FREEPORT-MCMORAN COPPER & GOLD

Copper Queen Branch/Freeport-McMoRan Corporation
36 West Highway 92
Bisbee, Arizona 85603

January 24, 2012

Ms. Mindi Cross, Manager
Water Quality Compliance Section
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007

Re: Mitigation Order on Consent No. P-121-07

Dear Ms. Cross:

In follow up to our meeting on November 29, 2011, Freeport-McMoRan Corporation—Copper Queen Branch (FMC) proposes to modify the schedule submitted as Figure 24 to *Revision 1 Work Plan to Characterize and Mitigate Sulfate in Drinking Water Supplies in the Vicinity of the Concentrator Tailing Storage Area*, approved by ADEQ on August 3, 2008. The purpose of the modification is to revise the approved schedule for submission of a Feasibility Study and Mitigation Plan to reflect existing circumstances, including the actual time for development and approval of the Aquifer Characterization Report (ACR), which extended beyond the approved schedule, and FMC's mitigation work on existing wells that has also been underway for the last year. In addition, FMC needs more information to complete certain aspects of the Feasibility Study and Mitigation Plan.

The current schedule called for submission of the ACR, approval of the ACR, submission of a Feasibility Study Report, and then submission of a Mitigation Plan Report between February 2008 and December 2009. The schedule also contemplated Treatability Studies, if needed.

The development, review and approval of the ACR extended beyond the original schedule. It has been our understanding throughout the process that ADEQ did not wish to receive either the Feasibility Study Report or a proposed Mitigation Plan until after the ACR was approved.

As you know, FMC also has been focused on mitigation actions for existing affected private and public well owners in accordance with section III.D of the Mitigation Order. On an interim basis, FMC has provided parties using affected water supplies with bottled water. FMC has also identified, evaluated and initiated implementation of proposed final mitigation actions, by coordinating with (1) Naco Water Company on improvements to the portion of its system served by well NWC-3; Arizona Water Company (AWC) to connect San Jose residents with affected wells to the AWC system; and (3) private well owners to deepen their wells or install household treatment systems. As a result, the actions that will be presented in the Feasibility Study and proposed as final actions in the Mitigation Plan for currently affected wells are underway. FMC proposes to submit a Feasibility Study and Mitigation Plan that addresses these actions by March 31, 2012.

FMC will continue to monitor sulfate concentrations on a quarterly basis. Our monitoring includes wells located between the leading edge of the plume and the AWC well field, including the two wells installed at the request of AWC. FMC has determined, based on expert evaluation and groundwater velocity calculations, that future impacts of the sulfate plume on other water supply wells are not imminent (see the attached technical memorandum prepared by Clear Creek Associates). Further, FMC intends to undertake additional evaluation of potential mitigation options, including ongoing studies of alternative sulfate treatment technologies, to complete a second Feasibility Study for wells that might be affected in the future. We currently estimate that the treatability studies will be completed in the next 12 to 15 months. Consequently, FMC proposes to address potential future mitigation actions in a Feasibility Study to be submitted in July of 2013 and a Mitigation Plan to be submitted 60 days after ADEQ approves the Feasibility Study.

Attachment A to this request is proposed to replace the current Work Plan Figure 24 schedule. We appreciate ADEQ's consideration of this request. If you have any questions or need any additional information regarding the proposed schedule, please contact me at (520) 432-6206.

Very truly yours,

Rebecca A. Sawyer
Sr. Environmental Engineer
Freeport-McMoRan Corporation, Copper Queen Branch

Attachments

Enclosure

cc: Mr. Jerry Smit/ADEQ
Mike Jaworski/Freeport-McMoRan Corporation
Stu Brown/Freeport-McMoRan Copper & Gold
Jim Norris/Clear Creek Associates
Sheila Deely/Freeport-McMoRan Copper & Gold
Dal Moellenberg/Gallagher & Kennedy

ATTACHMENT A

Schedule for Mitigation Plan and Feasibility Study

1. Submit Feasibility Study Report and Mitigation Plan for existing wells impacted by sulfate plume as identified by the approved Aquifer Characterization Report: March 31, 2012.

2. Submit Feasibility Study Report for existing wells that may be impacted by the sulfate plume in the future as identified by the approved Aquifer Characterization Report: July 2013.

3. Submit Mitigation Plan to address existing wells that may be impacted by the sulfate plume in the future as identified by the approved Aquifer Characterization Report: TBD

CLEAR CREEK ASSOCIATES

TECHNICAL MEMORANDUM

To: Rebecca Sawyer, Freeport-McMoRan Corporation, Copper Queen Branch
From: James Norris, R.G., Clear Creek Associates
Subject: Travel Time Analysis for Leading Edge of the Sulfate Plume Mitigation Order on Consent No. P-121-07
Date: January 16, 2012

REGISTERED GEOLOGIST
CERTIFICATE NO. 30842
JAMES R. NORRIS
Date Signed 1/16/12
ARIZONA U.S.A.
Expires 12/31/14

1 INTRODUCTION

This memorandum contains migration rate estimates for the leading edge of the sulfate plume[1] based on site-specific water level and hydraulic properties data. The purpose of the analysis is to evaluate the timeframe over which the sulfate plume could potentially migrate from its current location to the Arizona Water Company (AWC) wellfield west of the plume.

A more detailed analysis of the direction and migration rate of the sulfate plume will be conducted using the groundwater flow and sulfate transport model presented in the *Aquifer Characterization Report* (Clear Creek Associates, 2010). The numerical modeling results will be used to determine whether the sulfate plume would migrate to the AWC wellfield and, if so, in what timeframe. The modeling results will be reported as part of the Feasibility Study for drinking water supply wells that might be impacted in the future.

2 BACKGROUND AND PROCEDURE

Figures 1 and 2 are maps showing sulfate concentrations and water levels, respectively, in the vicinity of the sulfate plume in the third quarter of 2011. Figure 3 shows wells completed in the basin fill aquifer at the leading edge of the sulfate plume.

The basin fill aquifer consists of unconsolidated sand and gravel deposits that contain the leading edge of the sulfate plume. This analysis focused on the basin fill aquifer because it is the only aquifer containing sulfate in excess of 250 mg/L at the front of the sulfate plume. The hydrology, nature, and extent of the westward-migrating sulfate plume are detailed in the *Aquifer Characterization Report* (Clear Creek Associates, 2010) submitted to Arizona Department of Environmental Quality. The water level and water quality data presented in this analysis are collected and reported quarterly to ADEQ (e.g., Clear Creek Associates, 2011) pursuant to Mitigation Order on Consent P-121-07 (Mitigation Order).

[1] The sulfate plume is defined as the zone of groundwater with sulfate concentrations exceeding 250 milligrams per liter due to the Concentrator Tailing Storage Area.

Darcy's Law calculations were used to estimate the rate of plume movement and potential travel times to the AWC wellfield, assuming that the amount of groundwater pumping at the front of the plume would remain at current levels into the future. Water levels in basin fill wells at the leading edge of the plume were used to calculate the hydraulic gradient that constitutes the driving force for groundwater flow. Hydraulic conductivity and porosity estimates for basin fill were used with the calculated hydraulic gradient to calculate the average groundwater flow velocity. The flow velocity and distance between the plume and points of interest were used to calculate the travel time assuming sulfate is transported at the same velocity as the average groundwater velocity (i.e., sulfate migration is not retarded by chemical processes). The following equations were used for this analysis.

Average Groundwater Flow Velocity = ((Hydraulic Conductivity) (Hydraulic Gradient))/Porosity (1)

Travel Time = Distance/Average Groundwater Flow Velocity (2)

3 WATER LEVELS, GROUNDWATER FLOW DIRECTION, AND HYDRAULIC GRADIENTS

Figure 2 illustrates groundwater elevations measured during the third quarter of 2011. Groundwater flow is perpendicular to equipotential lines such as the water elevation contours shown on Figure 2. Thus, groundwater in the region between the plume and the AWC wellfield flows westerly. The velocity of groundwater flow is directly proportional to the hydraulic gradient which is calculated as the water elevation difference between two measurement points divided by the distance separating them. Water level data for basin fill wells at the front of the plume were compiled and the distances between wells were determined to calculate the hydraulic gradient.

