East Mission Flats Repository
2012 Annual Water Monitoring Report

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Acronyms and Abbreviations

BPRP	Basin Property Remediation Program
CDA	Coeur d'Alene
CLP	Contract Laboratory Program
COPC	Chemical of Potential Concern
CRQL	Contract Required Quantitation Limit
DO	Dissolved Oxygen
EMFR	East Mission Flats Repository
EMP	Enhanced Monitoring Plan
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
IDEQ	Idaho Department of Environmental Quality
MDL	Method Detection Limit
mg/L	milligrams per Liter
mV	millivolt
ORP	Oxidation-Reduction Potential
OU	Operable Unit
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
SAP	Sampling and Analysis Plan
SCM	Site Conceptual Model
USEPA	U.S. Environmental Protection Agency

Section 1.0 Introduction and Purpose

The East Mission Flats Repository (EMFR) is located approximately 2 miles west of Cataldo, Idaho on the north side of Interstate 90, northeast of the Cataldo Mission (Figure 1). Since August 2009, the EMFR has been used as a disposal site in support of the *Bunker Hill Mining and Metallurgical Complex Operable Unit 3 (OU3) Record of Decision* (USEPA 2002). Waste materials from a variety of sources (e.g., Basin Property Remediation Program [BPRP], Institutional Controls Program, and commercial and infrastructure development projects) in OU3 are disposed at the EMFR. Approximately 38,200 cubic yards of waste soils were placed at EMFR during the 2012 construction season (North Wind 2013). The waste materials deposited at the EMFR contain inorganic metals associated with historical mining activities. In order to demonstrate that waste disposal is not further contributing to elevated metals concentrations in water in the vicinity of the repository, monitoring of groundwater, pore water, and periodic floodwater occurs. The metals or chemicals of potential concern (COPCs) in groundwater for protection of human health include antimony, arsenic, cadmium, lead, and zinc.

The objectives of the sampling and monitoring activities at EMFR are to 1) evaluate water levels and water quality parameters of pore water within the repository waste; 2) evaluate the quality of floodwater entering and leaving the site; 3) evaluate hydraulic gradients and groundwater flow direction over time, both vertically and horizontally at the EMFR site; and 4) evaluate the potential effects of the repository on groundwater.

The purpose of this annual report is to summarize and discuss the sampling and monitoring data collected at the EMFR through 2012 relative to the sampling and monitoring objectives.

Section 2.0 Site Conceptual Model

The Site Conceptual Model (SCM) summarized below is based on information from the 90% Design Report (TerraGraphics 2009a), the Enhanced Monitoring Plan (EMP) (TerraGraphics 2009b), and data collected since these documents were produced.

The Coeur d'Alene River (CDA) River flows in an approximate arc around the site three quarters of a mile to the east, south, and west. The EMFR is located in the floodplain of the CDA River. The floodplain extends into the broader part of the valley that makes up the Cataldo Flats and experiences frequent flooding during spring runoff. Sediment contaminated with inorganic metals is carried by the floodwater and deposited on the surrounding floodplain during each flood event. These contaminated sediments comprise approximately the upper 3 feet of native material at EMFR, prior to any waste being placed within the repository.

A review of monitoring well boring logs indicates i) approximately 10 to 15 feet of silt and clay exist below ground surface (bgs), ii) an upper aquifer composed of alluvial sand and gravel exists to 105 feet bgs, iii) a silt layer exists to 116 feet bgs, and iv) a lower aquifer lies below 116 feet bgs. Wells 07-EMF-MW-A (MW-A), 07-EMF-MW-B (MW-B), 07-EMF-MW-C (MW-C), and 07-EMF-MW-D (MW-D) are all screened from about 18 to 28 feet bgs. Well 08-EMF-MW-E (MW-E) is screened from 15 to 25 feet bgs, and 08-EMF-MW-F (MW-F) is screened from 20 to 30 bgs. Both of these wells are located outside the immediate EMFR area (Figure 2). MW-A, MW-B, MW-C, MW-D, and MW-F are completed in the upper aquifer (Figure 2). MW-E is located approximately 1,750 feet to the northwest of the repository and has a much higher water level, different water quality, and different lithology based on the well log compared to the other wells, suggesting it is in a different hydrologic unit. Well 09-EMF-MW-C-Deep (MW-C-Deep) is completed with perforations in the depth range of 75 to 95 feet. The Decontamination well (Decon well) is completed with perforations in the depth range of 58 to 78 feet from top of native land surface (76 to 96 feet from top of the repository surface). MW-C-Deep and the Decon well are screened deeper in the upper aquifer than the other wells.

A strong surface water-groundwater interaction occurs at the site, as observed in water levels, and is likely related to the upper sand and gravel aquifer extending to the CDA River. Shallow groundwater beneath the site generally flows toward the southwest, but during high-water events the gradient shifts toward the west/northwest. Also during high-water events, the groundwater vertical hydraulic gradient is upward, whereas during other times of the year the vertical gradient is downward.

Groundwater levels in the upper aquifer are below the base of the repository for most of the year. However, wells completed in the upper aquifer show groundwater levels rising above the base of the repository during periods of high river stage. Overbank flooding associated with high river stage and possible upward groundwater flow result in the presence of floodwater near the repository during high-water events.

Section 3.0 Methods

Groundwater, floodwater, and water within the repository waste were monitored at the EMFR in 2012. Figure 2 shows the 2012 monitoring network, consisting of the following:

- Seven groundwater monitoring wells: MW-A, MW-B, MW-C, MW-C-Deep, MW-D, MW-E, and MW-F, plus the Decon well.
- Two surface water (i.e., floodwater) level sites: LL-1 and LL-2.
- Four floodwater sampling sites: EMF-SW-A (SW-A), EMF-SW-B (SW-B), EMF-SW-C (SW-C), and EMF-SW-D (SW-D).
- Two piezometers: 10-EMF-PZ-A (PZ-A) and 10-EMF-PZ-B (PZ-B).

The EMFR Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP) provides more detail on the monitoring, sampling, documentation, analytical, and data-review procedures for all but the floodwater and piezometer locations (TerraGraphics 2010). Documentation of floodwater and piezometer sampling procedures will be incorporated into the forthcoming EMFR SAP/QAPP revision.

Quarterly groundwater monitoring and sampling occurred in January, April, July, and October 2012. Groundwater and floodwater samples were shipped to the U.S. Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) designated laboratory and analyzed for total and dissolved metals (antimony, arsenic, cadmium, lead, and zinc), hardness, total phosphorus, and dissolved cations (calcium, magnesium, potassium, and sodium). Groundwater samples were also delivered to the Idaho Department of Environmental Quality's (IDEQ) contracted local laboratory (SVL Analytical, Inc.) and analyzed for dissolved anions (chloride, nitrate and nitrogen, and sulfate) and alkalinity. Floodwater samples were delivered to SVL

Analytical and analyzed for total and dissolved metals (antimony, arsenic, cadmium, lead, and zinc).

3.1 Groundwater Monitoring and Sampling

The field crew collected groundwater samples using dedicated low-flow pumps at the seven monitoring wells and the production pump in the Decon well. The Decon well was not sampled in the third and fourth quarters of 2012 because it was winterized during the off-season.

Dataloggers are deployed in select wells (MW-A, MW-B, MW-C, MW-C-Deep, and MW-D) and record water-level measurements every half hour. Dataloggers were downloaded quarterly during the sampling events. Water levels were measured by hand at the seven monitoring wells (MW-A, MW-B, MW-C, MW-C-Deep, MW-D, MW-E, and MW-F). The water-level data from the dataloggers were compensated for barometric pressure.

Groundwater field parameters were measured prior to sample collection. Field parameters include temperature, pH, specific conductance, dissolved oxygen (DO), and oxidation-reduction potential (ORP).

Total depths were measured in the groundwater monitoring wells using an E-tape during the fourth quarter 2012 sampling event. This allowed for the determination of sediment accumulation that may cause clogging of the well screen.

3.2 Floodwater Monitoring and Sampling

Floodwater sampling was conducted opportunistically at the direction of the USEPA. Floodwater sampling occurred when water was flowing into the site (April 26, 2012) and when water was flowing out of the site (April 30, 2012). Water levels were measured by dataloggers at both floodwater sites (LL-1 and LL-2). See Appendix A for a more detailed description of floodwater sampling.

3.3 Piezometer Monitoring and Sampling

A water quality probe, In-Situ Troll® 9500 (Troll), is installed in PZ-A and records water level, temperature, pH, DO, conductivity, and ORP. A datalogger that records water levels is deployed in PZ-B. Equipment operations, data reporting, and data computations were reviewed for the Troll data following Wagner et al. (2006). An attempt to collect a sample at PZ-A occurred on May 2, 2012, but sufficient water was not present to follow standard groundwater monitoring protocols. See Appendix B for a more detailed description of the piezometer monitoring.

3.4 Data Analysis and Statistical Methods

The following subsections describe how data were reviewed and/or analyzed for this annual report.

3.4.1 Water Levels and Hydraulic Gradient

Water levels were used to evaluate the hydrologic conceptual model of the EMFR area, horizontal and vertical hydraulic gradients, and groundwater flow direction. Groundwater fluctuations were compared to the CDA River stage elevation at the U.S. Geological Survey gage station at Cataldo (Site #12413500, http://waterdata.usgs.gov/usa/nwis/uv?site_no=12413500).

3.4.2 Data Quality Review

A data-quality review was conducted to ensure compliance with the SAP/QAPP (TerraGraphics 2010). Information was reviewed for holding times, appropriate preservation, field quality control (QC) sample frequency, laboratory verification and validation, and data completeness. The data-quality review included Stage 2A validation review of the SVL data (USEPA 2009a, 2010). The USEPA chemist conducted Stage 4 data verification and validation on 100% of the CLP-analyzed data (USEPA 2009a, 2010). The USEPA data validation reports and field quality assurance/quality control (QA/QC) sample results were reviewed and summarized as part of the data-quality review.

3.4.3 Regulatory Thresholds

Dissolved metals data were compared to regulatory thresholds. Regulatory thresholds for antimony, arsenic, cadmium, and lead in groundwater are the National Primary Drinking Water Standards (i.e., maximum contaminant levels) and the regulatory threshold for zinc is the National Secondary Drinking Water Standard. These standards are based on total concentrations; however, the dissolved metal concentrations in the groundwater are compared to the regulatory thresholds because it is assumed that dissolved concentrations are indicators of contamination in groundwater under all conditions (CH2M Hill 2006).

3.4.4 Exploratory Analysis

To evaluate the potential effects of the repository on groundwater, dissolved metal and field parameter data are the focus of this report. Total metals, hardness, total phosphorous, dissolved cations and anions, and alkalinity were analyzed by the laboratory and data are maintained electronically if future analyses are needed. Dissolved metal data for each well were evaluated for the frequency of detected results (i.e., results reported by the laboratory as detected above the level of the reported sample quantitation limit), frequency of detected results above the reporting limit[1], and frequency above the regulatory threshold. The metals with at least one well having a greater than 50% detection frequency were graphed on time-series plots. Patterns in the data were explored by examining the detection frequencies in combination with the time-series plots. For those data where dissolved metals were not detected, a value of half the detection limit was used to display in the figures. Some detected sample results were also detected in the associated field blank and were qualified as estimates based on the data validation and verification procedures. These dissolved metals data were shown in the time-series plots and discussed if they affected data patterns. Field parameter data were also graphed on time-series plots and examined for patterns in the data set.

3.4.5 Statistics

Statistical analyses as described in USEPA's Unified Guidance (USEPA 2009b) were conducted to further analyze the dissolved metals data for trends in groundwater quality. Non-parametric

[1] Reporting limit is defined in the SAP/QAPP (TerraGraphics 2010).

statistical tests were used for these analyses. Nonparametric analyses do not require the data to be normally distributed.

The Mann-Kendall statistical analysis was used to evaluate if trends in select dissolved metals have occurred in groundwater over time at the EMFR. The Kruskal-Wallis rank sum test was first conducted prior to the Mann-Kendall to test for significant differences between seasons (using α=0.05). If significant seasonal bias was observed, then the seasonal Mann-Kendall analysis was used.

The dissolved metals data used in the statistical analyses are presented in Section 4.3.5. However, some data were excluded from the statistical analyses as described below. It was not possible to conduct statistical analyses for those wells and analytes where all sample results were below the detection limit because there was zero variation in analyte concentration measurements during the monitoring period. Statistical trend analyses were also not conducted for those wells and results with less than 50% detection frequency and/or a sample size of less than eight ($n \leq 8$). These wells and metals are discussed qualitatively in this report using the exploratory analysis described above in Section 3.4.4. For non-detect data included in the trend analysis, one half the lowest detection limit was substituted as the analyte concentration to ensure all non-detect values were lower than the lowest detected value for each well (USEPA 2009b). Some detected sample results were within five times the concentration detected in the field blank and were withheld from the statistical analysis, because the measured concentrations may be due to sources other than the groundwater and may bias the trend analysis (USEPA 1989).

A Nonparametric Prediction Limit Test was performed to determine if any sample concentrations from 2012 were higher than the maximum observed pre-construction background concentration. The Nonparametric Prediction Limit Test was conducted for all analytes that had at least one detected result; substitution was not used for non-detected values because the test evaluated maximum values. The prediction limit value was the maximum background concentration for each analyte for all the wells at the EMFR, except for the Decon well and MW-E. This background value was then compared to the 2012 data. The Confidence Level, which represents the probability that an exceedance value indicates a statistically significant increase in analyte concentrations, was calculated based on the USEPA Unified Guidance (USEPA 2009b) Chapter 18 equation.

$$\textit{Confidence Level} = n/(n+m)$$

where:

n represents the number of background samples for each analyte, including all wells used in the analysis.

m represents the number of future samples that are currently being tested against the prediction limit.

The number of pre-construction background samples at EMFR, *n*, for each analyte is 32. Because the prediction limit test is conducted annually with samples that are collected quarterly, *m* is calculated by multiplying the total number of wells for each analyte by four (not including results less than five times the field blank result).

Section 4.0 Results and Discussion

This section presents results and discusses the piezometer monitoring data, floodwater sampling data, and groundwater data including sediment infilling in wells, hydraulic gradients, field parameters, and dissolved metals. Quarterly monitoring memoranda and QA/QC memoranda were prepared after each sampling and monitoring event (TerraGraphics 2012d, e, f; and 2013b).

4.1 Piezometer Monitoring Data

Piezometers PZ-A and PZ-B are screened within the waste at EMFR (Figure 2). No water was detected in PZ-B in 2012, nor has it ever contained water since deployment of the datalogger in 2011. Water was observed in PZ-A seasonally; it was detected above the water-level sensor on April 24, 2012, and fell below the sensor on July 6, 2012 (Figure 3). An attempt to collect a water sample from PZ-A occurred on May 2, 2012; however, there was not enough water to collect a sample following the procedures outlined in the SAP/QAPP. During sampling, the piezometer was pumped dry and water was not detected for 24 hours following the sample attempt.

The 2012 Troll data show the water in PZ-A had a near-neutral pH, lacked DO, and had a fairly high conductivity (see Appendix B for details). The USEPA Office of the Inspector General's review of the site indicated that if reducing conditions exist in the repository, adsorbed metals may be released into solution and contaminate the groundwater (USEPA 2009c). Release of metals into groundwater was evaluated by examining the groundwater dissolved metal data (see Sections 4.3.4 and 4.3.5). An initial analysis was performed on the PZ-A 2012 water-level and water-quality data to evaluate the causal mechanisms for the water present at that location (see Appendix B). Water in PZ-A is possibly from infiltration of precipitation, groundwater upwelling, lateral infiltration of floodwater, or a combination thereof. The source of water in the repository, as represented by the PZ-A 2012 water-level data, is undetermined at this time. However, the water level data suggest that precipitation is not as likely a source of water in EMFR compared to the vertical flow of groundwater and/or the lateral migration of floodwater.

4.2 Floodwater Data

The hydrograph of the CDA River generally corresponded to the floodwater (LL-1) site hydrograph as shown in Figure 3. Overall, metals concentrations were higher in floodwater entering the site compared to floodwater leaving the site. These data suggest that surface water quality is not negatively impacted by the repository. For more details, see Appendix A.

4.3 Groundwater Monitoring Data

4.3.1 Sediment Infilling

Depth to bottom of the well was measured (to an accuracy of 0.01 feet) at seven of the eight monitoring wells to determine if sediment is accumulating in the wells and causing clogging of the well screen. Depth to bottom in the Decon well was not measured because the pump is permanently deployed. In 2011 and 2012, the depth to bottom in all seven wells has remained unchanged. Based on these measurements, sediment infilling did not occur in the groundwater monitoring wells.

4.3.2 Water Levels and Groundwater Hydraulic Gradients

Figure 3 presents hydrographs of wells with water-level instruments installed, PZ-A, LL-1 (floodwater site), and the CDA River. Overall, groundwater and floodwater (at LL-1) fluctuations correlate well with fluctuations in the CDA River. Groundwater levels were highest in the spring and lowest in the fall and closely mimicked the river patterns. The lowest horizontal gradients observed in Figure 3 (as shown by similar water-level elevations in all the wells) occurred during periods of low water levels in fall/winter, as well as on the rising limb of individual water-level peaks (with the exception of the two highest peaks in late March 2012 and late April 2012).

Water levels from MW-A, MW-B, MW-C, MW-D, and MW-F were used to evaluate the flow direction and horizontal hydraulic gradient. The MW-E water level elevation is not included in the contour map because it is considered to be in a different hydrologic unit. As an example of the general site conditions, Figure 4 presents a contour map showing the 2012 third quarter groundwater elevations measured during sampling. The general flow direction in 2012 was from the north-northeast to south-southwest, with some flow to the south-southeast. Therefore, well MW-D is upgradient from EMFR, with wells MW-B, MW-C, MW-C-Deep (screened deeper so not included in the contour map), and MW-F downgradient. Well MW-A is located cross-gradient to the repository during most of the year. Based on hand measurements collected during the 2012 quarterly sampling events, the lowest hydraulic gradient near the repository footprint was 4.6×10^{-4} feet/foot (January) and the highest hydraulic gradient near the repository footprint was 1.1×10^{-3} feet/foot (April).

Figure 5 is a contour map of the March 31, 2012 groundwater peak, as measured by the dataloggers, showing the horizontal hydraulic gradient shift. MW-F is not included because it does not have a datalogger installed. The hydraulic gradient at this time was from the southeast toward the northwest for about eight days, with MW-A as the upgradient well. All of the wells except MW-E are screened in a gravel layer that may extend to the CDA River located to the east. At high river levels, the river may recharge this gravel layer.

Based on manual water-level measurements taken during the October 2012 sampling event there appears to be an anomalous horizontal hydraulic gradient reversal between MW-F and MW-B where flow is toward the northeast. At this time, it is unclear if this reversal is reflective of i) actual conditions, ii) a measurement or recording error, or iii) water-level measurements collected on two different days. Future sampling events will measure water levels in a single day to eliminate this as a potential source of error. Additional steps may be taken to further define groundwater flow in this area.

Water levels from MW-C and MW-C-Deep were used to evaluate the vertical hydraulic gradient. These two wells are located less than 50 feet apart and MW-C-Deep is approximately 67.5 feet deeper than MW-C. Figure 6 shows a hydrograph of these two wells. Generally, there was a slight downward hydraulic gradient during most of the year. However, at the two highest groundwater-level elevations in 2012 (late March and late April) there was an upward hydraulic gradient noted by the higher water level elevation in MW-C-Deep. During the late-March 2012 water-level peak, the upward hydraulic gradient occurred for approximately three days. During the late-April 2012 water-level peak, the upward hydraulic gradient occurred for approximately seven days.

4.3.3 Groundwater Field Parameters

Figure 7 presents graphs of field parameters pH, ORP, and specific conductance. Appendix C contains a table of all field-parameter data. DO is not shown because the groundwater exhibits low DO (except the Decon well), and remains so at most wells. Wells MW-B and MW-C had spikes of higher DO in April 2012, likely due to groundwater recharge; DO was then depleted by the next sampling event. The spikes at MW-B and MW-C in 2012 were higher than the historical maximum for DO at these two wells (see Appendix C) and could have been due to the timing of the event with respect to aquifer recharge.

The pH values recorded in April 2012 at wells MW-B, MW-C, MW-C-Deep, and MW-D were higher than those previously recorded for each respective well (see Appendix C). However, as seen in Figure 7, there was no apparent trend and pH generally hovered around 5.5, which is slightly acidic and similar to the pH of typical rainwater.

ORP values were fairly consistent between wells, with the exception of MW-E. ORP values in all wells appear to be decreasing over time since monitoring began (before the start of waste disposal) to less than 200 millivolts (mV), approaching a reducing environment (Figure 7). The 2012 ORP values were consistent with that trend, except MW-F had one high value in the last quarter of 2012.

The 2012 specific conductance results were similar to past years. Specific conductance was fairly low in groundwater and has no apparent trend, except for MW-E, which has been increasing for the duration of monitoring. Field-parameter results for MW-E were different from the other wells, which is one reason this well is believed to be in a separate hydrologic unit.

4.3.4 Data Quality Review Summary

A total of 42 groundwater samples were submitted for laboratory analysis during 2012. Thirty (30) samples were collected from eight sites and eight samples were collected for QA/QC purposes (i.e., field duplicate and field blank). All field QA/QC samples were collected at the appropriate frequency. All holding times were met and preservation was confirmed by the laboratories.

All analytical methods followed those as outlined in the SAP/QAPP (TerraGraphics 2010). A USEPA chemist reviewed all CLP data by conducting Stage 4 data validation and verification; data validation reports are contained in the quarterly QA/QC memoranda. A detailed record of the data quality review results can be found in the quarterly QA/QC memoranda (TerraGraphics 2012a, b, c; and 2013a). The USEPA chemist qualified select sample results from various sites as estimates (J) because the reported results were above the Method Detection Limit (MDL) but below the Contract Required Quantitation Limit (CRQL). Select samples were also qualified as estimates by USEPA chemists due to the Inductively Coupled Plasma Mass Spectrometry (ICP-MS) serial dilution results having a greater than 10% difference and an initial sample greater than 50 times the MDLs. No samples were qualified as estimates by SVL Analytical.

Select sample results from various sites were qualified as estimates due to concentrations that were not 10 times greater than the associated field blank concentrations. No sample results were rejected and the final completeness in 2012 is assessed at 100%.

4.3.5 Groundwater Dissolved Metals Data

Appendix C contains the 2012 groundwater dissolved metals data and Figure 8 presents time-series plots of dissolved arsenic, cadmium, and zinc results. Arsenic, cadmium, and zinc have at least two wells with detection frequencies of greater than 50% as shown in Appendix D.

Dissolved antimony was not detected from any of the wells during 2012, nor has it been detected from any well since monitoring began at EMFR in 2007.

Dissolved lead was not detected above the reporting limit from any of the wells during 2012, nor has it been detected above the reporting limit from any well historically (Appendix C).

Dissolved arsenic has never exceeded the regulatory threshold from any well except MW-E (see Figure 8). Prior to 2012, six arsenic results from MW-E have been observed above the regulatory threshold; however, this well is considered to be in a different hydrologic unit. The Mann-Kendall analysis completed for MW-E only did not show a significant trend in arsenic results over time, indicating that EMFR is not further contributing to arsenic at MW-E (see Table 1). The patterns observed in Figure 8 for all wells except MW-E are likely not true increases in dissolved arsenic in 2012 and may be an artifact of the detection in the associated field blank (see Section 4.3.4).

Dissolved cadmium did not exceed the regulatory threshold during any sampling events in 2012. As seen in Figure 8, no significant trend over time was detected by the Mann-Kendall analysis for wells MW-A, MW-C, and MW-F (see Table 1). This suggests that EMFR is not negatively impacting dissolved cadmium concentrations.

Since monitoring began, dissolved zinc has been detected above the reporting limit 100% of the time at all wells, with the exception of MW-C-Deep and MW-E (78% and 75%, respectively – see Appendix D). The Mann-Kendall analysis was performed for zinc at all wells, except the Decon well where only five values exist. Seasonal Mann-Kendall was completed for MW-D because the results of the Kruskal-Wallis rank sum test showed there was a significant difference between seasons ($p=0.016$). No other well showed a significant seasonal trend for any of the data. Results from the Mann-Kendall trend analyses indicate a statistically significant decreasing trend for zinc at MW-B and a statistically significant increasing trend for zinc at MW-A (Table 1). There were no other significant trends for zinc at any other well. An increasing trend in zinc concentrations at MW-A may not be indicative of contamination associated with the repository because MW-A is considered cross-gradient to the repository except at high flow when it is upgradient of the repository. Additionally, concentrations at MW-A have not been near regulatory thresholds (see Figure 8). Prior to 2012, no dissolved zinc result exceeded the regulatory threshold of 5.0 milligrams per liter (mg/L). Only one exceedance of the regulatory threshold occurred during 2012 (i.e., the August sample from the Decon well). It is unknown if this detected zinc concentration could be related to the pitless adaptor break in the Decon well discovered on October 8, 2012. A break in the pitless adaptor caused a significant amount of water to come out of the adaptor and into the wellhead (North Wind 2013). Upon discovery, the pitless adaptor was fixed immediately.

In addition to the trends described above, a Nonparametric Prediction Limit Test was conducted to determine if any 2012 sample results exceeded the maximum concentration from samples collected prior to repository construction. Table 2 displays the Nonparametric Prediction Limits and 2012 results. Although the 2012 data showed one arsenic result, one cadmium result, and one zinc result that exceeded the prediction limit values, the exceedance was not significant at the 0.95 level of significance. These results indicate that the metals concentrations measured above the prediction limit value continue to remain within the range of expected concentrations.

Section 5.0 Conclusions and Recommendations

Conclusions regarding the EMFR sampling and monitoring objectives are summarized as follows.

Objective 1 – evaluate water levels and water quality parameters of pore water within the repository waste: The 2012 Troll data show the water in PZ-A had a near-neutral pH, lacked DO, and had a fairly high conductivity. Based on an initial analysis of water level data, the source of water in the repository is undetermined at this time. However, the water level data suggest that precipitation is not as likely a source of water in EMFR compared to the vertical flow of groundwater and/or the lateral migration of floodwater.

Objective 2 – evaluate the quality of floodwater entering and leaving the site: Overall, metals concentrations were higher in floodwater entering the site compared to floodwater leaving the site, suggesting that surface water quality is not negatively impacted by the repository.

Objective 3 – evaluate hydraulic gradients and groundwater flow direction over time, both vertically and horizontally: For most of 2012, the general vertical hydraulic gradient was slightly downward and the horizontal flow direction was from the north-northeast to south-southwest, with some flow to the south-southeast. During these times, MW-A was cross-gradient to the repository and MW-D was upgradient of the repository. However, at the two highest groundwater-level elevation peaks in 2012 (late March and late April), the horizontal hydraulic gradient shifted and was from the southeast toward the northwest for about eight days, where MW-A became the upgradient well and MW-D became the cross gradient well. There was also an upward vertical hydraulic gradient during this time.

Objective 4 – evaluate the potential effects of the repository on groundwater: Based on dissolved metal and field parameter data collected through 2012, waste placement at the EMFR is not negatively impacting groundwater quality. The increasing trend in dissolved zinc observed at MW-A and the regulatory exceedances of dissolved arsenic at MW-E and dissolved zinc at the Decon well were not likely the result of waste placed at the repository. MW-A is cross-gradient to the repository most of the year, and MW-E is considered to be in a different hydrologic unit. The Decon well is downgradient of the repository but significantly deeper than the other monitoring wells (e.g., MW-C). If increased groundwater contamination occurs, it would first be expected in MW-B and MW-C if caused by the repository.

Continued monitoring at the groundwater, piezometer, and floodwater locations is recommended, as well as the installation of a datalogger in MW-F to gain a better understanding of the groundwater gradient.

