registered in New Mexico as having been designed in accordance with 19.10 NMAC. Diversion designs shall be kept on-site or otherwise be made available, upon request, to the Director for inspection.

(iv) When no longer needed, temporary diversions shall be removed and the disturbed area reclaimed.

(5) Stream Diversions When streams are to be diverted, the stream channel diversion shall be designed, constructed, and removed in accordance with the following:

(a) unless site-specific characteristics require different measures to meet the performance standard and are included in the approved permit, the combination of channel, bank and flood plain configurations shall be adequate to safely pass the peak run-off of a 10-year, 24-hour precipitation event for temporary diversions, a 100-year, 24-hour precipitation event for permanent diversions;

(b) the design and construction of all intermittent and perennial stream channel diversions shall be certified as meeting 19.10 NMAC by a professional engineer registered in New Mexico. As-built drawings shall be completed promptly after construction and be retained on site or otherwise made available upon request to the Director; and

(c) when no longer needed, temporary stream channel diversions shall be removed and the disturbed area reclaimed.

(6) Impoundments If impoundments are required they shall be designed, constructed and maintained to minimize adverse impacts to the hydrologic balance and adjoining property and to assure the safety of the public.

(a) Unless site-specific characteristics require different measures to meet the performance standard and are included in the approved permit, impoundments having earthen embankments but not subject to the jurisdiction of the Mine Safety and Health Administration or the State Engineer shall:

(i) have a minimum elevation at the top of the settled embankment of 1.0 foot above the water surface in the pond with the spillway flowing at the design depth;

(ii) have a top width of the embankment not less than 6 feet;

(iii) have combined upstream and downstream side slopes of the settled embankment not less than 5 horizontal : 1 vertical with neither slope steeper than 2 horizontal : 1 vertical. Slopes shall be vegetated or otherwise stabilized to control erosion;

(iv) have the embankment foundation cleared of all vegetative matter, all surfaces sloped to no steeper than 1 horizontal : 1 vertical and the entire foundation area scarified;
(v) have fill material free of vegetative matter and frozen soil;
(vi) have spillways provided to safely discharge the peak runoff of a 25-year, 24-hour precipitation event, or an event with a 90-percent chance of not being exceeded for the design life of the structure; or
(vii) have other site-specific design criteria for embankments as long as they result in a minimum static safety factor of 1.3 with water impounded to the design level;
(viii) be designed and certified by a professional engineer registered in New Mexico as having been designed and constructed in accordance with 19.10 NMAC. As-built drawings shall be completed promptly after construction and be retained on site or otherwise made available upon request to the Director; and
(ix) if necessary for sediment control be, in place before any other disturbance to the watershed for the impoundment.

(b) When no longer required, impoundments shall be graded to achieve positive drainage unless:
(i) the surface estate owner has requested in writing that they be retained;
(ii) they are consistent with the approved reclamation plan; and
(iii) they are appropriate for the post-mining land use or the self-sustaining ecosystem.

(7) Minimization of Mass Movement All man-made piles such as waste dumps, topsoil stockpiles and ore piles shall be constructed and maintained to minimize mass movement.

(8) Riparian and Wetland Areas Disturbance to riparian and wetland areas shall be minimized during mining. Adverse effects to riparian and wetland areas shall be mitigated during reclamation unless the mitigation conflicts with the approved post-mining land use.

(9) Roads Roads shall be constructed and maintained to control erosion.

(a) Drainage control structures shall be used as necessary to control runoff and to minimize erosion, sedimentation and flooding. Drainage facilities shall be installed as road construction progresses and shall be capable of safely passing a 10-year, 24 hour precipitation event unless site-specific characteristics indicate a different standard is appropriate and is included in the approved permit. Culverts and drainage pipes shall be constructed and maintained to avoid plugging, collapsing, or erosion.

(b) Roads to be constructed in or across intermittent or perennial streams require site-specific designs to be submitted with the permit application.

(c) Roads to be made permanent must be approved by the surface owner and be consistent with the approved post-mining land use.

(10) Subsidence Control Underground and in situ solution mining activities shall be planned and conducted, to the extent technologically and economically feasible, to prevent subsidence which may cause material damage to structures or property not owned by the operator.

(a) Underground and in situ solution mining activities near any aquifer that serves as a significant source of water supply to a public water system shall be conducted so as to avoid disruption of the aquifer and consequent exchange of ground water between the aquifer and other strata.

(b) Underground and in situ solution mining activities conducted beneath or adjacent to any perennial stream must be performed in a manner so that subsidence is not likely to cause material damage to streams, water bodies and associated structures.

(11) Explosives Blasting shall be conducted to prevent injury to persons or damage to property not owned by the operator. Fly rock shall be confined to the permit area. The Director may require a detailed blasting plan, pre-blast surveys or specify blast design limits to control possible adverse effects to structures.

Comparison of Part 6 requirements in the Act vs. Rules

ACT:

(3) include backfilling or partial backfilling only when necessary to achieve reclamation objectives that cannot be accomplished through other mitigation measures;

RULES:

D. Site Stabilization & Configuration The permit area shall be stabilized, to the extent practicable, to minimize future impact to the environment and protect air and water resources. The final surface configuration of the disturbed area shall be suitable for achieving a self-sustaining ecosystem or approved post-mining land use.

(1) Final slopes and drainage configurations must be compatible with a self-sustaining ecosystem or approved post-mining land use.

(2) Backfilling or partial backfilling shall be required only when necessary to achieve reclamation objectives that cannot be accomplished through other mitigation measures.

(3) All reconstructed slopes, embankments and roads shall be designed, constructed and maintained to minimize mass movement.

ACT:

(4) require approval by the director that the permit area will achieve a self-sustaining ecosystem appropriate for the life zone of the surrounding areas following closure unless conflicting with the approved post-mining land use;

RULES:

19.10.6.603 PERFORMANCE AND RECLAMATION STANDARDS AND REQUIREMENTS: The permit area will be reclaimed to achieve a self-sustaining ecosystem appropriate for the life zone of the surrounding areas following closure unless conflicting with the approved post-mining land use. Each reclamation plan must be developed to meet the site-specific characteristics of the mining operation and the site.

G. Revegetation To obtain the release of financial assurance revegetated lands must meet the following standards:

(1) Revegetation success for a self-sustaining ecosystem shall be determined through comparison of ground cover, productivity and diversity and shall be made on the basis of the following approved reference areas; through the use of technical guidance procedures published by the U. S. Department of Agriculture; other reasonably attainable standards approved by the Director; or a combination. Data collection shall be performed using the same methods and techniques on reference areas and reclaimed areas.

(a) foliage or basal cover and productivity of living perennial plants of the revegetated area shall be established equal to 90 percent of the reference area or equal to the approved revegetation standard to within a 90-percent statistical confidence;

(b) diversity of plant life forms (woody plants, grasses, forbs) shall consider what is reasonable based on the physical environment of the reclaimed area; and

(c) woody plant species shall be established to the approved density with an 80 percent statistical confidence.

(2) For areas for which the approved post-mining land use is for wildlife habitat or forest land, success of vegetation shall be determined on the basis of tree or shrub stocking (density) and ground cover.

(a) The ground cover of living perennial plants shall be equal to 90 percent of the native ground cover of the reference area or the approved standard to within a 90 percent statistical confidence and shall be adequate to control erosion.

(b) Tree stocking for forest land shall have stocking rates of plant species equal to 90 percent of the approved reference area or other approved standard with an 80 percent statistical confidence and shall be adequate to control erosion.

(c) If wildlife habitat is to be the post-mining land use, the operator shall select and use plant species on reclaimed areas based on the following criteria:

(i) their proven nutritional value for fish and wildlife;
(ii) their uses as cover and security for wildlife;
(iii) their ability to support and enhance fish and wildlife habitat; and
(iv) distribute plant life forms to maximize benefits of edge effect, cover and other benefits for fish and wildlife.

(3) Revegetation for other post-mining land shall be consistent with the approved post-mining land use. Site-specific standards may include standards for foliar or basal cover, production and diversity and will be included in the approved permit.

ACT:

(5) require that new mining operations be designed in a manner that incorporates measures to reduce, to the extent practicable, the formation of acid and other toxic drainage that may otherwise occur following closure to prevent releases that cause federal or state standards to be exceeded;

RULES:

D.(4) Measures must be taken to reduce, to the extent practicable, the formation of acid and other toxic drainage that may otherwise occur following closure to prevent releases that cause federal or state standards to be exceeded.

ACT:

(6) require that nonpoint source surface releases of acid or other toxic substances shall be contained within the permit area;

RULES:

D.(5) Nonpoint source surface releases for acid or other toxic substances shall be contained within the permit area.

ACT:

(7) require that all waste, waste management units, pits, heaps, pads and any other storage piles are designed, sited and constructed in a manner that facilitates, to the maximum extent practicable, contemporaneous reclamation and are consistent with the new mining operation's approved reclamation plan; and

RULES:

B. Contemporaneous Reclamation Contemporaneous reclamation is required to the maximum extent practicable and in a manner that is consistent with the approved reclamation plan

ACT:

(8) where sufficient topsoil is present, take measures to preserve it from erosion or contamination and assure that it is in a usable condition for sustaining vegetation when needed;

RULES:

E. Topsoil Where sufficient topsoil is present, the operator shall take measures to preserve it from erosion or contamination and assure that it is in a usable condition for sustaining vegetation when needed. The following requirements shall be met unless site-specific characteristics mandate different requirements and those requirements are included in the approved permit.

(1) Topsoil and topdressing shall be sampled and analyzed for vegetation establishment suitability:
(a) sample spacing and interval shall be based on site-specific materials; and
(b) suitability will be identified by analysis based on site-specific materials.

(2) If revegetation is a component of the reclamation plan and if sufficient topsoil is present in the disturbed or borrow areas, it shall be collected and preserved to the extent practicable. Sufficient topsoil means that it is of sufficient quality to conform to the definition of topsoil. Any necessary topdressing may be obtained from areas to be disturbed or borrow areas and shall be salvaged separately from other materials as needed to ensure its availability for distribution when needed for reclamation.

(3) Where direct distribution of topsoil or topdressing is not possible, it shall be stockpiled separately and in a manner to prevent loss of the resource.

(4) Topsoil and topdressing shall be distributed in a manner to establish and maintain vegetation, consistent with the approved permit.

(5) After distribution, topsoiled and topdressed areas shall be stabilized to protect loss of the resource.

(6) Where topsoil has been stockpiled for more than one year, the permittee may be required to conduct analyses to determine if amendments are necessary.

ACT:

I. *adopt regulations that establish a permit application process for new mining operations that includes:*

(6) *a determination of the probable hydrologic consequences of the new mining operation and reclamation, both on and off the permit area, with respect to the hydrologic regime, quantity and quality of surface and ground water systems, including the dissolved and suspended solids under seasonal flow conditions;*

RULES:

6.602.D.13 (Baseline Data Collection)

(v) a determination of the probable hydrologic consequences of the operation and reclamation, on both the permit and affected areas, with respect to the hydrologic regime, quantity and quality of surface and ground water systems that may be affected by the proposed operations, including the dissolved and suspended solids under seasonal flow conditions.

ACT:

69-36-12 New mining operations; mining operation permit required

B. *The director shall issue the permit for a new mining operation if the director finds that:*

(4) *the mining operation is designed to meet without perpetual care all applicable environmental requirements imposed by the New Mexico Mining Act and regulations adopted pursuant to that act and other laws following closure; and*

RULES:

H. The operation will be designed to meet without perpetual care all applicable environmental requirements of the Act, 19.10 NMAC and other laws following closure,

Cooperating Agencies - NMCC Meeting – Notes
30 Sept 2014 14:00 MST

Attendee	Company	Initial	Present
Doug Haywood (via phone)	BLM	D.Haywood	X
Leighandra Keevan (via phone)	BLM	LK	X
Matthew Wunder	NM G & F	M.Wunder	X
Mark Watson	NM G & F	M.Watson	X
Brad Reid	NMED	BR	X
Kurt Vollbrecht	NMED	KV	X
Bryan Dail (via phone)	NMED SWQB	BD	X
Kristine Pintado	NMED SWQB	KP	Not present
Kevin Myers	NMOSE	KM	X
Dave Henney (via phone)	Solv	D.Henney	X
DJ Ennis	MMD	DJE	X
Chris Eustice	MMD	CE	X
Holland Shepherd	MMD	HS	Not present
Katie Emmer	THEMAC	KE	X

Next Meeting Date: WEDNESDAY 12 November, 2014 14:00

Attachment: New EIS Schedule at the back of this document

Action Items

Upcoming Meetings

- Further discussion with NMED, Solv, SRK, JSAI & NMCC re: geochemistry: was 7 Oct 2014, RESCHEDULED for 29 Oct 2014

NMCC Upcoming Deliverables

- NMCC & JSAI will submit revised UAA workplan based on NMED SWQB review as soon as possible. Note: This was submitted 6 October 2014
- NMCC is working with AMEC on development of revised MORP for submission perhaps later this year.

Other Action Items / Notes

- DJ Ennis is the new permit lead for Copper Flat at MMD
- NMCC will work with JSAI on addressing questions raised in the 23 Sept 2014 meeting with MMD and other agencies regarding pit reclamation plans
- NMCC will inform agencies when the anticipated jurisdictional determination letter is received from the Las Cruces ACOE district office.

- NMED will contact NMCC for a meeting to discuss the May 2014 report *Results from First Year of Stage 1 Abatement Investigation at the Copper Flat Mine Site Near Hillsboro, New Mexico* prior to sending an official response letter.

1. Geochemistry report comment responses

   A call including NMED, MMD, BLM, Solv, SRK, NMCC, and JSAI was held on Monday 22 September to discuss main comments from NMED and Solv after review of NMCC's response to comments on the Pit Lake Geochemistry Report. NMED and Solv have indicated they have 3 outstanding main concerns to address: Stratification, current calibration, and scaling. NMED considers Hg, Se, Cl, and Cu to be the outstanding COCs to address with remediation.

   At NMED's suggestion, NMCC will work with SRK and JSAI on response strategies to address comments and concerns discussed on 22 Sept and another call between the parties is scheduled for additional discussion on 7 October.
   PLEASE NOTE: SINCE THE MEETING ON THE 30TH OF SEPTEMBER THIS GEOCHEMISTRY CALL HAS BEEN RESCHEDULED FOR 29 OCTOBER TO ALLOW NMCC, SRK, AND JSAI TO FURTHER DEVELOP RESPONSES.

   It appears NMED and NMCC are both hopeful we are nearing a resolution to outstanding concerns. Once all concerns are identified and a path to resolution resolved, NMCC will consider re-running the agreed model with proposed reclamation plans to demonstrate achievement of applicable standards. NMCC will also consider re-issuing the Pit Lake report to integrate all corrections and resolutions of comments.

   In addition to the pit lake comment discussions, NMCC received a letter dated 17 September 2014 from NMED with separate comments on the Geochemistry Report. NMCC will be working to address these.

2. Pit water standards navigation plans

   - Use Attainability Analysis

NMCC submitted a proposed UAA workplan to NMED SWQB based on previous SWQB guidance on 29 August and received written comments (which were copied to NMED GWQB) on 19 September. NMCC is working on these comments and considering whether to attempt to re-submit the revised UAA as soon as possible for potential field work prior to frost this fall, or work through comments slowly for resubmission and review in anticipation of field work in the summer of 2015.

   - Jurisdictional determination request

NMCC submitted a jurisdictional determination request for the open pit water body at Copper Flat to Rick Gatewood at the Las Cruces ACOE office on 4 August, with additional requested information provided on the 10th of August, 10th of September and 17th of September. Yesterday, 29 September I received an email from Rick Gatewood indicating that EPA has "concurred with the isolated water call" and ACOE will send the AJD (Approved Jurisdictional Determination) letter to NMCC.

3. Pit reclamation plans

   As you are all aware, we met with you to further discuss NMCC's pit reclamation plans on 23 September here in this conference room. Based on that meeting, we've assembled a list of items to research and further develop.

   We believe that a path to resolution for the pit reclamation has been identified and we will continue to work on reclamation plans and studies and give you updates on our progress as we go along. We have an internal meeting scheduled for later this week to decide how to divide up tasks and move forward.

4. Groundwater model status

   I am very happy to report that the groundwater model has been agreed. JSAI completed a number of graphics for the EIS at LWA's direction and as we understand it Solv is using those outputs to press forward with drafting EIS chapter 3.

   As previously agreed, JSAI or LWA will be putting together the final model for OSE review shortly. I do not believe the agreed model is substantially different from what OSE has already seen, but we will be sure to get it to Alan and Kevin for them to make their own determination.

   JSAI has been directed to begin work on a report containing Probable Hydrologic Consequences in October for NMCC review. We will let you know when to expect this submission before we turn it in.

5. EIS Schedule – Doug

   D.Haywood: BLM has worked with Solv and NMCC to create the schedule you should have there, note the state cooperators review in item 20 starting April 28, 2015. Solv is preparing Ch3 for BLM review; we have that on the calendar to start reviewing in November.

   We have a long way to go but if this schedule sticks we'd be looking at a Final ROD in mid-2016 (see item 47).
   NOTE: DISCUSSED EIS SCHEDULE ATTACHED TO THESE NOTES AT THE BACK.

6. EIS status – Doug, Dave

   Dave: Solv analysts are busy with their sections, contacting their counterparts at BLM and working on Chapter 3. The groundwater model section is done so the results for the groundwater effects have been distributed and are being applied.

7. Permit application package status

    - MORP

    AMEC continues work on the MORP draft. I'm not yet sure if it will be ready for submission in November 2014, but we are pressing toward that goal.

    - Probable Hydrologic Consequences – discussed above

8. Stage I Abatement Plan, revised Discharge Permit status

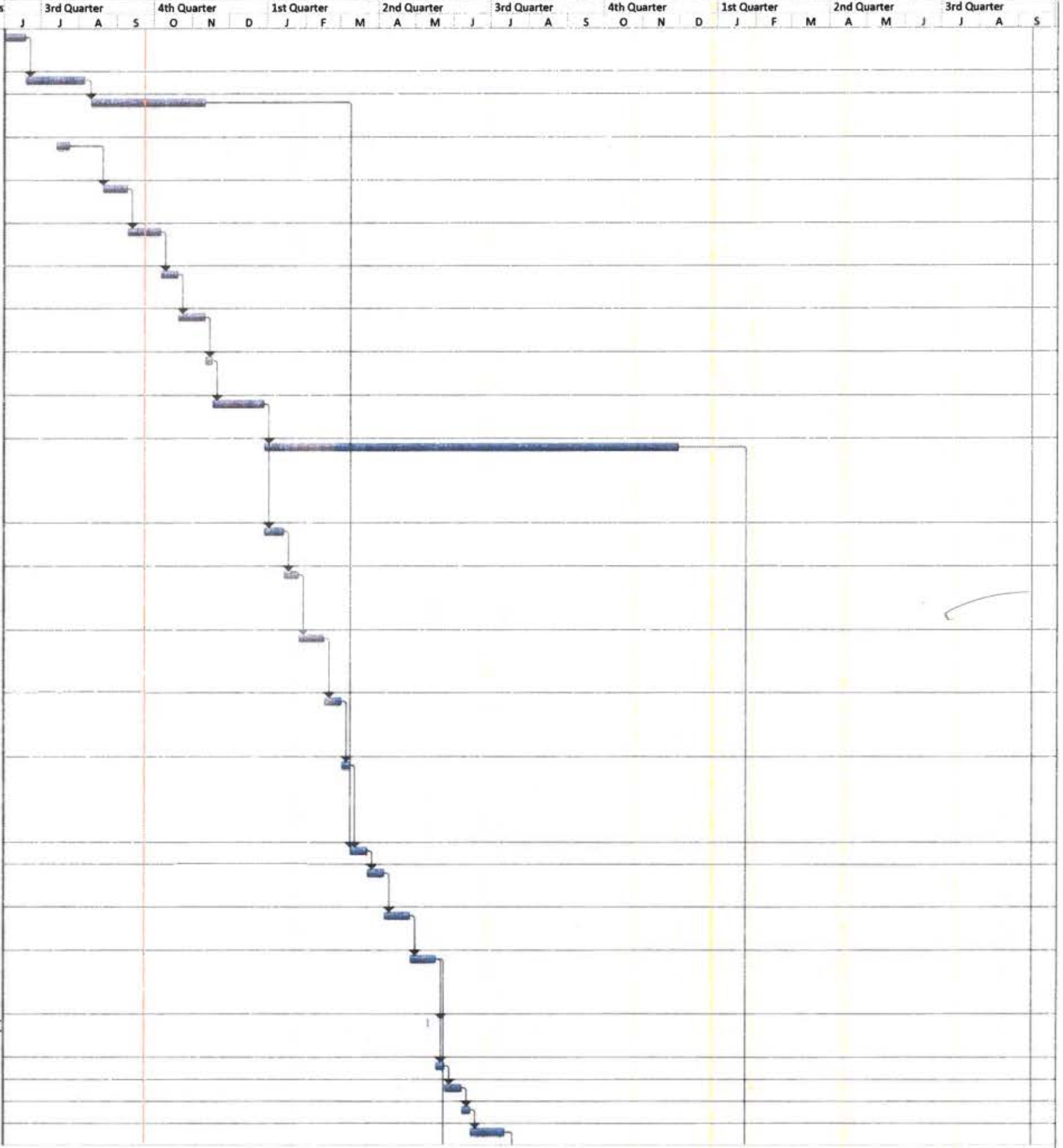
    NMCC is available to meet with NMED about the submitted Stage I characterization report any time, just let us know.

    NMCC has conducted an internal review of the DP checklist provided by NMED to establish what assistance we should pursue from outside contractors. While no schedule has been set for the revised DP submission yet, we do have some internal wheels turning on this. NMCC agrees with NMED that it would be good to submit a revised DP as soon as possible and we will let you know when to expect this prior to turning it in.

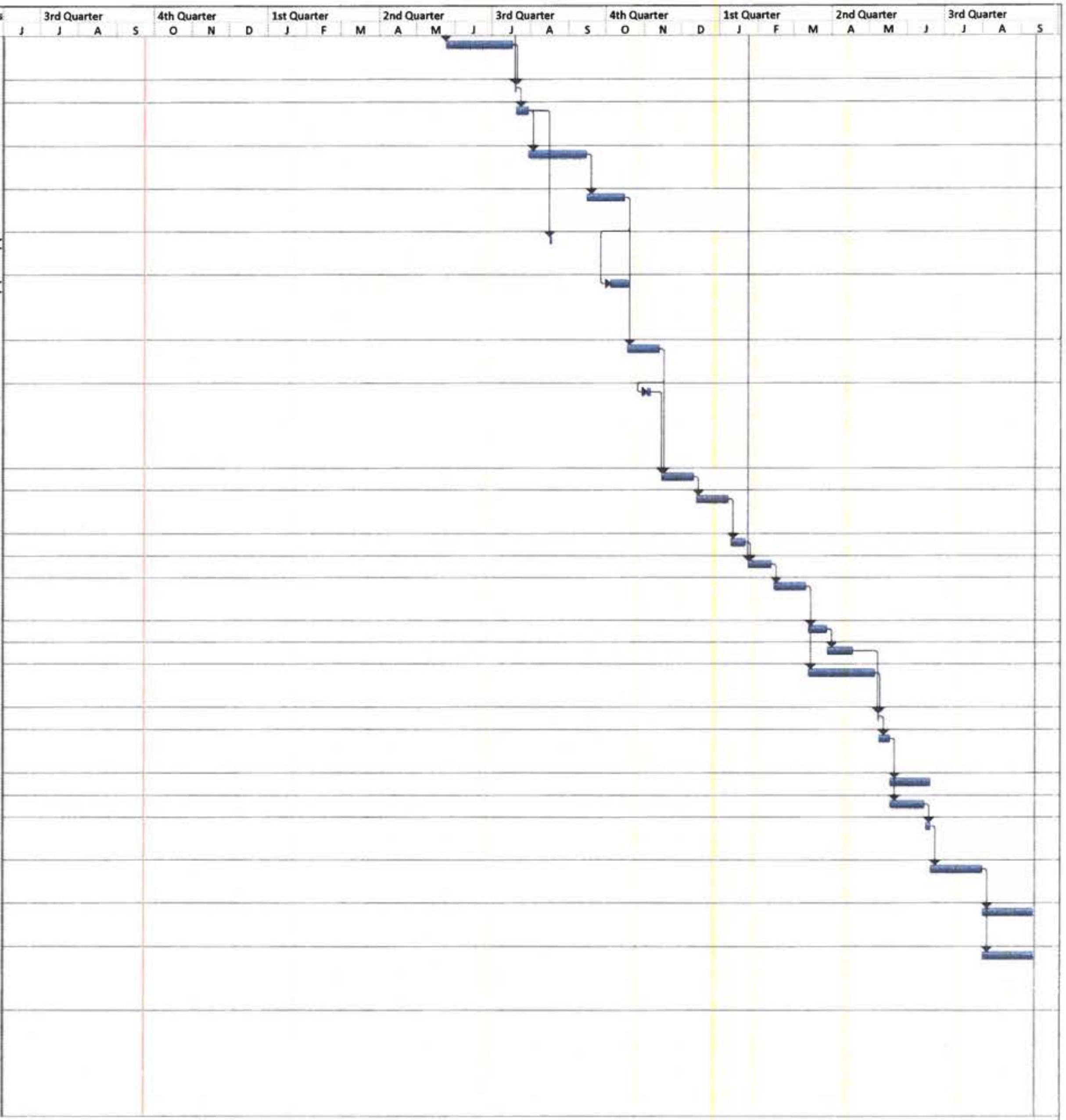
9. Next meeting date: WEDNESDAY, November 12th at 14:00

Geochemistry Conversation without NMCC present was foregone this meeting

ID	Task Name	Duration	Start	Finish	Predecess
1	Solv: revise Ch 2 to incorporate comments; rtn	13 days	Mon 6/2/14	Wed 6/18/14	
2	BLM: staff review Ch 2	34 days	Thu 6/19/14	Tue 8/5/14	1
3	Solv: incorporate Ch 2 BLM comments into PDEIS	67 days	Mon 8/11/14	Tue 11/11/14	2
4	LWA: Define sensitivity runs, EIS outputs; send LWA	9 days	Mon 7/14/14	Thu 7/24/14	
5	JSAI: Produce sensitivity runs and EIS outputs	14 days	Thu 8/21/14	Tue 9/9/14	4
6	Solv: develop Ch 3 resource sections	19 days	Wed 9/10/14	Mon 10/6/14	5
7	Solv: senior review of draft Ch 3 resource sections	10 days	Tue 10/7/14	Mon 10/20/14	6
8	Solv: edit draft Ch 3 resource sections	16 days	Tue 10/21/14	Tue 11/11/14	7
9	Solv: authors incorporate Ch 3 resource section edits	4 days	Wed 11/12/14	Mon 11/17/14	8
10	BLM: IDT review Ch 3 resource sections	30 days	Tue 11/18/14	Mon 12/29/14	9
11	Coordinate with USACE/EPA regarding required approvals as advised by BLM	240 days	Tue 12/30/14	Mon 11/30/15	10
12	Solv: revise Ch 3 resource sections	12 days	Tue 12/30/14	Wed 1/14/15	10
13	Solv: senior review of revised Ch 3 resource sections	8 days	Thu 1/15/15	Mon 1/26/15	12
14	Solv: edit & send revised and compiled Ch 3 resource sections to Doug	15 days	Tue 1/27/15	Mon 2/16/15	13
15	BLM (Doug): Review revised and compiled Ch 3 resource sections	10 days	Tue 2/17/15	Mon 3/2/15	14
16	Solv: incorporate Doug's comments into revised and compiled Ch 3 resource sections	5 days	Tue 3/3/15	Mon 3/9/15	15
17	BLM LCDO: Review PDEIS	10 days	Tue 3/10/15	Mon 3/23/15	3,16
18	BLM State Office: Review PDEIS	10 days	Tue 3/24/15	Mon 4/6/15	17
19	Solv: incorporate BLM comments and distribute	15 days	Tue 4/7/15	Mon 4/27/15	18
20	BLM, State Cooperators: Comments on Internal DEIS	15 days	Tue 4/28/15	Mon 5/18/15	19
21	Joint mtg to review Internal DEIS	1 day	Tue 5/12/15	Tue 5/12/15	20FS-1 days
22	Solv: Integrate BLM edits	5 days	Tue 5/19/15	Mon 5/25/15	20
23	BLM: Final Review of PDEIS	10 days	Tue 5/26/15	Mon 6/8/15	22
24	Solv: Final Edits	5 days	Tue 6/9/15	Mon 6/15/15	23
25	Print DEIS	20 days	Tue 6/16/15	Mon 7/13/15	24



ID	Task Name	Duration	Start	Finish	Predecess
26	Prepare NOA and press release	40 days	Mon 5/25/15	Fri 7/17/15	20
27	BLM, Solv: file with EPA	1 day	Mon 7/20/15	Mon 7/20/15	25,26
28	EPA: Publish NOA (Must be Friday)	8 days	Tue 7/21/15	Thu 7/30/15	27
29	Public Review (45 calendar day minimum)	33 days	Fri 7/31/15	Tue 9/15/15	28
30	Possible extension of comment period	23 days	Wed 9/16/15	Fri 10/16/15	29
31	BLM & NMCC/Solv: Conduct possible Public Meetings	2 days	Mon 8/17/15	Tue 8/18/15	28FS+1 days
32	Solv: Provide table of issues and concerns to BLM	11 days	Mon 10/5/15	Mon 10/19/15	30FS-10 days
33	Solv, BLM: analyze comments	20 days	Mon 10/19/15	Fri 11/13/15	30
34	Solv, BLM: joint review meeting to draft responses, and develop recommendations for FEIS	3 days	Wed 11/4/15	Fri 11/6/15	33FS-8 days
35	Solv: Preliminary FEIS	20 days	Mon 11/16/15	Fri 12/11/15	33,34
36	BLM: Review of Preliminary FEIS	20 days	Mon 12/14/15	Fri 1/8/16	35
37	BLM State Office Review	10 days	Mon 1/11/16	Fri 1/22/16	36
38	Solv: Prepare Admin FEIS	15 days	Mon 1/25/16	Fri 2/12/16	37,11
39	BLM, State: Comments on Admin FEIS	20 days	Mon 2/15/16	Fri 3/11/16	38
40	Solv: Admin FEIS	11 days	Mon 3/14/16	Mon 3/28/16	39
41	BLM: Print FEIS	15 days	Tue 3/29/16	Mon 4/18/16	40
42	Solv: Prepare NOA and press release	40 days	Mon 3/14/16	Fri 5/6/16	39
43	BLM & NMCC: File w/EPA	1 day	Mon 5/9/16	Mon 5/9/16	41,42
44	EPA: Publish NOA (Must be Friday)	7 days	Tue 5/10/16	Wed 5/18/16	43
45	Protest Period (30 days)	23 days	Thu 5/19/16	Mon 6/20/16	44
46	Solv: Draft & Final ROD	20 days	Thu 5/19/16	Wed 6/15/16	44
47	BLM & NMCC: Issue final ROD	2 days	Fri 6/17/16	Mon 6/20/16	46FS+1 day
48	NMCC: MPO updated to match ROD	30 days	Tue 6/21/16	Mon 8/1/16	47
49	BLM: Review and approve updated MPO	30 days	Tue 8/2/16	Mon 9/12/16	48
50	BLM, State: Review and approve Reclamation cost estimate	30 days	Tue 8/2/16	Mon 9/12/16	48
51	**Note: Sections 106 and 7 consultation schedules are not currently shown and will be added as they become known**				



Reid, Brad, NMENV

From: Katie Emmer <kemmer@themacresourcesgroup.com>
Sent: Tuesday, October 07, 2014 4:51 PM
To: Pintado, Kristine, NMENV; Dail, Bryan, NMENV; Reid, Brad, NMENV; Vollbrecht, Kurt, NMENV; Haywood, Doug; Leighandra Keeven (lkeeven@blm.gov); Eustice, Chris, EMNRD; Ennis, David, EMNRD; Shepherd, Holland, EMNRD; Dave Henney (Dave.Henney@solvllc.com); Myers, Kevin, OSE; Wunder, Matthew, DGF; Watson, Mark L., DGF
Cc: sfinch@shomaker.com
Subject: Copper Flat: Approved Jurisdicational Determination, Open Pit Water Body Inclusive of Associated 230 Acre Watershed
Attachments: Steven_Finch_JD_stand alone_10_06_2014.pdf; SPA-2014-00364-LCO (3).pdf

All,

I've the attached Approved Jurisdictional Determination letter for the Copper Flat Open Pit Water Body and associated 230 acre watershed, just received today from the Army Corps of Engineers. I am sharing this with you per my commitment to do so upon receipt as mentioned in the 30 September 2014 Cooperating Agency Meeting at MMD.

Best regards,

Katie Emmer | Permitting & Environmental Compliance Manager

M: +1 505.400.7925| **F:** +1 505.881.4616
A: 2424 Louisiana Blvd. NE, Suite 301, Albuquerque, NM 87110
W: themacresourcesgroup.com | **E:** kemmer@themacresourcesgroup.com

THEMAC
RESOURCES

REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
LAS CRUCES REGULATORY FIELD OFFICE
505 S. MAIN ST. SUITE 142
LAS CRUCES, NEW MEXICO 88001
(575)-556-9939

October 6, 2014

Regulatory Division

SUBJECT: Approved Jurisdictional Determination – Action No. SPA-2014-00364-LCO, Open Pit Water Body Inclusive of the Associated 230 Acre Watershed at Copper Flat Mine in Sierra County, New Mexico

Ms. Katie Emmer
New Mexico Copper Corporation
Permitting and Environmental Compliance Manager
2424 Louisiana Blvd. NE., Ste. 301
Albuquerque, NM 87110

Dear Ms. Emmer:

I am writing this letter in response to your request for an approved jurisdictional determination (JD) for property located at latitude 32.97025, longitude -107.53411, near the Community of Hillsboro, in Sierra County, New Mexico. The request for jurisdictional determination is for the 230 acre Copper Flat watershed. The project site is an isolated water without a surface or ground water connection to the nearest surface drainage, Grayback Arroyo, which is an ephemeral stream. We have assigned Action No. SPA-2014-00364-LCO to your request. Please reference this number in all future correspondence concerning the site.

Based on the information provided, we have determined that the site is not jurisdictional or subject to regulation under Section 404 of the Clean Water Act.

The basis for this approved JD (attached) is that the project site contains intrastate waters with no nexus to interstate or foreign commerce. A copy of this JD is also available at http://www.spa.usace.army.mil/reg/JD. This approved JD is valid for five years unless new information warrants revision of the determination before the expiration date.

You may accept or appeal this approved JD or provide new information in accordance with the attached Notification of Administration Appeal Options and Process and Request for Appeal (NAAOP-RFA). If you elect to appeal this approved JD, you must complete Section II of the form and return it to the Army Engineer Division, South Pacific, CESPD-PDS-O, Attn: Tom Cavanaugh, Administrative Appeal Review Officer, 1455 Market Street, Room 1760, San Francisco, CA 94103-1399 within 60 days of the date of this notice. Failure to notify the Corps within 60 days of the date of this notice means that you accept the approved JD in its entirety and waive all rights to appeal the approved JD.

If you have any questions, please contact Richard Gatewood at 575-556-9939 or by e-mail at richard.h.gatewood@usace.army.mil. At your convenience, please complete a Customer Service Survey on-line available at http://corpsmapu.usace.army.mil/cm_apex/f?p=regulatory_survey.

Sincerely,

Richard Gatewood
Marcy L. Leavitt
Chief, NM/TX Branch

Enclosure(s)

Approved Jurisdictional Determination
NAAOP-RFA Form

Copy Furnished with Enclosure(s)

Mr. Steven Finch, Jr. C.P.G.
John Shomaker & Associates, Inc.
V. P., Principal Hydrogeologist-Geochemist
2611 Broadbent Parkway N.E.
Albuquerque, NM 87107

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): September 29, 2014

B. DISTRICT OFFICE, FILE NAME, AND NUMBER: CESPA-RD-NM-LC; SPA-2014-00364-LCO; Open pit water body inclusive of the associated 230 watershed at Copper Flat in Sierra County, New Mexico

C. PROJECT LOCATION AND BACKGROUND INFORMATION:

State:New Mexico County/parish/borough: Sierra City: Hillsboro

Center coordinates of site (lat/long in degree decimal format): Lat. 32.97025° N, Long. -107.53411° W.

Universal Transverse Mercator:

Name of nearest waterbody: Grayback Arroyo and ephemeral tributary to the Rio Grande a TNW

Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: None

Name of watershed or Hydrologic Unit Code (HUC): 13020211

☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.

☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☒ Office (Desk) Determination. Date: September 17, 2014

☐ Field Determination. Date(s):

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** "*navigable waters of the U.S.*" within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]

☐ Waters subject to the ebb and flow of the tide.

☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are no** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. **Waters of the U.S.**
   a. **Indicate presence of waters of U.S. in review area (check all that apply):** [1]
      - ☐ TNWs, including territorial seas
      - ☐ Wetlands adjacent to TNWs
      - ☐ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
      - ☐ Non-RPWs that flow directly or indirectly into TNWs
      - ☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
      - ☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
      - ☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
      - ☐ Impoundments of jurisdictional waters
      - ☐ Isolated (interstate or intrastate) waters, including isolated wetlands

   b. **Identify (estimate) size of waters of the U.S. in the review area:**
      Non-wetland waters: linear feet: width (ft) and/or acres.
      Wetlands: acres.

   c. **Limits (boundaries) of jurisdiction** based on: **Not Applicable.**
      Elevation of established OHWM (if known): .

2. **Non-regulated waters/wetlands (check if applicable):**[3]

   ☒ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: **230 acre concentric watershed containing a 5 to 14 acre open water mine pit at the bottom.**

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[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.

[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).

[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: .

   Summarize rationale supporting determination: .

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": .

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. **Characteristics of non-TNWs that flow directly or indirectly into TNW**

   (i) General Area Conditions:
   Watershed size: **Pick List**
   Drainage area: **Pick List**
   Average annual rainfall: inches
   Average annual snowfall: inches

   (ii) Physical Characteristics:
   (a) Relationship with TNW:
   ☐ Tributary flows directly into TNW.
   ☐ Tributary flows through **Pick List** tributaries before entering TNW.

   Project waters are **Pick List** river miles from TNW.
   Project waters are **Pick List** river miles from RPW.
   Project waters are **Pick List** aerial (straight) miles from TNW.
   Project waters are **Pick List** aerial (straight) miles from RPW.
   Project waters cross or serve as state boundaries. Explain: .

   Identify flow route to TNW[5]: .
   Tributary stream order, if known: .

---

[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.

