Operable Unit 2 Groundwater Annual Data Summary Report for CY2014

Bunker Hill Mining and Metallurgical Complex Superfund Site, Shoshone County, Idaho

State of Idaho
Department of Environmental Quality

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Table of Contents

Acronyms and Abbreviations v
1 Introduction and Purpose 4
2 Groundwater Monitoring 4
3 Optimization Process for BEMP 6
4 Data Analysis 7
4.1 Methods 7
4.2 Results 8
4.2.1 Transect 1 10
4.2.2 Transect 1 to 2 10
4.2.3 Transect 2 11
4.2.4 Transect 2 to 3 12
4.2.5 Deadwood Gulch 13
4.2.6 Magnet Gulch 14
4.2.7 Transect 3 to 5 14
4.2.8 Smelter Closure Area 16
4.2.9 Government Gulch and Transect 4 17
4.2.10 Transect 5 18
4.2.11 Transect 5 to 6 19
4.2.12 Transect 6 20
4.2.13 Transect 7 21
5 Conclusions and Recommendations 22
5.1 Summary for 2015 Five-Year Review 22
5.2 BEMP Optimization Documents 24
5.3 CY2015 Recommendations 24
5.4 Future Data Analysis 25
References 26
Appendix A. Maps and Tables 28
Appendix B. QA/QC Memoranda 48

List of Tables

Table 1. Total site count for future groundwater monitoring events. 6
Table 2. Method for interpretation of Current Condition. 8
Table 3. Statistical results for cadmium in Transect 1. 10
Table 4. Statistical results for zinc in Transect 1. 10
Table 5. Statistical results for cadmium in Transect 1 to Transect 2. 10
Table 6. Statistical results for zinc in Transect 1 to Transect 2. 11
Table 7. Statistical results for cadmium in Transect 2. 11
Table 8. Statistical results for zinc in Transect 2. 12
Table 9. Statistical results for cadmium in Transect 2 to Transect 3. 12
Table 10. Statistical results for zinc in Transect 2 to Transect 3. 13
Table 11. Statistical results for cadmium in Deadwood Gulch. 13
Table 12. Statistical results for zinc in Deadwood Gulch. 14
Table 13. Statistical results for cadmium in Magnet Gulch. 14
Table 14. Statistical results for zinc in Magnet Gulch. 14
Table 15. Statistical results for cadmium in Transect 3 to Transect 5. 15
Table 16. Statistical results for zinc in Transect 3 to Transect 5. 16
Table 17. Statistical results for cadmium in the Smelter Closure Area. 17
Table 18. Statistical results for zinc in the Smelter Closure Area. 17
Table 19. Statistical results for cadmium in Transect 4. 18
Table 20. Statistical results for zinc in Transect 4. 18
Table 21. Statistical results for cadmium in Transect 5. 19
Table 22. Statistical results for zinc in Transect 5. 19
Table 23. Statistical results for cadmium in Transect 5 to Transect 6. 20
Table 24. Statistical results for zinc in Transect 5 to Transect 6. 20
Table 25. Statistical results for cadmium in Transect 6. 21
Table 26. Statistical results for zinc in Transect 6. 21
Table 27. Statistical results for cadmium in Transect 7. 21
Table 28. Statistical results for zinc in Transect 7. 22

Acronyms and Abbreviations

ARARs	applicable or relevant and appropriate requirements
BEMP	Basin Environmental Monitoring Plan
CIA	Central Impoundment Area
CLP	Contract Laboratory Program
COC	contaminants of concern
CY	calendar year
DEQ	Idaho Department of Environmental Quality
DO	dissolved oxygen
EMP	Environmental Monitoring Plan
EMS	Environmental Management Support, Inc.
EPA	U.S. Environmental Protection Agency
ft bgs	feet below ground surface
GSI	GSI Environmental, Inc.
GWCS	groundwater collection system
I-90	Interstate-90
LTM	long-term monitoring location
MCL	maximum contaminant level
MK	Mann-Kendall test
ORP	oxidation reduction potential
OSRTI	Office of Superfund Remediation and Technology Innovation
OU	operable unit
PTM	principal threat material
PZ	piezometers
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RA	remedial action
ROD	Record of Decision
SCA	Smelter Closure Area
SFCDR	South Fork of the Coeur d'Alene River
TAL	Target Analyte List
TerraGraphics	TerraGraphics Environmental Engineering, Inc.
USGS	U.S. Geological Survey
WQX	Water Quality Exchange

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1 Introduction and Purpose

The purpose of this annual report is to summarize the activities and results for groundwater monitoring conducted within Operable Unit 2 (OU2) of the Bunker Hill Mining and Metallurgical Complex Superfund Site, Shoshone County, Idaho. This monitoring is guided by the 1992 OU2 Record of Decision (ROD) (EPA 1992) and the 2012 ROD Amendment (EPA 2012). Since 2004, the Idaho Department of Environmental Quality (DEQ) has administered groundwater monitoring in accordance with the OU2 *Environmental Monitoring Plan* (EMP; CH2M HILL 2006a). In 2014, optimization of the groundwater monitoring program began in an effort to integrate groundwater monitoring into the Basin Environmental Monitoring Plan (BEMP) including updates to the overall BEMP guidance document (EPA 2004).

This annual report is structured as follows:

- **Section 2 – Groundwater Monitoring** provides a summary of the calendar year (CY) 2014 monitoring events.
- **Section 3 – Optimization Process for BEMP** describes the ongoing efforts to integrate groundwater monitoring into the BEMP.
- **Section 4 – Data Analysis** presents the statistical analysis methods and results for OU2 groundwater data conducted to establish baseline information to measure remedy effectiveness and maintain long-term groundwater quality information.
- **Section 5 – Conclusions and Recommendations** provides a summary of groundwater results for the 2015 Five-Year Review and recommendations for CY2015 groundwater monitoring and future data analysis.

2 Groundwater Monitoring

Monitoring events take place during the spring and fall of each year to collect data during high and low flow conditions. The monitoring timeframe for the 2015 Five-Year Review includes CY 2010 to 2014. During the spring of 2010 to 2014, samples were collected from 74 groundwater sites which include a combination of wells and piezometers. During the fall of 2010 to 2013, samples were collected from 88 sites. Optimization efforts during the summer of 2014 reduced the fall 2014 sampling event to 71 sites (EPA 2014 with additional details in Section 3). Locations of groundwater monitoring sites within OU2 are shown on the maps included in Appendix A.

One recent addition to the monitoring program is collection of baseline groundwater quality data prior to installation of the groundwater collection system (GWCS) within OU2, to be located between the Central Impoundment Area (CIA) and I-90 (CH2M Hill 2012a). Monitoring began in fall 2013 and data will continue to be collected prior to and during construction and operations to estimate dissolved metal loads to the South Fork of the Coeur d'Alene River (SFCDR), monitor remedy performance and effectiveness, and evaluate long-term response to the collection system operation.

For this CY2014 annual report, the following is a summary of details included in the spring and fall Sampling Trip Summary Reports (TerraGraphics 2014a and 2014b):

- Groundwater monitoring dates: May 15 to June 10, 2014 for the spring event and October 6 to 17, 2014 for the fall event.

- A list of sites sampled.
- Groundwater sampling field sheets containing field conditions, sampling details, and field parameters collected including pH, temperature, specific conductivity, dissolved oxygen (DO), and oxidation-reduction potential (ORP).
- Analyte lists, including:
    - Primary Contaminants of Concern (COC): dissolved metals for the Target Analyte List (TAL): Al, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Ni, K, Ag, Na, Sb, V, Zn, As, Pb, Se, Tl, Hg and hardness. All COCs were collected during the spring event. As part of optimization efforts, Hg was not collected during fall 2014.
    - Secondary Contaminants of Concern (COC): nutrients (total phosphorous) collected at 29 sites in spring and 18 sites in fall.
    - Additional geochemistry analytes at locations near the CIA for collection of baseline groundwater quality data prior to installation of the GWCS.
- A list of wells containing data loggers that were downloaded.
- Field issues and deviations from planned activities.
- Locations and types of quality assurance (QA) / quality control (QC) samples collected.
- Maintenance activities performed and recommended for the future.

A data quality review was conducted to ensure compliance with the Quality Assurance Project Plan (QAPP) for EMP (CH2M HILL 2006b) and associated CY2014 OU2 QAPP Addendums (Sample Alteration Forms). Exceptions to the procedures for sample collection, labeling, handling, and analysis are identified in the associated QA/QC memoranda (included in Appendix B). The USEPA chemist conducted Stage 4 (S4VEM) data verification and validation (EPA 2002, 2009, 2010) on approximately 50% of the Contract Laboratory Program (CLP) analyzed data for the spring and fall events. A Stage 2B (S2BVE) data validation and verification was conducted on the remainder of the CLP data. The EPA data validation reports and information for holding times, appropriate preservation, field QC sample frequency, and data completeness were reviewed and summarized as part of the data quality review (Appendix B).

A total of 164 water samples were submitted for laboratory analysis during 2014, including 152 groundwater and 12 QA/QC samples. Two sites were dry in the fall event due to slow recharge or a small water column (BH-DW-GW-0001 and BH-SF-E-PZ-01). All field QA/QC samples were collected at the appropriate frequency. All holding times were met and preservation was confirmed by the laboratories. Laboratory analyses were performed through the EPA CLP laboratory (baseline samples for the GWCS were also analyzed by EPA's Manchester and R5 laboratories, and the local analytical laboratory [SVL Analytical, Inc.]). No data were rejected based on the data quality review. All sampling event laboratory data were assessed at 100% completeness. Certain analytical data were qualified as estimates (*J*) during the data quality review at various sampling locations and for various events (Appendix B).

3 Optimization Process for BEMP

The history of past OU2 groundwater monitoring included data collection for the following purposes:

- 1987 to 1994 – Remedial Investigation and Design (characterization monitoring; pre-remediation),
- 1994 to 2000 – Phase I Remedial Action Implementation (detection monitoring; during and immediately following remediation), and
- 2000 to current – Post-Phase I Remedial Action Implementation (post remediation effectiveness, long-term monitoring, and further definition of future remedial actions).

Optimization efforts conducted during 2014 included reducing the total number of sites sampled during the fall and spring events and also reducing the frequency of sampling for some of the sites. Each site was assigned a sampling frequency of semi-annual (both fall and spring each year), annual (only during the fall event) or every five years. A summary of the total number of sites to be sampled in future years is shown in Table 1. As stated in Section 2, implementation of this change began with the 2014 fall low flow event. These changes were made based on review of historic data, future monitoring needs for the GWCS, and ongoing discussions between DEQ and EPA (EPA 2014, DEQ 2014). In addition, the analyte list was reduced to eight analytes (Sb, As, Cd, Cu, Pb, Zn, hardness, and phosphorus). Mercury will continue to be collected every five years at select locations.

Table 1. Total site count for future groundwater monitoring events.

Event	2015		2016		2017		2018		2019		2020	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Semi-Annual (spring and fall)	27	27	27	27	27	27	27	27	27	27	27	27
Annual (fall only)	-	32	-	32	-	32	-	32	-	32	-	32
5-Year	-	-	-	-	-	-	-	12	-	-	-	-
Total Number of Sites	**27**	**59**	**27**	**59**	**27**	**59**	**27**	**71**	**27**	**59**	**27**	**59**

Concurrent with the above effort, an independent, third party, optimization review of the BEMP began (GSI and EMS 2014). Technical support for this review was provided by the EPA Office of Superfund Remediation and Technology Innovation (OSRTI). This optimization review provided recommendations to improve the monitoring program for all media (groundwater, surface water, sediment, and biological) by defining the following monitoring objective categories:

- *Site Characterization* - Data collected can be incorporated into an updated Conceptual Site Model.
- *Remedy Selection and Design* - Data can be used to support future remedy selection and designs.

- *Remedy Performance* - Data can be used to measure both the short- and long-term effectiveness and performance of completed and ongoing remedies.
- *Long-Term Remedial Response and Restoration* - Data can be evaluated across the spatial extent of OU2 and over the span of decades.
- *Demonstration of Protectiveness* - Demonstrating protectiveness may be difficult as many of the contaminated media will contain high levels of contaminants for many years in the future.
- *Model Support* - Site characterization data are used as the foundation of model development and refinement.
- *Catastrophic or Anomalous Events* - Since contaminant transport is more sensitive to seasonal and large-scale weather events, data can be used to measure changes to the distribution of contaminants, function of remedies, and re-establish baseline conditions following these events.

Future opportunities for additional optimization will be identified and performed based on review of the results in this report against the above monitoring objective categories and other recommendations from the ongoing optimization review (see additional details in Section 5 of this report).

4 Data Analysis

Previous statistical analysis of OU2 groundwater data was completed in 2012 for both historic (all available data for a given well) and current time periods (2002-2009; CH2M Hill 2012b). Data analysis in this report was performed following the same methods as the previous analysis to update the results for only the current time period (2002-2014).

4.1 Methods

The following is a list of assumptions and methods used to perform data analysis:

- **Monitoring Network**: Analysis was performed using data from the sites identified as part of the future monitoring network (EPA 2014).
- **Analytes**: Indicator metals, consisting of dissolved cadmium and zinc, are included in this analysis.
- **Date Range**: Data used for this analysis includes the most recent period from October 2002 to October 2014. This time period represents a common timeframe for all wells that is considered most representative of the current conditions.
- **Data Used**: All available data within the period of record (October 2002 to October 2014) were used as independent data points. Estimated (J flagged) data were treated as detections. Duplicate and replicate samples were used as independent data points. All data used in this analysis were downloaded from EPA's Water Quality Exchange (WQX).
- **Applicable or Relevant and Appropriate Requirements (ARARs)**: ARARs for groundwater are the maximum contaminant levels (MCLs) as established in the 1992 OU2 ROD (EPA 1992). The MCL for cadmium is 5 ppb and the MCL for zinc is 5,000 ppb.

- **Trends Over Time**: The evaluation of trends over time are based upon results from the Mann-Kendall (MK) test. The MK method is a non-parametric test which does not depend upon any underlying distribution of observed values. The MK tests for the relative change [increase/decrease] over the period of observations, testing for a slope in the line connecting observed values. A MK test was only performed if eight or more data points were available for the site within the recent time period (October 2002 to October 2014). Trend significance was determined at 95% level (p-value < 0.05). All trends were qualified increasing or decreasing regardless of whether the trend was significant or not significant. No assumptions were made based on an underlying distribution and test results are not impacted by the magnitude of extreme values. The null hypothesis is that time series values are independent, identically distributed (no monotonic trend).

- **MCL Ratios**: The MCL ratio is the median concentration using recent data (October 2002 to October 2014), divided by the analyte-specific MCL. The median MCL ratio has been selected as a conservative estimate which, in comparison to the mean ratio, reduces the influence of extreme values. In these analyses, 'conservative' means that deviations from the best estimate per location are more likely underestimated rather than overestimated.

- **Current Conditions**: Interpretation of the current condition for each site was determined utilizing the trend and MCL ratio results with the decision logic shown in Table 2.

Table 2. Method for interpretation of Current Condition.

Trend Results		Median MCL Ratio		Current Condition
NS	AND	>1	THEN	**NOT IMPROVING**
Decreasing	AND	>1	THEN	**IMPROVING**
Increasing	AND	Any case	THEN	**CAUTION**
NS or Decreasing	AND	≤1	THEN	**STABLE** (target end goal)

NS= no statistically significant trend

4.2 Results

The OU2 groundwater monitoring network is divided into decision units (or subareas) based on previously assigned transects (CH2M HILL 2003) and areas of past remedial actions (Appendix A). Each decision unit subsection below includes a description of the area, result tables, and brief discussion of results. Area descriptions are based on previous transect descriptions and past remedial action information (EPA 2007 and 2008). Discussion of results includes a comparison of the current results presented in this report (for a data range of October 2002 to October 2014) to the previous statistical results for a data range of October 2002 to October 2009 (as presented in CH2M Hill, 2012b). If previous statistics were not included in that report, the results presented here are identified as baseline conditions.