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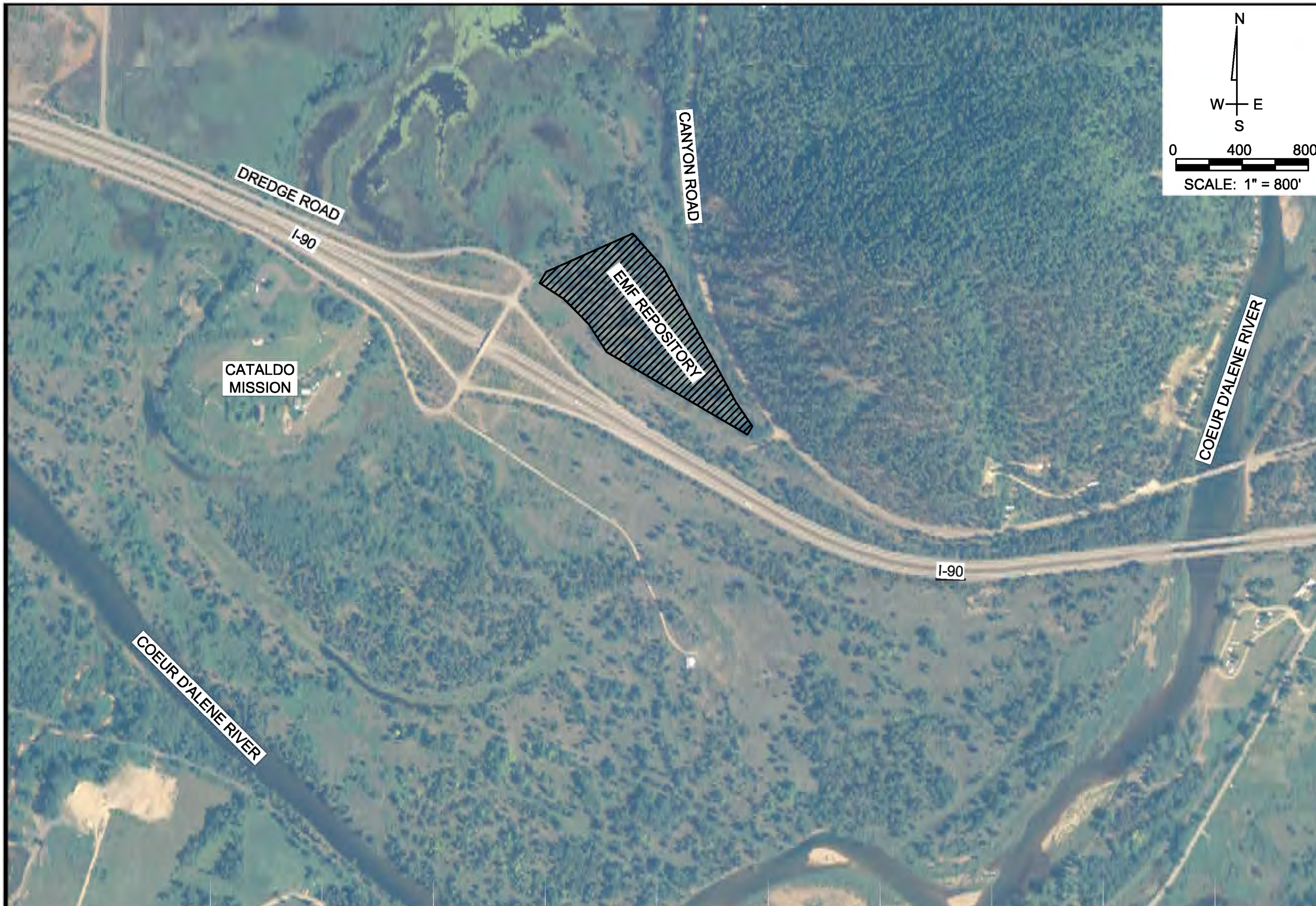
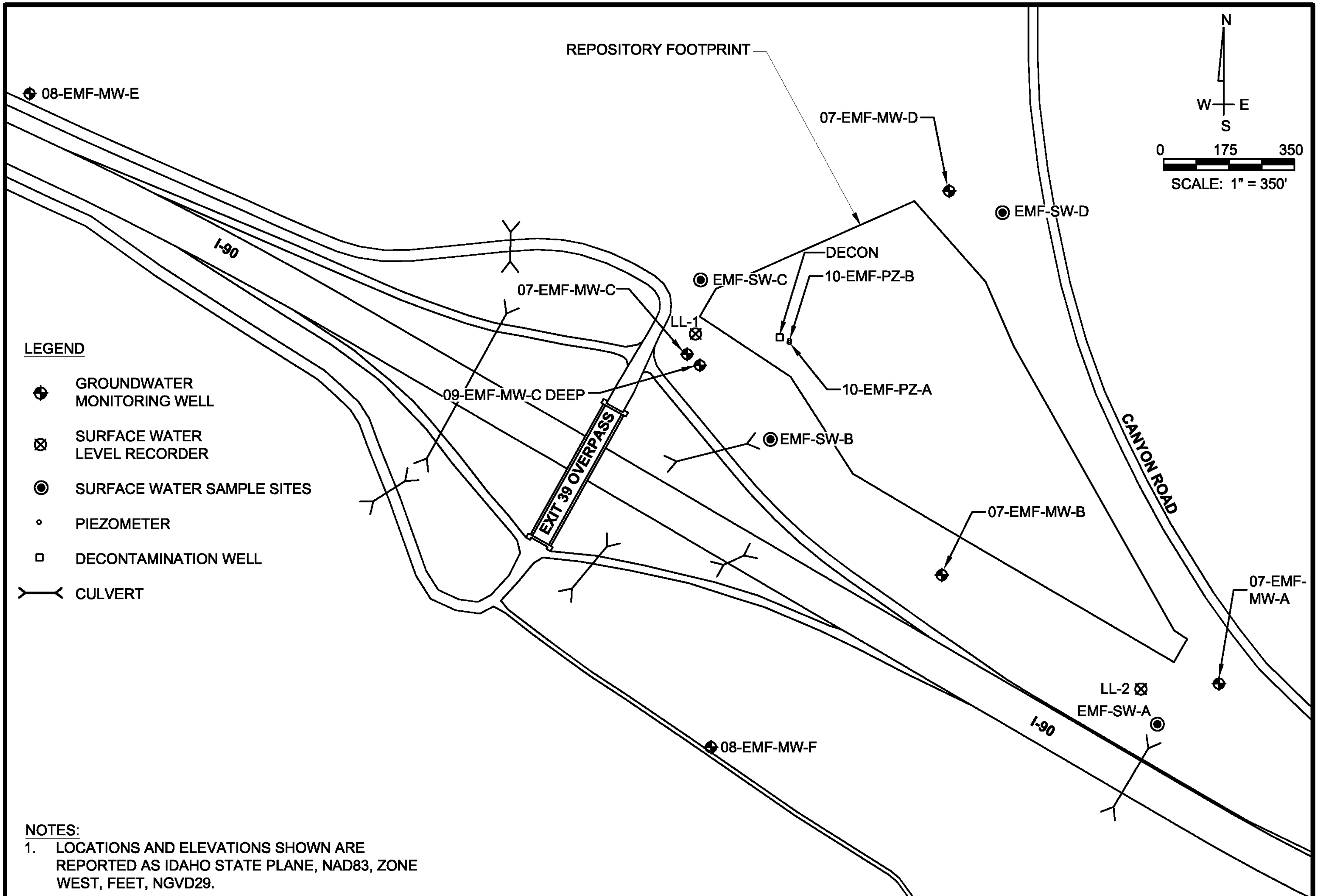


SCALE: 1" = 800' (8.5x11 PRINT)	TerraGraphics Environmental Engineering, Inc.	EAST MISSION FLATS	FIGURE 1 EMF REPOSITORY SITE	PROJECT NO: 2010-2A-6340-20
DRAWN BY: D.PFEIFER				DATE: 9/27/2013
ENGINEER: D.FORSETH		CATALDO, IDAHO		FILE NAME: emf gw_location map_092713.dwg

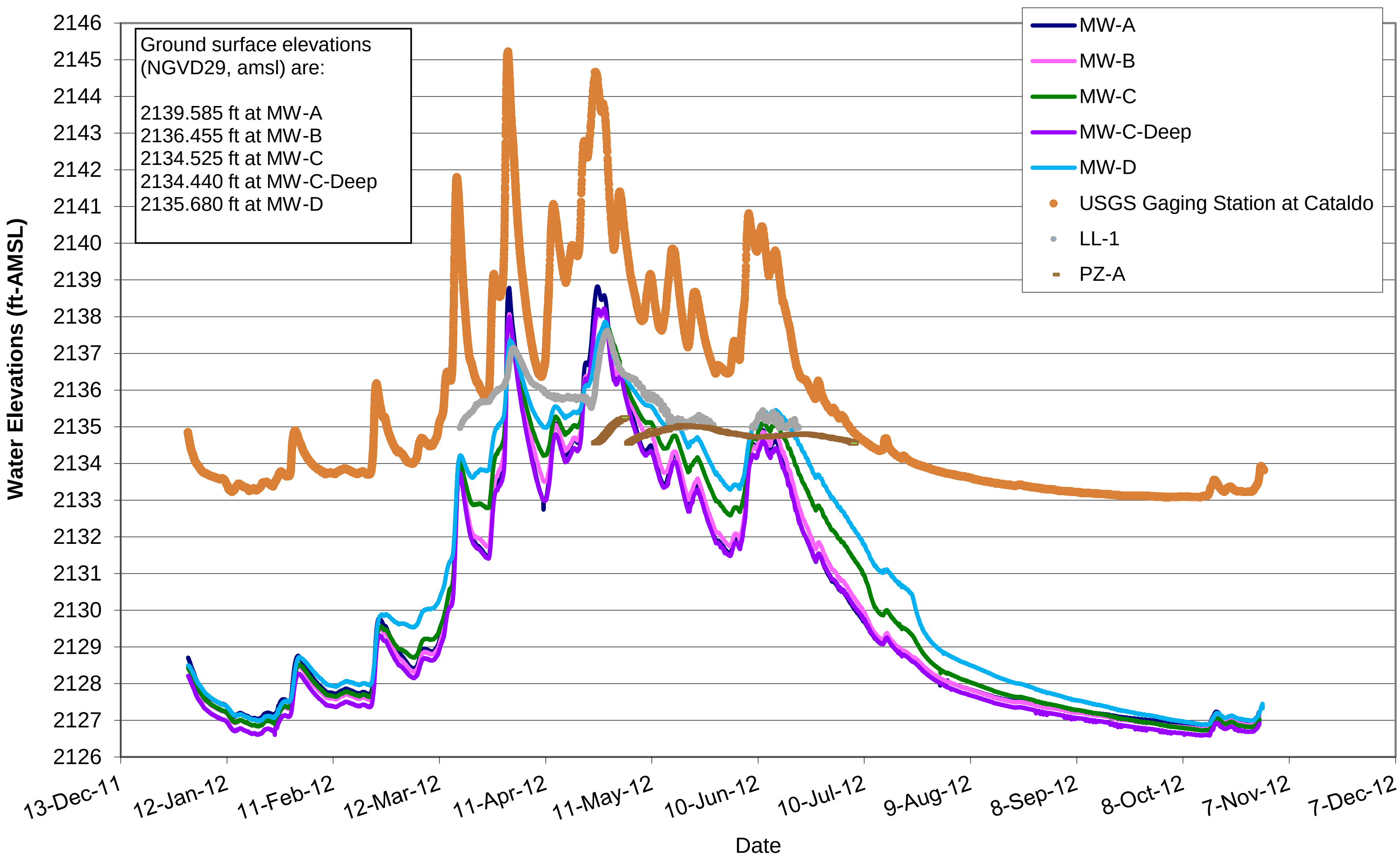


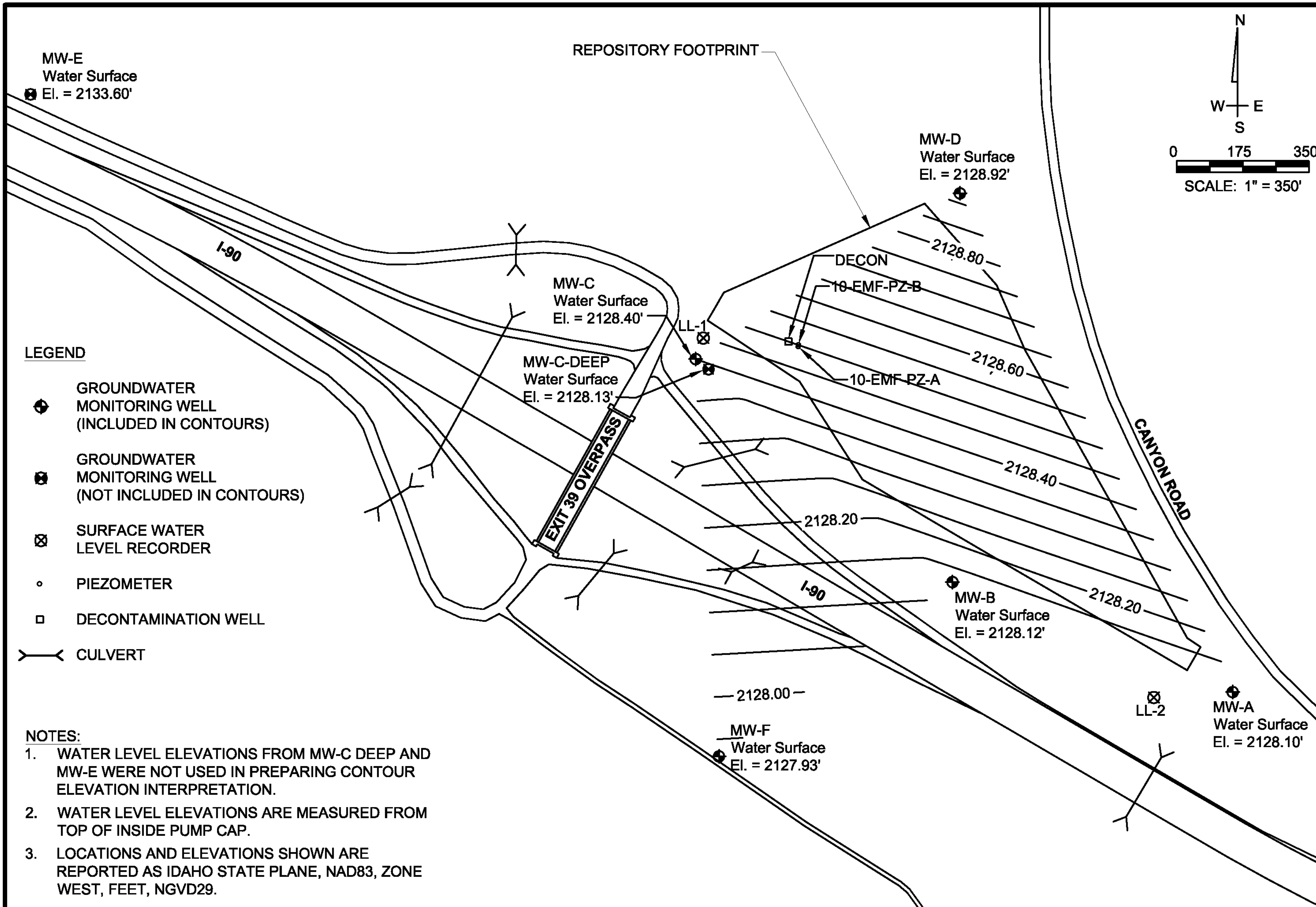
NOTES:
1. LOCATIONS AND ELEVATIONS SHOWN ARE REPORTED AS IDAHO STATE PLANE, NAD83, ZONE WEST, FEET, NGVD29.

SCALE: 1" = 350' (8.5x11 PRINT)	TerraGraphics Environmental Engineering, Inc.	EAST MISSION FLATS REPOSITORY	FIGURE 2 EMFR MONITORING LOCATIONS	PROJECT NO: 12025-08
DRAWN BY: S. LARSON				DATE: 4/25/2013
ENGINEER: C. HALEY		CATALDO, IDAHO		FILE NAME: emf_gw_apr2012.dwg

M:\Basin\Basin Repositories\EMF Design\Drawings\EMF GROUNDWATER\ARCHIVE DWGS\2012\EMFR_GW_Monitoring Locations.dwg 4/25/2013

Figure 3. Water Levels at EMFR Monitoring Wells, PZ-A, & Surface Water Site Compared to River Stage at Cataldo





LEGEND

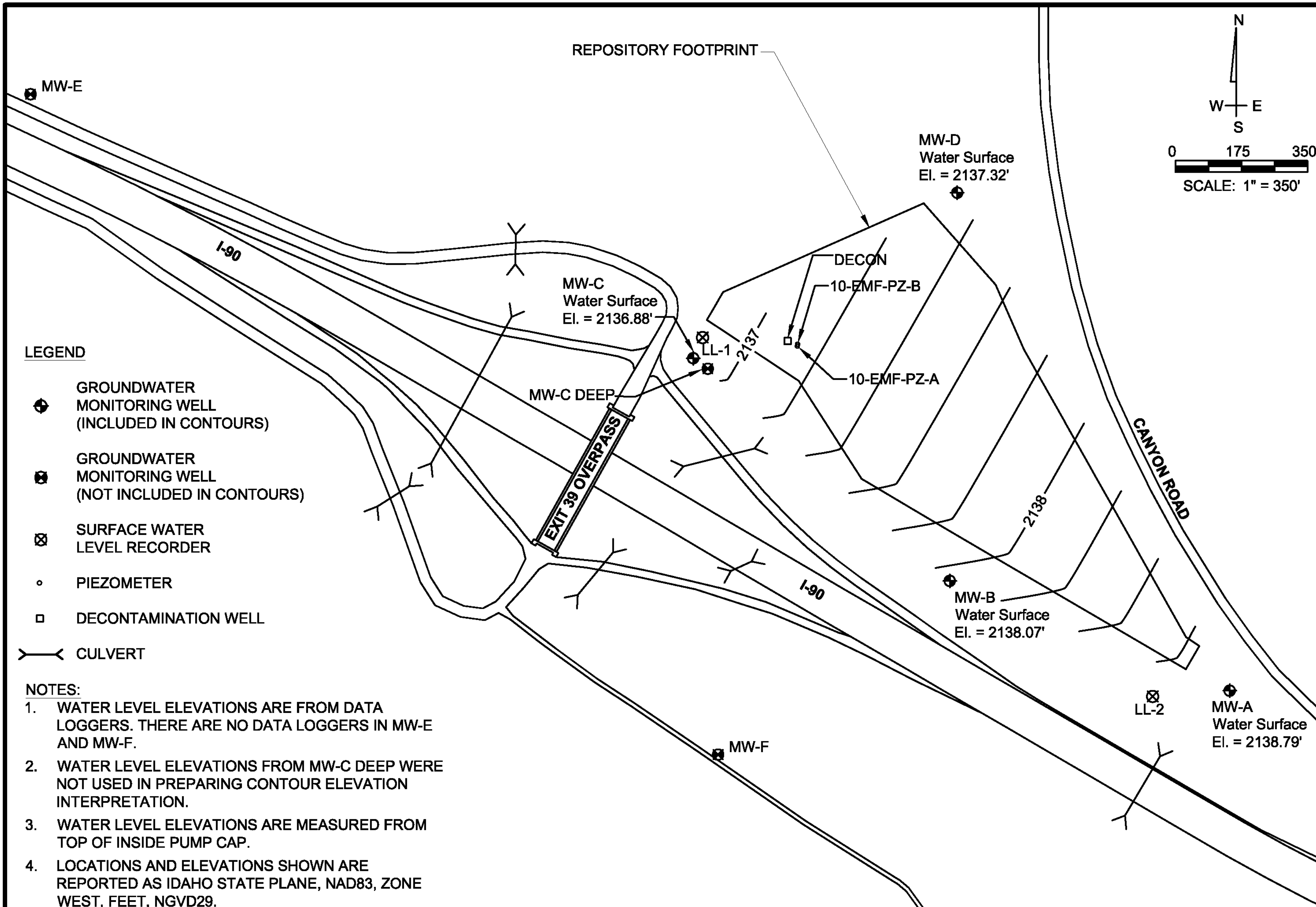
- GROUNDWATER MONITORING WELL (INCLUDED IN CONTOURS)
- GROUNDWATER MONITORING WELL (NOT INCLUDED IN CONTOURS)
- SURFACE WATER LEVEL RECORDER
- PIEZOMETER
- DECONTAMINATION WELL
- CULVERT

NOTES:

1. WATER LEVEL ELEVATIONS FROM MW-C DEEP AND MW-E WERE NOT USED IN PREPARING CONTOUR ELEVATION INTERPRETATION.
2. WATER LEVEL ELEVATIONS ARE MEASURED FROM TOP OF INSIDE PUMP CAP.
3. LOCATIONS AND ELEVATIONS SHOWN ARE REPORTED AS IDAHO STATE PLANE, NAD83, ZONE WEST, FEET, NGVD29.

SCALE: 1" = 350' (8.5x11 PRINT)	TerraGraphics Environmental Engineering, Inc.	EAST MISSION FLATS	FIGURE 4	PROJECT NO: 2010-2F-7170-2
DRAWN BY: S. LARSON			7/31/12 & 8/1/12 GROUNDWATER LEVEL ELEVATIONS AND CONTOURS	DATE: 7/19/2013
ENGINEER: S.BARKER		CATALDO, IDAHO		FILE NAME: emf gw_july2012_042413_dp.dwg

H:\EMF\EMF GW_JULY2012_042413_DP.dwg 7/19/2013



LEGEND

- GROUNDWATER MONITORING WELL (INCLUDED IN CONTOURS)
- GROUNDWATER MONITORING WELL (NOT INCLUDED IN CONTOURS)
- SURFACE WATER LEVEL RECORDER
- PIEZOMETER
- DECONTAMINATION WELL
- CULVERT

NOTES:

1. WATER LEVEL ELEVATIONS ARE FROM DATA LOGGERS. THERE ARE NO DATA LOGGERS IN MW-E AND MW-F.
2. WATER LEVEL ELEVATIONS FROM MW-C DEEP WERE NOT USED IN PREPARING CONTOUR ELEVATION INTERPRETATION.
3. WATER LEVEL ELEVATIONS ARE MEASURED FROM TOP OF INSIDE PUMP CAP.
4. LOCATIONS AND ELEVATIONS SHOWN ARE REPORTED AS IDAHO STATE PLANE, NAD83, ZONE WEST, FEET, NGVD29.

SCALE: 1" = 350' (8.5x11 PRINT)	TerraGraphics Environmental Engineering, Inc.	EAST MISSION FLATS	FIGURE 5	PROJECT NO: 12025-08-02
DRAWN BY: C.HALEY			3/31/12 GROUNDWATER LEVEL ELEVATIONS AND CONTOURS	DATE: 7/19/2013
ENGINEER: D.FORSETH		CATALDO, IDAHO		FILE NAME: emf gw_mar2012_041513_dp.dwg

H:\EMF\EMF GW_Mar2012_041513_DP.dwg 7/19/2013

Figure 6. Hydrographs of MW-C and MW-C-Deep

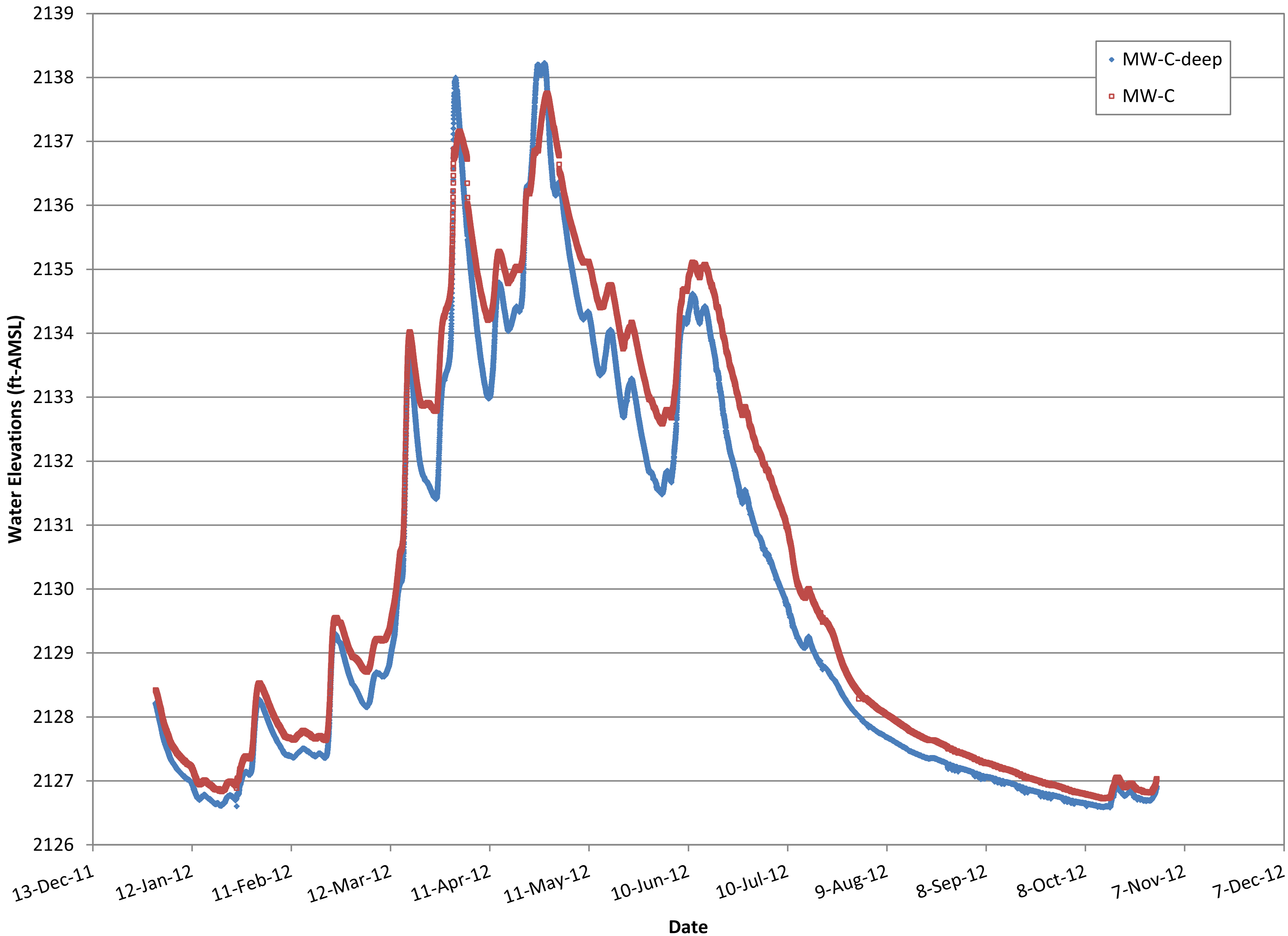
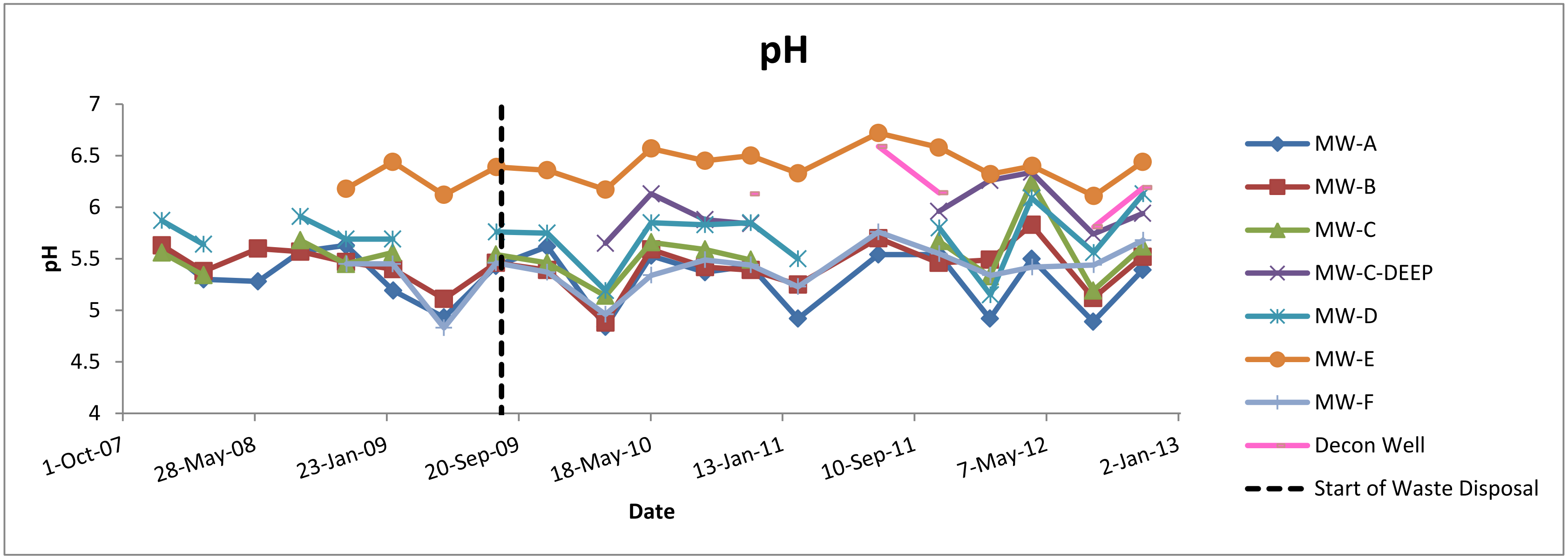