[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):

Tributary is:
☐ Natural
☐ Artificial (man-made). Explain: .
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):
☐ Silts
☐ Cobbles
☐ Bedrock
☐ Other. Explain: .
☐ Sands
☐ Gravel
☐ Vegetation. Type/% cover:
☐ Concrete
☐ Muck

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:
Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List.** Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☐ Bed and banks
☐ OHWM[6] (check all indicators that apply):
  ☐ clear, natural line impressed on the bank
  ☐ changes in the character of soil
  ☐ shelving
  ☐ vegetation matted down, bent, or absent
  ☐ leaf litter disturbed or washed away
  ☐ sediment deposition
  ☐ water staining
  ☐ other (list):
  ☐ the presence of litter and debris
  ☐ destruction of terrestrial vegetation
  ☐ the presence of wrack line
  ☐ sediment sorting
  ☐ scour
  ☐ multiple observed or predicted flow events
  ☐ abrupt change in plant community
☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
☐ High Tide Line indicated by:
  ☐ oil or scum line along shore objects
  ☐ fine shell or debris deposits (foreshore)
  ☐ physical markings/characteristics
  ☐ tidal gauges
  ☐ other (list):
☐ Mean High Water Mark indicated by:
  ☐ survey to available datum;
  ☐ physical markings;
  ☐ vegetation lines/changes in vegetation types.

(iii) Chemical Characteristics:
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: .
Identify specific pollutants, if known: .

---

[6] A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7] Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):
☐ Riparian corridor. Characteristics (type, average width): .
☐ Wetland fringe. Characteristics: .
☐ Habitat for:
  ☐ Federally Listed species. Explain findings: .
  ☐ Fish/spawn areas. Explain findings: .
  ☐ Other environmentally-sensitive species. Explain findings: .
  ☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:

(a) General Wetland Characteristics:
Properties:
Wetland size: acres
Wetland type. Explain: .
Wetland quality. Explain: .
Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:
Flow is: **Pick List**. Explain: .

Surface flow is**: Pick List**
Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:
☐ Directly abutting
☐ Not directly abutting
  ☐ Discrete wetland hydrologic connection. Explain: .
  ☐ Ecological connection. Explain: .
  ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW
Project wetlands are **Pick List** river miles from TNW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Flow is from: **Pick List.**
Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) Chemical Characteristics:
Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .
Identify specific pollutants, if known: .

(iii) Biological Characteristics. Wetland supports (check all that apply):
☐ Riparian buffer. Characteristics (type, average width): .
☐ Vegetation type/percent cover. Explain: .
☐ Habitat for:
  ☐ Federally Listed species. Explain findings: .
  ☐ Fish/spawn areas. Explain findings: .
  ☐ Other environmentally-sensitive species. Explain findings: .
  ☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)
All wetland(s) being considered in the cumulative analysis: **Pick List**
Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: .

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   ☐ TNWs: linear feet width (ft), Or, acres.
   ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   ☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: .
   ☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
☐ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional waters within the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional wetlands in the review area: acres.

7. **Impoundments of jurisdictional waters.[9]**
As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
☐ Demonstrate that impoundment was created from "waters of the U.S.," or
☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]

☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

---

[8] See Footnote # 3.
[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.
[10] **Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.***

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):

☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.

☒ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.

☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).

☒ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: **The 230 acre watershed terminates in an open water mine pit that is a terminal, isolated, intrastate water that does not have a significant nexus with jurisdictional waters.**

☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
☒ Lakes/ponds: 5 - 14 acres.
☒ Other non-wetland waters: 230 acres. List type of aquatic resource: upland sheet flow, and ephemeral riverine and palustrine bottom.
☐ Wetlands: acres.

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: map figure 3, showing watershed drainage boundary prepared by John Shomaker & Associates, Inc. Aug 4, 2014.
☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
  ☐ Office concurs with data sheets/delineation report.
  ☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps: .
☐ Corps navigable waters' study: .
☐ U.S. Geological Survey Hydrologic Atlas: .
  ☐ USGS NHD data.
  ☐ USGS 8 and 12 digit HUC maps.
☐ U.S. Geological Survey map(s). Cite scale & quad name: .
☐ USDA Natural Resources Conservation Service Soil Survey. Citation: .
☐ National wetlands inventory map(s). Cite name: .
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is:Not a Floodplain (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☐ Aerial (Name & Date): .
or ☒ Other (Name & Date): Seven photos taken of the open pit water body.
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☒ Other information (please specify): Concentric 230-acre watershed drains to bottom; 5 - 14 acre open mine pit. The 230 acre watershed and open pit are an isolated drainage.

.

B. ADDITIONAL COMMENTS TO SUPPORT JD: The applicant has requested an approved jurisdictional determination for a 230 acre roughly bowl shaped watershed containing a 5 to 14 acre open water mine pit at the bottom (1). The review area and the project area are the same, the 230-acre Copper Flats watershed. The Copper Flats watershed drains to and terminates in the manmade open water mine pit which is currently approximately 5 acres in size. The open water mine pit was created during past mining operations and its size varies depending on the amount of inflow from the watershed (1). The technical memorandum explains that the open water pit is located in impermeable bed rock and is a hydrologic sink in which the only means for the water to exit is evaporation. Average annual evaporation rates in the open pit exceed average annual drainage collection. (2). Average runoff to the open pit is estimated at 1 acre-foot per year and average net evaporation from the open pit is estimated at 20 acre-feet per year. The applicant states that the water in the open water pit will not be used for processing copper ore, so there would not be a nexus to interstate commerce (3).

The maps and discussion provided by the agent demonstrate that there is no physical surface connection between the 230-acre watershed and Grayback Arroyo, an ephemeral stream located approximately 1200 feet to the south of the open water pit (1). Grayback arroyo is a tributary to the Rio Grande, which is a TNW. The technical memorandum explains that the Grayback Arroyo channel was re-configured between 1970 and 1982 around the Copper Flat open water pit and watershed and the two drainages became hydrologically disconnected (2).

The applicant has identified two drainages within the project area on the north side of the open pit. According to the applicant, the northwest topographic drainage is approximately 2,011 ft in length, has no defined channel, and storm water is likely conveyed through as sheet flow. Width and depth are difficult to discern, but the applicant estimates this channel varies from 0-10 ft in width and from 0-2 ft in depth. The northeast topographic drainage is approximately 1,296 ft in length, with segments of defined channel in the upper half (channel width varies between 0 and 8 ft); depth is difficult to discern, the applicant estimates it varies from 0-2 ft. The majority of the northeast drainage appears to also convey storm water via sheet flow. Outside of these two drainages, the 230 acre watershed conveys stormwater via sheet flow (4).

References:

(1) Letter and proposed jurisdictional determination from John Shomaker and Associates, Inc. to Richard Gatewood dated August 4, 2014, NMCC_JD_2014Sept_w_cvltr.pdf
(2) Technical Memorandum dated September 10, 2014, JSAI_TM_Grayback open pit hydrology_10Sept2014_Final.pdf
(3) Letter from Themac Resources to Rick Gatewood dated August 15, 2015, Letter_ACOE_wateruse_15Aug2014.pdf .

Reid, Brad, NMENV

From: Hogan, James, NMENV
Sent: Wednesday, October 15, 2014 11:56 AM
To: Vollbrecht, Kurt, NMENV; Reid, Brad, NMENV
Cc: Pintado, Kristine, NMENV; Dail, Bryan, NMENV
Subject: FW: Copper Flat open pit UAA workplan
Attachments: NMCC_UAA_workplan_6Oct2014.pdf

Kurt / Brad –

Please let us know if you have any comments on this revised UAA workplan. We think this is pretty good and we will likely approve with some comments.

Thanks
James

From: Katie Emmer [mailto:kemmer@themacresourcesgroup.com]
Sent: Monday, October 06, 2014 3:35 PM
To: Pintado, Kristine, NMENV
Cc: Dail, Bryan, NMENV; Hogan, James, NMENV; paulcassidy@aquaticconsultants.com; nelson.russell@epa.gov; Steve Finch
Subject: Copper Flat open pit UAA workplan

Ms. Pintado,

A revised UAA workplan based on NMED's comments in your letter dated 17 September 2014, is attached.

Best regards,

Katie Emmer | Permitting & Environmental Compliance Manager

M: +1 505.400.7925| **F:** +1 505.881.4616
A: 2424 Louisiana Blvd. NE, Suite 301, Albuquerque, NM 87110
W: themacresourcesgroup.com | **E:** kemmer@themacresourcesgroup.com

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August 29, 2014

Kristine Pintado, Water Quality Standards Coordinator
Surface Water Quality Bureau
New Mexico Environment Department
Harold Runnel Building
1190 St. Francis Dr.
P.O. Box 5469
Santa Fe, New Mexico 87502

Re: Copper Flat open pit aquatic life and recreational Use Attainability Analysis workplan

Dear Ms. Pintado:

On behalf of New Mexico Copper Corporation, John Shomaker & Associates, Inc. (JSAI) has prepared this Use Attainability Analysis (UAA) workplan for determining if aquatic life and recreational uses and associated New Mexico Water Quality Control Commission (NMWQCC) surface water quality standards (NMAC 20.6.4) apply to the Copper Flat open pit.

The Copper Flat open pit currently contains water that is considered a non-classified perennial water of the state subject to surface water quality standards for the default uses related to primary contact, aquatic life, livestock, and wildlife. Livestock and wildlife are existing uses. It is uncertain if primary contact and aquatic life designated uses should apply to the Copper Flat open pit water because it is man-made, disconnected from adjacent water courses, and is a hydrologic sink.

A UAA is a structured scientific assessment of the factors affecting the attainment of uses specified in Section 101(a)(2) of the Clean Water Act (aquatic life and primary contact recreation uses). The factors to be considered in such an analysis include the physical, chemical, biological, and economic use removal criteria described in EPA' s water quality standards regulation (40 CFR 131.10(g)(1)-(6)).

Under 40 CFR 131.10(g) regulation states one may remove a designated use which is not an existing use, as defined in § 131.3, or establish sub-categories of a use if the State can demonstrate that attaining the designated use is not feasible because:

1. Naturally occurring pollutant concentrations prevent the attainment of the use; or
2. Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by

the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or

3. Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or
4. Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use; or
5. Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or
6. Controls more stringent than those required by sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact.

Underlined items 1, 3, 4, and 5 likely apply to the Copper Flat open pit water body.

Process

The purpose of the proposed UAA analysis is to determine if the Copper Flat Open Pit does or does not support aquatic life or recreational uses; either it is or is not feasible to achieve the Clean Water Act §101(a)(2) goals. The following questions will be addressed:

1. What are the existing aquatic life and recreational uses for the Copper Flat open pit water?
2. What evidence and records are provided to described the existing uses as defined in Subsection E of 20.6.4.5.E NMAC?
3. What are the causes of any impairment of the uses?
4. What are the attainable uses based on the physical, chemical and biological characteristics of the water body?

If the data show that primary contact and aquatic life uses do not apply, then the appropriate water quality standards designations are §20.6.4.97 NMAC (livestock and wildlife uses). It is our understanding the Department will proceed, as indicated in §20.6.4.15.D NMAC, to post the UAA on the Department's Surface Water Quality Bureau website, and notify interested parties of a 30-day public comment period. Depending on the comments received, the Department may then submit this UAA and responses to comments to EPA Region 6 for technical approval. If EPA grants technical approval, the waters listed in this UAA will be subject to §20.6.4.97 NMAC.

Copper Flat UAA Approach (Water Body Survey and Assessment)

Copper Flat Open Pit is a manmade feature created in 1982, and is a hydrologic sink disconnected from adjacent water courses. A dam was created in 1982 to divert Grayback Arroyo around the Open Pit. The Open Pit area is naturally mineralized, and it is believed that only livestock and wildlife uses can be obtained through reclamation efforts. The UAA would be performed to evaluate the applicability of aquatic life and recreational uses. The potential cases that apply to Copper Flat Open Pit are:

1. Naturally occurring pollution concentrations (source of water is groundwater inflow and storm water runoff from mineralized ore body),
2. Low flow conditions (the Open Pit is a hydraulic sink not connected to a water course), and
3. Human caused conditions prevent attainment and cannot be remedied (the open pit is secured and not accessible to the public thereby preventing recreational uses).

It is possible that if more than one factor occur, aquatic communities could be more limited than if only a single stressor occurred. These factors are evaluated in Table 1.

Table 1. Potentially applicable use attainability factors and evidence evaluated in the UAA

case	attainability factor	evidence evaluated
1	naturally occurring concentrations	water concentrations reported from historical pre-mining conditions, and recent concentrations from nearby reference streams
2	low flow conditions	seasonal conditions related to physical habitat
3	irremediable human caused conditions	recent data on the effectiveness of proposed reclamation and projected results of implementing alternative additional actions

Proposed Outline of Analysis Report

- Watershed Description and History
- Hydrologic Conditions
- Surface Water Chemistry
- Physical Habitat Conditions
- Biological Conditions
- Recreational Uses
- Feasibility of Remedying Pollution Sources
- Conclusions and Recommendations

PROPOSED WORKPLAN

This UAA workplan was prepared according to 20.6.4.15 NMAC and guidance provided in the EPA's *Water Quality Handbook - Chapter 2: Designation of Uses (40 CFR 131.10), Section 2.9 Use Attainability Analyses - 40 CFR 131.10(j) and (k).* EPA indicates that the specific analyses included in their handbook are optional, but "represent the type of analyses EPA believes are sufficient for States to justify changes in uses designated in a water quality standard and to determine uses that are attainable. States may use alternative analyses as long as they are scientifically and technically supportable."

Preparation of Water Body Survey and Assessment

The primary component of the UAA would be a Water Body Survey and Assessment. The Water Body Survey and Assessment would consider selected physical, chemical, and biological factors for the existing pit water body that is located at the site of the proposed pit water body in order to identify any existing uses and determine attainable uses for the proposed pit. Selected physical and chemical factors would also be considered for the proposed pit, based on the mine plan and predictive geochemical modeling results, to determine attainable uses for the proposed pit. Economic limitations on attaining uses for the proposed pit would also be considered.

Table 1 presents physical, chemical, and biological factors to be considered for the existing pit, and Table 2 presents factors to be considered for the proposed pit, when conducting the UAA for the proposed open pit water body at Copper Flat Mine.

Preparation of the assessment would be guided by 40 CFR 131.10(g), which lists the conditions that may result in a designated use not being feasible, EPA's *Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analysis* (1983; volume III, 1984), and EPA's *Interim Economic Guidance for Water Quality Standards Workbook* (1995). Data collection and analysis methods would follow standard practices recommended by the EPA and other described in Wetzel (2001).

Scope of Data

EPA indicates that "States are encouraged to use existing data to perform the physical, chemical, and biological evaluations presented in this guidance document. The Water Body Survey and Assessment would include selected physical and chemical factors for which data have already been collected for the existing pit. Table 2 presents data available for the open pit from previous studies.

If physical limitations are identified in the assessment, the assessment would also explain why the physical limits would not be "reversible," and identify limitations on the ability to restore the physical integrity of the water body.

Table 2. Summary of existing physical and chemical data to be considered for Water Body Survey and Assessment for Copper Flat open pit water body

physical factors	chemical factors
characteristics	toxicants (B, Cd, Hg, Mn, Mo, Ni, Se, V, Zn)
size (dimensions, depth-area relationship, depth-volume relationship, bathymetry)	nutrients (nitrogen)
annual hydrology (water balance)	alkalinity
substrate composition and characteristics	pH
hydrologic sink	dissolved solids

Because the study will be carried out over a limited time period, no modeling will be attempted. However, sufficient short-term data will be generated to demonstrate whether or not the open pit water can reasonably achieve each of its designated uses.

Physical Conditions

In situ measurements to determine the thermal characteristics, water clarity, and light attenuation of the water body as they deal with stratification, nutrient cycling, and plankton growth have already been collected as part of the Baseline Data collection required for a new mining permit with the New Mexico Mines and Minerals Division. Past investigations have also characterized sediment depth and composition. Substrate type, has also been evaluated across the open pit bottom. The existing data on the physical conditions will be used to determine if sufficient habitat is available for a diverse macroinvertebrate population.

Nutrient Conditions

There is a substantial database of historical chemical data that includes most inorganic parameters. The existing inorganic water quality data will be used as part of the analysis.

Nutrients are important to sustain phytoplankton and zooplankton as part of the aquatic food web. Ammonia, can also be a toxic chemical to many species. Accordingly, the following analytes will be measure in the epilimnion, or for the upper 1/3 of the water column if an epilmnion does not exist. The sample will consist of a three location composite.

- Nitrate
- Nitrite
- Phosphorus, total
- Phosphorus, dissolved

- Ammonia
- Total Kjeldahl N
- Total organic and inorganic carbon
- Chlorophyll-a
- pH
- N:P:C ratio

Biological Conditions

The current community structure of the water body needs to be established to determine if a food web exists. A composite sample will be created from three locations. The composite will be examined to identify the number and genera of primary producers (algae) and the various forms of zooplankton that provide food for higher life forms (fish):

- Algae identification, count, and percent composition by genus; tolerance indicators
- Zooplankton forms, count, and percent composition (cladocera, rotifers, copepods, etc)
- Benthic macroinverebrate forms, count and percent composition; tolerance indicators, oligochaete/chironomid ratio (Weiderholm), and Trophic Condition Index
- Aquatic macrophyte distribution and identification

Fish

The effort to collect fish will be both electro-fishing and experimental mesh gill nets. The experimental mess gill nets are 150 ft long and range in mesh size from ½ inch to 3 inches. One net night will be set with three nets (8 hour sample overnight). Any fish collected with be identified, weighed, measured, and returned to the water. If fish are caught, a representative sample will also be photographed. The electro-fishing survey will utilize an 18ft Smith-Root electro-fishing boat with two netters, an observer, and a boat driver. The electro-fishing effort will be 3,600 seconds (measured by the boat meter of actual electro-fishing time). The sample will be split into two with 1,800 seconds during daylight and 1,800 seconds after dark. If any fish are collected, a representative sample will also be photographed. Any fish collected with be identified, weighed, measured, and returned to the water. Population estimates will be conducted on all species where the sample size is large enough.

Integrated Conditions

The following section will integrate the data and make final qualitative and quantitative descriptions and analyses of the water body biological integrity. The analysis will include, but not be limited to:

- Descriptive Classification of Biological Health
- Quantitative Descriptive Score (EPA 1983)
- Carlson Trophic Status Index
- Nygaard Trophic Index
- Palmer Organic Pollution Index
- USEPA Phytoplankton Index of Trophic Status

The proposed assessment will be performed by JSAI and Aquatic Consultants, Inc. in cooperation with New Mexico Copper Corporation.

NMED Review of Draft Water Body Survey and Assessment

The Water Body Survey and Assessment would be submitted in draft form to NMED for review and comment prior to finalizing the UAA, public notice, and consultation with other appropriate state and/or federal agencies. After addressing NMED comments, the UAA for the proposed open pit water body at Copper Flat Mine would be finalized and submitted to NMED.

Sincerely,

JOHN SHOMAKER & ASSOCIATES, INC.

Steven T. Finch, Jr.
V.P., Principal Hydrogeologist-Geochemist

STF:sf

CC: Katie Emmer, New Mexico Copper Corporation
Bryan Dail, Environmental Specialist, Standards Planning and Reporting Team, NMED SWQB
James Hogan, Chief, NMED SWQB
Paul Cassidy, Aquatic Consultants, Inc.

From:	Dail, Bryan, NMENV
Sent:	Monday, October 20, 2014 3:58 PM
To:	Steve Finch
Cc:	Katie Emmer; Hogan, James, NMENV; Scarano, Jeff, NMENV; Reid, Brad, NMENV; paulcassidy@aquaticconsultants.com; Dail, Bryan, NMENV; Pintado, Kristine, NMENV
Subject:	NMCC revised UAA workplan
Attachments:	NMCC Revised UAA_Accept_102014_dbd_final.pdf

Dear Mr. Finch:

Attached is the Environment Department's letter regarding the revised UAA work plan titled *"New Mexico Copper Corporation Use Attainability Analysis Workplan for Copper Flat Pit Mine Lake"*.

Please feel free to contact Kris Pintado or me if you have any questions regarding this letter or the additional comments made upon the revised work plan. An original will be sent via the U.S. Post.

-Bryan

Bryan Dail, PhD
Surface Water Quality Bureau
Monitoring, Standards & Assessment Section
New Mexico Environment Department
Phone: (505) 476-3799
Email: bryan.dail@state.nm.us

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SUSANA MARTINEZ
Governor
JOHN A. SANCHEZ
Lieutenant Governor

RYAN FLYNN
Cabinet Secretary
BUTCH TONGATE
Deputy Secretary

October 20, 2014

Steven T. Finch, Jr.
Vice President, Principal Hydrogeologist-Geochemist
John Shomaker and Associates, Inc.
2611 Broadbent Parkway NE
Albuquerque, New Mexico 87107

Re: New Mexico Copper Corporation Use Attainability Analysis Workplan for Copper Flat Pit Mine Lake

Dear Mr. Finch:

On October 6, 2014 the New Mexico Environment Department (Department), Surface Water Quality Bureau received the revised document entitled, *"Copper Flat open pit aquatic life and recreational Use Attainability Analysis (UAA) workplan"* from John Shomaker & Associates, Inc., on behalf of New Mexico Copper Corporation (NMCC). The Department is approving the revised UAA work plan with the following additional comments:

1) The revised 40 CFR 131.10(g) factors that are now under consideration no longer include factor 1, "natural conditions", yet "*naturally occurring concentrations*" are included in Table 1 of the revised work plan. If natural metal concentrations are to be considered as a factor and reason for non-attainability, the NMCC would need to demonstrate a statistically defensible body of data that the water chemistry in the pit lake is natural or "background".

2) The Copper Flat pit lake is considered an unclassified perennial water of the state, which includes a warmwater aquatic life use. Therefore, another physical parameter that should be monitored is temperature (e.g., Table 3). Temperature extremes, sources of thermal inputs, and duration of temperature exposure are key parameters used in evaluating the best aquatic life uses and criteria.

3) The utility of the Palmer Organic Pollution Index (p. 9) for use in the UAA is not clear as this index relates to tolerances and sensitivities of algal taxa to organic pollutants. It is not clear why this index is relevant to the Copper Flat pit lake.

4) The revised work plan appears to rely on the Department to post the UAA and notify interested parties. To clarify, the Department is not required to conduct the public notification or comment period for the UAA. The UAA procedures pursuant to 20.6.4.15.D NMAC require the work plan to include "provisions for public notice and consultation with appropriate state and federal agencies" which the Department expects will be conducted by the proponent. Subsequently and upon "approval of the work plan by the Department, the proponent shall conduct the use attainability analysis in accordance with the approved work plan". This is stated in the rule because any water quality standards revision requires the meaningful involvement of the public and intergovernmental coordination. It is also important to consider this input before completion of the UAA and submittal of the "data, findings and conclusions" to the Department. The Department will provide necessary guidance and assist as we are able in this effort however the primary responsibility rests with the proponent.

We appreciate the efforts by the NMCC on the development of the work plan for the Copper Flat pit mine UAA. In approving the revised UAA work plan, we hope the additional comments are helpful, and encourage you to consider them in conducting the UAA. If you have questions about the UAA process or comments in this letter, please contact Bryan Dail at (505) 476-3799 (Bryan.Dail@state.nm.us) or me at (505) 827-2822 (Kristine.Pintado@state.nm.us).

Sincerely,

Kristine L. Pintado

Kristine L. Pintado
Water Quality Standards Coordinator
Surface Water Quality Bureau

Copy via email:
Katie Emmer, Permitting and Environmental Compliance Manager, New Mexico Copper Corporation
James Hogan, Bureau Chief, NMED SWQB
Jeff Scarano, Manager, Assessment and Standards Section, NMED SWQB
Bryan Dail, Environmental Specialist, Standards, Planning and Reporting Team, NMED SWQB
Brad Reid, Environmental Specialist, NMED GWQB
Paul Cassidy, Aquatic Consultants, Inc.

From: Dail, Bryan, NMENV
Sent: Monday, October 20, 2014 2:43 PM
To: Vollbrecht, Kurt, NMENV; Hogan, James, NMENV; Reid, Brad, NMENV
Cc: Pintado, Kristine, NMENV
Subject: RE: Copper Flat open pit UAA workplan

Kurt:

We may have caught typos as this has gone under more review since we sent your way, but I'd be grateful if you could point them out as we don't want to miss them!

To answer your question, yes, there will be sampling for fish...although it may be a safe bet that no fish would be found, the UAA is an evidence-based approach to making the case for proper use designation different than the default, which is "fishable" waters.

I think their fishing plan is minor in effort, but fitting to the task given the probability of fish and size of the water body. In doing so, it won't be a definitive statement (absence of evidence not being evidence of absence), but it will be one that they can say is backed by the latest scientific knowledge.

Cheers, and thanks for your review,

-Bryan

From: Vollbrecht, Kurt, NMENV
Sent: Monday, October 20, 2014 2:32 PM
To: Hogan, James, NMENV; Reid, Brad, NMENV
Cc: Pintado, Kristine, NMENV; Dail, Bryan, NMENV
Subject: RE: Copper Flat open pit UAA workplan

I don't have any substantive comments. There were a few typos...are they really going to try to find fish out there?!

Kurt Vollbrecht, Program Manager
Mining Environmental Compliance Section
Ground Water Quality Bureau
New Mexico Environment Department
(505) 827-0195

From: Hogan, James, NMENV
Sent: Wednesday, October 15, 2014 11:56 AM
To: Vollbrecht, Kurt, NMENV; Reid, Brad, NMENV
Cc: Pintado, Kristine, NMENV; Dail, Bryan, NMENV
Subject: FW: Copper Flat open pit UAA workplan

Kurt / Brad –

Please let us know if you have any comments on this revised UAA workplan. We think this is pretty good and we will likely approve with some comments.

Thanks
James

From: Katie Emmer [mailto:kemmer@themacresourcesgroup.com]
Sent: Monday, October 06, 2014 3:35 PM
To: Pintado, Kristine, NMENV
Cc: Dail, Bryan, NMENV; Hogan, James, NMENV; paulcassidy@aquaticconsultants.com; nelson.russell@epa.gov; Steve Finch
Subject: Copper Flat open pit UAA workplan

Ms. Pintado,

A revised UAA workplan based on NMED's comments in your letter dated 17 September 2014, is attached.

Best regards,

Katie Emmer | Permitting & Environmental Compliance Manager

M: +1 505.400.7925| **F**: +1 505.881.4616
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THEMAC
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RYAN FLYNN
Cabinet Secretary

BUTCH TONGATE
Deputy Secretary

Internal Memorandum

October 21, 2014

To: Jeff Kendall, General Counsel

From: Trais Kliphuis, Acting Director, Resource Protection Division

RE: Request for Legal Representation, Copper Flat Mine

The Ground and Surface Water Quality Bureaus request legal assistance for upcoming permitting actions and determinations related to the Copper Flat Mine. The Copper Flat Mine is owned by the New Mexico Copper Corporation (NMCC), a wholly owned subsidiary of THEMAC Resources Group, Ltd.

Currently the Copper Flat Mine site includes a 12.8 acre open pit water body, several waste rock piles, a diversion channel re-routing the Greyback Arroyo around the open pit, the original tailing impoundment with at least 1.2 million tons of tailings over a 60 acre area, and ancillary facilities including power lines and water pipelines.

NMCC is planning on submitting a revised Discharge Permit application to the Ground Water Quality Bureau (GWQB) sometime in early 2015. The application will be processed pursuant to the copper rule, Section 20.6.7 NMAC. Legal assistance is requested to represent the bureaus in the event that a Public Hearing is held for the proposed discharge permit.

Legal assistance is also requested to assist with work related to the Use Attainability Analysis (UAA) being pursued by NMCC. The UAA may be used by NMCC to support a proposal to modify the surface water quality standards (20.6.4 NMAC) that apply to the existing pit water body and the future water body that will persist following closure of the mine.

Andrew Knight is the OGC staff most familiar with the copper rule implementation while Kevin Powers is most familiar with the UAA process and associated surface water quality standards.

Any questions should be directed to Kurt Vollbrecht at 827-0195.

THEMAC
RESOURCES

TO: Katie Emmer
FROM: Steve Raugust
CC: BLM-EIS: Mark Nelson; NMED GWQB: Patrick Longmire, Brad Reid, Kurt Vollbrecht; MMD: D.J. Ennis; NMED SWQB, Bryan Dail; JSAI: Steve Finch; SRK: Amy Prestia, Ruth Warrender, Rob Bowell.
DATE: October 29, 2014
SUBJECT: Agenda for October 29, 2014 Environmental Geochemistry Conference Call

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NMCC is proceeding to address written comments on the May 2013 Geochemical Characterization and related documents dated September 19, 2014 and verbal comments to the September 2013 Pit Model report provided during the September 22, 2014 conference call. However SRK received approval for additional scope and funding on October 21, 2014, so technical discussion will focus more on strategy than results. However, the call provides an opportunity to inform the agencies on the path forward as we are progressing. Items for discussion are:

- NMCC's management has requested NMCC's technical team coordinate with NMED, BLM and others to obtain more formal responses to NMCC's documents and comment responses, such as the September 19, 2014 comments to the geochemical characterization documents. NMCC to elaborate.
- Brief general overview of the road map and timing of completing the final model, documenting report, running water quality projections based on reclamation strategies for the pit and documenting those results.
- Issues, Clarification, Discussion on September 19, 2014 Geochemical Characterization agency comments.
- NMCC strategy and timing to address September 19 comments.
- Progress with respect to the Pit model
    - Strategies and approach to improving the calibration of the exiting pit
    - Research and documentation regarding pit lake stratification
    - Approach and research in progress with respect to reactive pit wall thicknesses and fracture densities.
- Timing of NMCC responses to September 22, 2014 verbal agency comments.
- Open discussion to other topics not above.

SRK has provided the call information below and the call is scheduled for 9 am MDT and is expected to last about an hour.

US
1-866-321-0159
Pin: 996783#

UK
0800 2794047
Pin – 996783#

From:	Steve Raugust <sraugust@themacresourcesgroup.com>
Sent:	Wednesday, October 29, 2014 4:58 PM
To:	Vollbrecht, Kurt, NMENV; Reid, Brad, NMENV; Longmire, Patrick, NMENV; 'Nelson, Mark' (NelsonMR@cdmsmith.com)
Cc:	Katie Emmer
Subject:	NMCC Notes on 9-22-14 call and SRK scope
Attachments:	Summary Notes for 22Sep2014 Pit Geochem Call.pdf

All,

Attached is a memo that includes NMCC notes from the September 22, 2014 Geochemistry conference call. Also in the memo is SRK's current scope of work to resolve the Sept 22, 2014 pit model comments (based on NMCC's notes), the Sept 19, 2014 NMED compiled characterizations comments, and revision of the Sept 2013 pit model report.

Please review to make sure we are all on the same page. I believe we are. As discussed today, SRKs scope is executed and they are proceeding with work.

Steve Raugust, CEG | Resource Development Manager

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TO: Kurt Volbrecht, NMED
FROM: Steve Raugust, THEMAC Resources
CC: NMED: Brad Reid, Patrick Longmire; EIS/CDM-Smith: Mark Nelson
DATE: October 29, 2014
SUBJECT: NMCC summary notes for September 22, 2014 pit geochemistry conference call and SRK response scope of work.

This memo provides the notes taken by New Mexico Copper Corporation (NMCC) during the September 22, 2014 pit geochemistry conference call. Below the conference call notes, SRK Consulting's scope of work comment resolution scope of work approved by NMCC October, 21 2014 is provided. The scope of work includes coordinating with NMCC to respond to NMED and CDM-Smith's (BLM EIS Contractor) comments provided in the September 22, 2014 conference call (below), the final compiled NMED comments to the geochemical characterization reports dated September 19, 2014, and revision to the SRK September 2013 Predictive Geochemical Modeling of the Pit Lake Water Quality report that incorporates agency comments and additional model results.

1.0 NMCC Notes on Pit Geochemistry Call, 22 Sept 2014

In attendance:

Name	Company	Initial
Rob Bowell	SRK	RB
Ruth Warrender	SRK	RW
Amy Prestia	SRK	AP
Mark Nelson	CDM	MN
Steve Finch	JSAI	SF
Katie Emmer	NMCC	KE
Steve Raugust	NMCC	SR
Kurt Vollbrecht	NMED GWQB	KV
Brad Reid	NMED GWQB	BR
Patrick Longmire	NMED GWQB	PL
Bryan Dail	NMED SWQB	BD
DJ Ennis	MMD	DJE

KV: We would like to use this call to get to a point where we can move forward, we'd like to get the model to a place where we are comfortable that it will evaluate relative impacts and improvement to water quality from proposed mitigation. Get the model to a point where we are happy with the calibration, need to be able to defend it in a hearing. We see these main concerns to discuss:

1. Calibration on the existing pit lake water quality is not great
2. Decide whether it's homogeneous or heterogeneous (pit stratification issue)
3. Address scaling, fracture density and wall rock reaction assumption issues

KV: I will let P. Longmire drive the agenda.

SF: Before we get started, I'd like to ask if we've agreed on the COCs?

PL: Yes, we have identified: copper, mercury, selenium and chloride. Some of these are based on input from the NMED SWQB. Good job documenting there is no observed mercury, I believe mercury is not a long term issue. We know the model overestimates selenium, we believe chloride will be useful in evaluating the water balance and water evaporation in the pit.

PL: Appreciate that a lot of sophistication has been put into the model, in both the input parameters and simulations. We all know these are calculations, but they provide insight.

PL: Rob, could you re-do the simulations for the existing conditions to address concerns about the calibration?

RB: Yes, technically we can, but would like to look at this in detail. There is a minimal practical detection limit for selenium, which is significantly higher with an overlap with sulfur. There is calculated vs. measured, it could be what you are asking us to do is impossible. Selenium is a notorious element.

PL: Perhaps you could write a paragraph on what you feel describes the analytical interferences.

RB: We can talk to the labs and see what variability they have seen.

PL: Re: the revision of table 3.5- what is the saturated index value?

RB: Could be -2 to 2. This might be in the main report.

PL: During reclamation, there may be more details, but we don't want to get into an iterative loop, but if you could show the model can reproduce the conditions observed today that would help the public believe in the results.

RB: Most people don't go into this level. There is always some variation.

MN: In general I thought the response was short and lacked a level of detail I would expect, there may be budget limitations but the pit lake is crucial and I would have appreciated more detail.

RB: The comments were on a high level, can you give examples?

MN: Yes, regarding stratification, you just say there are "several studies" but don't give references. You should supply the references.

RB: We can provide the references.

MN: Also, we need more detail on scaling – in your equation for rock mass – you have a "thickness of fracture zone" term but don't provide the definition. The scale of factors could be explained in more detail.

MN: Discussion of concern the responses were "short, terse and don't build confidence".

SR: Do you have something comparatively better?

MN: Site specific fracture data

SR: We don't have a mine permit and the existing walls would be a poor correlation

MN: Goes on about the used Lithonia Granite blasting study reference, discussion of reference applicability between NM, SR, RB

KV: Could we do a sensitivity analysis

RB: We can do that

SR: I am going to insist that the sensitivities have to make sense

MN: It's hard to understand what assumption was used. This is a common issue with reports, often use a couple of terms that may or may not mean the same thing. We can't tell what assumptions are made by reading this. SR assumes that these are assumptions related to HCT scaling and reactive wall mass, which are MN's primary concerns.
-More discussion about fractures and applicable data-

RB: Generally more fracturing = more surface area

SF: We know what range we are in

SR: I would not trust the existing Copper Flat pit walls as a reference as they have been exposed for 30 years and we don't know the sophistication of the blasting methods.

MN: There's not sufficient detail to show how the facture density was addressed: What is the basis of the assumption? You have no site specific data. This could cause over or under estimation.

KE: We can explain the assumptions

MN: You can explain how the assumptions will affect the mitigation

MN: Specific comments: Main things

1. Stratification – clarify the references used
2. Check the scaling and reactive mass equations in wall rock from comment 24 in the July28, 2014 NMCC response memo. MN indicates units not working out.
3. Question regarding HCT data and saturation conditions used:
    a. RB: Once the rock is saturated... every step uses a different rock water mass
    b. MN: That could be clarified in the response.
4. Information about how fracture density is defined
5. When the lake comes to hydrologic equilibrium it's not reaching geochemical equilibrium at the same time. Explain that in more detail
    a. RB: For what purpose? We push the model out already. Would a narrative be what you are looking for?

SR: Not sure we've caught everything discussed. Let's review:
Discussion: Calibration- COC of copper has to do with livestock, wildlife concern; calibration predicted existing pit and existing pit actual results are an order of magnitude low. Copper calibration of the existing pit should be resolved for confidence in predicting the future pit. COC of Selenium because of the wildlife standard. COC of Chloride because it is an indicator of evapo-concentration. Need to resolve the mercury as a COC issue; Longmire says he doesn't believe it is but he still listed it above.

KV: Main things:

1. Stratification
2. Calibration
3. Scaling – fracture density, reactive density

KV: Re-convene in 2 weeks for further discussion
Next call date agreed: Oct 7 at 9am Mountain

2.0 SRK Comment Response Scope of Work, Approved Oct 21, 2014

- Prepare a written response to address agency comments received by NMCC on September 19, 2014 from the NMED regarding the June 2013 *Geochemical Characterization* report. These responses will be incorporated into a joint response that will be submitted on NMCC letterhead. Input on defining baseline groundwater conditions will be provided by Shomaker.

- In response to comments received by the agencies during the September 22, 2014 conference call, which resulted from their consideration of the July 28, 2014 responses to NMED and EIS Contractor previous comments, SRK will address the Agencies remaining concerns which include: 1) improving the existing pit model calibration; 2) providing additional documentation and references for the argument that the future pit will not be stratified, 3) addressing uncertainties in the assumptions of the reactive wall rock thickness and fracture density used in calibrating the existing pit and for use in the future pit. SRK will conduct sensitivity analysis in order to better define the range of influent groundwater chemistry and pit wall fracturing. Input on estimating the groundwater conditions and pit wall fracturing will be provided by Shomaker and NMCC.

- Revise the *Predictive Geochemical Modeling of Pit Lake Water Quality* report to incorporate agency comments and additional model results.

- Participate in 2 additional conference calls with Shoemaker and NMCC to discuss sensitivity analysis results and response to comments, which includes preparation and follow-up activities.

- Participate in 2 additional conference calls with regulatory agencies to address questions and comments on the response to their comments, which includes preparation and follow-up activities.

Reid, Brad, NMENV

From: Steve Raugust <sraugust@themacresourcesgroup.com>
Sent: Wednesday, October 29, 2014 11:59 AM
To: Vollbrecht, Kurt, NMENV
Cc: Longmire, Patrick, NMENV; Reid, Brad, NMENV; 'Nelson, Mark' (NelsonMR@cdmsmith.com); Katie Emmer
Subject: Summary Copper Flat Geochem Rpt Comments
Attachments: Summary of Copper Flat Geochm Comment 29Oct2014.pdf

Kurt, et al.,

Attached is the summary log of comments and response to the Copper Flat Geochemistry reports as of Oct 29, 2014. Detail on comments and responses are not provided in this but the chronology of the exchanges of comments and responses are. Hopefully, this can help get started on an appropriate acknowledgement.