Wells selected for water level analysis and hydraulic gradient calculations are monitoring wells BMO-2008-4B, BMO-2008-5B, and BMO-2008-6B at the leading edge of the plume, BMO-2008-13B which is upgradient of BMO-2008-6B, BMO-2010-3B along Greenbush Draw between the plume edge and the AWC wellfield, wells at the AWC wellfield (extraction wells AWC-02, AWC-03, AWC-04, and AWC-05 and monitoring well COB MW-3), and monitoring wells NSD-02 and NSD-03 downgradient of the AWC wellfield (Figures 1, 2, and 3). Water level data for these wells are tabulated on Table 1. Figure 4 is a graph of water elevations over time at the wells.

The water level data on Figure 4 show contrasting behaviors in wells at and in front of the leading edge of the plume. Water elevations in wells distant to the AWC wellfield (e.g., BMO-2008-4B, BMO-2008-5B, and BMO-2008-6B, BMO-2010-3B, and NSD-03) vary less over time than do water elevations in wells within or peripheral to the wellfield (i.e., AWC-02, AWC-03, AWC-04, AWC-05[2], COB MW-3, and NSD-02). The large variation in water elevations in wells within or close to the wellfield is due to water level drawdown caused by pumping at the wellfield. The large fluctuations in water levels at the AWC wells are likely due to residual drawdown in the wells (i.e., incomplete recovery of the water levels at the time of measurement). In COB MW-03 and NSD-02 the fluctuations are likely due to drawdown which can vary over time due to changes in the rates and locations of pumping. The effect of the wellfield diminishes with distance from it such that NSD-03 which is farther from the wellfield has higher water level elevations and less water level fluctuation than NSD-02.

The regional hydraulic gradient is the driving force for movement of the sulfate plume. Static (non-pumping) groundwater elevations are the most representative data on which to base regional hydraulic gradient calculations. The water elevations at AWC-02, AWC-03, AWC-04, AWC-05, COB MW-03, and NSD-02 appear to be influenced by wellfield operations and do not represent water levels characteristic of regional conditions. Localized hydraulic gradients that occur in the vicinity of an individual pumping well or a wellfield can also influence sulfate movement, but only when the sulfate plume has moved within the capture zone of the wellfield. Localized hydraulic gradients caused by pumping wells may result in the capture of sulfate if the plume impinges on the wellfield, but do not control the large scale movement of the plume at a distance from the wellfield.

Water level data for wells near the front of the plume were used to characterize the water elevation in the upgradient area. With respect to the AWC wellfield, the upgradient area is the area from which sulfate-bearing groundwater is flowing. Water level data for the downgradient area, the direction in which sulfate–bearing groundwater is flowing, are provided by wells near and west of the AWC wellfield. However, water level data representing the regional hydraulic gradient are limited because many downgradient monitoring points are influenced by the AWC wellfield. Wells influenced by wellfield drawdown have lower water elevations than wells outside the influence of the wellfield. For example, the water elevations at NSD-03 are higher than those at COB MW-3 even though NSD-03 is downgradient of the wellfield with respect to the regional groundwater flow system. The use of water elevations influenced by drawdown would bias travel time calculations by yielding higher hydraulic gradients and flow velocities, and shorter travel times (Equations 1 and 2) than would the use of water elevations from wells outside the influence of the wellfield.

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[2] Water level elevations at AWC-05 are not shown on Figure 4 because they are almost 200 feet lower than in other AWC wells with the exception of a measurement in June 2009 (Table 2). It is uncertain whether the lower water elevations were measured while the well was pumping, but the June 2009 measurement is comparable to pseudostatic water levels in the other AWC wells.

Water levels at NSD-03 are the downgradient data most representative of the regional hydraulic gradient influencing migration of the sulfate plume. Although water levels at NSD-02 are influenced by wellfield pumping, they are more representative of the regional hydraulic gradient than water levels at COB MW-3 which are anomalously low compared to NSD-02, NSD-03, and the AWC wells. For this reason, hydraulic gradient calculations were conducted using data for NSD-02 to represent a downgradient water level condition between those at COB MW-3 and NSD-03.

The following well pairs were used to estimate the hydraulic gradient between the front of the plume and the AWC wellfield:

- BMO-2010-3B and BMO-2008-4B: characterizes potential flow path between the plume and BMO-2010-3B
- NSD-02 and BMO-2010-3B: characterizes potential flow path between BMO-2010-3B and AWC wellfield
- NSD-02 and BMO-2008-5B: characterizes potential flow path between BMO-2008 and AWC wellfield
- BMO-2008-6B and BMO-2008-13B: characterizes flow path north of the AWC wellfield

Table 2 contains water level differences for measurements collected at approximately the same time, distances between the well pairs, and the calculated apparent hydraulic gradients over time. The term "apparent" is used here to indicate that the hydraulic gradients are approximate in that they are calculated along lines between existing points that may not be orthogonal to the potentiometric field. The apparent hydraulic gradients at the well pairs range from 0.0012 feet per foot (ft/ft) to 0.0040 ft/ft.

4 HYDRAULIC CONDUCTIVITY

The hydraulic conductivity of basin fill has been estimated by interpretation of pumping tests conducted at various locations in the vicinity of the sulfate plume. The pumping test data and their interpretation are described in the *Aquifer Characterization Report* (Clear Creek Associates, 2010). Table 3 lists hydraulic conductivity estimates for basin fill, including the arithmetic and geometric means for the data set. Basin fill hydraulic conductivities range from 2.3 feet/day (ft/day) to 100.9 ft/day and have arithemetic and geometric means of 39.5 ft/day and 29.7 ft/day, respectively. Figure 5 is a cumulative frequency plot of the basin fill hydraulic conductivity estimates.

Hydraulic conductivity estimates for wells BMO-2008-4B, BMO-2008-5B, BMO-2008-6B, and BMO-2010-3B at the leading edge of the sulfate plume are 39.5 ft/day, 55 ft/day, 2.3 ft/day, and 15.5 ft/day, respectively (Figure 5). The arithmetic and geometric mean hydraulic conductivities of wells at the leading edge of the plume are 28.1 ft/day and 16.6 ft/day, respectively. The arithmetic mean of hydraulic conductivity (28.1 ft/day) was used as the best estimate of local conditions with which to calculate groundwater flow velocities.

5 GROUNDWATER FLOW VELOCITY AND TRAVEL TIME CALCULATIONS

Groundwater flow velocities were calculated using the apparent hydraulic gradients (Table 2), the average hydraulic conductivity of 28.1 ft/day, and an assumed average porosity of 25%. Travel time calculations for the edge of the sulfate plume to move to the east edge of the AWC wellfield were conducted by dividing the shortest distance between AWC-05 and plume edge depicted on Figure 1 (4,100 feet) by the calculated groundwater velocities. The other AWC wells range from 4,600 feet to 5,200 feet from the plume and would have longer travel times. Flow from BMO-2008-6B to AWC-05 was not considered likely given the westward trajectory of the plume.

Table 4 summarizes the groundwater flow velocity and travel time calculations. Calculated groundwater velocities ranged between 47 and 115 feet per year (ft/yr) for hydraulic gradients calculated between well pairs BMO-2010-3B and BMO-2008-4B, NSD-02 and BMO-2010-3B, NSD-02 and BMO-2008-5B, and BMO-2008-6B and BMO-2008-13B. The fastest velocities were calculated from hydraulic gradients that used the July 2011 water elevation at NSD-02 which was about 6 feet lower than previous measurements (Figure 4) and may be anomalously low. The calculated travel times for the plume edge to migrate to the AWC wellfield ranged from 36 years to 86 years.

6 TRAVEL TIME SENSITIVITY ANALYSIS

A sensitivity analysis was conducted by varying the assumptions used for calculations in two scenarios. The first scenario increases the hydraulic conductivity to 55 ft/day, the maximum value measured at the leading edge of the plume while maintaining the hydraulic gradients measured to NSD-02. The second scenario is that of high hydraulic gradients and a high hydraulic conductivity. The second scenario used the apparent hydraulic gradients between a well influenced by the AWC wellfield, COB MW-3, and upgradient wells BMO-2008-4B, BMO-2008-5B, and BMO-2010-3B, and assumed a hydraulic conductivity of 55 ft/day. Travel times in both scenarios represented the time to travel the shortest distance (4,100 feet) between the plume edge and AWC-05. The results of sensitivity calculations are provided on Table 5.

