FINAL
SILVER DYKE ADIT DISCHARGE TREATMENT PILOT TESTS
TECHNICAL MEMORANDUM

CARPENTER-SNOW CREEK MINING DISTRICT NPL SITE
SUPPLEMENTAL STUDIES FOR THE REMEDIAL INVESTIGATION
CASCADE COUNTY, MONTANA

May 2015

Prepared for:

Montana Department of Environmental Quality
Remediation Division
P.O. Box 200901
Helena, Montana 59620

and

U.S. Environmental Protection Agency – Region 8
10 West 15th Street
Helena, Montana 59626

Prepared By:

Tetra Tech, Inc. (EMI Unit)
7 West 6th Avenue, Suite 612
Helena, Montana 59601
(406) 442-5588

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ACRONYMS AND ABBREVIATIONS

AMSL	Above mean sea level
COC	Chain of Custody
COD	Chemical Oxygen Demand
CSCMD	Carpenter-Snow Creek Mining District
DEQ	Montana Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
ESAT	Environmental Services Assistance Team
FS	Feasibility Study
gpm	Gallons per minute
mg/L	Milligrams per liter
MIW	Mine influenced water
NPL	National Priorities List
OU	Operable Unit
PVC	Polyvinyl chloride
SAP	Sampling and Analysis Plan
SRB	Sulfate Reducing Bioreactor
TCLP	Toxicity Characteristic Leaching Procedure
Tetra Tech	Tetra Tech, Inc. (EMI Unit)
USFS	U.S. Forest Service

1.0 INTRODUCTION

The Montana Department of Environmental Quality (DEQ), in cooperation with the U.S. Environmental Protection Agency (EPA) and the U.S. Forest Service (USFS), tasked Tetra Tech, Inc. (EMI Unit) (Tetra Tech) to perform pilot scale treatability testing on mine influenced water (MIW) from the Silver Dyke adit at the Carpenter-Snow Creek Mining District (CSCMD) National Priorities List (NPL) Site to determine viable passive treatment alternatives. The CSCMD site is in Cascade County in an area starting approximately 4 miles northeast of Neihart, Montana, trending southwest through town and ending just southwest of Neihart.

Mine tailings, waste rock, and MIW are present throughout the CSCMD Site. Previous investigations showed that MIW discharging from many adits at the CSCMD Site contain elevated concentrations of heavy metals and arsenic that may pose a risk to ecological receptors and to human recreational and residential users.

In 2012, EPA and DEQ expressed interest in determining if passive treatment technologies at the CSCMD Site could be a component of future response actions that would address CSCMD MIW. Through a screening of available technologies and bench scale treatability testing, Tetra Tech identified two technologies to test: a sulfate reducing bioreactor (SRB) and Aquafix® (Aquafix), a water-powered quicklime application system. Tetra Tech conducted a pilot scale treatability study using these two technologies and has prepared this technical memorandum for the DEQ under Contract Number 414038, Task Order 9, to present data collected from the pilot study. MIW from the Silver Dyke mine was used in this pilot study (Figure 1-1).

The remainder of this technical memorandum contains:

- The site history for the Silver Dyke mine ,
- The methods used for the pilot scale treatability study, and
- The pilot scale testing results.

2.0 SITE HISTORY

In 2013, Tetra Tech conducted bench scale treatability testing of adit discharge water to evaluate potential MIW treatment alternatives as specified in the 2013 Sampling and Analysis Plan (SAP) Addendum 02 for the CSCMD Site (Tetra Tech 2013b). Silver Dyke mine MIW was used for the bench scale work and for the pilot study treatability described in this memorandum because the mine's MIW is likely a major contributor of dissolved and total metals to Carpenter Creek in Operable Unit 3 (OU3). The pilot study treatability results will be used to develop passive treatment alternatives for the upcoming OU3 Feasibility Study (FS). The pilot study work was conducted as specified in the 2014 SAP Addendum 02 for the CSCMD Site (Tetra Tech 2014b). The following section briefly describes the mine.

Silver Dyke Mine

During its operation, the Silver Dyke mine was the largest producer of ore in the Neihart mining district, with silver production second only to Silver Bow County (Schafer 1935). The ore body consisted of "a partially altered quartz porphyry and gneiss breccia surrounded by granite gneiss on one side and unaltered porphyry on the other." The ore body was configured in an elliptical shape with a maximum length of 600 feet and width of 400 feet and was mined to a depth of approximately 150 feet.

Beginning in 1921, 1 million tons of ore were blocked out and a 500-ton flotation mill was constructed. In 1926, the capacity of the mill was increased to 950 tons. The Silver Dyke operated until 1929, when the blocked-out ore was depleted and no new deposits could be found. Water is flowing continuously from an adit at an elevation of 6,830 feet above mean sea level (AMSL) on the southwest side of the Silver Dyke mine. The adit drainage is the primary source of water in Sih'mem Creek, a tributary to Carpenter Creek. Tetra Tech has monitored the flow since 2012 from a 6-inch polyvinyl chloride (PVC) pipe that drains the collapsed adit. The average flow from the adit in 2012, 2013, and 2014 were 41, 43, and 25 gallons per minute (gpm), respectively (Tetra Tech 2013a, Tetra Tech 2014a, Tetra Tech 2015). The metals concentrations in this water are the highest observed at the CSCMD Site.

3.0 METHODS

The pilot scale treatability testing was performed at the Silver Dyke adit in accordance with the 2014 SAP Addendum 02 for the CSCMD Site (Tetra Tech 2014b). Deviations to the SAP are noted in Sections 3.2.1 and 3.3.1. Field notes for the methods are in Appendix A.

3.1 WATER SAMPLING

All surface water samples were collected in accordance with Tetra Tech SOP009-4 of the 2014 SAP Addendum 02. Surface water samples were shipped to the EPA Environmental Services Assistance Team (ESAT) laboratory to be analyzed for dissolved metals, total metals and sulfates (anions) as described in the SAP Addendum 02. Surface water samples were collected for dissolved metals analysis, using a pump or syringe that pushed water through a 0.45 micron barrel water filter into a sample jar. Bioreactor samples were analyzed for chemical oxygen demand (COD) at Energy Labs, Inc. in Helena, Montana as described in the SAP Addendum 02.

3.2 AQUAFIX PILOT SCALE TEST

Aquafix is a system designed to add quicklime to water, which it is powered by, to raise the pH. The Aquafix unit continuously adds quicklime to MIW to raise the pH to a range predetermined for optimal metals removal. Bench scale testing showed optimal metals precipitation between pH 7 and 8.5 (Tetra Tech 2014a). The quicklime feed rate from the unit is adjusted by increasing or decreasing the MIW flow through the unit using a valve. The quicklime feed rate adjusts accordingly to the flow.

On September 8, 2014, the Aquafix unit was installed along Sih'mem Creek in an area excavated to give the unit six feet of head from the adit discharge point. A lined sedimentation basin designed for a 24-hour retention time plus 500 cubic feet of sludge storage capacity was installed on Sih'mem Creek approximately 100 feet below the unit.

Sediment basin installation

The 6-inch PVC pipe that drains the Silver Dyke adit was reduced to a 2-inch PVC pipe with an overflow that fed the Aquafix unit. A portion of Sih'mem Creek (Silver Dyke adit MIW) was piped into the Aquafix unit were it turned a water wheel which turned an auger feeding quicklime into the channel. The overflow flowed out of the pipe to the channel and under the unit. The flow that turned the wheel was discharged from the unit to the channel, where it combined with the overflow and the quicklime fed from the unit. The combined flow and quicklime flowed down the channel to the sediment basin, and then on to Sih'mem Creek.

On September 15, initial water samples at the adit and along Sih'mem Creek, Carpenter Creek, and Belt Creek were collected. Quicklime treatment of the adit water using the Aquafix unit began on September 16, 2014. Quicklime was added to the hopper as necessary to maintain an available supply for pilot treatment and MIW rates into the unit were adjusted as necessary using the valve in an attempt to maintain an optimal pH.

Installed Aquafix unit

Surface water samples were collected once per day for five days after treatment began, and once per week for the remaining three weeks of the pilot test period. Samples were collected from the sample locations shown on Figure 1-1.

Water quality parameters including pH, oxidation/reduction potential, dissolved oxygen, and specific conductivity were measured during surface water sampling at each surface water sample location using a Hanna multi-parameter sonde (Table 3-1) in accordance with SOP009-4 from the SAP. Parameters in the sediment basin were logged at 15-minute intervals by a dedicated sonde. Raw water quality parameter data from the basin is included in Appendix B. To monitor the pH of the treated water in the sedimentation basin, real time parameters were checked several times per week by plugging a data logger into the dedicated sonde. This allowed the operator to monitor pH in the basin and make changes to the lime addition rate to keep the treated water in the target pH range.

A sample of the waste (precipitate) produced by the quicklime treatment was collected from the sediment basin after pilot testing was complete. The sample was analyzed using Toxicity Characteristic Leaching Procedure (TCLP) at Energy Labs in Helena, Montana. The results of the TCLP are in Appendix C.