I'll summarize our notes from the 9/22 conference call and SRK's current scope and get that to you shortly.

Thanks, Appreciate the productive call today.

Steve Raugust, CEG | **Resource Development Manager**

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TO: Kurt Volbrecht, NMED
FROM: Steve Raugust, New Mexico Copper Corporation
CC: NMED: Brad Reid, Patrick Longmire; EIS/CDM-Smith: Mark Nelson
DATE: Oct 29, 2014
SUBJECT: Summary Log of Copper Flat Project Environmental Geochemistry Reports, Agency Comments, NMCC Responses as of 27Oct2014.

Summary Log of Copper Flat Project Environmental Geochemistry Reports, Agency Comments, NMCC Responses as of 27Oct2014.

Items	Geochemical Characterization Report, Vol 1 Text, Vol 2 Appendices (Includes Predictive Modeling of the TSF and WRDF)	Predictive Modeling Report Pit Lake Water Quality	Humidity Cell Termination Report	PFS/DFS Data Gap Analysis
Date Report Submitted	May 2013 (SRK May 2013)	September 2013 (SRK Sept 2013)	February 2014 (SRK Feb 2014a)	February 2014 (SRK Feb 2014b)
Initial Comments to SRK May 2013	January 13, 2014 -13 Preliminary (not on letterhead) Written Comments from NMED (Longmire)	-	-	
NMCC Responses to NMED January 13, 2014 comments to SRK May 2013	Majority of responses provided to NMED in HCT Termination Report	-	-	
Final NMED Comments to SRK May 2013 dated September 19, 2014.	Sept 19, 2014 – Final (on Letterhead), 8 comments received; 2 comments are from Initial January 2013 and the remaining 6 are new. 11 original January 2014 comments addressed in SRK February 2014a or other means (Need this acknowledged in Writing).	-	Sept 19, 2014 – Final (on Letterhead), 4 comments received	Sept 19, 2014 – Final (on Letterhead), 1 comment received

Draft NMED/EIS Comments dated April 22, 2014 to SRK Sept 2014.	-	April 22, 2014 – 28 comments received as draft (not on letterhead) from NMED (Longmire) and 3 comments from EIS/CDM (Nelson) via email.	-	-
NMCC Responses to April 22 comments submitted on July 28, 2014. A conference call on the same date also occurred to discuss the comments.	-	July 28, 2014 -Written NMCC responses to April 22, 2014 NMED/EIS comments provided to NMED and EIS/BLM (on THEMAC letterhead).	-	-
NMED/EIS Pit Model Comments resulting from a conference call on Sept 22, 2014.	-	All comments were resolved by the July 28, 2014 memo except for those related to 1) existing pit calibration 2) pit lake stratification, and 3) reactive wall thickness and fracture density (Need this acknowledged in Writing).	-	-

From:	Steve Raugust <sraugust@themacresourcesgroup.com>
Sent:	Thursday, October 30, 2014 4:57 PM
To:	Vollbrecht, Kurt, NMENV; Reid, Brad, NMENV; Longmire, Patrick, NMENV; 'Nelson, Mark' (NelsonMR@cdmsmith.com)
Cc:	Katie Emmer
Subject:	29Oct2014 Geochem Call Notes
Attachments:	NMCC_Notes_GeochemCall_29October2014 Final.pdf

All,

Attached are the notes Katie kept during our October 29, 2014 geochemistry conference call. As I was reviewing these, one significant concern occurred to me regarding the COC of mercury. Based on the 9/22/2014 conference call and October 29, 2014 conference call, I am making the interpretation that mercury is not a COC. NMCC and our consultants are moving forward under the understanding that we have resolved the mercury as a COC issue. We need to be clear on that because when I read the notes I read things like NMED doesn't "believe" mercury is a COC or "probably" not a COC. It's very important to document this issue correctly and definitively as it could do a lot of damage if we have a misunderstanding. Again, NMCC's position is Mercury is not a COC and we are proceeding as such.

It was a good call, we are making progress. Appreciate everyone's participation.

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KLE Notes on Geochem Call, 29 October 2014

Call Participants

Name	Company	Initial	Present
Rob Bowell	SRK	RB	No
Ruth Warrender	SRK	RW	No
Amy Prestia	SRK	AP	No
Mark Nelson	CDM	MN	X
Steve Finch	JSAI	SF	No
Katie Emmer	NMCC	KE	X
Steve Raugust	NMCC	SR	X
Kurt Vollbrecht	NMED GWQB	KV	X
Brad Reid	NMED GWQB	BR	X
Patrick Longmire	NMED GWQB	PL	X
Bryan Dail	NMED SWQB	BD	No
DJ Ennis	MMD	DJE	No

SR: I talked to KV about this yesterday- this is going to be a non-technical call. We've only just authorized additional funds for SRK last week and they haven't had a lot of time to make a lot of progress yet, we are working but we aren't ready to discuss things in detail yet. SRK and JSAI will not be joining us for this call, but I do have a few things I'd like to cover. Our management would like to document comments and our responses. We started receiving draft comments and having conversations as early as January 2014. It appears some of Longmire's comments were resolved either in our HCT report or previous discussions. Only 2 comments made it into the 19 September 2014 letter that NMCC received from NMED. The other 11 comments are gone, but we don't' have documentation for resolving those 11. Similar to comments from the draft 22 April comments. In our 22 September 2014 call we discussed that we are all on the same page regarding three comments left, a lot of other comments are no longer being worked.

PL: Did you get DJ Ennis' comments?

BR: The 19 Sept letter including all comments on the geochemistry report – from PL, DJE, and BR. As for the Pit Lake report- I thought we were not doing official letters to keep things efficient.

SR: We need to strategize on this. NMCC leadership wants to know we are making progress, and I believe we are. I'm not sure the protocol, but we do need something in writing that we've resolved previous comments and we are clear on the 3 remaining comments that we are dealing with right now.

PL: I had thought NMCC would do a reclamation plan for the pit and fold responses to comments into it. Recall if your chloride calibration isn't right you are underestimating all of your analytes. We could send you a letter and indicate what 3 issues are outstanding.

SR: We are working based on our notes from the 22 September 2014 call, hopefully we captured everything.

KV: We can document the 3 issues.

MN: Consider having someone write up meeting notes and distribute to get agency agreement.

PL: If we could get a report from NMCC that addresses those three comments, we will evaluate it. We are not holding you up.

KV: I understand what you are looking for, you can provide a summary of notes that you have?

SR: Yes, I will do that today.

KV: We can work from that summary and send a letter to document what we need to document.

MN: I'm willing to provide whatever you need.

SR: We are working to get a calibrated model that everyone agrees on. We understand we need consensus on the model so that we can use it to run water quality estimates and prove we can meet standards. We do have a workplan that we are addressing, we have a strategy and I think we agree on what remains to be done.

KV: Yes. It might be prudent to confirm that what SRK is working on to be sure we are all on the same page.

SR: I can get you our notes and the SRK workplan.

PL: If we get you this letter, when do you think you can get us a work product to review?

SR: We are working on responses; hope to have that to you in December. Then in January we could submit a revised pit model report and follow with model projections.

PL: So you have not dismissed the last three main things?

SR: That is correct. We are down to the stuff that matters.

KV: So a discussion about responses early December, we can talk that through and follow with a re-run of the model in January 2015.

SR: We are thinking a revised model report in January 2015.

KV: Ok to clarify, our three main things:

1. Calibration: copper, selenium, mercury, chloride
2. Pit lake stratification
3. Scaling factors: fracture density, reactive zone

SR: I thought we had worked mercury out.

PL: I had agreed that mercury is probably not an issue.

KV: Do we have documentation that explains that mercury is not an issue?

SR: We provided discussion in our July 2014 memo; I thought PL had noted mercury is not a long-term issue.

KV: BR has the STF memo from July 25, 2014

SR: I would like to ask for a few clarifications on the Sept 19 2014 letter comments. I noticed a couple relate to waste management plans - #2 on waste, #6. We may want to give a short response and then address these in the Discharge Permit application; they are not model questions, more waste management.

KV: Understand this is more part of a permit application, general response in comment and then detail in the Discharge Permit would be fine.

SR: #7 regarding the statistical demonstration of fluoride, iron, manganese – we have a lot of background data, what do you mean by statistically defensible?

KV: One well sample is not enough to indicate background concentrations. You need a defensible data set.

SR: Steve Finch can pull this together, I am pretty sure we have the data.

KV: We need you to package up a technically defensible amount of data to show background concentrations already exceed standards. SF has done this for Cunningham Hill and can do this.

PL: EPA has guidance for upper confidence limits; there is an established protocol to follow.

KV: We have accepted that approach in the past.

SR: I have a question about comment #8 on the 19 September 2014 letter – you ask about additional discussion for sensitivity analyses not conducted, not sure what you are looking for here.

BR: For waste rock you looked at a sensitivity analysis, were there others you considered?

PL: Intuitively the greater the mixing zone the better the water quality.

SR: It's probably more related to the TSF lining, there's just not enough seepage.

KV: So 10 ft down is the same as 100 ft down because there is so little seepage.

PL: Good point.

SR: That might be the answer.

KV: Might be. If there's something specific we will get back to you. BR to follow up with author of the comment and SR to follow up on methodology used by Mike Jones.

SR: That's all I have as far as questions for now, SRK will get to the others. We need to get you our notes and scope so that everyone is on the same page. We have started to advance work on responses: SF has estimated existing pit water quality using the groundwater model; this will be another tool we can use to firm up calibration. The results fall in the range of SRKs existing pit calibration . Working is ongoing on pit lake stratification, we are looking at existing pits in the west, which show and don't show stratification and why. We are looking at fracture density and thickness at Little Rock, Rosemont, other sites in NV. I've spent a lot of time on the Lithonia granite study. I am finding there is no common way to do estimate reactive wall thickness and fracture density, not everyone ties to these parameters to blasting. The way we've approached things may be as robust as any other. S F cites several studies that we'll be looking into.

PL: I have to sign off here, but we'll get you a letter. KV- I'll plan to get together with you next Monday.

SR: Of the sites we are reviewing, only two had an existing pit lake to calibrate to, ours and Cunningham Hill. Those that don't have a pit lake don't get to test their theories until they get until they excavate their pit. .

BR: You have that fracture on the NW side of the pit with the seep.

KE: It comes and goes. We do have some data on it.

SR: It's not like Cunningham. From what I'm reading, our work is as robust or more so than others. I've reviewed the Lithonia study and I'm getting convinced our approach is conservative. A lot of work has been done on controlled blasting. When we mine, we will be using blasting methods that are appropriate to minimize vibration and damage to pit walls. It's a matter of documenting, but I think we are on the right track.

MN: Thanks for the update. From my perspective if your data does not have a site specific basis it becomes a fudge factor that is almost arbitrary. Good that you are looking at site specific data. This could be another calibration factor. I would ask: it would be good to get more clarification on the equations- get specific about how fracture density is being defined. It's a struggle, there are multiple ways to define fracture density but it's not clear what SRK did.

BR: The 19 Sept letter closed saying we would have a meeting to discuss schedule and format for addressing these comments. Would this conversation stand in for that meeting?

SR: I think so. We are addressing these comments.

KV: So you will provide a written response?

SR: Yes we will provide a written response to all of these comments.

BR: You can defer to the waste management plan as appropriate. Don't need lengthy responses. These comments on waste management are thoughts for consideration down the road.

SR: We can touch on them.

MN: Please include me in the responses. This relates to the effects analysis. We will want to see how these responses play out against the EIS schedule and make sure the EIS gets updated as needed. I have sent my section to BLM and I have proposed that BLM include conditions of approval- including that NMCC provide the pit lake water quality plan when it's ready, and then that it be updated at the end of mine life. There's plenty of uncertainty. I hesitate to hang my hat on the model entirely.

KV: We need to send MN the 19 Sept letter, SR will get us that summary, and NMED will work on a written letter with status on what we've been through and what's left to resolve.

SR: Please acknowledge what's resolved.

KV: We will need to think this through, regarding what is in the record. Will you be getting back to us in early December?

SR: Yes. We will provide responses in December and a call to follow up in mid-December.

KV: And you will follow up with the report.

SR: Yes. This has been 1.5 hours and I do appreciate everyone's time. I think we covered a lot of ground.

~Signing out, end call~

Cooperating Agencies - NMCC Meeting – Notes
12 Nov 2014 14:00 MST

Attendee	Company	Initial	Present
Doug Haywood (via phone)	BLM	D.Haywood	Not present
Leighandra Keevan (via phone)	BLM	LK	X
Matthew Wunder	NM G & F	M.Wunder	Not present
Mark Watson	NM G & F	M.Watson	Not present
John Hall	NMED	JH	X
Brad Reid	NMED	BR	X
Kurt Vollbrecht	NMED	KV	Not present
Bryan Dail	NMED SWQB	BD	X
Kristine Pintado	NMED SWQB	KP	Not present
Kevin Myers	NMOSE	KM	X
Dave Henney (via phone)	Solv	D.Henney	X
Davena Crosley	MMD	DC	X
DJ Ennis	MMD	DJE	X
Chris Eustice	MMD	CE	Not present
Holland Shepherd	MMD	HS	X
Katie Emmer	THEMAC	KE	X

Next Meeting Date: Tuesday 6 January 2014 14:00 MST

Identified Action Items:

- NMED to send letter re: geochemistry comments by 14 Nov 2014
- NMCC plans to submit latest response on geochemistry comments in early December 2014

1. Geochemistry comment resolution efforts

KE: A call including NMED, Solv, and NMCC (but not attended by BLM, MMD, SRK or JSAI) was held on 29 October to discuss progress made by NMCC and its consultants in addressing the main comments from NMED and Solv discussed in the 22 September phone call. NMCC had succeeded in getting funding to additional geochemistry work to address comments only the week prior to the 29th of October, so not a lot of work had been completed. Nevertheless, discussion regarding strategy for addressing comments, schedule, and some NMCC requests for documentation did take place. I'll give a summary of main points discussed and Brad can add in anything I miss or elaborate.

- NMCC is requesting some documentation of comments resolved. To support this, NMCC transmitted internal notes for the 22 Sept 2014 call on 29 Oct and notes on the 29 Oct call on 30 Oct. NMED indicated they understand NMCC's request and will get NMCC a letter regarding what has been resolved already and what remains to be resolved.

BR: confirms NMED intends to send out the letter on geochemistry comments this week.

- NMCC is preparing a written response to the three main outstanding concerns, which are, as NMCC understands it:
    a. Calibration for Copper, Selenium and Chloride
    b. Pit water stratification
    c. Scaling factors: fracture density and reactive zones.
- NMCC is preparing a written response to the separate NMED 19 September 2014 letter with comments on the Geochemistry Report.
- NMCC plans to provide responses to the three main outstanding concerns by early December and to schedule a follow up call in mid-December. It is understood that a revised Pit Water Geochemistry report reflecting changes and resolution of comments would be ultimately prepared by NMCC, although the schedule for this has not been determined.

2. Pit water standards navigation plans

- Use Attainability Analysis: work plan approved 20 Oct 2014

  KE: Field work to complete the approved work plan was executed at Copper Flat on November 6 and 7. We had great conditions: no trouble getting the boat in and out of the pit water, completed day and night electrofishing and other approved data collection without incident and without encountering any fish. Samples were submitted to laboratories and once data comes back JSAI will work with Aquatic Consultants (a group also out of Albuquerque) to write up a Use Attainability Analysis report for submission to the NMED SWQB. We have no set schedule for when the UAA will be submitted but we will remain in communication with SWQB about when to expect that document. It is NMCC's intention to continue to move this process along as expeditiously as possible.

Discussion:
KE: I believe, based on my conversations with KP, that we can submit the UAA at any time and eventually it will be up to NMCC, as the proponent, to request the WQCC to review it, but I believe there is some interim step in which NMED SWQB will review the UAA.
BD: The NMED SWQB will review the UAA and offer its opinion and suggestions before the proponent refers to WQCC.
HS: Can you walk us through the steps of this process?
BD: There are existing and probable uses that a water body can support. It may be there are also designated uses that are assumptions. In this case the UAA may find that the water body has limited ability to support the aquatic life use. The UAA should collect a preponderance of evidence to support what the actual uses are at the pit water body. With recreation, for example, you can show there is limited access and swimming is not happening at the pit. As for

the process, the proponent submits a work plan to investigate uses, that plan is approved and then the work collects, in this case, old and new data. Collected data is used to create the UAA- a report on identified uses. The UAA is submitted to NMED SWQB for review and suggestions. Eventually, the proponent refers the UAA to the WQCC. The WQCC reviews the UAA and may then agree to remove rebuttable uses.

Discussion re: existing use vs. designated use: standards for existing uses cannot be removed or modified in NM (although they may be in AZ or NV based on risk assessments). Standards for designated uses may be modified or removed through the UAA process we are discussing.

HS: So the designated use is not reality.
BD: The designated use is a presumption; it may not be the actual use. Some segments of streams may have natural causation for not meeting some standards.
BD: The UAA should identify the existing uses. Limiting aquatic life is what we are probably looking at. It looks like recreation is also not happening. The department has no problem with closing off this water so that recreation is not taking place.
HS: How long will the process take?
BD: This may be limited by when the WQCC is meeting. I'm not sure their schedule. I think they are meeting in April/May.
KE: NMCC would certainly like to complete the UAA in 2015, I need to follow up on the timing but I don't believe this is unobtainable.

- Jurisdictional determination request: Approved 7 Oct 2014 – distributed to agencies, previously discussed.

3. Pit reclamation plans

KE: NMCC has been working internally to address items identified for further research or elaboration regarding pit reclamation plans and studies. We may respond to the agencies in a stand-alone memo or integrate responses in the revised MORP – both options are being considered.

4. Groundwater model status

KE: At the risk of sounding like a broken record, the report on the GW Model is that the EIS contractor did agree on a version by JSAI in September and the outputs of that model are being used to develop the EIS chapter 3 draft. As we've discussed previously, JSAI has put together for the final model for OSE review. I had a conversation with KM regarding the potential submission of this model to OSE. Kevin talked to an OSE lawyer and reported that received model files would not be published or advertised but also would not be shielded from public release if requested. As such, NMCC is considering when it would be best to submit the model files for OSE review.

Discussion-
KM: OSE doesn't have any urgent deadline to review the model right now. It could reach a point where someone wants OSE to see it. You could certainly preview it to OSE, this is something Roca Honda did to make sure there weren't any large concerns. But I think in this case you are talking about the model files themselves.
KE: It's fully NMCC's intent to submit the model files at some point; it's just that right now, given some discretion, NMCC may take some time to getting around to turning them in.

KE: Similarly, JSAI has drafted up a Probable Hydrologic Consequences report for NMCC review. The timing on the submission of this report is also not yet decided. We will let you know when to expect this before we submit.

Discussion: Probable Hydrologic Consequences, for MMD, is both water quality and water quantity.
KE: That's right, I should probably use a different title for the document JSAI is preparing- which deals exclusively with water quantity based on the water model and NMCC's preferred mine plan, which is based on the Definitive Feasibility Study.
DJE: The geochemistry reports have been addressing water quality concerns, and are part of the Probable Hydrologic Consequences, MMD will depend on NMED for that evaluation.
HS: MMD will look to OSE for evaluation of the water quantity piece.

5. EIS status – Dave

D.Henney: Solv is nearly done completing the Ch3 resource sections; we are incorporating comments, also working on BLM comments on Ch2, with some help from NMCC.

Discussion- Solv will submit Ch 3 to BLM for review next week. Ch3 will cover affected environment and environmental effects. Ch4 will cover cumulative effects. BLM has through the end of December to review and make comments on the Ch3 sections being delivered next week. Solv will be getting a preliminary draft EIS back to BLM in February of 2015.

6. Permit application package status

    - MORP

    KE: AMEC continues to work on the MORP draft but had to stop work for about 3 weeks in October. We are anticipating the submission of the Revised MORP will slip into early 2015, especially if NMCC elects to hold it until geochemistry concerns are resolved and the pit reclamation plan is finalized.

    - Probable Hydrologic Consequences – discussed above

7. Stage I Abatement Plan, revised Discharge Permit status

KE: NMCC is available to meet with NMED about the submitted Stage I characterization report any time, just let us know.

KE: NMCC has conducted an internal review of the DP checklist provided by NMED to establish what assistance we should pursue from outside contractors. While no schedule has been set for the revised DP submission yet, we do have some internal wheels turning on this- it appears we'd be looking at an application in late Q1 or early Q2 2015. NMCC agrees with NMED that it would be good to submit a revised DP as soon as possible and we will let you know when to expect this prior to turning it in.

8. Next meeting date : 6 Jan 2015- 2pm at MMD conference room
9. Geochemistry Conversation without NMCC present: MMD, NMED, NMOSE, BLM, Solv :

   This meeting was foregone.

Reid, Brad, NMENV

From:	Reid, Brad, NMENV
Sent:	Thursday, November 13, 2014 4:55 PM
To:	Steve Raugust (sraugust@themacresourcesgroup.com); Katie Emmer
Cc:	Vollbrecht, Kurt, NMENV
Subject:	FW: Comment 8 from Sept 19 NMED letter

Steve,

See comments from DJ below. Brad

From: Ennis, David, EMNRD
Sent: Thursday, November 13, 2014 2:16 PM
To: Reid, Brad, NMENV
Subject: RE: Comment 8 from Sept 19 NMED letter

Hi Brad,

The idea behind that comment is that only one variable (mixing zones) was tested for its sensitivity. Typically, I think a sensitivity analysis should change multiple input variables (not just one) in the model in order to gauge which of these variables significantly affect the results.

So, my point was: Why was "mixing zones" selected for sensitivity analysis? And what was the rationale behind not testing other input variables?

For instance, other input variables that might be valuable to test include, but are not limited to:

- hydraulic conductivity of the andesite (assumed to be <10-6 cm/s) beneath the WRDF
- seepage rate through the WRDF (assumed to be 5-10% of infiltration)
- total mass of rock in the WRDF available for chemical weathering (assumed to be 20% of the total mass; cited reference has a range of 10-30%).

Thanks for passing this along from Steve, and please let me know if this is unclear.

Thanks,
DJ

From: Steve Raugust [mailto:sraugust@themacresourcesgroup.com]
Sent: Wednesday, November 12, 2014 3:25 PM
To: Reid, Brad, NMENV
Cc: Katie Emmer
Subject: Comment 8 from Sept 19 NMED letter

Brad,

Were you able to get any more perspective on this comment from the September 19, 2014 Characterization Comments? In order to respond I believe we need more clarity. In other words, provide some additional definition for "additional parameters considered", such as hydrogeological or geochemical in nature. In this case JSAI did the hydrology and SRK the geochemistry and I need to know which way to direct the comment to develop and response.

8) Section 8.8 – The sensitivity analyses for the WRDF and TSF appear to only account for varying groundwater mixing zones (10 ft., 30 ft., and 50 ft. mixing zones for the WRDF and 50 ft., 75 ft., and 100 ft. for the TSF). The predicted results using the various mixing zones are nearly identical, suggesting this parameter is not sensitive to the model output. Please provide a discussion of additional parameters considered, if any, for the sensitivity analyses and why sensitivity analyses were not conducted for other parameters.

It is true the mixing zones were varied; however per our Oct. 29 conf call, I believe this can best be addressed with a discussion that the potential seepage into groundwater is so low due to the lined TSF and impermeable andesite under the WRDF, that a sensitivity on other hydrologic parameters is probably meaningless. However, the comment is too vague for us to be sure of what the intent of the comment is.

Thanks.

Steve Raugust, CEG | Resource Development Manager

T: +1 505.881.1353 | **F:** +1 505.881.4616 | **M:** +1 505.967.9542
A: 2424 Louisiana Blvd. NE, Suite 301, Albuquerque, NM 87110
W: themacresourcesgroup.com | **E:** sraugust@themacresourcesgroup.com

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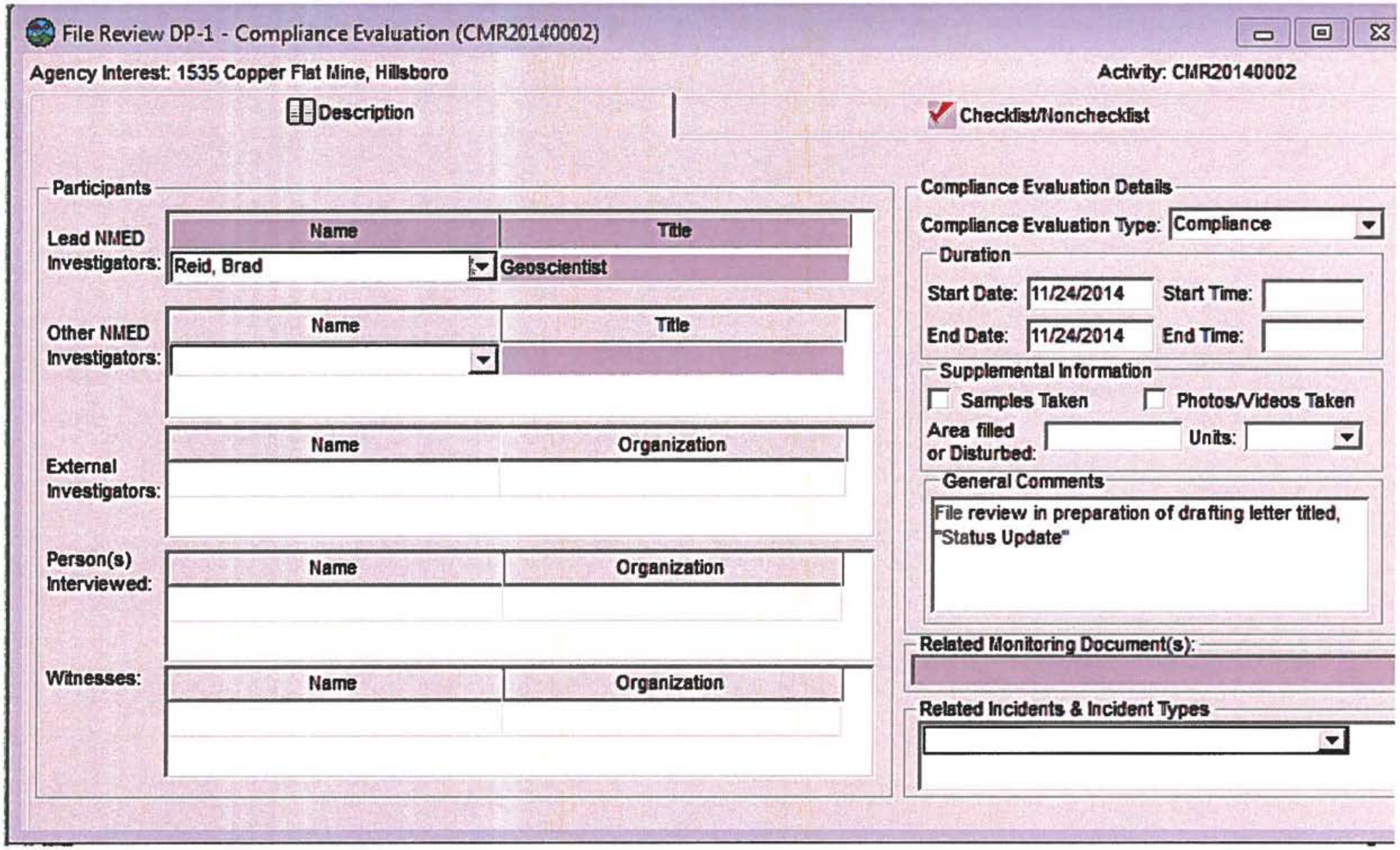

File Review DP-1 - Compliance Evaluation (CMR20140002)

Agency Interest: 1535 Copper Flat Mine, Hillsboro

Activity: CMR20140002

Participants

Lead NMED Investigators:

Name	Title
Reid, Brad	Geoscientist

Other NMED Investigators:

Name	Title

External Investigators:

Name	Organization

Person(s) Interviewed:

Name	Organization

Witnesses:

Name	Organization

Compliance Evaluation Details

Compliance Evaluation Type: Compliance

Duration

Start Date: 11/24/2014
Start Time:
End Date: 11/24/2014
End Time:

Supplemental Information

☐ Samples Taken
☐ Photos/Videos Taken
Area filled or Disturbed:
Units:

General Comments

File review in preparation of drafting letter titled, "Status Update"

Related Monitoring Document(s):

Related Incidents & Incident Types

NEW MEXICO
ENVIRONMENT DEPA

Harold Runnels Buildi
1190 St. Francis Dri
P.O. Box 5469, Santa Fe, NM
Phone (505) 827-2918 Fax (5
www.nmenv.state.n

SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

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7005 1820 0001 5770 1666

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Certified Fee		
Return Receipt Fee (Endorsement Required)		
Restricted Delivery Fee (Endorsement Required)		

Katie Emmer
Permitting & Environmental Compliance Manager
NM Copper Corporation
2424 Louisuanca Blvd NE, Suite 301
Albuquerque, NM 87110

PS Form 3800, June 2002
See Reverse for Instructions

CERTIFIED MAIL – RETURN RECEIPT REQUES

November 26, 2014

Katie Emmer, Permitting & Environmental Compliance Manager
New Mexico Copper Corporation
2424 Louisiana Blvd NE, Suite 301
Albuquerque, NM 87110

RE: Status Update: Copper Flat Project, Copper Flat Mine, DP-1

Dear Ms. Emmer,

The purpose of this letter is to provide the New Mexico Copper Corporation (NMCC) a status update for the Copper Flat Project, Copper Flat Mine, DP-1, from the regulatory perspective of the New Mexico Environment Department (NMED) Ground Water Quality Bureau (GWQB). Specifically, NMED will provide a status update with respect to the Ground Water discharge permit application and several environmental geochemistry reports submitted to NMED by NMCC that will be considered part of the discharge permit application and incorporated into the administrative record for DP-1.

Copper Flat Mine is owned by the NMCC, a wholly owned subsidiary of THEMAC Resources Group, Ltd.

Status of Ground Water Discharge Permit

NMCC submitted a Discharge Permit Application to NMED on March 31, 2011 that proposed a discharge volume of 2,875,873 gallons per day based on an ore processing capacity of 17,500 tons/day. The application was deemed administratively complete on May 4, 2011 and the first public notice (PN-1) was posted. However, since submittal of the application and following posting of the PN-1, NMCC has indicated that there will be changes to the proposed mine plan. NMED has indicated that the proposed changes (including a substantial increase to the proposed discharge volume), are significant enough to warrant resubmittal of a complete and revised Discharge Permit application. NMED understands that NMCC is planning on submitting a revised Discharge Permit application to NMED sometime in early 2015. The application will be processed pursuant to the copper mine rule, Section 20.6.7 NMAC.

Status of Geochemical Characterization Report, Humidity Cell Termination Report, and Copper Flat PFS and DFS Gap Analysis Report

NMED received the document titled, "Geochemical Characterization Report for the Copper Flat Project, New Mexico," on June 13, 2013. This report was prepared by SRK Consulting on behalf of NMCC. On January 14, 2014, representatives from NMED, the New Mexico Mining and Minerals Division (MMD), SRK Consulting, CDM Smith (EIS contractor), and the NMCC held a joint conference call to discuss the above mentioned report. For this conference call, NMED provided NMCC with preliminary written comments for discussion. On February 26, 2014, NMED received two additional documents associated with the geochemical characterization report titled "Humidity Cell Termination Report for the Copper Flat Project, New Mexico" and "Copper Flat PFS and DFS Gap Analysis". These reports were prepared by SRK Consulting on behalf of the NMCC, and in part addressed many of the issues discussed during the January 14, 2014 conference call. On September 19, 2014 NMED sent a letter to NMCC titled, "Comments on the Geochemical Characterization Report and associated documents for the Copper Flat Project, Copper Flat Mine, DP-1." This letter provided formal comments on the three reports referenced above and included all comments not adequately addressed by the February 26, 2014 submittals. During a conference call between NMED and NMCC on October 29, 2014, NMCC indicated to NMED that responses to the September 19, 2014 letter are in progress and forthcoming.

Status of Predictive Geochemical Modeling Report of Pit Lake Water Quality

NMED received the document titled, "Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico," on October 1, 2013. On April 22, 2014, representatives from NMED, MMD, SRK Consulting, CDM Smith (EIS contractor), and NMCC held a joint conference call to discuss the above mentioned report. For this conference call, NMED again provided NMCC with preliminary written comments from the agencies for discussion. On July 28, 2014, NMED received a written response from NMCC including a memo from John Shoemaker and Associates (JSAI) with intent to address the agency comments. On September 22, 2014 and October 29, 2014, conference calls were held to discuss the comments and responses. The outcome of the October 29, 2014 conference call was identification of three significant remaining issues that NMCC will need to address for NMED to determine that the Pit Lake Model can be used as a predictive tool for accurately quantifying future pit lake water quality controlled by evapocentration. These three remaining issues are as follows:

1) Calibration of the pit lake model to copper, selenium, and chloride measured values in the existing pit lake. Mercury was initially discussed for the calibration effort, but NMED agreed with the memo submitted on July 28, 2014 by JSAI that predicts that mercury will likely not be a contaminant of concern in the future pit lake,
2) Potential water quality affects due to pit lake geochemical stratification, and
3) Scaling factors related to pit wall fracture density and the pit wall reactive zone.

NMCC indicated to NMED during the November 12, 2014 Cooperating Agency meeting that NMCC plans to provide responses to the three remaining concerns by early December 2014 and will schedule a follow-up call shortly thereafter.

Evaluation of the above mentioned reports and associated documents is critical to development of a draft Ground Water Discharge Permit, and NMED may have additional comments during the technical review of the discharge permit application and/or upon receipt of the responses from NMCC.

NMED appreciates the diligence and organized efforts by NMCC to address agency comments and concerns during this process and looks forward to working with NMCC as the permitting process progresses. If you have any questions, please contact me at (505) 827-2963 or Kurt Vollbrecht, Mining Environmental Compliance Section Program Manager, at (505) 827-0195.

Sincerely,

Brad Reid

Brad Reid
Mining Environmental Compliance Section
Ground Water Quality Bureau

BR:BR

cc: Steve Raugust, Resource Development Manager, NMCC (signed PDF copy via electronic mail: sraugust@themacresourcesgroup.com)
Katie Emmer, Permitting & Environmental Compliance Manager, NMCC (signed PDF copy via electronic mail: kemmer@themacresourcesgroup.com)
Kurt Vollbrecht, Program Manager, GWQB-MECS (signed PDF copy via electronic mail: kurt.vollbrecht@state.nm.us)
Mark Nelson, CDM-Smith, (signed PDF copy via electronic mail: NelsonMR@cdm.com)
Patrick Longmire, NMED DOE Oversight Bureau (signed PDF copy via electronic mail: patrick.longmire@state.nm.us)
David Ennis, MMD (signed PDF copy via electronic mail: david.ennis@state.nm.us)
Bryan Dail, SWQB (signed PDF copy via electronic mail: bryan.dail@state.nm.us)

Reid, Brad, NMENV

From: Steve Raugust <sraugust@themacresourcesgroup.com>
Sent: Thursday, December 11, 2014 10:38 AM
To: Vollbrecht, Kurt, NMENV; Reid, Brad, NMENV; Longmire, Patrick, NMENV; dhaywood@blm.gov; Dave Henney; Ennis, David, EMNRD; Dail, Bryan, NMENV; 'Nelson, Mark' (NelsonMR@cdmsmith.com)
Cc: Katie Emmer; Jeffrey Smith
Subject: NMCC Geochemistry Characterization Responses 1 of 2
Attachments: NMCC Final Response NMED 19Sep14 Letter 11Dec2014.pdf

Kurt and others,

Attached are the NMCC responses to the NMED September 19, 2014 comments to the Copper Flat Geochemical Characterization reports. This is part 1 of a two part email submittal. The response to comment 3 requires two PHREEQE output files that will follow in a second email. Please review for discussion on December 29, 2014. If a hard copy is required, please let me know.

Regards

Steve Raugust, CEG | **Resource Development Manager**

T: +1 505.881.1353 | F: +1 505.881.4616 | M: +1 505.967.9542
A: 2424 Louisiana Blvd. NE, Suite 301, Albuquerque, NM 87110
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TO: Kurt Volbrecht, New Mexico Environment Department (NMED)
FROM: New Mexico Copper Corporation (NMCC)
CC: Patrick, Longmire, Ph.D, Brad Reid, Bryan Dail, PhD, NMED; Douglas Haywood, Bureau of Land Management; Dave Henney, Solv LLC; Mark Nelson, CDM Smith; David Ennis, MMD; Katie Emmer, Jeff Smith, NMCC.
DATE: December 11, 2014
SUBJECT: Response to NMED September 19, 2014 Comments to the Copper Flat Geochemical Characterization Reports

---

Introduction

SRK Consulting, Inc. (SRK) has undertaken a geochemical characterization study to assess the Acid Rock Drainage and Metal Leaching (ARDML) potential of waste rock, tailings and ore at the Copper Flat project, New Mexico. This assessment includes static and kinetic geochemical characterization testing of representative materials and the development of numerical predictions to assess potential future water quality associated with the waste rock dumps and tailings facility. The results of the characterization program and subsequent numerical predictions are provided in the *Geochemical Characterization Report for the Copper Flat Project* (SRK, 2013) report, prepared by SRK Consulting, Inc. and submitted in May 2013. At the time the Characterization Report was submitted the humidity cell testwork was ongoing. The final results were presented in the *Humidity Cell Termination Report for the Copper Flat Project* report submitted in February 2014.

These reports have since undergone review by the New Mexico Environment Department (NMED) and written comments were received on September 19, 2014. The purpose of this memorandum is to provide a formal response to comments and to provide additional information to supplement the Geochemical Characterization and Humidity Cell Termination reports.

Response to Comments and Amendments

Responses to comments from NMED have been prepared by SRK, New Mexico Copper Corporation (NMCC) and John Shomaker and Associates (JSAI) and are provided below. In each case, the comment has been summarized and a response has been provided in italics that details additional information to resolve the comment. In each case, the party responsible for preparing the response (i.e., SRK, THEMAC or JSAI) has been indicated in square brackets at the start of the text.

Characterization Report – General Comments

1) It will be necessary to address and/or comment on potential impacts to ground and surface water from any proposed Low Grade Ore Stockpile(s) based on the location and design of such stockpiles.

   [SRK] Based on the October 2013 revisions to the Definitive Feasibility Study (DFS), the low-low grade and high-low grade stockpiles will not be processed and the material in these stockpiles will become uneconomic waste rock. The DFS states that there will be three WRDFs with different cut-off grades; any high-low grade material will be deposited in WRDF1 and will have a cut-off grade of 0.168 wt% Cu. In addition WRDF1 is also located within the surface water and groundwater capture zone of the pit. In comparison, any low-low grade ore reporting to WRDF2 will have a lower cut-off grade of 0.131 wt%, which is within the 0.164 wt% cut-off grade and footprint of the Pre-feasibility Study (PFS) WRDF characterization. WRDF3 will receive material with a grade less than 0.131 wt%. The combined WRDF2 and WRDF3 will contain nearly 42 million tons of material which is less than the PFS WRDF which was intended to contain nearly 61 Million tons at the higher cut-off grade of 0.164 wt%. WRDF1 will contain about 3 million tons

of material which the same as the PFS low grade stockpile. More detail containing the characterization comparisons between the PFS and DFS is documented in the Copper Flat PFS and DFS Data Gap Analysis SRK Technical Memorandum dated February 13, 2014 (SRK, February 13, 2014)..