The first scenario resulted in flow velocities and travel times ranging from 93 ft/yr to 225 ft/yr and 18 years to 44 years, respectively. The first scenario is conservative in that it may overestimate flow velocities and underestimate travel times by using the highest hydraulic conductivity measured at the front of the plume (55 ft/day) which is almost double the arithmetic mean hydraulic conductivity (28 ft/day) measured at the front of the plume and 38% greater than the arithmetic mean of all hydraulic conductivity data (40 ft/day).

The second scenario resulted in flow velocities and travel times ranging from 93 ft/yr to 742 ft/year and 6 years to 44 years, respectively. Results for the second scenario indicate that travel times under 10 years could occur in the unlikely circumstances that the plume is moving under the high hydraulic gradients calculated with COB MW-3 which is clearly impacted by drawdown from the AWC wellfield and the same high hydraulic conductivity as the first scenario.

The sensitivity analysis results illustrate how the calculated flow velocities and travel times are highly sensitive to the assumed hydraulic gradients and hydraulic conductivity. The results of the first scenario are conservative because they are calculated with a high estimate of hydraulic conductivity. The second scenario results in unrealistically high velocities and short travel times because the hydraulic gradients are based on a well in the zone of drawdown of the AWC wellfield and a high hydraulic conductivity. Although the conditions of the second scenario may be appropriate in close proximity to the AWC wellfield, they do not control the migration of the plume at its current location.

7 CONCLUSION REGARDING TRAVEL TIME CALCULATIONS

The actual migration of the plume from NWC-03 provides a point of comparison for the calculated migration rates. The first measured sulfate concentration in a sample from NWC-03 (Figures 1 and 2) was 460 mg/L in October 2005 based on data in the *Aquifer Characterization Report* (Clear Creek Associates, 2010). The edge of the sulfate plume in the third quarter of 2011 was no farther west than wells TVI-875 and SCHWARTZ (Figure 1). If the plume had just arrived at NWC-03 in October 2005, it has moved no more than the distance to TVI-875 (1,400 feet) and SCHWARTZ (1,200 feet) in 6 years indicating a maximum velocity of 200 ft/yr to 233 ft/yr. At a velocity of 233 ft/yr, the travel time for the plume to migrate 4,100 feet to the AWC wellfield is 18 years. The actual velocity and travel time are likely slower than this estimate because the plume had arrived at NWC-03 prior to October 2005. If migration rates were faster than 200 ft/yr to 233 ft/yr, such as most of those calculated for the second sensitivity scenario, the plume would have already arrived at TVI-875 and SCHWARTZ, which is not observed.

Based on the foregoing Darcy's Law calculations using the average hydraulic conductivity at the front of the plume and hydraulic gradient calculated for NSD-02, our best estimate of the travel time from the current plume edge to the AWC wellfield is 36 years or more (Table 4). If the actual plume migration rate is closer to those calculated for the first sensitivity scenario (maximum hydraulic conductivity at front of plume) and the apparent plume migration rate at NWC-03 (considered an overestimate), the travel time would be 18 years or more (Table 5). The second sensitivity scenario (maximum hydraulic conductivity at front of plume and maximum hydraulic gradient) is considered to yield unrealistically short travel times that do not agree with the apparent migration rate from NWC-03. The question of whether the AWC wellfield will capture the sulfate plume in the future is being addressed by numerical modeling of groundwater flow and sulfate transport.

8 SULFATE CONCENTRATION DATA AND GROUNDWATER MONITORING

Sulfate concentration data for basin fill aquifer wells downgradient of the leading edge of the sulfate plume are listed in Table 6. Figure 6 shows sulfate concentrations from 2008 through 2011 at the BMO-2008-5B, BMO-2008-6B, BMO-2010-3B, COB MW-3, AWC-02, AWC-03, AWC-04, and AWC-05. Sulfate concentrations at these wells are generally less than 50 mg/L except for BMO-2008-5B and COB MW-3. The sulfate concentration at BMO-2008-5B has ranged between 175 mg/L and 203 mg/L. Sulfate concentration data for COB MW-3 show two peaks of 102 mg/L and 112 mg/L against a background of approximately 50 mg/L. The cause of the concentration peaks at COB MW-3 is uncertain, but both occurred in winter suggesting a possible relation to a seasonal variable.

The position of the sulfate plume is monitored at wells upgradient of the AWC wellfield. It is unlikely that the arrival of the sulfate plume at BMO-2008-6B would threaten the AWC wellfield given the westerly direction of groundwater flow. However, the arrival of the plume at BMO-2008-5B or BMO-2010-3B could indicate a potential for migration to the wellfield.

AWC-05 is 2,408 feet from BMO-2010-3B and 4,110 feet from BMO-2008-5B. The sulfate plume would take 21 years to migrate from BMO-2010-3B to AWC-05 and 35 years to migrate from BMO-2008-5B to AWC-05 at the fastest a plume migration rate (115 ft/yr) calculated for our best estimate of average conditions, The sulfate plume would take 10 years to migrate to AWC-05 from BMO-2010-3B and 18 years from BMO-2008-5B at the maximum apparent migration rate based on NWC-03 data (233 ft/yr), but the apparent travel time is probably underestimated because the timing of plume arrival at NWC-03 is uncertain. Ongoing quarterly groundwater sampling at BMO-2008-5B and BMO-2010-3B will be used to monitor the movement of the sulfate plume for refinement of the travel time calculations.

9 REFERENCES

Clear Creek Associates. 2010. Revision 1 Aquifer Characterization Report. December 15, 2010.

Clear Creek Associates. 2011. Third Quarter 2011 Groundwater Monitoring Report. October 7, 2011

TABLE 1
Groundwater Elevation Data

Well Name	ADWR 55 Registry No.	UTM East (meters)	UTM North (meters)	Measuring Point Elevation[1] (ft amsl)	Date	Depth To Water (feet)	Groundwater Elevation (ft amsl)
AWC-02	616586	598907.911	3468549.357	4547.64	4/8/08	116	4431.64
					8/27/08	121.12	4426.52
					10/23/08	115	4432.64
					4/22/09	118	4429.64
					10/9/09	117	4430.64
					4/23/10	119	4428.64
AWC-03	616585	599090.322	3468681.898	4539.52	4/8/08	112	4427.52
					8/27/08	119.40	4420.12
					10/23/08	106	4433.52
					4/22/09	114	4425.52
					10/9/09	116	4423.52
					4/23/10	116	4423.52
AWC-04	616584	598949.929	3468717.084	4540.48	4/8/08	108	4432.48
					8/18/08	112.56	4427.92
					10/23/08	111.31	4429.17
					4/22/09	110	4430.48
					10/9/09	110	4430.48
					4/23/10	109	4431.48
AWC-05	590620	599269.904	3468541.692	4542.51	4/8/08	284	4258.51
					8/27/08	299.65	4242.86
					10/23/08	284	4258.51
					4/22/09	286	4256.51
					6/3/09	125	4417.51
					10/9/09	289	4253.51
					4/23/10	278	4264.51
BMO-2008-4B	910096	601099.405	3468383.430	4573.17	12/11/08	130.77	4442.40
					2/18/09	130.58	4442.59
					4/30/09	131.24	4441.93
					8/6/09	131.96	4441.21
					10/27/09	132.04	4441.13
					2/24/10	131.82	4441.35
					4/16/10	132.65	4440.52
					7/2/10	133.20	4439.97
					2/15/11	133.78	4439.39
					7/22/11	134.80	4438.37
BMO-2008-5B	909653	600438.159	3468994.715	4585.10	9/30/08	145.10	4440.00
					2/18/09	144.35	4440.75
					4/27/09	144.78	4440.32
					8/4/09	145.36	4439.74
					10/29/09	145.88	4439.22
					2/15/10	145.42	4439.68
					4/15/10	145.80	4439.30
					7/7/10	146.59	4438.51
					10/5/10	147.00	4438.10
					2/14/11	147.56	4437.54
					5/12/11	148.04	4437.06
					7/13/11	148.31	4436.79
BMO-2008-6B	909146	600366.523	3469820.644	4627.44	7/16/08	190.13	4437.31
					11/4/08	190.23	4437.21
					2/19/09	189.71	4437.73
					4/27/09	189.99	4437.45
					8/4/09	190.80	4436.64
					10/26/09	191.04	4436.40
					2/15/10	190.82	4436.62
					4/15/10	190.75	4436.69
					7/1/10	191.43	4436.01
					10/5/10	192.50	4434.94
					2/14/11	192.19	4435.25
					5/12/11	192.70	4434.74
					7/12/11	193.30	4434.14