3.2.1 Deviations to the SAP for the Aquafix Pilot Test

Deviations to the 2014 SAP Addendum 02 were:

1. Initial sediment samples were not collected. Analytical results for ESAT sediment samples from a sample event in September 2014 will be used in the FS as the initial sediment samples for the pilot treatment monitoring.
2. The sedimentation basin for the pilot treatment was constructed upstream of the planned location because groundwater was prohibitively shallow at the planned location.
3. The pH in the pilot treatment water was controlled by adjusting the flow rate of water into the Aquafix unit because the quicklime feed rate could not be appropriately controlled.
4. Flow from the Silver Dyke adit was not monitored during the pilot treatment because the flow monitor was not compatible with the piping system which powered the Aquafix unit.

3.3 SULFATE REDUCING BIOREACTOR PILOT SCALE TEST

The SRB pilot test was conducted on the Aquafix quicklime treated MIW in the sediment basin described in Section 3.2. The SRB pilot testing units were constructed on August 29, 2015 using 50-gallon poly barrels with bottom-drain valves and threaded sealing lids. Two six-inch PVC pipes perforated for 12 inches on one end of the pipe with 1-1/4-inch diameter holes and cut to the height of the barrel were placed in the center of each barrel with perforations located on the bottom of the barrel. A substrate, based on the bench scale study, was then mixed together on a poly tarp at the pilot location consisting of approximately:

- 60 percent horse manure obtained from Jordan Ranches (30 lbs),
- 30 percent weed-free straw obtained from Murdoch's Ranch Supply (4 lbs), and
- 10 percent top soil obtained from an undisturbed area near the pilot location (5 lbs).

Bioreactor Interior

The mixed substrate was placed in each barrel's annular space between the outside of the PVC pipe and the barrel wall to approximately 6 inches below the top of the barrel. Water from the Silver Dyke adit was poured into the PVC pipe in each barrel until the water level was above the top of the manure/hay/soil substrate. The lids were threaded onto each barrel. The substrate and MIW-filled drums were left undisturbed for approximately 3 weeks prior to pilot operation to develop the appropriate microbial communities. The filled and capped barrels were then moved to the location shown on Figure 1-1 on level ground surface.

Poly trickle irrigation tubing (1/4 inch diameter) was installed from the sediment basin outflow to barrel to allow for adequate gravity-fed water pressure to the barrels. The tubing was connected to the barrels in series with the inlet tube from the sediment basin fed into a connector that was inserted and sealed through one barrel lid so that the inflowing water was directed into the center of the interior 6-inch PVC pipe. Outflow holes were drilled in the barrels above the substrate and tubing and tubing connectors were placed in the holes. The outflow tubing in the first barrel was used as inflow tubing in the second barrel and the outflow tubing in the second barrel was directed back to Sih'mem Creek. A trickle-irrigation valve was placed at each barrel inlet for flow adjustment. Due to clogging issues, it was later determined that a larger diameter trickle irrigation tubing was necessary to allow adequate flow-through in the barrels. Once inflow and outflow at the barrels had equilibrated, the flow to the barrels was adjusted to approximately 0.008 gpm or 0.5 gallons per hour. The flow rate was based on an anticipated 220-hour (approximately 9-day) total retention time, which was determined for optimal metals removal by bench scale testing.

With the flow into the reactors controlled at 0.5 gallons per hour, MIW residence time in the SRB was approximately four and one-half days. This allowed the SRB to flush approximately 6 times during the test period. Potential air entry points for each barrel were sealed with silicone to maintain anaerobic conditions. The bioreactor setup is shown in Figure 3-1.

During bench scale testing, it was observed that dissolved arsenic concentration increased in the bioreactor. This was likely caused by the anaerobic degradation of the bioreactor substrates. Samples of the manure and soil substrates were collected and analyzed for total metals and TCLP to quantify initial metals concentrations and leachability of the substrates. Arsenic was not observed in the TCLP results. The source of the arsenic mobilization in bench-scale testing is not known but could have been due to anaerobic degradation of organic substrates. This has been observed in other SRBs in Montana (CR Kendall) (Golder Associates, Inc., 2006) and at sites with bacterial sulfate reduction in ferrihydrite-rich systems (Saalfield and Bostick, 2009). TCLP results are included in Appendix C.

To characterize the effects of the SRB on the quicklime treated MIW, the influent and effluent of the SRB was sampled during operation and analyzed for dissolved metals, anions, and COD.

3.3.1 DEVIATIONS TO THE SAP FOR THE SRB

Deviations to the 2014 SAP Addendum 02 during the SRB pilot test of the quicklime treated mine influenced water were:

1. The field logbook only shows one sample from the SRB was collected for dissolved metals. The sample cannot be located. There was no chain of custody (COC) with the sample listed on it and no analytical results for the sample were received from the laboratory.
2. Only three samples were collected from the SRB for total metals. Two of the samples collected did not include dissolved metals samples.
3. Even after replacement with a larger poly supply line the pilot test was terminated before scheduled due to continual clogging of the larger supply line.

4.0 PILOT SCALE TESTING RESULTS

The following sections discuss the results of the Aquafix and SRB pilot scale tests, respectively.

4.1 AQUAFIX RESULTS

Analytical results for surface water samples collected from Sih'mem Creek, Carpenter Creek, and Belt Creek are shown in Tables 4-1, 4-2, and 4-3, respectively. Analytical results for sediment samples collected from Sih'mem Creek, Carpenter Creek, and Belt Creek are shown in Tables 4-4, 4-5, and 4-6, respectively.

Quicklime addition via the Aquafix system was effective at significantly raising the pH and decreasing metals concentrations of the MIW from the Silver Dyke adit based on the samples collected above the Aquafix unit and below the unit (Sih'men Creek SC1 and SC2). Results from Sih'men Creek SC3, Carpenter Creek and Belt Creek were varied, and increases and decreases in metals concentrations are not necessarily dependent on the quicklime treatment at the Silver Dyke mine.

Sih'mem Creek (AQSC2) dissolved metals concentrations best illustrate the effects of the quicklime treatment on the Silver Dyke MIW and are used as the example of the treatment effects in this memo. The dissolved metals concentrations in Table 4-7 shows the effects of pH via the quicklime treatment by providing the range of dissolved metals concentrations at SC1 (MIW prior to treatment) and dissolved metals concentrations of the treated water at specific pHs at SC2 (sediment basin outlet). Figures 4-1, 4-2, and 4-3 show graphs of the dissolved metals concentrations and pH over the pilot testing period at SC2. All dissolved metals showed similar trends inversely related to the pH. In general, minimum metals concentrations for dissolved metals at SC2 were observed on September 18, 2014 when the recorded pH was 11.5. These concentrations were observed when pH was above the target pH range of 7.5-9.0 specified in the 2014 SAP (Tetra Tech 2014b), where the optimal dissolved metals precipitation concentrations were initially expected.

Operation and maintenance of the Aquafix system was straightforward. MIW flow that powered the water wheel was adjusted using a valve until the desired pH (quicklime feed rate) was achieved. The adjustment was relatively simple during fairly steady flow conditions, but could become difficult during rapidly changing flow rates. After determining an appropriate quicklime feed rate, the system was self-sufficient as long as the quicklime was regularly stocked in the hopper. TCLP results of the sample of precipitate taken from the sediment basin did not show any metals concentrations that would require the precipitate be disposed of as hazardous waste. Only two metals were reported in the TCLP results; copper at 0.02 milligrams per liter (mg/L) and zinc at 1 mg/L. Neither result would prohibit sludge disposal at a municipal landfill. The TCLP results are included in Appendix C.

4.2 SULFATE REDUCING BIOREACTOR RESULTS

The bioreactor bench scale testing was unsuccessful. The irrigation tubing used to transport water from the sediment basin to the pond clogged constantly. Only three samples were collected during the pilot testing period. The field team collected the required dissolved metals

sample once, and the sample was lost. The field log showed it was collected, but it was not listed on a COC for analysis and no analytical results for that sample were received from the lab.

5.0 CONCLUSIONS

Tetra Tech performed pilot scale testing of two potential passive treatment technologies on MIW from the Silver Dyke adit at the CSCMD Site. The two technologies tested were a quicklime addition system using an Aquafix unit and an SRB. The SRB pilot test was unsuccessful, and no determinations could be made from the data collected.

The quicklime addition was effective at significantly decreasing dissolved metals concentrations in the MIW, and is a viable technology for treating MIW from the Silver Dyke adit. One ton of quicklime was consumed during the pilot test period.

6.0 REFERENCES

Golder Associates, Inc. 2006. "Technical Memorandum: RE: Kendall Mine Passive Treatment Data Assessment". July.

Saalfield and Bostick. 2009. "Changes in Iron, Sulfur, and Arsenic Speciation Associated with Bacterial Sulfite Reduction in Ferrihydrite-Rich Systems". Environmental Science and Technology Vol. 43, NO. 23.