2) Discuss how existing waste rock piles will be managed to minimize impacts to ground and surface water.

   [NMCC] Any existing waste rock remaining from Quintana Minerals 1982 operations will be incorporated into the proposed waste rock disposal facilities (WRDFs), except the existing waste rock piles immediately north and northwest of the pit. However, both of these existing waste rock piles are small and are within the open pit surface drainage area. Attachment 1 shows the locations of these existing waste rock piles.

3) Provide a table showing the results of mass transfer (precipitation-dissolution) calculations of equilibrated mineral phases to assist in the discussion on simulated water chemistry.

   [SRK] An electronic version of the full PHREEQC output files that contains this information are provided as separate files associated with this memorandum.

Characterization Report – Specific Comments

5) The acid neutralization classification (PAF vs. NAF) in the legend for Table 5-3 are switched.

   [SRK] This error has been corrected and the revised Table 5-3 is shown below.

Material Type	#	Paste pH (s.u.)	Sulfide sulfur (wt%)	AP ($CaCO_3$ eq/t)		NP ($CaCO_3$ eq/t)		NNP ($CaCO_3$ eq/t)		NPR	
				Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Andesite	4	7.99	0.08	2.50	4.40	23.8	1.58	🟩 21.5	6.0	🟩 61.9	39.7
Diabase	2	6.86	0.02	0.60	0.42	44.4	49.1	🟩 43.9	49.8	🟩 137	179
Sulfide waste	50	8.41	0.36	12.9	8.30	26.4	9.77	🟧 13.6	11.9	🟩 3.25	3.07
Transitional waste	10	6.49	1.19	38.2	17.9	14.7	13.5	🟥 -23.5	27.2	🟥 0.51	0.55
Sulfide ore	48	8.12	0.89	30.6	18.1	28.3	11.0	🟧 -2.31	20.2	🟧 1.27	1.03
Transitional ore	17	7.31	0.83	26.5	19.5	18.5	17.8	🟧 -7.98	25.5	🟧 2.47	6.54
Oxide ore	1	7.77	0.01	0.30	-	8.40	-	🟧 8.40	-	🟩 28.0	-

#	Number of samples representing material type
🟩	Non acid forming (NAF)
🟧	Uncertain acid generating characteristics
🟥	Potentially acid forming (PAF)

6) Discuss the fate and transport of leachate that may flow from the base of the WRDF along the underlying topography at the waste rock/bedrock interface and out of the downslope toe of the WRSF. How will this seepage be captured and contained to prevent a potential impact to ground or surface water quality?

   [NMCC] Section 8.3.1 of SRK's May 2013 geochemical characterization report estimates that using 0.25 inches per year of infiltration through the engineered WRDF cover, it would take hundreds of years to wet the total thickness of the waste rock to field capacity. Any infiltration that did actually flow through the WRDF and then flow laterally along the waste rock-bedrock interface

and out the toe of the WRDF would be captured and contained through the construction of headwalls, impoundments, and diversion structures per NMAC 20.6.7.21. Details of this capture, containment, and conveyance will be provided in the Groundwater Discharge Permit Application.

7) The modeling predicts that seepage from the WRDF will not affect the existing 'baseline' concentrations. A statistically defensible demonstration needs to be provided to establish background standards for any constituent elevated above 20.6.2.3103 NMAC groundwater standards.

   [JSAI] Comment is addressed in the JSAI Technical Memorandum dated December 5, 2014 and appended as Attachment 2 of this comment response memorandum.

Humidity Cell Termination Report – General Comments

8) Provide a discussion of why sensitivity analyses for the WRSF and TSF geochemical models were not conducted on any parameters other than the groundwater mixing zone.

   [JSAI] Other input variables include 1) hydraulic conductivity, 2) seepage rate, and 3) total mass of rock available for chemical weathering.

   Hydraulic Conductivity
   Test data from the andesite resulted in a hydraulic conductivity range of 9.5×10^{-7} to less than 6×10^{-9} cm/s. The model used a hydraulic conductivity of 7.06×10^{-7} cm/s. To vary the hydraulic conductivity for sensitivity analysis would involve using a lower value, resulting in less effect. The worst case was already considered negligible; therefore there was no justification for varying hydraulic conductivity. The worst case was also considered for the lined TSF, where manufacturer defects are considered to locally enhance hydraulic conductivity and allow seepage.

   Seepage Rate
   This sensitivity analysis already exists in the model projections. The seepage rate was considered to range between 5 and 10 percent of infiltration. A 5 percent value resulted in 0.13 gpm of seepage for the entire 160 acres of WRDF, and a 10 percent value resulted in 0.27 gpm of seepage. This is considered a worst case scenario because infiltration through the reclaimed WRDF would take hundreds of years only to encounter the low-permeability andesite.

   Total Rock Mass Available for Water-Rock Reaction
   The model used 20 percent of the total rock mass was available for water-rock reaction. The range is estimated to be 10 to 30 percent. The total rock mass available for leaching is only significant if there is a wide range of seepage rates and sources of water to consider.
   In conclusion, sensitivity analysis for other parameters other than the mixing zone do not make sense because the worst case seepage is so low that any sensitivity analyses performed would still result in a fraction of a gpm of seepage.

Humidity Cell Termination Report – Specific Comments

9) In Figures 3-4, 3-5 and 3-6 of the Humidity Cell Termination Report the units for Fe(II) and Fe(III) need to be consistent with total dissolved Fe (mg/kg/week). Concentrations of Fe(III) in sample SRK 0858 exceed total dissolved Fe, which needs to be addressed and corrected.

   [SRK] Figures 3-4, 3-5 and 3-6 of the Humidity Cell Termination Report have been updated to show consistent units. The revised figures are presented below.

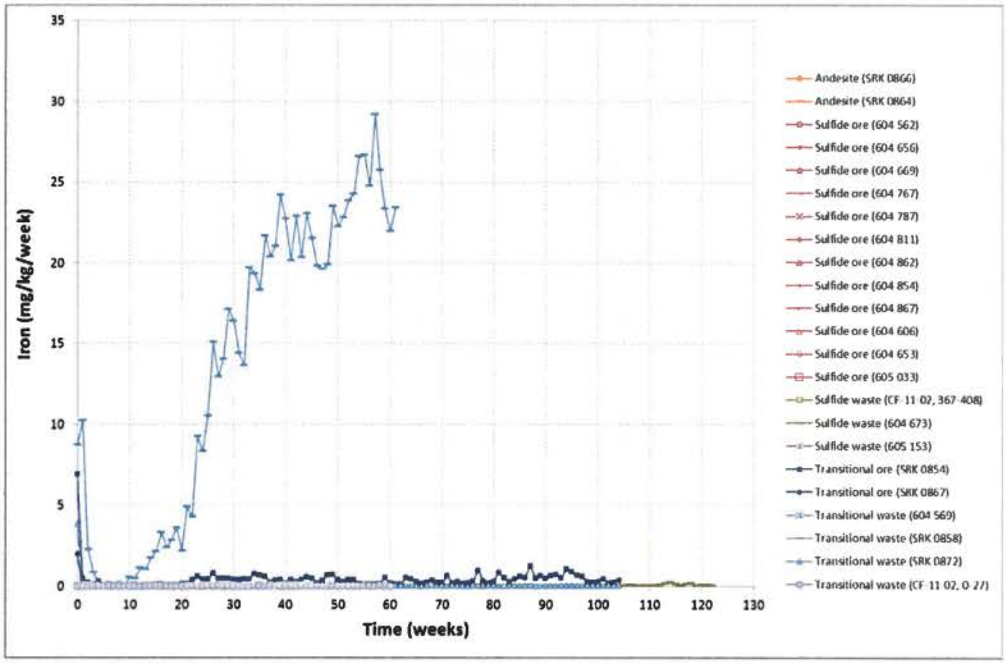


Figure 3-4: Waste Rock/Ore HCT Effluent Iron

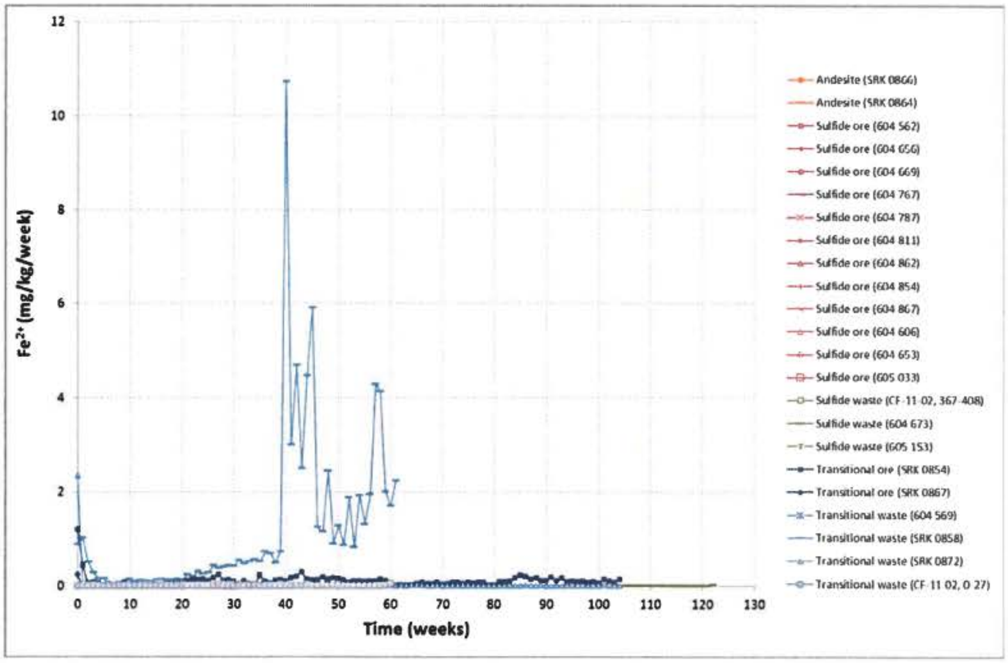


Figure 3-4: Waste Rock/Ore HCT Effluent Fe^{2+}

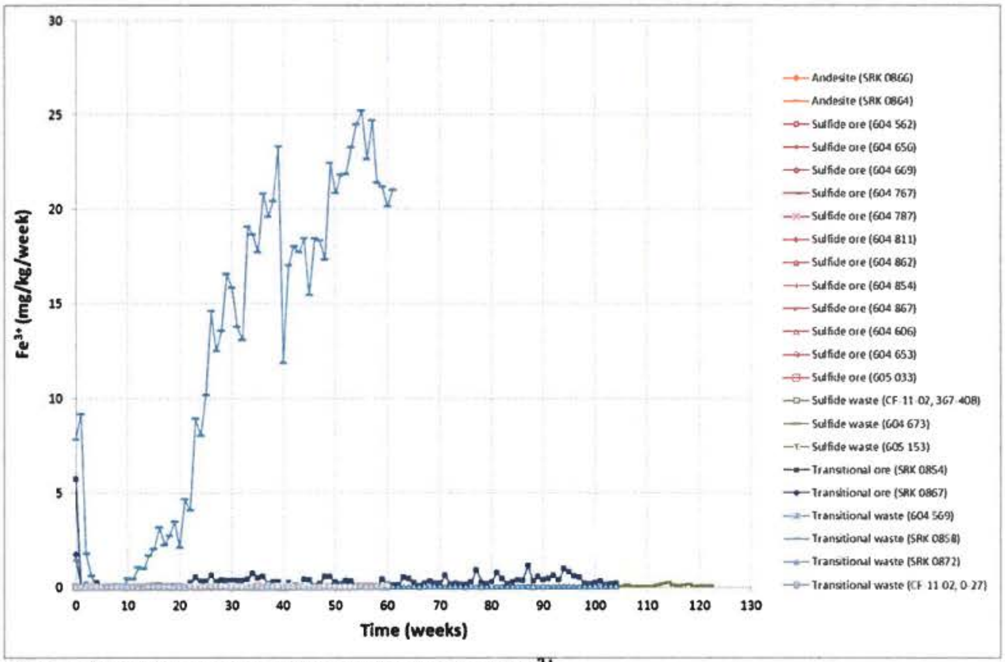
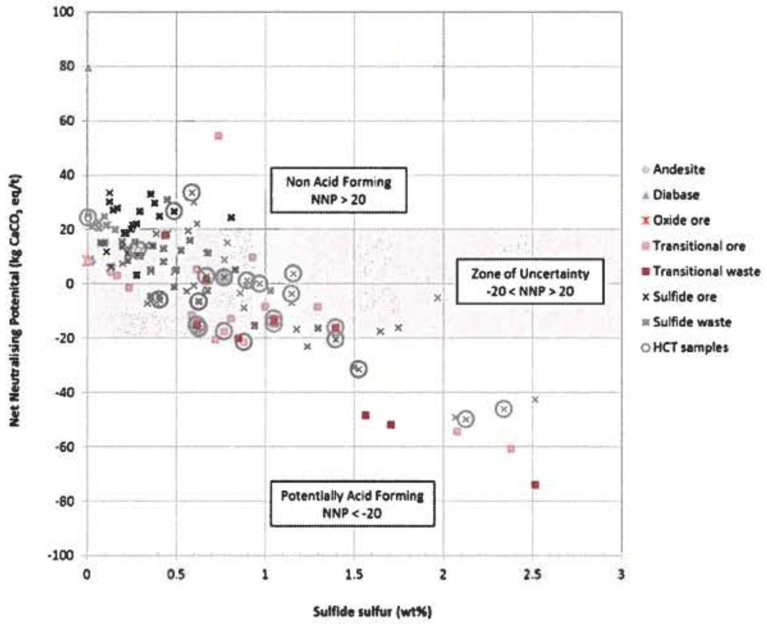


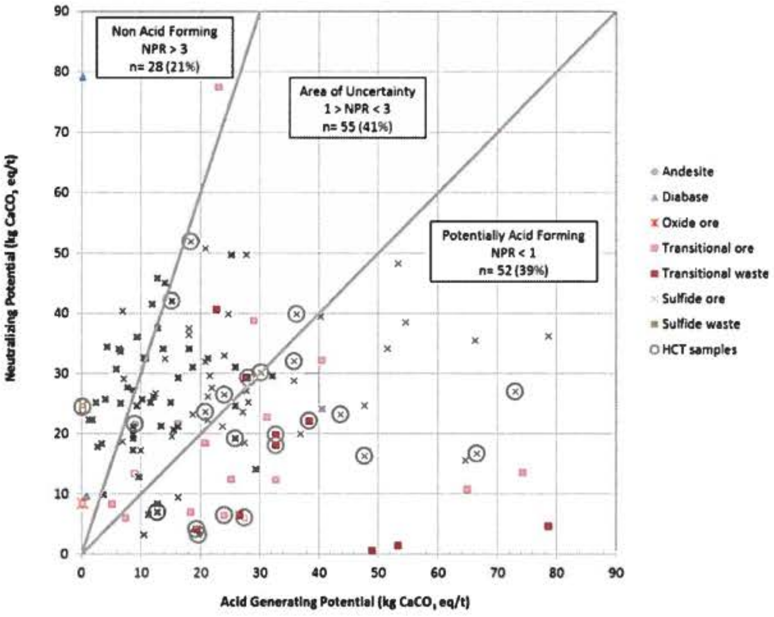
Figure 3-6: Waste Rock/Ore HCT Effluent Fe^{3+}

10) Provide a brief description of the criteria used to select the HCT samples or the rational/justification for sample selection.

[SRK] Humidity cells were selected to be representative of the range of geochemical behavior observed from the static testwork results. The figures presented below show how the geochemical behavior of the humidity cells fits into the range of behavior observed for the entire static database. The graphs show that the distribution of the selected HCT samples and are not either positively or negatively biased in the dataset.

Although a large number of ore samples were included in the HCT program, this largely relates to the change in the cut-off grade (from 0.23 wt% to 0.164 wt%) that occurred since the geochemical characterization program was initiated in 2010. However given the ore grade material has a tendency to show similar reactive geochemistry to waste grade material, this change in the number of ore grade samples does not compromise the overall validity or completeness of the waste rock geochemistry program.


Net Neutralising Potential (kg CaCO3 eq/t)
100
80
60
40
20
0
-20
-40
-60
-80
-100
0
0.5
1
1.5
2
2.5
3
Sulfide sulfur (wt%)
Non Acid Forming
NNP > 20
Zone of Uncertainty
-20 < NNP > 20
Potentially Acid Forming
NNP < -20
Andesite
Diabase
Oxide ore
Transitional ore
Transitional waste
Sulfide ore
Sulfide waste
HCT samples


Neutralizing Potential (kg CaCO3 eq/t)
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
Acid Generating Potential (kg CaCO3 eq/t)
Non Acid Forming
NPR > 3
n= 28 (21%)
Area of Uncertainty
1 > NPR < 3
n= 55 (41%)
Potentially Acid Forming
NPR < 1
n= 52 (39%)
Andesite
Diabase
Oxide ore
Transitional ore
Transitional waste
Sulfide ore
Sulfide waste
HCT samples

11) Describe and/or provide published references for the mechanism by which phlogopite and chlinochlore provide acid buffering capacity.

[SRK] When mafic minerals are sufficiently reactive they provide buffering potential through the consumption of acid as per the following reaction of clinochlore with sulfuric acid (Nesbitt & Jambor, 1994):

$Mg_3Fe_2Al_2Si_3O_{10}(OH)_8 + 2H_2SO_4 + 2O_2 \rightarrow 3Mg^{2+} + 3SO_4^{2-} + 2FeOOH + Al_2Si_2O_5(OH)_4 + SiO_2 + 3H_2O$

The effect of this reaction is for magnesium to become the major cation balancing sulfate. As a result, the dissolution of chlorite in the presence of sulfuric acid is acid-neutralizing. Similar reactions can be written for other intermediate and fast-weathering silicates outlined by Sverdrup, 1990 (see table below). The aluminum from the clinochlore is assumed to form kaolinite whilst the iron forms iron oxyhydroxides. Other secondary mineral products may include gibbsite or jarosite.

12) Given the low relative percentages of phlogopite and clinochlore in the mineralogy (<1% and <10%, respectively), would it be expected that these minerals would contribute to neutralizing capacity. For example Sverdrup (1990) states that these will not be practical neutralizing minerals unless they occur in excess of 10%. Discuss.

[SRK] Despite their relatively low abundance both clinochlore and phlogopite will act to buffer the pH (see table below). Clinochlore (group 2) and phlogopite (group 3 'biotite') are fast and intermediate weathering respectively and since both minerals are not encapsulated in silica they should show reactivity similar to that given in the table. Other studies have shown that highly crystalline coarse pyrite can show very slow oxidation (Bowell, 1994; Williamson and Rimstidt, 1994). Under these conditions when the rate of pyrite oxidation is slow, the silicate minerals listed can provide adequate buffering to acid rock drainage.

The rates of pyrite oxidation are assumed to be consistent and slow across all humidity cells. It is therefore hypothesized that the acid-generating cells have excessive acid-generating potential because the copper-sulfide minerals in these samples are oxidizing quickly and at a rate that exceeds any neutralization capacity. The release rate of copper in solution is taken as evidence of this hypothesis.

Relative reaction rates and buffering capacity of key carbonate, silicate, oxide and hydroxide minerals (Taken from Sverdrup, 1990)

Group Name	Typical Minerals	Buffering pH Range (s.u.)	Approximate Neutralizing Potential Range	Relative Reactivity
1. Dissolving	Calcite, aragonite, dolomite, magnesite, portlandite, brucite	6 - 11.2	7.8 - 14.8	1.0
2. Fast Weathering	Anorthite, nepheline, olivine, garnet, jadeite, leucite, clinochlore, spodumene, kutnahorite, diopside, siderite, wollastonite	5.5 - 11	2.8 - 6.2	0.6
3. Intermediate Weathering	Epidote, zoisite, enstatite, hypersthene, augite, hedenbergite, hornblende, glaucophane, tremolite, actinolite, anthophyllite, serpentine, chrysotile, talc, biotite	4.8 - 7.3	1.7 - 5.8	0.4
4. Slow Weathering	Albite, oligoclase, labradorite, vermiculite, montmorillonite, manganite, goethite, gibbsite, kaolinite	2.4 - 5.1	0.5 - 2.9	0.02
5. Very Slow Weathering	K-feldspar, ferrihydrite, muscovite,	2.2 - 4.1	0.2 - 0.6	0.01
6. Inert	Quartz, hematite, rutile, zircon	3.3 - 3.5	<0.01	0.004

Gap Analysis Report – Specific Comment

13) It is stated that the numerical predictions undertaken for the WRDF as part of the PFS are based on a higher cut-off grade and therefore represent a conservative estimate of future water quality. However, in Table 1 of the Gap Analysis Report, the PFS cutoff is 0.164% and the DFS cutoff is 0.168%, and therefore it appears the PFS has a slightly lower cut-off grade than the DFS, and thus the DFS cut-off grade would represent the more conservative scenario. Please comment on the effect(s) if any, this has on the numerical predictions for the WRDF.

[SRK] From a total of 132 samples tested using static geochemical characterization methods, only two samples fall within the range of 0.164% - 0.168% copper. These two samples were not included in the humidity cell program and thus did not form part of the numerical model inputs. As such, this difference in cut-off grade will have no impact on the numerical predictions.

References

Bowell, R.J., 1994, Sulfide Oxidation and Production of Gossans, Ashanti Mine, Ghana. *International Geology Reviews*, 8, pp732-752

Nesbitt, H.W. and Jambor, J.L., 1994, Role of mafic minerals in neutralizing ARD, demonstrated using a chemical weathering methodology. *In: Modern Approaches to Ore and Environmental Mineralogy,* pp403-421

SRK, February 13, 2014, Copper Flat PFS and DFS Data Gap Analysis, External Technical Memorandum to THEMAC Resources Group, SRK Consulting, Cardiff, UK.

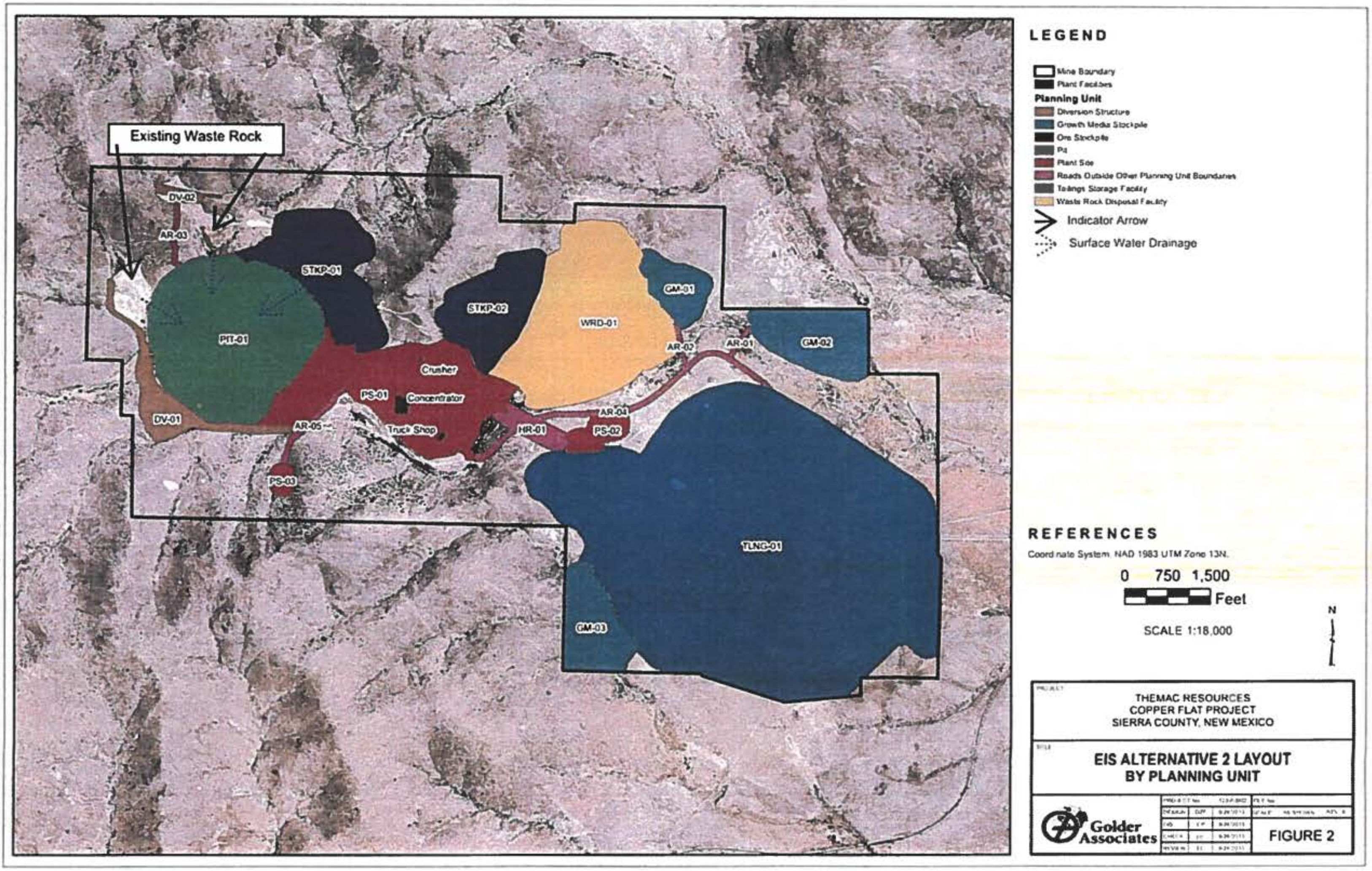
Sverdrup, H.U., 1990, The kinetics of base cation release due to chemical weathering. Lund University Press, Lund, 246p

Williamson M. A. and Rimstidt J. D., 1994, The kinetics and electrochemical rate-determining step of aqueous pyrite oxidation. *Geochimica et Cosmochimica Acta*, 58, pp5443-5454

Attachment 1:

Locations of Existing Waste Rock Piles with Respect to EIS Alternative 2 Site Layout

Attachment 1: EIS Alternative 2 Layout



Attachment 2:

JSAI December 5, 2014 Background Groundwater Chemistry Memorandum

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WATER-RESOURCE AND ENVIRONMENTAL CONSULTANTS
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TECHNICAL MEMORANDUM

To: Katie Emmer, Permitting and Environmental Compliance Manager,
New Mexico Copper Corporation

From: Annie McCoy, Senior Hydrogeologist
Steven T. Finch, Jr., Principal Hydrogeologist-Geochemist

Date: December 5, 2014

Subject: Statistical analysis of background concentrations of iron, manganese, and fluoride in groundwater in the andesite, Copper Flat Project

John Shomaker & Associates, Inc. (JSAI) is pleased to provide this memorandum addressing specific comments provided by the New Mexico Environment Department (NMED) on the report titled *Geochemical Characterization Report for the Copper Flat Project, New Mexico*, prepared by SRK Consulting and received by NMED on June 13, 2013. The NMED's specific comments addressed in this memorandum were provided in a September 19, 2014 letter from Mr. Kurt Volbrecht, Program Manager of NMED's Mining Environmental Compliance Section, Ground Water Quality Bureau:

> 7) Table 8-9 – The text in Section 8.11.1 describes that background concentrations of fluoride, iron, and manganese in the andesite aquifer beneath the WRDF naturally exceed Water Quality Control Commission (WQCC) standards. The modeling predicts that seepage from the WRDF will not affect the existing "baseline" concentrations. NMCC will be required to provide a statistically defensible demonstration to establish background standards for any constituent elevated above 20.6.2.3103 NMAC ground water standards.

To address these comments, this memorandum provides a statistical analysis of background concentrations of iron, manganese, and fluoride in groundwater in the andesite at the Copper Flat Project site.

Monitoring Points in the Andesite

Table 1 presents monitoring points identified as being in the Cretaceous-age andesite rocks at Copper Flat. Table 2 presents iron, manganese, and fluoride data for these monitoring points. Monitoring points in the andesite at Copper Flat represent a range of depths and elevations, and spatial distribution from east to west in the andesite. Wells completed in the andesite range in depth from 26 to 380 ft. Four of these wells have time-series datasets for iron, manganese, and fluoride consisting of two to seven sampling events spanning the time period 1981 to 2013 (Table 2). Two springs discharging from andesite were sampled in 1993, and a surface water monitoring point in the andesite was sampled in 1981 prior to the creation of the open pit during previous mining operations in 1982 (Table 2).

There are twenty historical data points for iron and manganese, and 24 data points for fluoride (Table 2). Three monitoring points, GWQ-6, GWQ96-22A, and GWQ96-22B, have had iron and manganese concentrations that exceeded New Mexico Water Quality Control Commission (NMWQCC) standards. Iron and manganese concentrations have been highly variable at these wells. Two monitoring points, GWQ96-22A and GWQ96-22B, have had fluoride concentrations that exceeded the NMWQCC standard.

Trends in Water Quality Data

Figures 1 through 3 present the spatial distribution of iron, manganese, and fluoride in groundwater in the andesite, and Figures 4 through 6 present time-series datasets for iron, manganese, and fluoride. Figures 1 through 6 show no apparent trends with respect to spatial distribution or time for iron, manganese, and fluoride at monitoring points in the andesite. The monitoring points with elevated (and variable) concentrations of these constituents represent a range of depths and elevations in the andesite, precluding the identification of any spatial trend. The dataset presented in Table 2 is representative of natural conditions and natural variability in iron, manganese, and fluoride concentrations in groundwater in the andesite.

Methods and Procedures

Parametric and non-parametric confidence intervals were the statistical strategy for this evaluation. The Environmental Protection Agency's (EPA) unified guidance document for statistical analysis of groundwater monitoring data identifies confidence intervals as the primary tool for compliance/assessment and corrective action monitoring (EPA, 2009). The use of empirical distributions to define populations is commonly used as a general statistical approach (e.g., Miller and Freund, 1977; EPA, 2009). The use of empirical distributions (non-parametric statistics) does not rely on the assumption that the data are normally distributed, as do the method-of-moments (parametric) statistics. All data handling and statistical analysis was performed in Microsoft Excel.

Table 1. Summary of monitoring points in Cretaceous andesite, Copper Flat Project, Sierra County, New Mexico

well name	monitoring point type	year drilled	casing diameter, in.	total depth, ft	screen interval, ft	measuring-point elevation (2011 survey), ft amsl	total depth elevation, ft amsl	Fe, Mn, and/or F data available
GWQ-4	well	1948	5	150	-	5,565.85	5,415.85	yes
GWQ-5R	well	2011	4	120	80 to 120	5,412.80	5,292.80	(F only)
GWQ-6 (GWQ-6N)	well	-	-	85	-	5,395.36	5,310.36	yes
GWQ96-22A	well	1996	2	244	174 to 244	5,596.17	5,352.17	yes
GWQ96-22B	well	1996	2	380	340 to 380	5,595.95	5,215.95	yes
LRG-4159	well	2002	6	200	5 to 200	5,719.70	5,519.70	yes
Pague Well	well	-	-	26	-	5,550.81	5,524.81	(F only)
BG Spring	spring	na	na	na	na	5,765	na	yes
BG-2 Spring	spring	na	na	na	na	5,960	na	yes
SWQ-2	surface water	na	na	na	na	5,380.26	na	yes

ft	feet
in.	inches
-	information not available
na	not applicable

Fe	iron
Mn	manganese
F	fluoride

Table 2. Iron, manganese, and fluoride data for monitoring points in Cretaceous andesite, Copper Flat Project, Sierra County, New Mexico

well name	date	iron, mg/L	manganese, mg/L	fluoride, mg/L
GWQ-4	6/10/1981	<0.1	<0.05	0.6
	11/6/1981	<0.1	<0.05	0.7
	4/1/1993	0.20	<0.02	0.73
	5/26/1994	0.13	<0.03	0.63
	11/5/2010	0.059	0.029	0.73
GWQ-5R	1/10/2013	-	-	1.25
GWQ-6 (GWQ-6N)	6/15/1981	<0.1	0.11	1.09
	2/25/1982	<0.1	<0.05	1.1
	4/1/1993	**5.05**	**0.36**	0.84
GWQ96-22A	7/13/1996	<0.05	0.08	**3.3**
	4/9/1997	**6.50**	**2.80**	0.8
	8/8/1997	0.13	**0.53**	**2.2**
	1/30/2010	**2.10**	**0.74**	**2.6**
	7/1/2010	0.02	**0.65**	**2.7**
	10/7/2010	0.32	**0.49**	**2.7**
	1/9/2013	-	-	**3.1**
GWQ96-22B	7/13/1996	<0.05	**0.41**	**1.8**
	10/7/2010	**9.30**	**1.20**	**3.0**
	1/9/2013	-	-	**3.3**
LRG-4159	11/4/2010	0.036	<0.002	0.66
Pague Well	8/20/1946	-	-	1.2
BG Spring	4/1/1993	<0.05	0.2	0.86
BG-2 Spring	4/1/1993	<0.05	0.1	0.82
SWQ-2	10/27/1981	<0.05	<0.05	0.8
total no. of data points		20	20	24
mean [a]		**1.21**	**0.39**	1.56
standard deviation [a]		2.61	0.65	0.99
NMWQCC standard		1.0	0.2	1.6

mg/L	milligrams per liter
-	data not available
NMWQCC	New Mexico Water Quality Control Commission
bold	excceds NMWQCC standard

[a] below-detection-limit values were treated as one half of the detection limit for computational purposes

Water Quality Data

Table 2 presents iron, manganese, and fluoride data for the individual monitoring points, as well as descriptive statistics for the complete iron, manganese, and fluoride datasets. The statistical analysis presented here requires numeric data and does not depend on well-by-well statistics. Iron and manganese concentrations entered as less than a specified detection limit were treated as half the detection limit for computational purposes. There are no such entries for fluoride. All data are as previously reported in Newcomer and Finch (1993), INTERA (2012), and JSAI (2014). These data have met the quality assurance/quality control requirements for the Copper Flat Project, and we have not re-evaluated them.

Results and Discussion

Table 3 presents iron, manganese, and fluoride data in order from lowest to highest concentration, and principal end-points of the statistical analysis including the 50th, 75th, and 90th percentiles of the empirical distribution and the standard (method-of-moments) descriptive statistics. The method-of-moments statistics include the computed mean and upper confidence limit (UCL) on the mean using Student's-t statistic for 19 degrees of freedom (23 degrees of freedom for fluoride dataset) for a single-tailed test with $\alpha = 0.25$ and $\alpha = 0.10$ (i.e., representing 25 percent and 10 percent, respectively, in the right-hand tail, to correspond with the 75th and 90th percentiles of the empirical distribution).

Figure 7 presents a histogram of iron concentrations. Based on the form of the histogram, and the fact that the mean and median values are not in close agreement, the iron data do not appear to have a normal distribution.

Figure 8 presents a histogram of manganese concentrations. Based on the form of the histogram, and the fact that the mean and median values are not in close agreement, the manganese data do not appear to have a normal distribution.

Figure 9 presents a histogram of fluoride concentrations. Based on the form of the histogram, the fluoride data do not appear to have a normal distribution, although the mean and median values are in relatively close agreement.

Based on data evaluation, the iron, manganese, and fluoride datasets are not normally distributed, and the empirical distributions (non-parametric statistics) represent the more appropriate method for statistical analysis, as they do not rely on the assumption that the data are normally distributed. Based on available data and recognizing potential concerns that the background condition not be set too broadly, we recommend that the upper control limit be set for the 90th percentile. Based on this analysis and using the 90th percentile, we propose background concentrations for iron, manganese, and fluoride in groundwater in the andesite as presented in Table 4.

Table 3. Iron, manganese, and fluoride data in order from lowest to highest concentration, and principal end-points of statistical analysis, for groundwater in the andesite, Copper Flat Project, Sierra County, New Mexico

principal end-points	iron, mg/L	manganese, mg/L	fluoride, mg/L
	0.02	*0.001*	0.6
	0.025	*0.01*	0.63
	0.025	*0.015*	0.66
	0.025	*0.025*	0.7
	0.025	*0.025*	0.73
	0.025	*0.025*	0.73
	0.036	*0.025*	0.8
	0.05	0.029	0.8
	0.05	0.08	0.82
	0.05	0.1	0.84
	0.05	0.11	0.86
	0.059	0.2	1.09
	0.13	0.36	1.1
	0.13	0.41	1.2
	0.20	0.49	1.25
	0.32	0.53	1.8
	2.10	0.65	2.2
	5.05	0.74	2.6
	6.50	1.20	2.7
	9.30	2.80	2.7
			3.0
			3.1
			3.3
			3.3
empirical distribution			
median (50th percentile)	0.05	0.11	1.10
75th percentile	0.23	0.50	2.63
90th percentile	5.20	0.79	3.05
method-of-moments			
mean	1.21	0.39	1.56
UCL (α = 0.25)	3.00	0.84	2.24
UCL (α = 0.10)	4.68	1.26	2.87

mg/L	milligrams per liter
italics	below-detection-limit values were treated as one half of the detection limit
UCL	upper confidence limit

Table 4. Proposed background concentrations for iron, manganese, and fluoride in groundwater in the andesite, Copper Flat Project, Sierra County, New Mexico

empirical distribution	iron, mg/L	manganese, mg/L	fluoride, mg/L
90th percentile	5.20	0.79	3.05

References

[EPA] U.S. Environmental Protection Agency, 2009, Statistical analysis of groundwater monitoring data at RCRA facilities, unified guidance, March 2009: EPA Document 530/R-09-007.

INTERA, 2012, Baseline data characterization report for Copper Flat Mine, Sierra County, New Mexico: report prepared for New Mexico Copper Corporation, June 2012.

[JSAI] John Shomaker & Associates, Inc., 2014, Results from first year of Stage 1 Abatement Investigation at the Copper Flat Mine site near Hillsboro, New Mexico: consultant's report prepared by John Shomaker & Associates, Inc. for New Mexico Copper Corporation, May 2014.

Miller, I., and Freund, J.E., 1977, Probability and statistics for engineers, 2nd Ed.: Prentice-Hall, Inc., Englewood Cliffs, NJ, 529 p.

Newcomer, R.W., and Finch, S.T., 1993, Water quality and impacts of proposed mine and mill, Copper Flat Mine Site, Sierra County, New Mexico: consultant's report prepared by John W. Shomaker, Inc. for Gold Express Corporation, 31 p.

Attachments:

Figure 1. Geologic map of Copper Flat Mine permit area showing iron concentrations for monitoring points in Cretaceous andesite, Copper Flat Project, Sierra County, New Mexico.