All data analysis results are summarized in the following tables presented in Appendix A:

- Table A-1. Monitoring Network and Data Summary (October 2002 to October 2014).
- Table A-2. Summary Statistics by Location for Dissolved Cadmium.
- Table A-3. Summary Statistics by Location for Dissolved Zinc.

- Table A-4. Site-Specific Trend Test Results for Dissolved Cadmium.
- Table A-5. Site-Specific Trend Test Results for Dissolved Zinc.
- Table A-6. Median MCL Ratios for Dissolved Cadmium.
- Table A-7. Median MCL Ratios for Dissolved Zinc.

For the sites within each decision unit, result tables were compiled within the following subsections to present the following information:

- Well ID: Well or Piezometer Identification
- Monitoring Purpose:
    - LTM = OU2 long-term monitoring location
    - RA Effectiveness GWCS = Remedial Action effectiveness monitoring location for the future Groundwater Collection System
- Screened Interval: Depth of the well or piezometer screen in feet below ground surface (ft bgs)
- Hydrologic Unit:
    - *Single:* the single unconfined aquifer located in the easternmost portion of the Box where the confining unit is not present,
    - *Upper:* the upper, unconfined aquifer associated with the main-stem SFCDR valley and defined by the presence of the underlying fine-grained confining unit,
    - *Upland or Trib:* the upland tributary groundwater system(s), located in the gulches and hillsides of the SFCDR valley floor which discharge directly to the upper aquifers described above,
    - *Lower:* the lower, confined aquifer associated with the main-stem SFCDR valley and defined by the presence of the overlying confining unit.
- Analyte: dissolved cadmium or zinc
- Trend: Described in Section 4.1 and compiled from Appendix A tables. Within Tables A-5 and A-6, all trends are qualified as increasing or decreasing regardless of significance. However, within these results tables, trend is reported as follows:
    - NS = No statistically significant trend
    - DEC = Decreasing Trend
    - INC = Increasing Trend
- Median MCL Ratio: Described in Section 4.1 and compiled from Appendix A Tables A-6 and A-7.
- Current Condition: Described in Section 4.1.

4.2.1 Transect 1

- **Decision Unit Description:** Eastern OU2 boundary; upgradient of OU2 near Elizabeth Park. This location establishes background conditions for groundwater flow entering OU2.
- **Results:** Current conditions are stable for cadmium and zinc; same as 2002-2009 timeframe.

Table 3. Statistical results for cadmium in Transect 1.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-E-0001	LTM	46.0-59.0	Single	Cadmium	NS	0.1	STABLE

Table 4. Statistical results for zinc in Transect 1.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-E-0001	LTM	46.0-59.0	Single	Zinc	NS	0.04	STABLE

4.2.2 Transect 1 to 2

- **Decision Unit Description:** Elizabeth Park to Kellogg; including Milo Gulch and the historic SFCDR channel (PZ-01 and PZ-10).
- **Results:** Current conditions are the same as the 2002-2009 timeframe for E-0101, E-0104, and E-202-U for cadmium and zinc. Baseline conditions are presented for the remaining sites.

Table 5. Statistical results for cadmium in Transect 1 to Transect 2.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-E-0101	LTM	15.0-20.0	Single	Cadmium	DEC	2.8	IMPROVING
BH-SF-E-PZ-01	LTM	12.8-17.8	Upper	Cadmium	NS	3.6	NOT IMPROVING
BH-SF-E-0104	LTM	59.0-79.0	Single	Cadmium	INC	3.7	CAUTION
BH-SF-E-0202-U	LTM	17.0-27.0	Upper	Cadmium	NS	1.0	STABLE
BH-SF-E-0203-L	LTM	62.5-82.5	Lower	Cadmium	NS	0.2	STABLE
BH-SF-E-PZ-10	LTM	15.0-20.0	Upper	Cadmium	NS	34.2	NOT IMPROVING

Table 6. Statistical results for zinc in Transect 1 to Transect 2.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-E-0101	LTM	15.0-20.0	Single	Zinc	DEC	0.5	STABLE
BH-SF-E-PZ-01	LTM	12.8-17.8	Upper	Zinc	NS	0.4	STABLE
BH-SF-E-0104	LTM	59.0-79.0	Single	Zinc	NS	1.8	NOT IMPROVING
BH-SF-E-0202-U	LTM	17.0-27.0	Upper	Zinc	NS	0.2	STABLE
BH-SF-E-0203-L	LTM	62.5-82.5	Lower	Zinc	DEC	0.1	STABLE
BH-SF-E-PZ-10	LTM	15.0-20.0	Upper	Zinc	NS	3.1	NOT IMPROVING

4.2.3 Transect 2

- **Decision Unit Description:** East and upgradient of the CIA source materials near the city of Kellogg. This location allows assessment of groundwater conditions upgradient of the CIA.

- **Results:** Current conditions are the same as the 2002-2009 timeframe for all sites except E-0309-U where cadmium changed from Not Improving to Caution and zinc changed from Stable to Caution because both trends changed from NS to increasing.

Table 7. Statistical results for cadmium in Transect 2.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-E-0301-U	LTM	15.0-20.0	Upper	Cadmium	DEC	15.6	IMPROVING
BH-SF-E-0302-L	LTM	68.0-73.0	Lower	Cadmium	DEC	7.4	IMPROVING
BH-SF-E-0305-U	LTM	15-20	Upper	Cadmium	NS	6.2	NOT IMPROVING
BH-SF-E-0306-L	LTM	40.0-80.0	Lower	Cadmium	DEC	7.8	IMPROVING
BH-SF-E-0309-U	LTM	22.0-32.0	Upper	Cadmium	INC	2.2	CAUTION
BH-SF-E-0310-L	LTM	55.0-90.0	Lower	Cadmium	NS	0.2	STABLE

Table 8. Statistical results for zinc in Transect 2.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-E-0301-U	LTM	15.0-20.0	Upper	Zinc	DEC	3.4	IMPROVING
BH-SF-E-0302-L	LTM	68.0-73.0	Lower	Zinc	DEC	2.0	IMPROVING
BH-SF-E-0305-U	LTM	15-20	Upper	Zinc	NS	1.2	NOT IMPROVING
BH-SF-E-0306-L	LTM	40.0-80.0	Lower	Zinc	DEC	1.6	IMPROVING
BH-SF-E-0309-U	LTM	22.0-32.0	Upper	Zinc	INC	0.3	CAUTION
BH-SF-E-0310-L	LTM	55.0-90.0	Lower	Zinc	NS	0.06	STABLE

4.2.4 Transect 2 to 3

- **Decision Unit Description:** This location allows assessment of groundwater conditions within the immediate vicinity of the CIA.
- **Results:** Current conditions are the same as the 2002-2009 timeframe for E-0317-U, E-0402-U, and E-403-U. Baseline conditions are presented for the remaining sites.

Table 9. Statistical results for cadmium in Transect 2 to Transect 3.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-E-0317-U	RA Effectiveness GWCS	14.0-19.0	Upper	Cadmium	NS	4.2	NOT IMPROVING
BH-SF-E-0318-U	RA Effectiveness GWCS	70-80	Upper	Cadmium	DEC	1.9	IMPROVING
BH-SF-E-0320-U	RA Effectiveness GWCS	12.0-17.0	Upper	Cadmium	NS	6.8	NOT IMPROVING
BH-SF-E-0402-U	RA Effectiveness GWCS	11.0-13.5	Upper	Cadmium	INC	11.1	CAUTION
BH-SF-E-0403-U	RA Effectiveness GWCS	17.5-20.0	Upper	Cadmium	INC	9.8	CAUTION
BH-SF-E-PZ-23	RA Effectiveness GWCS	11.5-16.5	Upper	Cadmium	NS	87.8	NOT IMPROVING
BH-SF-E-0407-U	RA Effectiveness GWCS	72-77	Upper	Cadmium	NS	99.8	NOT IMPROVING
BH-SF-E-0410-U	RA Effectiveness GWCS	12.0-17.0	Upper	Cadmium	NS	44.3	NOT IMPROVING
BH-SF-E-PZ-16	RA Effectiveness GWCS	11.0-16.0	Upper	Cadmium	DEC	32.7	IMPROVING

Table 10. Statistical results for zinc in Transect 2 to Transect 3.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-E-0317-U	RA Effectiveness GWCS	14.0-19.0	Upper	Zinc	NS	1.4	NOT IMPROVING
BH-SF-E-0318-U	RA Effectiveness GWCS	70-80	Upper	Zinc	NS	0.3	STABLE
BH-SF-E-0320-U	RA Effectiveness GWCS	12.0-17.0	Upper	Zinc	NS	1.8	NOT IMPROVING
BH-SF-E-0402-U	RA Effectiveness GWCS	11.0-13.5	Upper	Zinc	NS	4.7	NOT IMPROVING
BH-SF-E-0403-U	RA Effectiveness GWCS	17.5-20.0	Upper	Zinc	NS	3.0	NOT IMPROVING
BH-SF-E-PZ-23	RA Effectiveness GWCS	11.5-16.5	Upper	Zinc	DEC	3.7	IMPROVING
BH-SF-E-0407-U	RA Effectiveness GWCS	72-77	Upper	Zinc	NS	3.1	NOT IMPROVING
BH-SF-E-0410-U	RA Effectiveness GWCS	12.0-17.0	Upper	Zinc	NS	4.9	NOT IMPROVING
BH-SF-E-PZ-16	RA Effectiveness GWCS	11.0-16.0	Upper	Zinc	DEC	3.9	IMPROVING

4.2.5 Deadwood Gulch

- **Decision Unit Description:** Deadwood Gulch is a tributary to Bunker Creek and located to the east of the A-4 Gypsum Pond. This pond is a discrete source of dissolved zinc and a potential source of phosphorus. The pond has a soil cover cap and channels were created for both Deadwood Gulch and Magnet Gulch.

- **Results:** Current conditions are the same as the 2002-2009 timeframe for zinc. Cadmium changed from Not Improving to Improving because the trend changed from NS to decreasing.

Table 11. Statistical results for cadmium in Deadwood Gulch.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-DW-GW-0001	LTM	35-40	Upland	Cadmium	DEC	2.9	IMPROVING

Table 12. Statistical results for zinc in Deadwood Gulch.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-DW-GW-0001	LTM	35-40	Upland	Zinc	DEC	0.2	STABLE

4.2.6 Magnet Gulch

- **Decision Unit Description:** Magnet Gulch is a tributary to Bunker Creek and located on the western edge of the A-4 Gypsum Pond. Previous remedial actions in Upper Magnet Gulch included extensive removal of contaminated materials.

- **Results:** Baseline conditions are presented for this site.

Table 13. Statistical results for cadmium in Magnet Gulch.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-E-PZ-18	LTM	11.0-16.0	Upper	Cadmium	DEC	21.2	IMPROVING

Table 14. Statistical results for zinc in Magnet Gulch.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-E-PZ-18	LTM	11.0-16.0	Upper	Zinc	NS	1.9	NOT IMPROVING

4.2.7 Transect 3 to 5

- **Decision Unit Description:** This location is west and downgradient of the CIA and allows assessment of groundwater conditions downgradient of CIA source materials and the future GWCS.

- **Results:** Current conditions are the same as the 2002-2009 timeframe for cadmium and zinc in E-0424-L, E-0426-L, E-0427-U, and E-0502-U and for zinc in E-0423-U and E-0428-L. Conditions have changed for E-0423-U (cadmium) from Stable to Caution because the trend changed from NS to increasing and the median MCL ratio slightly increased from 0.9 to 1.1. Conditions have also changed for E-0425-U (cadmium and zinc) from Not Improving to Improving because the trends changed from NS to decreasing and for E-0428-L (cadmium) from Not Improving to Improving because the trend changed from NS to decreasing. Baseline conditions are presented for PZ-25, PZ-26B, PZ-21, and E-0503-U.

Table 15. Statistical results for cadmium in Transect 3 to Transect 5.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-E-0423-U	RA Effectiveness GWCS	14.0-19.0	Upper	Cadmium	INC	1.1	CAUTION
BH-SF-E-0424-L	RA Effectiveness GWCS	66.0-91.0	Lower	Cadmium	NS	0.2	STABLE
BH-SF-E-0425-U	RA Effectiveness GWCS	15.0-40.0	Upper	Cadmium	DEC	20.8	IMPROVING
BH-SF-E-0426-L	RA Effectiveness GWCS	66.0-91.0	Lower	Cadmium	NS	0.3	STABLE
BH-SF-E-0427-U	RA Effectiveness GWCS	16.5-21.5	Upper	Cadmium	DEC	38.8	IMPROVING
BH-SF-E-0428-L	RA Effectiveness GWCS	60.0-95.0	Lower	Cadmium	DEC	6.0	IMPROVING
BH-SF-E-PZ-25	RA Effectiveness GWCS	12.0-17.0	Upper	Cadmium	NS	16.5	NOT IMPROVING
BH-SF-E-PZ-26B	RA Effectiveness GWCS	11.2-16.2	Upper	Cadmium	NS	21.9	NOT IMPROVING
BH-SF-E-PZ-21	RA Effectiveness GWCS	15.0-20.0	Upper	Cadmium	NS	73.2	NOT IMPROVING
BH-SF-E-0502-U	RA Effectiveness GWCS	15.5-20.5	Upper	Cadmium	INC	4.6	CAUTION
BH-SF-E-0503-U	RA Effectiveness GWCS	12.7-14.7	Upper	Cadmium	DEC	85.2	IMPROVING

Table 16. Statistical results for zinc in Transect 3 to Transect 5.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-E-0423-U	RA Effectiveness GWCS	14.0-19.0	Upper	Zinc	NS	4.4	NOT IMPROVING
BH-SF-E-0424-L	RA Effectiveness GWCS	66.0-91.0	Lower	Zinc	NS	0.2	STABLE
BH-SF-E-0425-U	RA Effectiveness GWCS	15.0-40.0	Upper	Zinc	DEC	5.3	IMPROVING
BH-SF-E-0426-L	RA Effectiveness GWCS	66.0-91.0	Lower	Zinc	NS	1.3	NOT IMPROVING
BH-SF-E-0427-U	RA Effectiveness GWCS	16.5-21.5	Upper	Zinc	NS	2.0	NOT IMPROVING
BH-SF-E-0428-L	RA Effectiveness GWCS	60.0-95.0	Lower	Zinc	DEC	1.6	IMPROVING
BH-SF-E-PZ-25	RA Effectiveness GWCS	12.0-17.0	Upper	Zinc	NS	4.7	NOT IMPROVING
BH-SF-E-PZ-26B	RA Effectiveness GWCS	11.2-16.2	Upper	Zinc	NS	1.7	NOT IMPROVING
BH-SF-E-PZ-21	RA Effectiveness GWCS	15.0-20.0	Upper	Zinc	NS	3.4	NOT IMPROVING
BH-SF-E-0502-U	RA Effectiveness GWCS	15.5-20.5	Upper	Zinc	NS	1.8	NOT IMPROVING
BH-SF-E-0503-U	RA Effectiveness GWCS	12.7-14.7	Upper	Zinc	DEC	1.6	IMPROVING

4.2.8 Smelter Closure Area

- **Decision Unit Description:** This repository for principal threat material (PTM) and demolition debris was closed in 1998 and capped with a geomembrane liner and revegetated. A golf course is now located upgradient of the Smelter Closure Area with a pond added for irrigation which may impact downgradient groundwater level.