TABLE 1
Groundwater Elevation Data

Well Name	ADWR 55 Registry No.	UTM East (meters)	UTM North (meters)	Measuring Point Elevation[1] (ft amsl)	Date	Depth To Water (feet)	Groundwater Elevation (ft amsl)
BMO-2008-13B	909551	601657.612	3470076.358	4649.21	10/3/08	206.42	4442.79
					2/17/09	206.11	4443.10
					5/6/09	206.32	4442.89
					8/5/09	206.79	4442.42
					10/28/09	207.08	4442.13
					2/16/10	207.26	4441.95
					4/14/10	207.27	4441.94
					7/6/10	207.68	4441.53
					2/10/11	208.51	4440.70
					5/13/11	208.95	4440.26
					7/15/11	209.36	4439.85
BMO-2010-3B	219970	599977.962	3468347.363	4550.59	7/28/10	115.38	4435.21
					11/10/10	115.80	4434.79
					1/20/11	115.46	4435.13
					4/7/11	116.11	4434.48
					7/13/11	117.30	4433.29
					10/13/11	117.72	4432.87
COB MW-3	906823	599169.225	3468726.000	4538.63	2/28/08	120.84	4417.79
					5/20/08	125.00	4413.63
					7/30/08	118.50	4420.13
					10/23/08	117.93	4420.70
					2/12/09	110.91	4427.72
					4/23/09	125.13	4413.50
					7/22/09	124.09	4414.54
					10/22/09	118.03	4420.60
					3/3/10	120.14	4418.49
					4/26/10	123.12	4415.51
					7/13/10	128.6	4410.03
					7/14/11	132.41	4406.22
NSD-02	527587	598820.051	3468821.474	4531.38	10/7/09	101.17	4430.21
					3/16/10	99.43	4431.95
					5/25/10	101.63	4429.75
					8/25/10	102.38	4429.00
					3/17/11	102.68	4428.70
					6/17/11	109.29	4422.09
NSD-03	527586	598070.538	3468694.259	4518.28	10/7/09	85.62	4432.66
					3/16/10	83.51	4434.77
					5/25/10	84.49	4433.79
					8/25/10	85.70	4432.58
					3/17/11	86.76	4431.52
					6/17/11	88.76	4429.52

ADWR = Arizona Department of Water Resources; UTM = Universal Transverse Mercator Zone 12, North American Datum 1983 (NAD83);

ft amsl = feet above mean sea level; NR = No Record

CLEAR CREEK ASSOCIATES

TABLE 2
Water Levels and Apparent Hydraulic Gradient Calculations

Well	Date	Water Elevation (ft amsl)	Well	Date	Water Elevation (ft amsl)	Water Elevation Difference (ft)	Distance Between Wells (ft)	Apparent Hydraulic Gradient (ft/ft)
BMO-2010-3B	07/28/10	4435.21	BMO-2008-4B	07/02/10	4439.97	4.76	3680	0.0013
	01/20/11	4435.13		02/15/11	4439.39	4.26		0.0012
	07/13/11	4433.29		07/22/11	4438.37	5.08		0.0014
NSD-02	08/25/10	4429	BMO-2010-3B	07/28/10	4435.210	6.21	4104	0.0015
	03/17/11	4428.7		04/07/11	4434.480	5.78		0.0014
	06/17/11	4422.09		07/13/11	4433.290	11.2		0.0027
NSD-02	10/07/09	4430.21	BMO-2008-4B	10/27/09	4441.13	10.92	7613	0.0014
	03/16/10	4431.95		02/24/10	4441.35	9.4		0.0012
	05/25/10	4429.75		04/16/10	4440.52	10.77		0.0014
	08/25/10	4429		07/02/10	4439.97	10.97		0.0014
	03/17/11	4428.7		02/15/11	4439.39	10.69		0.0014
	06/17/11	4422.09		07/22/11	4438.37	16.28		0.0021
NSD-02	10/07/09	4430.21	BMO-2008-5B	10/29/09	4439.220	9.01	5338	0.0017
	03/16/10	4431.95		02/15/10	4439.680	7.73		0.0014
	05/25/10	4429.75		04/15/10	4439.300	9.55		0.0018
	08/25/10	4429		07/07/10	4438.510	9.51		0.0018
	03/17/11	4428.7		02/14/11	4437.540	8.84		0.0017
	06/17/11	4422.09		05/12/11	4437.060	14.97		0.0028
BMO-2008-6B	11/04/08	4437.21	BMO-2008-13B	10/3/08	4442.79	5.58	4317	0.0013
	02/19/09	4437.73		2/17/09	4443.10	5.37		0.0012
	04/27/09	4437.45		5/6/09	4442.89	5.44		0.0013
	08/04/09	4436.64		8/5/09	4442.42	5.78		0.0013
	10/26/09	4436.4		10/28/09	4442.13	5.73		0.0013
	02/15/10	4436.62		2/16/10	4441.95	5.33		0.0012
	04/15/10	4436.69		4/14/10	4441.94	5.25		0.0012
	07/01/10	4436.01		7/6/10	4441.53	5.52		0.0013
	02/14/11	4435.25		2/10/11	4440.70	5.45		0.0013
	05/12/11	4434.74		5/13/11	4440.26	5.52		0.0013
	07/12/11	4434.14		7/15/11	4439.85	5.71		0.0013

ft amsl = feet above mean sea level; ft = feet; ft/ft = feet per foot

TABLE 3
Basin Fill Hydraulic Conductivity Estimates

Well	Hydraulic Conductivity (ft/day)
COB MW-1	100.9
TM-13	59.0
BMO-2008-5B	55.0
TVI 875	49.3
NWC-03	41.6
BMO-2008-4B	39.5
TM-11	39.0
BMO-2008-3B	30.8
BMO-2008-13B	24.0
BMO-2008-8B	17.8
BMO-2010-3B	15.5
BMO-2008-6B	2.3
Arithmetic Mean	39.5
Geometric Mean	29.7

ft/day = feet per day

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TABLE 4
Groundwater Flow Velocities and Travel Times

Well	Date	Well	Date	Apparent Hydraulic Gradient (ft/ft)	Hydraulic Conductivity (ft/day)	Porosity	Velocity (ft/day)	Velocity (ft/yr)	Distance (ft)		Travel Time (yr)
BMO-2010-3B	07/28/10	BMO-2008-4B	07/02/10	0.0013	28.1	0.25	0.15	53	Shortest Distance Between Plume Edge and AWC-05	4100	77
	01/20/11		02/15/11	0.0012			0.13	47			86
	07/13/11		07/22/11	0.0014			0.16	57			72
NSD-02	08/25/10	BMO-2010-3B	07/28/10	0.0015			0.17	62			66
	03/17/11		04/07/11	0.0014			0.16	58			71
	06/17/11		07/13/11	0.0027			0.31	112			37
NSD-02	10/07/09	BMO-2008-4B	10/27/09	0.0014			0.16	59			70
	03/16/10		02/24/10	0.0012			0.14	51			81
	05/25/10		04/16/10	0.0014			0.16	58			71
	08/25/10		07/02/10	0.0014			0.16	59			69
	03/17/11		02/15/11	0.0014			0.16	58			71
	06/17/11		07/22/11	0.0021			0.24	88			47
NSD-02	10/07/09	BMO-2008-5B	10/29/09	0.0017			0.19	69			59
	03/16/10		02/15/10	0.0014			0.16	59			69
	05/25/10		04/15/10	0.0018			0.20	73			56
	08/25/10		07/07/10	0.0018			0.20	73			56
	03/17/11		02/14/11	0.0017			0.19	68			60
	06/17/11		05/12/11	0.0028			0.32	115			36

ft/ft = feet per foot; ft/day = feet per day; ft/yr = feet per year; ft = feet; yr = year