Figure 2. Geologic map of Copper Flat Mine permit area showing manganese concentrations for monitoring points in Cretaceous andesite, Copper Flat Project, Sierra County, New Mexico.

Figure 3. Geologic map of Copper Flat Mine permit area showing fluoride concentrations for monitoring points in Cretaceous andesite, Copper Flat Project, Sierra County, New Mexico.

Figure 4. Time-series graph of iron concentrations in monitoring wells installed in andesite, Copper Flat Project, Sierra County, New Mexico.

Figure 5. Time-series graph of manganese concentrations in monitoring wells installed in andesite, Copper Flat Project, Sierra County, New Mexico

Figure 6. Time-series graph of fluoride concentrations in monitoring wells installed in andesite, Copper Flat Project, Sierra County, New Mexico.

Figure 7. Histogram of iron concentrations at monitoring points in andesite, Copper Flat Project, Sierra County, New Mexico.

Figure 8. Histogram of manganese concentrations at monitoring points in andesite, Copper Flat Project, Sierra County, New Mexico.

Figure 9. Histogram of fluoride concentrations at monitoring points in andesite, Copper Flat Project, Sierra County, New Mexico.

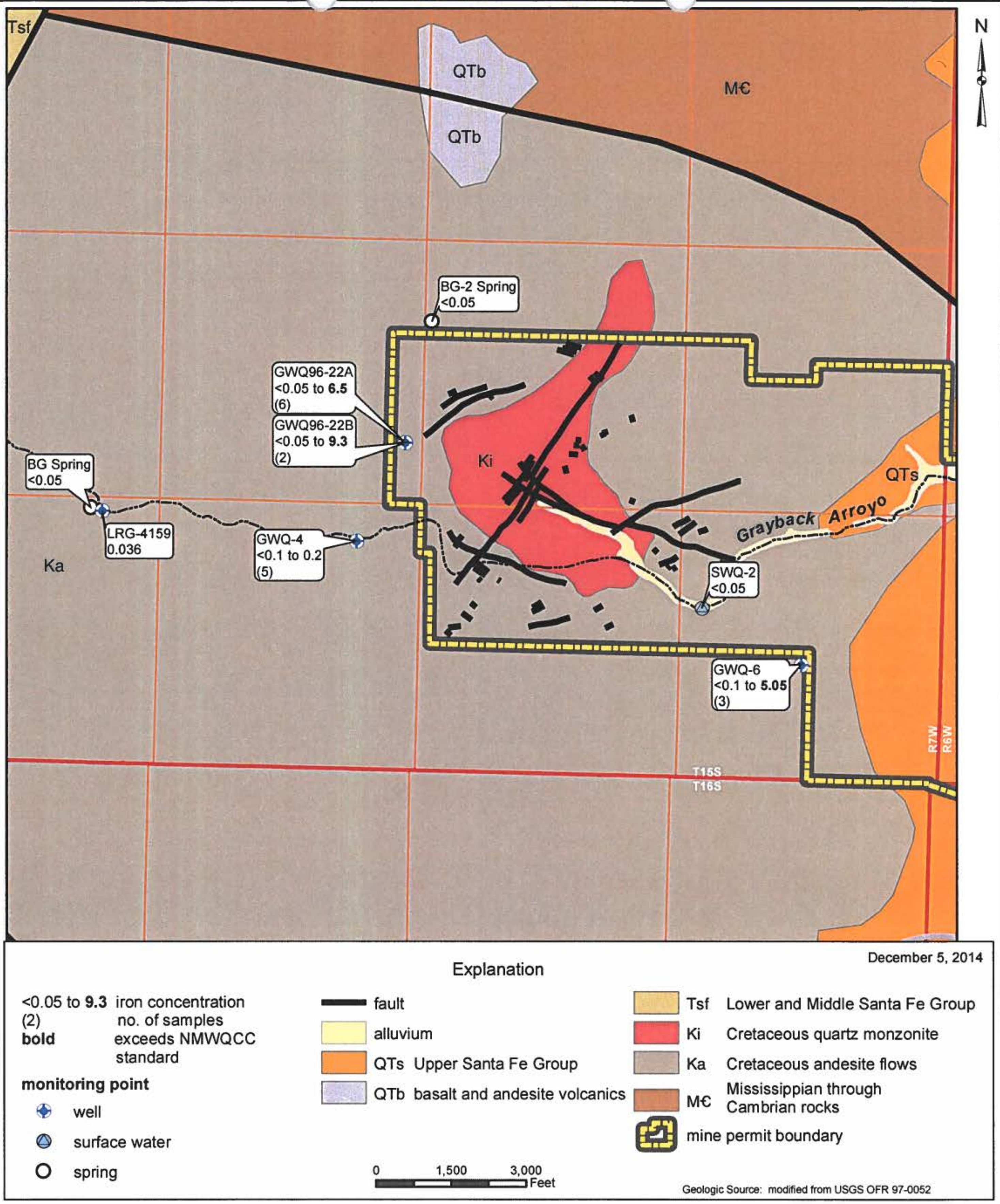

Figure 1. Geologic map of Copper Flat Mine permit area showing iron concentrations for monitoring points in Cretaceous andesite, Copper Flat Project, Sierra County, New Mexico.

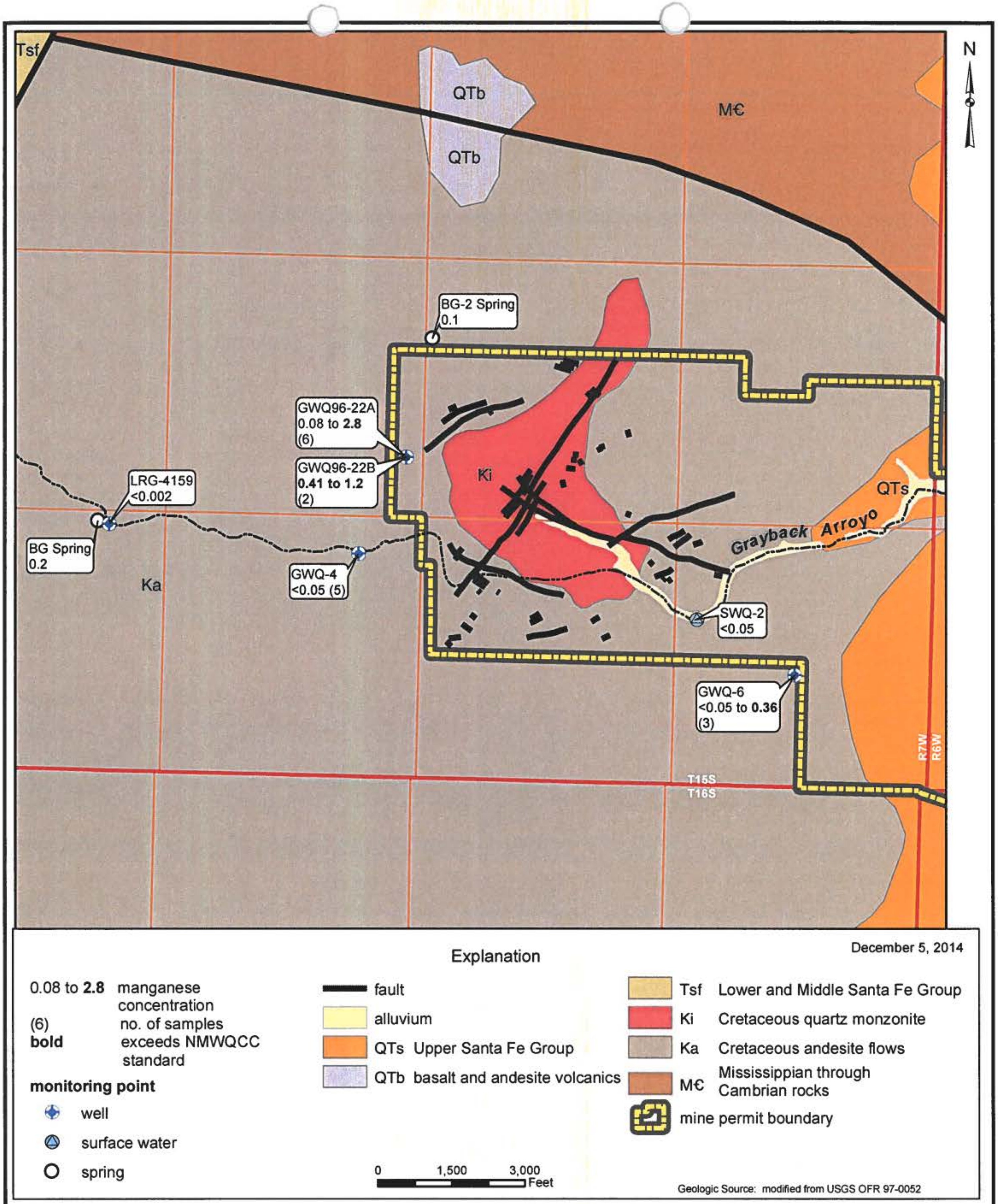

Figure 2. Geologic map of Copper Flat Mine permit area showing manganese concentrations for monitoring points in Cretaceous andesite, Copper Flat Project, Sierra County, New Mexico.

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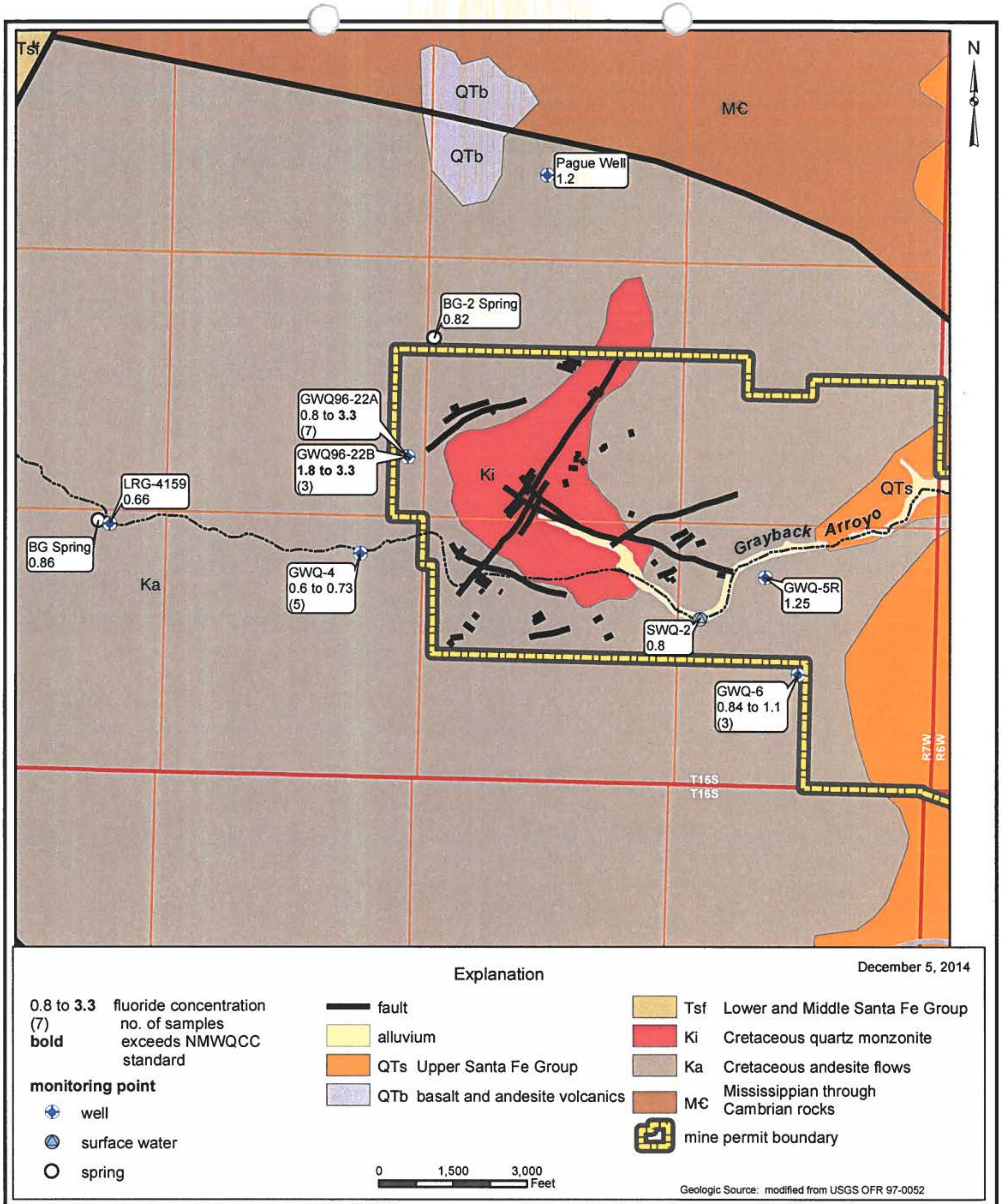

Figure 3. Geologic map of Copper Flat Mine permit area showing fluoride concentrations for monitoring points in Cretaceous andesite, Copper Flat Project, Sierra County, New Mexico.

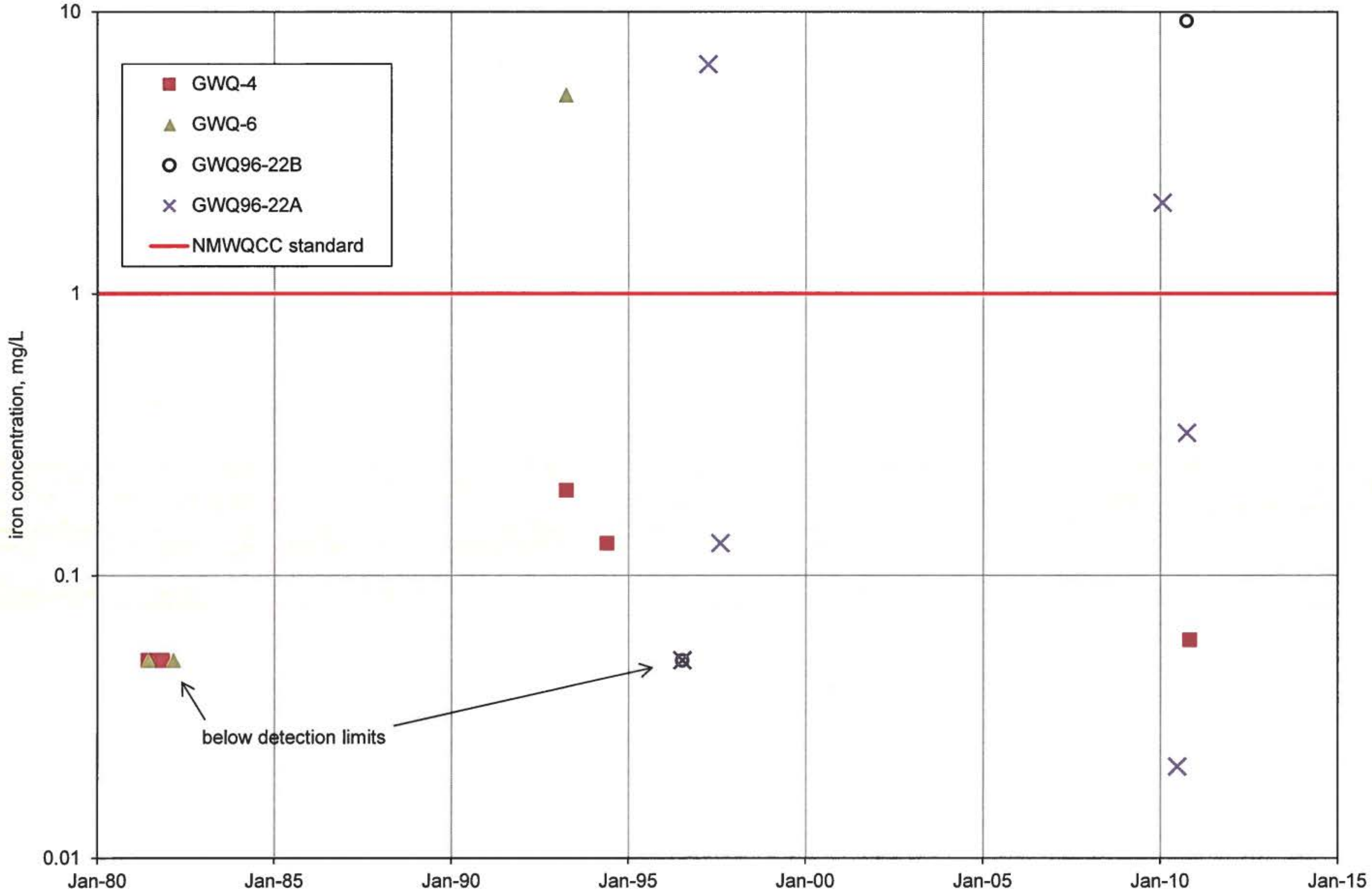

Figure 4. Time-series graph of iron concentrations in monitoring wells installed in andesite, Copper Flat Project, Sierra County, New Mexico.

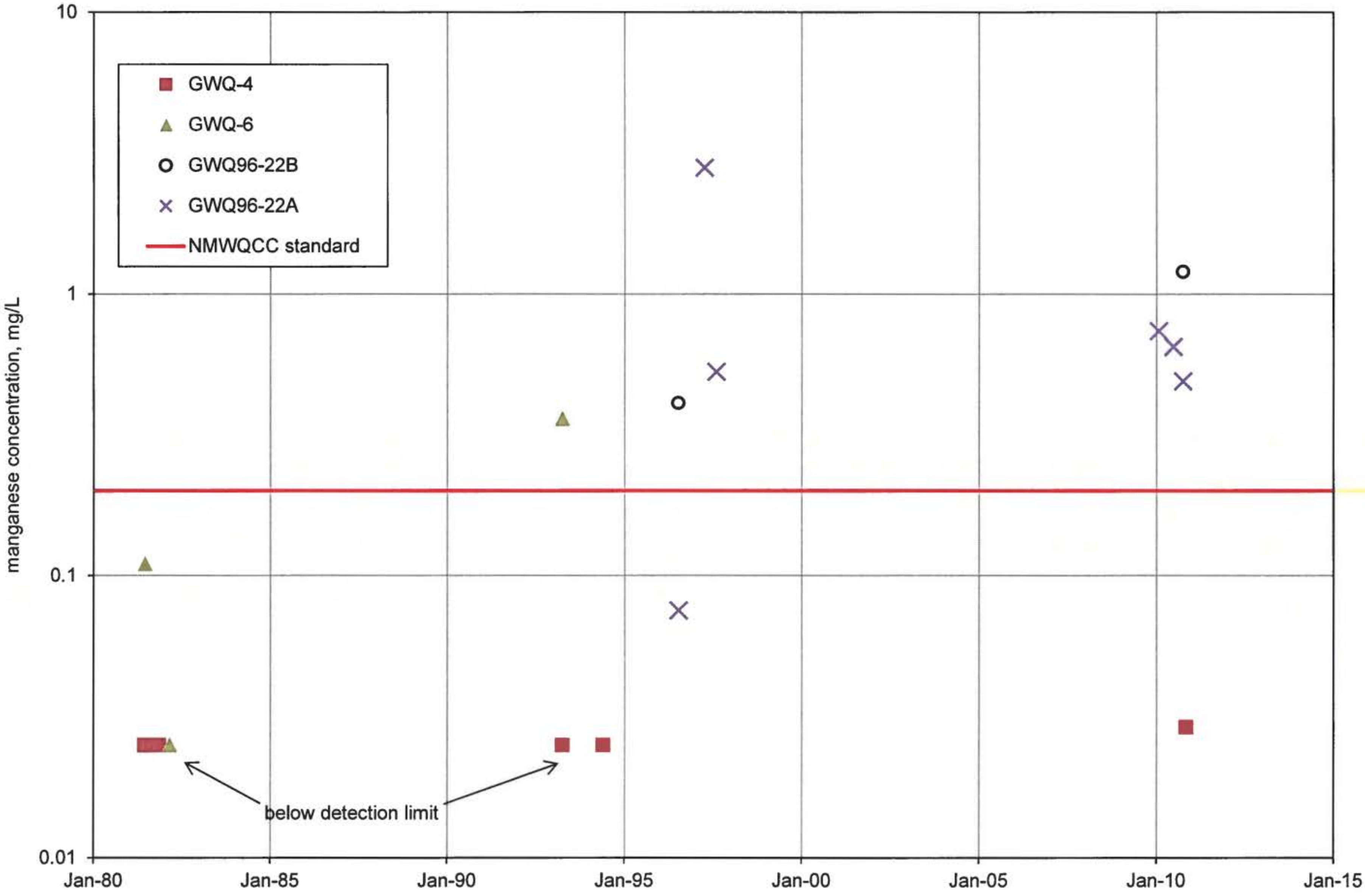

Figure 5. Time-series graph of manganese concentrations in monitoring wells installed in andesite, Copper Flat Project, Sierra County, New Mexico.

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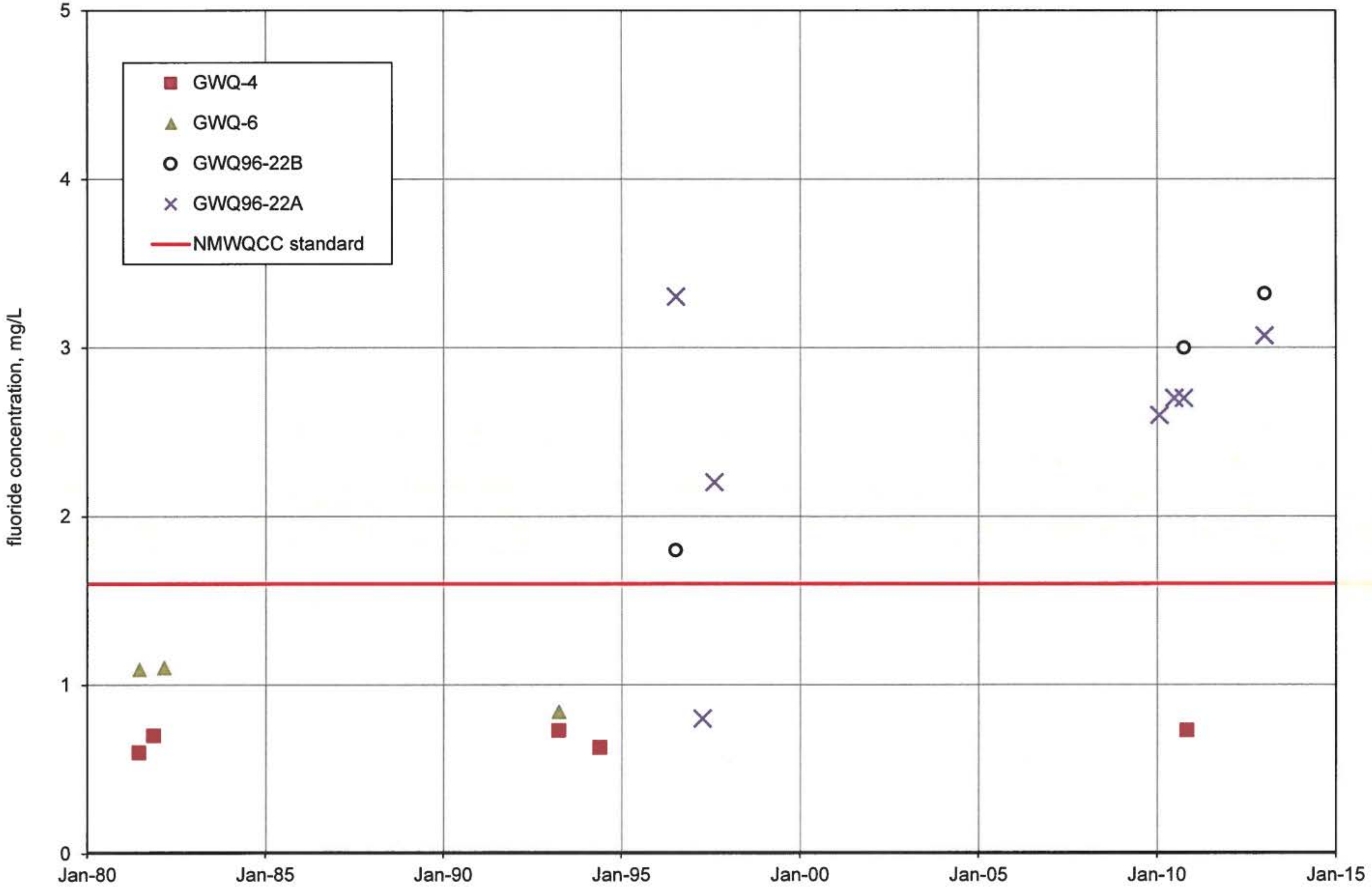

Figure 6. Time-series graph of fluoride concentrations in monitoring wells installed in andesite, Copper Flat Project, Sierra County, New Mexico.

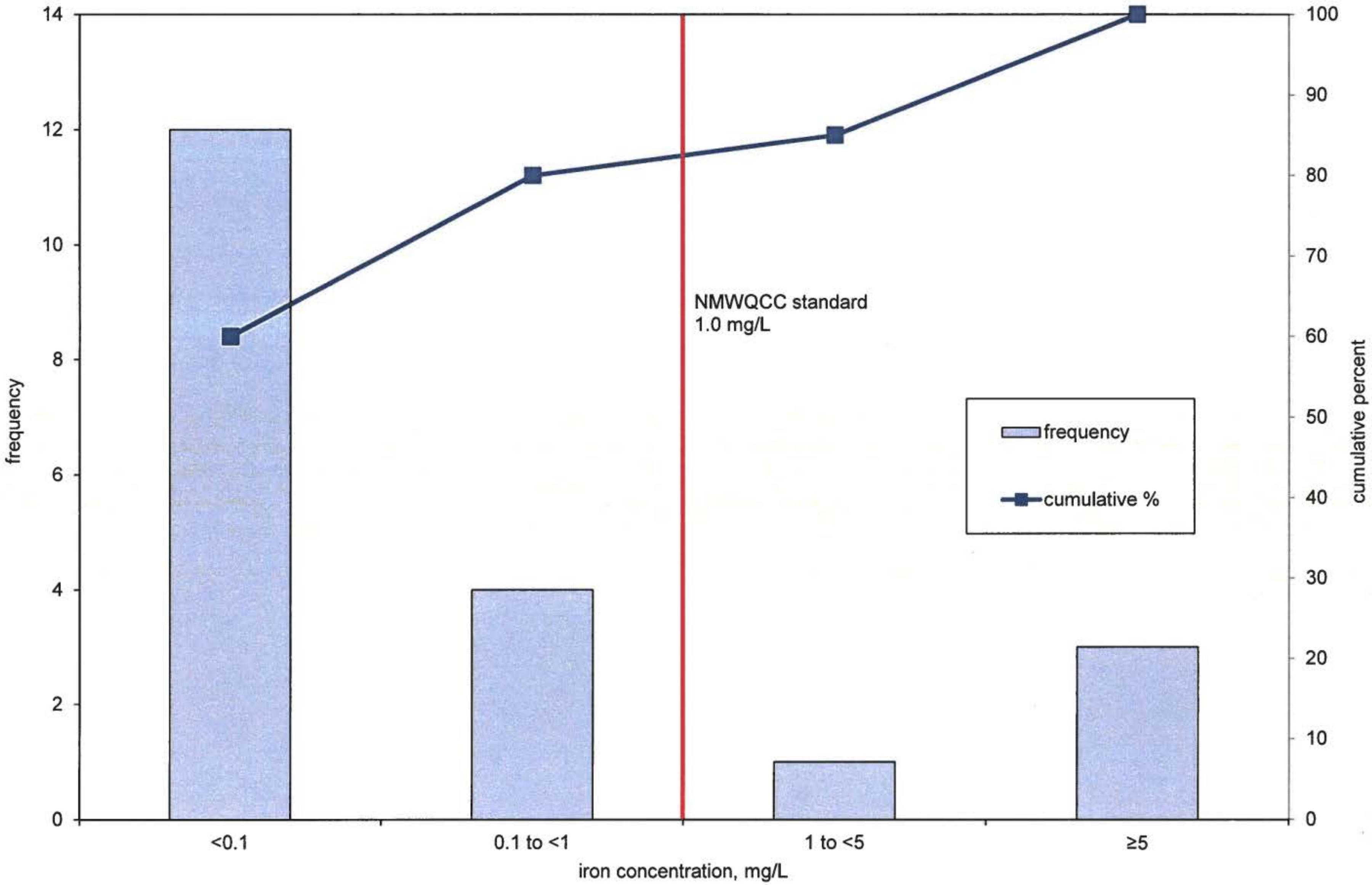

Figure 7. Histogram of iron concentrations at monitoring points in andesite, Copper Flat Project, Sierra County, New Mexico.

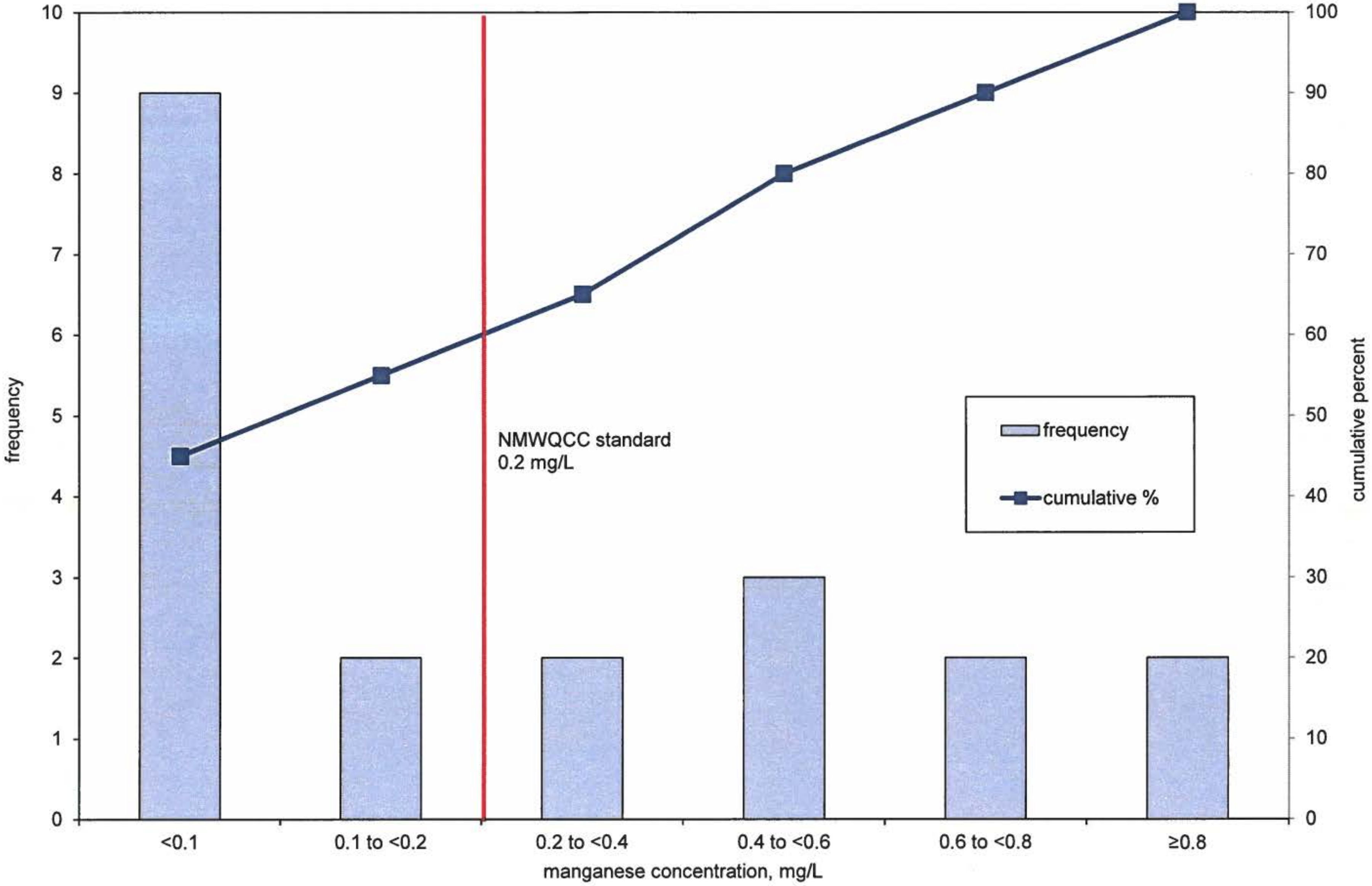

Figure 8. Histogram of manganese concentrations at monitoring points in andesite, Copper Flat Project, Sierra County, New Mexico.

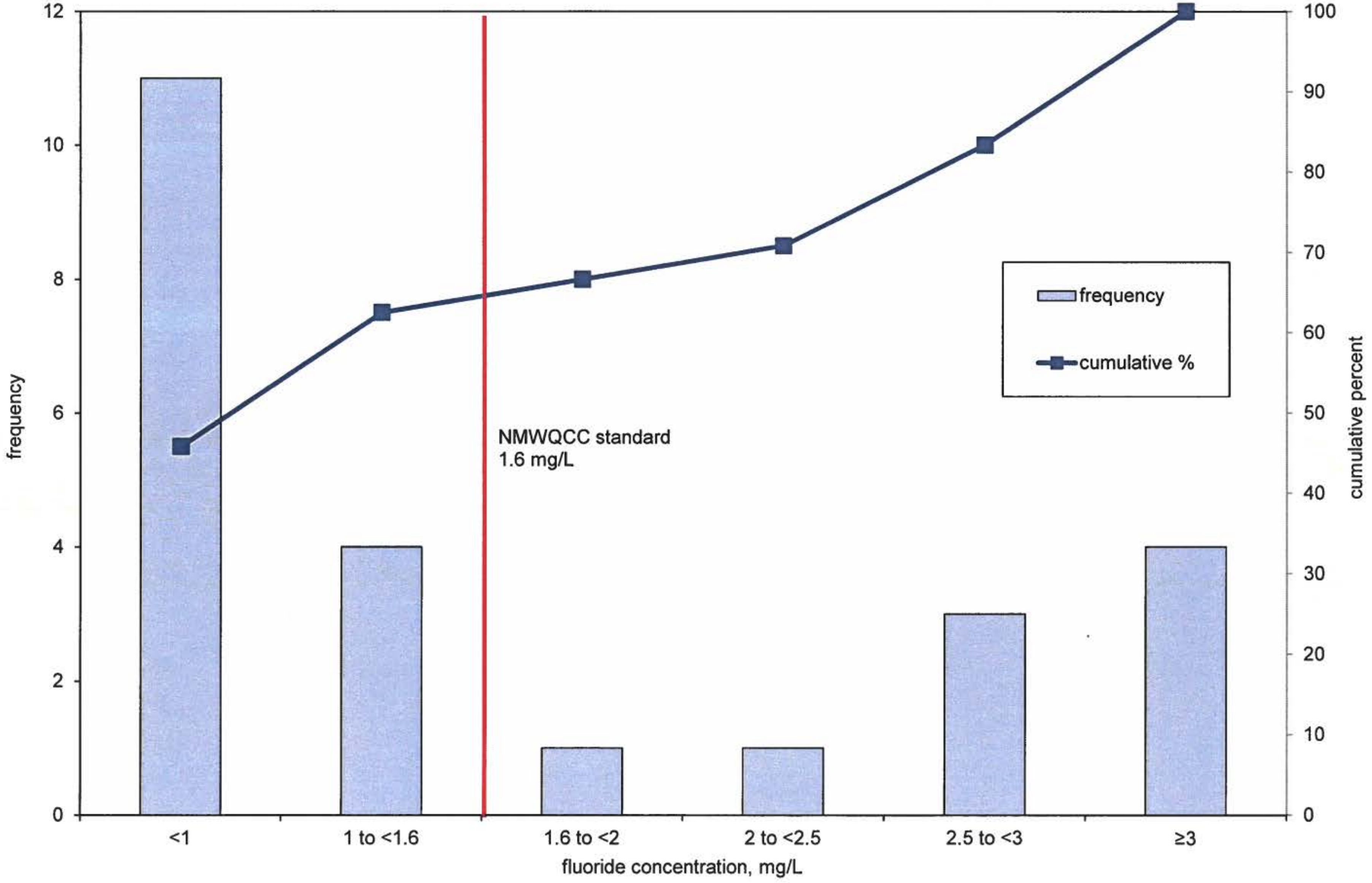

Figure 9. Histogram of fluoride concentrations at monitoring points in andesite, Copper Flat Project, Sierra County, New Mexico.

Reid, Brad, NMENV

From: Steve Raugust <sraugust@themacresourcesgroup.com>
Sent: Thursday, December 11, 2014 10:44 AM
To: Vollbrecht, Kurt, NMENV; Reid, Brad, NMENV; Longmire, Patrick, NMENV; dhaywood@blm.gov; Dave Henney; Ennis, David, EMNRD; Dail, Bryan, NMENV; 'Nelson, Mark' (NelsonMR@cdmsmith.com)
Cc: Katie Emmer; Jeffrey Smith
Subject: NMCC Geochemistry Characterization Responses 2 of 2
Attachments: Copper Flat_TSF_model_95% draindown_GW_mix_14March2013.pqo; Copper Flat_WRDF_model_5% seepage_14March2013.pqo

Kurt and others,

Attached is part 2 of NMCC responses to NMED's September 19, 2014 comments to NMCC's geochemical characterization reports. These are PHREEQE output files associated with the WRDF and TSF which are provided as the response to comment 3. Most of you will not be able to read these files, but they should be saved in association with the memo previously sent as part of the submittal.

Regards,

Steve Raugust, CEG | **Resource Development Manager**

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THEMAC
RESOURCES

Reid, Brad, NMENV

From: Steve Raugust <sraugust@themacresourcesgroup.com>
Sent: Friday, December 19, 2014 2:37 PM
To: Vollbrecht, Kurt, NMENV; Reid, Brad, NMENV; Longmire, Patrick, NMENV; dhaywood@blm.gov; Dave Henney; Ennis, David, EMNRD; Dail, Bryan, NMENV; 'Nelson, Mark' (NelsonMR@cdmsmith.com)
Cc: Katie Emmer; Jeffrey Smith; sfinch@shomaker.com; Bowell, Rob (rbowell@srk.co.uk); rwarrender@srk.co.uk; aprestia@srk.com
Subject: Revised Copper Flat Pit Model Report-Draft 19Dec2014
Attachments: Copper_Flat_Pit_Lake_Modeling_Report_191000_04_RW_20141218_DFT.pdf; Appendix_A_JSAI_NMCC_OpenPit_TM_17Dec2014.pdf; Appendix_F_Technical Memo- pit HgCOC_30Jun2014.pdf

Copper Flat Geochemistry Review Team,

Please find attached a revised draft of the Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico report. This report has been revised based on comments received from NMED, MMD and CDM during several conference calls held between April and October 2014 to discuss comments and responses. During the most recent conference call on October 29, 2014, NMED, MMD and CDM identified three remaining issues that were not addressed in the July 28, 2014 response letter from NMCC. Below is a summary of the remaining issues along with a brief description of how the issues have been addressed and the location of the relevant information in the attached report. Also attached are two memos prepared by JSAI that were prepared to further support the pit lake study approach.