- **Results:** Baseline conditions are presented for all sites.

Table 17. Statistical results for cadmium in the Smelter Closure Area.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SCA-GW-0001	LTM	25.0-30.0	Upland	Cadmium	NS	0.4	STABLE
BH-SCA-GW-0005	LTM	24.5-34.5	Upland	Cadmium	DEC	123.7	IMPROVING
BH-SCA-GW-0006	LTM	5.7-15.7	Upland	Cadmium	NS	192.0	NOT IMPROVING
BH-SF-E-0501-U	LTM	24.0-29.0	Upland	Cadmium	DEC	98.1	IMPROVING

Table 18. Statistical results for zinc in the Smelter Closure Area.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SCA-GW-0001	LTM	25.0-30.0	Upland	Zinc	NS	0.003	STABLE
BH-SCA-GW-0005	LTM	24.5-34.5	Upland	Zinc	DEC	0.1	STABLE
BH-SCA-GW-0006	LTM	5.7-15.7	Upland	Zinc	NS	1.7	NOT IMPROVING
BH-SF-E-0501-U	LTM	24.0-29.0	Upland	Zinc	DEC	1.5	IMPROVING

4.2.9 Government Gulch and Transect 4

- **Decision Unit Description:** The mouth of Government Gulch is located at the transition area of the Government Gulch tributary drainage and the SFCDR valley floor. This location allows assessment of groundwater conditions discharging from the Government Gulch upland tributary system to the SFCDR alluvial aquifer.

- **Results:** Current conditions are the same as the 2002-2009 timeframe for cadmium in GG-GW-0007 and both cadmium and zinc in GG-GW-0008. Current conditions have changed for zinc in GG-GW-0007 from Not Improving to Improving because the trend changed from NS to decreasing. Baseline conditions are presented for GG-GW-0002, GG-GW-0004, GG-GW-0009 and PZ-31.

Table 19. Statistical results for cadmium in Transect 4.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-GG-GW-0002	LTM	18.5-22.5	Trib	Cadmium	NS	4.2	NOT IMPROVING
BH-GG-GW-0004	LTM	17.5-22.5	Trib	Cadmium	DEC	60.3	IMPROVING
BH-GG-GW-0007	RA Effectiveness GWCS	15.0-25.0	Trib	Cadmium	DEC	60.6	IMPROVING
BH-GG-GW-0008	RA Effectiveness GWCS	40-60	Trib	Cadmium	INC	2.1	CAUTION
BH-GG-GW-0009	LTM	27-37	Trib	Cadmium	NS	896.0	NOT IMPROVING
BH-SF-E-PZ-31	RA Effectiveness GWCS	11.0-16.0	Upper	Cadmium	DEC	60.1	IMPROVING

Table 20. Statistical results for zinc in Transect 4.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-GG-GW-0002	LTM	18.5-22.5	Trib	Zinc	NS	0.08	STABLE
BH-GG-GW-0004	LTM	17.5-22.5	Trib	Zinc	DEC	3.7	IMPROVING
BH-GG-GW-0007	RA Effectiveness GWCS	15.0-25.0	Trib	Zinc	DEC	1.3	IMPROVING
BH-GG-GW-0008	RA Effectiveness GWCS	40-60	Trib	Zinc	INC	0.09	CAUTION
BH-GG-GW-0009	LTM	27-37	Trib	Zinc	NS	16.7	NOT IMPROVING
BH-SF-E-PZ-31	RA Effectiveness GWCS	11.0-16.0	Upper	Zinc	NS	1.5	NOT IMPROVING

4.2.10 Transect 5

- **Decision Unit Description:** The eastern edge of Smelterville Flats near the city of Smelterville. This location allows assessment of groundwater conditions downgradient of Government Gulch and the CIA, and upgradient of Smelterville Flats.

- **Results:** Current conditions are the same as the 2002-2009 timeframe for zinc in W-0001-U and cadmium in W-0003-U and W-0004-L. Conditions have changed for cadmium in W-0001-U from Not Improving to Improving because the trend changed from NS to decreasing, for zinc in W-0003-U from Caution to Not Improving because the trend changed from increasing to NS, for

zinc in W-0004-U from Improving to Stable because the MCL ratio is 1.0, and for cadmium and zinc in W-0005-U from Stable to Caution because the trend changed from NS to increasing.

Table 21. Statistical results for cadmium in Transect 5.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-W-0001-U	LTM	10.0-20.0	Upper	Cadmium	DEC	4.5	IMPROVING
BH-SF-W-0003-U	LTM	16.0-21.0	Upper	Cadmium	NS	32.2	NOT IMPROVING
BH-SF-W-0004-L	LTM	75.0-95.0	Lower	Cadmium	DEC	1.3	IMPROVING
BH-SF-W-0005-U	LTM	11.0-21.0	Upper	Cadmium	INC	0.9	CAUTION

Table 22. Statistical results for zinc in Transect 5.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-W-0001-U	LTM	10.0-20.0	Upper	Zinc	NS	1.7	NOT IMPROVING
BH-SF-W-0003-U	LTM	16.0-21.0	Upper	Zinc	NS	1.6	NOT IMPROVING
BH-SF-W-0004-L	LTM	75.0-95.0	Lower	Zinc	DEC	1.0	STABLE
BH-SF-W-0005-U	LTM	11.0-21.0	Upper	Zinc	INC	0.1	CAUTION

4.2.11 Transect 5 to 6

- **Decision Unit Description:** This location allows assessment of groundwater conditions for Smelterville Flats (located in the northeastern portion of this area), Grouse Gulch (south of Smelterville), the current Page Repository and past Page Pond Tailings Impoundment, and general areas where contaminated materials are in the floodplain (widespread tailings mixed with natural alluvium on the main valley floor between 4-7 ft thick) and beneath populated areas and infrastructure (examples include I-90 and the airport).

- **Results:** Current conditions are the same as the 2002-2009 timeframe for zinc in W-0008-U, for cadmium in W-0010-U, and for cadmium and zinc in W-0104-U. Conditions have changed for cadmium in W-0008-U from Improving to Not Improving because the trend changed from decreasing to NS and for zinc in W-0010-U from Improving to Stable because the median MCL ratio decreased from 1.1 to 0.9. Baseline conditions are presented for W-0021-U, PZ-04, PZ-05, and W-0018-U.

Table 23. Statistical results for cadmium in Transect 5 to Transect 6.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-W-0008-U	LTM	14.0-19.0	Upper	Cadmium	NS	1.7	NOT IMPROVING
BH-SF-W-0010-U	LTM	12.0-22.0	Upper	Cadmium	DEC	9.2	IMPROVING
BH-SF-W-0021-U	LTM	13.95-23.95	Upper	Cadmium	NS	4.7	NOT IMPROVING
BH-SF-W-0104-U	LTM	16.0-21.0	Upper	Cadmium	DEC	16.2	IMPROVING
BH-SF-W-PZ-04	LTM	5.75-10.75	Upper	Cadmium	DEC	11.1	IMPROVING
BH-SF-W-PZ-05	LTM	5.0-10.0	Upper	Cadmium	NS	7.1	NOT IMPROVING
BH-SF-W-0018-U	LTM	5.0-10.0	Upper	Cadmium	DEC	0.6	STABLE

Table 24. Statistical results for zinc in Transect 5 to Transect 6.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-W-0008-U	LTM	14.0-19.0	Upper	Zinc	NS	0.1	STABLE
BH-SF-W-0010-U	LTM	12.0-22.0	Upper	Zinc	DEC	0.9	STABLE
BH-SF-W-0021-U	LTM	13.95-23.95	Upper	Zinc	NS	0.9	STABLE
BH-SF-W-0104-U	LTM	16.0-21.0	Upper	Zinc	DEC	1.8	IMPROVING
BH-SF-W-PZ-04	LTM	5.75-10.75	Upper	Zinc	NS	1.5	NOT IMPROVING
BH-SF-W-PZ-05	LTM	5.0-10.0	Upper	Zinc	NS	1.1	NOT IMPROVING
BH-SF-W-0018-U	LTM	5.0-10.0	Upper	Zinc	DEC	0.04	STABLE

4.2.12 Transect 6

- **Decision Unit Description:** West and downgradient of Smelterville Flats. This location allows assessment of groundwater conditions downgradient of Smelterville Flats and above the confluence with the Pine Creek groundwater system.

- **Results:** Current conditions are the same as the 2002-2009 timeframe for cadmium in W-0201-U and for cadmium and zinc in W-0202-L. Conditions have changed for zinc in W-0201-U from Not Improving to Improving because the trend changed from NS to decreasing.

Table 25. Statistical results for cadmium in Transect 6.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-W-0201-U	LTM	15.0-45.0	Upper	Cadmium	NS	0.4	STABLE
BH-SF-W-0202-L	LTM	110-135	Lower	Cadmium	NS	0.1	STABLE

Table 26. Statistical results for zinc in Transect 6.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-W-0201-U	LTM	15.0-45.0	Upper	Zinc	DEC	1.1	IMPROVING
BH-SF-W-0202-L	LTM	110-135	Lower	Zinc	DEC	0.5	STABLE

4.2.13 Transect 7

- **Decision Unit Description:** Western OU2 boundary near Pinehurst Narrows. This location allows assessment of groundwater conditions exiting the OU2 boundary and below the confluence with the Pine Creek groundwater system.

- **Results:** Current conditions are the same as the 2002-2009 timeframe for cadmium and zinc in W-0204-U and W-0205-L, for zinc in W-0206-U, and for cadmium in W-0207-L. Conditions have changed for cadmium in W-0206-U from Not Improving to Improving because the trend changed from NS to decreasing and for zinc in W-0207-L from Stable to Caution because the trend changed from NS to increasing.

Table 27. Statistical results for cadmium in Transect 7.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-W-0204-U	Point of Compliance	15.0-45.0	Upper	Cadmium	NS	0.2	STABLE
BH-SF-W-0205-L	Point of Compliance	118-143	Lower	Cadmium	NS	0.2	STABLE
BH-SF-W-0206-U	Point of Compliance	15-25	Upper	Cadmium	DEC	1.1	IMPROVING
BH-SF-W-0207-L	Point of Compliance	129-149	Lower	Cadmium	NS	0.2	STABLE

Table 28. Statistical results for zinc in Transect 7.

Well ID	Monitoring Purpose	Screened Interval (ft bgs)	Hydrologic Unit	Analyte	Trend	Median MCL Ratio	Current Condition
BH-SF-W-0204-U	Point of Compliance	15.0-45.0	Upper	Zinc	INC	0.007	CAUTION
BH-SF-W-0205-L	Point of Compliance	118-143	Lower	Zinc	NS	0.002	STABLE
BH-SF-W-0206-U	Point of Compliance	15-25	Upper	Zinc	DEC	0.2	STABLE
BH-SF-W-0207-L	Point of Compliance	129-149	Lower	Zinc	INC	0.007	CAUTION

5 Conclusions and Recommendations

This section includes an overall summary for the 2015 Five-Year Review based on the OU2 results presented in Section 4. Ongoing BEMP optimization efforts, including a description of two planning documents in preparation, are also described. Finally, recommendations for CY2015 and future data analysis are presented.

5.1 Summary for 2015 Five-Year Review

The 1992 OU2 ROD requires water quality monitoring to evaluate compliance with groundwater ARARs and evaluate the performance of remedial actions. Since 2004, DEQ has administered groundwater monitoring in accordance with the OU2 EMP. In 2014, optimization of the groundwater monitoring program began in an effort to integrate groundwater monitoring into the BEMP.

The groundwater monitoring network stretches from the eastern OU2 boundary, near Elizabeth Park, to the western boundary near Pinehurst Narrows (see figure in Appendix A). Monitoring events take place during the spring and fall of each year to collect data during high and low flow conditions. During the spring of 2010 to 2014, samples were collected from 74 sites which include a combination of wells and piezometers. During the fall of 2010 to 2013, samples were collected from 88 sites. Optimization efforts during the summer of 2014 reduced the fall 2014 sampling event to 71 sites. During all events, field parameters were collected and samples underwent laboratory analysis for a number of dissolved metals at all sites and total phosphorus at select sites.

The OU2 groundwater network is subdivided into decision units based on transects and areas of past remedial actions. To assess groundwater conditions, statistical analysis was performed for 62 sites using groundwater data for dissolved cadmium and zinc collected between October 2002 and October 2014. This timeframe represents the post-Phase I remedial action implementation period. The purpose of this analysis is to establish baseline information for the optimization efforts and continue to maintain long-term groundwater quality information.

Analyses included trends over time, median MCL ratios (to compare the median concentration to the contaminant MCL), and interpretation of a current condition for each site based on the trend and ratio. Current conditions include the following: Not Improving (no statistically significant trend and ratio is greater than 1), Improving (decreasing trend and ratio is greater than 1), Caution (increasing trend and any ratio), and Stable (no statistically significant trend or decreasing trend and ratio less than or equal to 1).

For sites with not improving or caution conditions, the short-term goal is transition to an improving condition (a decreasing trend). The target end goal for all sites is a stable condition. The following discussion describes the results across OU2; however, this interpretation is limited based on the location and number of sites included in this analysis.

Overall results for cadmium across all of OU2 show 29% of sites as not improving, 37% improving, 13% caution, and 21% stable. No statistically significant trend is present in 48% of the sites. Decreasing or increasing trends are only noted for sites with statistically significant trends. Decreasing trends are present in 39% and increasing trends in 13% of sites. The average MCL ratio for cadmium is 36.5 with 77% of sites having ratios greater than the remediation target of 1.0.

Results for zinc across OU2 show 39% of sites as not improving, 21% improving, 8% caution, and 32% stable. No statistically significant trend is present in 56% of the sites. Decreasing trends are present in 35% and increasing trends in 8% of sites. The average MCL ratio for zinc is 1.8 with 61% of sites having ratios greater than the remediation target of 1.0.

Current conditions for both cadmium and zinc are stable in the one site analyzed upgradient of OU2 (Transect 1). This site represents background conditions for groundwater flow entering OU2. Within the easternmost portion of OU2, a single unconfined aquifer is present. Transition to an upper and lower aquifer occurs to the west and upgradient of the CIA (upgradient of Transect 2). The upper, unconfined aquifer is associated with the main-stem SFCDR valley and defined by the presence of the underlying fine-grained confining unit. The lower, confined aquifer is associated with the main-stem SFCDR valley and defined by the presence of the overlying confining unit.

The majority of sites included in this analysis (40 of 62 sites) are located within the vicinity of the CIA (Transect 2 to 3), downgradient of the CIA (Transect 3 to 5), in the vicinity of the Smelter Closure Area (SCA), and near Transect 4. Conditions for cadmium are not improving at 33% of sites, improving at 40%, caution at 18%, and stable at 10%. Conditions for zinc are not improving at 48% of sites, improving at 28%, caution at 8%, and stable at 18%. The highest ratios for cadmium in all of OU2 are located within this area, including peak ratios of 99.8 between Transects 2 to 3, 85.2 between Transects 3 to 5, 192.0 for the SCA, 60.6 near Transect 4, and 896.0 in the upper part of Government Creek. Zinc within this area also had the highest ratios for OU2, including peak ratios of 4.9 between Transects 2 to 3, 5.3 between Transects 3 to 5, 1.7 for the SCA, 3.7 near Transect 4 and 16.7 in the upper part of Government Creek. Construction and operation of the GWCS will target improving groundwater conditions in the vicinity and downgradient of the CIA. As for the vicinity of Transect 4, remedial actions for Government Creek were previously determined to be of lower priority because actions in this area would provide significantly less reduction in dissolved metals loading to surface water when compared to remedial efforts in other areas of OU2 and OU3 (EPA 2013).