Schafer, Paul A. 1935. Geology and Ore Deposits of the Neihart Mining District, Cascade County, Montana. Bureau of Mines and Geology Memoir No. 13. Montana School of Mines, Butte.

Tetra Tech. 2013a. "Silver Dyke Adit and Broadwater Adit Water Balance Technical Memorandum". March.

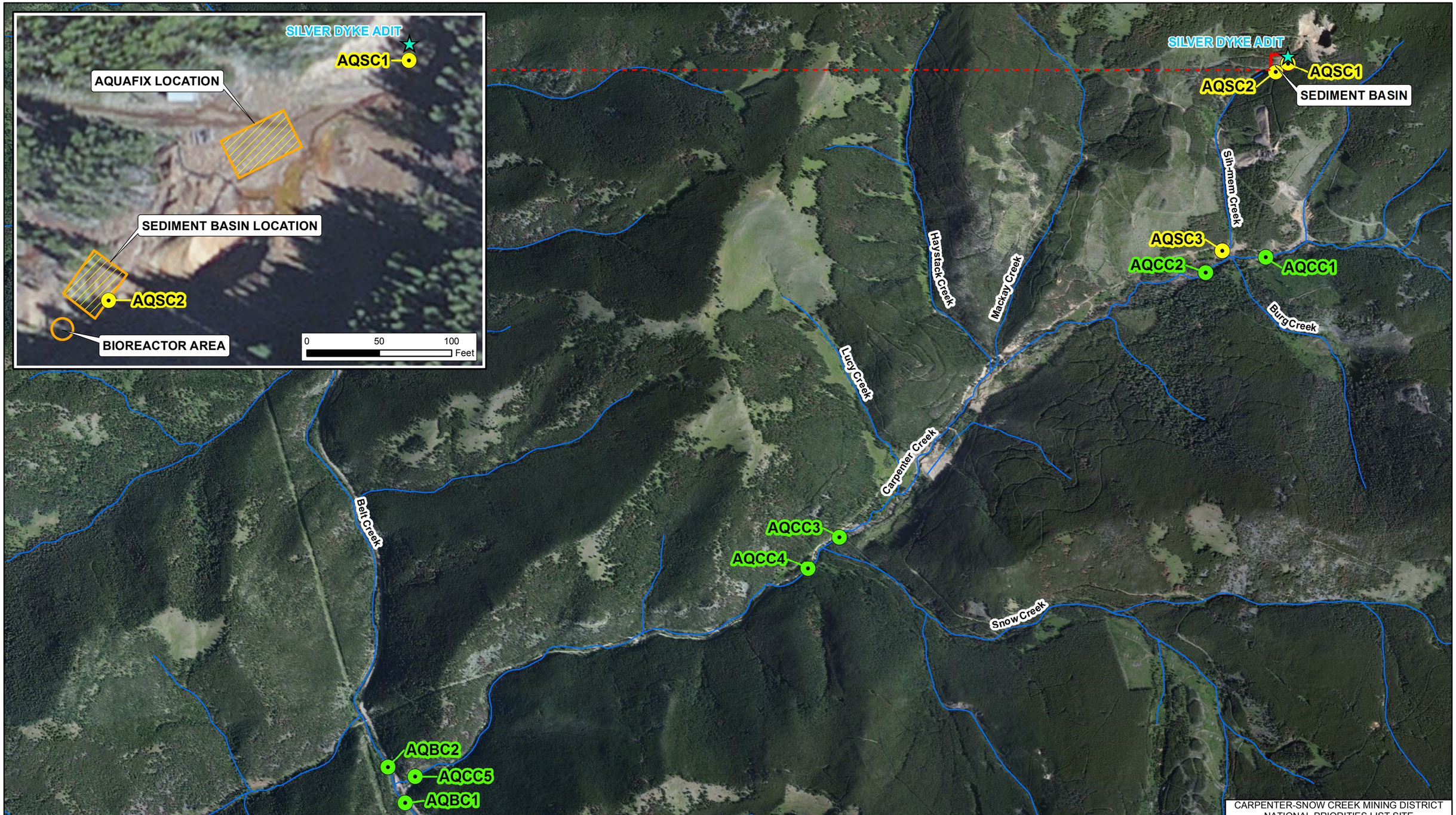
Tetra Tech. 2013b. "Sampling and Analysis Plan for the Carpenter-Snow Creek Mining District NPL Site Addendum 2." April.

Tetra Tech. 2014a. "Adit Discharge Monitoring Technical Memorandum." February 2014.

Tetra Tech. 2014b. "Final Sampling and Analysis Plan for the Carpenter-Snow Creek Mining District NPL Site Addendum 2." July.

Tetra Tech. 2015. "Adit Discharge Monitoring Technical Memorandum". May.