> *Comment 1: Calibration of the pit lake model to copper, selenium and chloride measured values in the existing pit lake. Mercury was initially discussed for the calibration effort, but NMED agreed with the memo submitted on July 28, 2014 by JSAI that predicts mercury will likely not be a contaminant of concern in the future pit lake.*
>
> *Comment 1 Resolution:* The numerical predictions for the current pit lake chemistry have been re-run in order to determine if the calibration of the pit lake predictions can be improved with respect to copper, selenium and chloride. As part of this effort, a sensitivity analysis on the groundwater inputs was completed to determine if varying the groundwater chemistry results in an improvement of the pit lake calibration model. In addition, additional equilibrium phases were incorporated into the model. The results of the revised calibration model are presented in Section 4.1 of the attached report. Although the revised model shows an improvement in the calibration for some constituents (e.g., cadmium), the calibration for copper, selenium and chloride remains essentially the same. Previously, the results of the calibration model were compared to a single concentration, representing an average concentration in the existing pit over the period 2010-2011. This comparison was misleading for some constituents (particularly copper) since the pit lake chemistry has varied significantly throughout this period. Therefore, Table 4-2 has been revised to show the calibration results in comparison to the range of concentrations observed for the existing pit lake rather than a single (i.e. average) value. This results in a better understanding of which constituents may be under or over predicted by the models. It also shows that for many parameters, the concentration predicted by the model is within the range of measured concentrations in the existing pit. SRK believed the calibration demonstrates the PHREEQC code developed to predict water quality for Copper Flat provides a reasonably accurate prediction for the existing pit lake within the limits of available data and is acceptable to be applied to predicting future pit water quality.
>
> A separate review of the pit lake calibration was completed by JSAI using the groundwater flow model to simulate the effects of evaporation on TDS, sulfate and chloride concentrations using mixing (i.e., without mineral precipitation). The results of this effort indicate that both approaches are reasonably well calibrated to the effects of evaporation. A description of this modeling is provided in Section 4.3 of the attached report and the December 17, 2014 memo from JSAI (attached).

<u>Comment 2:</u> Potential water quality affects due to pit lake geochemical stratification.

<u>Comment 2 Resolution:</u> Additional information on the potential for stratification of the future pit lake has been incorporated into Section 4.4 of the attached report. Profile data from the existing pit lake (e.g., temperature, dissolved oxygen and chemistry) have also been provided in Section 1.2.7 and shows the existing pit water is not chemically stratified and is only thermally stratified seasonally. A review of pit lakes in similar environments is provided in Section 4.4 and the December 17, 2014 memo prepared by JSAI (attached). The additional information provided on pit lake stratification demonstrates the future pit lake will be well mixed, remain oxygenated, and will not permanently stratify.

What does this mean? Does it mean that it will seasonally stratify?

<u>Comment 3:</u> Scaling factors related to pit wall fracture density and the pit wall reactive zone.

<u>Comment 3 Resolution:</u> Additional information on the assumptions of reactive wall rock thickness and fracture density used in the modeling is provided in Section 3.2.2 and 4.1 of the attached report. A number of studies that looked at the density and thickness of pit wall fracturing caused by blasting were reviewed. A detailed summary of these studies is provided in the December 17, 2014 memo from JSAI. This review demonstrates that there is no standard approach for the incorporation of pit wall fracturing information into pit lake geochemical predictions. The research confirms the approach taken for the Copper Flat pit lake modeling is reasonable and is consistent with the range identified in the available literature.

We have a conference call scheduled for Dec. 29 at 10 MDT to discuss this report and also the characterization comment responses sent to the group on Dec. 11. NMCC will prepare an agenda for that call and SRK will provide the call in details.

Regards and Happy Holidays.

Steve Raugust, CEG | Resource Development Manager

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TECHNICAL MEMORANDUM

To: Steve Raugust, New Mexico Copper Corporation
Katie Emmer, New Mexico Copper Corporation

From: Steven T. Finch, Jr., Principal Hydrogeologist-Geochemist, JSAI

Date: December 17, 2014

Subject: Review of methods and assumptions for predicting open pit water quality, Copper Flat Project, New Mexico

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New Mexico Copper Corporation (NMCC) is in the process of obtaining a mining permit for the Copper Flat property near Hillsboro, New Mexico. To determine if the proposed Copper Flat open-pit water would meet New Mexico Water Quality Control Commission (NMWQCC) standards for stock and wildlife use, SRK (2013) prepared a report titled *Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico*. The SRK (2013) geochemical model incorporated the water model developed by JSAI (2013). Reviewers of the SRK (2013) report have raised questions about the following issues:

1. More detail is needed to validate the assumption of 10-percent average fracture density in the pit walls and the amount of wall rock available for leaching.
2. More detail is needed to demonstrate that the proposed open pit water body will be well mixed, remain oxygenated, and not chemically stratify.
3. The geochemical model needs to be calibrated to chloride concentrations in the existing open pit to make sure the effects of evaporation are accounted for.

This Technical Memorandum consists of three sections for addressing the issues listed above. Sections 1.0 and 2.0 compare the SRK (2013) approach and assumptions to other open pit geochemical investigations, Section 3.0 presents calibration and sensitivity analysis results of the water model (JSAI, 2013) to historical water-quality data from the existing open pit, and Section 4.0 is a summary of findings.

1.0 REVIEW OF OPEN PIT WALL-ROCK STUDIES

1.1 SRK (2013) Copper Flat Model

SRK (2013) used different conceptual models of wall rock available for leaching: one for the existing and one for the future Copper Flat open pit. The difference is due to the blasting technique; the existing pit was mined in 1982 using production blasting similar to the blasting effects analyzed by Siskind and Fumanti (1974), and the proposed pit would be mined using presplit drilling and smooth wall blasting practices. The two conceptual models are summarized below.

1.1.1 Existing Open Pit

For the existing Copper Flat open pit, SRK (2013) estimated 10-percent fracturing in the first 2 ft of open pit wall rock (crushed zone) and 5-percent fracturing for a 3.8-ft-thick transition zone. The limit of oxidation and depth to undisturbed rock was assumed to be about 6 ft behind the pit wall (see fig. 3-9; SRK, 2013). A reactive rim of 0.04 ft around the fractures was assumed for the rock in the pit walls (based on HCT results).

Quintana Minerals only used production blasting to create the existing pit. Production blasting uses large widely-spaced explosive charges that are designed to fragment a large amount of *burden* (the rock that lies between the existing slope face and the blast hole). Production blasting is the most efficient way to remove large rock burdens, but it typically creates radial fractures around the blast hole and back break (fractures that extend into the final slope face), which reduce the strength of the remaining rock mass and increase its susceptibility to slope raveling and rock fall.

1.1.2 Proposed Open Pit

For the future Copper Flat open pit, SRK (2013) estimated fracturing is 10 percent of rock volume for the first 1 ft of open pit wall rock (crushed zone), with no transition zone between the crushed zone and undisturbed zone (see fig. 3-3; SRK, 2013). The open pit wall rock approximate 1 ft from the surface was assumed to be the limit of oxidation and the depth to undisturbed rock (see fig. 3-9, SRK, 2013). A reactive rim of 0.04 ft around the fractures was assumed for the rock in the pit walls. The 1-ft crushed zone and no transition zone represent presplit drilling and smooth wall blasting practices. Presplit holes are blasted before production blasts. Procedure uses small diameter holes at close spacing and lightly loaded with distributed charges. Presplit holes protect the final pit wall cut by producing a fracture plane along the final slope face that fractures from production blasts cannot pass.

1.1.3 Rock Mass Available for Leaching

For both scenarios, water flow is assumed to be mobile in the crushed zone and oxidized rind. The calculation of reactive mass was based on an average rock density of 169 lb/ft^3 (2,700 kg/m^3).

Chemistry of open pit run-off, for each pit wall material type, is estimated from scaled kinetic test cell (HCT) leachate concentrations. Average HCT solute concentrations are scaled up based on the pit wall water-rock ratio, and computed based on the estimated degree of fracturing and thickness of the reactive rind (SRK, 2013; p. 30).

1.2 Review of Pit Wall Fracturing References

1.2.1 Blasting Effects

Siskind and Fumanti (1974), a key reference used by SRK (2013), studied the fracturing produced in the vicinity of large-diameter blast holes (production blasting) in Lithonia Granite. The purpose of the Siskind and Fumanti (1974) study was to evaluate the use of production blasting to increase permeability for in-situ mining, where the amount of fracturing between holes is intended to be maximized for economic efficiency. A severely fractured zone was found to extend approximately 25 inches (64 cm) from the center of the 6-1/2-inch (16.5 cm) blast holes. A second zone, characterized by a lesser degree of fracturing, extended from 25 to 45 inches (64 to 114 cm). Beyond 45 inches (114 cm), the rock was undamaged. Carroll and Scott (1966) evaluated blasting effects on quartz monzonite and granodiorite (Climax Stock near Mercury, Nevada) and found that production blasting created an altered zone 0 to 8 ft in depth, and blast damage 2 to 4 ft in depth.

Kelsall and others (1984) found that in granite and basalt blasting enhanced permeability by about 10 times near the blast face, but the extent of blast effects were generally limited to <3.3 ft (<1 m), and possibly as little as 1 ft (0.3 m) when using low-charge blast methods.

It is important to note that granite, granodiorite, and quartz monzonite are similar intrusive rocks with similar rock properties. The primary difference is the quartz and feldspar content. The quartz monzonite at Copper Flat is therefore analogous to the granite and granodiorite in the blasting studies cited above. The Siskind and Fumanti (1974) study cites physical properties of the Lithonia Granite. Recent physical properties or the principal rock types of the Copper Flat Ore are presented in a 2013 report prepared by Mine Design Engineering of Kingston, Ontario, Canada for THEMAC Resources (Mine Design, 2013). The Mine Design report (2013) was prepared for the purposes of engineering the future pit walls for geotechnical stability. Table 1 presents a comparison of selected physical properties Lithonia Granite to the Copper Flat Quartz Monzonite and Quartz Monzonite Breccia.

Figure 1 presents the Copper Flat pit outline (Pre-Feasibility Study; PFS) from the 2013 Mine Design report, which shows the major rock types, their distribution, and the locations of the geotechnical drill holes where the samples from Table 1 were collected. From information presented in Mine Design (2013), and other available information, the Definitive Feasibility Study (DFS) pit geometry was developed. For geochemical characterization purposes, the PFS pit is very similar to the DFS Pit (SRK, 2014).

Table 1. Summary of the physical properties of the Lithonia Granite with Copper Flat Quartz Monzonite (QM) and Quartz Monzonite Breccia (QMBX)

Laboratory Analysis	Lithonia Granite (Tested by prevous investigators)	Lithonia Granite (Tested by authors at H-100 control hole)	QM (Average Values)	QM (Maximum Values)	QM (Minimum Values)	QMBX (Average Values)	QMBX (Maximum Values)	QMBX (Minimum Values)
Specific Gravity	2.63	-	2.68	-	-	2.57	-	-
Density (lb/ft^3)	164	-	167	-	-	160	-	-
Tensile Strength (lb/in^2)	450	-	2,132	3,075	493	1,247	1,697	653
Compressive Strength (lb/in^2)	30,000	28,000	18,490	29,400	11,810	6,614	6,614	6,614
Young's Modulus (lb/in^2)	3,000,000	6,400,000	5,018,000	6,135,000	3,626,000	2,973,000	2,973,000	2,973,000
Poisson's Ratio	0.26	-	0.10	0.09	0.11	0.12	0.12	0.12

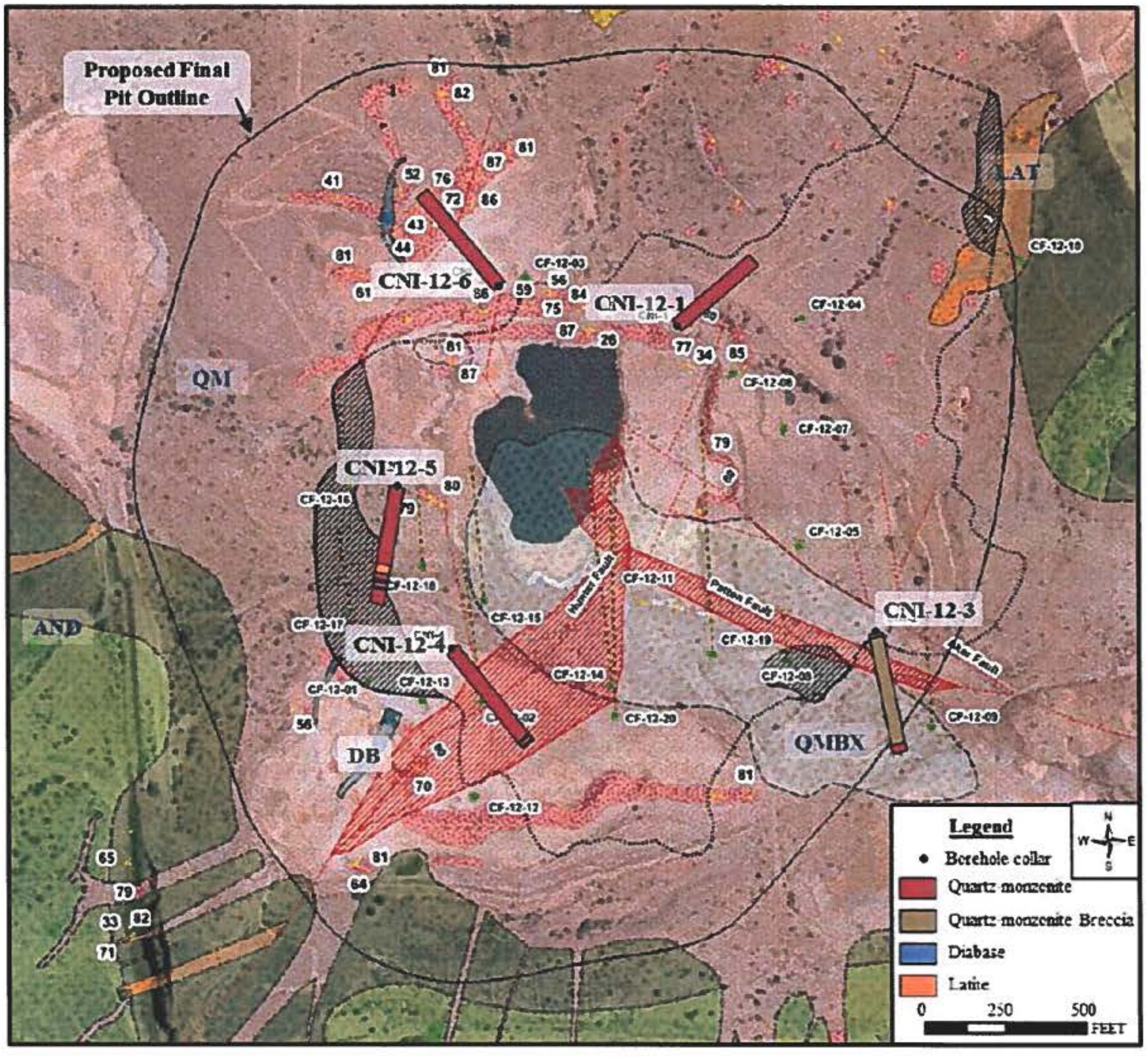


Figure 1. Geotechnical drill hole locations and the Pre-Feasibility Study pit outline (Mine Design, 2013).

1.2.2 Fracture Permeability

Molebatsi and others (2009) noted that many open-pit mines are located in fractured rock systems where water flow paths are complex and difficult to predict. These flow paths are typically controlled by a small subset of fractures that are permeable and interconnected. Most models of flow in fractured rock systems are based on a network of interconnected fractures that are all assumed to be permeable. However, this assumption is rarely observed in natural rocks where a significant number of the fractures within a connected cluster may be impermeable.

Field observations have shown that only a small proportion of fractures contribute to the overall flow, resulting in a complex and heterogeneous flow system. Up to 20 percent of the total number of fractures may contribute to overall flow (Bear et al., 1993). Although fracture connectivity has been used to explain heterogeneous phenomena (de Marsily, 1985), it is likely that additional aspects such as the effect of partial or total closure of individual fractures could further increase flow heterogeneity and tortuosity. Effectively impermeable fractures that (although mappable) will not conduct flow will thus need to be excluded from the conductive fracture cluster.

Not discussed in detail by Molebatsi and others (2009) is the rock type and mineralization of fractures, degree of fracturing, hydraulic conductivity in comparison to fracture density, and specific yield of rock. Obviously, fractured rock with low hydraulic conductivity would have more impermeable fractures than high hydraulic conductivity fractured rock that effectively behaves as a porous medium.

1.3 Other Open-Pit Geochemical Models

1.3.1 URS (2009) Little Rock Mine Post-Closure Pit Lake Model

The Little Rock open pit mine is located near Silver City, New Mexico, and is currently operating. URS (2009) assumed that a mixture of the in-situ field leaching tests and the HCT leachates represents the pit wall runoff. For the most likely case, an equal-weight mixture of the mean in-field leachate results, week-0 HCT results, and HCT results from the first 4-week idle period was used to represent run-on from the exposed pit walls above the pit lake. URS (2009) assumed: 1) rock samples collected within 100 ft of the final pit wall are representative of the exposed wall rock, and 2) a combination of the in-situ field leachates and the HCT leachates mimics weathering of pit wall rock. There is no discussion of blasting effects or increased fracture density on leaching of wall rock.

1.3.2 Tetra Tech (2010) Rosemont Copper Project

The Rosemont Copper project is located in southeastern Arizona. For simulating the initial flushing of blast-fractured pit walls, Tetra Tech (2010) used the first rinse from the HCTs to represent the chemical source terms. The HCT concentrations were generally higher than from the Synthetic Precipitation Leaching Procedure (SPLP) results, which generally correspond to rock that has had more time to weather before contacting water.

The near-surface wall rock of the anticipated ultimate pit shell is expected to be affected by blasting. An initial chemical flushing of the blast-affected pit wall rock was incorporated into the pit lake model. The near-pit wall rock is anticipated to have altered hydraulic properties and increased fracture density as a result of blasting and the extraction of surrounding rock. An increase in the porosity and specific yield (3 to 15 percent) of the near-surface wall rock is expected. The blast-affected wall rock was considered to extend for a distance of six (6) ft behind the ultimate pit wall; there was no basis provided for this assumption.

Where available, the chemical source terms used for flushing of the blast-affected wall rock for each formation were developed using the averaged first-rinse HCT data. Scaling of HCT data was not considered. For formations without HCT data, the concentrations of major cations and anions derived from SPLP tests were multiplied by a factor of three (3) and the trace metals were multiplied by a factor of two (2). Three (3) pore volumes of the blast-affected wall rock were considered in the model for the initial flush, after which standard groundwater inflow chemistry was assumed.

1.3.3 Schafer (2007) Betze Pit Lake Water Quality Predictions

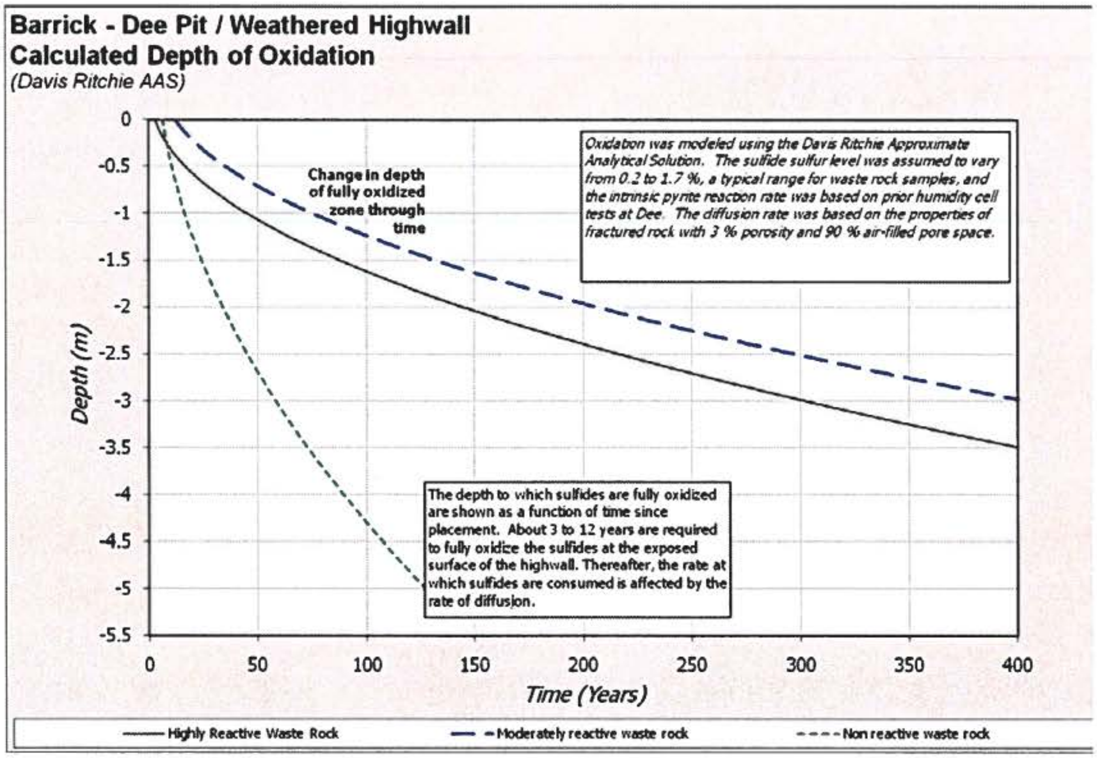
Schafer (2007) estimated the thickness of the weathered zone behind the pit wall by applying the approximate analytical solution (shrinking core model) derived by Davis and others (1986). The shrinking core model considers that particle size and the reactive core shrink simultaneously; therefore, sulfide oxidation rates decrease over time. A porosity of 2 percent was used to represent the highwall, while the rate of interparticle diffusion was determined from historical humidity cell tests. The rate of interparticle diffusion was calculated using the Millington Quirk equation (Jury et al., 1991). For portions of the highwall with relatively low sulfide levels, oxygen can penetrate nearly 16.4 ft (5 m) after 400 years, while the depth of oxygen penetration is closer to 9.8 ft (3 m) after 400 years for higher sulfide zones. The overall average thickness of the oxidized wall rock was estimated to be 9.8 ft (3 m).

1.3.4 Schafer (2010) Dee Pit Lake, Arturo Mine

Schafer (2010) assumes the thickness of a weathered highwall increases with increasing exposure to oxidation. The thickness of the weathered zone was estimated for the Dee pit lakes by applying the approximate analytical solution derived by Davis and others (1986). A porosity of 3 percent was used to represent the highwall. Other data needed to calibrate the Davis and others (1986) equations were determined from pyrite weathering rates observed in humidity cell tests. The rate of interparticle diffusion was calculated using the Millington Quirk equation (Jury et al., 1991). For portions of the highwall with relatively low sulfide levels, oxygen can penetrate over 15 ft (5 m) after 400 years, while the depth of oxygen penetration is closer to 10 ft (3 m) after 400 years for higher sulfide zones (see Fig. 2 below).

1.3.5 Adrian Brown (1997) Cunningham Hill Mine Open Pit

A water model and geochemical model were coupled to predict open pit water quality. The model was calibrated to existing water levels and water-quality data (alkalinity, calcium, and sulfate). Inputs from existing acid wall seepage (AWS) were used to simulate open pit water-rock interactions. The water-quality model was simply a mixing model if open pit water quality remained under-saturated with respect to gypsum.



Barrick - Dee Pit / Weathered Highwall
Calculated Depth of Oxidation
(Davis Ritchie AAS)

Oxidation was modeled using the Davis Ritchie Approximate Analytical Solution. The sulfide sulfur level was assumed to vary from 0.2 to 1.7 %, a typical range for waste rock samples, and the intrinsic pyrite reaction rate was based on prior humidity cell tests at Dee. The diffusion rate was based on the properties of fractured rock with 3 % porosity and 90 % air-filled pore space.

The depth to which sulfides are fully oxidized are shown as a function of time since placement. About 3 to 12 years are required to fully oxidize the sulfides at the exposed surface of the highwall. Thereafter, the rate at which sulfides are consumed is affected by the rate of diffusion.

Figure 2. Graph showing depth of oxygen penetration based on the Davis and others (1986) approximate analytical solution (Schafer (2010) Fig. 13).

A groundwater flow and solute transport model of the open pit and surrounding groundwater system was developed by JSAI (1999), and later updated and recalibrated by JSAI (2011). It was demonstrated that the open pit general chemistry is more influenced by water budget components (mixing) than by mineral precipitation reactions.

1.3.6 Kempton and Atkins (2009)

Kempton and Atkins (2009) provide a review of methods for predicting water quality in open pits where sulfide oxidation is a major source term. Shrinking core models have been demonstrated to effectively simulate conditions in uniform materials, such as tailings. However, it is difficult to evaluate accuracy in the more heterogeneous pit benches and walls.

Kempton and Atkins (2009) evaluated a method for direct measurement of sulfide oxidation rates in mine pit benches by sealing a drape-chamber apparatus to the surface. They found that application of this method to benches and waste rock have not found the measured oxidation rates to be meaningfully correlated to sulfide sulfur, presence of surface rubble, moisture conditions, or carbonate content of the underlying rock. This suggests that physical processes such as blast-induced wall rock porosity and depth of pit-wall oxidation were more important than chemical processes. It was noted that fracturing is lower in competent rock, such as granite, and that careful blasting can reduce fracturing. Kempton and Atkins (2009) concluded that reliable comparisons of model-simulated versus observed pit lake water quality are needed to accurately assess model capabilities; this is exactly what SRK (2013) has done.

1.4 Discussion

Geochemical models for predicting open pit water quality are commonly most sensitive to the water budget components and the calculated solute contributions from sulfide oxidation. Open pit water-quality models with the least accurate predictions have under-estimated the potential for sulfide oxidation in wall rock and poorly represented water budget components (Kuipers and others, 2006). One reason for inaccurate water quality predictions is the lack of historical data for model calibration; most projects do not have an existing open pit water body with good time-series data. In contrast, the proposed Copper Flat open pit geochemical and groundwater flow model is calibrated to an existing open pit water body with 30 years of data.

Open pit wall blast damage for granite, granodiorite, and quartz monzonite rocks extends 2 to 4 ft in depth when assessing effects from production type blasting (Carroll and Scott, 1966; Siskind and Fumanti, 1974; and Kelsall and others, 1984).

Kelsall and others (1984) found that production blasting enhances permeability by about 10 times near the blast face. Molebatsi and others (2009) indicate that a small percentage (<20 percent) of the total fractures will contribute to permeability of the system. Typically, fractured rock groundwater systems are assumed to have a specific yield of less than 5 percent, and commonly less than 1 percent. The calibrated Copper Flat groundwater flow model simulates a specific yield of 0.001 (0.1 percent) in the quartz monzonite. If blast fracturing increased the effective porosity (specific yield) by an order of magnitude, the specific yield of the blast zone would be 1 percent. The 5 to 10 percent fracture density used by SRK (2013) can be considered conservative given the properties of the open pit wall rock estimated from the calibrated groundwater flow model.

A summary of the case studies reviewed is presented in Table 2. SRK (2013) is the only open pit water-quality model that includes blasting effects in the pit walls, scaled HCT data, and calibration to existing pit water chemistry.

Table 2. Summary of open pit water-quality prediction studies

reference	open pit	pit wall fracture assumptions	sulfide oxidation model	calibration to existing pit
SRK (2013)	Copper Flat	5 - 10 % fracture density (porosity) with depth based on blasting method; ranging from 1 to 6 ft	based on scaled HCT data	yes
Adrian Brown (1997)	Cunningham Hill	used measured acid wall seepage (AWS) data	used measured AWS data	yes
URS (2009)	Little Rock	none	based on HCT data	no
Tetra Tech (2010)	Rosemont	3 to 6% porosity, 6 ft depth	based on HCT data	no
Schafer (2007)	Betze	2 % porosity with oxidation depth increasing with time; 10 to 16 ft after 400 years	shrinking core model	no
Schafer (2010)	Dee	3 % porosity with oxidation depth increasing with time; 10 to 15 ft after 400 years	shrinking core model	no

2.0 STRATIFICATION OF OPEN PIT WATER BODIES

SRK (2013) concluded the proposed Copper Flat pit will not stratify, and will remain oxygenated. The proposed Copper Flat open pit water body will have a maximum depth of approximately 200 ft with a maximum surface area of about 22 acres.

2.1 Overview

Based on elevation and latitude, the Copper Flat open pit water body is classified as a warm monomitic type lake (Wetzel, 2001; fig 6-7). A warm monomitic lake mixes freely once a year in the winter at or above 4 °C. However, wind effects and water body geometry can have an effect on the degree and frequency of mixing. Baseline data (INTERA, 2012) from the existing pit water body provides evidence that a thermocline develops in the summer and mixing occurs in the winter. A chemocline does not develop, and the water body remains oxygenated (dissolved oxygen = 6 to 9 mg/L) throughout the full water column year-round. The existing open pit water body has an area of about 5 acres, maximum depth of 30 ft, and length of about 460 ft.

The relative depth (RD) of the predicted Copper Flat open pit water body at the maximum pit water stage is approximately 18 percent. RD relates the maximum depth of a lake (Z) to the width (d). Assuming an approximately circular lake, the width is a function of surface area (A) and can be determined from:

$$d = 2(A/\pi)^{\wedge}0.5$$

The percent RD is defined as:

$$RD = (Z/d)*100 \text{ percent}$$

The estimated RD of 18 percent is considerably greater than 5 percent, which typically suggests that the lake is likely to stratify. Such stratification may result in oxidizing conditions in the upper portions of the lake and more chemically reducing (oxygen-deprived) conditions at depth. However, pit lakes that form in arid regions are unlikely to stratify, relative to lakes that form in cooler, wetter climates (Jewell, 2009). A prerequisite for permanent stratification is that precipitation plus runoff is greater than evaporation during the summer months when the water body is potentially undergoing temporary thermal stratification (Jewell, 2009).

While stratification of an open pit water body has implications for water quality at depth, the near-surface waters will remain oxidized. These near-surface waters are considered the most important from an open pit water-quality perspective given the potential ecological risks associated with them. The water quality at depth is less important given the expected terminal nature of the open pit water body.

2.2 Case Studies

Jewell (2009) evaluated six permanently-stratified and eight open pit lakes with seasonal thermocline, and concludes that permanently stratified lakes have vertical density contrast greater than 0.0005 g/cm^3 and a Wedderburn number greater than 1. The Wedderburn number considers thermocline depth, maximum lake length, water density, and wind speed. Jewell (2009) failed to note that most permanently-stratified open pit lakes receive AWS inputs and have acidic water. A summary table of existing open pit water bodies and their characteristics is presented in Table 3.

Table 3. Summary of open pit water bodies and stratification characteristics

open pit	location	effective length (ft)	maximum depth (ft)	relative depth (percent)	thermocline depth (ft)	acidic
permanently stratified						
Brenda	B.C.	2,296	492	21	39	no
Spenceville	California	253	50	20	13	yes
Berkeley	Montana	5,900	426	7	23	yes
Seasonal thermocline and well mixed						
Humbolt	Nevada	944	137	15	8	no
Blackhawk	Utah	492	na	na	33	no
Blowout	Utah	656	230	35	39	no
Colosseum	California	482	157	33	na	no
Cunningham Hill	NM	407	90	22	20	no
Copper Flat (existing)	NM	537	30	6	20	no[1]
Copper Flat (proposed)	NM	1,105	200	18	TBD	no
Yerington	Nevada	5,412	400	13	49	no

[1] there have been temporary acidic conditions where the pit water naturally neutralizes over time

TBD - to be determined

2.3 Discussion

The proposed Copper Flat open pit is expected to have a seasonal thermocline, be well mixed, oxygenated, and not acidic. Relative depth does not appear to govern the conditions for creating a permanently stratified open pit water body; however, acidic water and higher latitude are key conditions for creating permanent stratification.

3.0 COPPER FLAT OPEN PIT WATER MODEL

The Copper Flat open pit and groundwater flow model (water model) developed by JSAI (2013) was calibrated to water levels, water budgets, and hydraulic properties. The water model was used by SRK (2013) in the geochemical model. The JSAI (2013) water model was an interim version that was finalized in 2014, but the pit water balance did not change.

The water model is used here to address calibration to the Copper Flat open pit evaporation. Evaporation accounts for all of the outflow from the open pit water body; however, the water model only simulates average climate conditions. Figures 3 through 5 illustrate the model-simulated effects of evaporation on total dissolved solids, (TDS), sulfate, and chloride concentrations in the open pit when considering mixing without mineral precipitation.

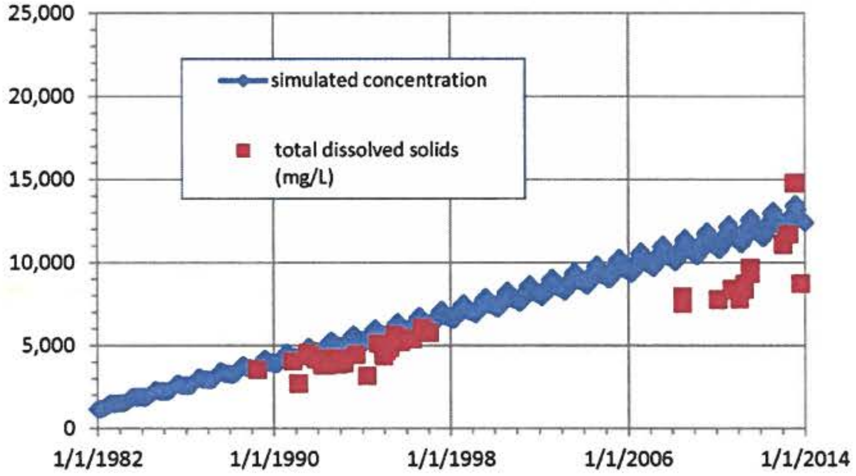


Figure 3. Graph showing water-model simulated and measured TDS concentrations for the Copper Flat open pit water body.

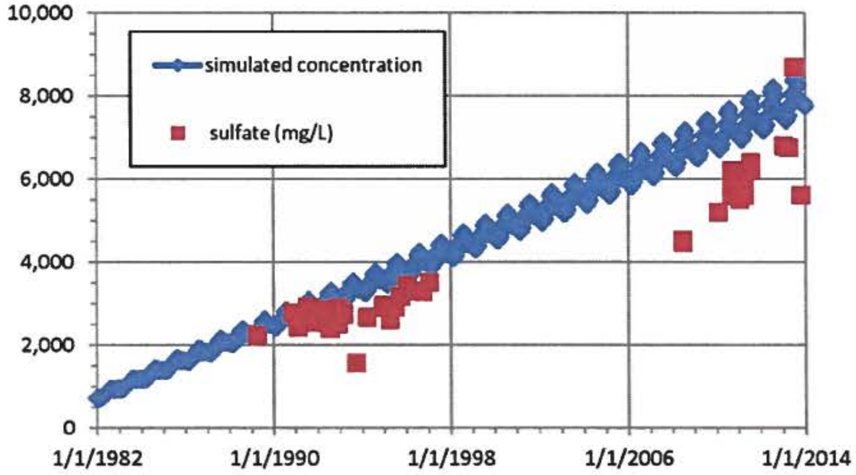


Figure 4. Graph showing water-model simulated and measured sulfate concentrations for the Copper Flat open pit water body.

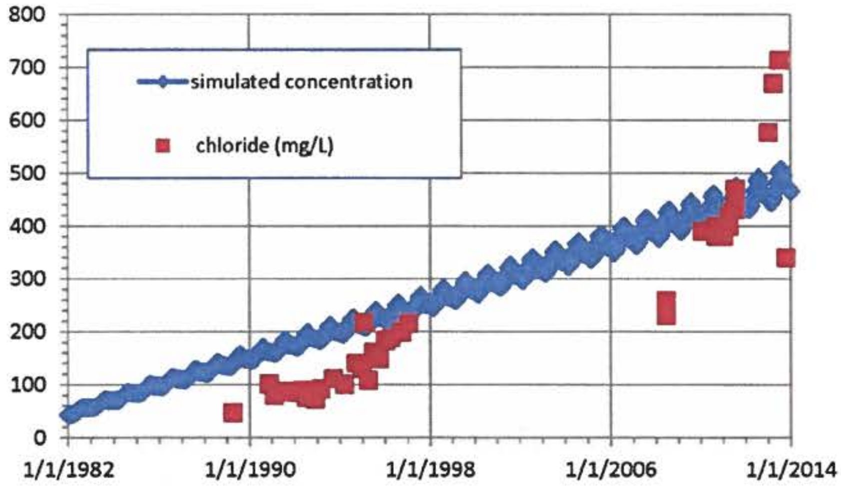


Figure 5. Graph showing water-model simulated and measured chloride concentrations for the Copper Flat open pit water body.

Data collected during 2013 show the evapo-concentration effects of extreme drought with concentrations well above the model-simulated concentrations, but 4th quarter 2013 concentrations were well below the model-simulated concentrations, due to a heavy monsoon period (Figs. 3 through 5). The model appears to reasonably simulate the average climate conditions.

SRK (2013) calibration of the geochemical model to existing pit conditions was performed for the 2011 dataset. The geochemical model considers mixing from the water model and mineral precipitation reactions. The geochemical model calibrates to TDS and sulfate better than the water model with mixing alone, but the water model calibrates better to chloride concentrations than the geochemical model (Table 4). The effects of evaporation are reasonably calibrated in the water model and reflected in the geochemical model.

Table 4. Comparison of water-model and geochemical-model simulated TDS, chloride, and sulfate concentrations to measured concentrations, Copper Flat open pit

constituent	2010-2011 measured range (mg/L)	geochemical-model results (mg/L)	water-model results (mg/L)
total dissolved solids (TDS)	7,770 to 9,410	7,751	11,621
sulfate	5,200 to 6,400	5,152	7,263
chloride	380 to 470	235	436

mg/L - milligrams per liter

4.0 SUMMARY OF FINDINGS

In summary, SRK (2013) assumptions used for reactive wall thickness and fracture density for the existing and proposed future pit are reasonable and supported by detailed studies pertaining to blasting effects on quartz monzonite rocks cited in Section 1.0. SRK (2013) used fracture-density results reflective of production blasting for the existing Quintana pit walls, and fracture density results reflective of low-charge blasting methods for the future open pit. Sensitivity of model results to fracture density and reactive wall thickness is reflected in these two simulations.

Out of the case studies reviewed (Table 2), SRK (2013) is the only open pit water quality model that considers blasting effects in the pit walls, scaled HCT data, and calibration to existing pit water chemistry. Calibration of the water model and geochemical model to existing data strengthens the ability to accurately predict future conditions.