Throughout OU2, several upland tributary groundwater systems, located in the gulches and hillsides of the SFCDR valley floor, discharge directly to the single and upper aquifer. Conditions associated with two tributaries to Bunker Creek, located south of the CIA, show improving conditions for cadmium (Deadwood and Magnet Gulch), stable conditions for zinc (Deadwood Gulch), and not improving conditions for zinc (Magnet Gulch); however, interpretation of these conditions are limited by only one site analyzed within each of these gulches.

From Smelterville Flats to downgradient of the Page Repository (Transect 5 to 6), upper aquifer conditions were analyzed in seven sites. Conditions for cadmium are not improving in three sites, improving in three sites, and stable in one site with ratios ranging from 0.6 to 16.2. Conditions for zinc are not improving in two sites, improving in one site, and stable in four sites with ratios ranging from 0.04 to 1.8.

Confluence with the Pine Creek groundwater system is present in the westernmost section of OU2. Conditions above the confluence (Transect 6) are monitored in one upper and one lower aquifer site. Conditions are stable in both sites for cadmium and in the lower site for zinc (ratios ranging from 0.1 to 0.5); while improving for zinc in the upper site (a ratio of 1.1).

Below the confluence, which represents groundwater flow exiting the OU2 boundary (Transect 7), conditions are monitored at two upper and two lower aquifer sites. Conditions are stable in three sites for cadmium (one upper and two lower) and two sites for zinc (one upper and one lower) with ratios ranging from 0.002 to 0.2. One upper site below the confluence is improving for cadmium (a ratio of 1.1); while one upper and one lower site are caution for zinc (ratios of 0.007).

Presently, an OU2 Groundwater QAPP is being prepared to integrate the optimized groundwater monitoring program into BEMP. Future monitoring events will include 27 sites during spring events, 59 sites during fall events, and 12 additional sites on a five year basis during the fall event. In addition, the analyte list will be reduced to include only the contaminants identified in the 2012 ROD Amendment at all sites and total phosphorus at select sites. Mercury will be analyzed on a five year timeframe. Another ongoing optimization effort is preparation of a GWCS Remedial Action Effectiveness Plan which will identify monitoring objectives for estimating dissolved metal loads to the SFCDR, determining remedy performance and effectiveness, and evaluating long-term response to the collection system operations.

5.2 BEMP Optimization Documents

Two planning documents, related to OU2 groundwater monitoring, are currently being prepared as part of BEMP optimization at a timeframe concurrent with preparation of this report:

- *GWCS RA Effectiveness Plan*: This plan will be prepared with support from an independent, third party through OSTRI to identify the current and future monitoring objectives for the GWCS.
- *Quality Assurance Project Plan (QAPP) for OU2 Groundwater*: This QAPP will be used to integrate groundwater monitoring into BEMP and will incorporate the optimization efforts described in Section 3 of this report. Upon completion of the GWCS RA Effectiveness Plan, this QAPP will be updated to reflect the monitoring objectives.

5.3 CY2015 Recommendations

Three maintenance needs were identified during the CY2014 groundwater monitoring events. These activities are planned to be conducted during CY2015:

- The monument for well BH-SF-W-0023-U was washed away between the fall 2013 and spring 2014 sampling events. Locate this well and perform proper well abandonment by an Idaho licensed well driller.
- Trim the inside PVC at wells BH-SF-E-0407-U and BH-SF-E-0409-U to allow for closure of the well casing lids.
- Ten wells installed for baseline GWCS monitoring, located west and north of I-90, will be surveyed by a Professional Land Surveyor.

Also during CY2015, data loggers in wells no longer planned for future monitoring will be moved to new monitoring locations. Recommendations and movement to the new locations will be coordinated with EPA.

5.4 Future Data Analysis

This report includes a brief summary of general statistics for groundwater sites across OU2. Additional data analysis will be performed in the future based on recommendations developed during BEMP optimization. The following are possible future data analysis methods to be considered:

- Evaluate the monitoring network and analyte lists against the monitoring objective categories presented in Section 3 of this report and other recommendations from the ongoing optimization review.
- Partner with the U.S. Geological Survey (USGS) to evaluate groundwater/surface water interactions.
- Focus on data evaluation within specific areas of interest (e.g., Government Gulch, Osburn Tailing Impoundment, phosphorus detections in the vicinity of Smelterville Flats and Page Repository).
- Evaluate groundwater monitoring conducted by other organizations (e.g., A-4 Gypsum Pond) for inclusion of data into the BEMP monitoring evaluation.
- Additional analysis to measure remedial action effectiveness and/or support remedy optimization efforts. Methods could include those presented in *Statistical Analysis of Post-Phase I RA Water Quality Data 2000-2004 OU2* (CH2M Hill 2006).
- Perform long-term groundwater trend analyses using different historical timeframe(s) and/or division of the data by season (fall or spring only) and evaluation of potential outliers.

References

CH2M Hill. 2003. *Focused Hydrogeologic Investigation and Site-Wide Monitoring Network Expansion, Bunker Hill Superfund Site, Kellogg, Idaho*. February 3, 2003.

CH2M Hill. 2006a. *Environmental Monitoring Plan, Operable Unit 2, Bunker Hill Mining and Metallurgical Complex Superfund Site.* Prepared for EPA Region 10. January 2006.

CH2M Hill, 2006b. Final Quality Assurance Project Plan Bunker Hill OU2 Environmental Monitoring Shoshone County, Idaho. June.

CH2M Hill. 2012a. Quality Assurance Project Plan CIA Drain Remedial Design Field Investigation. September.

CH2M Hill. 2012b. *Statistical Analysis of Groundwater Monitoring Data for Operable Unit 2, Bunker Hill Mining and Metallurgical Complex Superfund Site, Shoshone County, Idaho*. March 23, 2012.

DEQ (Idaho Department of Environmental Quality). 2014. *Memorandum: Recommendations for OU2 Groundwater Monitoring Optimization Process.* June 9, 2014.

EPA (U.S. Environmental Protection Agency). 1992. *Record of Decision (ROD), Bunker Hill Mining and Metallurgical Complex, Shoshone County, Idaho.* September.

EPA. 2002. USEPA Guidance on Environmental Data Verification and Data Validation. USEPA QA/G-8. November.

EPA. 2004. Basin Environmental Monitoring Plan, *Bunker Hill Mining and Metallurgical Complex, Operable Unit 2., Operable Unit 2.* March 26, 2004.

EPA. 2007. *Phase I Remedial Action Assessment Report, Operable Unit 2, Bunker Hill Mining and Metallurgical Complex Superfund Site*. Prepared by CH2M Hill. October 2007.

EPA. 2008. *Source Areas of Concern Report, Operable Unit 2, Bunker Hill Mining and Metallurgical Complex Superfund Site*. Prepared by CH2M Hill. March 24, 2008.

EPA, 2009. Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use, OSWER No. 9200. 1-85,EPA 540-R-08-005. January.

EPA. 2010. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review, OSWER 9240.1-51, EPA 540-R-10-011. January.

EPA. 2012. *Interim Record of Decision (ROD) Amendment, Upper Basin of the Coeur d'Alene River, Bunker Hill Superfund Site, Shoshone County, Idaho.* August.

EPA. 2013. *Superfund Cleanup Implementation Plan, 2012-2022, Bunker Hill Mining and Metallurgical Complex Superfund Site*. February 20, 2013.

EPA. 2014. *Memorandum: Draft –Reduced Groundwater Sampling Program – Fall Sampling 2014.*

GSI and EMS (GSI Environmental, Inc. and Environmental Management Support, Inc.). August 25, 2014. Memorandum: The Bunker Hill Mining and Metallurgical Site, CERCLIS IDD048340921, Site Monitoring Optimization Preliminary Review. Prepared for EPA, Office of Superfund Remediation and Technology Innovation (OSRTI), Region 10.

TerraGraphics (TerraGraphics Environmental Engineering, Inc.). 2014a. *Memorandum: Sampling Trip Summary for OU2 Spring 2014 Sampling Event*. July 3, 2014.

TerraGraphics. 2014b. *Memorandum: Sampling Trip Summary for OU2 Fall 2014 Sampling Event*. November 19, 2014.

Appendix A. Maps and Tables

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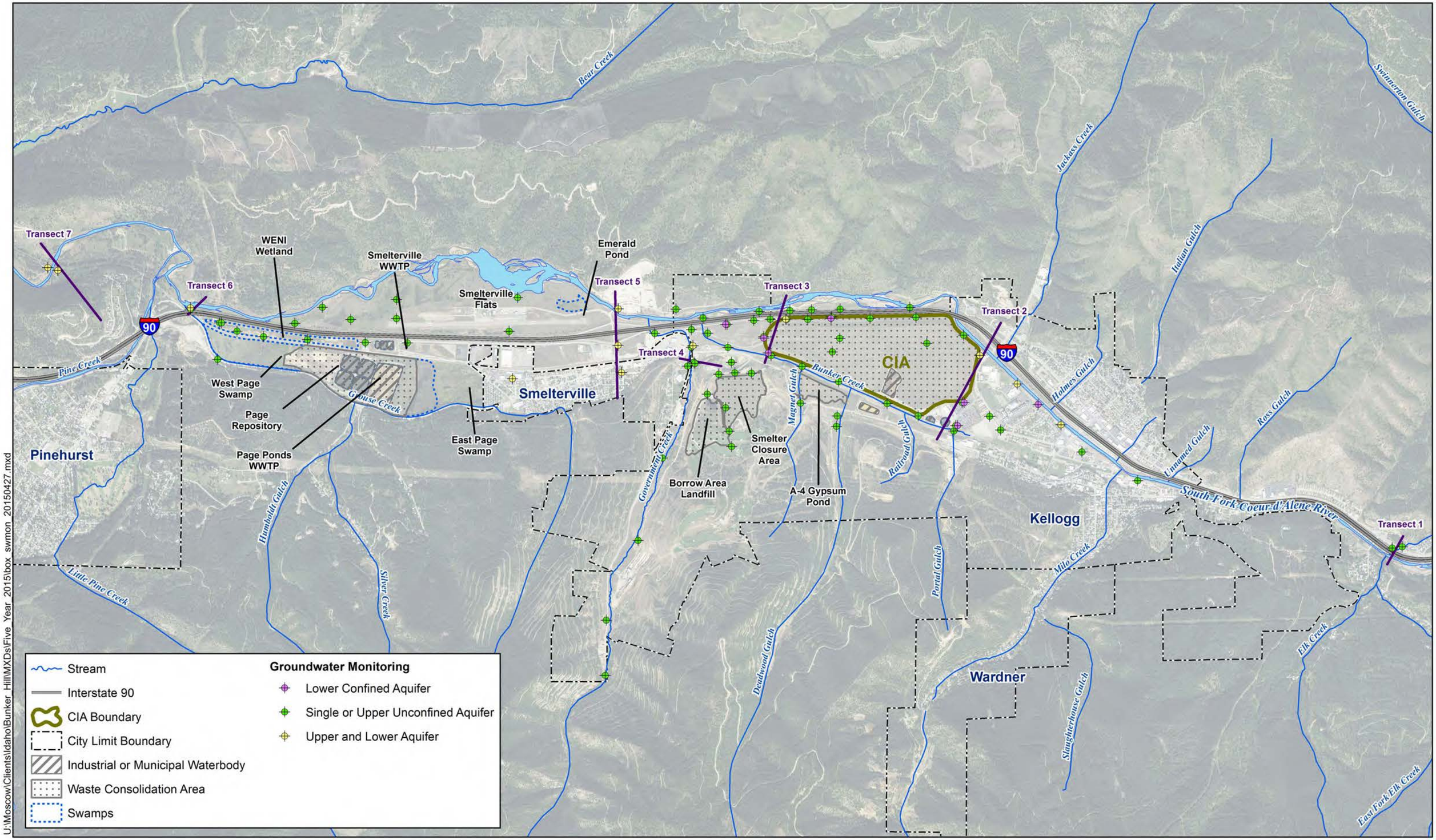

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TerraGraphics Environmental Engineering, Inc.
www.TerraGraphics.com

Print Date	Project Manager	Project Name
April 29, 2015	S. Spalinger	BEMP Monitoring
Project Number	Requestor	
13011-06-04	R. Nimmer	
	Cartographer	
	B. Bailey	

This map was produced using information obtained from several different sources that have not been independently verified. These sources have also not provided information on the precision and accuracy of the data. Information on this map is not a substitute for survey data.

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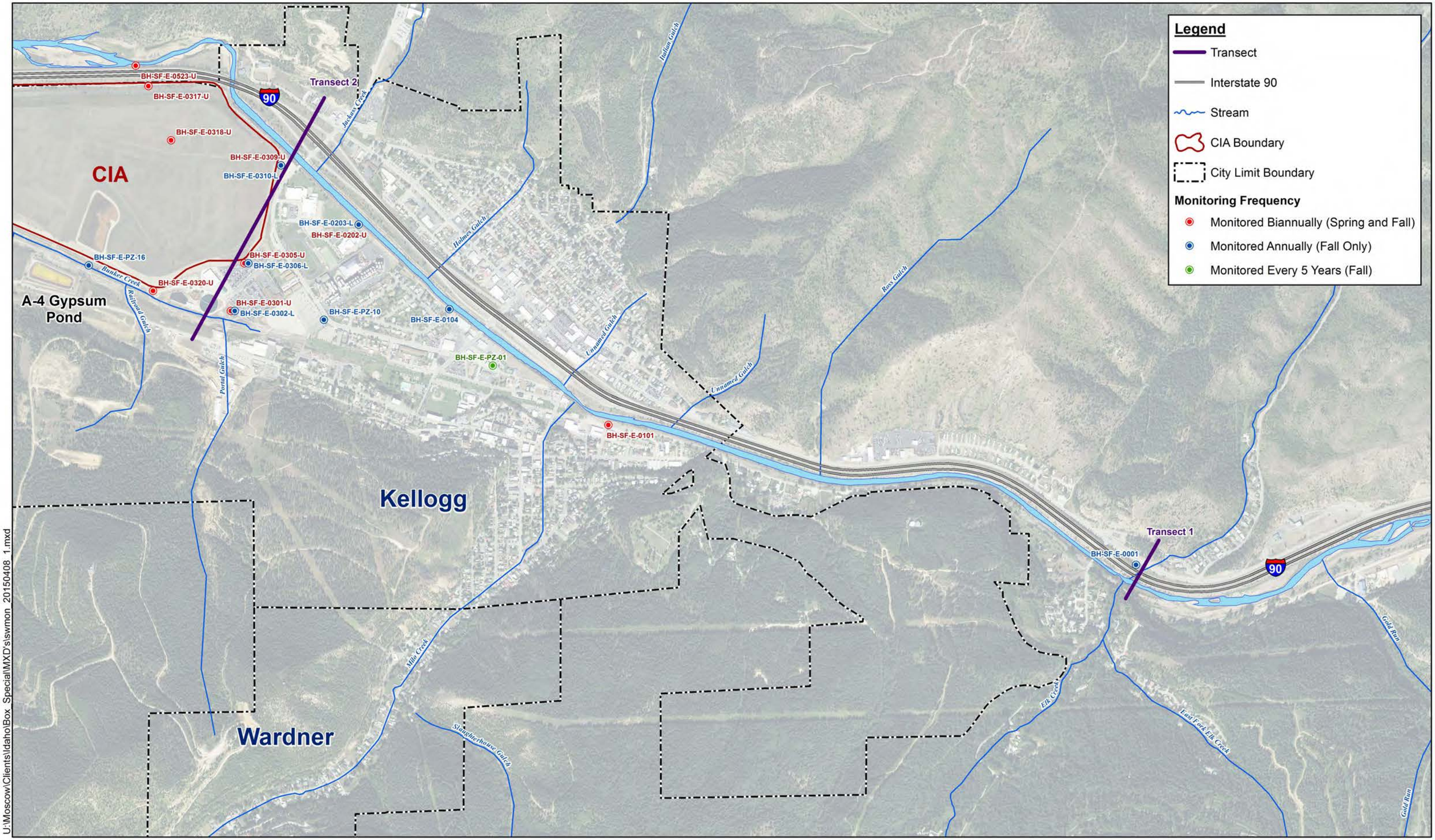
1 inch = 2,333 feet
0 2,000 4,000 Feet