Figure 7. Graphs of Select Field Parameters



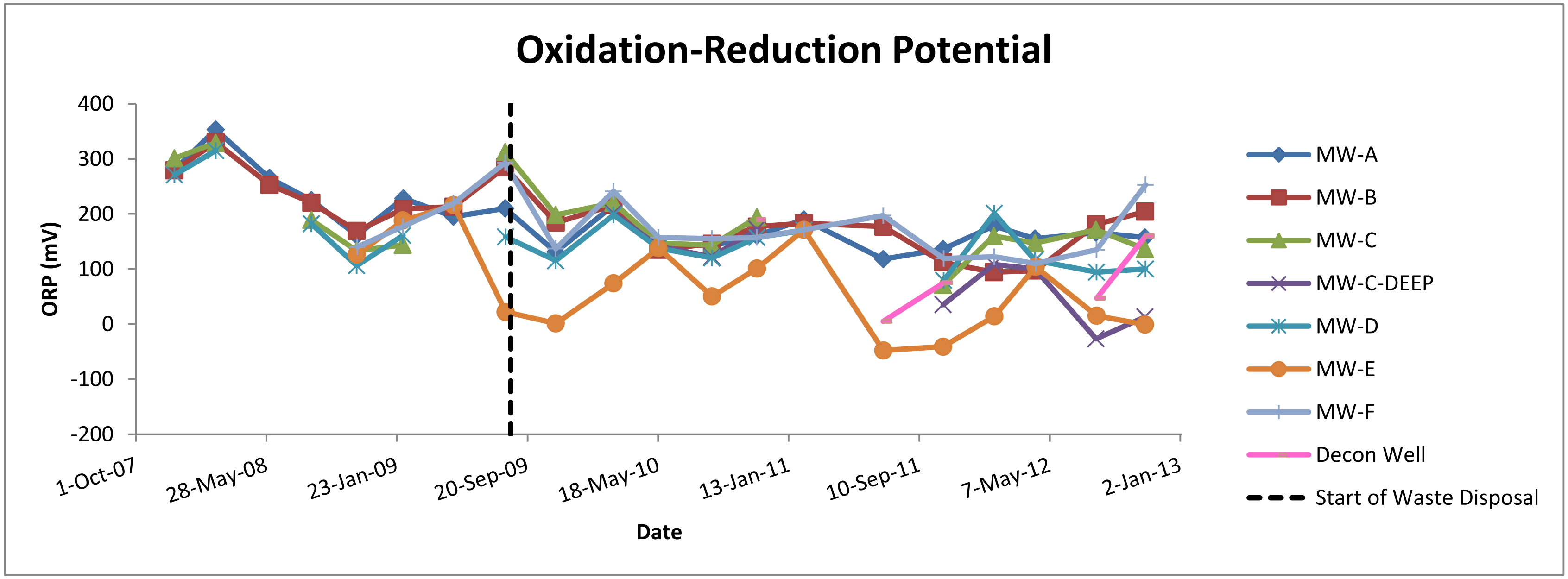
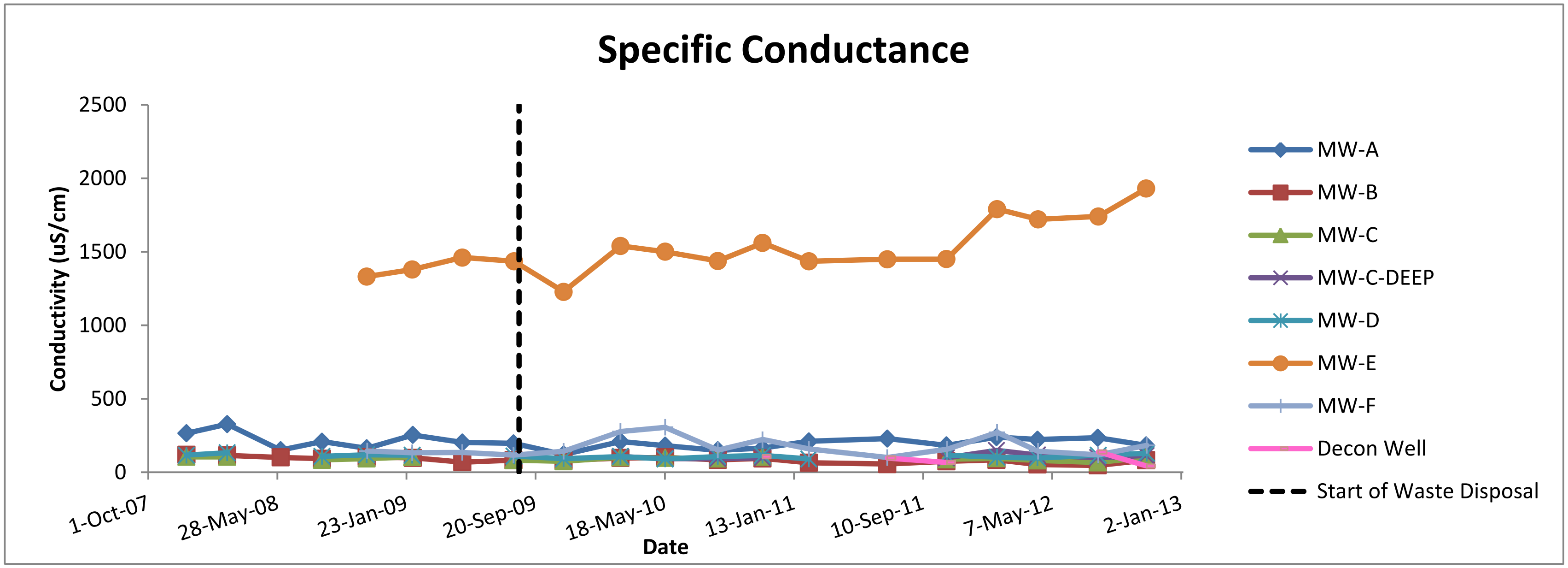


Figure 7. Graphs of Select Field Parameters



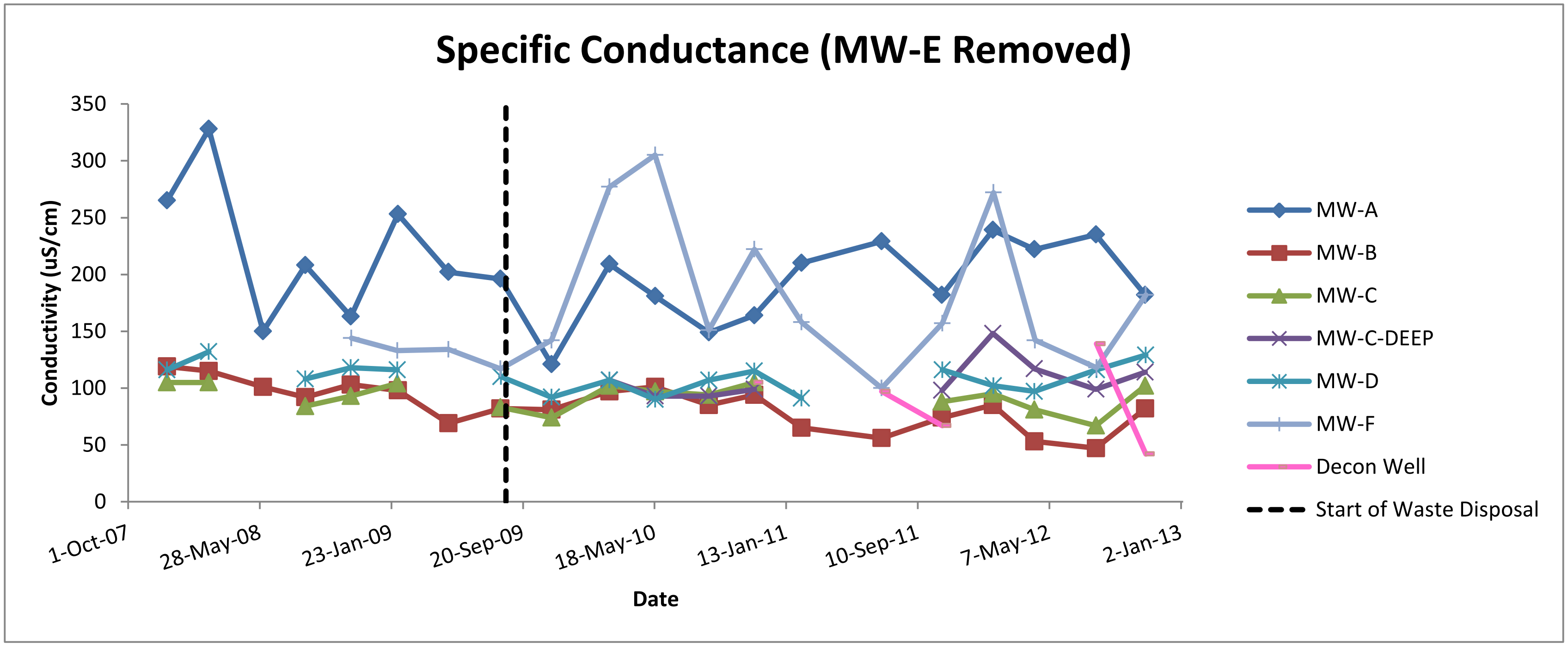
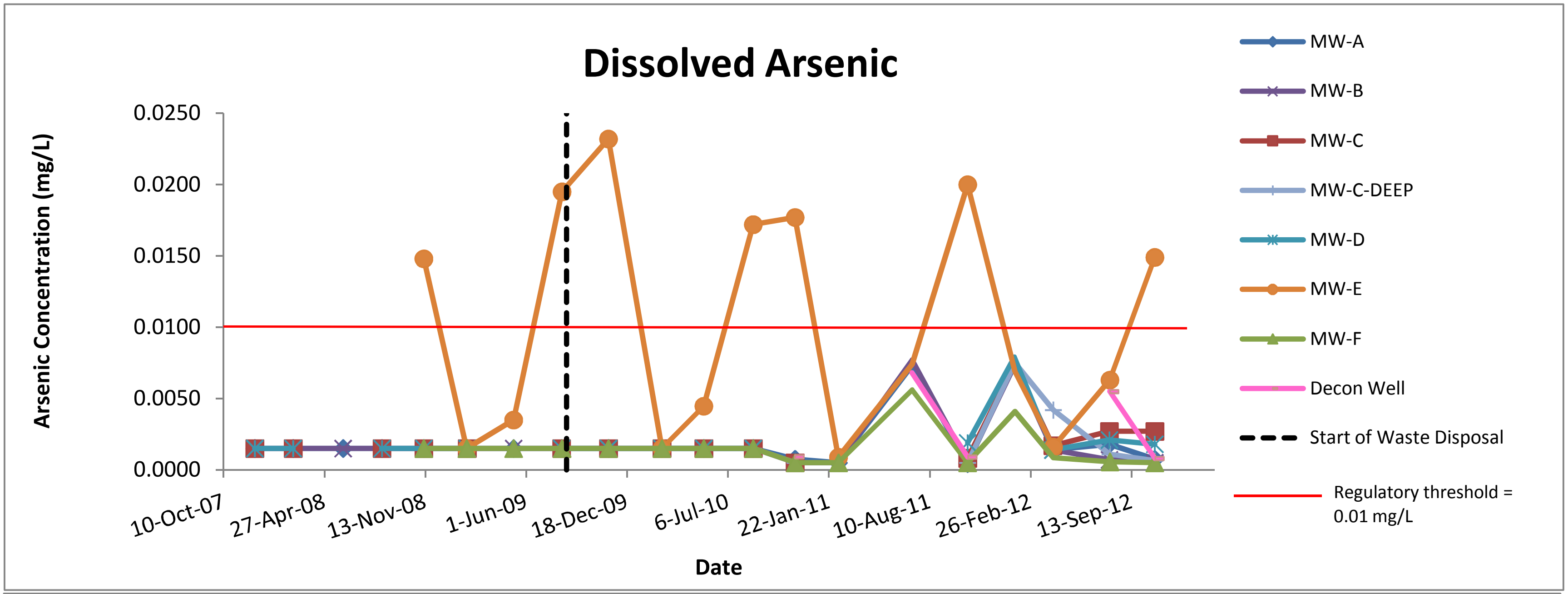


Figure 8. Dissolved Arsenic, Cadmium, and Zinc Concentrations



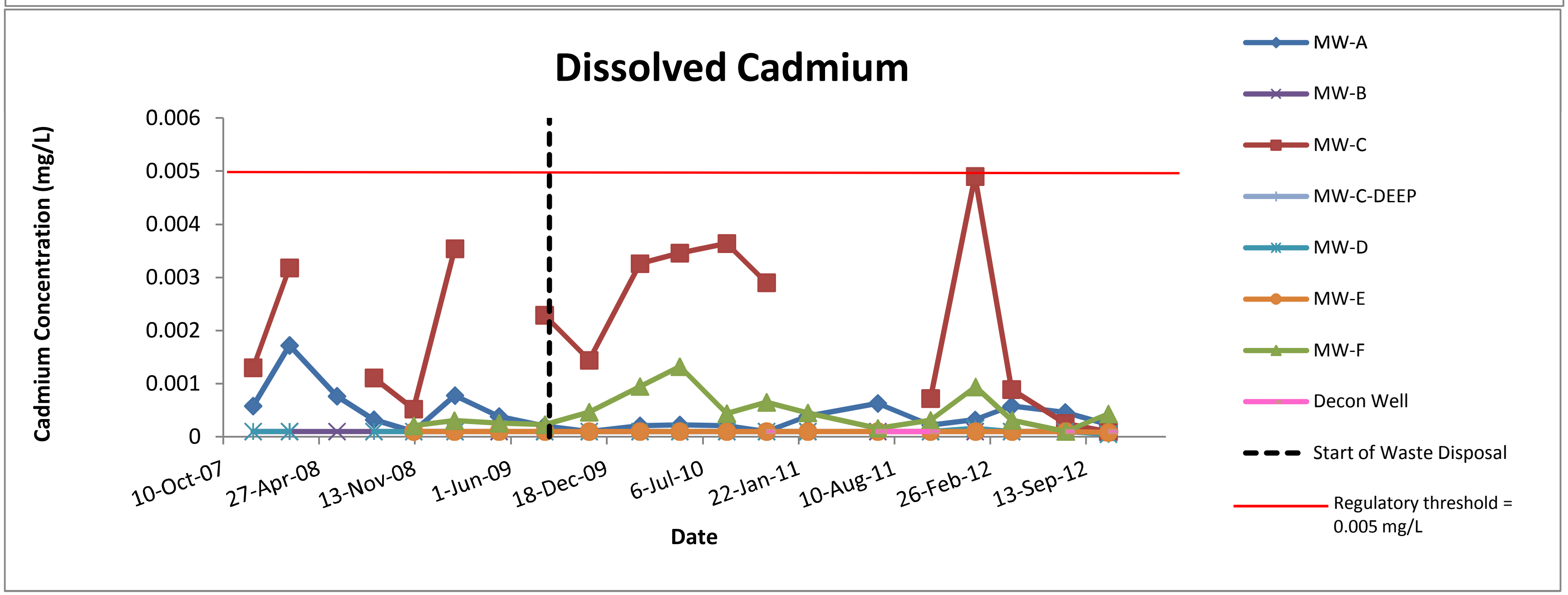
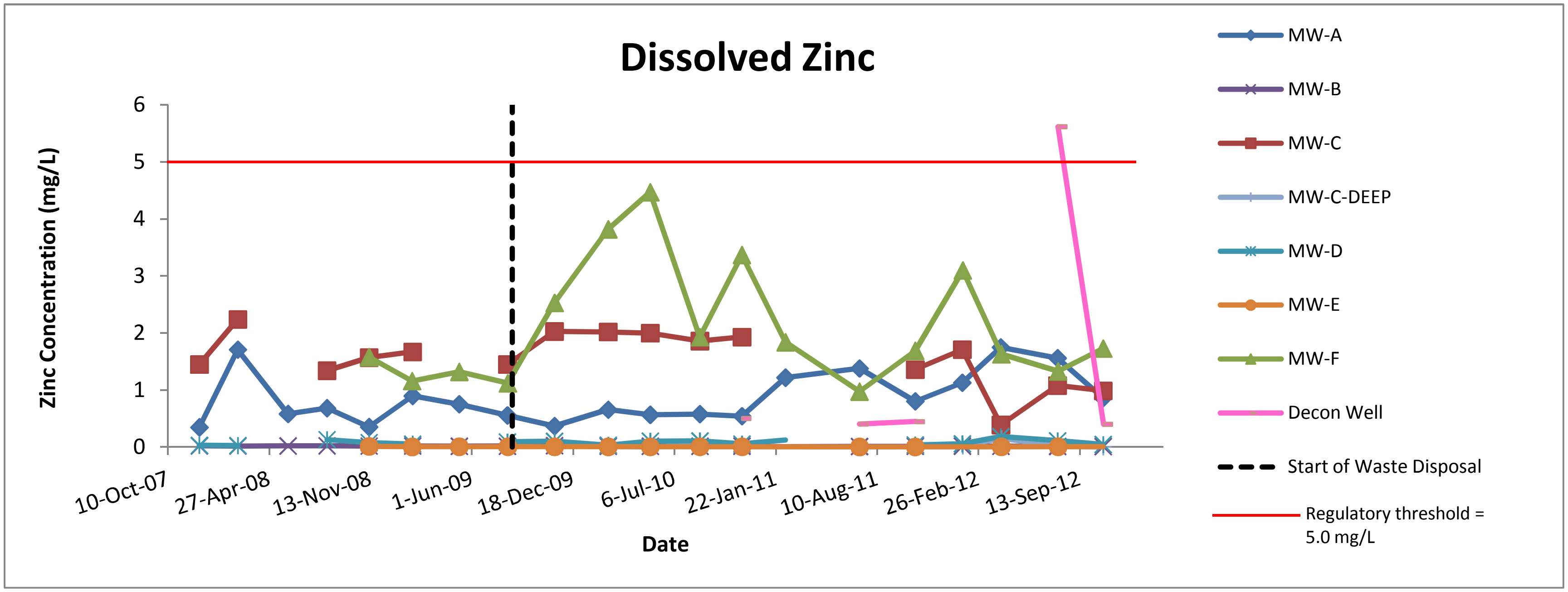


Figure 8. Dissolved Arsenic, Cadmium, and Zinc Concentrations



Notes:

-No symbol for a sampling event indicates the result was less than 5 times the field blank concentration.

-For non detected values, half of the detection limit was used for graphing purposes.

Table 1. Mann-Kendall Trend Analysis Results for EMFR Wells

Analyte	Well	No.	Mann-Kendall Trend	P-value
Arsenic	MW-E	14	No trend	0.743
Cadmium	MW-A	20	No trend	0.696
	MW-C	16	No trend	0.558
	MW-F	16	No trend	0.928
Zinc	MW-A	20	Increasing	0.035
	MW-B	19	Decreasing	<0.001
	MW-C	16	No trend	0.125
	MW-D	16	No trend (SMK)	0.207
	MW-E	13	No trend	0.200
	MW-F	16	No trend	0.964
	MW-C-Deep	8	No trend	0.536

Notes:

No. = number of data points used in trend analysis.

mg/L = milligrams per liter

P-value = probability of acquiring a test statistic that is at least as large as the observed, assuming the null hypothesis is true. The null hypothesis is rejected when the P-value is less than the significance level (alpha value) indicating the result is statistically significant (i.e., there is a trend).

An alpha value of 0.05 (α=0.05) was used to determine if the Mann-Kendall Trend is significant.

SMK = Seasonal Mann-Kendall analysis was performed for zinc at this well.

Table 2. Nonparametric Prediction Limits and 2012 Results

Prediction Limit Analyte	Background Sample Size (*n*)	Prediction Limit Value (mg/L)	No. of Future Values (*m*)	2012 Concentration above Prediction Limit Value (mg/L)	Well with Concentration above Prediction Limit Value	Sampling Date when Concentration was above Prediction Limit Value	Regulatory Threshold (mg/L)	Confidence Level
Arsenic	32	0.003	17	0.0042	MW-C-DEEP	4/11/12	0.01[a]	0.65
Cadmium	32	0.00354	24	0.0049	MW-C	1/25/12	0.005[a]	0.57
Lead	32	0.003	18	None	None	None	0.015[a]	0.64
Zinc	32	2.24	23	3.1	MW-F	1/26/12	5.0[b]	0.58

Notes:

a. National Primary Drinking Water Regulation

b. National Secondary Drinking Water Regulation

Appendix A

2012 EMFR Floodwater Memorandum

TerraGraphics
Environmental Engineering, Inc.

TECHNICAL MEMORANDUM

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Phone: (406) 441-5441; Fax: (406) 441-5443

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Phone: (406) 846-9566; Fax: (406) 846-9567

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Phone: (702) 685-2229; Fax: (702) 685-2223

To: Don Carpenter, IDEQ, Boise

From: Mike Puett, TerraGraphics, Boise
Robin Nimmer, TerraGraphics, Moscow

Date: November 28, 2012

Subject: EMFR Floodwater Analysis April 2012

Job Code: 12025-08-02

1 Introduction

The purpose of this memo is to summarize the results of floodwater sampling conducted at the East Mission Flats Repository (EMFR) on April 26 and April 30, 2012. The objective of the sampling was to evaluate the quality of floodwater surrounding EMFR after contaminated soil had been placed on the site. This sampling effort was not part of a regular sampling program but was conducted opportunistically to evaluate water quality during a flood event with approximately a 3 year recurrence interval.

2 General

The decision to sample was based on the level of floodwater observed onsite at EMFR. The event was triggered because Coeur d'Alene (CDA) River floodwater was observed flowing into the area surrounding EMFR through the culvert under Interstate-90 (I-90) at site EMF-SW-A, on April 25, 2012. Based on National Weather Service (NOAA, 2012) predictions, the CDA River at Cataldo was forecasted to peak the evening of April 26, 2012. The actual stage peak of 43.70 feet (22,200 cubic feet/second) above the gage baseline (2,100.00 feet amsl) was recorded by the U.S. Geological Survey (USGS) at 22:00 on that day. A stage-hydrograph of the CDA River is shown on Figure 1, and summarizes stage elevations from April 20, 2012 through May 4, 2012 (NOAA, 2012). Sampling floodwater before and after the peak flow provided water quality data for floodwater entering and leaving the area surrounding the repository.

Samples were collected on two separate days. The first set of samples was collected in the early afternoon of April 26, 2012 while water levels were rising at the base of EMFR. At that time, floodwater from the CDA River was observed flowing into the area surrounding EMFR through the culvert at EMF-SW-A and the culvert under the I-90 west-bound on-ramp west of the EMFR site. Floodwater at EMFR was also likely from rising water levels in the wetland west of EMFR. A second set of samples was collected during mid-morning of April 30, 2012, after the stage height dropped approximately 4 feet from the peak and water levels surrounding EMFR were receding.

On each sampling occasion, samples were collected from four locations chosen to represent the various hydrologic zones around EMFR. The sampling locations are shown on Figure 2 and described in Table 1. Location EMF-SW-A is located at the mouth of a culvert just south of the ICP dump pad. This sample location represents a mixture of floodwater from the CDA River flowing in and out of the area through the culvert running under Interstate 90 and the floodwater conveyed through the side channel running parallel to Canyon Road. Location EMF-SW-B is southwest of the repository. This location represents water flowing into and out of the catchment between I-90 and the exit 39 west bound exit ramp. EMF-SW-C is located west of the repository near the repository access road bridge. This location represents a mixture of Coeur d'Alene River floodwaters and water from the wetlands northwest of the repository that flows into the area surrounding the repository during high water events. EMF-SW-D is located northeast of the repository between Canyon road and the repository. This sample location represents the floodwater conveyed through the side channel running parallel to Canyon Road.

Field parameters were measured during sample collection and included: pH, conductivity, temperature, dissolved oxygen (DO), and oxidation-reduction potential (ORP). The samples were delivered to SVL Analytical, Inc. (SVL) in Kellogg, Idaho for analysis of total and dissolved antimony, arsenic, cadmium, lead, and zinc.

3 Field Observations

Visual observations during the rise of the floodwater in the area surrounding EMFR on April 26, 2012 were noted. Water was entering EMFR from the CDA River via a culvert at EMF-SW-A. Depth of the turbulent water in the 24-inch diameter culvert was measured to be 20 inches and the flow through the culvert was estimated to be 83 percent of the culvert's capacity. Water discharging from the culvert was observed flowing northwest toward EMF-SW-B. At EMF-SW-B, the mouth of the culvert was over a foot under water and fairly stagnant, but the direction of water flow could not be determined due to windy conditions. The catchment area connected via this culvert did not have water in it. In the area of monitoring well 09-EMF-MW-C-Deep, a small wake was observed behind this well indicating that water was flowing directly north toward the repository bridge. Water at surface water site EMF-SW-C (located under the repository bridge) was observed to be stagnant. However, surface water was observed flowing along the toe of the repository slope just north of the bridge in a southwesterly direction. Water at EMF-SW-D was observed flowing west-southwest towards EMF-SW-C along the toe of the repository slope.

Visual observations during water receding from EMFR on April 30, 2012 were noted. Surface water was observed flowing out of EMFR from the same culvert at site EMF-SW-A on the morning sampling occurred. Surface water flow direction could only be determined at EMF-SW-A, where water was turbulent. Windy conditions made visual observations difficult at the other sampling sites with minimal flow or stagnant water. Water depth in the culverts were not measured.

4 Results

The field parameters are summarized in Table 2 for the April 26 and 30, 2012 sampling events. pH values increased at EMF-SW-B and EMF-SW-C. Conductivity increased at all sites except

EMF-SW-B; whereas, DO decreased at these same sites. The water temperature and ORP increased at all four sites.

Water quality results for total recoverable and dissolved metals are summarized in Tables 3 and Table 4, respectively. Figures for total cadmium, lead, and zinc as well as dissolved cadmium and zinc are located in Attachment A. The laboratory reports are provided in Attachment B. Total and dissolved antimony and arsenic were not detected in any of the samples. Total and dissolved cadmium were detected in samples from all four sites during the April 26, 2012 sampling event. Total cadmium was detected in all of the April 30, 2012 samples from all sites with the exception of EMF-SW-C. Dissolved cadmium was only detected during the April 30, 2012 event in a sample from EMF-SW-A. Total and dissolved cadmium concentrations decreased between the two sampling events. Total lead was detected in samples from all sites during the April 26, 2012 sampling event; the highest concentration of 0.00645 milligrams per liter (mg/L) was detected at EMF-SW-B. Total lead was not detected in any of the samples from the April 30, 2012 sampling event. Dissolved lead was not detected in any of the samples from both events. Total and dissolved zinc were detected in all samples from both events. Total and dissolved zinc concentrations were highest in samples from all sites during the April 26, 2012 sampling event. EMF-SW-B had the highest total and dissolved zinc concentrations of 0.159 mg/L and 0.131 mg/L, respectively. For the April 30, 2012 sampling event, EMF-SW-A had the highest total and dissolved zinc concentrations of 0.0859 mg/L and 0.0900 mg/L, respectively.

The acute Criteria Maximum Concentration (CMC) for aquatic life in surface water according to the Idaho Administrative Code of the Department of Environmental Quality, IDAPA 58.01.02, "Water Quality Standards," were compared with the dissolved metal results. Because antimony has no CMC, the criteria for Human Health for Consumption of Water and Organisms was used. The regulatory thresholds for dissolved cadmium, lead, and zinc are dependent on water hardness. For this evaluation, the regulatory thresholds were calculated using the equations provided in IDAPA 58.01.02 and a hardness of 80 mg/L as calcium carbonate ($CaCO_3$) - the average hardness for the CDA River as reported by the Idaho Department of Environmental Quality (IDEQ) (TerraGraphics, 2008). Note: based on a hardness of 80 mg/L, the calculated regulatory threshold for dissolved cadmium is lower than the method reporting limit. In this evaluation, dissolved zinc exceeded the regulatory threshold at all sites but EMF-SW-D during the April 26, 2012 sampling event. None of the sites exceeded the dissolved zinc regulatory threshold during the April 30, 2012 sampling event.

5 Conclusions and Recommendations

Similar to the May 2008 and May 2011 floodwater sampling results, the April 2012 floodwater sampling results showed a decrease in total metals as the floodwater receded from the area surrounding the EMFR. During the recession of floodwater from the area surrounding the EMFR, a detectable increase in total metals concentration has never been measured. The April 2012 data continue to support the hypothesis that the floodwater flowing back to the river is cleaner than the floodwater that entered the area. This is likely the result of the metals-laden sediment, transported by the floodwater, settling out while the water is on the floodplain. Deposition of sediment on the floodplain during flood events is a natural phenomenon occurring on many floodplains around the world and it is not related to the presence of the EMFR. The data provide no indication that the EMFR is adversely impacting surface water quality.

TerraGraphics recommends continued water quality monitoring during subsequent floodwater events to evaluate the hypothesis that metals concentrations are lower as water drains from the area surrounding the EMFR. It is recommended that future flood sampling attempts to capture larger flows than previously sampled. Future flood sampling results should continue to be generally compared to the historical results indicating that the area surrounding the EMFR is a depositional environment.

6 References

National Oceanic Atmospheric Association (NOAA). 2012. Coeur d'Alene River at Cataldo, data courtesy of the US Geologic Survey, http://waterdata.usgs.gov/id/nwis/uv/?site_no=12413500.

TerraGraphics. 2008. Internal memo from Kelly Kincella and Dan McCracken to Don Vernon regarding EMFR Flood Water Analysis, June 19, 2008.