Relative depth does not appear to govern the conditions for creating a permanently stratified open pit water body; however, significant acidic water inputs and higher latitude are key conditions for creating permanent stratification. The proposed Copper Flat open pit is expected to be seasonally stratified (thermocline only), well mixed, oxygenated, and not acidic. Baseline data from profiles in the existing pit at Copper Flat support the conclusion that the proposed pit will be well mixed and oxygenated.

Using the water model to simulate mixing and evapoconcentration effects on chloride, sulfate, and TDS demonstrates that the water model is calibrated to the effects of evaporation. The results in Table 4 compare simulated evapoconcentration with no mineral precipitation (water model only) to simulated evapoconcentration with mineral precipitation (water model and geochemical model). This comparison of model results to historical data is a sensitivity analysis that shows that the water and geochemical models are well calibrated to effects of evaporation.

The SRK (2013) geochemical model is representative of expected conditions at Copper Flat, and presents the best technical approach for predicting water quality at the future Copper Flat open pit.

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TECHNICAL MEMORANDUM

To: Steve Raugust, New Mexico Copper Corporation
Katie Emmer, New Mexico Copper Corporation

From: Steven T. Finch, Jr., Principal Hydrogeologist-Geochemist, JSAI

Date: June 30, 2014

Subject: **Evaluation of mercury as a COC for Copper Flat pit water**

John Shomaker & Associates, Inc. (JSAI) has reviewed the report "*Predictive Geochemical Modeling of Pit Lake water quality at the Copper Flat Project, New Mexico*" (SRK, September 2013), the supporting report "*Geochemical Characterization report for the Copper Flat Project, New Mexico*" (*SRK,* May 2013), and Stage 1 abatement data to determine if mercury is a potential contaminant of concern for the existing and future pit water at the Copper Flat mine.

The following review comment for the SRK pit lake geochemistry report was provided by the New Mexico Environment Department (NMED):

1. Executive Summary (Page vi) – More detail should be provided on why the predicted exceedance of mercury does not represent a true ecological risk to wildlife.

SRK Draft Response: *The assumption that mercury is unlikely to represent a true ecological risk for wildlife uses was based on the fact that predicted mercury concentrations are only marginally elevated above the NMAC 20.6.4900 guideline. However, the model predicted concentrations of mercury are an artifact of the model inputs and scaling factor, and as a result over-predicted.*

JSAI Draft Response: The only model-simulated input for mercury is from the source terms for the pit wall material (Table 3-3), with values for the HCT effluent testing ranging from 0.00001 to 0.000005 mg/L. It was assumed that mercury detections in the HCT samples would be scaled with the other constituents. However, it may not be representative to scale up detectable traces of mercury because there is no source mineral in the ore body and concentrations in the HCT testing do not significantly vary (see Fig B-6). Furthermore, the NMWQCC surface water standard for wildlife is 0.00077 mg/L, which is near or below the detection limit for the input data. For these reasons, mercury does not provide an ecological risk.

SUPPORTING DATA AND BACKGROUND INFORMATION

Background information includes mineralogical characterization of the ore body, laboratory analysis of pit water, surface water and surrounding groundwater, geochemical analysis of salt rind from the existing pit, and SRK HCT testing results.

Mineralogy of Ore Body

Mercury is known to occur as HgS (Cinnabar), and as a trace constituent in some sulfides and sulfosalts. Cinnabar has not been identified with the Copper Flat Deposit (McLemore, 2001), nor does the ore deposit have sulfosalts such as tennantite.

Whole Rock Analysis of Open Pit Salts

Mercury can also be adsorbed onto iron hydroxides and other mineral surfaces. Whole rock analysis of the salt rim that has formed around the existing pit resulted in non detection (<0.0057 mg/kg) of mercury. The lab analysis is attached. The Salt rim is mostly composed of gypsum with iron and aluminum oxyhydroxides. If mercury were present in the pit water, it should have been detected in the salt residue if it was adsorbed onto the oxyhydroxides.

Water-Quality Analyses

Laboratory water quality analysis for mercury has been performed on samples from open pit water, surface water runoff above (SWQ-1) and below (SWQ-2 and SWQ-3) the pit, and from monitoring wells adjacent to the pit. Attached Tables 1, 2, and 3 summarize the results; mercury was not detected in any of the samples.

Laboratory method detection limits vary, but are most commonly 0.001 and 0.0002 mg/L mercury. The samples with a detection limit of 0.0002 mg/L should be used to compare to the NMED surface water standard of 0.0077 mg/L for wildlife uses. Many of the sample points that were analyzed with a detection limit of 0.001 mg/L were also analyzed using a method with 0.0002 mg/L detection limit.

Geochemical Characterization (HCT testing)

SRK pit lake geochemistry report figure B-6 shows the results of the humidity cell effluent for mercury. Most of the samples tested show mercury below detection (0.000075 mg/kg) in the effluent. Two detections occurred: 1) a few samples during the first five weeks (<0.0003 mg/kg), and 2) two samples at about 90 weeks into the testing. The few, inconsistent, detections of mercury, and the low reporting concentrations suggest the detections could also be attributed to sample or lab error.

Mercury inputs into the geochemistry model included:

- Solution 11, Quartz Monzonite, at 0.000011 mg/L
- Solution 12, coarse chrystalline porphyry, at 0.000019 mg/L
- Solution 13, undefined material, at 0.000009 mg/L

These inputs are then scaled as part of the model calibration. The runoff mix scaling factor for Solution 11 is 102.3, results in a solution concentration of 0.001125 mg/L. Surface water samples SWQ-2 and SWQ-3 from below the existing waste rock facility had below detection mercury concentrations (Table 2). SWQ-2 and SWQ-3 should be analogous to model simulated runoff mix to the pit because quartz monzonite covers the largest area of the pit shell, and storm water is the largest component of inflow.

Model Results

The observed Mercury value for the existing pit water is <0.0002 mg/L, where the SRK geochemistry model calibrates to a value of 0.001 mg/L. Model simulated mercury concentrations appear to be at least an order of magnitude too high. Mercury is mentioned as a potential concern, but the result is acknowledged to be a model artifact. Model artifacts should not be presented as conclusions.

The lack of detected mercury in the existing pit water, surface water runoff from the existing waste rock piles, and groundwater are evidence that mercury should not be a constituent of concern for the future pit water.

Table 1. Summary of mercury results from Copper Flat open pit water

sample location	collection date	mercury (mg/L)
pit wall seepage	8/19/2010	<0.001
PL-WQ	7/19/1991	<0.0002
PL-WQ	12/12/1994	<0.001
PL-WQ	12/19/1994	<0.001
PL-WQ	9/21/1995	<0.001
PL-WQ (0 ft)	1/30/2010	<0.0002
PL-WQ-01 (28 ft)	9/10/2010	<0.0002
PL-WQ-03 (3 ft)	9/10/2010	<0.0002
PL-WQ-04 (comp)	9/10/2010	<0.0002
PL-WQ-05 (7ft)	1/20/2011	<0.0002
PL-WQ-06 (17 ft)	1/20/2011	<0.0002
PL-WQ-07 (26 ft)	1/20/2011	<0.0002
PL-WQ-08 (comp)	1/20/2011	<0.0002
PL-WQ-09 (1 ft)	4/14/2011	<0.0002
PL-WQ-10 (3 ft)	4/14/2011	<0.0002
PL-WQ-11 (16 ft)	4/14/2011	<0.0002
PL-WQ-12 (comp)	4/14/2011	<0.0002
PL-WQ-13 (2 ft)	7/20/2011	<0.0002
PL-WQ-14 (11 ft)	7/20/2011	<0.0002
PL-WQ-15 (23.5 ft)	7/20/2011	<0.0002
PL-WQ-16 (comp)	7/20/2011	<0.0002

Table 2. Summary of mercury results from Copper Flat surface water

sample location	analysis date	mercury (mg/L)
SWQ-1	12/28/1982	<0.001
SWQ-1	2/21/1983	<0.001
SWQ-1	4/1/1993	<0.001
SWQ-2	2/25/1982	<0.001
SWQ-2	5/12/1982	<0.001
SWQ-2	2/21/1983	<0.001
SWQ-2	5/13/1983	<0.001
SWQ-2	8/9/1983	<0.001
SWQ-2	11/1/1983	<0.001
SWQ-2	12/23/1983	<0.001
SWQ-2	3/16/1984	<0.001
SWQ-2	5/30/1984	<0.001
SWQ-2	9/12/1984	<0.001
SWQ-2	11/27/1984	<0.001
SWQ-2	7/19/1991	<0.0002
SWQ-2	3/31/1993	<0.001
SWQ-2	8/25/2010	<0.0002
SWQ-2	4/28/2011	<0.0002
SWQ-2A	10/27/1981	<0.001
SWQ-2A	2/25/1982	<0.001
SWQ-3	7/19/1991	<0.0002
SWQ-3	3/31/1993	<0.001
SWQ-3	8/19/2010	<0.0002
SWQ-3	10/21/2010	<0.0002
SWQ-3	4/27/2011	<0.033

Table 3. Summary of mercury results from Copper Flat groundwater

sample location	analysis date	mercury (mg/L)
GWQ96-22A	7/13/1996	<0.001
GWQ96-22A	4/9/1997	<0.001
GWQ96-22A	1/30/2010	<0.0002
GWQ96-22A	7/1/2010	<0.0002
GWQ96-22A	10/7/2010	<0.0002
GWQ96-22A	7/9/2013	0.000004
GWQ96-22B	7/13/1996	<0.001
GWQ96-22B	10/7/2010	<0.0002
GWQ96-22B	7/9/2013	0.000003
GWQ96-23A	7/14/1996	<0.001
GWQ96-23A	4/9/1997	<0.001
GWQ96-23A	1/30/2010	<0.0002
GWQ96-23A	7/1/2010	<0.0002
GWQ96-23A	10/6/2010	<0.0002
GWQ96-23A	5/12/2011	<0.0002
GWQ96-23A	7/9/2013	0.0000009
GWQ96-23B	7/14/1996	<0.001
GWQ96-23B	10/6/2010	<0.0002
GWQ96-23B	5/12/2011	<0.0002
GWQ96-23B	7/9/2013	0.000001

Analytical Report
Lab Order: **1404C35**

Hall Environmental Analysis Laboratory, Inc.

Date Reported: **5/6/2014**

CLIENT:	John Shomaker & Assoc.	**Client Sample ID:**	Copper Flat Open Pit
Project:	NMCC/Open Pit	**Collection Date:**	4/30/2014 9:00:00 AM
Lab ID:	1404C35-001A	**Matrix:**	Soil

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed	Batch ID
EPA METHOD 7471: MERCURY							Analyst: **JML**	
Mercury	ND	0.0057	0.034		mg/Kg	1	5/1/2014 5:03:06 PM	12968
EPA METHOD 6010B: SOIL METALS							Analyst: **TES**	
Aluminum	2330	4.91	29.2		mg/Kg	10	5/5/2014 11:32:55 AM	12987
Arsenic	ND	1.57	2.44		mg/Kg	1	5/5/2014 11:17:35 AM	12987
Cadmium	ND	0.0497	0.0974		mg/Kg	1	5/5/2014 11:17:35 AM	12987
Calcium	85700	417	1220		mg/Kg	50	5/5/2014 11:34:44 AM	12987
Copper	419	2.89	2.92		mg/Kg	10	5/5/2014 11:32:55 AM	12987
Iron	6270	40.0	48.7	B	mg/Kg	50	5/5/2014 11:34:44 AM	12987
Magnesium	173	1.46	24.4		mg/Kg	1	5/5/2014 11:17:35 AM	12987
Manganese	777	0.272	0.974		mg/Kg	10	5/5/2014 11:32:55 AM	12987
Potassium	179	12.2	48.7		mg/Kg	1	5/5/2014 11:17:35 AM	12987
Selenium	ND	1.31	2.44		mg/Kg	1	5/5/2014 11:17:35 AM	12987
Sodium	42.8	1.74	24.4		mg/Kg	1	5/5/2014 11:17:35 AM	12987
Vanadium	1.66	0.439	2.44	J	mg/Kg	1	5/5/2014 11:17:35 AM	12987

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	P	Sample pH greater than 2.
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits		

From: Katie Emmer <kemmer@themacresourcesgroup.com>
Sent: Monday, December 22, 2014 4:15 PM
To: Hogan, James, NMENV; Pintado, Kristine, NMENV; Dail, Bryan, NMENV; Vollbrecht, Kurt, NMENV; Hall, John, NMENV; Reid, Brad, NMENV
Cc: Steve Finch
Subject: Proposed meeting to discuss path to NMED secretary Determination

Hi all,

I've caught up with Kurt Vollbrecht and Kris Pintado about this and I know it's a hectic time of year but I am writing to see if we can identify a day that would work in January for a meeting with GWQB, SWQB, me and Steve Finch to discuss Copper Flat.

We completed approved UAA field work in November and will be working on the UAA report as lab results come back. We've begun work on a revised Discharge Permit application and will be working in early 2015 to pull that together for submission. What we're hoping to discuss together in January is what steps are needed to reach the milestone of receiving the NMED Secretary's written determination that is a requirement for MMD to permit Copper Flat. We've discussed this topic with James Hogan, Kurt Vollbrecht and Brad Reid long ago, but we'd like to discuss again what exactly must be achieved in this effort.

In speaking with Kurt and Kris, I've identified a few days that will not work. I am listing below a few options for a potential meeting in Santa Fe. Please respond to me directly to let me know which days/times would work for you and I'll see if anything stands out. Having this discussion with everyone present would be helpful as we plan the next steps for Copper Flat permitting efforts.

Potential meeting dates:

Tuesday, Jan 6 at 12 or 12:30 (Copper Flat Cooperating Agency meeting is at 2pm on Jan 6)
Thursday, Jan 8
Tuesday, Jan 20
Wednesday Jan 21
Thursday Jan 22

Thank you for your thoughts.
Wishing everyone safe and happy holidays.

Katie Emmer | **Permitting & Environmental Compliance Manager**

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THEMAC RESOURCES

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RESOURCES

TO: Kurt Vollbecht, Patrick, Longmire, Ph.D, Brad Reid, Bryan Dail, PhD, NMED; Mark Nelson, CDM Smith; Amy Prestia, Ruth Warrender, Rob Bowell, SRK; Steve Finch, JSAI.
FROM: Steve Raugust, NMCC
CC: Katie Emmer, Jeff Smith, NMCC
DATE: December 29, 2014
SUBJECT: Agenda - December 29, 2014 Geochemistry Conference Call, 10 am MDT

Call in Information
U.S. Toll Free
1-866-321-0159
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U.K. Toll Free
0800 2794047
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Purpose: To provide an overview of NMCC responses to NMED/EIS comments to NMCC Environmental Geochemical Characterization as documented in NMED's Sept 19, 2014 Letter to NMCC, as well as, the Pit Model report as documented in the NMED's November 26, 2014 letter.

- Introductions for anyone new joining the call
- Pit model report
    1. Revised existing pit model calibration
    2. Revised arguments and documentation of Copper Flat pit stratification potential
    3. Revised arguments and documentation for estimated HCT scaling factors, fracture density and reactive pit wall thickness.
- Characterization reports
    1. Potential impacts from low grade ore stockpiles
    2. Management of existing waste rock piles
    3. Table of mass transfer calculations
    4. NA, 4 not used
    5. Correction of characterization report Table 5-3
    6. Fate and transport of leachate along pile/bedrock interface
    7. Naturally occurring andesite background concentrations of fluoride, iron, and manganese
    8. Waste rock leachate sensitivities
    9. Inconsistent dissolved iron presentations
    10. HCT sample selection
    11. Elaboration of buffering silicate minerals
    12. Elaboration of buffering silicate minerals
    13. Clarification of PFS/DFS cutoff grades.
- Conclude discussions.
- Next Steps.

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K. Emmer Notes on Geochem Call, 29 December 2014

Call Participants

Name	Company	Initial
Bryan Dail	NMED SWQB	BD
Patrick Longmire	NMED	PL
Brad Reid	NMED	BR
Kurt Vollbrecht	NMED	KV
Mark Nelson	CDM/Solv	MN
Rob Bowell	SRK	RB
Ruth Warrender	SRK	RW
Amy Prestia	SRK	AP
Steve Finch	JSAI	SF
Katie Emmer	NMCC	KE
Steve Raugust	NMCC	SR

Action Items – agreed during call

- ① NMED will review NMCC responses to comments on the characterization reports and provide a written response either accepting them or indicating what else needs further work.
- ② NMED will review the DRAFT Pit report and provide suggestions to NMCC on how to tie existing data to the existing pit calibration in a useful way.
- ③ NMED and CDM will review the remainder of the revised pit report and provide NMCC with a written response.

Begin Call

AP: To kick off, we sent off a revised Pit Lake report just before the holiday and addressed the comments we've received from the agencies. Don't know if you've had time to look at that. We did try to summarize where the changes occurred so you can see them in a cover email. We can start by going through our responses on comments and have discussion.

SR: I'd like to give the NMED a chance to say where they are. We'd like SRK to guide us through the work that has been done; I put the Pit Lake report comments at the front of the agenda so we can get right to them, as they might have the most interest. We don't expect NMED will have had time to review the whole report. Everything was so interconnected we went ahead and provided the next iteration of the Pit Lake report, which may be able to be finalized. That said, have you had a chance to look at the Pit Lake report or the characterization?

PL: I've read your three page summary, which was great. And I've read the SF memo, which was great. I am in a position to listen to what's been revised, what's improved, what uncertainty still exists.

SR: I think SRK can do a great job of giving you an overview to aid in your review. So, there's been a cursory review by NMED.

--MN joins—

AP: In the email that SR sent, we provided to a road map to how the report was revised to address the comments and where we stand. 1- The calibration with the pit model, trying to estimate the current pit chemistry using the assumptions and same approach we used for the future pit water. What we did was conduct a few sensitivity analyses – such as if we changed the groundwater chemistry would we see a better calibration as well as some better equilibrium – results are in section 4.1 of the report – in some we saw improvements, some we didn't. We compared results to a range of chemistry rather than average because we know there is some fluctuation over time. Comparing to a range gives realistic feel for where the calibration fits. It's still not perfect.

RB: The results we've got are in table 4.2. Still have a challenge with elements close to detection limit- chromium and arsenic. Arsenic relates to Fe. Obviously some Fe is in the analysis which is colloidal so unless we do an ultra-filtration, we will never get it exactly. So we still under predict Fe, the Arsenic is still under predicting. Most of the major elements are better – fall within the range of existing data. Some elements over predicted- Boron does not have a good control within the model. Fluoride is under predicting the range – we report 2 predictions for the calibration model: one is the base case the other looks at the groundwater sensitivity. You can see the predicted result for the calibration is not sensitive to the base case vs. the groundwater sensitivity.

PL: What new phases did you add in for equilibration?

RB: Look at table 3-6 we went back and looked at the predictive runs done previously. Some phases were saturated.

RW: The main phase we included was cadmium. We had already done a detailed look in the previous phases – didn't have a significant improvement.

PL: The cadmium came in pretty close.

RW: Definitely an improvement.

RB: We are fairly close with cadmium to the detection limit. I'm pleased it's close but it's going to be a challenge when you are close to the detection limit.

PL: I don't know, the cadmium result should be well above the detection limit. We appreciate the sophistication in the model – we understand these are complicated. SF's calculation came in pretty close on the chloride. If we can get that, at least we know the model is calibrated to existing conditions. I know this is really hard because of the climate and what's used in the water balance.

RB: If you look at section 4.3 for the calculated concentration for the existing lake it actually over-predicts early in the pit life (Figure 1-8). If the last 20 years of data is included, the actual chloride concentrations would be even closer to what we would predict. It's somewhere between the including all of the historical data and the current concentration; we should accept the calibration is good within a reasonable limit.

PL: I understand. The sulfate using the gypsum is in the 90s, then more separation in 2008. The chloride goes crazy because of the drought. I understand the complexity. I do like the discussion SF provided. Looking at Copper, the average in the current, vs. sensitivity – still some uncertainty. That was one of the key parameters.

RW: Re: the Copper, the concentrations have been very variable in the last 5-10 years. It has been biased toward the high ends by one very high end recent sample. Our concentrations are in the range, although the low end, but likely reasonable.

RB: Look at figure 1-12 with depth information – we have one sampling with very high copper, which is a reflection of the chemistry showing seasonal changes with depth. For one event it's at 2 mg/L. That's only for a short period.

AP: Look at figure 1-9 for longer period of copper.

PL: So you came out with 0.03 mg/L and there are some, a couple in that range.

RB: A couple below, 3-5 points in that range. The challenge with copper is there's quite a range. What we've tried to do with the input data is reflect that range in the sensitivity analysis.

PL: Going back to the table – the main phase controlling copper- what was that?

RW: Probably brochantite (?) – copper sulfate. Having to use that as the analog; it's reasonable for the pH.

PL: Do you have digestions of the gypsum to show the copper?

SF: I have a result that would give you that information.

RB: We show a picture of the crust, the memo with the geochemical characterization – we'll have to find that.

PL: That's good supporting information; that helps with the validation of the calibration.

KV: So it sounds like Cu and Se are ok. Chloride we're still looking at – I'm going to put you guys on hold and have a side bar. –

SF: Hey MN, this is SF. Have you had a chance to review the stuff that's been sent?

MN: Not yet but I appreciate the summary.

KV: We are back.

PL: Ok, with the copper, you are in the range although it's variable but maybe that's the best we can do. If we can get the memo to look at the gypsum, that would be good. Looking at Se – I think it's a limitation of PHREEQC, that's probably the major control?

RB: We've included mercury selenite. It's not unreasonable. It does form at neutral conditions. We are generally over predicting. The saturation of mercury selenite will be limited. We don't really have a good mineralogical control. It would preferentially predict arsenic adsorption over Selenium.

PL: With the mercury selenite phase – is that consistent with the mercury? By having mercury being controlled – that's consistent, right? We have to figure out – Se is real important trace element for the surface water. PHREEQC- sulfate was added, that's going to out compete – but it over estimated rather than under, so.

KV: What does that do as you project it out to the future?

BR: It probably gives us a positive bias.

AP: Table 4-3 shows the predicted for the future. Se is 0.29 at 100 years.

PL: Maybe this is a similar approach with the mercury – these are the short comings with the calculation – the monitoring data similar to mercury – in reality it may not be an issue.

RB: We'll look for the mineralogy and provide you with that data.

PL: The existing data is much lower, recognize that adsorption data as imperfect.

RB: It is a very rare mineral so it's not that easy to obtain to sufficient of it to actually to be able to do any work on it. I think it would be a challenge.

PL: Does everyone agree that Se, though over predicted, may not be an issue.

MN: What do you mean not an issue? Calibration for developing mitigation for reclamation? Certainly it's an issue for water quality.

RW: We know it's an issue for the existing pit.

KV: Right now it currently is?

RB: Yes, above wildlife and just over livestock.

PL: I appreciate that. Wildlife is 5 ppb? Yes.

KV: Currently we're predicting exceeding standards for Se and at 100 years.

SF: Remember these are without any reclamation.

KV: Although the model is predicting Se – in the future we expect the same level – so we need reclamation to try to drive the standard back down.

SR: That's the objective once we agree to a model calibration.

BD: There are proposed EPA standards to get to 1.3 from 5 if recommendations are accepted.

KV: That's a livestock standard?

BD: It's an aquatic life standard, a chronic standard.

PL: So we would deal with Se during reclamation?

SR: We have to get a model we agree on so we can see what reclamation will be needed to get those concentrations down.

MN: It's going to be a challenge to model different reclamation strategies – hard to know what it means exactly. If you come up with something that cuts the concentration in half – still a challenge on how to address it in water quality. What does it mean?

SR: The existing calibration over predicts, so if it cuts in half, it's still an over prediction.

SF: At least you have something to calibrate to and can work with. It's rare to have something to calibrate to, we should appreciate that we have that.

RW: The calibration model gives us a good idea of how this predicts, we can use this to guide the model.

MN: Any reason to believe the high bias will be linear?

RB: No.

PL: What if you do a simple PHREEQC calibration where you figure out how much ferrihydrite would have to be present to get something – the other oxy ions – vary the mass of the ferrihydrite.

RB: You'd be forcing the Arsenic as well – that's a problem.

PL: Some mines deal with waste waters by adding ferrihydrite.

RB: We have more vanadium; it will be adsorbed before selenium. I think we would just generate a high demand for ferrihydrite. Let me think about that before we say it is worthwhile doing. I'd like to look at the activation constant for each of these species. Let me think through that one before I say yes.

PL: We have to deal with Se. Important driver for the surface water. Chloride – SF presented in his analysis, I liked the summary you did, a lot of information – from just using a simple physical model of evaporation you were able to come in with the results the range of the chloride – that's good. The chloride, at this point, since we are under saturated with halite.

RB: The challenge you have with the chloride concentrations is the 3 readings in the last 12 months is much higher than the historic data. If you look at the historic, prior to the drought and groundwater, that's a challenge.

SF: It's all over the place.

PL: It is, we are dealing with some climatic changes and it's resulting in an imperfect calibration with that but we are in the range. If being in the range is acceptable… what I want to discuss is a physical model at this point in time where we are under saturated with most soluble chloride phases. Is a physical model for chloride based on the water balance, is that acceptable for us?

RB: If we were to report the median value rather than the mean it would be closer to the calibration. It's a challenge –the recent data skews.

MN: You have done a ton of work on the model. To what extent do we understand the current pit? Temporal variations in the pit lake, and how it relates. Is the mean a valid number to compare the model results to? Have you taken a close look at the specifics of the existing data? If the median is much lower than the mean that's something we should think through.

RB: There is an analysis there where we show data over time. A very detailed review in 2010, 2011 as part of baseline. We know there is some change, a long term change – figure 1-8 of the model report – you see we have gradual increase in sulfate and chloride and it's just taken off recently.

MN: What about comparing the results to the mean?

RB: We can do. That's why we show the range. With the chloride we fall in the range of the existing chemistry and we are below the mean.

KV: I see the output the model is 221.

SR: It's in the range of all the data.

RB: We may need to show all the data back to the 1980s. Our range in that table is only recent.

SR: That would make everything fall in.

RB: We can add the median value in too.

MN: I think it's important to understand the existing data we have.

SR: It seems like some constituents would lend better to a median and others an average, depending on the distribution. There are others that are distributed more equally.

MN: What about a geometric mean? Have you looked to see if they are logmetrically distributed? I appreciate that we have an imperfect dataset.

RB: From the mid 90s to 2009, there was no data collected. We have no way of saying what the trend of information was in that time.

SR: I do think we are on to something. We've beat the calibration to death.

RB: The challenge with predictive work, you can tinker with codes but whether that's realistic must be considered. The only changes we have made are ones we feel are reasonable. We have some phases that are perhaps not in equilibrium. Another dimension – have not reported all the values by only using NMCC data from the last 4 years.

MN: The target population has its own variability spatially and temporally.

KV: We are looking at evapoconcentration over time – numbers should get higher with time. We want to calibrate to what's there today, not what was there in 1980.

SF: It ramps up rapidly to 700+ mg/L and then the Sept rain event drops it below 350 to what it was 3-4 years ago. You have a long term trend and short term things. For prediction, at the end of the day, you have to go with the long term trends. You can drive yourself crazy with all these little short term deals.

SR: Or the longer you have the data, the better off you are for recreating something more meaningful.

MN: What might be interesting, up to NMCC – you say you looked at data closely for the last couple of years. What if you plot that as a hydrograph along with precipitation? It could make a big difference whether the sample was collected right after a rainfall event. We may be getting to the point of diminishing returns in the calibration of the model.

RB: We will discuss that and come back with something.

PL: That would be good – look at the distribution – log normal or normal. We do have a path forward with that. I have to leave in 30 min. Do we want to talk about fracturing? Other 2 comments?

SR: I'd like to point out – at least we have something to calibrate to, we shouldn't get to distracted by that, this is the only predictive model out of several regional case studies we have found. In most cases we don't have that luxury. Keep this under consideration. Let's not beat this calibration to the point of diminishing returns.

PL: In the end we should be more confident.

RB: We are not going to get an exact number for anything but at least a general trend will be reasonably accurate.

SR: I don't feel we can do more with the model with the existing calibration, we can put more effort in existing data, but looking at the longer duration will help- that will bring chloride into line.

MN: Good point that there has not been many opportunities to model a lake with an existing lake – not a lot of stuff to compare to, we could take a statistical route. Evaluate whether a calibrated result from that population of pit lake data.

SR: I'd like to see how it looks if it includes the whole duration.

MN: That will give a broad range of data over time, but worth the effort and see what you learn.

AP: Comment 2 is related to stratification. SF put a lot of effort into reviewing the literature and documenting it. SRK added to that and some information in our report. As we discussed, we incorporated existing chemistry to show trends. The results show the current pit doesn't show chemical stratification – there is a small thermal stratification, but chemically no. For the future, we predict a similar environment; it will be mixed and not be stratified chemically.

PL: TDS for the July 20, 2011 shows some variation, the most – but we will go through and read the discussion.

MN: Se+4 tends to adsorb more than Se+3. Wouldn't the assumption of a fully oxygenated lake in the future wouldn't that lead to higher Se conditions than assuming more reducing conditions?

RB: There is an attenuation method there. I am not sure you would stabilize Se 6.

MN: There's quite a difference between 4 and 6.

RB: It's whether you have stabilization. I'd have to look. I think 6 would require quite high redox potential.

SR: So you will look at what's been provided.

KV: yes.

SR: Last issue is the reactive wall thickness, fracture density, scaling issue.

RB: We've provided a revised discussion – pg 23 of the report and also in SF's memo. We looked at different blast methods and different proposed effects of blasting from different studies. Table 3-2 is from SF. A table in the memo that SF provided that shows a series of studies that were undertaken, different geotechnical properties. See page 4 of the Appendix A. Within that I think it shows in detail the justification for the estimates we've taken as being not unreasonable.

RW: Just to summarize, SF's memo provides a very detailed literature review and what that demonstrate is that there is no standard approach but does support the methods we used in our model.

RB: We were quite conservative in our estimation of what was a reactive zone.

SR: We did back up the estimates that we made, you can find it in the report and detail in SF's memo in Appendix A. Basically I think we are good. We think we have an appropriate thickness. We have some documentation for what we propose to use. That's worth reviewing because that's where the bulk of the analysis.

PL: Table 2 summarizes what SF had.

RB: Different approaches to determining the reactive wall.

SR: Six different approaches by 6 different groups. We have to go what we think is reasonable.

MN: Did you do sensitivities with the pit wall?

RW: No.

SR: We didn't because the information provided didn't justify it. You will have to evaluate that.

PL: Just to go back – I do have the intrinsic constants for selenite – adsorption for high density – log values, 13 and 5, selenite- 8 and .8. The larger intrinsic constants for hydrite are from Zomback and Morel (sp?). Mark – you were looking at fracture density, I do think SF's memo provides a lot more information.

MN: I appreciate the effort, I will study those.

KV: Are we good to go?

PL: Let's summarize the action items, SR if you could do that.

SR: From what I heard on the calibration – a closer look at the comparing the model to the existing data, we've done as much as we can do with the model now in order to make that more acceptable – I think we have a good calibration now. We're over predicting Se, which is preferable to under predicting. We are almost on with chloride and copper fits within the range of historic data. To wrap it up, we will take a couple more looks at how we are getting the total range – whether 2010-13 or further back to the 1990s. I agree with SF- the more data the better. That will help. I don't know what to say about various statistical analyses. We can look at mean vs. median on a constitute basis – some lend themselves better than others. Chloride, given increase over time, a median may be better. A more even distribution – a mean may be better. For now we have to look at how we compare the existing data.

MN: Take a look at the confidence level around that mean. If 20 samples over a time frame, we would have a range in the central tendency of the data. We may be asking too much to try to get spot on.

SR: It is a calibration to an existing pit, and imperfect model. It's never going to be perfect. I realize that we do have the advantage of an existing pit – let's not abuse that. We need some suggestions from NMED to consider how to present that data. How do we compare the results to our data in the most appropriate fashion?

PL: MN will look at the fracturing. We have the discussion on the pit lake homogeneity. I agree I think we are getting pretty close.

SR: If we can get some dialogue in writing we can work with SRK so they can look at those relationships before we finalize this next report. There are probably other things you guys will comment on when you review the report in detail. There should be some correspondence from NMED that NMCC can respond to for this draft report.

KV: We will look through that and do that.

MN: Thanks very much for the summary and the extra effort.

KV: Pat has to go. We are done with the pit lake model discussion. Want to go through the characterization comments?

--PL departs--

SR: We have a memo dated 11 December in which we try to go through all the comments from the Sept 19 NMED letter.

KV: These comments, there's a mix of sources. Some from PL, some from DJ (Ennis, not on call), some from BR. We've had a cursory look – we may need to go through and provide you with some written comments.

SR: We addressed each comment. There was actually no number 4. So there are actually only 12 comments. We put time and effort into trying to address them; hopefully we've caught everything there.

KV: These were not that complicated.

SR: Many were clarifications.

AP: Want to go through now or review first?

KV: We'd like to look at it first.

BR: Any concern on any of these?

SR: We have a lot of confidence in these.

KV: We will have a strong look at these.

BR: No matter what you guys are probably looking for a written response – either happy or with questions.

SR: Yes. That wraps the discussion – the next steps would be NMED comments/suggestions for the pit report – suggestions on presenting the existing data as we've discussed. There may be other details you may find. I think SRK and JSAI have done a good job of responding to comments. The last thing is tying the calibration to existing data. For characterization comment responses hopefully a letter saying you've been through and accept them and if not why.

KV: That's fine, I agree.

~Signing out, end call~

Cooperating Agencies - NMCC Meeting – Notes
6 January 2015 14:00 MST

Attendee	Company	Initial	Present
Doug Haywood (via phone)	BLM	D.Haywood	X
Leighandra Keevan (via phone)	BLM	LK	X
Matthew Wunder	NM G & F	M.Wunder	Not present
Mark Watson	NM G & F	M.Watson	Not present
John Hall	NMED	JH	X
Brad Reid	NMED	BR	X
Kurt Vollbrecht	NMED	KV	Not present
Bryan Dail	NMED SWQB	BD	X
Kristine Pintado	NMED SWQB	KP	Not present
Kevin Myers	NMOSE	KM	X
Dave Henney (via phone)	Solv	D.Henney	X
Davena Crosley	MMD	DC	X
DJ Ennis	MMD	DJE	X
Chris Eustice	MMD	CE	X
Holland Shepherd	MMD	HS	Not present
Katie Emmer	THEMAC	KE	X

Next Meeting Date: Tuesday, 17 February 14:00 MST

Identified Action Items:

- NMED will meet internally on geochemistry and respond to NMCC re: identified issues in writing
- KLE will call Corey Durr to discuss the 22 January Determination meeting and see if he'd like to participate: DONE- Corey will be participating via phone on 22 January.
- KLE will touch base with D. Haywood on EIS section review status on or around 12 Jan

1. Geochemistry comment resolution efforts

KE: A call including NMED, Solv, NMCC, SRK, and JSAI (but not attended by BLM or MMD) was held on 29 December to discuss the recently submitted (19 Dec 2014) revised draft of the Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico report as well as the Dec 11, 2014 Response to NMED September 19, 2014 Comments to the Copper Flat Geochemical Characterization Reports. NMCC took and distributed extensive notes from that conversation. The majority of the call focused on the three identified outstanding issues for NMED regarding the Pit Lake report. NMED and Solv had not yet had time to fully review any of the submissions from NMCC, so in some cases we just discussed what SRK and JSAI had done to hopefully ease review.

The action items identified in that call are as follows:

- NMED will review NMCC responses to comments on the characterization reports and provide a written response either accepting them or indicating what else needs further work.
- NMED will review the DRAFT Pit report and provide suggestions to NMCC on how to tie existing data to the existing pit calibration in a useful way.
- NMED and CDM will review the remainder of the revised pit report and provide NMCC with a written response.

NMCC is working with SRK and JSAI to identify ways to better present existing data in the DRAFT Pit report, however it would be useful to receive NMED's responses before NMCC attempt to submit anything further to NMED for review.

BR: I agree with the action items listed. We need to get with everyone who made comments. NMED intends to meet soon to discuss. Not sure when NMCC will get a response in writing.

2. Pit water standards navigation plans
    - Use Attainability Analysis draft report- Approved workplan was completed in early November, JSAI has the results of Aquatic Consultants' field work and is compiling a UAA report for NMED SWQB review. The report will include historical data, as well as data collected recently regarding the physical habitat conditions, surface water chemistry and the biological assessment done in November. No target date for submission yet, but hope to have that in to NMED for review in Q1 2015.
    - Meeting to discuss path to NMED determination – NMCC has been in contact with Kris Pintado and Kurt Vollbrecht over the phone and I sent an email prior to the winter holidays regarding our hope to have a meeting with NMED about what will be necessary to get to the NMED Secretary's determination necessary for a mine permit. We are looking at Jan 8, 20, 21, and 22 as potential days for this meeting.

D.Haywood: Would you call Corey Durr and run the 22 January call by him? He may want to participate in the call.

KE: Sure. We are planning to address state regulatory compliance but it might be something Corey is interested in. I'll give him a call and explain what we're planning to talk about. He would be welcome to join us if he would like.

3. EIS Status – Doug, Dave

D.Haywood: BLM has been evaluating the next chapter of the EIS, I believe the majority of the sections have been reviewed and returned to Solv.

D.Henney: Yes, the majority are in.

KE: Doug, do you have any projection of when the remaining sections will be available for Solv?

D.Haywood: Why don't you call me early next week and we can touch base. I know Jack has a lot of comments to address, I'll check with the team and see. Some of our people are still out on vacation.

4. EE for MMD: timing

KE: I spoke with DJE briefly in December about a question I had with the timeline and we agreed it might be useful to look together again at the EIS schedule and bring up the EE timeline. We have previously discussed that the Final EE would be completed at the time of the Final EIS and that MMD's hearing regarding the mine permit would need to happen after the ROD. DJ noted that the public doesn't like to be consulted once it appears a decision has already been made. We wondered if perhaps MMD would consider evaluating the DRAFT EIS as the EE and whether MMD would consider having a hearing based on the Draft EIS.

DJE: We may need to discuss this internally.

Discussion- The review of the DEIS will be an opportunity for the MMD to make sure that it's covering all MMD's requirements. The state agency review dates on the current EIS calendar are in late April through early May, and then review and comment can happen again when the DEIS is published for public comment. MMD may still want to wait to do the hearing after the ROD.

5. Permit Application Package status

KE: Regarding the MORP: We have a draft report from AMEC in our office. We would like to see the geochemistry discussions resolved so we can finalize pit reclamation plans prior to turning in the MORP so we can turn in a complete document. As such, we plan to suspend work on the MORP draft until the geochemistry is resolved and hopefully turn it in within 1-2 months of that milestone.

6. Revised Discharge Permit status

KE: JSAI began updating some of the figures for this revised application in December 2014. Jeff Smith and I will be working on getting the other pieces complete or finding assistance on them this January with the goal of submitted the document in late March or early April.