Box Area Sitewide Monitoring Overview Map



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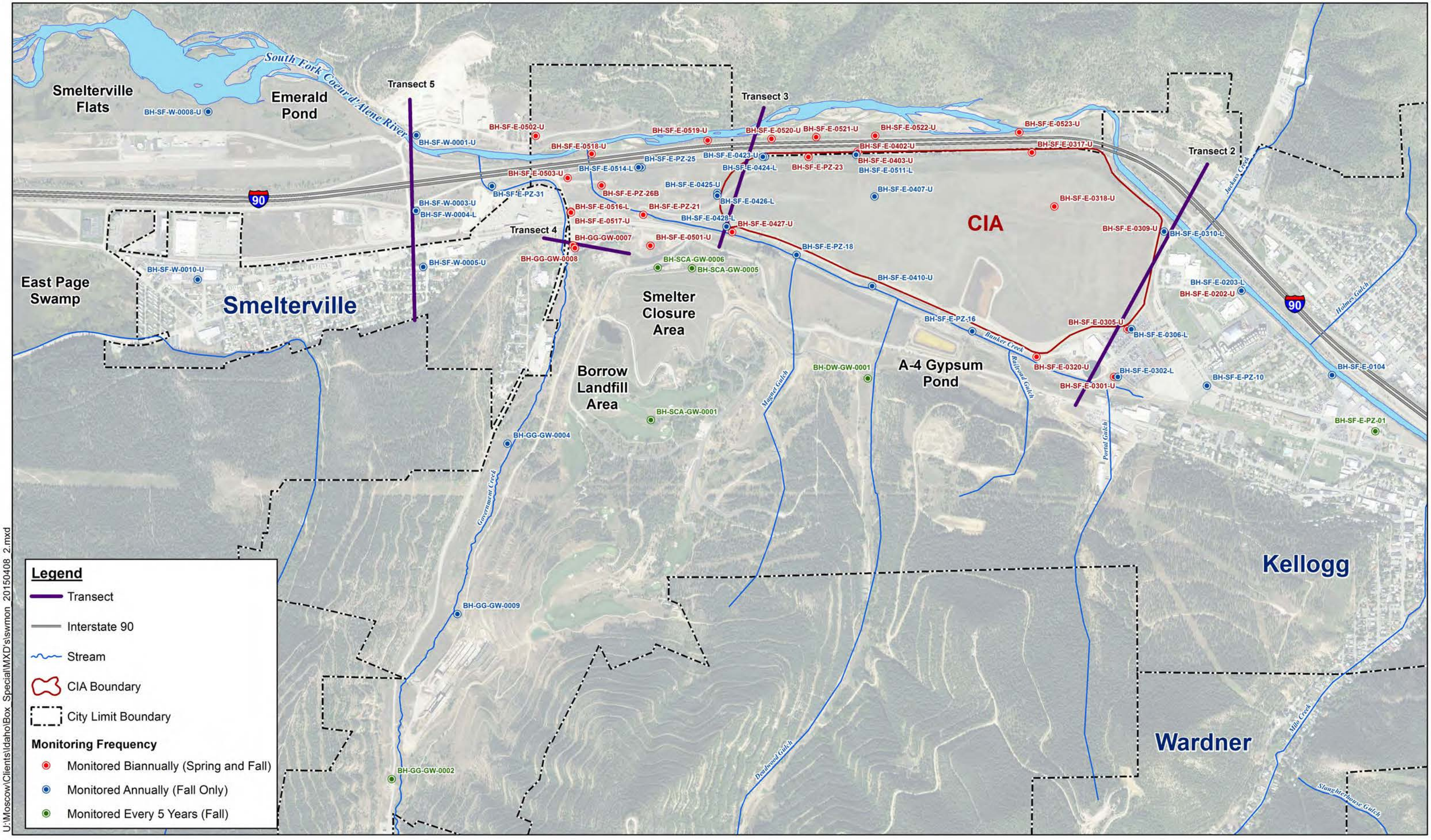
TerraGraphics Environmental Engineering, Inc. www.TerraGraphics.com	Print Date: April 10, 2015 Project Number: 14005-06-01	Project Manager: R. Nimmer Requestor: R. Nimmer Cartographer: B. Bailey	Project Name: Box Water Quality Monitoring	This map was produced using information obtained from several different sources that have not been independently verified. These sources have also not provided information on the precision and accuracy of the data. Information on this map is not a substitute for survey data.	1:13,500 0 500 1,000 Feet	OU2 Groundwater Monitoring Locations - Map 1



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TerraGraphics Environmental Engineering, Inc.
www.TerraGraphics.com

Print Date	Project Manager	Project Name
April 23, 2015	R. Nimmer	Box Water Quality Monitoirng
Project Number	Requestor	
14005-06-01	R. Nimmer	
	Cartographer	
	B. Bailey	

This map was produced using information obtained from several different sources that have not been independently verified. These sources have also not provided information on the precision and accuracy of the data. Information on this map is not a substitute for survey data.

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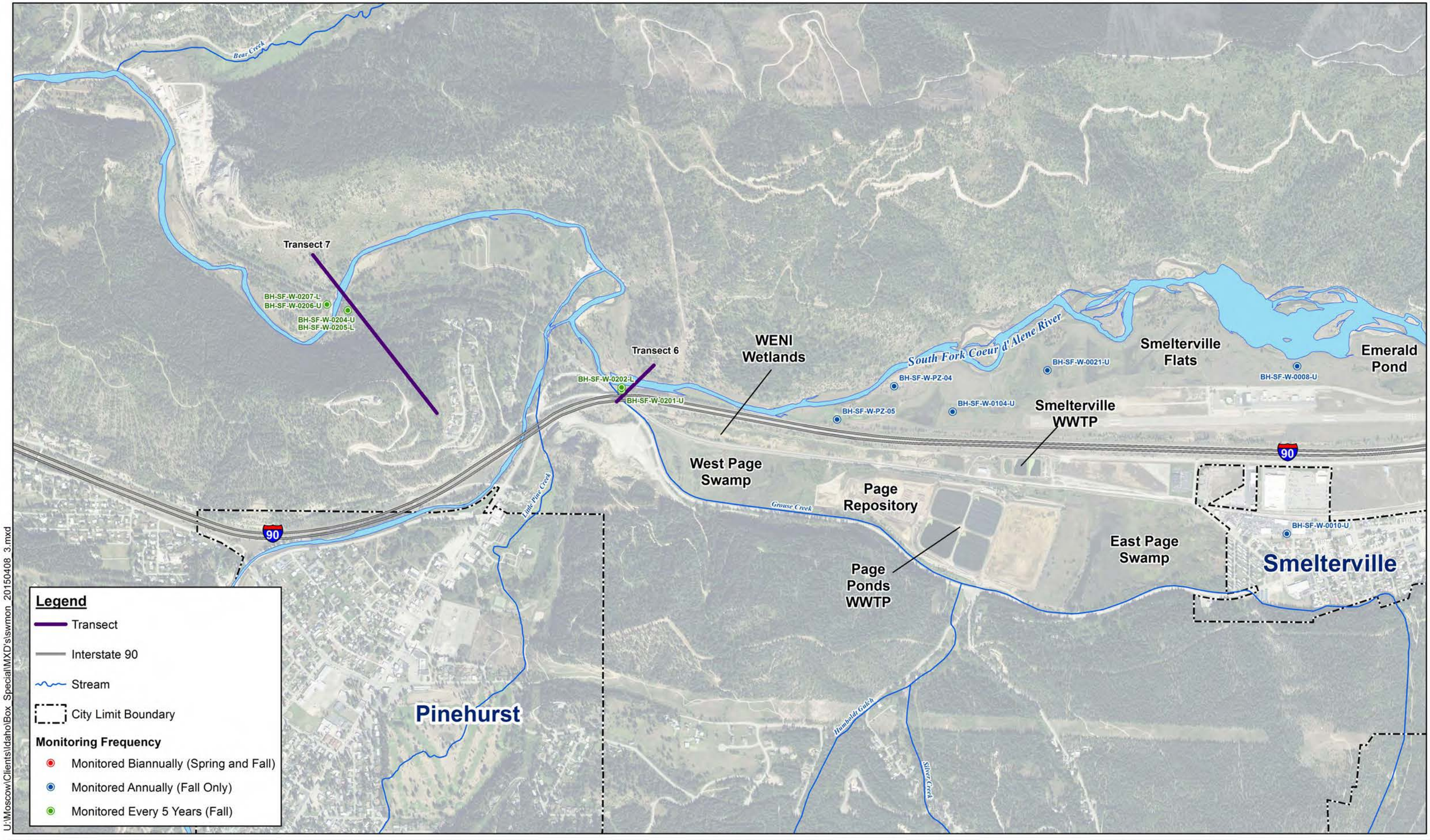
OU2 Groundwater Monitoring Locations - Map 2



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TerraGraphics Environmental Engineering, Inc.
www.TerraGraphics.com

Print Date	Project Manager	Project Name
April 10, 2015	R. Nimmer	Box Water Quality Monitoring
Project Number	Requestor	
14005-06-04	R. Nimmer	
	Cartographer	
	B. Bailey	

This map was produced using information obtained from several different sources that have not been independently verified. These sources have also not provided information on the precision and accuracy of the data. Information on this map is not a substitute for survey data.

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OU2 Groundwater Monitoring Locations - Map 3

Table A-1. Monitoring Site Network and Data Summary (October 2002 to October 2014).

Well ID	Sampling Events	Start Date	End Date	Period of Record (POR)
BH-SF-E-0001	30	3/31/2003	10/6/2014	12
BH-SF-E-0101	34	10/14/2002	10/6/2014	12
BH-SF-E-0104	20	10/10/2006	10/6/2014	8
BH-SF-E-0202-U	21	10/10/2006	10/6/2014	8
BH-SF-E-0203-L	13	10/11/2006	10/6/2014	8
BH-SF-E-0301-U	40	10/14/2002	10/13/2014	12
BH-SF-E-0302-L	23	10/14/2002	10/13/2014	12
BH-SF-E-0305-U	31	4/2/2003	10/13/2014	12
BH-SF-E-0306-L	23	4/2/2003	10/13/2014	12
BH-SF-E-0309-U	30	4/1/2003	10/6/2014	12
BH-SF-E-0310-L	21	4/1/2003	10/6/2014	12
BH-SF-E-0317-U	39	10/17/2002	10/6/2014	12
BH-SF-E-0318-U	19	5/2/2003	10/17/2014	11
BH-SF-E-0320-U	35	10/14/2002	10/13/2014	12
BH-SF-E-0402-U	36	10/17/2002	10/6/2014	12
BH-SF-E-0403-U	37	10/17/2002	10/6/2014	12
BH-SF-E-0407-U	31	5/1/2003	10/17/2014	11
BH-SF-E-0410-U	38	10/14/2002	10/13/2014	12
BH-SF-E-0423-U	38	10/17/2002	10/7/2014	12
BH-SF-E-0424-L	23	4/7/2003	10/8/2014	12
BH-SF-E-0427-U	39	10/14/2002	10/13/2014	12
BH-SF-E-0428-L	20	4/7/2003	10/13/2014	12
BH-SF-E-0511-L	2	10/30/2012	11/12/2013	1
BH-SF-E-0514-L	2	11/5/2012	11/12/2013	1
BH-SF-E-0516-L	2	10/30/2012	11/12/2013	1
BH-SF-E-0517-U	2	10/31/2012	10/31/2012	0
BH-SF-E-0518-U	1	11/12/2013	11/12/2013	0
BH-SF-E-0519-U	2	11/12/2013	11/12/2013	0
BH-SF-E-0520-U	1	11/12/2013	11/12/2013	0
BH-SF-E-0521-U	1	11/12/2013	11/12/2013	0
BH-SF-E-0522-U	1	11/12/2013	11/12/2013	0
BH-SF-E-0523-U	1	11/12/2013	11/12/2013	0
BH-SF-E-PZ-01	10	9/25/2008	6/5/2014	6
BH-SF-E-PZ-10	11	9/24/2008	10/15/2014	6
BH-SF-E-PZ-16	16	9/23/2008	10/16/2014	6
BH-SF-E-PZ-18	17	9/23/2008	10/16/2014	6

Well ID	Sampling Events	Start Date	End Date	Period of Record (POR)
BH-SF-E-PZ-21	14	9/22/2008	10/15/2014	6
BH-SF-E-PZ-23	18	9/23/2008	10/16/2014	6
BH-DW-GW-0001	18	1/15/2003	6/3/2014	11
BH-GG-GW-0002	21	10/16/2002	10/16/2014	12
BH-GG-GW-0004	34	10/16/2002	10/16/2014	12
BH-GG-GW-0007	33	4/4/2003	10/16/2014	12
BH-GG-GW-0008	34	4/4/2003	10/16/2014	12
BH-GG-GW-0009	19	10/25/2006	10/16/2014	8
BH-SCA-GW-0001	25	5/7/2003	10/17/2014	11
BH-SCA-GW-0005	34	10/17/2002	10/16/2014	12
BH-SCA-GW-0006	33	10/17/2002	10/8/2014	12
BH-SF-E-0425-U	34	4/7/2003	10/9/2014	12
BH-SF-E-0426-L	24	4/7/2003	10/9/2014	12
BH-SF-E-0501-U	36	10/17/2002	10/8/2014	12
BH-SF-E-0502-U	35	10/16/2002	10/7/2014	12
BH-SF-E-0503-U	37	10/17/2002	10/6/2014	12
BH-SF-E-PZ-25	14	9/23/2008	10/16/2014	6
BH-SF-E-PZ-26B	4	9/22/2008	10/15/2014	6
BH-SF-E-PZ-31	14	9/23/2008	10/15/2014	6
BH-SF-W-0001-U	30	4/8/2003	10/7/2014	12
BH-SF-W-0003-U	32	4/9/2003	10/8/2014	12
BH-SF-W-0004-L	22	4/9/2003	10/8/2014	12
BH-SF-W-0005-U	33	10/16/2002	10/8/2014	12
BH-SF-W-0008-U	38	10/16/2002	10/7/2014	12
BH-SF-W-0010-U	36	10/16/2002	10/16/2014	12
BH-SF-W-0018-U	23	10/16/2002	10/6/2008	6
BH-SF-W-0021-U	20	10/17/2006	10/7/2014	8
BH-SF-W-0104-U	36	10/16/2002	10/7/2014	12
BH-SF-W-0201-U	30	4/8/2003	10/9/2014	12
BH-SF-W-0202-L	23	4/3/2003	10/9/2014	12
BH-SF-W-0204-U	30	4/8/2003	10/9/2014	12
BH-SF-W-0205-L	23	4/8/2003	10/9/2014	12
BH-SF-W-0206-U	19	10/23/2006	10/9/2014	8
BH-SF-W-0207-L	13	10/23/2006	10/9/2014	8
BH-SF-W-PZ-04	16	9/30/2008	10/15/2014	6
BH-SF-W-PZ-05	13	9/30/2008	10/15/2014	6

Table A-2. Summary Statistics by Location for Dissolved Cadmium.