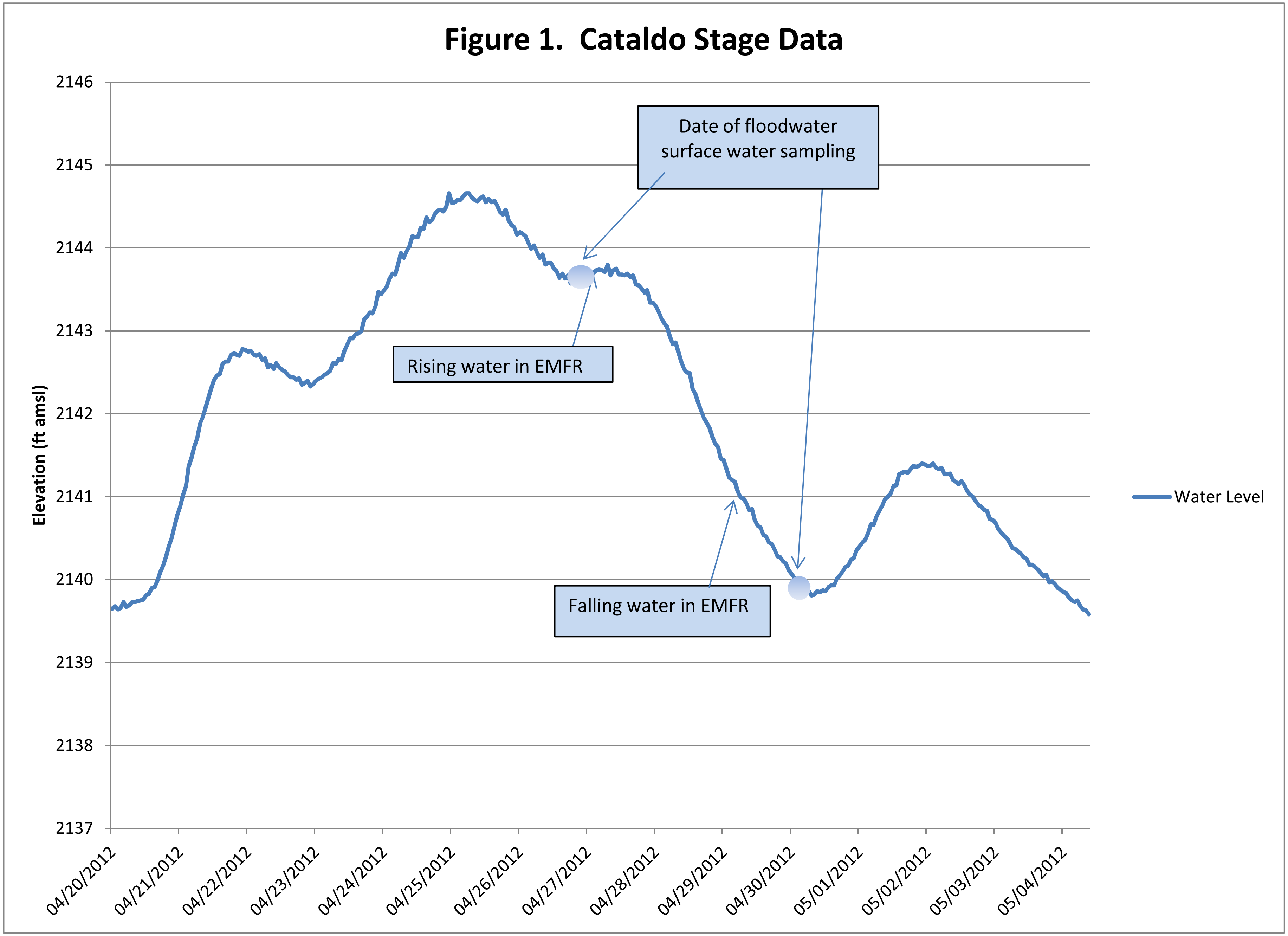

Figure 1. Cataldo Stage Data
Elevation (ft amsl)
2146
2145
2144
2143
2142
2141
2140
2139
2138
2137
04/20/2012
04/21/2012
04/22/2012
04/23/2012
04/24/2012
04/25/2012
04/26/2012
04/27/2012
04/28/2012
04/29/2012
04/30/2012
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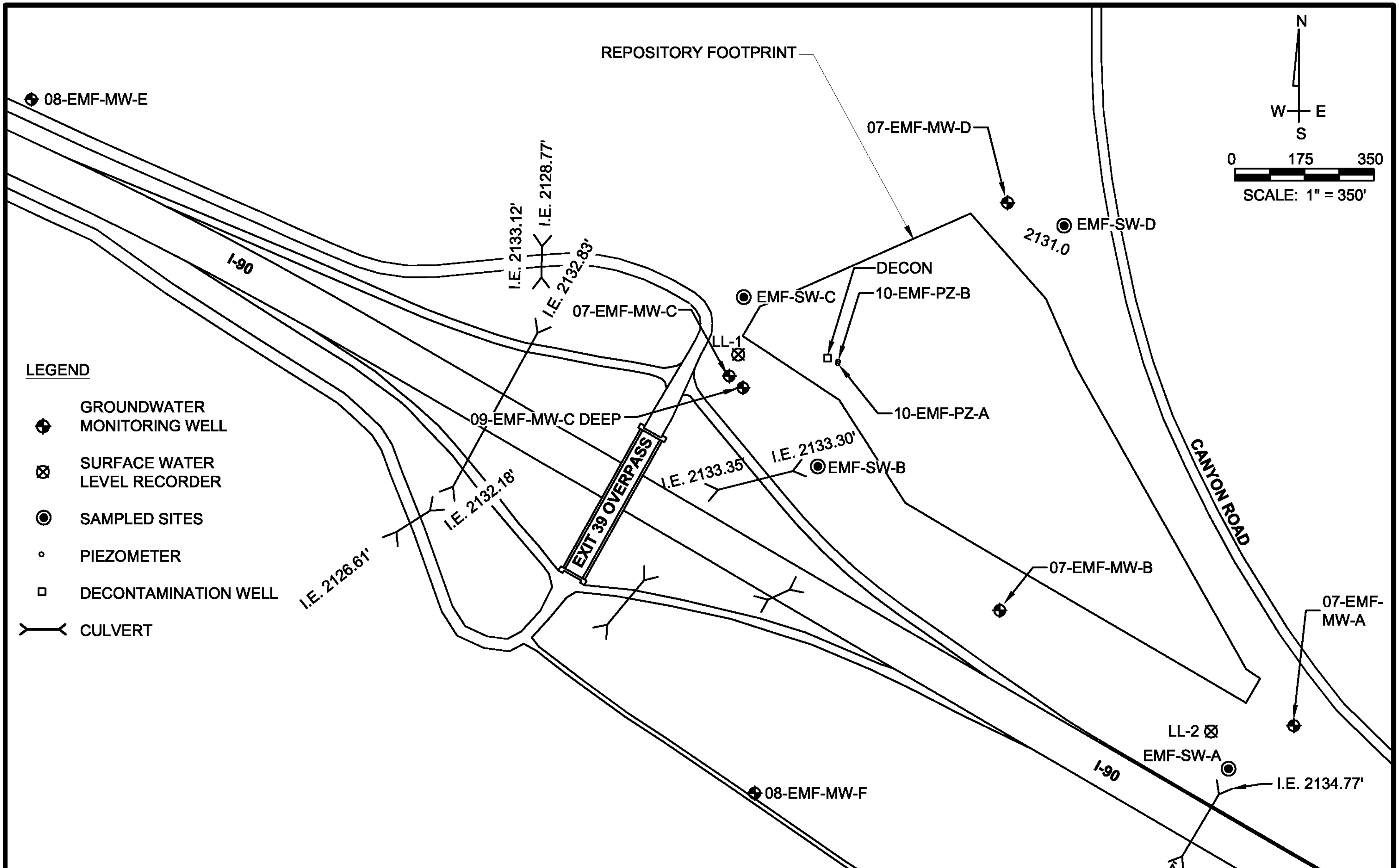
05/03/2012
05/04/2012
Date of floodwater surface water sampling
Rising water in EMFR
Falling water in EMFR
Water Level



NOTES:

1. LOCATIONS AND ELEVATIONS SHOWN ARE REPORTED AS IDAHO STATE PLANE, NAD83, ZONE WEST, FEET, NGVD29.

SCALE: 1" = 350' (8.5x11 PRINT)	TerraGraphics Environmental Engineering, Inc.	EAST MISSION FLATS REPOSITORY	FIGURE 2	PROJECT NO: 12025-08
DRAWN BY: S. LARSON			APRIL 2012 FLOOD SAMPLING	DATE: 8/23/2012
ENGINEER: C. HALEY		CATALDO, IDAHO		FILE NAME: emf_gw_apr2012.dwg

Table 1
Floodwater Sample Location Information
April 2012 Floodwater Event
East Mission Flats Repository

Hydrologic Zone	Water Action	Physical Location Description	Site Location ID
Floodwater from CDA River entering EMFR via culvert.	Flowing	Outlet of culvert by MW-A.	EMF-SW-A
Water in EMFR area and mouth of culvert connected to catchment area.	Stagnant	Outlet of culvert between MW-C and MW-B.	EMF-SW-B
Water likely from the wetland to the north and the river via culvert west of the overpass.	Stagnant	Northeast of the Interstate-90 overpass, near the overpass bridge.	EMF-SW-C
Steady flow from NE to SW, possibly from the river.	Flowing	Southeast of MW-D.	EMF-SW-D

Table 2
Field Parameters
EMFR Floodwater Monitoring Results
April 2012 Floodwater Event
East Mission Flats Repository

Site ID	Date	Parameter				
		pH	Conductivity (µS/cm)	Temperature (°C)	DO (mg/L)	ORP (mV)
EMF-SW-A	26-Apr-12	6.69	46	8.25	9.75	203
	30-Apr-12	6.40	68	10.74	7.15	414
EMF-SW-B	26-Apr-12	6.41	75	10.24	7.17	186
	30-Apr-12	6.71	67	11.74	7.50	245
EMF-SW-C	26-Apr-12	6.65	65	10.48	8.10	183
	30-Apr-12	6.80	70	11.95	7.31	211
EMF-SW-D	26-Apr-12	6.88	65	11.55	7.69	182
	30-Apr-12	6.72	69	11.98	6.74	207

Notes:
°C = degree Celsius
mg/L = milligram per liter
mV = millivolt
µS/cm = microSiemen per centimeter
DO = dissolved oxygen
ORP = oxygen reduction potential

Table 3
Total Recoverable Metals
EMFR Floodwater Monitoring Results
April 2012 Floodwater Event
East Mission Flats Repository

Sample ID	Analyte	Reporting Limit	Results (mg/L)[a]		
			26-Apr-12	30-Apr-12	Difference[b]
EMF-SW-A	Antimony	0.00300	ND	ND	0
	Arsenic	0.0030	ND	ND	0
	Cadmium	0.00020	0.00050	0.00030	-0.00020
	Lead	0.00300	0.0106	ND	-0.0106
	Zinc	0.0050	0.104	0.0859	-0.018
EMF-SW-B	Antimony	0.00300	ND	ND	0
	Arsenic	0.0030	ND	ND	0
	Cadmium	0.00020	0.00058	0.00021	-0.00037
	Lead	0.00300	0.00645	ND	-0.00645
	Zinc	0.0050	0.159	0.0625	-0.097
EMF-SW-C	Antimony	0.00300	ND	ND	0
	Arsenic	0.0030	ND	ND	0
	Cadmium	0.00020	0.00046	ND	-0.00046
	Lead	0.00300	0.00539	ND	-0.00539
	Zinc	0.0050	0.113	0.0552	-0.058
EMF-SW-D	Antimony	0.00300	ND	ND	0
	Arsenic	0.0030	ND	ND	0
	Cadmium	0.00020	0.00039	0.00022	-0.00017
	Lead	0.00300	0.00373	ND	-0.00373
	Zinc	0.0050	0.0713	0.0564	-0.0149

Notes

a. Samples analyzed by EPA Method 200.7

b. Difference = (26 April results) - (30 April results). Negative number indicates decrease in metals concentration over reporting period.

ND - Not detected above method reporting limit

Table 4
Dissolved Metals
EMFR Floodwater Monitoring Results
April 2012 Floodwater Event
East Mission Flats Repository

Sample ID	Analyte	Reporting Limit	Results (mg/L)[a] 26-Apr-12	30-Apr-12	Difference[b]	Regulatory Threshold[c]
EMF-SW-A	Antimony	0.00300	ND	ND	0	0.0056 [d]
	Arsenic	0.0030	ND	ND	0	0.340
	Cadmium	0.00020	0.00049	0.00026	-0.00023	0.0011
	Lead	0.00300	ND	ND	0	0.049
	Zinc	0.0050	0.113	0.0900	-0.023	0.097
EMF-SW-B	Antimony	0.00300	ND	ND	0	0.0056 [d]
	Arsenic	0.0030	ND	ND	0	0.340
	Cadmium	0.00020	0.00059	ND	-0.00059	0.0011
	Lead	0.00300	ND	ND	0	0.049
	Zinc	0.0050	0.131	0.0630	-0.068	0.097
EMF-SW-C	Antimony	0.00300	ND	ND	0	0.0056 [d]
	Arsenic	0.0030	ND	ND	0	0.340
	Cadmium	0.00020	0.00065	ND	-0.00065	0.0011
	Lead	0.00300	ND	ND	0	0.049
	Zinc	0.0050	0.111	0.0555	-0.056	0.097
EMF-SW-D	Antimony	0.00300	ND	ND	0	0.0056 [d]
	Arsenic	0.0030	ND	ND	0	0.340
	Cadmium	0.00020	0.00035	ND	-0.00035	0.0011
	Lead	0.00300	ND	ND	0	0.049
	Zinc	0.0050	0.0810	0.0567	-0.0243	0.097

Notes:

mg/L = milligram per liter

ND = Not detected above method reporting limit.

a. Samples analyzed by EPA Method 200.7.

b. Difference = (26 April results) - (30 April results). Negative number indicates decrease in metals concentration over reporting period.

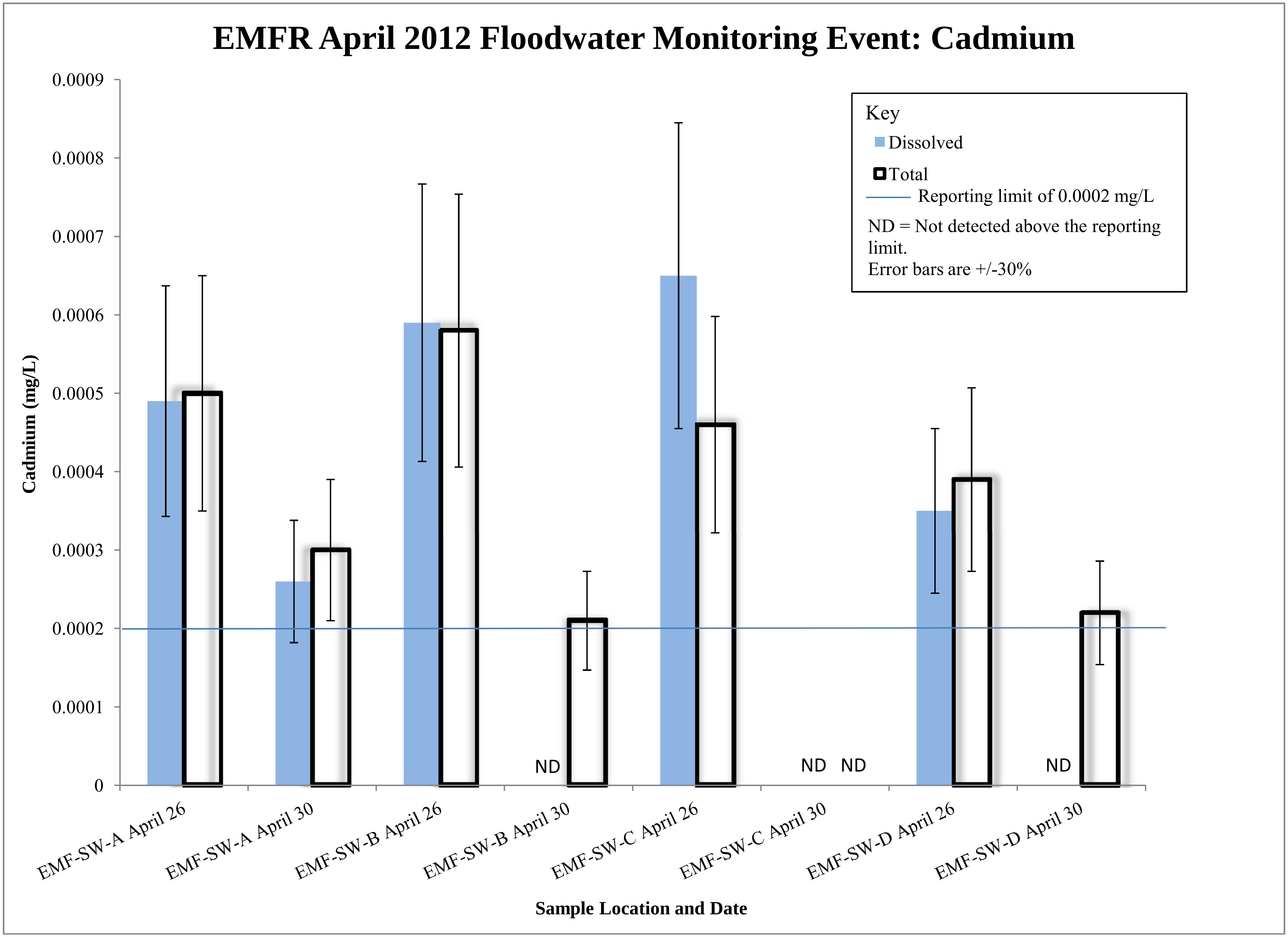
c. Idaho Ambient Water Quality Criteria for Aquatic Life - Acute Criteria (Cd, Pb, and Zn values calculated based on a hardness of 80 mg/L)

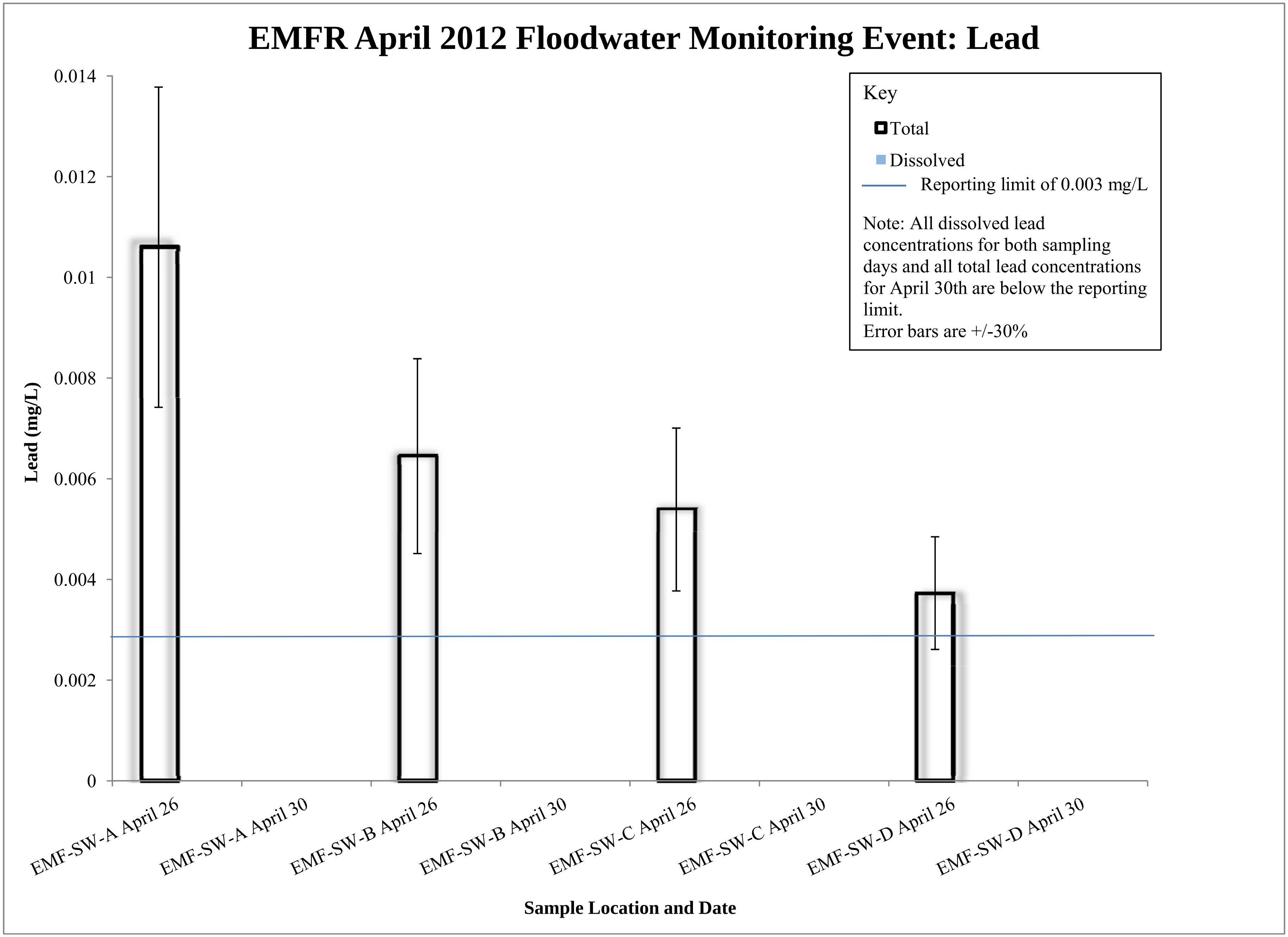
d. Idaho Ambient Water Quality Criteria - Human Health for Consumption of Water & Organisms

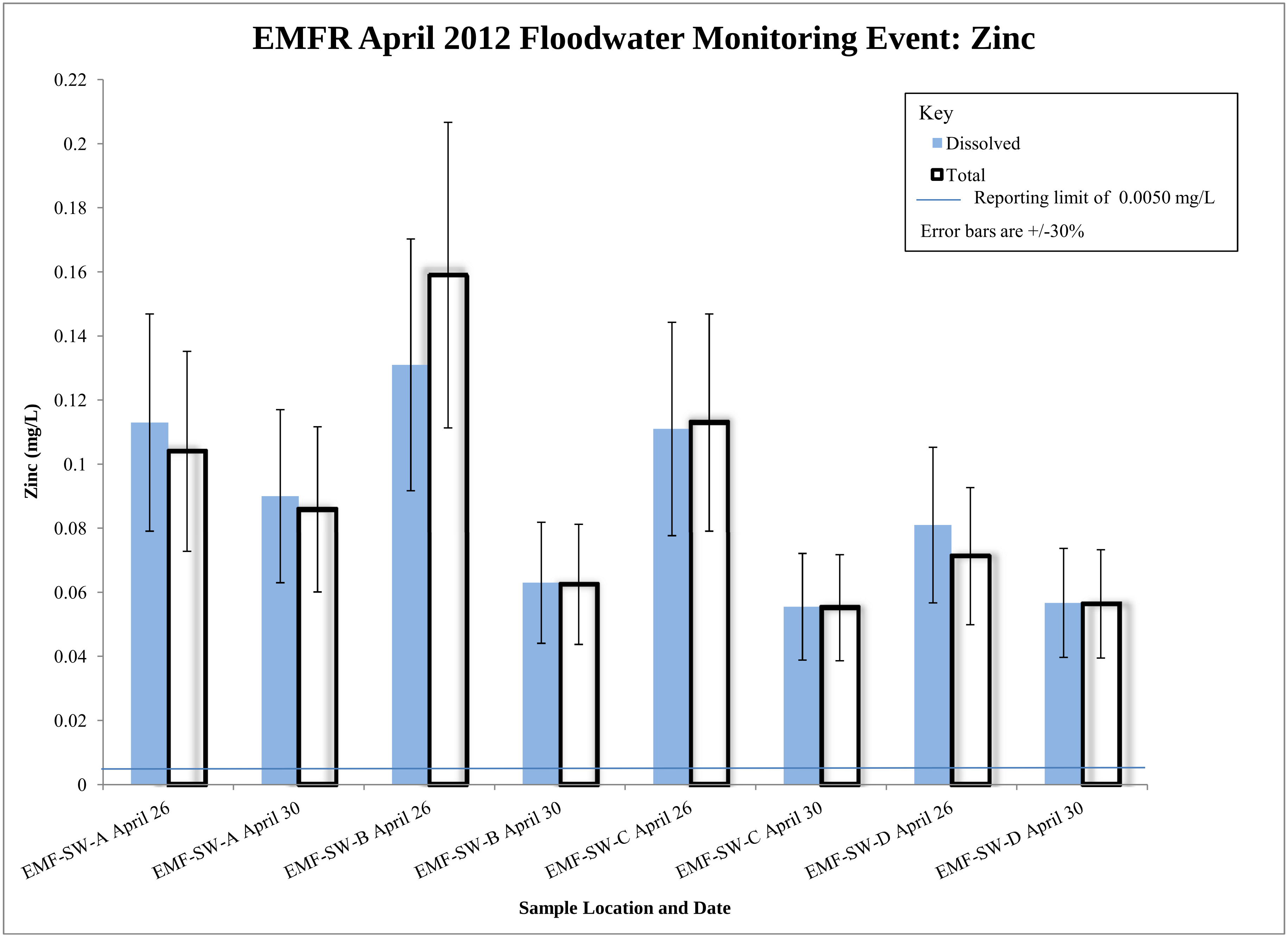
(pink shading) = Value exceeds regulatory threshold

Attachment A

Metals Concentrations Figures


EMFR April 2012 Floodwater Monitoring Event: Cadmium
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
Cadmium (mg/L)
Key
Dissolved
Total
Reporting limit of 0.0002 mg/L
ND = Not detected above the reporting limit.
Error bars are +/-30%
ND
ND
ND
ND
EMF-SW-A April 26
EMF-SW-A April 30
EMF-SW-B April 26
EMF-SW-B April 30
EMF-SW-C April 26
EMF-SW-C April 30
EMF-SW-D April 26
EMF-SW-D April 30
Sample Location and Date


EMFR April 2012 Floodwater Monitoring Event: Lead
Lead (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Key
Total
Dissolved
Reporting limit of 0.003 mg/L
Note: All dissolved lead concentrations for both sampling days and all total lead concentrations for April 30th are below the reporting limit.
Error bars are +/-30%
EMF-SW-A April 26
EMF-SW-A April 30
EMF-SW-B April 26
EMF-SW-B April 30
EMF-SW-C April 26
EMF-SW-C April 30
EMF-SW-D April 26
EMF-SW-D April 30
Sample Location and Date


EMFR April 2012 Floodwater Monitoring Event: Zinc
Zinc (mg/L)
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Key
Dissolved
Total
Reporting limit of 0.0050 mg/L
Error bars are +/-30%
EMF-SW-A April 26
EMF-SW-A April 30
EMF-SW-B April 26
EMF-SW-B April 30
EMF-SW-C April 26
EMF-SW-C April 30
EMF-SW-D April 26
EMF-SW-D April 30
Sample Location and Date

Attachment B

SVL Laboratory Reports

One Government Gulch - PO Box 929 | Kellogg ID 83837-0929 | (208) 784-1258 | Fax (208) 783-0891

Terragraphics (Moscow)	**Project Name: Terragraphics EMF Well**
121 S Jackson	Work Order: **W2D0583**
Moscow, ID 83843	Reported: 09-May-12 09:15

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Sampled By	Date Received
(EMF-SW-A)042612	W2D0583-01	Surface Water	26-Apr-12 12:30	GM	26-Apr-2012
(EMF-SW-B)042612	W2D0583-02	Surface Water	26-Apr-12 13:15	GM	26-Apr-2012
(EMF-SW-C)042612	W2D0583-03	Surface Water	26-Apr-12 13:45	GM	26-Apr-2012
(EMF-SW-C-C)042612	W2D0583-04	Surface Water	26-Apr-12 13:45	GM	26-Apr-2012
(EMF-SW-D)042612	W2D0583-05	Surface Water	26-Apr-12 14:10	GM	26-Apr-2012

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested.
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.