BR: I know you are planning to consult the copper rule in this. One of the things that has come up with another applicant- make sure you look at the requirements for cover. The rule states you may need to be testing to show you have adequate water holding capacity. Take a look at the rule and make sure you follow that.

KE: Sounds good. If there's anything in particular you want to bring to our attention or discuss, I could also come up for a meeting or give you a call if that's helpful.

7. Next Meeting date: 17 Feb at 2pm

8. Geochemistry Conversation without NMCC present: Conducted after KLE departed.

THEMAC
RESOURCES

NMED and NMCC Discussion of Path to NMED Secretary's Determination
22 January 2015

Attendee	Company	Initial	Present
Corey Durr	BLM	CD	Not present
Steve Finch	JSAI	SF	X
John Hall	NMED GWQB	JHall	X
Brad Reid (via phone)	NMED GWQB	BR	X
Kurt Vollbrecht	NMED GWQB	KV	Not present
Patrick Longmire	NMED GWQB	PL	X
Bryan Dail (via phone)	NMED SWQB	BD	X
James Hogan	NMED SWQB	JHogan	X
Kristine Pintado	NMED SWQB	KP	X
Katie Emmer	THEMAC	KE	X

I. Current status of NMCC state permit applications

KE: For those in the Cooperating Agency meetings this will be a re-hash, but wanted to note that NMCC is working on a Discharge Permit revision for submission sometime in Q1 we hope. This has enough of a change from the original DP application submitted in March 2011 that a new public notice will be necessary.

NMCC is working on the UAA report – we submitted the proposed workplan back in August/September at NMED SWQB was great about getting comments back to us on very short turn around times. The field work for the approved work plan was completed in early November 2014. No fish were found in the pit water.

NMCC secured an air permit for proposed mine operations in June of 2013, so that's done. There may be minor modifications to the permit based on modifications to the mine plan when the site becomes operational.

II. Review of status that will be sufficient for NMED Determination letter
   a. Groundwater Quality – Discharge permit will account for main requirements
   b. Surface Water Quality – UAA in process
   c. Air Quality – permit secured

KE: We know we need to make each of the NMED agencies "happy"- that is, show the proposed action will not be detrimental to human health or the environment to secure a

Secretary's Determination letter, we just want to discuss the path to that and make sure we aren't missing anything here.

J.Hogan: In the case of groundwater and air, you have a permit you have to get- a discharge permit, the air permit. In the case of surface water, we are not looking at permitting an action, so it's more of a soft regulatory process. Surface water, in support of the NMED Secretary, will be making a determination that the future pit water will meet or exceed the applicable standard. There are two different processes we are looking at and although we may use some of the same data, we are answering two different questions.

1. The first question is what are the applicable water quality standards (WQS). The WQS have default uses and criteria that apply – the UAA will adjust this bar based on what is attainable.

2. The second question is "Will the future pit lake be able to meet the applicable water quality standards based on current pit lake chemistry, modeling of the future pit lake and other remediation actions taken at closure, etc.?"

J.Hall: So you use existing standards, you don't look at NPDES standards?

J.Hogan: NPDES permits are concerned with discharges that are permitted; only if a discharge is being made to a surface water. I don't think you have that here. Sometimes we've looked at discharges to groundwater that are so close to a surface water they are expected to impact the surface water.

SF: The pit itself is a hydrologic sink; we don't believe groundwater standards apply to the pit.

J.Hall: Groundwater standards do not apply to the pit (because it is a hydrologic sink).

SF: Do you need anything from the surface water side of the process to get through the Discharge Permit?

BR: We can draft a Discharge Permit without a connection to the UAA or other surface water issues – that is, they can be independent.

III. Discuss the current pit vs. the future pit
   a. UAA is based on current pit: focused on changing regs for the existing pit with the expectation that will apply to the future pit

KE: We understand based on previous discussions that the UAA has to be based on the current pit and its physical attributes. Still, we are cognizant that the future pit will have different physical attributes: it will be larger, deeper, the ore body will have been removed so the pit walls will be different. We are looking at certain reclamation efforts to meet other regulations. We wanted to discuss this current vs. future piece and make sure we are all clear on this action.

J.Hogan: One of the reasons it makes sense to do the UAA on the current pit is the key aspects of the current pit: it's an isolated water body, it's not connected to other surface waters; also the current uses are comparable to what's proposed for the future pit. If future reclamation called for a different use that might be another situation. Kurt and I have both discussed that there is uncertainty about the future in these decisions but we are looking at what uses are reasonable and I believe the current water body that exists is the best demonstration of what to expect for the future that we have.

IV. UAA Process clarification – discussion of steps
    a. UAA to NMED

KE: JSAI is working on the UAA draft now, just to clarify, would you anticipate any further involvement from EPA in this process?

J. Hogan: I don't. We may want to send it to EPA to allow them to review, they may write and say it's a state matter in light of the jurisdictional determination, or they may take no action.

KP: The one caveat there would be if you needed an NPDES permit, but currently that appears to make no sense as you have a USACE determination that this is not a water of the US. I don't see how EPA could issue or require a federally issued NPDES permit. I don't expect EPA to weigh in although we will keep them in the loop.

J. Hogan: If the WQCC approves new regulations (WQS) applicable to the pit lake then they would apply under the State Mining Act.

    b. NMED comments back to NMCC

SF: From what you've seen, do you expect that NMED will remove or modify the standards?

J.Hogan: We have no expectation. We are looking to you to put together the data analysis and see how it supports what's existing and what's attainable. We are looking to you to make a recommendation. The existing uses are straightforward. The challenge for you will be looking at what could be attainable, what's the highest use that could be attained and trying to demonstrate something that doesn't exist. You have to make a recommendation about what can't be attained.

SF: The definitions don't seem straight forward to me.

J.Hogan: Looking at the regulations, "aquatic life" is any organisms that need water for the majority of their life cycle. Dragon flies, macroinvertibrates, shellfish.

Discussion: look at the "limited aquatic life" definition- that could be limited to just 10 days of water needed for certain organisms.

c. NMCC addresses comments and petitions WQCC

Discussion: NMED expects to provide feedback on the UAA, NMCC will need to petition the WQCC.

d. WQCC hearing

J.Hogan: When you file a petition you include a draft schedule, proposed rule: based on default and modification based on UAA. The WQCC meets monthly, I think three months is a reasonable lead time to get on their schedule. You always have to see how the public responds, but to me, this is a small regulatory issue and decision and it should take less than an hour with the WQCC, whereas the Tri-annual process is going on and that's much larger.

e. Anything else?

Agreed that nothing more is anticipated.

V. Review of geochemistry predictions, reclamation plan
  a. Surface water
  b. MMD
  c. Others

Discussion of NMCC geochemistry model-

KE: NMCC has turned in 2 main reports to NMED, MMD, and the EIS contractor: The Geochemistry Characterization Report which discusses the tailings storage facility and the waste rock piles, and the Pit Lake model report. The model for the pit water body has been the subject of much discussion and we believe we are getting close to resolving final concerns regarding calibration. We want to make sure that everyone understands the agreed upon model will be something that both surface water and groundwater need to be on board about. I know that Bryan Dail has participated in the review of the model. We've discussed this at cooperating agency meetings too- the geochemistry model for the pit, once we have it at a place that everyone agrees is "good enough" will be the model we use to design reclamation plans for the future pit.

J.Hogan: What I hear you asking is whether, if groundwater reviews the model and oks it, is there any concern that surface water would later come back and say that we have additional concerns with the geochemistry model. I understand that Bryan Dail has been tracking with the discussions on the geochemistry model.

BD: I have been involved in the discussions regarding the pit model and I would say I am fairly satisfied with it.

J.Hogan: Yes, so we will be sure that surface water's concerns are included and addressed in the comment resolution process. When NMED gives the go ahead on the geochemistry model, we will make sure that groundwater and surface water are both on the same page with that so there aren't surprises in the future.

BR: It is our understanding that whatever standards apply to the pit, NMCC will use the model to show that through reclamation efforts you will meet those standards.

KE: That's our intention.

J.Hall: Can you clarify what MMD is looking for regarding the pit?

KE: From what I understand, MMD both wants to see that the pit water will meet applicable surface water standards per NMED requirements, but also that the pit and surrounding area within the permit boundary meets MMD regulations in 19.10.6.603 Performance and Reclamation Standards and Requirements and they are focused on things such as site stabilization and configuration, topsoil, erosion control, revegatation per those regs.

SF: I just wanted to discuss the Discharge Permit briefly – we have the groundwater model, which shows the pit is a sink, and the geochemistry reports as well as a draft monitoring plan – we know we need material characterization, an SWPPP, a metering plan. Are there any other major elements NMED is aware of that we need?

BR: I would refer you to the Copper Rule and say make sure you include everything required in that – we are being very black and white in our interpretation. We have not yet issued a DP under the Copper Rule. We've sent some letters requesting additional information.

~~Patrick Longmire joins the meeting~~

Discussion of the geochem model review status.

PL: I like the effort and approach of the pit geochemistry model, the HCTs, I think it's very robust and well thought out. We are just looking at the calibration. I expect to be able to get with Brad next week to discuss it. It may be that we need to agree on the model and then make sure the reclamation plan is conservative.

J.Hogan: How is the calibration compared to the current pit water body?

PL: We have three remaining constituents we are looking at- Copper is low, Chloride is underestimated, Selenium is overestimated. I will say the input files, the scenarios run, it's really impressive.

Discussion of remaining items being addressed based on NMED comments: calibration, the approach to fracturing, if the pit is stratified.

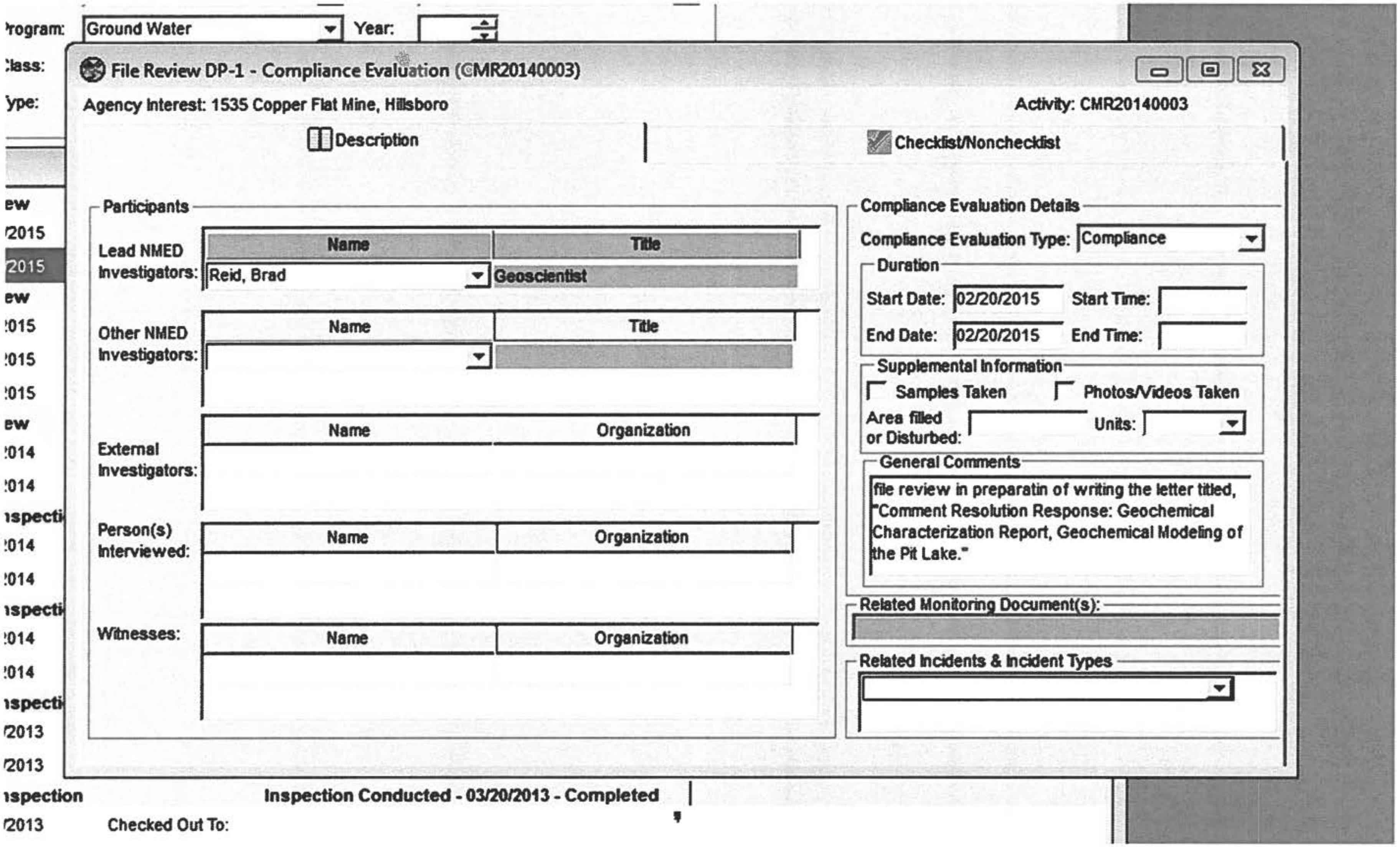
KE: SRK and JSAI have both worked on the model and we are coming to the conclusion that that model is as good as we can make it, we are looking at diminishing returns on efforts to revise it at this point. Does NMED have a sense of when NMCC might see a written response recent submissions?

PL: Some of the comments came from DJ Ennis, so we need to discuss them with him. But I can catch up with Brad about this next week.

KE: Would it be reasonable then for NMED to respond by the first or second week of February?

BR/PL: Yes, that should work.

~ Agreed that NMED will plan to get written responses to NMCC regarding the geochemistry model by mid-February. Meeting adjourns. ~



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File Review DP-1 - Compliance Evaluation (CMR20140003)

Agency Interest: 1535 Copper Flat Mine, Hillsboro

Activity: CMR20140003

Description | Checklist/Nonchecklist

Participants

Lead NMED Investigators:

Name	Title
Reid, Brad	Geoscientist

Other NMED Investigators:

Name	Title

External Investigators:

Name	Organization

Person(s) Interviewed:

Name	Organization

Witnesses:

Name	Organization

Compliance Evaluation Details

Compliance Evaluation Type: Compliance

Duration

Start Date: 02/20/2015 Start Time:

End Date: 02/20/2015 End Time:

Supplemental Information

☐ Samples Taken ☐ Photos/Videos Taken

Area filled or Disturbed: Units:

General Comments

file review in preparatin of writing the letter titled, "Comment Resolution Response: Geochemical Characterization Report, Geochemical Modeling of the Pit Lake."

Related Monitoring Document(s):

Related Incidents & Incident Types

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ıspection Inspection Conducted - 03/20/2013 - Completed
/2013 Checked Out To:

NEW MEXICO
ENVIRONMENT DEPARTMENT

Harold Runnels Building
1190 St. Francis Drive
P.O. Box 5469, Santa Fe, NM 87502-5469
Phone (505) 827-2918 Fax (505) 827-2965
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SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

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Katie Emmer
Permitting & Environme
New Mexico Copper Co
2424 Louisiana Blvd NE
Albuquerque, NM 8711
PS Form 3800, June 2002

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

February 23, 2015

Katie Emmer, Permitting & Environmental Compliance Manager
New Mexico Copper Corporation
2424 Louisiana Blvd NE, Suite 301
Albuquerque, NM 87110

RE: Comment Resolution Response: Geochemical Characterization Report, Geochemical Modeling of the Pit Lake and associated documents for the Copper Flat Project, Copper Flat Mine, DP-1

Dear Ms. Emmer,

The purpose of this letter is to provide the New Mexico Copper Corporation (NMCC) with comment resolution pertaining to the Geochemical Characterization Report, the Geochemical Modeling Report of Pit Lake Water Quality and associated documents for the Copper Flat Project, Copper Flat Mine, DP-1.

Copper Flat Mine is owned by the NMCC, a wholly owned subsidiary of THEMAC Resources Group, Ltd.

Geochemical Characterization Report and Associated Documents

On December 11, 2015, NMED received a memorandum and associated attachments from NMCC titled, "Response to NMED September 19, 2014 Comments to the Copper Flat Geochemical Characterization Reports" ("Memorandum"). Other than the three comments in response to this memorandum that follow, NMED has no further comments on the geochemical characterization work completed to date. The results of the geochemical characterization work and the following comments should be incorporated into a Discharge Permit application that meets the requirements of the Copper Mine Rule, Section 20.6.7 NMAC ("copper rule").

Memorandum Comment 2: NMCC states that existing waste rock piles from former Quintana Minerals operations will be incorporated into proposed waste rock disposal facilities with the exception of the waste rock piles located north and northwest of the pit. NMCC refers NMED to a map showing the mine units (Attachment 1) and states that the waste rock piles are within the open pit surface drainage area (OPSDA). The "open pit surface drainage area" as defined in the copper rule means the area in which storm water drains into an open pit and cannot feasibly be diverted by gravity outside the pit perimeter, and the underlying ground water is hydrologically contained by pumping or evaporation of water from the open pit (Section 20.6.7.7 NMAC). Based on Attachment 1, it is difficult to determine whether the waste rock pile north of the open pit meets this definition. Technical approval of a Ground Water Discharge Permit application by NMED will require a formal determination to define the extent of the OPSDA.

Memorandum Comment 7: Comment 7 pertains to the existing "baseline" concentrations for constituents at Copper Flat that may naturally exceed Section 20.6.2.3103 NMAC ground water standards. Attachment 2 is a Technical Memorandum prepared by John Shoemaker & Associates, Inc. (JSAI) titled, "Statistical analysis of background concentrations of iron, manganese, and fluoride in groundwater in the andesite, Copper Flat Project," and dated December 5, 2014. In the memo, JSAI reviews data from monitoring points in the andesite around the Copper Flat Mine and applies parametric and non-parametric statistical analysis to the data in order to propose background concentrations. Due to a non-uniform distribution of the data, JSAI uses a non-parametric test to determine background concentrations for iron, manganese, and fluoride in groundwater in the andesite aquifer.

A review of the data utilized by JSAI to propose background concentrations seems to indicate that there are areas at the mine site with elevated concentrations of constituents above ground water standards (e.g., GWQ96-22A & B), but there are also other areas where concentrations are and have historically been below ground water standards (e.g., GWQ-4). This is expected due to natural variability of an ore body and local geologic control (e.g., faults, mineralized zones) that may affect water quality. As such, it is not appropriate to apply the background concentrations as proposed by JSAI uniformly across the mine site. However, the copper rule requires a monitoring well proposal for the mine site be included in the discharge permit application. Upon installation of all approved monitoring wells, areas where appropriate background concentrations for constituents that naturally exceed Section 20.6.2.3103 NMAC ground water standards at the mine site can be better established.

Memorandum Comment 11: The stoichiometric equation showing the reaction of clinochlore with sulfuric acid is not balanced. Please note the corrected version below.

Equation as Submitted:

$Mg_3FeAl_2Si_3O_{10}(OH)_8 + 2H_2SO_4 + 2O_2 =$

$3Mg^{2+} + 3SO_4^{2-} + 2FeOOH + Al_2Si_2O_5(OH)_4 + SiO_2 + 3H_2O$

Balanced Equation

$Mg_3FeAl_2Si_3O_{10}(OH)_8 + 3H_2SO_4 + ½ O_2 =$

$3Mg^{2+} + 2FeOOH + Al_2Si_2O_5(OH)_4 + SiO_2 + 3SO_4^{2-} + 4H_2O$

Predictive Geochemical Modeling Report of Pit Lake Water Quality and Associated Documents

At this time, NMED has no further comments on the revised pit lake model and is in agreement with the model and associated documents as submitted. NMED understands that NMCC will use the revised model for input of parameters relevant to pit lake reclamation and mitigation, with the intent to model pit lake water quality at closure and beyond. Implementing reclamation and mitigation measures are designed in part to achieve surface water standards (Section 20.6.4 NMAC) in the pit lake, presently based on default designated uses (20.6.4.99 NMAC) but potentially modified through a Use Attainability Analysis (UAA) (20.6.4.15 NMAC). Because the pit lake is currently a hydrologic evaporative sink and is predicted to continue being a hydrologic evaporative sink during operations, at closure, and beyond, the ground water standards of Section 20.6.2.3103 NMAC will not apply (Section 20.6.7.24 NMAC and Subsection D of Section 20.6.2.33 NMAC).

Evaluation of the above mentioned reports and associated documents is critical to development of a draft Ground Water Discharge Permit. NMED understands that NMCC is planning on submitting a revised Discharge Permit application in accordance with the copper rule to NMED in 2015. NMED may have additional comments based on technical review of the discharge permit application and associated operational, monitoring and closure plans. The application will be processed pursuant to the copper rule, Section 20.6.7 NMAC.

NMED looks forward to working with NMCC as the permitting process progresses. If you have any questions, please contact me at (505) 827-0195 or Brad Reid at (505) 827-2963.

Sincerely,

Kurt Vollbrecht, Program Manager
Mining Environmental Compliance Section
Ground Water Quality Bureau

KV:BR

cc: Katie Emmer, Permitting & Environmental Compliance Manager, NMCC (signed PDF: kemmer@themacresourcesgroup.com)
Kurt Vollbrecht, Program Manager, GWQB-MECS (signed PDF: kurt.vollbrecht@state.nm.us)
Mark Nelson, CDM-Smith (signed PDF:NelsonMR@cdm.com)
Patrick Longmire, NMED DOE Oversight Bureau (signed PDF: patrick.longmire@state.nm.us)
David Ennis, MMD (signed PDF: david.ennis@state.nm.us)
Bryan Dail, SWQB (signed PDF: bryan.dail@state.nm.us)

Cooperating Agencies - NMCC Meeting – Notes
10 March 2015 14:00 MST
Call in: 605-475-4000 PIN 422-765

Attendee	Company	Initial	Present
Doug Haywood (via phone)	BLM	D.Haywood	X
Leighandra Keevan (via phone)	BLM	LK	No
Matthew Wunder	NM G & F	M.Wunder	No
Mark Watson	NM G & F	M.Watson	No
John Hall	NMED	JH	No
Brad Reid	NMED	BR	X
Kurt Vollbrecht	NMED	KV	X
Bryan Dail	NMED SWQB	BD	X
Kristine Pintado	NMED SWQB	KP	No
Kevin Myers	NMOSE	KM	X
Dave Henney (via phone)	Solv	D.Henney	X
Davena Crosley	MMD	DC	No
DJ Ennis	MMD	DJE	X
Chris Eustice	MMD	CE	X
Holland Shepherd	MMD	HS	X
Katie Emmer	THEMAC	KE	X

Next Meeting Date: 21 April 2015 14:00 MST

Identified Action Items:

- NMCC initial response on the potential release of the groundwater model to OSE for review in advance of the DEIS- we need more time to meet with our legal team and other advisors before we can make a positive decision. **At this time NMCC requests that the groundwater model not be released by BLM to OSE.** NMCC will respond with further answer after consulting with its legal team.
- NMCC will be working internally on running conceptual pit reclamation plans in the approved geochemistry model. NMCC plans to select a reclamation plan based on work with the model and will submit a reclamation plan with model results for state review once it's available.
- KE to send meeting notes from 22 January discussion with NMED to DJ Ennis, MMD.-DONE
- BR to send NMED 23 February letter re: geochemistry comment resolution to DHaywood at BLM. -DONE

1. Pit water standards navigation plans

   KE: Just a brief summary on where things stand
   - Use Attainability Analysis draft report
     - On KE desk for review, hope to have that in to NMED SWQB by beginning of April
   - Meeting to discuss path to NMED determination summary
     - Met on 22 January, James Hogan was great about defining specific aspects of the regulatory process for NMCC from SWQB's perspective. Dr. Hogan noted that SWQB will not be issuing a permit, so it's more of a "soft regulatory process"
     - Dr. Hogan made clear he sees two different processes answering two different questions, though the same data may apply: 1-What is the applicable water quality standards- the UAA may adjust the bar based on what is attainable, based on the current physical conditions of the pit; and 2- will the future pit be able to meet the applicable water quality standards based on current pit water chemistry, modeling of the future pit water and other remediation actions taken at closure.

   KE: Anyone that didn't get the meeting notes from the 22 January meeting, I'd be happy to send them along.

   DJE: Sure, we'd like to see them.

2. EIS status –

   D.Haywood: Solv is planning to get the assembled PDEIS to BLM by the end of this week, on 13 March. There are a few place holders for 9 identified millsites and a proposed substation but otherwise the document is to be complete.

   KE: If I can jump in, I'd just like to clarify for the state about the place holders you just mentioned: NMCC has nine millsite claims, five acres in size each, that were included in the proposed action MPO document but got overlooked in Baseline Data collection efforts. The BLM has agreed to let us jump on clearing this sites for appropriate resources, so we are working to get that done as quickly as possible so they can be analyzed and included in the EIS. In addition, there is some area on state land that was identified in Alternative 2 as a location NMCC would propose to build a substation because use of the existing substation at I-25 and HWY 152 would be very difficult and expensive due to capacity issues. This area would only be 20 acres but the location has not been specifically defined in engineering work, so we will be clearing about 100 acres on this state land section also for inclusion in the EIS.

   CE: Are these along the utility corridor where the pipeline lies?

   KE: They are near it but not in the exact same location. All of the sites are east of the mine permit boundary and noncontiguous to it.

   D.Haywood: So Dave, can you confirm that Solv is on schedule for this Friday?

   D.Henney: Yes. We are on schedule to finish and get the PDEIS done on Friday.

D.Haywood: BLM will be reviewing the document and providing comments for Solv to integrate in April. Based on the current schedule, we would be looking to provide all the cooperators the PDEIS for review by the 28th of April. I would like to schedule a meeting with the cooperators on the 12th of May, we can do that in Socorro or Las Cruces, Solv will be there and we can work through the document and discuss any comments you have. Cooperators have until the 18th of May to complete their review and submit comments to BLM. If you need added time you can always provide additional comments in August and September during public comment periods.

DJE: How long do you expect to need for the meeting on the 12th?

DHaywood: Plan on all day, we can start at 10 or earlier if you prefer.

DJE: Let's plan on 9am.

DHaywood: OK I will get a conference room for 9am in Socorro; we can work all day and get this done. I will send an email out by close of business tomorrow, if you don't see something from me email me, in case I miss someone on the list.

KM: So this will be review of just the PDEIS? Not supplemental documents? The groundwater model etc?

DHaywood: Dave, would the PDEIS have these supplemental documents?

DHenney: We should have the appendices included, however the groundwater model is not an appendix, it's part of the administrative record.

KM: There may not be enough time for OSE to review the model within the schedule as it currently stands.

DHaywood: From my perspective we can just provide the groundwater model now, it's done and it's final.

DJE: As I recall, NMCC had a concern about public access.

KE: Yes, in the past NMCC has requested that the model not be released to state cooperators until everything goes public due to the fact that the state cannot offer confidentiality in the case of a public record request. If it's ok, I'd like to discuss this with Jeff and get back to you. He may want to discuss this with our legal team. It may be that NMCC agrees there's no reason not to go ahead and release it, I just need to discuss it internally and I'll try to get back to you as soon as possible.

DHaywood: OK. We may just have to hold other pieces back at the end if OSE doesn't get enough time to review it initially.

KE: Sure. OK, I'll put NMCC's response in the meeting notes' action items so we have that documented and distributed as soon as possible.

3. Permit application package status
   KE: The MORP is still on hold for pit reclamation plans to be developed and modeled in geochem model.

4. Geochemistry status

KE: As most of you may be aware by being copied, NMED issued a letter to NMCC dated 23 February 2015 regarding Geochemistry comment resolution efforts. NMED noted three comments: one is a correction of an imbalanced stoichiometric equation, the other two address topics NMCC can respond to in the upcoming Discharge Permit application. NMED closes stating that they have no further comments on the revised pit lake model and are in agreement with the model and associated documents as submitted. As such, NMCC does not plan to submit any updates to geochemistry documents for Copper Flat.

NMCC next steps:

- Run JSAI developed conceptual pit reclamation plans on the approved model, make modifications if needed, decide on a proposed plan
- Submit proposed pit reclamation plans and model results for the reclamation for state review either in the MORP, or in a standalone document, or as part of the upcoming Discharge Permit application

BR: I would think a standalone document is OK, it's just part of the overall package for the DP.

HS: Separate is fine with us.

BR: I just realized I didn't send the letter from the NMED on the 23rd of February to the BLM, I will send that over to Doug.

5. Revised Discharge Permit status

KE: Jeff Smith is taking the helm on this, we expect to need some engineering work on stormwater controls and pulling together a few outstanding elements. I still don't have an ETA for this but a lot of the work has been done, it just needs to be pulled together and submitted. Given the small size of our shop at this time, I expect this will slip out into mid 2015.

6. Timing of the Environmental Evaluation

DJE: We've discussed this internally and we think we could consider the PFEIS the Draft EE. We'd like to discuss what the EE should be with Solv. Probably what we are going to ask for is a statement of the requirements of the Mining Act and Rules and then a comparison/cross-reference between the Mining Act, Rules, and MMD Guidance and the contents of the EIS.

D.Henney: That sounds doable.

HS: We want to have the MMD permit hearing before the ROD comes out, but we will need the permit to be technically approvable, or rather, almost technically approvable to go into our hearing.

DJE: It should be almost technically approvable. We do not need the NMED Secretary's Determination before the hearing. The public does not like to see a hearing on a permit that they feel pre-decisions have already been made.

KE: Ok, so this could move the MMD hearing schedule up, assuming NMCC has the other ducks in a row by then, to the point in the EIS schedule with ID #35, where Solv is preparing the PDEIS, to be done on the current schedule on 11 Dec 2015.

Discussion: Timing of the Discharge Permit would be good to have this done or mostly done. Discharge Permit may not require a hearing if it follows the Copper Rule as close as possible. NMED recommends NMCC go through the Copper Rule line by line to make sure the application follows it exactly. NMCC should schedule to go up to Santa Fe and discuss the application and the rule's intent as the work on the application progresses.

7. Next meeting date – Selected: 21 April 2015

Cooperating Agencies - NMCC Meeting –NOTES
21 April 2015 14:00 MST

Attendee	Company	Initial	Present
Doug Haywood (via phone)	BLM	D.Haywood	X
Leighandra Keevan (via phone)	BLM	LK	X
Matthew Wunder (via phone)	NM G & F	M.Wunder	X
Mark Watson (via phone)	NM G & F	M.Watson	X
John Hall	NMED	JH	X
Brad Reid	NMED	BR	X
Kurt Vollbrecht	NMED	KV	
Bryan Dail (via phone)	NMED SWQB	BD	X
Kristine Pintado	NMED SWQB	KP	
Doug Rappuhn (via phone)	NMOSE	DR	X
Dave Henney (via phone)	Solv	D.Henney	X
Davena Crosley	MMD	DC	
DJ Ennis	MMD	DJE	X
Chris Eustice	MMD	CE	X
Holland Shepherd	MMD	HS	
Katie Emmer	THEMAC	KE	X

Next Meeting Date: 9 June 2pm MDT at MMD

Identified Action Items

- KE will send NMED Juan Velasquez' contact information (DONE)
- Lee Wilson will transmit the EIS model files to Mike Johnson of OSE for review ASAP
- NMCC will work out with NMED a time to meet regarding the DP (scheduled for 29 April)
- Solv will assemble and distribute the DEIS to state cooperators on 4 May
- BLM, Solv, State cooperators have a DEIS review meeting in Socorro 18 May
- State cooperators will return comments to BLM/Solv by 26 May
- KE will notify NMED SWQB when to expect UAA report as soon as possible

1. Geochemistry status

KE: NMCC has assembled a team including JSAI, SRK and Steve Raugust to systematically evaluate the conceptual pit reclamation plans we've long discussed, as well as brainstorm more, and run them through the geochemistry model.

Current action items being pursued:

- Brainstormed additional ideas, considered the viability of the plans and how to model them, - DONE
- JSAI and SRK are working together to create and run the initial geochemistry models for the rapid fill plan, the team will be working through kinks and trying different ideas in April and May with a goal of having identified and proven plan by the end of June.
- Submit proposed pit reclamation plans and model results for the reclamation for state review either in the MORP, or in a standalone document, or as part of the upcoming Discharge Permit application

2. Pit water standards navigation plans

KE: Use Attainability Analysis draft report: JSAI delivered a revised Draft to me at the end of March, we had hoped to get it to NMED SWQB for review in early April, however it is pending NMCC management review. NMCC's COO, Jeff Smith, is busy with a number of priorities, but as soon as he can familiarize himself with the report and we can work through any issues or concerns he has and get approval, I will let NMED know when to expect it.

3. EIS status – Doug, Dave

D.Haywood: BLM uploaded the last of our comments on the PDEIS today. We have one outstanding analyst with comments, Tim Frye, but Solv should not wait for him, we can catch him in the next go around. Solv should have everything that I'm aware of; we may be off the schedule by a week. The DEIS is now back in Solv's hands.

D.Henney: We did receive the comments from BLM and we are expecting to need another week to resolve comments.

4. PDEIS Review by State Cooperators: timeframe

~Some discussion on the EIS schedule today~

The following immediate EIS schedule is proposed by Solv and agreed by BLM:

4 May: State cooperators to receive the DEIS from Solv for review.

18 May: Meeting in Socorro with BLM, Solv, State cooperators to discuss DEIS

26 May: State Cooperators return comments on the DEIS to Solv

26 May - 2 June: Solv integrates state cooperators comments

3 June – 10 June: BLM's final review of DEIS

10 June – 15 June: Solv does final edits to prepare DEIS for printing

KE: I do want to mention, while we are still on the EIS topic: It took some time to consider, but NMCC has agreed to BLM's preference to provide the groundwater model to OSE just last week. I've been in touch with Dave Henney and Lee Wilson and Lee has the directive to send to OSE the model package they provided to BLM with the model files used in the EIS. Doug Rappuhn, have you heard from Lee Wilson regarding the transmission of these files/where to send them?

~Some discussion on whether OSE has the EIS model files, who should get them~

DR: If you haven't already, you should talk to Mike Johnson, the Hydrology Bureau Chief, he would be the person to get the files. I believe Eric Keys has seen some model files recently, but I'm not sure what files he was looking at, Eric is new to the project.

D.Henney: I will ask Lee Wilson (or someone at his shop) to contact Mike Johnson and arrange to send the model files used in the EIS.

KE: Just one more note regarding a couple of new additional baseline data surveys: NMCC has conducted cultural resources and paleo surveys on the mill site claims and proposed substation areas in March and April. The cultural resource survey found 4 sites and the draft report of the survey is at BLM for review. The paleo survey found no fossils and the draft report is being prepared for BLM review this week. The vegetation and wildlife surveys are happening this week and in early May and will be incorporated into the DEIS as soon as they are available, NMCC is aiming to have the vegetation and wildlife reports to BLM by mid-May.

5. Permit application package status

KE: Once the additional baseline data surveys on the proposed substation area and mill sites are complete, we should probably package them up and send them to MMD to include in the baseline data reports.

The MORP is on hold pending finalization of plans for the reclamation of the pit.

6. Revised Discharge Permit status

KE: Jeff Smith is taking the helm on this, and Juan Velasquez, a consultant with previous experience with Roca Honda, has been helping out on that. I still don't have an ETA for this but a lot of the work has been done, it just needs to be pulled together and submitted. I've discussed with Jeff and Juan NMED's offer to meet with NMCC and provide feedback as the application.

BR: Yes, Juan contacted Kurt and he's setting up a meeting to come in and discuss the discharge permit. Could you send us his contact information?

KE: Sure, I can zap you his phone number and email address after the meeting.

7. Next meeting date: 9 June 2015, 2pm MDT

NEW MEXICO ENVIRONMENT DEPARTMENT
INSPECTION OF PUBLIC RECORD REQUEST FORM

Please fill out the following information:

1. Date: April 29, 2015
2. Requestor's Name: Juan R. Velasquez
3. Requestor's Address: 12912 Sand Cherry Pl. NE, Albuquerque, NM 87111
4. Phone No.: (505) 239 3728
5. Email: **jvelasquez@vemsinc.com**
6. Company Being Represented: New Mexico Copper Corporation, THEMAC Resources Group
7. Address: 2424 Louisiana Blvd. NE, Albuquerque, NM 87111
8. Document or File being requested to be reviewed or copied (please describe the records in sufficient detail to enable Department personnel to reasonably identify & locate the records:

Freeport McMoRan DP-376 Permit Renewal Application Feb. 2015

Chino North Mine Area Discharge Permit Renewal Application Feb. 2015

Tyrone Discharge Permit Renewal Application April 2015

NMED Bureau where Document/File can be found (if known): Groundwater Bureau

Signature

Revised 6/14/12

NEW MEXICO ENVIRONMENT DEPARTMENT
INSPECTION OF PUBLIC RECORD REQUEST FORM

Please fill out the following information:

1. Date: APRIL 30, 2015

2. Requestor's Name: JON BLOCK

3. Requestor's Address: c/o 1405 Luisa Street, Suite 5, Santa Fe, NM 87505

4. Phone No.: (505) 989-9022, Ext. 22

5. Email: jblock@nmelc.org

6. Company Being Represented: Hillsboro Mutual Domestic Water Consumers Assn

7. Address: Hillsboro, NM 88042

8. Document or File being requested to be reviewed or copied (please describe the records in sufficient detail to enable Department personnel to reasonably identify & locate the records:

Permit file DP-001 (Copper Flats)

We would like to review the complete file and may want some copies made.

9. NMED Bureau where Document/File can be found (if known): Ground Water Quality Bureau

Signature

The cost for copying by NMED is as indicated on Attachment A. Please send this request to:

Melissa Y. Mascareñas
Inspection of Public Records Officer
1190 St. Francis Drive, Ste. N-4050
Santa Fe, New Mexico 87505
fax: (505) 827-1628 or
email: melissa.mascarenas@state.nm.us

Revised 6/14/12

solv=™

MEMORANDUM

RECEIVED
MAY 5 2015
Ground Water Quality Bureau

TO: Doug Haywood, BLM
DJ Ennis, MMD
Mark Watson, DGF
Brad Reid, NMED
Bryan Dail, NMED
Rita Bates, NMED
Doug Rappuhn, OSE

FROM: Dave Henney

SUBJECT: Transmittal of Internal Draft EIS

DATE: 4 May 2015

The purpose of this memorandum is to transmit the Copper Flat Internal Draft Environmental Impact Statement. The document is stored electronically on the enclosed CD and includes MS Word files and a .pdf file that the reviewers may find easier to navigate within.

As a reminder and as we discussed at the last Cooperators' meeting, there will be a meeting at the BLM Socorro Field Office on May 18, 9:00am – 4:30pm, to discuss the document and comments will be due back to Solv on 5/26. Send comments back to dave.henney@solvllc.com.

I look forward to receiving comments on the Internal DEIS and continuing toward the final Record of Decision for this project.