Well ID	Sampling Events	Detects	Frequency	Minimum	1st Quarter	Median	Mean	3rd Quarter	Maximum	Standard Deviation	Coefficient of Variation	95UCL	CRIT	D-CRIT	D-FXCD
BH-SF-E-0001	30	15	0.5	9.00E-05	0.000385	0.00049	0.001413	0.001	0.005	0.001840535	1.302572297	0.001965727	0.005	0	0
BH-SF-E-0101	34	34	1	0.0073	0.01045	0.0138	0.01447	0.01682	0.0244	0.004769011	0.329579206	0.015815291	0.005	34	1
BH-SF-E-0104	20	20	1	0.0151	0.01695	0.01855	0.01838	0.01955	0.0224	0.002053976	0.111750577	0.019135453	0.005	20	1
BH-SF-E-0202-U	21	21	1	8.00E-04	0.0039	0.0051	0.01082	0.017	0.0302	0.009680852	0.894718344	0.014294811	0.005	11	0.52
BH-SF-E-0203-L	13	3	0.23	6.20E-05	0.00014	0.001	0.0009721	0.001	0.005	0.001285623	1.322521844	0.001558602	0.005	0	0
BH-SF-E-0301-U	40	40	1	0.0296	0.05515	0.0778	0.08326	0.1112	0.153	0.036159203	0.434292616	0.092664076	0.005	40	1
BH-SF-E-0302-L	23	23	1	0.0265	0.0324	0.037	0.03625	0.0394	0.043	0.004606504	0.127075979	0.037829919	0.005	23	1
BH-SF-E-0305-U	31	31	1	0.0191	0.0246	0.0309	0.04638	0.056	0.111	0.029050317	0.626354409	0.054962174	0.005	31	1
BH-SF-E-0306-L	23	23	1	0.0224	0.03515	0.0388	0.0373	0.0397	0.0487	0.005650219	0.151480415	0.039237888	0.005	23	1
BH-SF-E-0309-U	30	30	1	0.0054	0.008225	0.01085	0.01256	0.01485	0.0358	0.006649422	0.529412599	0.014556873	0.005	30	1
BH-SF-E-0310-L	21	9	0.43	2.00E-04	0.00038	0.001	0.002037	0.005	0.005	0.002162039	1.061383977	0.002813035	0.005	0	0
BH-SF-E-0317-U	39	39	1	0.0012	0.0112	0.0211	0.03229	0.03705	0.144	0.03545709	1.09808269	0.04162895	0.005	37	0.95
BH-SF-E-0318-U	19	19	1	0.0068	0.00835	0.0094	0.009363	0.0104	0.0123	0.001519214	0.162257201	0.009936284	0.005	19	1
BH-SF-E-0320-U	35	35	1	0.0232	0.0273	0.0339	0.04007	0.04815	0.094	0.016536874	0.412699626	0.044667764	0.005	35	1
BH-SF-E-0402-U	36	36	1	0.0103	0.0294	0.0554	0.1091	0.1708	0.299	0.096100963	0.880852089	0.135445336	0.005	36	1
BH-SF-E-0403-U	37	34	0.92	0.0027	0.0071	0.049	0.1446	0.236	0.5	0.168581962	1.165850361	0.190186631	0.005	31	0.84
BH-SF-E-0407-U	31	31	1	0.279	0.4425	0.499	0.6217	0.6565	2.37	0.389450244	0.62642793	0.736753117	0.005	31	1
BH-SF-E-0410-U	38	38	1	0.0921	0.173	0.2215	0.2392	0.2995	0.418	0.085871098	0.358992885	0.262113027	0.005	38	1
BH-SF-E-0423-U	38	35	0.92	0.0023	0.0046	0.00555	0.005803	0.006675	0.0122	0.001856979	0.320003286	0.006298499	0.005	24	0.63
BH-SF-E-0424-L	23	18	0.78	0.00059	0.00092	0.001	0.001373	0.00125	0.005	0.001163992	0.847773037	0.001772221	0.005	0	0
BH-SF-E-0427-U	39	39	1	0.107	0.147	0.194	0.1882	0.223	0.297	0.048870688	0.259674218	0.201071922	0.005	39	1
BH-SF-E-0428-L	20	20	1	0.0254	0.02918	0.03	0.03001	0.03108	0.0342	0.002469583	0.082292016	0.030918314	0.005	20	1
BH-SF-E-PZ-01	10	10	1	0.0126	0.01387	0.0179	0.01772	0.02068	0.0257	0.004324041	0.24402039	0.019969143	0.005	10	1
BH-SF-E-PZ-10	11	11	1	0.0572	0.0913	0.171	0.1489	0.1855	0.302	0.074309857	0.499058814	0.185753381	0.005	11	1
BH-SF-E-PZ-16	16	16	1	0.0814	0.1228	0.1635	0.1756	0.2252	0.297	0.070946655	0.40402423	0.204774216	0.005	16	1
BH-SF-E-PZ-18	17	17	1	0.0516	0.0844	0.106	0.1107	0.114	0.218	0.043810119	0.395755368	0.128177416	0.005	17	1
BH-SF-E-PZ-21	14	14	1	0.244	0.3055	0.366	0.3725	0.4137	0.52	0.08347616	0.224097073	0.409196589	0.005	14	1
BH-SF-E-PZ-23	18	18	1	0.293	0.3395	0.439	0.4366	0.477	0.723	0.113911845	0.260906654	0.480763135	0.005	18	1
BH-DW-GW-0001	18	18	1	0.0097	0.01335	0.01445	0.01489	0.0161	0.0252	0.003441766	0.231146123	0.016224358	0.005	18	1
BH-GG-GW-0002	21	21	1	0.00011	0.0159	0.0212	0.08255	0.091	0.659	0.145232883	1.759332314	0.134679381	0.005	20	0.95
BH-GG-GW-0004	34	34	1	0.177	0.2465	0.3015	0.3139	0.3672	0.567	0.09752797	0.31069758	0.341411672	0.005	34	1
BH-GG-GW-0007	33	33	1	0.0871	0.21	0.303	0.3	0.35	0.61	0.134938224	0.449794078	0.338637167	0.005	33	1
BH-GG-GW-0008	34	30	0.88	6.00E-05	0.005425	0.0103	0.008868	0.01222	0.0161	0.005014561	0.565466949	0.010282558	0.005	25	0.74
BH-GG-GW-0009	19	19	1	2.3	4.17	4.48	4.676	4.91	9.08	1.285712682	0.27495994	5.161170497	0.005	19	1
BH-SCA-GW-0001	25	8	0.32	0.00014	0.001	0.0019	0.002538	0.005	0.005	0.001996932	0.786813067	0.003194932	0.005	0	0
BH-SCA-GW-0005	34	34	1	0.444	0.5198	0.6185	0.7604	0.9568	1.52	0.319869375	0.420659357	0.850631974	0.005	34	1
BH-SCA-GW-0006	33	33	1	0.229	0.618	0.96	1.059	1.42	2.28	0.539078524	0.509044877	1.213355574	0.005	33	1

Well ID	Sampling Events	Detects	Frequency	Minimum	1st Quarter	Median	Mean	3rd Quarter	Maximum	Standard Deviation	Coefficient of Variation	95UCL	CRIT	D-CRIT	D-FXCD
BH-SF-E-0425-U	34	34	1	0.0631	0.0941	0.104	0.1036	0.113	0.149	0.021266307	0.205273237	0.109599014	0.005	34	1
BH-SF-E-0426-L	24	20	0.83	0.0011	0.001475	0.0017	0.002083	0.001825	0.005	0.00117387	0.563547816	0.002477132	0.005	0	0
BH-SF-E-0501-U	36	36	1	0.216	0.3457	0.4905	0.5196	0.6185	1.08	0.218930945	0.42134516	0.579618227	0.005	36	1
BH-SF-E-0502-U	35	35	1	0.0067	0.0112	0.023	0.02152	0.02815	0.0463	0.010146181	0.471476818	0.024340953	0.005	35	1
BH-SF-E-0503-U	37	37	1	0.0622	0.319	0.426	0.5352	0.71	1.62	0.321267447	0.600275498	0.62207466	0.005	37	1
BH-SF-E-PZ-25	14	14	1	0.0676	0.07628	0.0825	0.08412	0.09225	0.101	0.01087433	0.129271631	0.088900416	0.005	14	1
BH-SF-E-PZ-26B	4	4	1	0.0588	0.0849	0.1093	0.1024	0.1268	0.132	0.033492835	0.327078467	0.129945406	0.005	4	1
BH-SF-E-PZ-31	14	14	1	0.231	0.2672	0.3005	0.3226	0.3635	0.487	0.073395362	0.227511971	0.354865014	0.005	14	1
BH-SF-W-0001-U	30	30	1	0.0159	0.01992	0.0224	0.02316	0.02622	0.0315	0.004072498	0.17584189	0.024383003	0.005	30	1
BH-SF-W-0003-U	32	32	1	0.0049	0.134	0.161	0.1563	0.172	0.228	0.041509228	0.265574078	0.168369713	0.005	31	0.97
BH-SF-W-0004-L	22	22	1	0.0042	0.00535	0.00645	0.006182	0.006775	0.0078	0.001072885	0.173549824	0.006558244	0.005	17	0.77
BH-SF-W-0005-U	33	29	0.88	4.00E-04	0.0016	0.0044	0.004307	0.0067	0.0094	0.002896022	0.672398967	0.005136225	0.005	15	0.45
BH-SF-W-0008-U	38	38	1	0.0031	0.005325	0.0087	0.008061	0.0102	0.017	0.003368337	0.417856026	0.008959775	0.005	31	0.82
BH-SF-W-0010-U	36	36	1	0.0162	0.03082	0.04595	0.05249	0.0702	0.106	0.027453617	0.523025671	0.060016197	0.005	36	1
BH-SF-W-0018-U	23	16	0.7	0.0014	0.00235	0.003	0.003187	0.0038	0.005	0.001100539	0.34532126	0.003564458	0.005	0	0
BH-SF-W-0021-U	20	20	1	0.0157	0.01872	0.0236	0.02624	0.03015	0.0616	0.010532576	0.401393904	0.030113886	0.005	20	1
BH-SF-W-0104-U	36	36	1	0.0418	0.06852	0.0808	0.07934	0.09205	0.108	0.014767366	0.186127633	0.083388359	0.005	36	1
BH-SF-W-0201-U	30	25	0.83	2.00E-04	0.001225	0.00215	0.006365	0.009575	0.0266	0.006618006	1.039749507	0.008352439	0.005	13	0.43
BH-SF-W-0202-L	23	9	0.39	0.00018	0.00039	0.00047	0.0015	0.001	0.005	0.00190308	1.268719992	0.00215271	0.005	0	0
BH-SF-W-0204-U	30	4	0.13	1.00E-05	0.000235	0.001	0.001788	0.004	0.005	0.00200533	1.121548952	0.002390216	0.005	0	0
BH-SF-W-0205-L	23	2	0.09	2.00E-05	9.00E-04	0.001	0.002057	0.005	0.005	0.002014066	0.979127642	0.002747776	0.005	0	0
BH-SF-W-0206-U	19	16	0.84	0.001	0.00165	0.0053	0.005189	0.0081	0.0103	0.003358885	0.647308639	0.006456493	0.005	10	0.53
BH-SF-W-0207-L	13	2	0.15	8.00E-05	2.00E-04	0.001	0.001076	0.001	0.005	0.001267028	1.177534957	0.001654018	0.005	0	0
BH-SF-W-PZ-04	16	16	1	0.0194	0.05193	0.05565	0.05592	0.05792	0.0838	0.014080635	0.251799631	0.061710146	0.005	16	1
BH-SF-W-PZ-05	13	13	1	0.0064	0.0267	0.0355	0.03682	0.0467	0.0659	0.017673702	0.480002771	0.044882748	0.005	13	1

Column Definitions:

95UCL	95UCL (Assumed normal)
CRIT	Applicable critical value
D-CRIT	Count of detected records exceeding criterion
D-FXCD	Frequency of detected exceedance

Table A-3. Summary Statistics by Location for Dissolved Zinc.

Well ID	Sampling Events	Detects	Frequency	Minimum	1st Quarter	Median	Mean	3rd Quarter	Maximum	Standard Deviation	Coefficient of Variation	95UCL	CRIT	D-CRIT	D-FXCD
BH-SF-E-0001	30	30	1	0.0594	0.1638	0.183	0.1773	0.1982	0.244	0.04053411	0.228618781	0.18947271	5	0	0
BH-SF-E-0101	34	34	1	1.46	2.132	2.6	2.731	3.185	4.52	0.874600393	0.320249137	2.977716086	5	0	0
BH-SF-E-0104	20	20	1	4.7	8.57	9.125	8.984	9.875	10.3	1.248544604	0.138974244	9.44321527	5	19	0.95
BH-SF-E-0202-U	21	21	1	0.0981	0.462	0.88	1.778	3	5.32	1.728542521	0.972183645	2.398436982	5	2	0.1
BH-SF-E-0203-L	13	13	1	0.527	0.616	0.626	0.6423	0.668	0.832	0.078705553	0.122537059	0.678205498	5	0	0
BH-SF-E-0301-U	40	39	0.98	0.06	11.42	16.85	18.01	23.55	34.9	8.666859955	0.481224873	20.26402662	5	39	0.98
BH-SF-E-0302-L	23	23	1	6.92	8.94	9.89	9.615	10.45	11.6	1.205758417	0.125403892	10.02854583	5	23	1
BH-SF-E-0305-U	31	31	1	3.3	4.635	6.01	9.151	10.7	28.7	6.553365925	0.716136589	11.08702441	5	20	0.65
BH-SF-E-0306-L	23	23	1	2.52	6.565	7.81	7.078	8.03	9.12	1.728884696	0.244261754	7.670965422	5	20	0.87
BH-SF-E-0309-U	30	30	1	0.74	1.175	1.52	1.786	1.885	5.37	1.034261425	0.579093743	2.096596785	5	1	0.03
BH-SF-E-0310-L	21	21	1	0.222	0.269	0.291	0.3195	0.358	0.506	0.071465809	0.223680154	0.345151687	5	0	0
BH-SF-E-0317-U	39	39	1	0.493	3.29	6.94	8.461	11.1	33.3	6.705058697	0.792466458	10.22702781	5	24	0.62
BH-SF-E-0318-U	19	19	1	1.02	1.33	1.43	1.57	1.615	3.79	0.576849682	0.36742018	1.787677286	5	0	0
BH-SF-E-0320-U	35	35	1	5.98	8.175	8.97	10.01	11.5	18.8	2.904003525	0.290110242	10.81740303	5	35	1
BH-SF-E-0402-U	36	36	1	4.7	19.67	23.5	24.23	27.48	57.2	9.186200831	0.379125086	26.74832596	5	35	0.97
BH-SF-E-0403-U	37	37	1	9.39	13.1	15.2	16.93	18.9	32.8	5.636565414	0.332933574	18.45419645	5	37	1
BH-SF-E-0407-U	31	31	1	4.77	13.65	15.4	17.76	19.7	58.5	9.077217837	0.511104608	20.44163193	5	30	0.97
BH-SF-E-0410-U	38	38	1	10.4	16.4	24.7	24.97	30.48	49	9.561767455	0.382930214	27.52137112	5	38	1
BH-SF-E-0423-U	38	38	1	10.7	19.45	22.15	22.63	25.65	33	4.786110773	0.211494069	23.9070803	5	38	1
BH-SF-E-0424-L	23	23	1	0.94	1.095	1.14	1.149	1.205	1.42	0.105055397	0.091432025	1.185031447	5	0	0
BH-SF-E-0427-U	39	39	1	7.77	9.215	10.2	10.4	11.25	17.2	1.706580896	0.164094317	10.84949186	5	39	1
BH-SF-E-0428-L	20	19	0.95	6.62	7.285	7.83	7.761	8.22	8.61	0.594553742	0.076607878	7.979677135	5	19	0.95
BH-SF-E-PZ-01	10	10	1	1.49	1.628	2.13	2.118	2.465	2.88	0.530006289	0.250239041	2.393681917	5	0	0
BH-SF-E-PZ-10	11	11	1	8.02	11.66	15.5	16.1	18.5	28.6	6.640783223	0.412471008	19.3934435	5	11	1
BH-SF-E-PZ-16	16	16	1	12.7	14.42	19.35	19.01	21.82	27.9	4.979541478	0.261943266	21.05765422	5	16	1
BH-SF-E-PZ-18	17	17	1	5.99	8.86	9.42	10.11	10.8	16.4	2.726075476	0.269641491	11.19752856	5	17	1
BH-SF-E-PZ-21	14	13	0.93	0.04	14.27	16.95	23.57	33.78	58.1	15.63272821	0.663246848	30.44223522	5	13	0.93
BH-SF-E-PZ-23	18	18	1	11.7	14.8	18.3	18.98	23.7	26.9	4.870106896	0.256591512	20.86811959	5	18	1
BH-DW-GW-0001	18	18	1	0.658	0.8468	0.9365	0.9812	1.12	1.53	0.216890473	0.22104614	1.065287507	5	0	0
BH-GG-GW-0002	21	21	1	0.0017	0.248	0.394	1.625	1.9	12.1	2.774021251	1.707090001	2.620697446	5	2	0.1
BH-GG-GW-0004	34	34	1	11.3	15.82	18.25	19.66	22.3	35.3	5.442697769	0.276841189	21.19533099	5	34	1
BH-GG-GW-0007	33	33	1	1.86	4.33	6.29	6.452	8.73	13.1	2.937607928	0.455301911	7.293131928	5	18	0.55
BH-GG-GW-0008	34	32	0.94	0.0043	0.3425	0.4715	0.3987	0.5402	0.734	0.208457833	0.522843824	0.457503885	5	0	0
BH-GG-GW-0009	19	19	1	39.8	75.9	83.3	84.23	94.7	131	18.69242965	0.221921283	91.28368744	5	19	1
BH-SCA-GW-0001	25	17	0.68	0.0033	0.0067	0.0168	0.03484	0.059	0.139	0.036538643	1.048755527	0.046860144	5	0	0
BH-SCA-GW-0005	34	34	1	0.167	0.2575	0.53	0.7192	1.038	1.98	0.554889695	0.771537396	0.875728873	5	0	0
BH-SCA-GW-0006	33	33	1	3.8	6.41	8.38	9.103	13.3	18	4.205513697	0.461992057	10.30717426	5	27	0.82