FIGURES



Aerial Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

LEGEND

- STREAM
- MINE
- DISSOLVED METALS SAMPLING POINT
- TOTAL AND DISSOLVED METALS SAMPLING POINT

N

0 1,000 2,000 Feet

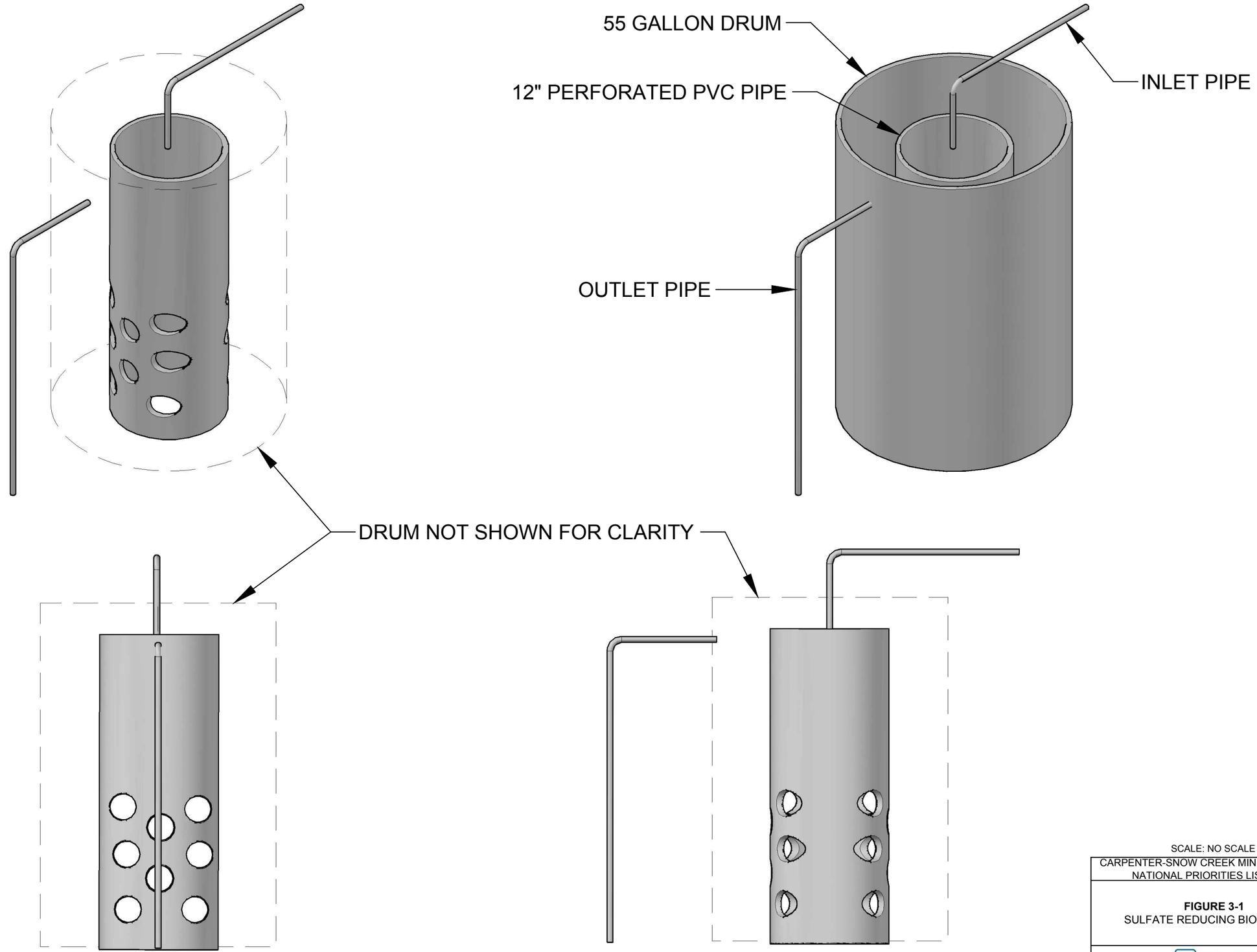
CARPENTER-SNOW CREEK MINING DISTRICT
NATIONAL PRIORITIES LIST SITE

FIGURE 1-1

SILVER DYKE AQUAFIX
PILOT STUDY AREA

TETRA TECH

GIS MAP BY DOUG HEROLD TTEMI-HELENA - Figure_1-1_Silver_Dyke_Aquafix_050515.mxd



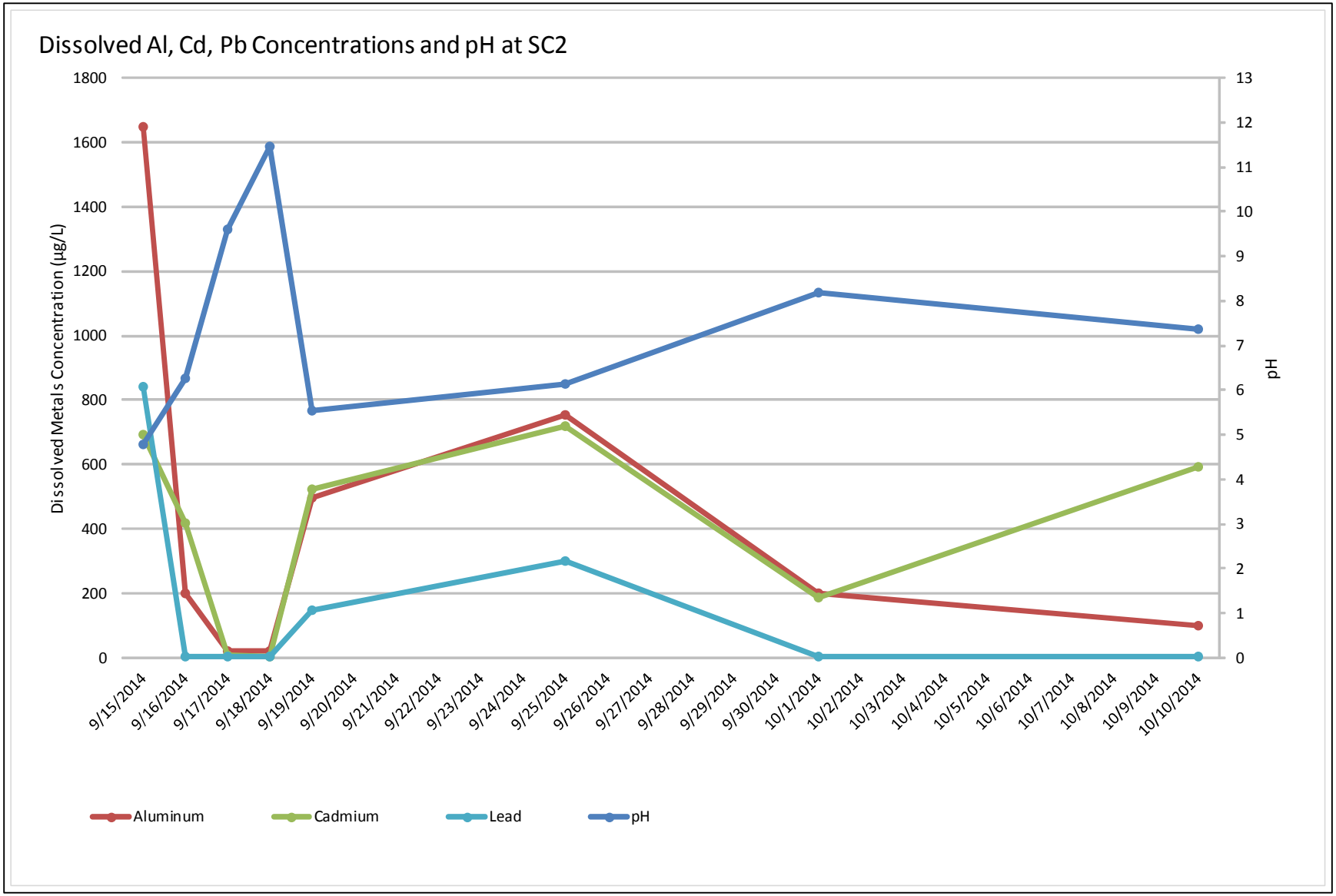
SCALE: NO SCALE

CARPENTER-SNOW CREEK MINING DISTRICT
NATIONAL PRIORITIES LIST SITE

FIGURE 3-1
SULFATE REDUCING BIOREATOR

TETRA TECH

Figure 3-1_Sulfate Reducing Bioreactor - 04/28/2015



CARPENTER-SNOW CREEK MINING DISTRICT
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FIGURE 4-1

DISSOLVED Al, Cd, Pb CONCENTRATIONS AND pH AT SC2

TETRA TECH

CAD DRAWING BY DOUG HEROLD TTEMI-HELENA - Figure 4-1_Dissolved Al Cd Pb and pH at SC2.dwg - 04/28/2015