TABLE 5
Results of Sensitivity Calculations

Well	Date	Water Elevation (ft amsl)	Well	Date	Water Elevation (ft amsl)	Water Elevation Difference (ft)	Distance Between Wells (ft)	Apparent Hydraulic Gradient (ft/ft)			Velocity (ft/day)	Velocity (ft/yr)	Distance (ft)		Travel Time (yr)
First Scenario: Sensitivity Calculation with Regional Hydraulic Gradient and High Hydraulic Conductivity															
BMO-2010-3B	07/28/10	4435.21	BMO-2008-4B	07/02/10	4439.97	4.76	3680	0.0013	55	0.25	0.28	104	Shortest Distance Between Plume Edge and AWC-05	4100	39
	01/20/11	4435.13		02/15/11	4439.39	4.26		0.0012			0.25	93			44
	07/13/11	4433.29		07/22/11	4438.37	5.08		0.0014			0.30	111			37
NSD-02	08/25/10	4429	BMO-2010-3B	07/28/10	4435.210	6.21	4104	0.0015			0.33	122			34
	03/17/11	4428.7		04/07/11	4434.480	5.78		0.0014			0.31	113			36
	06/17/11	4422.09		07/13/11	4433.290	11.2		0.0027			0.60	219			19
NSD-02	10/07/09	4430.21	BMO-2008-4B	10/27/09	4441.13	10.92	7613	0.0014			0.32	115			36
	03/16/10	4431.95		02/24/10	4441.35	9.4		0.0012			0.27	99			41
	05/25/10	4429.75		04/16/10	4440.52	10.77		0.0014			0.31	114			36
	08/25/10	4429		07/02/10	4439.97	10.97		0.0014			0.32	116			35
	03/17/11	4428.7		02/15/11	4439.39	10.69		0.0014			0.31	113			36
	06/17/11	4422.09		07/22/11	4438.37	16.28		0.0021			0.47	172			24
NSD-02	10/07/09	4430.21	BMO-2008-5B	10/29/09	4439.220	9.01	5338	0.0017			0.37	136			30
	03/16/10	4431.95		02/15/10	4439.680	7.73		0.0014			0.32	116			35
	05/25/10	4429.75		04/15/10	4439.300	9.55		0.0018			0.39	144			29
	08/25/10	4429		07/07/10	4438.510	9.51		0.0018			0.39	143			29
	03/17/11	4428.7		02/14/11	4437.540	8.84		0.0017			0.36	133			31
	06/17/11	4422.09		05/12/11	4437.060	14.97		0.0028			0.62	225			18
Second Scenario: Sensitivity Calculation with High Hydraulic Gradient and High Hydraulic Conductivity															
BMO-2010-3B	07/28/10	4435.21	BMO-2008-4B	07/02/10	4439.97	4.76	3680	0.0013	55	0.25	0.28	104	Shortest Distance Between Plume Edge and AWC-05	4100	39
	01/20/11	4435.13		02/15/11	4439.39	4.26		0.0012			0.25	93			44
	07/13/11	4433.29		07/22/11	4438.37	5.08		0.0014			0.30	111			37
COB MW-3	07/13/10	4410.03	BMO-2010-3B	07/28/10	4435.21	25.18	2929	0.0086			1.89	690			6
	07/14/11	4406.22		07/13/11	4433.29	27.07		0.0092			2.03	742			6
COB MW-3	02/12/09	4427.72	BMO-2008-4B	02/18/09	4442.59	14.87	6430	0.0023			0.51	186			22
	04/23/09	4413.5		04/30/09	4441.93	28.43		0.0044			0.97	355			12
	07/22/09	4414.54		08/06/09	4441.21	26.67		0.0041			0.91	333			12
	10/22/09	4420.6		10/27/09	4441.13	20.53		0.0032			0.70	256			16
	03/03/10	4418.49		02/24/10	4441.35	22.86		0.0036			0.78	285			14
	04/26/10	4415.51		04/16/10	4440.52	25.01		0.0039			0.86	312			13
	07/13/10	4410.03		07/02/10	4439.97	29.94		0.0047			1.02	374			11
	07/14/11	4406.22		07/22/11	4438.37	32.15		0.0050			1.10	402			10
COB MW-3	10/23/08	4420.7	BMO-2008-5B	09/30/08	4440	19.3	4254	0.0045			1.00	364			11
	02/12/09	4427.72		02/18/09	4440.75	13.03		0.0031			0.67	246			17
	04/23/09	4413.5		04/27/09	4440.32	26.82		0.0063			1.39	506			8
	07/22/09	4414.54		08/04/09	4439.74	25.2		0.0059			1.30	476			9
	10/22/09	4420.6		10/29/09	4439.22	18.62		0.0044			0.96	351			12
	03/03/10	4418.49		02/15/10	4439.68	21.19		0.0050			1.10	400			10
	04/26/10	4415.51		04/15/10	4439.3	23.79		0.0056			1.23	449			9
	07/13/10	4410.03		07/07/10	4438.51	28.48		0.0067			1.47	538			8
	07/14/11	4406.22		07/13/11	4436.79	30.57		0.0072			1.58	577			7

ft amsl = feet above mean sea level; ft = feet; ft/ft = feet per foot; ft/day = feet per day; ft/yr = feet per year

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Table 6
Sulfate Concentrations at Wells Downgradient of the Sulfate Plume

Well Name	ADWR 55 Registry No.	Sample Date	Sulfate, dissolved (mg/L)
AWC-02	616586	1/7/08	14
		3/3/08	16
		5/5/08	13.3
		8/12/08	14.3
		10/23/08	15.9
		3/11/09	15.5
		4/22/09	14.7
		7/22/09	14.2
		10/21/09	16.8
		2/3/10	18.6
		4/23/10	18.3
		7/20/10	18.2
		11/4/10	18.8
		1/19/11	18.4
		4/7/11	17.3
		7/13/11	12.9
AWC-03	616585	1/7/08	41
		3/3/08	38
		5/5/08	37.3
		8/12/08	38.8
		10/23/08	41.8
		3/11/09	64.2
		4/22/09	42.4
		7/22/09	41.8
		10/21/09	50.5
		2/3/10	42.0
		4/23/10	44.4
		7/20/10	46.7
		11/4/10	46.3
		1/19/11	49
		4/7/11	46.8
		7/13/11	47.6
		7/13/11	46.2
AWC-04	616584	2/4/08	18
		4/7/08	18
		6/2/08	14.3
		8/12/08	21.6
		10/23/08	24
		3/11/09	27.2
		4/22/09	26.1
		7/22/09	26.2
		10/21/09	25.7
		2/3/10	16.3
		4/23/10	27.4
		7/20/10	26.6
		11/4/10	24
		1/19/11	26.2
		4/7/11	25.8
		7/13/11	25.7

Table 6
Sulfate Concentrations at Wells Downgradient of the Sulfate Plume

Well Name	ADWR 55 Registry No.	Sample Date	Sulfate, dissolved (mg/L)
AWC-05	590620	2/4/08	13
		4/7/08	14
		6/2/08	14.3
		8/12/08	14.9
		10/23/08	15.4
		3/11/09	16.5
		6/3/09	12.1
		7/22/09	14.1
		10/21/09	16.5
		2/3/10	16.3
		4/23/10	17.6
		7/20/10	19.1
		11/4/10	18.4
		1/19/11	17
		4/7/11	17.6
		7/13/11	17.9
BMO-2008-5B	909653	9/30/08	193
		2/18/09	192
		4/27/09	177
		8/4/09	174
		10/29/09	181
		10/29/09	185
		2/15/10	185
		4/15/10	194
		7/7/10	183
		10/5/10	201
		2/14/11	203
		5/12/11	195
		7/13/11	200
BMO-2008-6B	909146	7/16/08	53.3
		11/4/08	60.3
		2/19/09	54.3
		4/27/09	52.7
		8/4/09	48.5
		10/26/09	48.7
		2/15/10	33.5
		4/15/10	37.0
		7/1/10	40.1
		10/5/10	37.2
		2/14/11	40.2
		5/12/11	35.0
		7/12/11	37.8
COB MW-3	906823	2/28/08	57.8
		3/27/08	57.7
		4/30/08	37
		5/20/08	35.8
		7/24/08	64.9
		7/30/08	67.3
		10/9/08	52.5
		10/23/08	76.6
		2/12/09	112
		4/23/09	43.7
		7/22/09	52.3
		10/22/09	74.2
		10/22/09	73.9
		3/3/10	102
		4/26/10	77.6
		7/13/10	46.5
		7/14/11	40.1