SVL holds the following certifications:
AZ:0538, **CA**:2080, **FL**(**NELAC**):E87993, **ID**:ID00019 & ID00965 (Microbiology), **NV**:ID000192007A, **WA**:1268

One Government Gulch - PO Box 929 Kellogg ID 83837-0929 (208) 784-1258 Fax (208) 783-0891

Terragraphics (Moscow)
121 S Jackson
Moscow, ID 83843

Project Name: Terragraphics EMF Well
Work Order: **W2D0583**
Reported: 09-May-12 09:15

Client Sample ID: **(EMF-SW-A)042612**
SVL Sample ID: **W2D0583-01 (Surface Water)**

Sample Report Page 1 of 1

Sampled: 26-Apr-12 12:30
Received: 26-Apr-12
Sampled By: GM

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00015	2.5	W218018	KWH	05/08/12 10:16	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0003	2.5	W218018	KWH	05/08/12 10:16	
EPA 200.8	**Cadmium**	0.00050	mg/L	0.00020	0.00002	2.5	W218018	KWH	05/08/12 10:16	
EPA 200.8	**Lead**	0.0106	mg/L	0.00300	0.000072	2.5	W218018	KWH	05/08/12 10:16	
EPA 200.8	**Zinc**	0.104	mg/L	0.0050	0.0010	2.5	W218018	KWH	05/08/12 10:16	
Metals (Dissolved)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00012		W218032	KWH	05/08/12 09:35	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0002		W218032	KWH	05/08/12 09:35	
EPA 200.8	**Cadmium**	0.00049	mg/L	0.00020	0.000014		W218032	KWH	05/08/12 09:35	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000058		W218032	KWH	05/08/12 09:35	
EPA 200.8	**Zinc**	0.113	mg/L	0.0050	0.0008		W218032	KWH	05/08/12 09:35	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern
Laboratory Director

SVL holds the following certifications:
AZ:0538, **CA**:2080, **FL**(**NELAC**):E87993, **ID**:ID00019 & ID00965 (Microbiology), **NV**:ID000192007A, **WA**:1268

One Government Gulch - PO Box 929 Kellogg ID 83837-0929 (208) 784-1258 Fax (208) 783-0891

Terragraphics (Moscow)
121 S Jackson
Moscow, ID 83843

Project Name: Terragraphics EMF Well
Work Order: **W2D0583**
Reported: 09-May-12 09:15

Client Sample ID: **(EMF-SW-B)042612**
SVL Sample ID: **W2D0583-02 (Surface Water)**

Sample Report Page 1 of 1

Sampled: 26-Apr-12 13:15
Received: 26-Apr-12
Sampled By: GM

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00015	2.5	W218018	KWH	05/08/12 10:47	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0003	2.5	W218018	KWH	05/08/12 10:47	
EPA 200.8	**Cadmium**	0.00058	mg/L	0.00020	0.00002	2.5	W218018	KWH	05/08/12 10:47	
EPA 200.8	**Lead**	0.00645	mg/L	0.00300	0.000072	2.5	W218018	KWH	05/08/12 10:47	
EPA 200.8	**Zinc**	0.159	mg/L	0.0050	0.0010	2.5	W218018	KWH	05/08/12 10:47	
Metals (Dissolved)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00012		W218032	KWH	05/08/12 09:48	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0002		W218032	KWH	05/08/12 09:48	
EPA 200.8	**Cadmium**	0.00059	mg/L	0.00020	0.000014		W218032	KWH	05/08/12 09:48	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000058		W218032	KWH	05/08/12 09:48	
EPA 200.8	**Zinc**	0.131	mg/L	0.0050	0.0008		W218032	KWH	05/08/12 09:48	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern
Laboratory Director

One Government Gulch - PO Box 929 Kellogg ID 83837-0929 (208) 784-1258 Fax (208) 783-0891

Terragraphics (Moscow)
121 S Jackson
Moscow, ID 83843

Project Name: Terragraphics EMF Well
Work Order: **W2D0583**
Reported: 09-May-12 09:15

Client Sample ID: **(EMF-SW-C)042612**
SVL Sample ID: **W2D0583-03 (Surface Water)**

Sample Report Page 1 of 1

Sampled: 26-Apr-12 13:45
Received: 26-Apr-12
Sampled By: GM

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00015	2.5	W218018	KWH	05/08/12 10:52	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0003	2.5	W218018	KWH	05/08/12 10:52	
EPA 200.8	**Cadmium**	0.00044	mg/L	0.00020	0.00002	2.5	W218018	KWH	05/08/12 10:52	
EPA 200.8	**Lead**	0.00536	mg/L	0.00300	0.000072	2.5	W218018	KWH	05/08/12 10:52	
EPA 200.8	**Zinc**	0.111	mg/L	0.0050	0.0010	2.5	W218018	KWH	05/08/12 10:52	
Metals (Dissolved)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00012		W218032	KWH	05/08/12 09:53	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0002		W218032	KWH	05/08/12 09:53	
EPA 200.8	**Cadmium**	0.00041	mg/L	0.00020	0.000014		W218032	KWH	05/08/12 09:53	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000058		W218032	KWH	05/08/12 09:53	
EPA 200.8	**Zinc**	0.110	mg/L	0.0050	0.0008		W218032	KWH	05/08/12 09:53	

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

Terragraphics (Moscow)
121 S Jackson
Moscow, ID 83843

Project Name: Terragraphics EMF Well
Work Order: **W2D0583**
Reported: 09-May-12 09:15

Client Sample ID: **(EMF-SW-C-C)042612**
SVL Sample ID: **W2D0583-04 (Surface Water)**

Sample Report Page 1 of 1

Sampled: 26-Apr-12 13:45
Received: 26-Apr-12
Sampled By: GM

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00015	2.5	W218018	KWH	05/08/12 10:56	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0003	2.5	W218018	KWH	05/08/12 10:56	
EPA 200.8	**Cadmium**	0.00046	mg/L	0.00020	0.00002	2.5	W218018	KWH	05/08/12 10:56	
EPA 200.8	**Lead**	0.00539	mg/L	0.00300	0.000072	2.5	W218018	KWH	05/08/12 10:56	
EPA 200.8	**Zinc**	0.113	mg/L	0.0050	0.0010	2.5	W218018	KWH	05/08/12 10:56	
Metals (Dissolved)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00012		W218032	KWH	05/08/12 09:57	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0002		W218032	KWH	05/08/12 09:57	
EPA 200.8	**Cadmium**	0.00065	mg/L	0.00020	0.000014		W218032	KWH	05/08/12 09:57	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000058		W218032	KWH	05/08/12 09:57	
EPA 200.8	**Zinc**	0.111	mg/L	0.0050	0.0008		W218032	KWH	05/08/12 09:57	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern
Laboratory Director

One Government Gulch - PO Box 929 Kellogg ID 83837-0929 (208) 784-1258 Fax (208) 783-0891

Terragraphics (Moscow)
121 S Jackson
Moscow, ID 83843

Project Name: Terragraphics EMF Well
Work Order: **W2D0583**
Reported: 09-May-12 09:15

Client Sample ID: **(EMF-SW-D)042612**
SVL Sample ID: **W2D0583-05 (Surface Water)**

Sample Report Page 1 of 1

Sampled: 26-Apr-12 14:10
Received: 26-Apr-12
Sampled By: GM

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00015	2.5	W218018	KWH	05/08/12 11:01	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0003	2.5	W218018	KWH	05/08/12 11:01	
EPA 200.8	**Cadmium**	0.00039	mg/L	0.00020	0.00002	2.5	W218018	KWH	05/08/12 11:01	
EPA 200.8	**Lead**	0.00373	mg/L	0.00300	0.000072	2.5	W218018	KWH	05/08/12 11:01	
EPA 200.8	**Zinc**	0.0713	mg/L	0.0050	0.0010	2.5	W218018	KWH	05/08/12 11:01	
Metals (Dissolved)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00012		W218032	KWH	05/08/12 10:02	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0002		W218032	KWH	05/08/12 10:02	
EPA 200.8	**Cadmium**	0.00035	mg/L	0.00020	0.000014		W218032	KWH	05/08/12 10:02	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000058		W218032	KWH	05/08/12 10:02	
EPA 200.8	**Zinc**	0.0810	mg/L	0.0050	0.0008		W218032	KWH	05/08/12 10:02	

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

Terragraphics (Moscow)
121 S Jackson
Moscow, ID 83843

Project Name: Terragraphics EMF Well
Work Order: **W2D0583**
Reported: 09-May-12 09:15

Quality Control - BLANK Data

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)								
EPA 200.8	Antimony	mg/L	<0.00300	0.00015	0.00300	W218018	08-May-12	
EPA 200.8	Arsenic	mg/L	<0.0030	0.0003	0.0030	W218018	08-May-12	
EPA 200.8	Lead	mg/L	<0.00300	0.000072	0.00300	W218018	08-May-12	
EPA 200.8	Zinc	mg/L	<0.0050	0.0010	0.0050	W218018	08-May-12	
EPA 200.8	Cadmium	mg/L	<0.00020	0.00002	0.00020	W218018	08-May-12	
Metals (Dissolved)								
EPA 200.8	Antimony	mg/L	<0.00300	0.00012	0.00300	W218032	08-May-12	
EPA 200.8	Arsenic	mg/L	<0.0030	0.0002	0.0030	W218032	08-May-12	
EPA 200.8	Cadmium	mg/L	<0.00020	0.000014	0.00020	W218032	08-May-12	
EPA 200.8	Lead	mg/L	<0.00300	0.000058	0.00300	W218032	08-May-12	
EPA 200.8	Zinc	mg/L	<0.0050	0.0008	0.0050	W218032	08-May-12	

Quality Control - LABORATORY CONTROL SAMPLE Data

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)									
EPA 200.8	Antimony	mg/L	0.0273	0.0250	109	85 - 115	W218018	08-May-12	
EPA 200.8	Arsenic	mg/L	0.0249	0.0250	99.7	85 - 115	W218018	08-May-12	
EPA 200.8	Lead	mg/L	0.0256	0.0250	102	85 - 115	W218018	08-May-12	
EPA 200.8	Zinc	mg/L	0.0250	0.0250	100	85 - 115	W218018	08-May-12	
EPA 200.8	Cadmium	mg/L	0.0258	0.0250	103	85 - 115	W218018	08-May-12	
Metals (Dissolved)									
EPA 200.8	Antimony	mg/L	0.0256	0.0250	102	85 - 115	W218032	08-May-12	
EPA 200.8	Arsenic	mg/L	0.0256	0.0250	102	85 - 115	W218032	08-May-12	
EPA 200.8	Cadmium	mg/L	0.0256	0.0250	103	85 - 115	W218032	08-May-12	
EPA 200.8	Lead	mg/L	0.0250	0.0250	99.9	85 - 115	W218032	08-May-12	
EPA 200.8	Zinc	mg/L	0.0255	0.0250	102	85 - 115	W218032	08-May-12	

Quality Control - DUPLICATE Data

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)									
EPA 200.8	Antimony	mg/L	<0.00300	<0.00300	<RL	20	W218018	08-May-12	
EPA 200.8	Arsenic	mg/L	<0.0030	<0.0030	<RL	20	W218018	08-May-12	
EPA 200.8	Lead	mg/L	0.0111	0.0106	4.9	20	W218018	08-May-12	
EPA 200.8	Zinc	mg/L	0.107	0.104	2.3	20	W218018	08-May-12	
EPA 200.8	Cadmium	mg/L	0.00051	0.00050	3.2	20	W218018	08-May-12	
Metals (Dissolved)									
EPA 200.8	Antimony	mg/L	<0.00300	<0.00300	<RL	20	W218032	08-May-12	
EPA 200.8	Arsenic	mg/L	<0.0030	<0.0030	<RL	20	W218032	08-May-12	
EPA 200.8	Cadmium	mg/L	0.00049	0.00049	0.3	20	W218032	08-May-12	
EPA 200.8	Lead	mg/L	<0.00300	<0.00300	<RL	20	W218032	08-May-12	
EPA 200.8	Zinc	mg/L	0.114	0.113	1.3	20	W218032	08-May-12	

Terragraphics (Moscow)
121 S Jackson
Moscow, ID 83843

Project Name: Terragraphics EMF Well
Work Order: **W2D0583**
Reported: 09-May-12 09:15

Quality Control - MATRIX SPIKE Data

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.8	Antimony	mg/L	0.0269	<0.00300	0.0250	107	70 - 130	W218018	08-May-12	
EPA 200.8	Arsenic	mg/L	0.0250	<0.0030	0.0250	97.8	70 - 130	W218018	08-May-12	
EPA 200.8	Lead	mg/L	0.0369	0.0106	0.0250	105	70 - 130	W218018	08-May-12	
EPA 200.8	Zinc	mg/L	0.129	0.104	0.0250	101	70 - 130	W218018	08-May-12	
EPA 200.8	Cadmium	mg/L	0.0260	0.00050	0.0250	102	70 - 130	W218018	08-May-12	
Metals (Dissolved)										
EPA 200.8	Antimony	mg/L	0.0261	<0.00300	0.0250	103	70 - 130	W218032	08-May-12	
EPA 200.8	Arsenic	mg/L	0.0260	<0.0030	0.0250	102	70 - 130	W218032	08-May-12	
EPA 200.8	Cadmium	mg/L	0.0268	0.00049	0.0250	105	70 - 130	W218032	08-May-12	
EPA 200.8	Lead	mg/L	0.0270	<0.00300	0.0250	104	70 - 130	W218032	08-May-12	
EPA 200.8	Zinc	mg/L	0.137	0.113	0.0250	96.6	70 - 130	W218032	08-May-12	

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

One Government Gulch - PO Box 929 Kellogg ID 83837-0929 (208) 784-1258 Fax (208) 783-0891

Terragraphics (Moscow)
121 S Jackson
Moscow, ID 83843

Project Name: Terragraphics EMF Well
Work Order: **W2D0641**
Reported: 14-May-12 14:19

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Sampled By	Date Received
(EMF-SW-A)043012	W2D0641-01	Surface Water	30-Apr-12 09:35	GM	30-Apr-2012
(EMF-SW-B)043012	W2D0641-02	Surface Water	30-Apr-12 10:00	GM	30-Apr-2012
(EMF-SW-C)043012	W2D0641-03	Surface Water	30-Apr-12 10:35	GM	30-Apr-2012
(EMF-SW-C-C)043012	W2D0641-04	Surface Water	30-Apr-12 10:35	GM	30-Apr-2012
(EMF-SW-D)043012	W2D0641-05	Surface Water	30-Apr-12 11:00	GM	30-Apr-2012

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested.
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.

One Government Gulch - PO Box 929 | Kellogg ID 83837-0929 | (208) 784-1258 | Fax (208) 783-0891

Terragraphics (Moscow)
121 S Jackson
Moscow, ID 83843

Project Name: Terragraphics EMF Well
Work Order: **W2D0641**
Reported: 14-May-12 14:19

Client Sample ID: **(EMF-SW-A)043012**
SVL Sample ID: **W2D0641-01 (Surface Water)**

Sample Report Page 1 of 1

Sampled: 30-Apr-12 09:35
Received: 30-Apr-12
Sampled By: GM

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00015	2.5	W218174	KWH	05/14/12 10:44	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0003	2.5	W218174	KWH	05/14/12 10:44	
EPA 200.8	**Cadmium**	0.00030	mg/L	0.00020	0.00002	2.5	W218174	KWH	05/14/12 10:44	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000072	2.5	W218174	KWH	05/14/12 10:44	
EPA 200.8	**Zinc**	0.0859	mg/L	0.0050	0.0010	2.5	W218174	KWH	05/14/12 10:44	
Metals (Dissolved)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00012		W218179	KWH	05/14/12 10:24	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0002		W218179	KWH	05/14/12 10:24	
EPA 200.8	**Cadmium**	0.00026	mg/L	0.00020	0.000014		W218179	KWH	05/14/12 10:24	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000058		W218179	KWH	05/14/12 10:24	
EPA 200.8	**Zinc**	0.0900	mg/L	0.0050	0.0008		W218179	KWH	05/14/12 10:24	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern
Laboratory Director

One Government Gulch - PO Box 929 Kellogg ID 83837-0929 (208) 784-1258 Fax (208) 783-0891

Terragraphics (Moscow)	**Project Name: Terragraphics EMF Well**
121 S Jackson	Work Order: **W2D0641**
Moscow, ID 83843	Reported: 14-May-12 14:19

Client Sample ID: **(EMF-SW-B)043012**
SVL Sample ID: **W2D0641-02 (Surface Water)**

Sample Report Page 1 of 1

Sampled: 30-Apr-12 10:00
Received: 30-Apr-12
Sampled By: GM

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00015	2.5	W218174	KWH	05/14/12 10:49	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0003	2.5	W218174	KWH	05/14/12 10:49	
EPA 200.8	**Cadmium**	0.00021	mg/L	0.00020	0.00002	2.5	W218174	KWH	05/14/12 10:49	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000072	2.5	W218174	KWH	05/14/12 10:49	
EPA 200.8	**Zinc**	0.0625	mg/L	0.0050	0.0010	2.5	W218174	KWH	05/14/12 10:49	
Metals (Dissolved)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00012		W218179	KWH	05/14/12 10:29	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0002		W218179	KWH	05/14/12 10:29	
EPA 200.8	Cadmium	< 0.00020	mg/L	0.00020	0.000014		W218179	KWH	05/14/12 10:29	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000058		W218179	KWH	05/14/12 10:29	
EPA 200.8	**Zinc**	0.0630	mg/L	0.0050	0.0008		W218179	KWH	05/14/12 10:29	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern
Laboratory Director

One Government Gulch - PO Box 929 Kellogg ID 83837-0929 (208) 784-1258 Fax (208) 783-0891

Terragraphics (Moscow)
121 S Jackson
Moscow, ID 83843

Project Name: Terragraphics EMF Well
Work Order: **W2D0641**
Reported: 14-May-12 14:19

Client Sample ID: **(EMF-SW-C)043012**
SVL Sample ID: **W2D0641-03 (Surface Water)**

Sample Report Page 1 of 1

Sampled: 30-Apr-12 10:35
Received: 30-Apr-12
Sampled By: GM

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00015	2.5	W218174	KWH	05/14/12 10:51	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0003	2.5	W218174	KWH	05/14/12 10:51	
EPA 200.8	Cadmium	< 0.00020	mg/L	0.00020	0.00002	2.5	W218174	KWH	05/14/12 10:51	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000072	2.5	W218174	KWH	05/14/12 10:51	
EPA 200.8	**Zinc**	0.0550	mg/L	0.0050	0.0010	2.5	W218174	KWH	05/14/12 10:51	
Metals (Dissolved)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00012		W218179	KWH	05/14/12 10:31	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0002		W218179	KWH	05/14/12 10:31	
EPA 200.8	Cadmium	< 0.00020	mg/L	0.00020	0.000014		W218179	KWH	05/14/12 10:31	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000058		W218179	KWH	05/14/12 10:31	
EPA 200.8	**Zinc**	0.0552	mg/L	0.0050	0.0008		W218179	KWH	05/14/12 10:31	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern
Laboratory Director

One Government Gulch - PO Box 929 Kellogg ID 83837-0929 (208) 784-1258 Fax (208) 783-0891

Terragraphics (Moscow)
121 S Jackson
Moscow, ID 83843

Project Name: Terragraphics EMF Well
Work Order: **W2D0641**
Reported: 14-May-12 14:19

Client Sample ID: **(EMF-SW-C-C)043012**
SVL Sample ID: **W2D0641-04 (Surface Water)**

Sample Report Page 1 of 1

Sampled: 30-Apr-12 10:35
Received: 30-Apr-12
Sampled By: GM

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00015	2.5	W218174	KWH	05/14/12 10:53	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0003	2.5	W218174	KWH	05/14/12 10:53	
EPA 200.8	Cadmium	< 0.00020	mg/L	0.00020	0.00002	2.5	W218174	KWH	05/14/12 10:53	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000072	2.5	W218174	KWH	05/14/12 10:53	
EPA 200.8	**Zinc**	0.0552	mg/L	0.0050	0.0010	2.5	W218174	KWH	05/14/12 10:53	
Metals (Dissolved)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00012		W218179	KWH	05/14/12 10:33	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0002		W218179	KWH	05/14/12 10:33	
EPA 200.8	Cadmium	< 0.00020	mg/L	0.00020	0.000014		W218179	KWH	05/14/12 10:33	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000058		W218179	KWH	05/14/12 10:33	
EPA 200.8	**Zinc**	0.0555	mg/L	0.0050	0.0008		W218179	KWH	05/14/12 10:33	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern
Laboratory Director

SVL holds the following certifications:
AZ:0538, **CA**:2080, **FL**(**NELAC**):E87993, **ID**:ID00019 & ID00965 (Microbiology), **NV**:ID000192007A, **WA**:1268

One Government Gulch - PO Box 929 Kellogg ID 83837-0929 (208) 784-1258 Fax (208) 783-0891

Terragraphics (Moscow)
121 S Jackson
Moscow, ID 83843

Project Name: Terragraphics EMF Well
Work Order: **W2D0641**
Reported: 14-May-12 14:19

Client Sample ID: **(EMF-SW-D)043012**
SVL Sample ID: **W2D0641-05 (Surface Water)**

Sample Report Page 1 of 1

Sampled: 30-Apr-12 11:00
Received: 30-Apr-12
Sampled By: GM

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00015	2.5	W218174	KWH	05/14/12 10:55	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0003	2.5	W218174	KWH	05/14/12 10:55	
EPA 200.8	**Cadmium**	0.00022	mg/L	0.00020	0.00002	2.5	W218174	KWH	05/14/12 10:55	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000072	2.5	W218174	KWH	05/14/12 10:55	
EPA 200.8	**Zinc**	0.0564	mg/L	0.0050	0.0010	2.5	W218174	KWH	05/14/12 10:55	
Metals (Dissolved)										
EPA 200.8	Antimony	< 0.00300	mg/L	0.00300	0.00012		W218179	KWH	05/14/12 10:35	
EPA 200.8	Arsenic	< 0.0030	mg/L	0.0030	0.0002		W218179	KWH	05/14/12 10:35	
EPA 200.8	Cadmium	< 0.00020	mg/L	0.00020	0.000014		W218179	KWH	05/14/12 10:35	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.000058		W218179	KWH	05/14/12 10:35	
EPA 200.8	**Zinc**	0.0567	mg/L	0.0050	0.0008		W218179	KWH	05/14/12 10:35	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

John Kern
Laboratory Director

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Terragraphics (Moscow)
121 S Jackson
Moscow, ID 83843

Project Name: Terragraphics EMF Well
Work Order: **W2D0641**
Reported: 14-May-12 14:19

Quality Control - BLANK Data

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)								
EPA 200.8	Antimony	mg/L	<0.00300	0.00015	0.00300	W218174	14-May-12	
EPA 200.8	Arsenic	mg/L	<0.0030	0.0003	0.0030	W218174	14-May-12	
EPA 200.8	Lead	mg/L	<0.00300	0.000072	0.00300	W218174	14-May-12	
EPA 200.8	Zinc	mg/L	<0.0050	0.0010	0.0050	W218174	14-May-12	
EPA 200.8	Cadmium	mg/L	<0.00020	0.00002	0.00020	W218174	14-May-12	
Metals (Dissolved)								
EPA 200.8	Antimony	mg/L	<0.00300	0.00012	0.00300	W218179	14-May-12	
EPA 200.8	Arsenic	mg/L	<0.0030	0.0002	0.0030	W218179	14-May-12	
EPA 200.8	Cadmium	mg/L	<0.00020	0.000014	0.00020	W218179	14-May-12	
EPA 200.8	Lead	mg/L	<0.00300	0.000058	0.00300	W218179	14-May-12	
EPA 200.8	Zinc	mg/L	<0.0050	0.0008	0.0050	W218179	14-May-12	

Quality Control - LABORATORY CONTROL SAMPLE Data

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)									
EPA 200.8	Antimony	mg/L	0.0284	0.0250	113	85 - 115	W218174	14-May-12	
EPA 200.8	Arsenic	mg/L	0.0261	0.0250	104	85 - 115	W218174	14-May-12	
EPA 200.8	Lead	mg/L	0.0255	0.0250	102	85 - 115	W218174	14-May-12	
EPA 200.8	Zinc	mg/L	0.0271	0.0250	108	85 - 115	W218174	14-May-12	
EPA 200.8	Cadmium	mg/L	0.0254	0.0250	102	85 - 115	W218174	14-May-12	
Metals (Dissolved)									
EPA 200.8	Antimony	mg/L	0.0254	0.0250	102	85 - 115	W218179	14-May-12	
EPA 200.8	Arsenic	mg/L	0.0262	0.0250	105	85 - 115	W218179	14-May-12	
EPA 200.8	Cadmium	mg/L	0.0257	0.0250	103	85 - 115	W218179	14-May-12	
EPA 200.8	Lead	mg/L	0.0258	0.0250	103	85 - 115	W218179	14-May-12	
EPA 200.8	Zinc	mg/L	0.0267	0.0250	107	85 - 115	W218179	14-May-12	

Quality Control - DUPLICATE Data

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)									
EPA 200.8	Antimony	mg/L	<0.00300	<0.00300	<RL	20	W218174	14-May-12	
EPA 200.8	Arsenic	mg/L	<0.0030	<0.0030	<RL	20	W218174	14-May-12	
EPA 200.8	Lead	mg/L	<0.00300	<0.00300	<RL	20	W218174	14-May-12	
EPA 200.8	Zinc	mg/L	0.0852	0.0859	0.9	20	W218174	14-May-12	
EPA 200.8	Cadmium	mg/L	0.00030	0.00030	0.3	20	W218174	14-May-12	
Metals (Dissolved)									
EPA 200.8	Antimony	mg/L	<0.00300	<0.00300	<RL	20	W218179	14-May-12	
EPA 200.8	Arsenic	mg/L	<0.0030	<0.0030	<RL	20	W218179	14-May-12	
EPA 200.8	Cadmium	mg/L	0.00026	0.00026	1.0	20	W218179	14-May-12	
EPA 200.8	Lead	mg/L	<0.00300	<0.00300	<RL	20	W218179	14-May-12	
EPA 200.8	Zinc	mg/L	0.0889	0.0900	1.2	20	W218179	14-May-12	

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Terragraphics (Moscow)	**Project Name: Terragraphics EMF Well**
121 S Jackson	Work Order: **W2D0641**
Moscow, ID 83843	Reported: 14-May-12 14:19

Quality Control - MATRIX SPIKE Data

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.8	Antimony	mg/L	0.0288	<0.00300	0.0250	114	70 - 130	W218174	14-May-12	
EPA 200.8	Arsenic	mg/L	0.0277	<0.0030	0.0250	105	70 - 130	W218174	14-May-12	
EPA 200.8	Lead	mg/L	0.0282	<0.00300	0.0250	101	70 - 130	W218174	14-May-12	
EPA 200.8	Zinc	mg/L	0.113	0.0859	0.0250	108	70 - 130	W218174	14-May-12	
EPA 200.8	Cadmium	mg/L	0.0263	0.00030	0.0250	104	70 - 130	W218174	14-May-12	
Metals (Dissolved)										
EPA 200.8	Antimony	mg/L	0.0256	<0.00300	0.0250	100	70 - 130	W218179	14-May-12	
EPA 200.8	Arsenic	mg/L	0.0285	<0.0030	0.0250	109	70 - 130	W218179	14-May-12	
EPA 200.8	Cadmium	mg/L	0.0261	0.00026	0.0250	103	70 - 130	W218179	14-May-12	
EPA 200.8	Lead	mg/L	0.0267	<0.00300	0.0250	99.3	70 - 130	W218179	14-May-12	
EPA 200.8	Zinc	mg/L	0.115	0.0900	0.0250	101	70 - 130	W218179	14-May-12	

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

Appendix B

EMFR 2012 Piezometer Memorandum

TerraGraphics Environmental Engineering, Inc.

www.terragraphics.com

121 S. Jackson St., Moscow, ID 83843
Phone: (208) 882-7858; Fax: (208) 883-3785

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Helena, MT 59601
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7000 Smoke Ranch Rd., Las Vegas, NV 89128
Phone: (702) 685-2229; Fax: (702) 685-2223

TECHNICAL MEMORANDUM

To: Don Carpenter, IDEQ, Boise

From: Robin Nimmer, TerraGraphics, Moscow
Mike Procsal TerraGraphics, Boise

Date: November 5, 2013

Project Code: 12025-08-02

Subject: Summary and Analysis of 2012 EMFR Piezometer Data

---

1 Introduction and Purpose

The East Mission Flats Repository (EMFR) is located immediately north of US I-90 near Exit 39 in Kootenai County, Idaho (Figure 1). The EMFR is designed for the long-term, safe storage of metals-contaminated waste soil derived from a variety of remedial actions conducted at the Bunker Hill Mining and Metallurgical Complex Superfund Site. Design work commenced in 2007, and the final design report was issued in June 2009 (TerraGraphics, 2009a). EMFR has been receiving waste since August 2009.

The EMFR design was reviewed by the Office of the Inspector General (OIG) and its findings were issued in June 2009 (OIG, 2009). In this report, the OIG recommended the designers confirm the adequacy of the repository design to prevent dissolved metal contaminants from being released. In response to the OIG recommendation, an Enhanced Monitoring Plan (EMP) for EMFR was issued by EPA (Environmental Protection Agency) and IDEQ (Idaho Department of Environmental Quality) on November 30, 2009 (TerraGraphics, 2009b). The EMP recommended installation of piezometers in the repository waste to monitor for the presence of water. If water is present in the piezometers, the EMP recommends additional work to monitor conditions within the waste soil that may lead to releases of metals to groundwater (i.e., reducing conditions). Detection of reducing conditions within the waste soil mass will initiate development of a corrective action to: 1) identify the cause of the reducing conditions and 2) if necessary, mitigate the impacts of metals migration to the underlying groundwater.

Two piezometers were installed within the EMFR in December 2010: 10-EMF-PZ-A (PZ-A) and 10-EMF-PZ-B (PZ-B) (Figure 1). The bottoms of PZ-A and PZ-B were set approximately 0.5 feet and 6.5 feet, respectively, above the native topographic surface. Water has not been detected in PZ-B, but water was detected in PZ-A on January 31, 2011, and water-level data have been collected with a datalogger since that time. On April 6, 2011, a multi-parameter probe and datalogger that records water level and field water quality parameters was installed in PZ-A.

The purpose of this memorandum is to summarize the 2012 water level and water quality data in PZ-A. Although water was detected, sufficient data have not been collected at this time to determine if reducing conditions are present within the waste soil mass. Therefore, this memorandum includes an initial evaluation of the causal mechanisms for the presence of water in PZ-A during 2012 and recommendations to collect additional data to determine if reducing conditions are present within the waste soil mass. If reducing conditions are detected in the future, then a water-source evaluation will be re-evaluated with additional annual data.

2 Site Conceptual Model

The Coeur d'Alene River (CDA River) flows in an approximate arc around the site three quarters of a mile to the east, south, and west. A review of monitoring well boring logs indicates an upper aquifer composed of alluvial sand and gravel overlain by 12 to 15 feet of silt and clay. Wells MW-A, MW-B, MW-C and MW-D are all about 28 feet deep and are completed in the upper aquifer in the vicinity of the facility (Figure 1). Well MW-C Deep is completed in a lower sand and gravel unit with perforations in the depth range of 76 to 96 feet. A strong surface water-groundwater interaction occurs at the site and is likely related to the upper sand and gravel aquifer extending to the CDA River. The high permeability sand and gravel layer allows for a rapid response in local groundwater elevations corresponding to the changes in river stage.