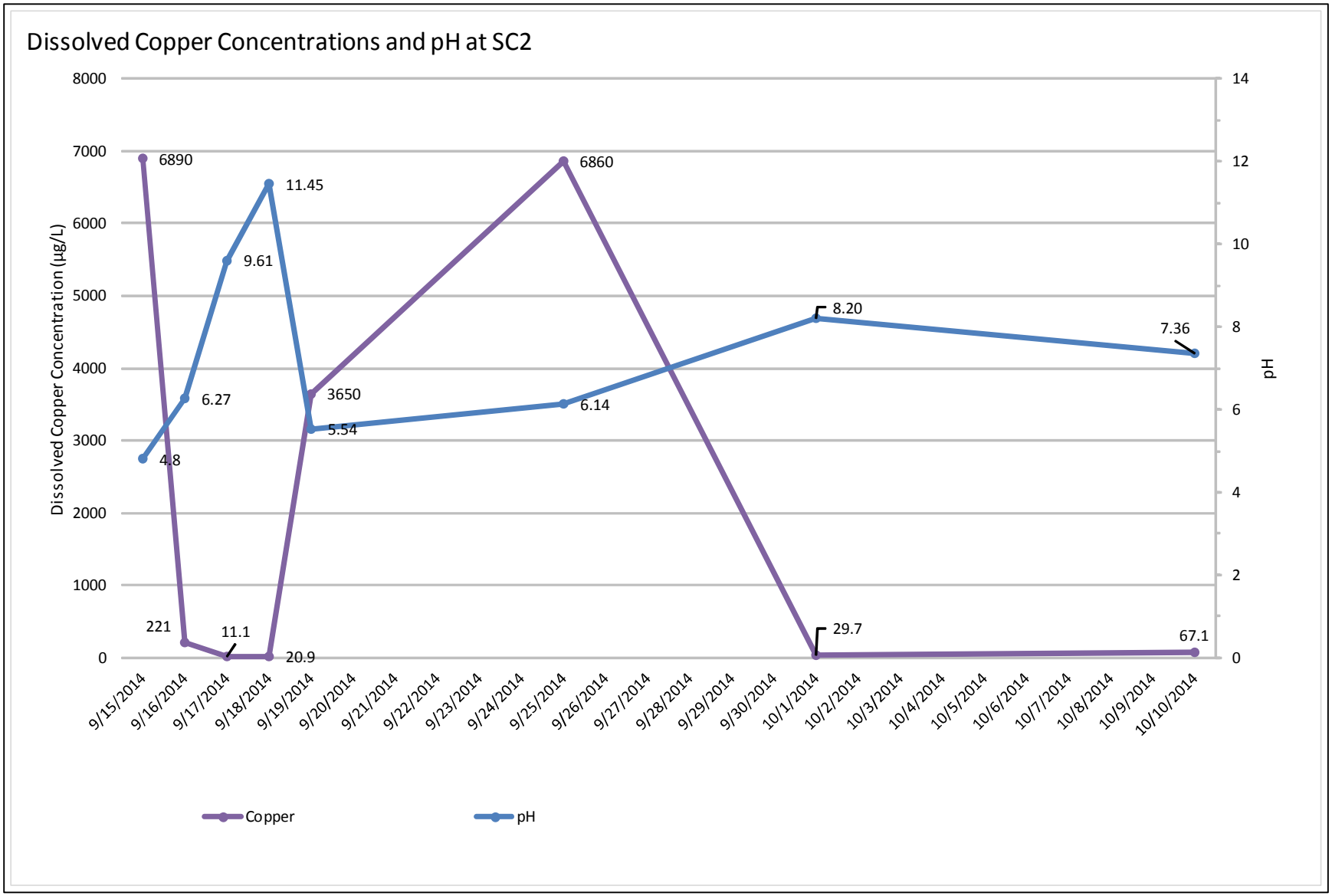

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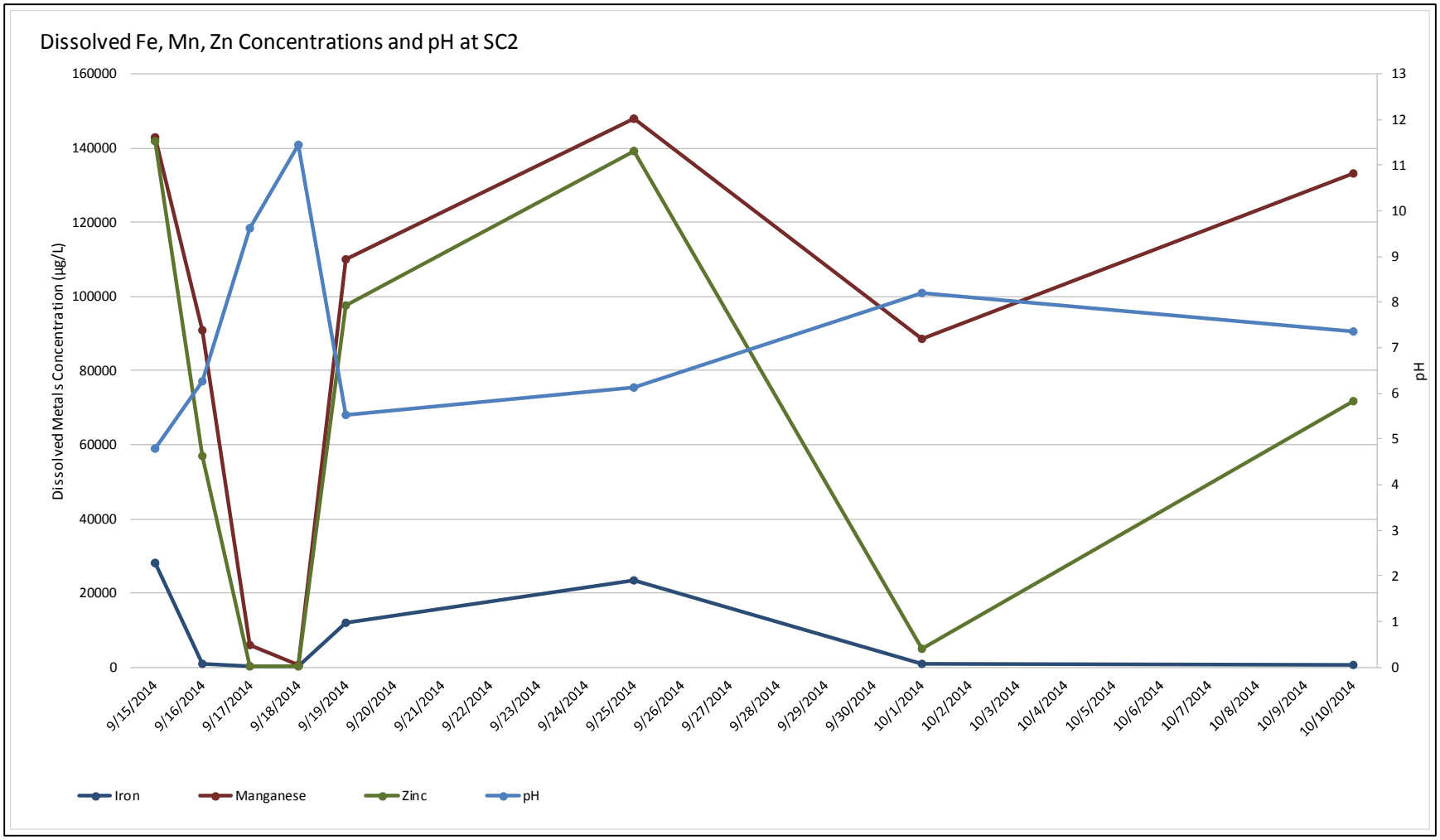
FIGURE 4-2

DISSOLVED COPPER CONCENTRATIONS AND pH AT SC2

TETRA TECH

CAD DRAWING BY DOUG HEROLD TTEMI-HELENA - Figure 4-2_Dissolved Copper and pH at SC2.dwg - 04/28/2015



CARPENTER-SNOW CREEK MINING DISTRICT
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FIGURE 4-3

DISSOLVED Fe, Mn, Zn CONCENTRATIONS AND pH AT SC2

TETRA TECH

CAD DRAWING BY DOUG HEROLD TTEMI-HELENA - Figure 4-3_Dissolved Fe Mn Zn and pH at SC2 - 04/28/2015

TABLES

** Sample label names were altered from the way they were described in the 2014 SAP Addendum.

SAP Description: SDAQX_1-SW-L-00X_2

SDAQ Prefix, denoting that the Aquafix would be installed at the Silver Dyke Adit (SD)
X_1 denotes various sampling locations:

1 Silver Dyke Adit (pipe discharge)
2 At first precipitation basin outlet
3 On Sih'mem Creek before the confluence of Carpenter Creek
4 A background location on Carpenter Creek
5 After the confluence of Sih'mem Creek and Carpenter Creek
6 On Carpenter Creek before the confluence of Snow Creek
7 On Carpenter Creek after the confluence of Snow Creek
8 The mouth of Carpenter Creek
9 A background location on Belt Creek
10 On Belt Creek after the confluence of Carpenter Creek

The L describes that the samples would be analyzed in a laboratory
X_2 represents the sample number

Sample Name, Belt Creek Example: AQBC1-SW-0X_2

No SD was included, only that the samples were related to the Aquafix (AQ)
Acronyms were used to better denote the sampling locations, by the location on the stream

SC1 Silver Dyke Adit (pipe discharge)
SC2 At first precipitation basin outlet
SC3 On Sih'mem Creek before the confluence of Carpenter Creek
CC1 A background location on Carpenter Creek
CC2 After the confluence of Sih'mem Creek and Carpenter Creek
CC3 On Carpenter Creek before the confluence of Snow Creek
CC4 On Carpenter Creek after the confluence of Snow Creek
CC5 The mouth of Carpenter Creek
BC1 A background location on Belt Creek
BC2 On Belt Creek after the confluence of Carpenter Creek

The L was not included in the Surface Water Samples
X_2 represents the sample number

TABLE 3-1
WATER QUALITY PARAMETERS AT SAMPLING POINTS

Site	Measurement/ Sample Name**	Date	Time	pH	Oxidation Reduction Potential (mV)	Dissolved Oxygen (ppm)	Specific Conductivity (µS/cm)	Temperature (ºC)
SC1	AQSC1-SW-01	9/15/2014	1330					
	AQSC1-SW-02	9/16/2014	1530					
	AQSC1-SW-03	9/17/2014	1515					
	AQSC1-SW-04	9/18/2014	1320					
	AQSC1-SW-05	9/19/2014	955	4.70	261.0	2.83	2768	8.68
	AQSC1-SW-06	9/25/2014	1330					
	AQSC1-SW-07	10/1/2014	1130					
	AQSC1-SW-08	10/10/2014	1505					
SC2	AQSC2-SW-01	9/15/2014	1330	4.80	236.4	6.94	2659	7.37
	AQSC2-SW-02	9/16/2014	1545	6.27	164.8	6.41	2805	9.80
	AQSC2-SW-03	9/17/2014	1530	9.61	99.3	4.23	2756	14.13
	AQSC2-SW-04	9/18/2014	1330	11.45	-12.0	4.92	2700	10.80
	AQSC2-SW-05	9/19/2014	1010	5.54	179.0	5.85	2728	8.88
	SC2- mmt	9/22/2014	1045	8.01	171.2	6.35	2752	9.05
	SC2- mmt	9/23/2014	1000	7.33	222.1	5.71	2765	8.56
	SC2- mmt	9/24/2014	1200	7.77	234.5	6.50	2764	10.34
	SC2- mmt	9/25/2014	930	6.48	105.3	6.13	2727	9.39
	AQSC2-SW-06	9/25/2014	1340	6.14	118.2	7.48	2884	10.69
	SC2- mmt	9/26/2014	830	7.63	285.1	6.10	2796	8.81
	AQSC2-SW-07	10/1/2014	1150	8.20	117.4	3.09	2763	11.55
	SC2- mmt	10/6/2014	945	8.34	16.8	3.19	2755	8.62
	SC2- mmt	10/7/2014	1025	8.27	199.9	4.99	2772	8.83
	SC2- mmt	10/8/2014	1145	8.19	216.1	3.30	2689	9.73
	AQSC2-SW-08	10/10/2014	1510	7.36	222.3	4.88	2863	14.13
SC3	AQSC3-SW-01	9/15/2014	1145	5.00	203.8	3.26	1041	9.95
	AQSC3-SW-02	9/16/2014	1640	4.47	337.0	5.60	1153	9.70
	AQSC3-SW-03	9/17/2014	1605	5.53	307.9	6.32	1160	10.84
	AQSC3-SW-04	9/18/2014	1545	5.30	290.0	6.72	1120	10.80
	AQSC3-SW-05	9/19/2014	1040	4.52	300.0	5.50	1128	9.39
	AQSC3-SW-06	9/25/2014	1550	5.24	216.4	5.74	1083	15.42
	AQSC3-SW-07	10/1/2014	1320	7.79	166.9	7.73	1053	8.33
	AQSC3-SW-08	10/10/2014	1610	7.10	230.5	5.75	1258	12.80
CC4	AQCC4-SW-01	9/15/2014	1220	7.28	147.1	3.09	127	12.11
	AQCC4-SW-02	9/16/2014	1810	7.69	177.2	7.78	164	10.78
	AQCC4-SW-03	9/17/2014	1725	7.66	232.0	7.53	163	12.50
	AQCC4-SW-04	9/18/2014	1620	7.50	203.0	7.47	163	12.40
	AQCC4-SW-05	9/19/2014	1125	7.40	151.0	8.08	181	8.64
	AQCC4-SW-06	9/25/2014	1630	7.64	140.4	7.08	175	15.44
	AQCC4-SW-07	10/1/2014	1345	8.17	143.2	8.06	212	7.78
	AQCC4-SW-08	10/10/2014	1645	7.96	195.1	7.63	177	10.99
CC5	AQCC5-SW-01	9/15/2014	1235	7.73	161.4	3.38	134	10.52
	AQCC5-SW-02	9/16/2014	1820	7.87	158.3	8.04	165	10.98
	AQCC5-SW-03	9/17/2014	1735	7.75	230.0	7.78	164	12.52
	AQCC5-SW-04	9/18/2014	1645	7.82	180.0	7.63	166	12.10
	AQCC5-SW-05	9/19/2014	1145	7.62	147.0	8.22	169	9.15
	AQCC5-SW-06	9/25/2014	1645	7.90	137.0	7.61	174	13.00
	AQCC5-SW-07	10/1/2014	1400	8.27	139.8	8.66	197	6.64
BC1	AQCC5-SW-08	10/10/2014	1700	8.14	198.0	8.24	181	8.37
	AQBC1-SW-01	9/15/2014	1240	8.18	153.3	3.63	140	8.48
	AQBC1-SW-02	9/16/2014	1825	8.36	137.0	8.24	170	9.75
	AQBC1-SW-03	9/17/2014	1750	8.35	217.0	8.08	168	11.00
	AQBC1-SW-04	9/18/2014	1655	8.45	158.0	7.95	166	10.40
	AQBC1-SW-05	9/19/2014	1150	8.25	151.0	8.47	171	9.32
	AQBC1-SW-06	9/25/2014	1650	8.32	135.1	7.84	176	11.36
	AQBC1-SW-07	10/1/2014	1405	8.35	124.1	8.46	170	7.67
	AQBC1-SW-08	10/10/2014	1710	8.37	193.8	8.63	172	7.40
BC2	AQBC2-SW-01	9/15/2014	1245	7.84	155.1	3.48	132	9.00
	AQBC2-SW-02	9/16/2014	1830	8.22	147.7	8.18	168	10.07
	AQBC2-SW-03	9/17/2014	1740	8.10	217.0	7.86	167	11.60
	AQBC2-SW-04	9/18/2014	1635	7.94	175.0	7.67	168	11.23
	AQBC2-SW-05	9/19/2014	1135	7.63	137.0	8.25	170	9.16
	AQBC2-SW-06	9/25/2014	1655	8.18	134.6	7.97	176	11.77
	AQBC2-SW-07	10/1/2014	1410	8.36	135.4	8.72	178	7.35
	AQBC2-SW-08	10/10/2014	1720	8.30	195.3	8.54	172	7.65