Well ID	Sampling Events	Detects	Frequency	Minimum	1st Quarter	Median	Mean	3rd Quarter	Maximum	Standard Deviation	Coefficient of Variation	95UCL	CRIT	D-CRIT	D-FXCD
BH-SF-E-0425-U	34	32	0.94	17.1	23.78	26.65	27.16	29.68	44.6	5.998652402	0.220863491	28.85216027	5	32	0.94
BH-SF-E-0426-L	24	24	1	4.37	6.04	6.355	6.247	6.53	7.52	0.596793364	0.095532794	6.447375962	5	23	0.96
BH-SF-E-0501-U	36	36	1	3.46	5.812	7.6	8.44	9.642	17.4	3.827078323	0.453445299	9.489163943	5	31	0.86
BH-SF-E-0502-U	35	35	1	2.8	4.765	9.1	8.133	10.9	12.9	3.296078189	0.405272125	9.049411942	5	26	0.74
BH-SF-E-0503-U	37	37	1	1.77	6.46	8.13	8.656	11.2	18	3.720298835	0.429794228	9.662014455	5	31	0.84
BH-SF-E-PZ-25	14	13	0.93	0.04	20.95	23.55	21.91	25.3	29	6.994053518	0.319217413	24.98462525	5	13	0.93
BH-SF-E-PZ-26B	4	4	1	3.59	6.995	8.375	7.362	8.742	9.11	2.546623582	0.34591464	9.456411517	5	3	0.75
BH-SF-E-PZ-31	14	14	1	6.14	6.958	7.435	7.974	8.587	12.4	1.76322569	0.221121857	8.749123928	5	14	1
BH-SF-W-0001-U	30	30	1	5.48	7.14	8.435	8.398	8.825	14.2	1.901126133	0.226378439	8.968923029	5	30	1
BH-SF-W-0003-U	32	32	1	5.35	6.97	7.93	7.831	8.71	10.6	1.28789741	0.164461424	8.205484233	5	32	1
BH-SF-W-0004-L	22	22	1	3.92	4.888	5.18	5.125	5.31	6.21	0.44756218	0.087329206	5.281952883	5	14	0.64
BH-SF-W-0005-U	33	33	1	0.001	0.274	0.609	0.7233	1.1	1.67	0.50029408	0.691682677	0.866550337	5	0	0
BH-SF-W-0008-U	38	38	1	0.25	0.4592	0.6145	0.6034	0.7062	1.3	0.218943734	0.362850072	0.661820864	5	0	0
BH-SF-W-0010-U	36	36	1	1.61	2.852	4.495	4.88	6.31	9.16	2.325403805	0.476517173	5.517491481	5	15	0.42
BH-SF-W-0018-U	23	21	0.91	0.008	0.17	0.22	0.2154	0.264	0.38	0.092168199	0.427893218	0.247011452	5	0	0
BH-SF-W-0021-U	20	20	1	2.99	3.608	4.405	4.961	6.268	8.32	1.768588884	0.356498465	5.611487792	5	7	0.35
BH-SF-W-0104-U	36	36	1	0.107	8.155	9.125	8.982	10.32	13.1	2.35059943	0.261701117	9.626398666	5	34	0.94
BH-SF-W-0201-U	30	30	1	2.13	4.52	5.5	5.98	6.565	24.7	3.770810288	0.630570282	7.112403786	5	18	0.6
BH-SF-W-0202-L	23	23	1	2.01	2.575	2.66	2.616	2.71	2.91	0.199197005	0.076145644	2.68431973	5	0	0
BH-SF-W-0204-U	30	23	0.77	0.0029	0.0292	0.0368	0.03691	0.04465	0.0616	0.014529184	0.393638154	0.041273228	5	0	0
BH-SF-W-0205-L	23	16	0.7	0.0027	0.0068	0.0113	0.03641	0.02905	0.248	0.061912778	1.700433346	0.057644578	5	0	0
BH-SF-W-0206-U	19	19	1	0.0372	0.5785	1.08	0.9423	1.27	1.83	0.4899407	0.519941314	1.127181721	5	0	0
BH-SF-W-0207-L	13	12	0.92	0.0144	0.0185	0.0348	0.06756	0.0435	0.503	0.131654083	1.948698682	0.127620634	5	0	0
BH-SF-W-PZ-04	16	16	1	2.9	6.82	7.485	7.266	8.035	8.77	1.359170703	0.187059001	7.824909215	5	15	0.94
BH-SF-W-PZ-05	13	13	1	2.44	4.01	5.74	7.642	11	16.8	4.86816727	0.637027908	9.862859441	5	8	0.62

Column Definitions:

95UCL	95UCL (Assumed normal)
CRIT	Applicable critical value
D-CRIT	Count of detected records exceeding criterion
D-FXCD	Frequency of detected exceedance

Table A-4. Site-Specific Trend Test Results for Dissolved Cadmium.

Well ID	Tau	SL	Score	D	Variance of S	Trend Significant	Trend Direction
BH-DW-GW-0001	-0.3672151	0.0370902	-56	152.499176	696	S	DEC
BH-GG-GW-0002	-0.2571429	0.1095017	-54	210	1096.666626	NS	DEC
BH-GG-GW-0004	-0.8553585	1.36E-12	-479	559.9991	4548.333	S	DEC
BH-GG-GW-0007	-0.3295455	0.007350499	-174	528	4165.333	S	DEC
BH-GG-GW-0008	0.4790008	7.51E-05	268	559.498	4547.333	S	INC
BH-GG-GW-0009	0.2411806	0.1611725	41	169.9970551	815	NS	INC
BH-SCA-GW-0001	-0.1404551	0.3622598	-39	277.6688843	1739.666626	NS	DEC
BH-SCA-GW-0005	-0.6910726	1.04E-08	-387	559.9991	4548.333	S	DEC
BH-SCA-GW-0006	0.100474	0.4203546	53	527.4997559	4164.333496	NS	INC
BH-SF-E-0001	0.08815148	0.5172956	37	419.732	3091	NS	INC
BH-SF-E-0101	-0.536195	9.25E-06	-300	559.498	4547.333	S	DEC
BH-SF-E-0104	0.6560938	6.47E-05	124	188.9974	948	S	INC
BH-SF-E-0202-U	0.04295955	0.8090239	9	209.4994	1095.667	NS	INC
BH-SF-E-0203-L	0.2249606	0.349933	15	66.6783295	224.3333282	NS	INC
BH-SF-E-0301-U	-0.456006	3.70E-05	-355	778.4985	7363.667	S	DEC
BH-SF-E-0302-L	-0.6361942	2.61E-05	-160	251.4955	1430	S	DEC
BH-SF-E-0305-U	-0.06889132	0.59821784	-32	464.4997253	3460.666748	NS	DEC
BH-SF-E-0306-L	-0.5754014	0.000141369	-145	251.998	1431.667	S	DEC
BH-SF-E-0309-U	0.3737047	0.004055977	162	433.4974	3138.667	S	INC
BH-SF-E-0310-L	-0.05642139	0.75668359	-11	194.9615326	1041.666626	NS	DEC
BH-SF-E-0317-U	0.2037787	0.06959605	151	741	6833.667	NS	INC
BH-SF-E-0318-U	-0.519194424	0.002293383	-88	169.4933472	814	S	DEC
BH-SF-E-0320-U	-0.1630252	0.1727762	-97	595	4958.333496	NS	DEC
BH-SF-E-0402-U	0.6783164	0	427	629.4997559	5389	S	INC
BH-SF-E-0403-U	0.7639106	0	508	664.9992676	5844	S	INC
BH-SF-E-0407-U	-0.05806452	0.65855658	-27	464.9999695	3461.666748	NS	DEC
BH-SF-E-0410-U	0.1024911	0.3720309	72	702.4998169	6326	NS	INC
BH-SF-E-0423-U	0.4554828	6.96E-05	317	695.9648	6311.667	S	INC
BH-SF-E-0424-L	0.1667342	0.2877307	41	245.9003906	1415.666626	NS	INC
BH-SF-E-0425-U	-0.3258761	0.007259504	-182	558.4944	4545.333	S	DEC
BH-SF-E-0426-L	-0.28703988	0.06047041	-76	264.7715759	1596	NS	DEC
BH-SF-E-0427-U	-0.5667861	4.48E-07	-418	737.4917	6826	S	DEC
BH-SF-E-0428-L	-0.528046906	0.001432902	-99	187.4833374	945	S	DEC
BH-SF-E-0501-U	-0.6497223	2.73E-08	-409	629.4998	5389	S	DEC
BH-SF-E-0502-U	0.4360276	0.000247598	259	593.9991	4956.333	S	INC

Well ID	Tau	SL	Score	D	Variance of S	Trend Significant	Trend Direction
BH-SF-E-0503-U	-0.5375375	3.02E-06	-358	666	5846	S	DEC
BH-SF-E-PZ-01	-0.06666667	0.85802764	-3	45	125	NS	DEC
BH-SF-E-PZ-10	-0.2727273	0.2757578	-15	54.9999962	165	NS	DEC
BH-SF-E-PZ-16	-0.49999997	0.007899663	-60	120.0000076	493.3333435	S	DEC
BH-SF-E-PZ-18	-0.523988843	0.003902544	-71	135.4990692	588.333313	S	DEC
BH-SF-E-PZ-21	0.04419957	0.86935222	4	90.49861908	332.6666565	NS	INC
BH-SF-E-PZ-23	-0.2622965	0.1393298	-40	152.499176	696	NS	DEC
BH-SF-E-PZ-25	0.07692307	0.74255681	7	91.00000763	333.6666565	NS	INC
BH-SF-E-PZ-26B	-0.3333333	0.7340952	-2	6.0000005	8.666667	NS	DEC
BH-SF-E-PZ-31	-0.538461506	0.008595041	-49	91.00000763	333.6666565	S	DEC
BH-SF-W-0001-U	-0.33218193	0.01069571	-144	433.4973755	3138.666748	S	DEC
BH-SF-W-0003-U	0.01214585	0.9353426	6	493.9959	3798.667	NS	INC
BH-SF-W-0004-L	-0.7467534	1.58E-06	-171	228.9913	1253.667	S	DEC
BH-SF-W-0005-U	0.2569011	0.03775561	135	525.4941	4160.333	S	INC
BH-SF-W-0008-U	-0.19285892	0.09190476	-135	699.9935303	6321	NS	DEC
BH-SF-W-0010-U	-0.6550088	2.15E-08	-412	628.9992	5388	S	DEC
BH-SF-W-0018-U	-0.38157535	0.01274904	-95	248.967865	1424.333374	S	DEC
BH-SF-W-0021-U	0.1108183	0.5161912	21	189.4993439	949	NS	INC
BH-SF-W-0104-U	-0.7238096	5.74E-10	-456	629.9999	5390	S	DEC
BH-SF-W-0201-U	0.1568637	0.2317277	68	433.4973755	3138.666748	NS	INC
BH-SF-W-0202-L	0.07825559	0.6309135	19	242.7941	1403.667	NS	INC
BH-SF-W-0204-U	0.01040102	0.9552855	4	384.5777	2862.667	NS	INC
BH-SF-W-0205-L	0.147514	0.3831139	32	216.9285583	1263.333374	NS	INC
BH-SF-W-0206-U	-0.39647749	0.02057626	-67	168.9881592	812.333313	S	DEC
BH-SF-W-0207-L	0.45392066	0.05231488	30	66.0908432	223.3333283	NS	INC
BH-SF-W-PZ-04	-0.594147444	0.001606217	-71	119.4989624	492.3333435	S	DEC
BH-SF-W-PZ-05	0.2564103	0.2463872	20	77.9999924	268.6666565	NS	INC

Column Definitions:

Tau	Kendall's tau statistic
SL	Two-sided p-value
Score	Kendall score
D	Denominator, tau = S/D-Crit
S	Significant – If SL = <0.05, result is significant
NS	Not Significant
INC	Increasing trend
DEC	Decreasing trend

Table A-5. Site-Specific Trend Test Results for Dissolved Zinc.