Flooding occurs frequently during spring runoff, and groundwater horizontal hydraulic gradients in the upper aquifer frequently shift during this time. The horizontal hydraulic gradient during low river flow is generally toward the southwest, with MW-D representing the upgradient well (Figure 2). The gradient often shifts toward the west or northwest, corresponding to an increase in river stage. MW-A periodically represents the upgradient well during the most significant shifts.

Groundwater levels in the upper aquifer are below the base of the repository for most of the year. However, groundwater levels rise above the base of the repository during periods of high river stage. Overbank flooding associated with high river stage and possible upward groundwater flow results in the presence of floodwater near the base of the repository during spring runoff.

The repository design evaluated the vertical and horizontal water infiltration pathways. The design report contains seepage velocity calculations for upward groundwater flow through the native silt and clay layer. It assumes that upward groundwater flow would only occur for a short time and that the low hydraulic conductivity of the compacted native sediments would impede water infiltration into the base of the repository (TerraGraphics, 2009a). The repository design report also contains model results indicating that lateral infiltration of floodwater into the repository waste would be between 15 and 17 feet during a 75-day period of floodwater inundation (TerraGraphics, 2009a). Since the time of the repository design, PZ-A and PZ-B were installed approximately 65 feet from the nearest toe of the repository and water has been detected in PZ-A in 2011 and 2012.

3 PZ-A Construction and 2012 Field Methods

PZ-A was installed to a depth of 17 feet below ground surface (bgs), approximately 0.5 feet above the native soil, with a 2-foot screened interval from 15 to 17 feet bgs. PZ-A has a 10-inch diameter borehole and was completed with a 4-inch diameter schedule-40 PVC casing. The piezometer is screened using a 0.010-inch slotted casing. A sediment trap approximately 2 to 3 inches deep was placed below the screened interval. The annular space was filled with 10-20 Colorado silica sand from approximately 13 to 17 feet bgs, bentonite chips from 4 to 13 feet bgs, and concrete from 0 to 4 feet bgs.

In 2012, water-level and water-quality measurements were collected in PZ-A using an In Situ Troll® 9500 (Troll) multi-parameter probe. The Troll is a down-hole water quality probe that measures and records hourly water level, pH, temperature, dissolved oxygen (DO), conductivity, and oxidation-reduction potential (ORP). The field crew calibrated the Troll three times in 2012 for all parameters per the manufacturer's instructions. The data reported in this memorandum have been reviewed and adjusted for calibration drift, sensor out of water, and erroneous data.

Sample collection from PZ-A was attempted using low-flow methods on May 2, 2012. Purging began at 09:40 and water-quality parameters were measured with a QED MP20 MicroPurge® flow-through cell. Parameters were recorded immediately and then at 1, 2, and 4 minutes. The groundwater sampling record for PZ-A is included in Attachment A. Purging was stopped at 09:45 because the piezometer went dry. It took only 5 minutes to completely purge the well dry using the low-flow protocol (pumping rate of approximately 100 milliliters per minute). During the purging process, insufficient water was available to collect a reliable and valid sample. The water level in PZ-A was then monitored for 30 minutes to record the rate of recharge. The recharge rate was estimated to be 0.15 feet per 30 minutes; however, the water level did not change over the last 8 minutes of observation. No water samples were submitted to the laboratory because 1) PZ-A could not be properly developed according to standard methods due to insufficient water, and 2) the sampling protocol as described in the EMFR Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP) (TerraGraphics, 2010) could not be followed.

4 PZ-A Water Levels and Parameter Results

The 2012 results of the PZ-A water-quality probe data are presented below for water level, DO, conductivity, temperature, pH, and ORP. Time-series plots of 2012 Troll data are shown in Figure 3 and include water-level elevation, conductivity, temperature, and pH. DO data are not shown because there was no change over the period of record. ORP data are not shown because the sensor was not functioning properly, and consequently the data were rejected.

4.1 Water Levels

Based on the Troll water-level data, the sensor became submerged at approximately 02:00 on April 24, 2012, and remained submerged until July 6, 2012, at approximately 01:00, with the exception of May 2 and May 3 when the well was purged dry. After July 6, the Troll did not record water levels above the sensor throughout the remainder of 2012. The maximum water column height of approximately 0.9 feet above the base of the piezometer was recorded at 09:00 on May 2. After this measurement was collected, the field crew purged the well dry while attempting to collect a sample for geochemical analysis. Water was not detected by the Troll sensor until 25 hours later, followed by a nearly continuous rise in water level until the maximum water column height of approximately 0.7 feet above the base of the piezometer was reached for the remainder of the year on May 18 and 19. The small near-instantaneous water-level changes observed in Figure 3 correspond to occasions when the probe was removed from PZ-A to collect manual measurements of depth-to-water.

Based on the Troll water-level data, PZ-A recharge rates were estimated. From April 24, 2012 when water was first measured within PZ-A until the May 2, 2012 sample attempt, the 24 hour water level increases ranged from 0.04 to 0.13 feet per day (1.5 inches per day). After the well was purged dry until the peak water height was achieved on May 18, the 24-hour recharge rate ranged from 0.01 to 0.07 feet per day (0.79 inches per day).

4.2 Dissolved Oxygen

Based on the DO data, the DO sensor appears to have been submerged on April 17, 2012, at approximately 18:00 and remained submerged until July 12, 2012, at approximately 04:00, with the exception of May 2 and May 3 when the well was purged dry. This sensor is located slightly below the others on the Troll. All of the DO concentrations were 0.0 milligrams per liter (mg/L). The DO sensor measurements were confirmed through a calibration check procedure and a bucket test where another water quality meter was used to measure DO.

4.3 Conductivity

The conductivity sensor became submerged on April 25, 2012, at approximately 03:00, and remained submerged until July 5, 2012, at approximately 00:00, with the exception of May 2 and May 3 when the well was purged dry. Conductivity ranged from 1,029 microsiemens per centimeter (µS/cm) to 1,369 µS/cm. Conductivity peaked on June 26, 2012. The jumps in the data relate to when the unit was removed and replaced during the depth-to-water hand measurements, and could be caused by the action of agitating the water (see Figure 3).

4.4 Temperature

The temperature data indicate that this sensor was submerged for the same period as the water level sensor. The temperature was relatively stable and ranged from 10.95 to 12.02 degrees Celsius, with a general increasing trend beginning on May 27, 2012, as seen in Figure 3.

4.5 pH

The Troll did not record pH (and ORP) data until the protective cap was manually removed on April 30, 2012, after the sensor was submerged. The sensor remained submerged until July 6, 2012, at approximately 00:00. During this time the water within PZ-A had a neutral pH (7.0 to 7.3) (Figure 3).

4.6 Oxidation-Reduction Potential

The ORP sensor had data drifting issues and did not function properly during the 2012 PZ-A water season; therefore, the data were rejected. The manufacturer installed a replacement probe in December 2012.

5 Initial Evaluation of Water Sources

Water-quality probe data from PZ-A; water-level data from PZ-A, nearby monitoring wells, and floodwater; and precipitation were reviewed to determine if the causal mechanism for the water observed in PZ-A could be identified. The potential sources of water within PZ-A include:

1. Direct infiltration of precipitation or snowmelt into the repository,
2. Upward flow of groundwater into the floor of the repository from the underlying upper aquifer, and/or
3. Infiltration of floodwater through the bank of the repository and then through the waste material to the vicinity of PZ-A.

5.1 Temperature

Figure 4 presents water temperatures observed in PZ-A, groundwater monitoring wells, and floodwater site LL-1 from mid-March to mid-July (i.e., the 2012 record for LL-1 and PZ-A). When water was present in PZ-A, water temperature showed a small steady increase, totaling approximately 1.1 degrees Celsius. Although a temperature difference is measured between PZ-A and the other monitoring locations, the lack of variability in PZ-A water temperature does not provide support for a groundwater or surface water influence. The rise in water temperature at PZ-A corresponds to the general rise in temperature recorded at all monitoring locations.

5.2 Dissolved Oxygen

PZ-A water quality monitoring showed 0.0 mg/L DO with no variability when water was present. These measured concentrations are qualitatively supported by a "rotten egg" smell (i.e., characteristic odor of hydrogen sulfide gas) noted during piezometer installation and monitoring. Figure 5 shows DO data measured during the 2012 quarterly sampling events at monitoring wells MW-A, MW-B, MW-C, MW-C-DEEP, and MW-D compared with water levels at each location. DO concentrations in monitoring wells were generally below 0.5 mg/L, with some wells showing elevated concentrations for sample events occurring during periods of increased river discharge and corresponding higher water levels in the wells. The DO concentrations in 2012 floodwater samples ranged from 7.2 to 9.8 mg/L. The absence of variability in DO concentrations does not provide support for a groundwater or surface water influence at PZ-A.

5.3 Conductivity

PZ-A conductivity generally increased when water was present and ranged from 1,029 to 1,369 µS/cm. Field measurements of conductivity at monitoring wells during the 2012 quarterly sampling events ranged from 47 µS/cm at well MW-B to 328 µS/cm at well MW-A. Conductivity of the floodwater sampled on April 30, 2012 ranged from 67 µS/cm to 70 µS/cm. Based on the PZ-A conductivity data, no rapid influx of the lower conductivity water appears to correspond to increases in floodwater or groundwater conductivity levels. The lack of any substantial difference in conductivity values between the two potential water sources does not provide a distinct signature to help differentiate the source of water within PZ-A.

5.4 pH

PZ-A data show stable, near neutral pH ranging from 7.0 to 7.3. The field pH values measured at monitoring wells during the 2012 quarterly sampling events ranged from 4.84 in MW-B to 6.34 in MW-C-DEEP. Surface water pH measured during collection of floodwater samples on April 30, 2012, ranged from 6.40 to 6.72. The lack of any substantial difference in pH values between the two potential water sources and the stable conditions measured in PZ-A do not allow for a determination of the source of water within PZ-A.

5.5 Water-Level Analysis

In addition to PZ-A, water levels are recorded at several locations throughout the site including nearby wells (MW-A, MW-B, MW-C, MW-C-Deep, and MW-D) floodwater site LL-1, and the USGS Gaging Station at Cataldo. These provide additional data that can be used to evaluate water sources in the repository. Figure 1 shows the site locations for all but the USGS Gage Station, located approximately 0.9 miles upstream of the I-90 bridge. The LL-1 site is for monitoring floodwater elevations immediately surrounding EMFR. Figure 6 shows hydrographs of PZ-A, groundwater monitoring wells, LL-1, and the CDA River. Water-level fluctuations in the CDA River have a strong influence on groundwater- and floodwater-level fluctuations at all monitoring locations.

Figure 2 is indicative of the typical horizontal groundwater gradient towards the southwest in the upper aquifer at EMFR during much of the year except high-flow conditions in the CDA River. However, CDA River high-flow conditions shift the groundwater hydraulic gradient to the northwest as shown in Figure 7 using water elevations based on datalogger data from March 31, 2012 at 17:30. Figure 8 presents a re-scaled version of the hydrographs in Figure 6 from mid-April through mid-July, 2012, to help better display a period corresponding to the groundwater gradient shift. The shift toward the northwest persisted for approximately eight days. Around April 20, 2012, groundwater levels began to rise in the following order: MW-A, MW-B, MW-C, MW-D, and MW-C-Deep. The gradient shift is the result of significant influence from flooding of the CDA River.

The vertical hydraulic gradient within the upper 100 feet of the subsurface aquifer also shifted during high-flow events. Based on water level data from wells MW-C and MW-C-Deep over the period of record, the vertical hydraulic gradient is generally downward. However, the vertical gradient, as measured by these two wells, was upward for approximately three days surrounding the peak river discharge occurring on March 31, 2012, and for seven days surrounding the peak discharge occurring on April 25, 2012 (Figure 8).

The water-level data described above (and as shown in Figures 6 and 8), as well as precipitation data, are compared to water levels at PZ-A to evaluate causal mechanisms. Figure 9 is a graph of water levels in PZ-A compared with precipitation data from the SNOTEL site at Humbolt Gulch (http://www.wcc.nrcs.usda.gov/nwcc/site?sitenum=535&state=id) to determine if a visual correlation exists. Based on this limited information, there does not appear to be a direct relationship between precipitation and 2012 water levels in PZ-A. The following observations suggest precipitation is not the source or the only source of water in PZ-A. Water has never been observed within PZ-A unless elevated groundwater levels and floodwater are present at the site. The water-level pattern at PZ-A is more similar to groundwater, floodwater, and river water levels than to precipitation. However, these observations do not conclusively remove precipitation as a source of water in PZ-A.

Figures 6 and 8 show that water levels in all of the wells and at the floodwater site LL-1 were higher than the water level in PZ-A when water was detected on April 24, 2012. This suggests that water in the repository as measured in PZ-A could be upward flow of groundwater from the upper aquifer into the repository and/or infiltration of floodwater through the embankment into the repository. Both these pathways, evaluated at the time of the repository design, were considered negligible sources of water into EMFR. No conclusive data are yet available and a more in-depth analysis has not yet been completed to determine if a single source or multiple sources are responsible for water observed in PZ-A.

6 Conclusions

A small amount of water was detected in PZ-A during the spring of 2012. Data collected from PZ-A in 2012 using a water-quality sensor indicate that the water within the repository has a near neutral pH, no measurable DO, stable temperature, and elevated conductivity when compared to local groundwater and floodwater. These 2012 parameter data do not provide a distinct signature to help differentiate the source of water within PZ-A. The source of water in the repository, as represented by the PZ-A 2012 water-level data, is undetermined at this time. However, the water level data suggest that precipitation is not as likely a source of water in EMFR compared to the vertical flow of groundwater and/or the lateral migration of floodwater.

The saturation of repository soil could increase the potential for dissolution of metals if reducing conditions are present; however, the current groundwater and floodwater monitoring data do not show an increase in metal concentrations.

7 Recommendations

Continued monitoring of groundwater, floodwater, and the piezometers is recommended because data from a longer period of monitoring may provide additional insight into frequency and timing of events that result in water within the repository soils as measured in PZ-A. In addition, the need to collect a representative sample of groundwater from PZ-A is still required to determine geochemical conditions within the repository waste. During the next occurrence of water within PZ-A, valid sample collection should be a priority in order to determine if reducing conditions are present in the repository soils. Based on the shallow water depth and the limited recharge that has occurred within PZ-A, sample collection according to preferred methods may not be possible. The following practices are recommended during the next sample attempt.

Under the direction of the agencies and upon the occurrence of the estimated peak groundwater and floodwater levels for the event, begin purging the piezometer at a pumping rate less than 100 milliliters per minute. Groundwater and/or floodwater levels at the time of purging should be at or above water levels observed in PZ-A to confirm communication between the water source and PZ-A. The purge parameters (pH, conductivity, DO, temperature, and ORP) should be monitored at 30 second intervals and recorded. The pumping rate will be measured using the time required to fill a container of a known volume. The pumping rate and total volume of water removed will be recorded. During purging, piezometer water-level measurements must be recorded at 30-second intervals to document the amount of drawdown during purging. The purging and sampling is recommended to proceed as follows.

- Purge the equivalent of twice the tubing volume then collect and retain in separate one liter splits, all water removed during subsequent purging.
- Continue purging until the purge parameters stabilize or all the water is removed.
- If the purge parameters stabilize and a sample can be collected according to standard groundwater sampling procedures included in the EMFR SAP/QAPP, submit the standard samples for laboratory analysis.
- If the piezometer is pumped dry or standard groundwater sampling procedures cannot be followed due to excessive drawdown, then the purge water will be submitted for laboratory analysis.
- If it is necessary to submit the purge water for laboratory analysis, the appropriate volume will be obtained from the mid portion of the overall purging period.

The analysis of dissolved cations (calcium, magnesium, potassium, and sodium), dissolved anions (chloride, nitrate as nitrogen, and sulfate), alkalinity (CO_3, HCO_3, OH), and dissolved metals should be conducted for PZ-A, floodwater, and groundwater to help evaluate the source of water in PZ-A and potential geochemical interactions. In addition, to help evaluate reduction-oxidation (redox) conditions in the repository soils, it is recommended the field determination of iron II is conducted using a color disc or colorimeter and DO is performed using Winkler titration or a colorimeter. Due to the dynamic nature of redox reactions, evaluation of iron II and DO should occur immediately following sample collection and be recorded in the field notes. If reducing conditions are present, a more in-depth analysis should be considered to determine the most likely source of water in PZ-A.

8 References

Office of the Inspector General (OIG), 2009. Hotline Report: Contaminated Soil Waste Repository at East Mission Flats, Idaho. Report No. 03-P-0162. U.S. Environmental Protection Agency. June.

TerraGraphics Environmental Engineering, Inc. (TerraGraphics), 2009a. East Mission Flats Repository 90% Design Report. June.

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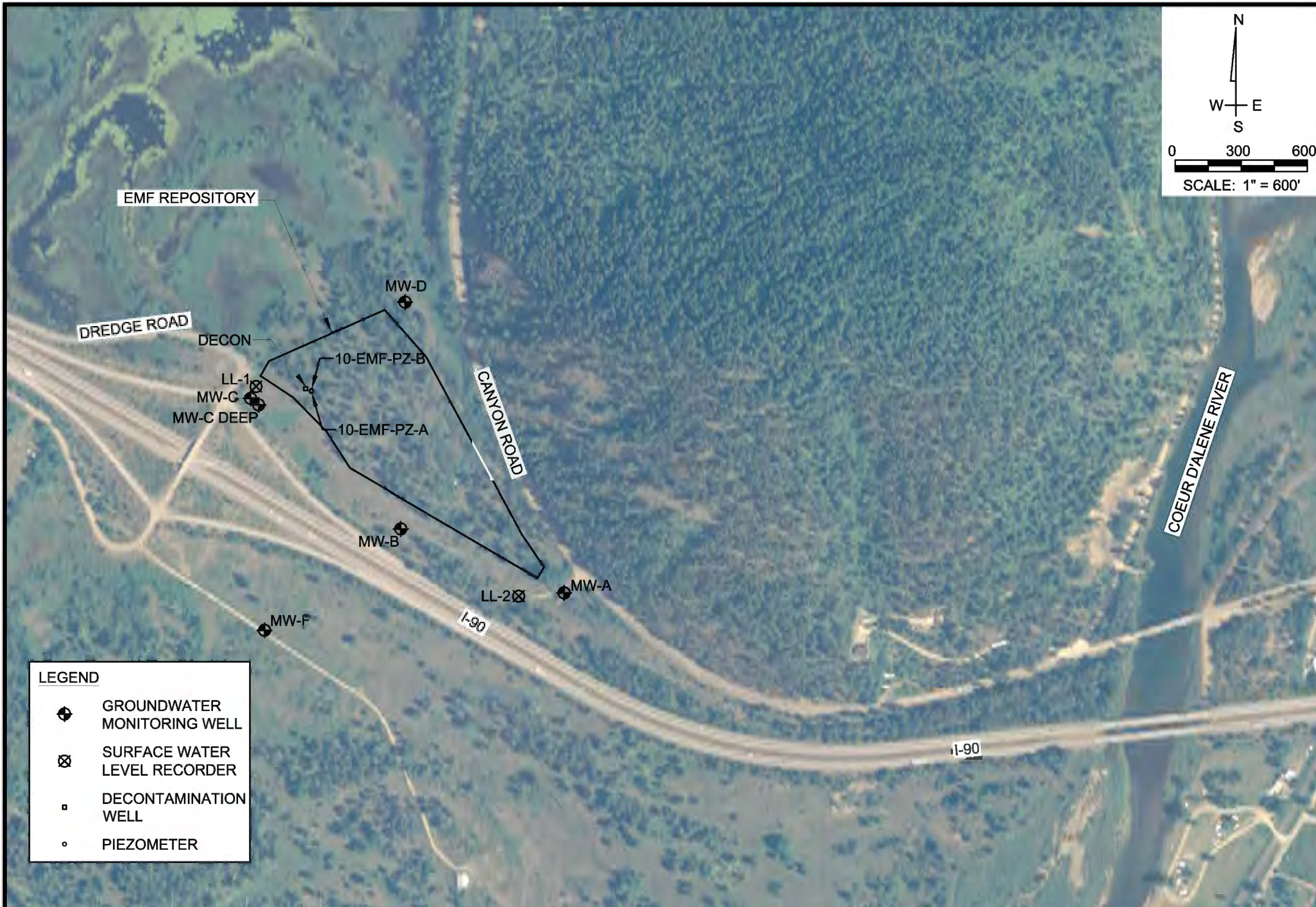
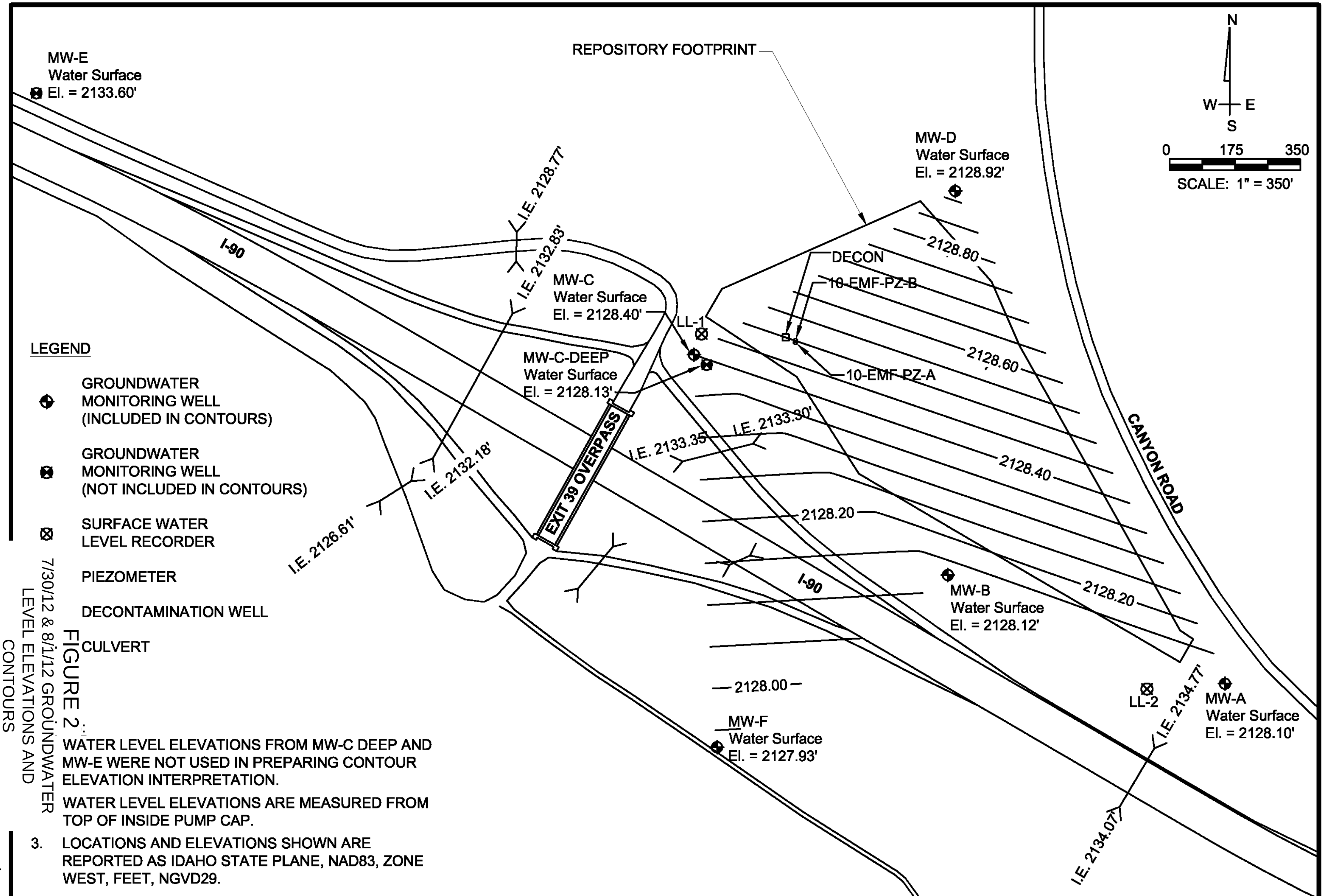
TerraGraphics, 2010. Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP) for Groundwater and Surface Water Monitoring at the East Mission Flats Repository. Revision 1. October.



M:\Basin\Basin Repositories\EMF Design\Drawings\EMF GROUNDWATER\EMF GW_Location Map_041613.dwg 4/16/2013

SCALE: 1" = 600' (8.5x11 PRINT)	**TerraGraphics** Environmental Engineering, Inc.	EAST MISSION FLATS	FIGURE 1 EMF REPOSITORY SITE	PROJECT NO: 2010-2A-6340-20
DRAWN BY: C.HALEY		CATALDO, IDAHO		DATE: 4/16/2013
ENGINEER: D.FORSETH				FILE NAME: emf gw_location map_041613.dwg



LEGEND

GROUNDWATER MONITORING WELL (INCLUDED IN CONTOURS)

GROUNDWATER MONITORING WELL (NOT INCLUDED IN CONTOURS)

SURFACE WATER LEVEL RECORDER

PIEZOMETER

DECONTAMINATION WELL

CULVERT

FIGURE 2
7/30/12 & 8/1/12 GROUNDWATER LEVEL ELEVATIONS AND CONTOURS

WATER LEVEL ELEVATIONS FROM MW-C DEEP AND MW-E WERE NOT USED IN PREPARING CONTOUR ELEVATION INTERPRETATION.

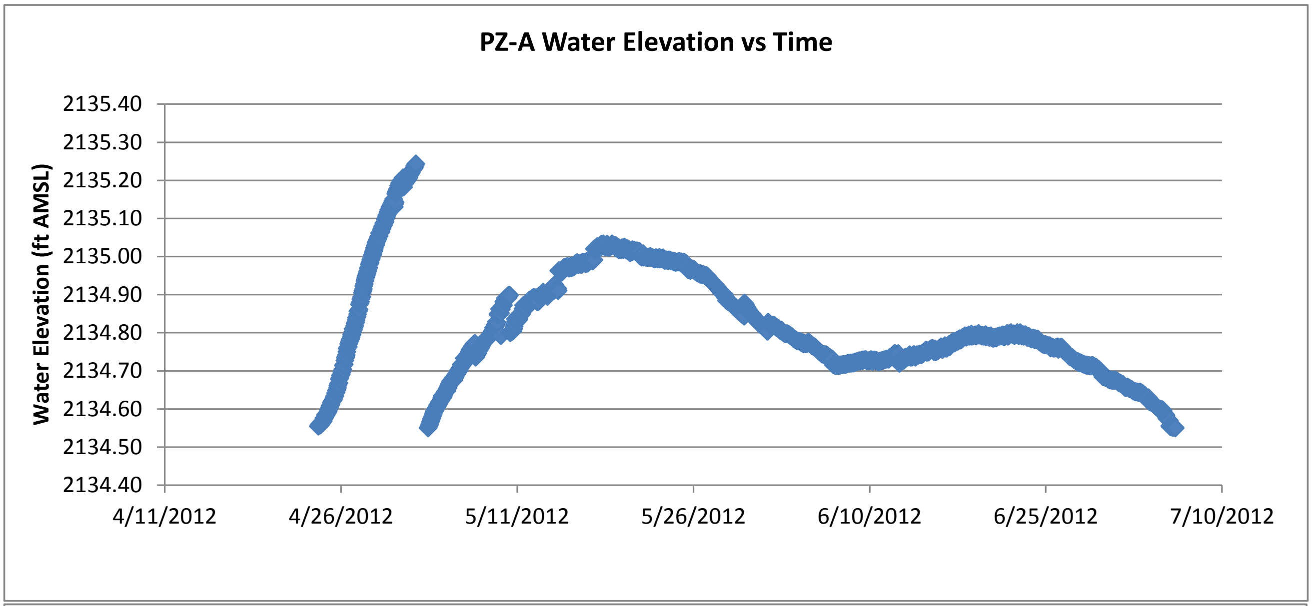
WATER LEVEL ELEVATIONS ARE MEASURED FROM TOP OF INSIDE PUMP CAP.