Notes:
** Measurements correspond with time of Sample noted.

AQ	Aquafix (related measurement/sample)
SC1	Sampling Point at Silver Dyke Adit (pipe discharge)
SC2	Sampling Point at first precipitation basin outlet
SC3	Sampling Point on Sih'mem Creek before the confluence of Carpenter Creek
CC4	Carpenter Creek sampling point upstream of Sih'mem Creek confluence
CC5	Carpenter Creek sampling point downstream of Sih'mem Creek confluence
BC1	Belt Creek sampling point upstream of Carpenter Creek confluence
BC2	Belt Creek sampling point downstream of Carpenter Creek confluence
mmt	measurement taken at sampling point
mV	milli-volts
ppm	parts per million
µS/cm	micro-Siemens per centimeter
ºC	degrees Celcius

TABLE 4-1
SIH'MEM CREEK SURFACE ANALYTICAL RESULTS

Location	Sih'mem Creek Sampling Point 1															
Sample ID	AQSC1-SW-01	AQSC1-SW-01	AQSC1-SW-02	AQSC1-SW-02	AQSC1-SW-03	AQSC1-SW-03	AQSC1-SW-04	AQSC1-SW-04	AQSC1-SW-05	AQSC1-SW-05	AQSC1-SW-06	AQSC1-SW-06	AQSC1-SW-07	AQSC1-SW-07	AQSC1-SW-08	AQSC1-SW-08
Date	9/15/2014	9/15/2014	9/16/2014	9/16/2014	9/17/2014	9/17/2014	9/18/2014	9/18/2014	9/19/2014	9/19/2014	9/25/2014	9/25/2014	10/1/2014	10/1/2014	10/10/2014	10/10/2014
Analysis	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals
Aluminum (µg/L)	1350 D	1400 D	1400 D	1480 D	1390 D	1490 D	1410 D	1530 D	1420 D	1580 D	1450 D	1580 D	1480	1560 D	1300 D	1270 D
Antimony (µg/L)	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<0.500 U	<2.50 U
Arsenic (µg/L)	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	1.84 J	<2.50 U
Barium (µg/L)	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<5.00 U	<25.0 U
Beryllium (µg/L)	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<2.00 U	<20.0 U	<10.0 U	<10.0 U
Cadmium (µg/L)	731 D	732 D	739 D	770 D	732 D	779 D	729 D	787 D	709 D	789 D	719 D	735 D	749 D	796 D	741	730 D
Calcium (µg/L)	317000 D	310000 D	310000 D	307000 D	302000 D	310000 D	300000 D	308000 D	291000 D	314000 D	301000 D	322000 D	336000	319000 D	340000 D	334000 D
Chromium (µg/L)	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<1.00 U	<5.00 U
Cobalt (µg/L)	246 D	272 D	237 D	267 D	231 D	263 D	237 D	280 D	229 D	277 D	258 D	262 D	236 D	274 D	237	263 D
Copper (µg/L)	7720 D	8590 D	7740 D	8760 D	7670 D	8750 D	8060 D	9400 D	7960 D	9540 D	9050 D	9220 D	8070 D	9370 D	7060	7350 D
Hardness (µg/L)	1350 D		1330 D		1290 D		1280 D		1250 D		1290 D		1410		1430 D	
Iron (µg/L)	35200 D	37800 D	33200 D	37300 D	32700 D	37700 D	31200 D	36800 D	34600 D	40900 D	31100 D	38000 D	31800	35100 D	35300 D	38100 D
Lead (µg/L)	684 D	763 D	679 D	786 D	679 D	754 D	655 D	763 D	674 D	769 D	606 D	702 D	630 D	721 D	595	698 D
Magnesium (µg/L)	135000 D	132000 D	134000 D	132000 D	130000 D	136000 D	130000 D	134000 D	126000 D	135000 D	131000 D	137000 D	139000	140000 D	142000 D	140000 D
Manganese (µg/L)	149000 D	147000 D	148000 D	147000 D	145000 D	149000 D	146000 D	151000 D	141000 D	151000 D	147000 D	153000 D	101000	155000 D	146000 D	143000 D
Nickel (µg/L)	280 D	298 D	264 D	300 D	260 D	291 D	270 D	310 D	254 D	308 D	294 D	291 D	261 D	304 D	258	280 D
Potassium (µg/L)	4590 JD	4640 JD	4580 JD	4580 JD	4410 JD	4700 JD	4320 JD	4800 JD	4200 JD	4650 JD	4340 JD	4560 JD	5260	4780 JD	3510 JD	4120 JD
Selenium (µg/L)	<10.0 U	<10.0 U	<10.0 U	<10.0 U	10.1 JD	10.6 JD	<10.0 U	<10.0 U	10.2 JD	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	4.82	7 JD
Silver (µg/L)	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<0.500 U	<2.50 U
Sodium (µg/L)	6820 JD	6690 JD	6790 JD	6610 JD	6450 JD	6820 JD	6460 JD	6720 JD	6230 JD	6610 JD	6410 JD	6430 JD	7100	6870 JD	6940 D	6860 D
Thallium (µg/L)	<5.00 U	7.94 JD	<5.00 U	12.9 D	<5.00 U	12.3 D	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	0.748 J	<2.50 U
Vanadium (µg/L)	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<2.00 U	<10.0 U
Zinc (µg/L)	147000 D	145000 D	147000 D	143000 D	142000 D	147000 D	144000 D	151000 D	138000 D	147000 D	147000 D	150000 D	132000	152000 D	148000 D	142000 BD

Notes:

AQSC1	Aquafix, Sih'mem Creek Sampling Point 1	<	less than detection limit
AQSC2	Aquafix, Sih'mem Creek Sampling Point 2	D	The reported value is from a dilution
AQSC3	Aquafix, Sih'mem Creek Sampling Point 3	U	Element was analyzed for but not detected above the Method Detection Limit
SW	Surface Water	J	Estimated because quality control criteria were not met
µg/L	micrograms per liter		
NC	Not calculated		