mg/L = milligrams per liter

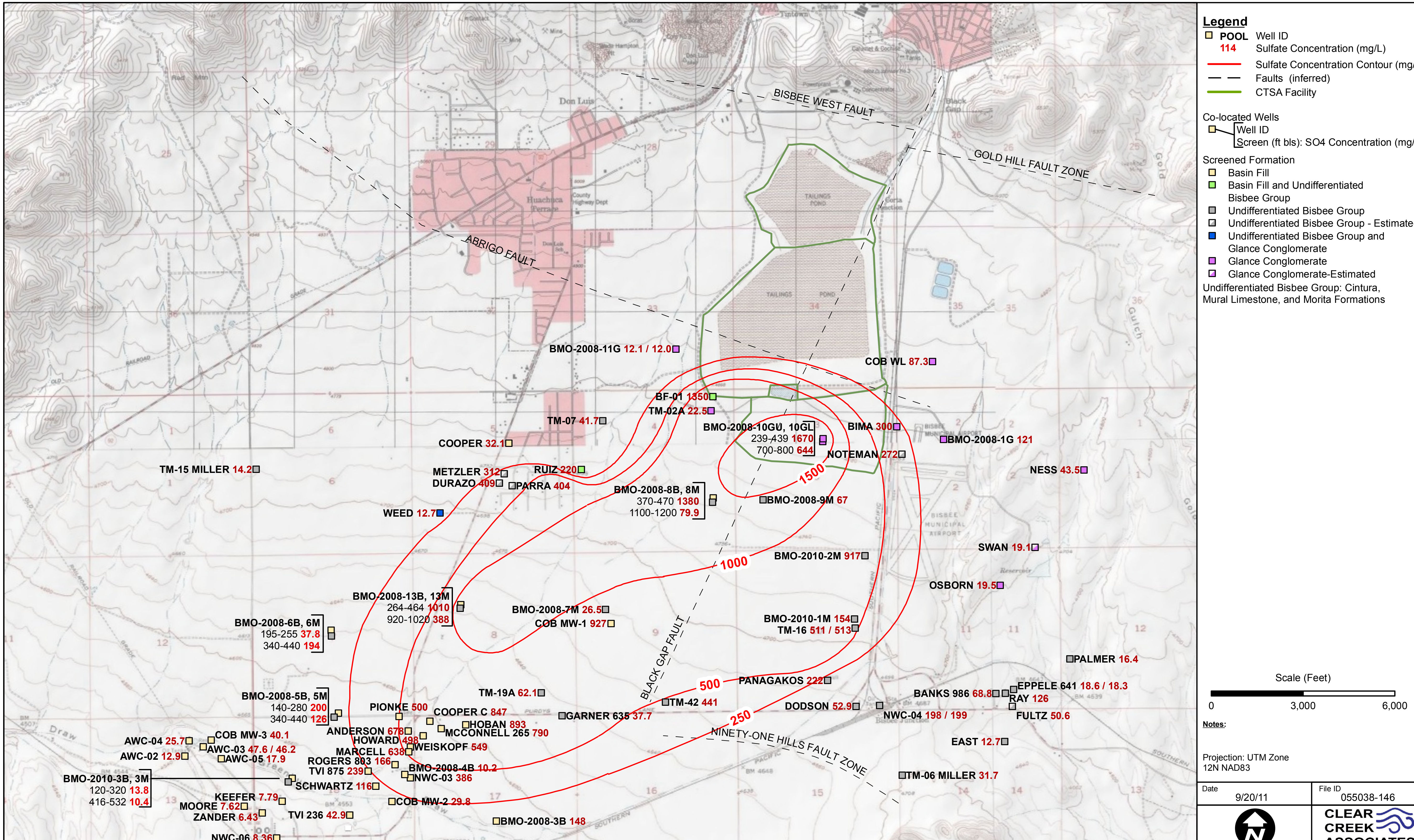
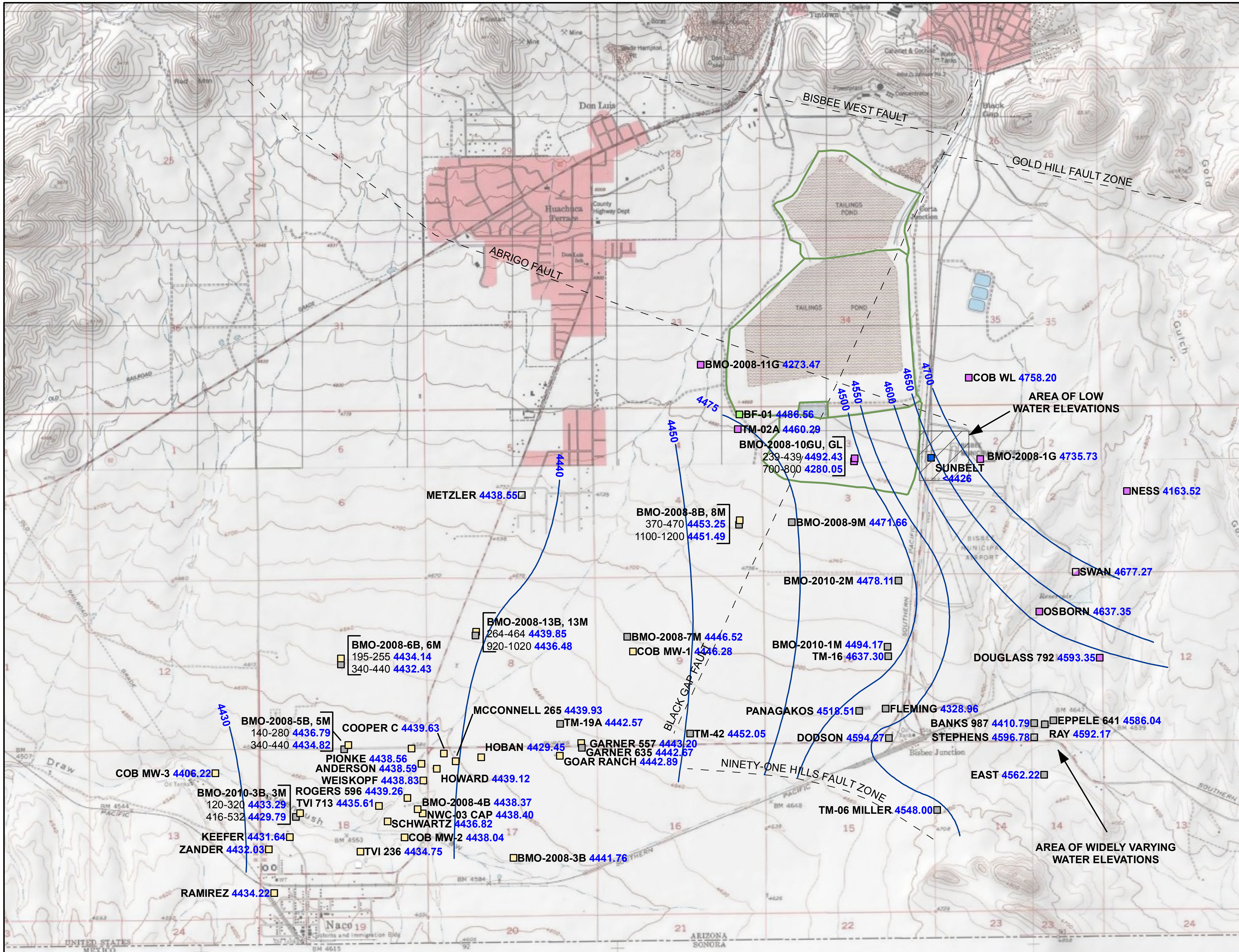


Figure 1
Sulfate Concentrations in Groundwater
Third Quarter 2011



Legend

BIMA Well ID
4406.83 Groundwater Elevation (ft amsl)
Groundwater Elevation Contours (dashed where inferred)
Faults (inferred)
CTSA Facility

Co-located Wells
Well ID
Screen (ft bls): Water Elevation (ft amsl)

Screened Formation
- Basin Fill
- Basin Fill and Undifferentiated Bisbee Group
- Undifferentiated Bisbee Group
- Undifferentiated Bisbee Group - Estimated
- Undifferentiated Bisbee Group and Glance Conglomerate
- Glance Conglomerate
- Glance Conglomerate-Estimated