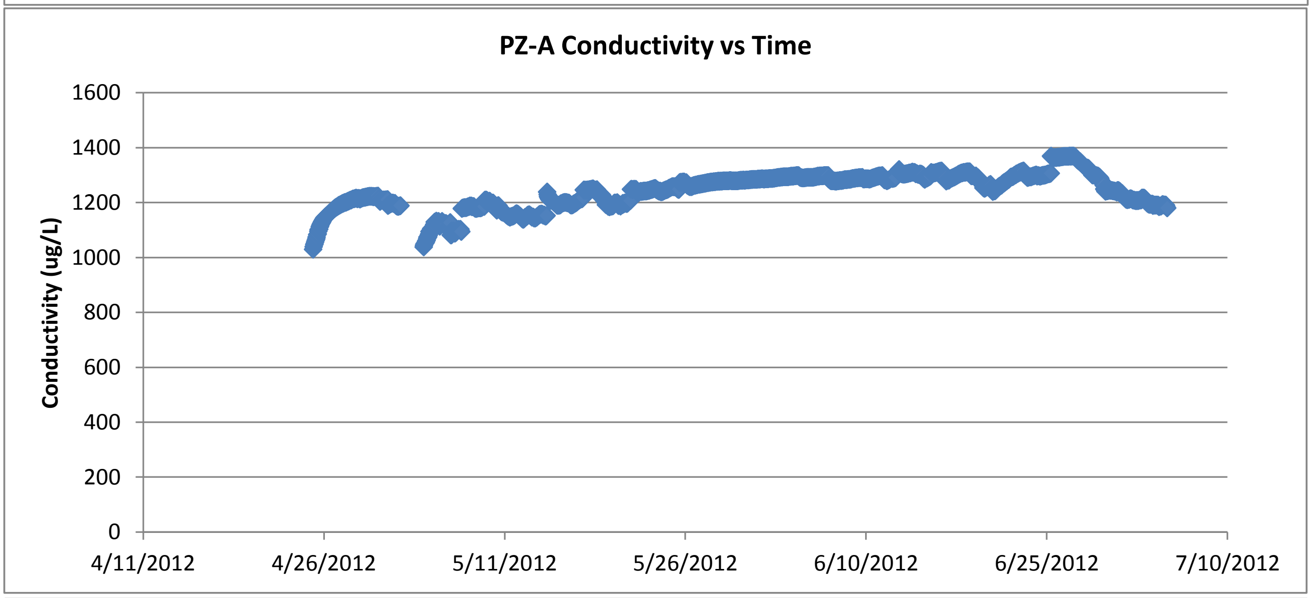
3. LOCATIONS AND ELEVATIONS SHOWN ARE REPORTED AS IDAHO STATE PLANE, NAD83, ZONE WEST, FEET, NGVD29.

H:\GW MAPS\EMF GW_JULI2012_090412.dwg 10/26/2012

SCALE: 1" = 350' (8.5x11 PRINT)	TerraGraphics Environmental Engineering, Inc.	EAST MISSION FLATS	FIGURE 3	PROJECT NO: 2010-2F-7170-2
DRAWN BY: S. LARSON			JULY 2012 GROUNDWATER LEVEL ELEVATIONS AND CONTOURS	DATE: 10/26/2012
ENGINEER: S.BARKER		CATALDO, IDAHO		FILE NAME: emf gw_jull2012_090412.dwg

Figure 3. Time-Series Plots of Select Field Parameters





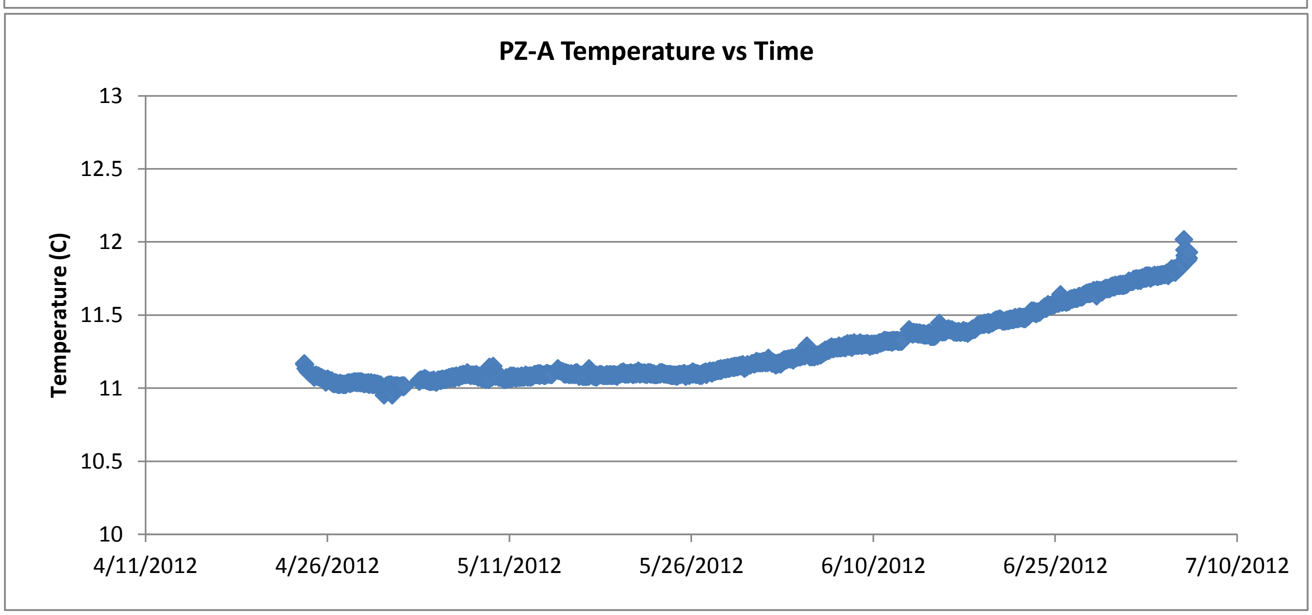


Figure 3. Time-Series Plots of Select Field Parameters

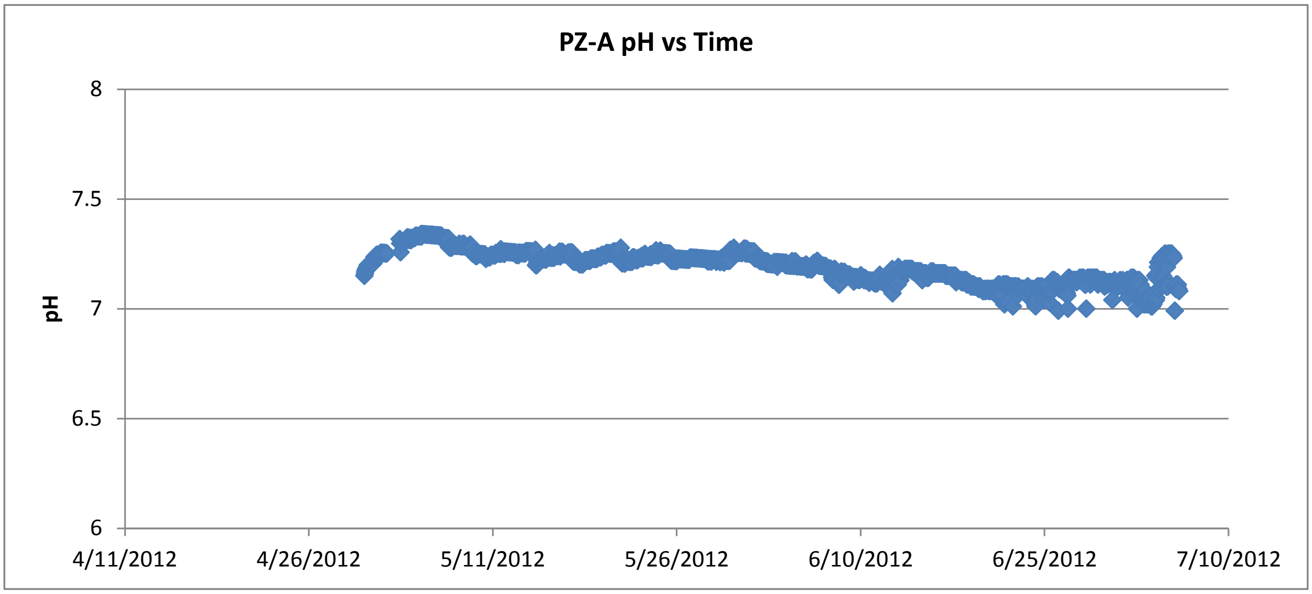


Figure 4. Water Temperature as Measured by Dataloggers

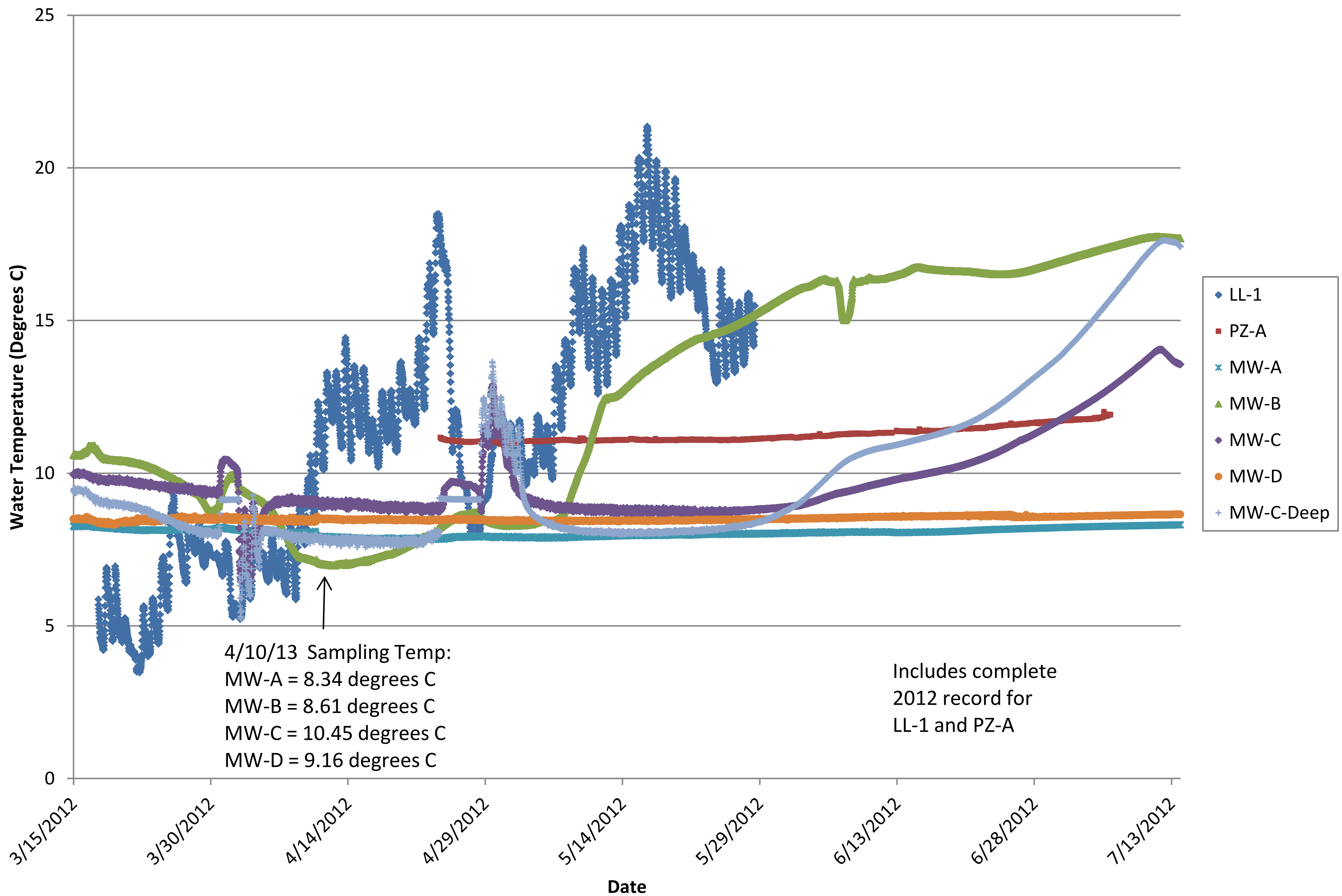
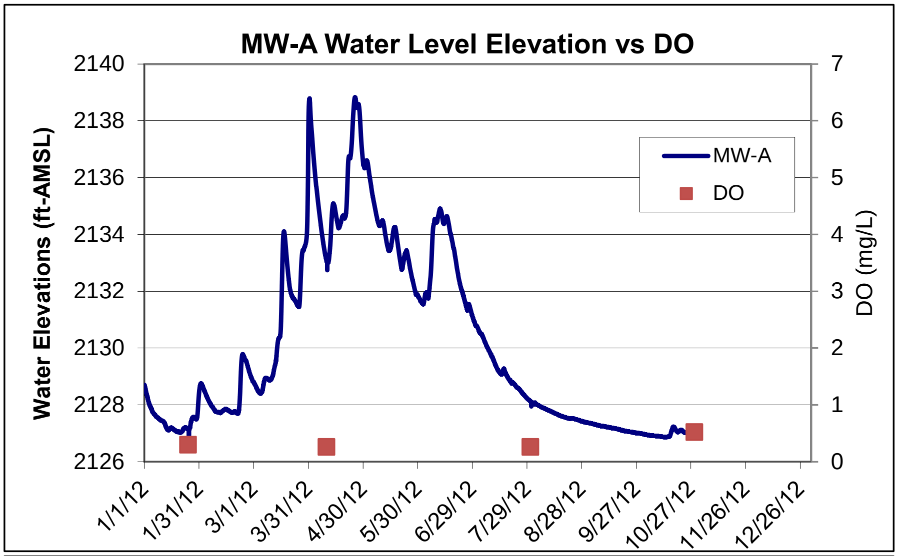
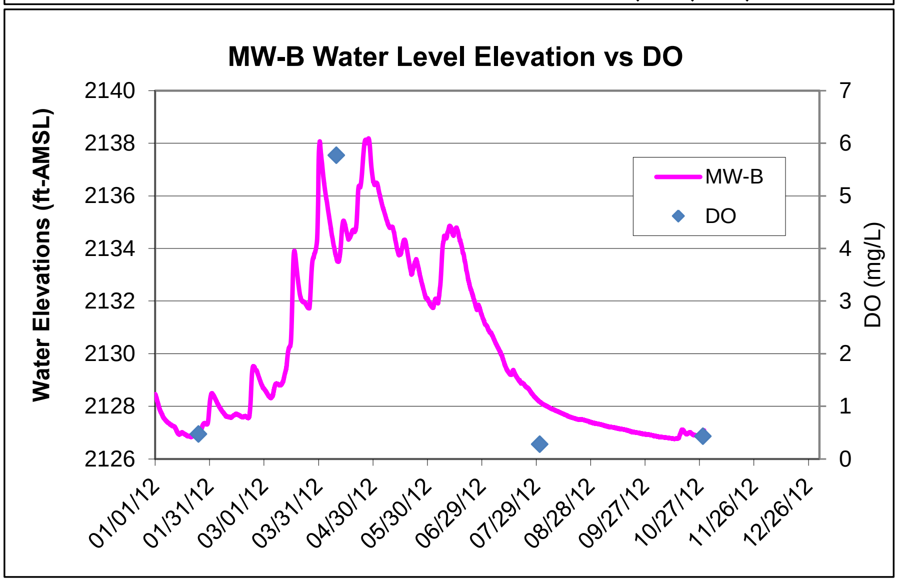


Figure 5. Water Level Elevations and DO Concentrations at Select Monitoring Wells





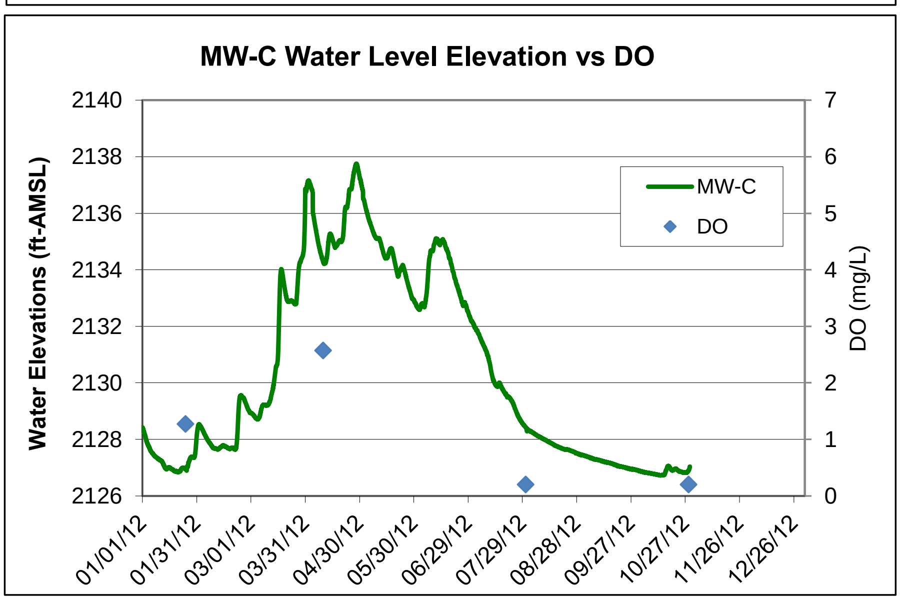
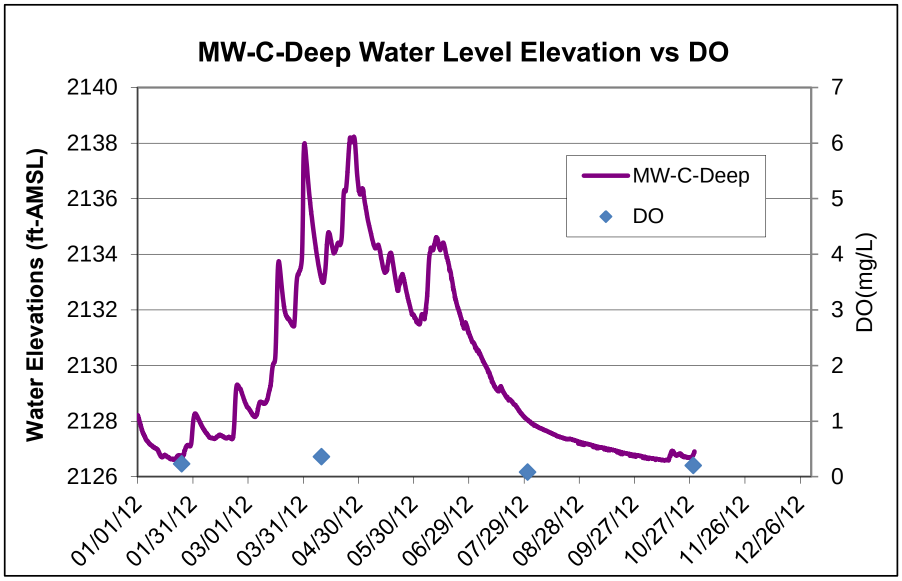


Figure 5. Water Level Elevations and DO Concentrations at Select Monitoring Wells



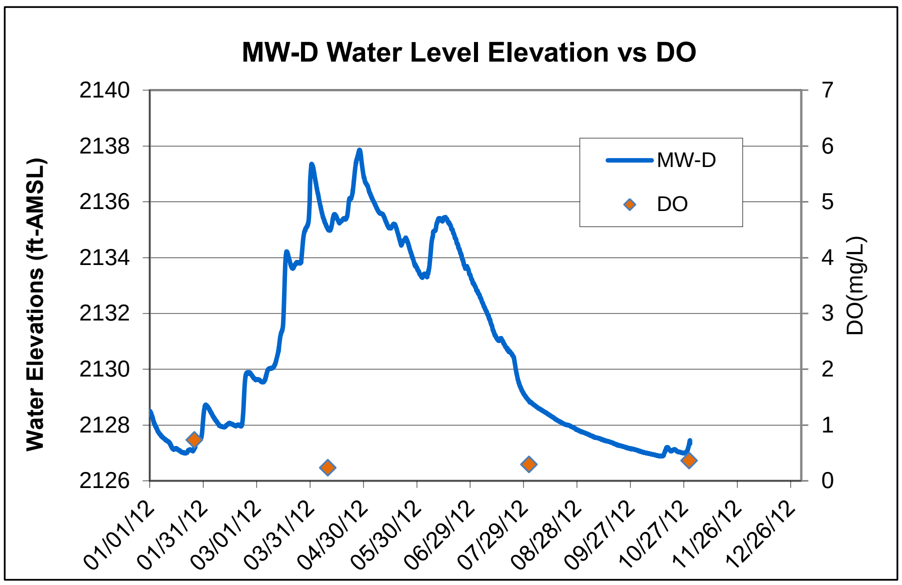
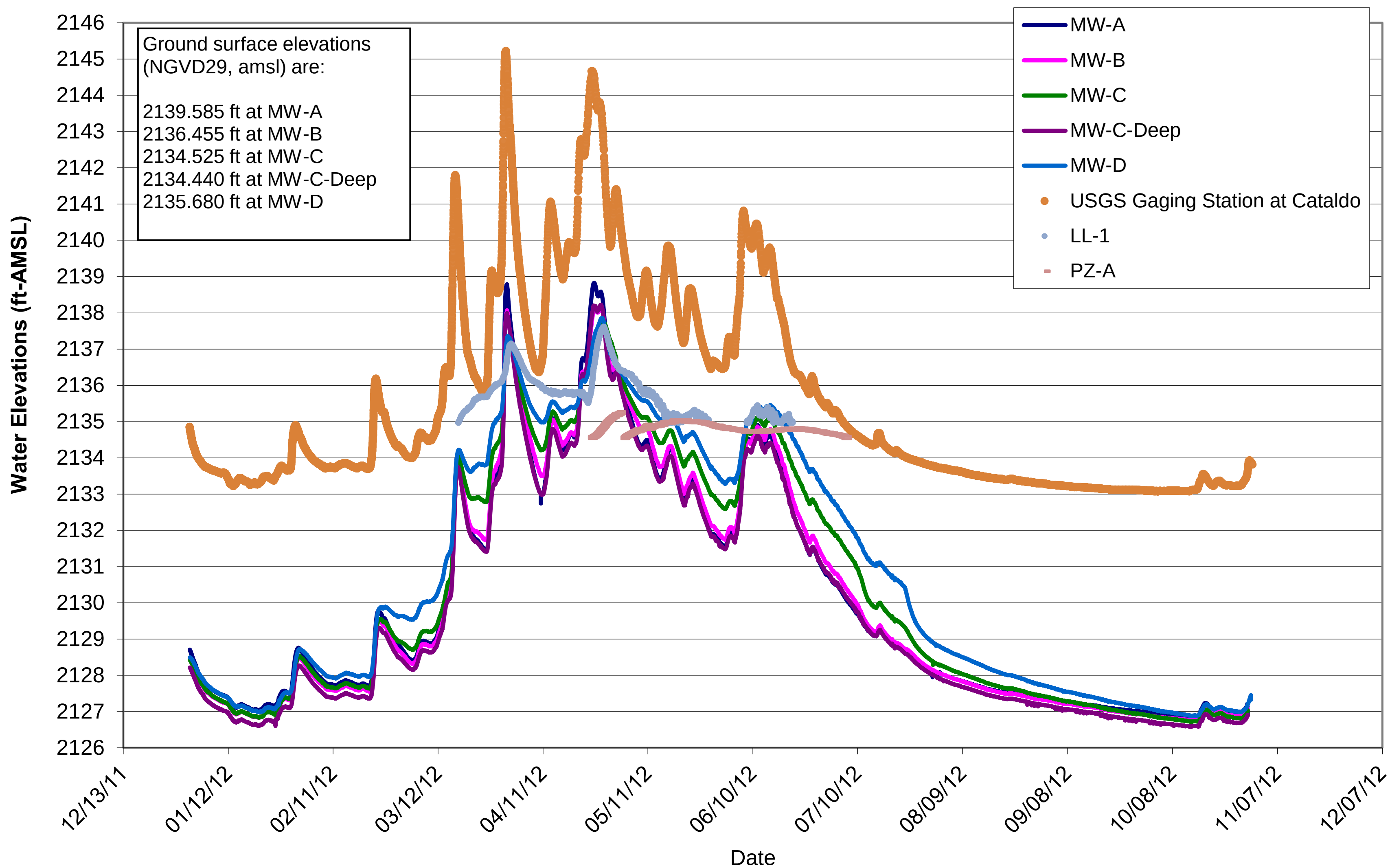
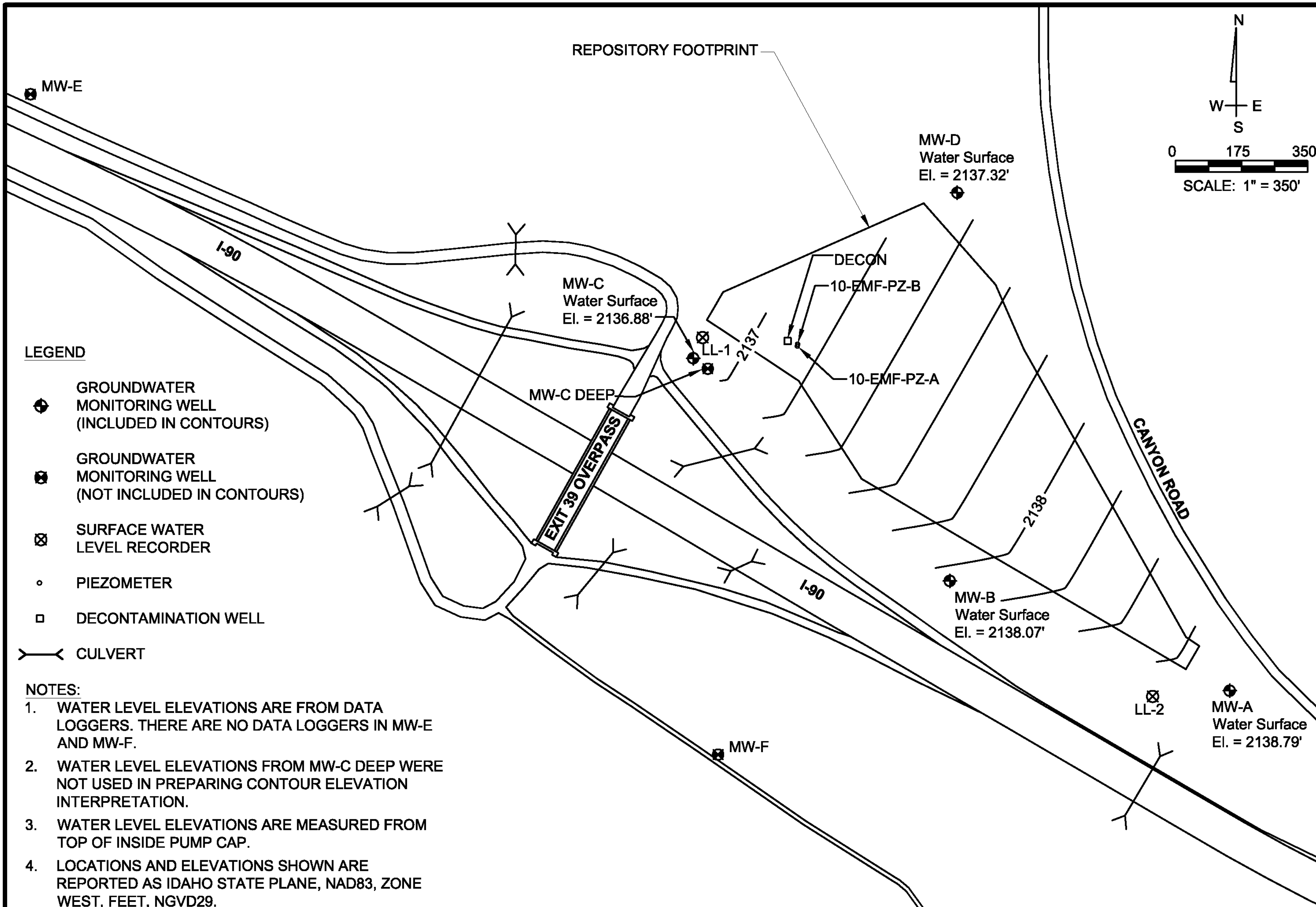


Figure 6. Water Levels at EMFR Monitoring Wells, PZ-A, & Surface Water Site Compared to River Stage at Cataldo





LEGEND

- GROUNDWATER MONITORING WELL (INCLUDED IN CONTOURS)
- GROUNDWATER MONITORING WELL (NOT INCLUDED IN CONTOURS)
- SURFACE WATER LEVEL RECORDER
- PIEZOMETER
- DECONTAMINATION WELL
- CULVERT

NOTES:

1. WATER LEVEL ELEVATIONS ARE FROM DATA LOGGERS. THERE ARE NO DATA LOGGERS IN MW-E AND MW-F.
2. WATER LEVEL ELEVATIONS FROM MW-C DEEP WERE NOT USED IN PREPARING CONTOUR ELEVATION INTERPRETATION.
3. WATER LEVEL ELEVATIONS ARE MEASURED FROM TOP OF INSIDE PUMP CAP.
4. LOCATIONS AND ELEVATIONS SHOWN ARE REPORTED AS IDAHO STATE PLANE, NAD83, ZONE WEST, FEET, NGVD29.