TABLE 4-1
SIH'MEM CREEK SURFACE ANALYTICAL RESULTS

Location	Sih'mem Creek Sampling Point 2															
Sample ID	AQSC2-SW-01	AQSC2-SW-01	AQSC2-SW-02	AQSC2-SW-02	AQSC2-SW-03	AQSC2-SW-03	AQSC2-SW-04	AQSC2-SW-04	AQSC2-SW-05	AQSC2-SW-05	AQSC2-SW-06	AQSC2-SW-06	AQSC2-SW-07	AQSC2-SW-07	AQSC2-SW-08	AQSC2-SW-08
Date	9/15/2014	9/15/2014	9/16/2014	9/16/2014	9/17/2014	9/17/2014	9/18/2014	9/18/2014	9/19/2014	9/19/2014	9/25/2014	9/25/2014	10/1/2014	10/1/2014	10/10/2014	10/10/2014
Analysis	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals
Aluminum (µg/L)	1650 D	1890 D	<200 U	282 JD	<20.0 U	1430	<20.0 U	<20.0 U	495 JD	853 D	754 D	1110 D	<200 U	1210 D	<100 U	320 D
Antimony (µg/L)	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<2.50 U	<5.00 U	<2.50 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<0.500 U	<2.50 U
Arsenic (µg/L)	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<2.50 U	<5.00 U	<2.50 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	0.871 J	<2.50 U
Barium (µg/L)	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<25.0 U	<50.0 U	<25.0 U	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<50.0 U	<5.00 U	<25.0 U
Beryllium (µg/L)	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<10.0 U	<10.0 U
Cadmium (µg/L)	693 D	754 D	420 D	451 D	8.38 D	38 D	1.88 D	1.52 JD	523 D	546 D	718 D	713 D	187 D	582 D	592	614 D
Calcium (µg/L)	304000 D	310000 D	469000 D	468000 D	700000	692000	766000	766000	424000 D	441000 D	335000 D	336000 D	466000 D	483000 D	427000 D	419000 D
Chromium (µg/L)	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<5.00 U	11.5 JD	5.61 JD	14.5 JD	<10.0 U	<10.0 U	<10.0 UJ	<10.0 U	<10.0 U	<10.0 U	<1.00 U	<5.00 U
Cobalt (µg/L)	223 D	267 D	114 D	132 D	3.03 D	15.3 D	1.54 D	1.58 JD	168 D	195 D	251 JD	240 D	48.7 D	201 D	188	213 D
Copper (µg/L)	6890 D	8070 D	221 D	1540 D	11.1 D	137 D	20.9 D	21.2 D	3650 D	4650 D	6860 JD	6840 D	29.7 D	5500 D	67.1	1230 D
Hardness (µg/L)	1290 D		1570 D		1910		1950		1480 D	NC	1400 D	NC	1640 D	NC	1620 D	NC
Iron (µg/L)	28200 D	32000 D	<1000 U	4910 D	<100 U	4570	<100 U	<100 U	11900 D	16300 D	23300 D	28500 D	<1000 U	21200 D	<500 U	6250 D
Lead (µg/L)	841 D	1020 D	3.55 D	89.5 D	3.31 D	197 D	2.65 D	3.2 D	149 D	301 D	302 D	493 D	1.87 JD	296 D	3.53	122 D
Magnesium (µg/L)	129000 D	131000 D	95800 D	96900 D	39100	41000	9300	9220	102000 D	105000 D	137000 D	135000 D	116000 D	130000 D	135000 D	133000 D
Manganese (µg/L)	143000 D	144000 D	90700 D	92200 D	6010	13100	446	338	110000 D	112000 D	148000 D	147000 D	88600 D	120000 D	133000 D	130000 D
Nickel (µg/L)	245 D	290 D	107 D	125 D	<2.50 U	<5.00 U	<2.50 U	<5.00 U	184 D	206 D	274 JD	268 D	34.7 D	204 D	178	210 D
Potassium (µg/L)	4500 JD	4600 JD	4640 JD	4860 JD	5370	5850	5490	5630	4600 JD	4940 JD	4670 JD	4340 JD	4620 JD	4640 JD	3660 JD	3880 JD
Selenium (µg/L)	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<5.00 U	<10.0 U	<5.00 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	2.35	
Silver (µg/L)	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<2.50 U	<5.00 U	<2.50 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<0.500 U	<2.50 U
Sodium (µg/L)	6550 JD	6610 JD	6640 JD	6660 JD	6630	6970	6740	6920	6630 JD	6840 JD	6800 JD	6340 JD	6500 JD	6740 JD	6990 D	6930 D
Thallium (µg/L)	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<2.50 U	<5.00 U	<2.50 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	11.2 D	<5.00 U	<5.00 U	0.705 J	11.8 D
Vanadium (µg/L)	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<10.0 U	<20.0 U	<10.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 UJ	<20.0 U	<20.0 U	<20.0 U	<2.00 U	<10.0 U
Zinc (µg/L)	142000 D	142000 D	57000 D	59900 D	398	3520	350	284	97500 D	99100 D	139000 D	135000 D	4980 D	94800 D	71600 D	80400 BD

Notes:

AQSC1	Aquafix, Sih'mem Creek Sampling Point 1	<	less than detection limit
AQSC2	Aquafix, Sih'mem Creek Sampling Point 2	D	The reported value is from a dilution
AQSC3	Aquafix, Sih'mem Creek Sampling Point 3	U	Element was analyzed for but not detected above the Method Detection Limit
SW	Surface Water	J	Estimated because quality control criteria were not met
µg/L	micrograms per liter		
mg/L	milligrams per liter		

TABLE 4-1
SIH'MEM CREEK SURFACE ANALYTICAL RESULTS

Location	Sih'mem Creek Sampling Point 3															
Sample ID	AQSC3-SW-01	AQSC3-SW-01	AQSC3-SW-02	AQSC3-SW-02	AQSC3-SW-03	AQSC3-SW-03	AQSC3-SW-04	AQSC3-SW-04	AQSC3-SW-05	AQSC3-SW-05	AQSC3-SW-06	AQSC3-SW-06	AQSC3-SW-07	AQSC3-SW-07	AQSC3-SW-08	AQSC3-SW-08
Date	9/15/2014	9/15/2014	9/16/2014	9/16/2014	9/17/2014	9/17/2014	9/18/2014	9/18/2014	9/19/2014	9/19/2014	9/25/2014	9/25/2014	10/1/2014	10/1/2014	10/10/2014	10/10/2014
Analysis	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals
Aluminum (µg/L)	3040	3180	29.3 J	3120	2980	3180	3160	3120	3220	3270	2940	4850 D	279	8910	3620 D	1680 D
Antimony (µg/L)	<2.50 U	<2.50 U	<0.500 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<5.00 U	<5.00 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U
Arsenic (µg/L)	<2.50 U	<2.50 U	<0.500 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<5.00 U	10.3 JD	<2.50 U	3.39 JD	<2.50 U	<2.50 U
Barium (µg/L)	<25.0 U	<25.0 U	17.6	<25.0 U	<25.0 U	<25.0 U	<25.0 U	<25.0 U	<25.0 U	<25.0 U	<50.0 U	219 D	50.1 D	73.8 D	40 JD	<25.0 U
Beryllium (µg/L)	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<20.0 U	<2.00 U	<2.00 U	<10.0 U	<10.0 U
Cadmium (µg/L)	224 D	236 D	5.96	234 D	234 D	243 D	233 D	242 D	244 D	246 D	249 D	239 D	147 D	161 D	218 D	212 D
Calcium (µg/L)	118000	118000	10900	120000	127000	123000	127000	121000	128000	124000	130000	127000 D	135000	134000	163000 D	156000 D
Chromium (µg/L)	<5.00 U	<5.00 U	<1.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<10.0 UJ	<10.0 U	<5.00 U	11 JD	5.06 JD	<5.00 U
Cobalt (µg/L)	3.69 D	4.38 D	<0.100 U	4.18 D	4.9 D	5.05 D	4.22 D	5.42 D	4.64 D	5.16 D	9.49 JD	10.7 D	23.9 D	36.1 JD	44.3 D	38.7 D
Copper (µg/L)	2600 D	3220 D	44.1	3200 D	2600 D	3200 D	2470 D	3060 D	2480 D	3160 D	3220 JD	3390 D	555 D	1900 JD	1760 D	1710 D
Hardness (µg/L)	472	NC	44	NC	502	NC	501	NC	509	NC	519	NC	504	NC	634 D	NC
Iron (µg/L)	<100 U	199 J	<100 U	<100 U	101 J	147 J	<100 U	<100 U	149 J	303	199 J	12400 D	<100 U	6840	2750 D	569 JD
Lead (µg/L)	129 D	153 D	3.66	153 D	720 D	207 D	241 D	209 D	285 D	229 D	682 D	2290 D	44.3 D	359 D	233 D	172 D
Magnesium (µg/L)	43000	43100	4150	43400	44700	44500	44900	44100	46100	45000	47300	46500 D	40700	43000	54900 D	51400 D
Manganese (µg/L)	19400	19600	438	19400	20100	20300	20100	20000	20500	20200	21400	23900 D	27400	28100	40600 D	38000 D
Nickel (µg/L)	76.4 D	91.1 D	1.8	89.2 D	75.4 D	91.8 D	72.6 D	89.5 D	73.8 D	89.5 D	95 JD	89.9 D	46.1 D	67.3 JD	80.5 D	76.9 D
Potassium (µg/L)	2650	2720	829 J	2750	2740	2770	2630	2640	2670	2730	2850	3510 JD	2720	3510	1990 JD	1640 JD
Selenium (µg/L)	<5.00 U	<5.00 U	<1.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<10.0 U	<10.0 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U
Silver (µg/L)	<2.50 U	<2.50 U	<0.500 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<5.00 U	10.2 D	<2.50 U	<2.50 U	<2.50 U	<2.50 U
Sodium (µg/L)	5790	5890	1670	6190	5910	6070	5950	5920	6070	6070	6310	5820 JD	5570	5710	6140 D	6080 D
Thallium (µg/L)	<2.50 U	<2.50 U	<0.500 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<2.50 U	<5.00 U	10.3 D	<2.50 U	<2.50 U	<2.50 U	2.66 JD
Vanadium (µg/L)	<10.0 U	<10.0 U	<2.00 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<10.0 U	<20.0 UJ	<20.0 U	<10.0 U	<10.0 UJ	<10.0 U	<10.0 U
Zinc (µg/L)	38600	38100	994	37300	39200	39200	40300	37900	40500	39400	41000	42400 D	24600	25600	35800 D	34100 BD