Undifferentiated Bisbee Group: Cintura, Mural Limestone, and Morita Formations

Scale (Feet)
0 3,000 6,000

Notes:
Projection: UTM Zone 12N NAD83

Date 9/20/11
File ID 055038-145

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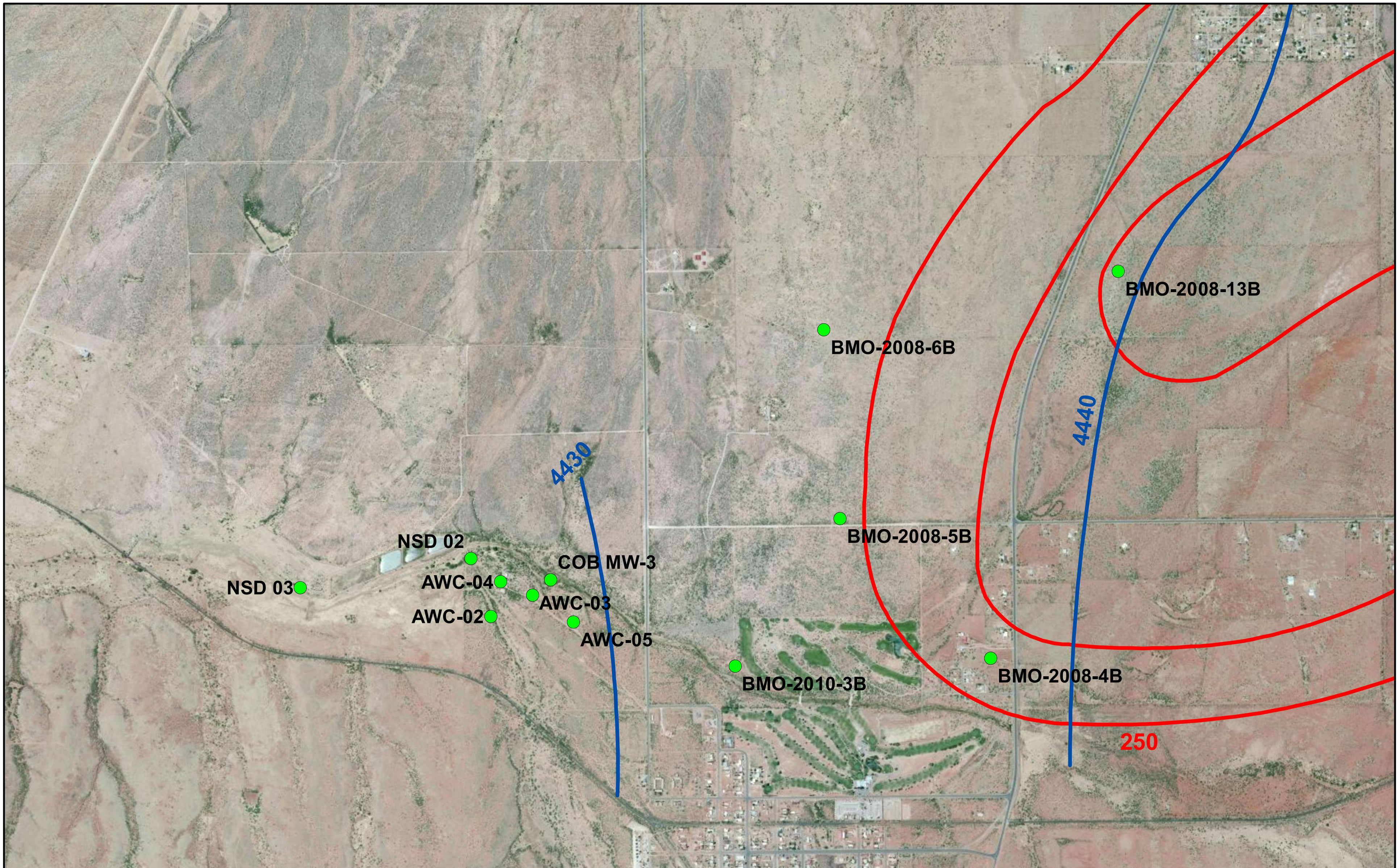
Figure 2
Groundwater Elevations
Third Quarter 2011



Legend

Well Location

Sulfate Concentration Contour Third Quarter 2011 (mg/L)

Groundwater Elevation Contour Third Quarter 2011 (ft amsl)

0 1,000 2,000

Feet

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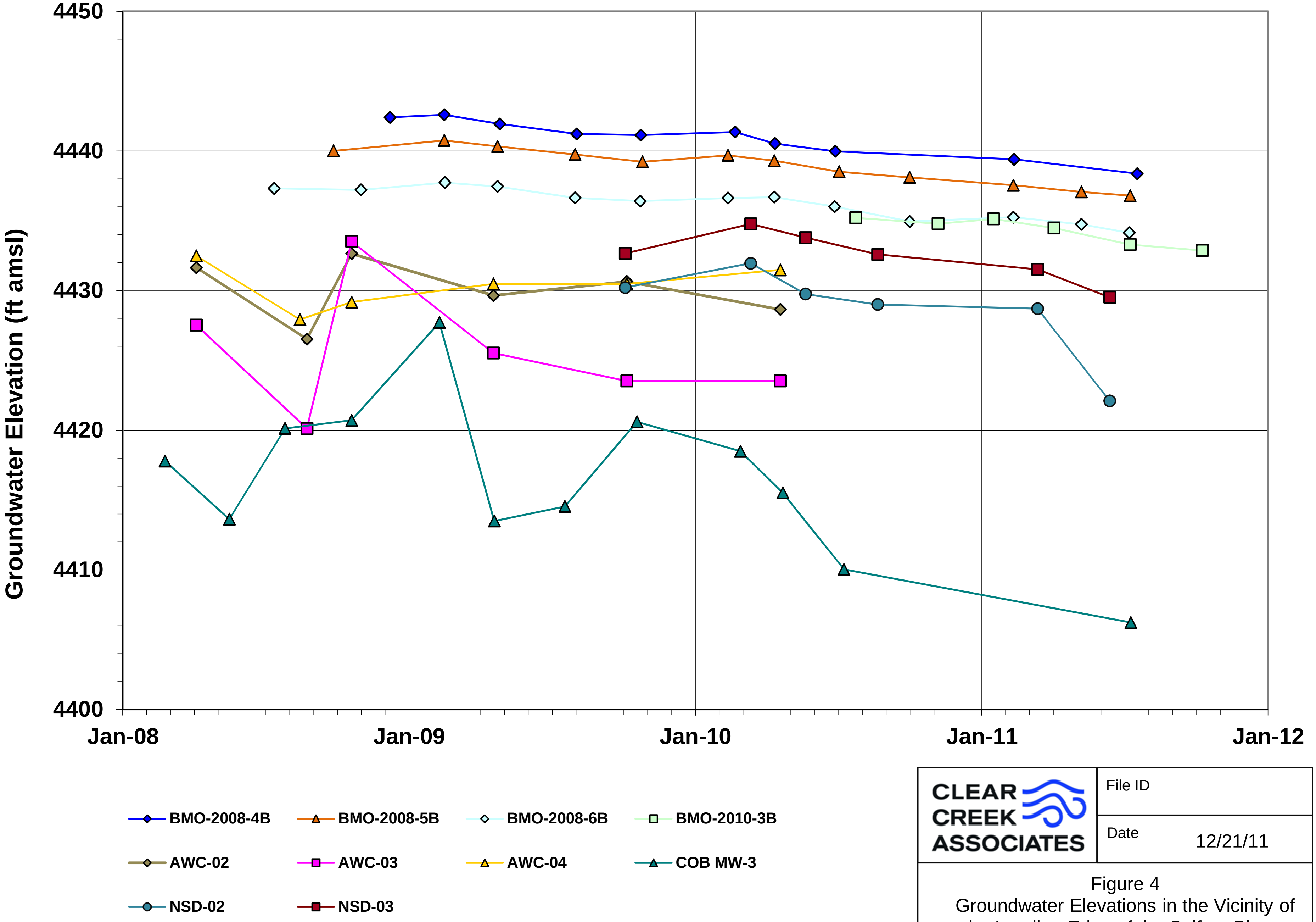
File ID 055038-167