Well ID	Tau	SL	Score	D	Variance of Score	Trend Significant	Trend Direction
BH-DW-GW-0001	-0.35410029	0.04454141	-54	152.499176	696	S	DEC
BH-GG-GW-0002	-0.27619049	0.08521008	-58	210	1096.666626	NS	DEC
BH-GG-GW-0004	-0.8385373	3.57E-12	-470	560.4998	4549.333	S	DEC
BH-GG-GW-0007	-0.34469697	0.00503965	-182	528	4165.333496	S	DEC
BH-GG-GW-0008	0.4153298	0.000583291	233	561	4550.333	S	INC
BH-GG-GW-0009	0.2280702	0.183699	39	170.9999847	817	NS	INC
BH-SCA-GW-0001	0.1507557	0.3037333	45	298.4962463	1830.333374	NS	INC
BH-SCA-GW-0005	-0.5472371	5.73E-06	-307	561	4550.333	S	DEC
BH-SCA-GW-0006	-0.03415566	0.79218966	-18	526.9990845	4163.333496	NS	DEC
BH-SF-E-0001	0.1803499	0.1691768	78	432.4927368	3136.666748	NS	INC
BH-SF-E-0101	-0.5755159	1.93E-06	-322	559.498	4547.333	S	DEC
BH-SF-E-0104	0.2222253	0.1829858	42	188.9973602	948	NS	INC
BH-SF-E-0202-U	0.0952381	0.5661428	20	210	1096.666626	NS	INC
BH-SF-E-0203-L	-0.55485028	0.01025367	-43	77.49838257	267.6666565	S	DEC
BH-SF-E-0301-U	-0.4524437	4.30E-05	-352	777.9974	7362	S	DEC
BH-SF-E-0302-L	-0.668004	1.01E-05	-168	251.4955	1430.667	S	DEC
BH-SF-E-0305-U	-0.02795699	0.83838707	-13	464.9999695	3461.666748	NS	DEC
BH-SF-E-0306-L	-0.4703557	0.001830526	-119	253	1433.667	S	DEC
BH-SF-E-0309-U	0.3590336	0.005678296	156	434.4997	3140.667	S	INC
BH-SF-E-0310-L	-0.31026343	0.05317652	-65	209.4994049	1095.666626	NS	DEC
BH-SF-E-0317-U	0.09182986	0.4176242	68	740.4999	6832.667	NS	INC
BH-SF-E-0318-U	-0.2228749	0.1952309	-38	170.4992523	816	NS	DEC
BH-SF-E-0320-U	-0.1531989	0.2011131	-91	593.9991455	4956.333496	NS	DEC
BH-SF-E-0402-U	-0.09705675	0.41365349	-61	628.49823	5387	NS	DEC
BH-SF-E-0403-U	0.01204825	0.9270289	8	663.997	5842	NS	INC
BH-SF-E-0407-U	-0.05621704	0.6706481	-26	462.4932251	3456	NS	DEC
BH-SF-E-0410-U	0.1935944	0.08963215	136	702.4998	6326	NS	INC
BH-SF-E-0423-U	-0.1609688	0.1590494	-113	701.9992676	6325	NS	DEC
BH-SF-E-0424-L	-0.1277509	0.4120183	-32	250.4875183	1428	NS	DEC
BH-SF-E-0425-U	-0.24823423	0.04785345	-123	495.4997559	3801.666748	S	DEC
BH-SF-E-0426-L	0	1	0	276	1625.333	NS	INC
BH-SF-E-0427-U	0.09891681	0.383559	73	737.9939	6827.667	NS	INC
BH-SF-E-0428-L	-0.6023392	0.000358992	-103	171	817	S	DEC
BH-SF-E-0501-U	-0.6825398	5.12E-09	-430	629.9999	5390	S	DEC
BH-SF-E-0502-U	0.227273	0.05699158	135	593.9991	4956.333	NS	INC

Well ID	Tau	SL	Score	D	Variance of Score	Trend Significant	Trend Direction
BH-SF-E-0503-U	-0.26937613	0.01987823	-179	664.4983521	5843	S	DEC
BH-SF-E-PZ-01	-0.02222222	1	-1	45	125	NS	DEC
BH-SF-E-PZ-10	-0.2363636	0.3502014	-13	54.9999962	165	NS	DEC
BH-SF-E-PZ-16	-0.39999998	0.03433986	-48	120.0000076	493.3333435	S	DEC
BH-SF-E-PZ-18	-0.1845031	0.3224367	-25	135.4990692	588.333313	NS	DEC
BH-SF-E-PZ-21	-0.2087912	0.3244236	-19	91.0000076	333.6666565	NS	DEC
BH-SF-E-PZ-23	-0.4248366	0.0153433	-65	153	697	S	DEC
BH-SF-E-PZ-25	-0.2087912	0.3244236	-19	91.0000076	333.6666565	NS	DEC
BH-SF-E-PZ-26B	0.3333333	0.7340952	2	6.0000005	8.666667	NS	INC
BH-SF-E-PZ-31	-0.2967033	0.1546298	-27	91.0000076	333.6666565	NS	DEC
BH-SF-W-0001-U	0.0990786	0.4535186	43	433.9988708	3139.666748	NS	INC
BH-SF-W-0003-U	0.02020206	0.8839321	10	494.999	3800.667	NS	INC
BH-SF-W-0004-L	-0.4826133	0.001907674	-111	229.9978	1255.667	S	DEC
BH-SF-W-0005-U	0.2683189	0.0299542	141	525.4940796	4159.666504	S	INC
BH-SF-W-0008-U	-0.19772404	0.08275446	-139	703	6327	NS	DEC
BH-SF-W-0010-U	-0.5830026	6.17E-07	-367	629.4998	5389	S	DEC
BH-SF-W-0018-U	-0.4703557	0.001830526	-119	253	1433.667	S	DEC
BH-SF-W-0021-U	0.08421052	0.62649632	16	190.0000153	950	NS	INC
BH-SF-W-0104-U	-0.6263919	8.60E-08	-394	628.9992	5388	S	DEC
BH-SF-W-0201-U	-0.33333334	0.01019605	-145	434.9999695	3141.666748	S	DEC
BH-SF-W-0202-L	-0.31139275	0.04163395	-78	250.4875183	1428.666626	S	DEC
BH-SF-W-0204-U	0.324138	0.01249862	141	435	3141.667	S	INC
BH-SF-W-0205-L	0.1626997	0.2904406	41	251.9980164	1431.666626	NS	INC
BH-SF-W-0206-U	-0.380117	0.02515093	-65	170.9999847	817	S	DEC
BH-SF-W-0207-L	0.5897437	0.006043673	46	77.99999	268.6667	S	INC
BH-SF-W-PZ-04	-0.34999996	0.06490338	-42	120.0000076	493.3333435	NS	DEC
BH-SF-W-PZ-05	-0.1025641	0.6693341	-8	77.9999924	268.6666565	NS	DEC

Column Definitions:

Tau	Kendall's tau statistic
SL	Two-sided p-value
Score	Kendall score
D	Denominator, tau = S/D-Crit
S	Significant – If SL = <0.05, result is significant
NS	Not Significant
INC	Increasing trend
DEC	Decreasing trend

Table A-6. Median MCL Ratios for Dissolved Cadmium.

Well ID	Sampling Events	Median	Criteria	Median Ratio	Frequency of Detected Exceedance
BH-SF-E-0001	30	0.00049	0.005	0.1	0
BH-SF-E-0101	34	0.0138	0.005	2.8	1
BH-SF-E-0104	20	0.01855	0.005	3.7	1
BH-SF-E-0202-U	21	0.0051	0.005	1.0	0.523809524
BH-SF-E-0203-L	13	0.001	0.005	0.2	0
BH-SF-E-0301-U	40	0.0778	0.005	15.6	1
BH-SF-E-0302-L	23	0.037	0.005	7.4	1
BH-SF-E-0305-U	31	0.0309	0.005	6.2	1
BH-SF-E-0306-L	23	0.0388	0.005	7.8	1
BH-SF-E-0309-U	30	0.01085	0.005	2.2	1
BH-SF-E-0310-L	21	0.001	0.005	0.2	0
BH-SF-E-0317-U	39	0.0211	0.005	4.2	0.948717949
BH-SF-E-0318-U	19	0.0094	0.005	1.9	1
BH-SF-E-0320-U	35	0.0339	0.005	6.8	1
BH-SF-E-0402-U	36	0.0554	0.005	11.1	1
BH-SF-E-0403-U	37	0.049	0.005	9.8	0.837837838
BH-SF-E-0407-U	31	0.499	0.005	99.8	1
BH-SF-E-0410-U	38	0.2215	0.005	44.3	1
BH-SF-E-0423-U	38	0.00555	0.005	1.1	0.631578947
BH-SF-E-0424-L	23	0.001	0.005	0.2	0
BH-SF-E-0427-U	39	0.194	0.005	38.8	1
BH-SF-E-0428-L	20	0.03	0.005	6.0	1
BH-SF-E-PZ-01	10	0.0179	0.005	3.58	1
BH-SF-E-PZ-10	11	0.171	0.005	34.2	1
BH-SF-E-PZ-16	16	0.1635	0.005	32.7	1
BH-SF-E-PZ-18	17	0.106	0.005	21.2	1
BH-SF-E-PZ-21	14	0.366	0.005	73.2	1
BH-SF-E-PZ-23	18	0.439	0.005	87.8	1
BH-DW-GW-0001	18	0.01445	0.005	2.9	1
BH-GG-GW-0002	21	0.0212	0.005	4.2	0.952380952
BH-GG-GW-0004	34	0.3015	0.005	60.3	1
BH-GG-GW-0007	33	0.303	0.005	60.6	1
BH-GG-GW-0008	34	0.0103	0.005	2.1	0.735294118
BH-GG-GW-0009	19	4.48	0.005	896.0	1

Well ID	Sampling Events	Median	Criteria	Median Ratio	Frequency of Detected Exceedance
BH-SCA-GW-0001	25	0.0019	0.005	0.4	0
BH-SCA-GW-0005	34	0.6185	0.005	123.7	1
BH-SCA-GW-0006	33	0.96	0.005	192.0	1
BH-SF-E-0425-U	34	0.104	0.005	20.8	1
BH-SF-E-0426-L	24	0.0017	0.005	0.3	0
BH-SF-E-0501-U	36	0.4905	0.005	98.1	1
BH-SF-E-0502-U	35	0.023	0.005	4.6	1
BH-SF-E-0503-U	37	0.426	0.005	85.2	1
BH-SF-E-PZ-25	14	0.0825	0.005	16.5	1
BH-SF-E-PZ-26B	4	0.1093	0.005	21.9	1
BH-SF-E-PZ-31	14	0.3005	0.005	60.1	1
BH-SF-W-0001-U	30	0.0224	0.005	4.5	1
BH-SF-W-0003-U	32	0.161	0.005	32.2	0.96875
BH-SF-W-0004-L	22	0.00645	0.005	1.3	0.772727273
BH-SF-W-0005-U	33	0.0044	0.005	0.9	0.454545455
BH-SF-W-0008-U	38	0.0087	0.005	1.7	0.815789474
BH-SF-W-0010-U	36	0.04595	0.005	9.2	1
BH-SF-W-0018-U	23	0.003	0.005	0.6	0
BH-SF-W-0021-U	20	0.0236	0.005	4.7	1
BH-SF-W-0104-U	36	0.0808	0.005	16.2	1
BH-SF-W-0201-U	30	0.00215	0.005	0.4	0.433333333
BH-SF-W-0202-L	23	0.00047	0.005	0.1	0
BH-SF-W-0204-U	30	0.001	0.005	0.2	0
BH-SF-W-0205-L	23	0.001	0.005	0.2	0
BH-SF-W-0206-U	19	0.0053	0.005	1.1	0.526315789
BH-SF-W-0207-L	13	0.001	0.005	0.2	0
BH-SF-W-PZ-04	16	0.05565	0.005	11.1	1
BH-SF-W-PZ-05	13	0.0355	0.005	7.1	1

Table A-7. Median MCL Ratios for Dissolved Zinc.

Well ID	Sampling Events	Median	Criteria	Median Ratio	Frequency of Detected Exceedance
BH-SF-E-0001	30	0.183	5	0.04	0
BH-SF-E-0101	34	2.6	5	0.5	0
BH-SF-E-0104	20	9.125	5	1.8	0.95
BH-SF-E-0202-U	21	0.88	5	0.2	0.095238095
BH-SF-E-0203-L	13	0.626	5	0.1	0
BH-SF-E-0301-U	40	16.85	5	3.4	0.975
BH-SF-E-0302-L	23	9.89	5	2.0	1
BH-SF-E-0305-U	31	6.01	5	1.2	0.64516129
BH-SF-E-0306-L	23	7.81	5	1.6	0.869565217
BH-SF-E-0309-U	30	1.52	5	0.3	0.033333333
BH-SF-E-0310-L	21	0.291	5	0.06	0
BH-SF-E-0317-U	39	6.94	5	1.4	0.615384615
BH-SF-E-0318-U	19	1.43	5	0.3	0
BH-SF-E-0320-U	35	8.97	5	1.8	1
BH-SF-E-0402-U	36	23.5	5	4.7	0.972222222
BH-SF-E-0403-U	37	15.2	5	3.0	1
BH-SF-E-0407-U	31	15.4	5	3.1	0.967741935
BH-SF-E-0410-U	38	24.7	5	4.9	1
BH-SF-E-0423-U	38	22.15	5	4.4	1
BH-SF-E-0424-L	23	1.14	5	0.2	0
BH-SF-E-0427-U	39	10.2	5	2.0	1
BH-SF-E-0428-L	20	7.83	5	1.6	0.95
BH-SF-E-PZ-01	10	2.13	5	0.4	0
BH-SF-E-PZ-10	11	15.5	5	3.1	1
BH-SF-E-PZ-16	16	19.35	5	3.9	1
BH-SF-E-PZ-18	17	9.42	5	1.9	1
BH-SF-E-PZ-21	14	16.95	5	3.4	0.928571429
BH-SF-E-PZ-23	18	18.3	5	3.7	1
BH-DW-GW-0001	18	0.9365	5	0.2	0
BH-GG-GW-0002	21	0.394	5	0.08	0.095238095
BH-GG-GW-0004	34	18.25	5	3.7	1
BH-GG-GW-0007	33	6.29	5	1.3	0.545454545
BH-GG-GW-0008	34	0.4715	5	0.09	0
BH-GG-GW-0009	19	83.3	5	16.7	1

Well ID	Sampling Events	Median	Criteria	Median Ratio	Frequency of Detected Exceedance
BH-SCA-GW-0001	25	0.0168	5	0.003	0
BH-SCA-GW-0005	34	0.53	5	0.1	0
BH-SCA-GW-0006	33	8.38	5	1.7	0.818181818
BH-SF-E-0425-U	34	26.65	5	5.3	0.941176471
BH-SF-E-0426-L	24	6.355	5	1.3	0.958333333
BH-SF-E-0501-U	36	7.6	5	1.5	0.861111111
BH-SF-E-0502-U	35	9.1	5	1.8	0.742857143
BH-SF-E-0503-U	37	8.13	5	1.6	0.837837838
BH-SF-E-PZ-25	14	23.55	5	4.7	0.928571429
BH-SF-E-PZ-26B	4	8.375	5	1.7	0.75
BH-SF-E-PZ-31	14	7.435	5	1.5	1
BH-SF-W-0001-U	30	8.435	5	1.7	1
BH-SF-W-0003-U	32	7.93	5	1.6	1
BH-SF-W-0004-L	22	5.18	5	1.0	0.636363636
BH-SF-W-0005-U	33	0.609	5	0.1	0
BH-SF-W-0008-U	38	0.6145	5	0.1	0
BH-SF-W-0010-U	36	4.495	5	0.9	0.416666667
BH-SF-W-0018-U	23	0.22	5	0.04	0
BH-SF-W-0021-U	20	4.405	5	0.9	0.35
BH-SF-W-0104-U	36	9.125	5	1.8	0.944444444
BH-SF-W-0201-U	30	5.5	5	1.1	0.6
BH-SF-W-0202-L	23	2.66	5	0.5	0
BH-SF-W-0204-U	30	0.0368	5	0.007	0
BH-SF-W-0205-L	23	0.0113	5	0.002	0
BH-SF-W-0206-U	19	1.08	5	0.2	0
BH-SF-W-0207-L	13	0.0348	5	0.007	0
BH-SF-W-PZ-04	16	7.485	5	1.5	0.9375
BH-SF-W-PZ-05	13	5.74	5	1.1	0.615384615

Appendix B. QA/QC Memoranda