SCALE: 1" = 350' (8.5x11 PRINT)	TerraGraphics Environmental Engineering, Inc.	EAST MISSION FLATS	FIGURE 7	PROJECT NO: 12025-08-02
DRAWN BY: C.HALEY			3/31/12 GROUNDWATER LEVEL ELEVATIONS AND CONTOURS	DATE: 8/12/2013
ENGINEER: D.FORSETH		CATALDO, IDAHO		FILE NAME: emf gw_mar2012_041513.dwg

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Figure 8. Water Levels at EMFR Monitoring Wells, PZ-A, and Surface Water Site

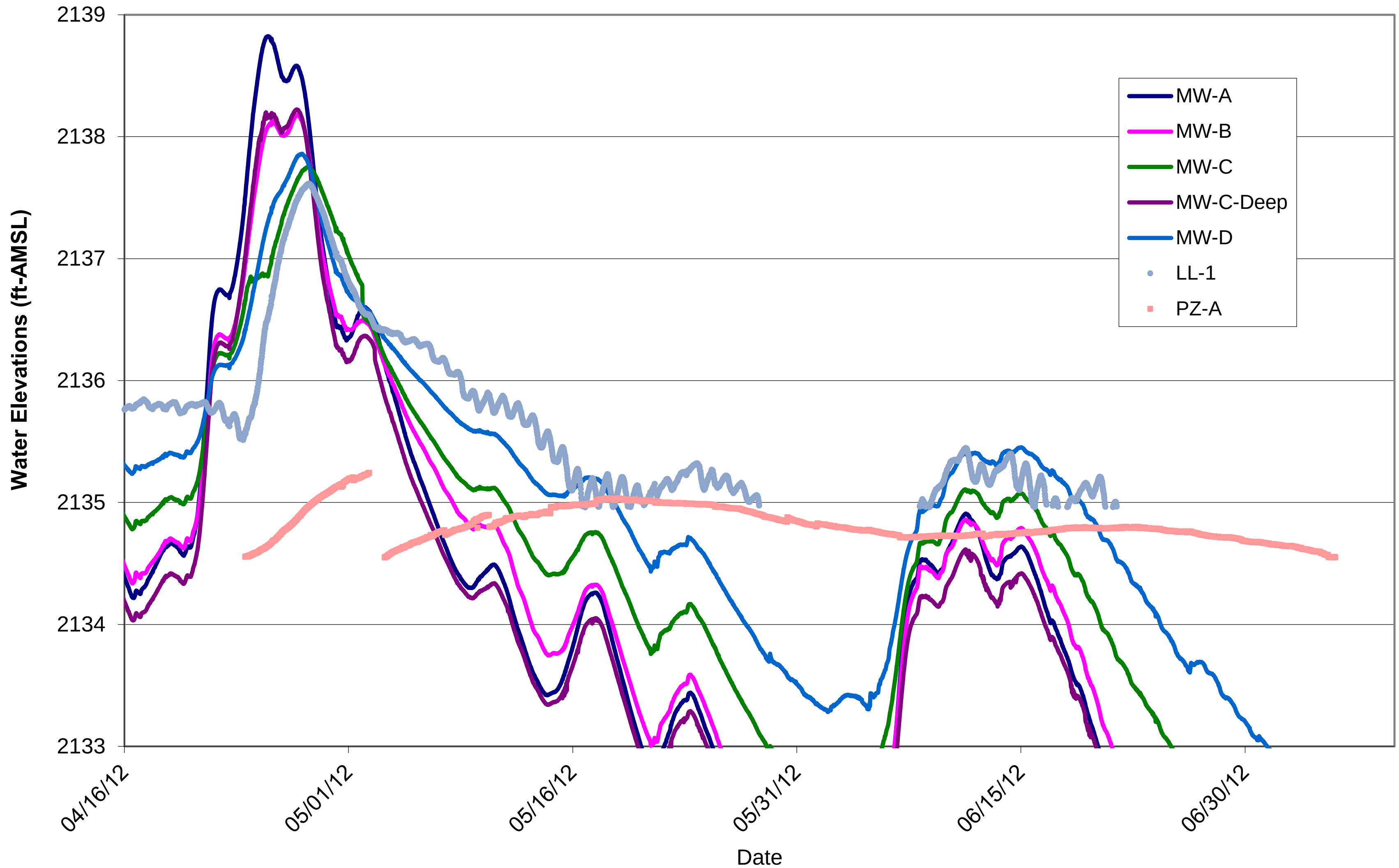
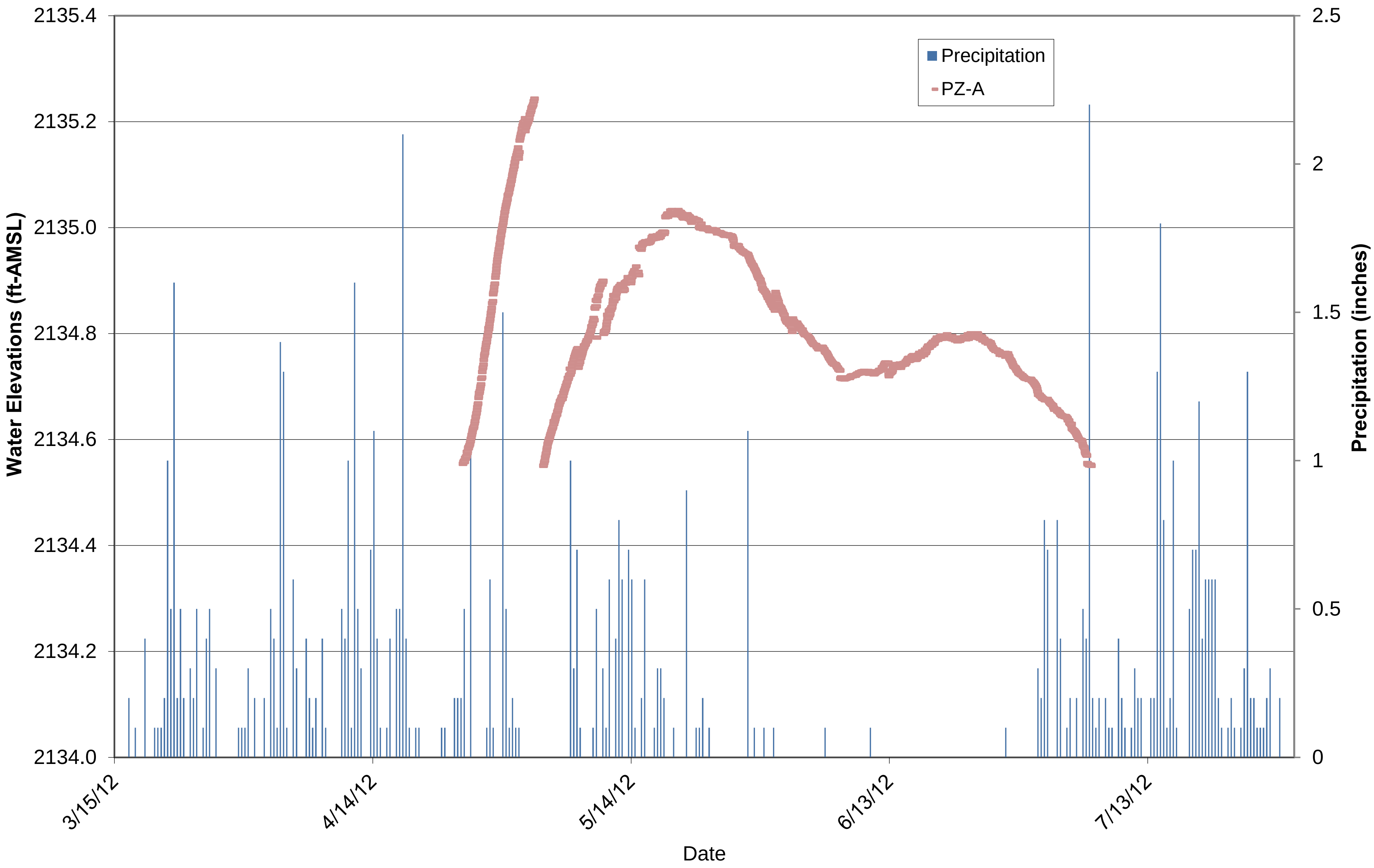


Figure 9. Water Level in PZ-A Compared to Daily Precipitation at Humboldt Gulch



Appendix C

Groundwater Field Parameter and Dissolved Metals Tables

Table C-1 Field Parameter Data
East Mission Flats Repository

Well	Date	Parameter				
		pH	Conductivity (uS/cm)	Temperature (^{O}C)	DO (mg/L)	ORP (mV)
MW-A	11 Dec 07	5.63	265	8.21	1.01	280
	25 Feb 08	5.30	328	7.73	0.36	353
	3-Jun-08	5.28	150	9.45	0.51	265
	19-Aug-08	5.57	208	11.05	0.39	225
	10-Nov-08	5.63	163	8.79	0.34	161
	4-Feb-09	5.19	253	7.95	0.39	228
	7-May-09	4.93	202	7.35	0.38	195
	10-Aug-09	5.43	196	9.23	0.24	210
	11-Nov-09	5.62	121	8.49	0.48	131
	25-Feb-10	4.84	209	7.97	0.32	216
	19-May-10	5.53	181	8.21	0.42	147
	25-Aug-10	5.37	149	9.17	0.33	142
	16-Nov-10	5.43	164	8.81	0.43	161
	10-Feb-11	4.92	210	7.69	0.40	190
	6-Jul-11	5.54	229	10.98	0.35	118
	24-Oct-11	5.54	182	9.21	***R***	136
	25-Jan-12	4.92	239	8.54	0.30	178
	10-Apr-12	5.50	222	8.34	0.26	155
	31-Jul-12	4.89	235	9.53	0.26	166
	29-Oct-12	5.39	182	10.35	0.52	157
MW-B	10 Dec 07	5.63	119	8.71	0.51	279
	25 Feb 08	5.38	115	7.46	0.75	330
	3-Jun-08	5.60	101	10.26	1.32	253
	19-Aug-08	5.57	92	16.92	0.34	220
	10-Nov-08	5.47	103	12.88	0.42	169
	4-Feb-09	5.40	98	10.48	1.98	209
	7-May-09	5.11	69	7.8	3.02	213
	10-Aug-09	5.46	82	11.81	0.55	285
	11-Nov-09	5.39	81	9.24	0.42	184
	25-Feb-10	4.88	97	8.2	0.55	216
	19-May-10	5.59	101	9.37	0.82	135
	25-Aug-10	5.42	85	10.13	0.67	146
	16-Nov-10	5.39	94	9.44	0.32	177
	10-Feb-11	5.25	65	4.24	8.09	183
	6-Jul-11	5.70	56	17.28	0.30	177
	24-Oct-11	5.46	74	13.55	0.37***J***	112
	25-Jan-12	5.49	85	11.53	0.47	94
	10-Apr-12	5.83	53	8.61	5.77	97
	31-Jul-12	5.12	47	18.55	0.28	181
	29-Oct-12	5.52	82	15.71	0.43	204

Well	Date	Parameter pH	Conductivity (uS/cm)	Temperature (^{O}C)	DO (mg/L)	ORP (mV)
MW-C	10 Dec 07	5.56	105	8.89	0.75	301
	25 Feb 08	5.34	105	8.07	0.52	329
	3-Jun-08	NS	NS	NS	NS	NS
	19-Aug-08	5.68	84	12.81	0.24	189
	10-Nov-08	5.45	93	11.51	0.3	133
	3-Feb-09	5.56	104	9.76	0.32	144
	7-May-09	NS	NS	NS	NS	NS
	10-Aug-09	5.54	83	12.42	0.7	312
	11-Nov-09	5.46	74	9.91	0.31	198
	25-Feb-10	5.14	102	8.89	0.42	220
	19-May-10	5.66	97	9.33	0.11***J***	147
	25-Aug-10	5.59	94	13.54	0.35	143
	16-Nov-10	5.49	105	11.94	0.21	194
	10-Feb-11	NS	NS	NS	NS	NS
	6-Jul-11	NS	NS	NS	NS	NS
	24-Oct-11	5.67	88	11.41	0.17***J***	71
	25-Jan-12	5.33	95	10.03	1.27	160
	10-Apr-12	6.24	81	10.45	2.57	147
	31-Jul-12	5.19	67	16.51	0.2	171
	29-Oct-12	5.62	102	14.22	0.20	136
MW-C Deep	25-Feb-10	5.65	107	9.07	1.06	201
	19-May-10	6.13	93	10.60	1.66	141
	25-Aug-10	5.88	93	13.90	0.21	122
	16-Nov-10	5.84	99	10.79	0.26	172
	10-Feb-11	NS	NS	NS	NS	NS
	6-Jul-11	NS	NS	NS	NS	NS
	24-Oct-11	5.96	98	10.52	0.11	35
	25-Jan-12	6.26	148	9.46	0.23	108
	10-Apr-12	6.34	117	10.03	0.36	100
	31-Jul-12	5.74	99	14.56	0.08	-27
	29-Oct-12	5.94	114	13.70	0.20	13
MW-D	10 Dec 07	5.87	116	8.95	0.5	271
	25 Feb 08	5.64	132	8.26	0.51	315
	3-Jun-08	NS	NS	NS	NS	NS
	19-Aug-08	5.91	108	10.22	0.4	182
	10-Nov-08	5.69	118	9.34	0.38	106
	3-Feb-09	5.69	116	8.43	0.32	161
	7-May-09	NS	NS	NS	NS	NS
	11-Aug-09	5.76	110	9.87	0.43	158
	11-Nov-09	5.75	92	8.72	0.26	115
	25-Feb-10	5.19	107	8.32	0.38	198
	19-May-10	5.85	90	9.13	0.30	138
	25-Aug-10	5.83	107	10.46	0.22	120
	16-Nov-10	5.85	115	9.44	0.25	157
	10-Feb-11	5.50	91	9.07	0.24	170
	6-Jul-11	NS	NS	NS	NS	NS
	25-Oct-11	5.80	116	9	0.57***J***	79
	26-Jan-12	5.15	102	8.44	0.73	201
	10-Apr-12	6.09	97	9.16	0.23	116
	1-Aug-12	5.56	116	10.95	0.29	94
	30-Oct-12	6.13	129	9.99	0.36	100

Well	Date	Parameter pH	Conductivity (uS/cm)	Temperature (^{O}C)	DO (mg/L)	ORP (mV)
MW-E	10-Nov-08	6.18	1,332	10.66	0.27	126
	3-Feb-09	6.44	1,379	8.29	0.42	188
	7-May-09	6.12	1,461	8.99	0.3	216
	11-Aug-09	6.39	1,435	11.14	0.39	22
	11-Nov-09	6.36	1,228	8.77	0.86	1
	25-Feb-10	6.17	1,540	8.61	0.22	74
	19-May-10	6.57	1,500	9.96	0.20	138
	25-Aug-10	6.45	1,438	12.26	0.25	50
	16-Nov-10	6.50	1,560	10.61	0.29	101
	10-Feb-11	6.33	1,436	8.23	0.31	171
	6-Jul-11	6.72	1,449	11.52	0.21	-48
	24-Oct-11	6.58	1,450	11.1	0.26	-41
	26-Jan-12	6.32	1,790	8.79	0.51	14
	11-Apr-12	6.40	1,720	8.67	0.31	104
	1-Aug-12	6.11	1,740	11.81	0.29	15
	29-Dec-12	6.44	1,930	12.53	0.30	-1
MW-F	11-Nov-08	5.45	144	9.43	0.44	140
	7-May-09	4.83	134	9.37	0.44	219
	10-Aug-09	5.46	117	11.63	1.23	293
	11-Nov-09	5.37	142	9.81	0.33	137
	25-Feb-10	4.96	277	9.07	0.78	241
	19-May-10	5.34	305	8.82	0.49	157
	25-Aug-10	5.49	151	11.08	1.63	155
	16-Nov-10	5.44	222	9.94	0.31	157
	10-Feb-11	5.23	158	8.82	0.75	171
	6-Jul-11	5.76	100	12.72	0.36	197
	25-Oct-11	5.55	157	10.65	0.41***J***	119
	26-Jan-12	5.34	272	9.70	0.46	122
	11-Apr-12	5.42	142	9.85	0.23	110
	1-Aug-12	5.44	118	12.29	0.17	135
	30-Oct-12	5.68	182	12.59	0.56	253

Well	Date	Parameter pH	Conductivity (uS/cm)	Temperature (^{O}C)	DO (mg/L)	ORP (mV)
Decon	16-Nov-10	6.13	105	10.12	2.98	190
	10-Feb-11	NS	NS	NS	NS	NS
	6-Jul-11	6.59	97	11.14	9.03	5
	25-Oct-11	6.14	67	11.00	3.85	75
	26-Jan-11	NS	NS	NS	NS	NS
	10-Apr-12	NS	NS	NS	NS	NS
	1-Aug-12	5.81	139	23.92	1.12	47
	30-Oct-12	6.19	42	12.40	2.36	160

Notes:
^{o}C = degree Celsius
mg/L = milligram per liter
mV = millivolt
µS/cm = microSiemen per centimeter
DO = Dissolved oxygen
ORP = Oxidation-reduction potential
NS = Not sampled; see text for explanation
R = Rejected; correct stabilization criterion was not correctly entered into the meter to achieve three stable readings per the EMFR SAP/QAPP

J = Estimated; May 2010 DO in mg/L was not recorded on field sheet. The reported value was estimated using the nomograph in Horne and Goldman (1994) based on the observed water temperature and DO% saturation. October 2011 DO estimated; DO stabilization criterion was not correctly entered into meter to achieve three stable readings per the EMFR SAP/QAPP.

Table C-2
Groundwater Monitoring Results
Dissolved Metals
East Mission Flats Repository

Well No.	Sample Date	Constituents (mg/L)				
		Antimony	Arsenic	Cadmium	Lead	Zinc
MW-A	11 Dec 07	ND	ND	0.000578***J***	ND	0.347***J***
	25 Feb 08	ND	ND	0.00172	ND	1.71***J***
	3-Jun-08	ND	ND	0.000763	ND	0.582
	19-Aug-08	ND	ND	0.000321	ND	0.683
	10-Nov-08	ND	ND	ND	ND	0.353
	4-Feb-09	ND	ND	0.000777	ND	0.898
	7-May-09	ND	ND	0.000382	ND	0.753
	10-Aug-09	ND	ND	0.000204	ND	0.558
	11-Nov-09	ND	ND	ND	ND	0.368
	25-Feb-10	ND	ND	0.000208	ND	0.657
	19-May-10	ND	ND	0.000225	ND	0.568
	25-Aug-10	ND	ND	0.000227	ND	0.584
	16-Nov-10	ND	ND	ND	ND	0.544***J***
	10-Feb-11	ND	ND	0.00039	ND	1.220***J***
	6-Jul-11	ND	0.0073***J***	0.00063	ND	1.380
	24-Oct-11	ND	ND	ND	ND	0.804
	25-Jan-12	ND	0.0074***J***	0.00032	ND	1.130
	10-Apr-12	ND	ND	0.00058	ND	1.750
	31-Jul-12	ND	ND	0.00046	ND	1.560
	29-Oct-12	ND	ND	0.00023	ND	0.862***J***
MW-B	10 Dec 07	ND	ND	ND	ND	0.0243***J***
	25 Feb 08	ND	ND	ND	ND	0.0198***J***
	3-Jun-08	ND	ND	ND	ND	0.0212
	19-Aug-08	ND	ND	ND	ND	0.0244
	10-Nov-08	ND	ND	ND	ND	0.0197
	4-Feb-09	ND	ND	ND	ND	0.021
	7-May-09	ND	ND	ND	ND	0.0168
	10-Aug-09	ND	ND	ND	ND	0.016
	11-Nov-09	ND	ND	ND	ND	0.0264
	25-Feb-10	ND	ND	ND	ND	0.0153
	19-May-10	ND	ND	ND	ND	0.0157
	25-Aug-10	ND	ND	ND	ND	0.0157
	16-Nov-10	ND	ND	ND	ND	0.0187***J***
	10-Feb-11	ND	ND	ND	ND	0.0091***J***
	6-Jul-11	ND	0.0077***J***	ND	ND	0.0126
	24-Oct-11	ND	ND	ND	ND	0.0148***J***
	25-Jan-12	ND	0.0073***J***	ND	ND	0.018
	10-Apr-12	ND	ND	ND	ND	0.0162
	31-Jul-12	ND	ND	ND	ND	0.0142
	29-Oct-12	ND	ND	ND	ND	0.0121***J***

Well No.	Sample Date	Constituents (mg/L)				
		Antimony	Arsenic	Cadmium	Lead	Zinc
MW-C	10 Dec 07	ND	ND	0.0013***J***	ND	1.45***J***
	25 Feb 08	ND	ND	0.00318	ND	2.24***J***
	3-Jun-08	NS	NS	NS	NS	NS
	19-Aug-08	ND	ND	0.00111	ND	1.34
	10-Nov-08	ND	ND	0.000522	ND	1.57
	3-Feb-09	ND	ND	0.00354	ND	1.67
	7-May-09	NS	NS	NS	NS	NS
	10-Aug-09	ND	ND	0.00229	ND	1.45
	11-Nov-09	ND	ND	0.00144	ND	2.03
	25-Feb-10	ND	ND	0.00326	ND	2.02
	19-May-10	ND	ND	0.00346	ND	2.00
	25-Aug-10	ND	ND	0.00364	ND	1.86
	16-Nov-10	ND	ND	0.0029	ND	1.930***J***
	10-Feb-11	NS	NS	NS	NS	NS
	6-Jul-11	NS	NS	NS	NS	NS
	24-Oct-11	ND	ND	0.00072	ND	1.360
	25-Jan-12	ND	0.0074***J***	0.0049	ND	1.710
	10-Apr-12	ND	ND	0.00089	ND	0.388
	31-Jul-12	ND	ND	0.00025	ND	1.080
	29-Oct-12	ND	ND	ND	ND	0.988***J***
MW-C Deep	25-Feb-10	ND	ND	ND	ND	0.0113
	19-May-10	ND	ND	ND	ND	ND
	25-Aug-10	ND	ND	ND	ND	0.0317
	16-Nov-10	ND	ND	ND	ND	0.0216***J***
	10-Feb-11	NS	NS	NS	NS	NS
	6-Jul-11	NS	NS	NS	NS	NS
	24-Oct-11	ND	ND	ND	ND	0.0167
	25-Jan-12	ND	0.0075***J***	ND	ND	0.0191
	10-Apr-12	ND	0.0042***J***	ND	ND	0.154
	31-Jul-12	ND	ND	ND	ND	0.0116
	29-Oct-12	ND	ND	ND	ND	ND

Well No.	Sample Date	Constituents (mg/L)				
		Antimony	Arsenic	Cadmium	Lead	Zinc
MW-D	10 Dec 07	ND	ND	ND	ND	0.0326***J***
	25 Feb 08	ND	ND	ND	ND	0.0285***J***
	3-Jun-08	NS	NS	NS	NS	NS
	19-Aug-08	ND	ND	ND	ND	0.132
	10-Nov-08	ND	ND	ND	ND	0.0794
	3-Feb-09	ND	ND	ND	ND	0.0531
	7-May-09	NS	NS	NS	NS	NS
	11-Aug-09	ND	ND	ND	ND	0.0918
	11-Nov-09	ND	ND	ND	ND	0.103
	25-Feb-10	ND	ND	ND	ND	0.0352
	19-May-10	ND	ND	ND	ND	0.105
	25-Aug-10	ND	ND	ND	ND	0.109
	16-Nov-10	ND	ND	ND	ND	0.0563***J***
	10-Feb-11	ND	ND	ND	ND	0.127***J***
	6-Jul-11	NS	NS	NS	NS	NS
	25-Oct-11	ND	ND	ND	ND	0.0395
	26-Jan-12	ND	0.0079***J***	ND	ND	0.0584
	10-Apr-12	ND	ND	ND	ND	0.184
	1-Aug-12	ND	ND	ND	ND	0.112
	30-Oct-12	ND	ND	ND	ND	0.0464***J***
MW-E	10 Nov 08	ND	0.0148	ND	ND	0.0141
	3-Feb-09	ND	ND	ND	ND	ND
	7-May-09	ND	0.0035	ND	ND	0.00889
	11-Aug-09	ND	0.0195	ND	ND	0.00848
	11-Nov-09	ND	0.0232	ND	ND	0.00671
	25-Feb-10	ND	ND	ND	ND	0.00599
	19-May-10	ND	0.00447	ND	ND	0.00633
	25-Aug-10	ND	0.0172	ND	ND	0.00687
	16-Nov-10	ND	0.0177	ND	ND	0.0069***J***
	10-Feb-11	ND	ND	ND	ND	ND
	6-Jul-11	ND	0.0074***J***	ND	ND	ND
	24-Oct-11	ND	0.020	ND	ND	ND
	26-Jan-12	ND	0.0069***J***	ND	ND	0.0051***J***
	11-Apr-12	ND	ND	ND	ND	0.0063 ***J***
	1-Aug-12	ND	0.0063	ND	ND	0.0064
	29-Oct-12	ND	0.0149	ND	ND	0.0071***J***

Well No.	Sample Date	Constituents (mg/L)				
		Antimony	Arsenic	Cadmium	Lead	Zinc
MW-F	11-Nov-08	ND	ND	0.000205	ND	1.58
	3-Feb-09	ND	ND	0.000304	ND	1.16
	7-May-09	ND	ND	0.000258	ND	1.32
	10-Aug-09	ND	ND	0.00023	ND	1.12
	11-Nov-09	ND	ND	0.000464	ND	2.53
	25-Feb-10	ND	ND	0.000947	ND	3.82
	19-May-10	ND	ND	0.00132	ND	4.47
	25-Aug-10	ND	ND	0.000436	ND	1.93
	16-Nov-10	ND	ND	0.00065	ND	3.370***J***
	10-Feb-11	ND	ND	0.00045	ND	1.840***J***
	6-Jul-11	ND	0.0056***J***	ND	ND	0.976
	25-Oct-11	ND	ND	0.00031	ND	1.690
	26-Jan-12	ND	0.0041***J***	0.00094	ND	3.100
	11-Apr-12	ND	ND	0.00031	ND	1.630
	1-Aug-12	ND	ND	ND	ND	1.330
	30-Oct-12	ND	ND	0.00043	ND	1.730***J***
Decon Well	16-Nov-10	ND	ND	ND	ND	0.504***J***
	10-Feb-11	NS	NS	NS	NS	NS
	6-Jul-11	ND	0.0068***J***	ND	ND	0.407
	25-Oct-11	ND	ND	ND	ND	0.449
	26-Jan-12	NS	NS	NS	NS	NS
	10-Apr-12	NS	NS	NS	NS	NS
	1-Aug-12	ND	0.0055	ND	ND	5.62
	30-Oct-12	ND	ND	ND	ND	0.401***J***
Reporting Limit [a]		0.003	0.003	0.0002	0.003	0.005
Regulatory Threshold		0.006[b]	0.01[b]	0.005[b]	0.015[b]	5.0[c]

Notes:

mg/L = milligrams per liter
ND = Not detected above reporting limit
NS = Not sampled
J = Reported concentration is an estimate based on data quality review

a. Reporting Limit (RL) provided as listed in the SAP/QAPP (TerraGraphics 2010). RL can be higher if a sample dilution is necessary.
b. National Primary Drinking Water Regulation (Maximum Contaminant Level)
c. National Secondary Drinking Water Regulation

[pink box] = Value exceeds the regulatory threshold

Appendix D

Summary of Detection Frequencies and Frequencies above Regulatory Thresholds

Table D-1
Dissolved Metal Frequency of Detection and Regulatory Threshold Exceedances

Metal	Well	No. of sampling events	No. of detects	Frequency of detection (%)	No. of detects above reporting limits[a]	Percent of detects above reporting limits	No. of detects above regulatory threshold	Percent of detects above regulatory threshold
Antimony	MW-A	20	0	0%	0	0%	0	0%
	MW-B	20	0	0%	0	0%	0	0%
	MW-C	16	0	0%	0	0%	0	0%
	MW-C-DEEP	9	0	0%	0	0%	0	0%
	MW-D	17	0	0%	0	0%	0	0%
	MW-E	16	0	0%	0	0%	0	0%
	MW-F	16	0	0%	0	0%	0	0%
	Decon	5	0	0%	0	0%	0	0%
Arsenic	MW-A	20	7	35%	2	10%	0	0%
	MW-B	20	4	20%	2	10%	0	0%
	MW-C	16	5	31%	1	6%	0	0%
	MW-C-DEEP	9	4	44%	2	22%	0	0%
	MW-D	17	6	35%	1	6%	0	0%
	MW-E	16	14	88%	12	75%	7	44%
	MW-F	16	4	25%	2	13%	0	0%
	Decon	5	5	100%	2	40%	0	0%
Cadmium	MW-A	20	17	85%	16	80%	0	0%
	MW-B	20	0	0%	0	0%	0	0%
	MW-C	16	16	100%	15	94%	0	0%
	MW-C-DEEP	9	0	0%	0	0%	0	0%
	MW-D	17	2	12%	0	0%	0	0%
	MW-E	16	1	6%	0	0%	0	0%
	MW-F	16	15	94%	14	88%	0	0%
	Decon	5	1	20%	0	0%	0	0%

Metal	Well	No. of sampling events	No. of detects	Frequency of detection (%)	No. of detects above reporting limits[a]	Percent of detects above reporting limits	No. of detects above regulatory threshold	Percent of detects above regulatory threshold
Lead	MW-A	20	1	5%	0	0%	0	0%
	MW-B	20	1	5%	0	0%	0	0%
	MW-C	16	4	25%	0	0%	0	0%
	MW-C-DEEP	9	2	22%	0	0%	0	0%
	MW-D	17	1	6%	0	0%	0	0%
	MW-E	16	0	0%	0	0%	0	0%
	MW-F	16	4	25%	0	0%	0	0%
	Decon	5	3	60%	0	0%	0	0%
Zinc	MW-A	20	20	100%	20	100%	0	0%
	MW-B	20	20	100%	20	100%	0	0%
	MW-C	16	16	100%	16	100%	0	0%
	MW-C-DEEP	9	8	89%	7	78%	0	0%
	MW-D	17	17	100%	17	100%	0	0%
	MW-E	16	15	94%	12	75%	0	0%
	MW-F	16	16	100%	16	100%	0	0%
	Decon	5	5	100%	5	100%	1	20%

Notes:

No. = number

a = Reporting Limit as listed in the SAP/QAPP (TerraGraphics 2010).

(shaded) = Exceeds 50%