Date 12/22/11

Figure 3
Basin Fill Wells
in the Vicinity of the Leading
Edge of the Sulfate Plume



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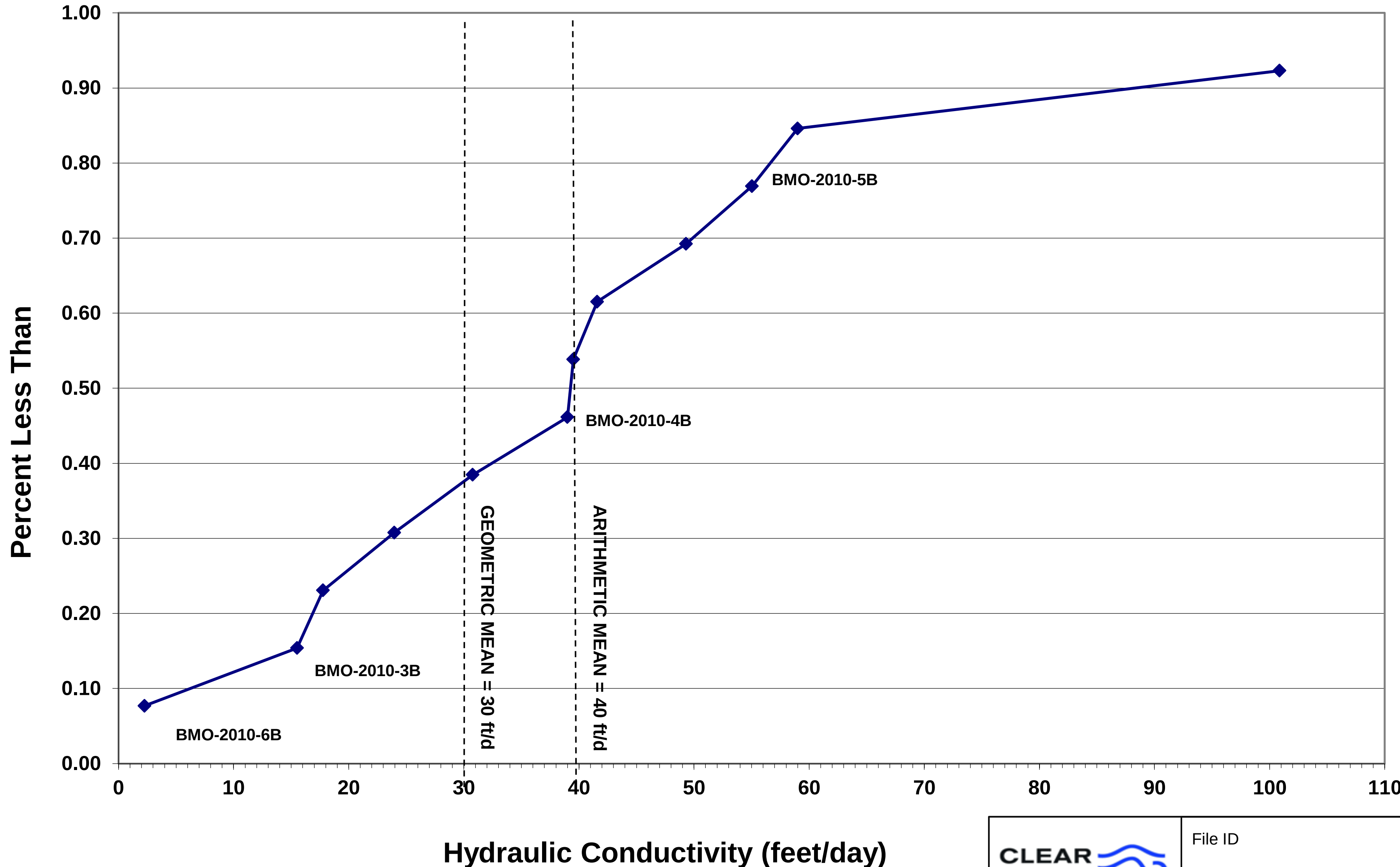
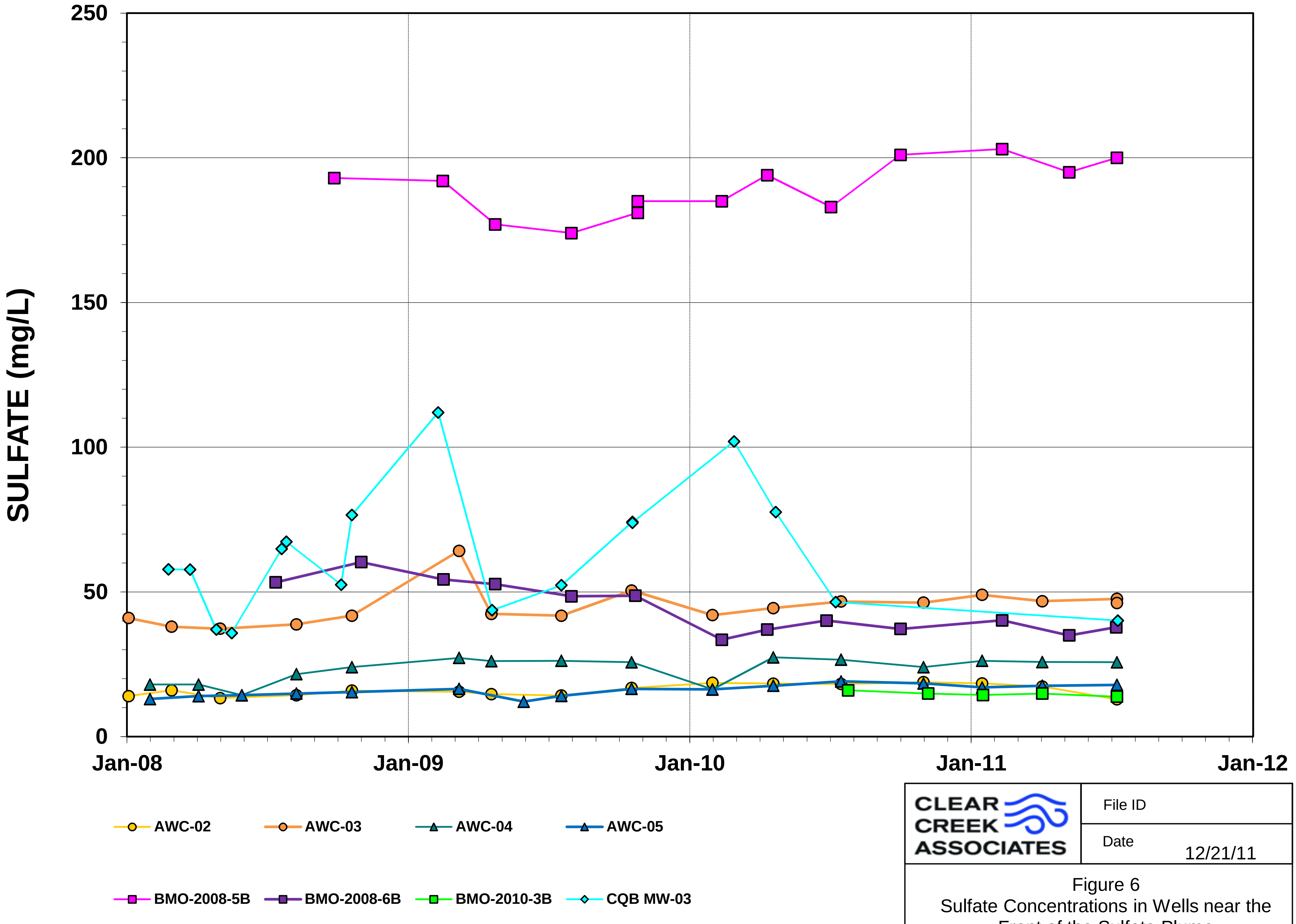
File ID	
Date	12/21/11

Figure 4
Groundwater Elevations in the Vicinity of the Leading Edge of the Sulfate Plume



CLEAR CREEK ASSOCIATES	File ID
	Date 12/21/11

Figure 5
Basin Fill Hydraulic Conductivities



CLEAR CREEK ASSOCIATES	File ID Date 12/21/11

Figure 6
Sulfate Concentrations in Wells near the Front of the Sulfate Plume