Notes:

AQSC1	Aquafix, Sih'mem Creek Sampling Point 1	<	less than detection limit
AQSC2	Aquafix, Sih'mem Creek Sampling Point 2	D	The reported value is from a dilution
AQSC3	Aquafix, Sih'mem Creek Sampling Point 3	U	Element was analyzed for but not detected above the Method Detection Limit
SW	Surface Water	J	Estimated because quality control criteria were not met
µg/L	micrograms per liter		
mg/L	milligrams per liter		

TABLE 4-2
CARPENTER CREEK SURFACE WATER ANALYTICAL RESULTS

Location	Carpenter Creek Sampling Point 1							
Sample ID Date Analysis	AQCC1-SW-01 9/15/2014 Dissolved Metals	AQCC1-SW-02 9/16/2014 Dissolved Metals	AQCC1-SW-03 9/17/2014 Dissolved Metals	AQCC1-SW-04 9/18/2014 Dissolved Metals	AQCC1-SW-05 9/19/2014 Dissolved Metals	AQCC1-SW-06 9/25/2014 Dissolved Metals	AQCC1-SW-07 10/1/2014 Dissolved Metals	AQCC1-SW-08 10/10/2014 Dissolved Metals
Aluminum (µg/L)	90.5	71.0	<20.0 U	22.3 J	<20.0 U	58.9	29.7 J	<20.0 U
Antimony (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Arsenic (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Barium (µg/L)	16.9	17.1	17.7	18.5	17.6	24.1	19.8	18.7
Beryllium (µg/L)	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U
Cadmium (µg/L)	17.3	11.7	3.29	3.56	3.47	5.36	7.11	3.28
Calcium (µg/L)	15300	13000	9910	10000	10300	11700	13800	11900
Chromium (µg/L)	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Cobalt (µg/L)	0.150 J	0.117 J	<0.100 U	<0.100 U	<0.100 U	0.201	0.586	0.15 J
Copper (µg/L)	160	111	32.6	35.0	32.5	74.7	52.2	18.8
Hardness (µg/L)	62	53	40	41	42	47	55	47
Iron (µg/L)	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U
Lead (µg/L)	12.4	9.33	4.67	3.21	1.93	38.9	3.64	1.43
Magnesium (µg/L)	5770	4920	3770	3820	3900	4370	4920	4260
Manganese (µg/L)	1130	766	265	291	286	501	887	301
Nickel (µg/L)	6.77	4.02	0.961 J	1.19	1.11	2.21	2.55	1.33
Potassium (µg/L)	930 J	859 J	808 J	834 J	831 J	920 J	992 J	741 J
Selenium (µg/L)	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Silver (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Sodium (µg/L)	1860	1740	1640	1670	1660	1750	1810	1730
Thallium (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Vanadium (µg/L)	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U
Zinc (µg/L)	2740	1810	581	634	641	984	1280	553

Location	Carpenter Creek Sampling Point 2							
Sample ID Date Analysis	AQCC2-SW-01 9/15/2014 Dissolved Metals	AQCC2-SW-02 9/16/2014 Dissolved Metals	AQCC2-SW-03 9/17/2014 Dissolved Metals	AQCC2-SW-04 9/18/2014 Dissolved Metals	AQCC2-SW-05 9/19/2014 Dissolved Metals	AQCC2-SW-06 9/25/2014 Dissolved Metals	AQCC2-SW-07 10/1/2014 Dissolved Metals	AQCC2-SW-08 10/10/2014 Dissolved Metals
Aluminum (µg/L)	43.5 J	2990	62.0	35.7 J	44.7 J	23.9 J	48.9 J	<20.0 U
Antimony (µg/L)	<0.500 U	<2.50 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Arsenic (µg/L)	<0.500 U	<2.50 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Barium (µg/L)	16.6	<25.0 U	33.8	17.7	20.0	19.3	21.4	18.8
Beryllium (µg/L)	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U
Cadmium (µg/L)	7.03	234 D	6.12	6.33	9.04	5.79	19.6	5.01
Calcium (µg/L)	11200	123000	10700	11200	12400	11700	21500	12800
Chromium (µg/L)	<1.00 U	<5.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Cobalt (µg/L)	<0.100 UJ	4.81 JD	0.176 J	0.115 J	0.144 J	<0.100 U	1.89	0.157 J
Copper (µg/L)	75.0 J	2760 JD	68.6	58.0	79.2	50.4	103	27
Hardness (µg/L)	45	486	44	46	51	47	84	51
Iron (µg/L)	<100 U	<100 U	203 J	<100 U	<100 U	<100 U	<100 U	<100 U
Lead (µg/L)	11.3	305 D	80.4	9.38	25.4	3.40	12.9	1.79
Magnesium (µg/L)	4240	43600	4100	4280	4770	4380	7360	4570
Manganese (µg/L)	528	19900	445	466	689	434	2650	427
Nickel (µg/L)	2.19 J	78.6 JD	2.07	2.12	3.14	2.26	6.92	1.74
Potassium (µg/L)	793 J	2790	871 J	870 J	890 J	912 J	1120	765 J
Selenium (µg/L)	<1.00 U	<5.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Silver (µg/L)	<0.500 U	<2.50 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Sodium (µg/L)	1610	5820	1680	1710	1800	1770	2100	1760
Thallium (µg/L)	<0.500 U	<2.50 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Vanadium (µg/L)	<2.00 UJ	<10.0 UJ	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U
Zinc (µg/L)	1180	40100	958	1070	1480	992	3330	838

Location	Carpenter Creek Sampling Point 3							
Sample ID Date Analysis	AQCC3-SW-01 9/15/2014 Dissolved Metals	AQCC3-SW-02 9/16/2014 Dissolved Metals	AQCC3-SW-03 9/17/2014 Dissolved Metals	AQCC3-SW-04 9/18/2014 Dissolved Metals	AQCC3-SW-05 9/19/2014 Dissolved Metals	AQCC3-SW-06 9/25/2014 Dissolved Metals	AQCC3-SW-07 10/1/2014 Dissolved Metals	AQCC3-SW-08 10/10/2014 Dissolved Metals
Aluminum (µg/L)	23.6 J	24.5 J	36.7 J	27.3 J	26.9 J	33.5 J	43.5 J	<20.0 U
Antimony (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Arsenic (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Barium (µg/L)	24.0	25.4	25.3	25.6	25.8	27.7	28.4	27.3
Beryllium (µg/L)	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U
Cadmium (µg/L)	6.54	6.43	6.13	6.48	6.81	6.07	10.4	6.7
Calcium (µg/L)	14800	15100	15300	15600	16000	17200	21500	19400
Chromium (µg/L)	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Cobalt (µg/L)	0.112 J	<0.100 U	0.101 J	<0.100 U	0.106 J	0.131 J	0.661	0.242
Copper (µg/L)	31.1	34.6	33.5	31.3	36.1	37.8	30.7	25.6
Hardness (µg/L)	56	58	58	59	61	65	79	72
Iron (µg/L)	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U
Lead (µg/L)	1.67	2.49	3.05	1.48	2.57	2.79	2.60	1.53
Magnesium (µg/L)	4710	4870	4880	4920	5020	5320	6170	5730
Manganese (µg/L)	389	382	364	382	401	366	1030	477
Nickel (µg/L)	2.78	2.39	2.16	2.33	2.47	2.78	3.79	2.69
Potassium (µg/L)	1040	1160	1110	1120	1100	1230	1370	1100
Selenium (µg/L)	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Silver (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Sodium (µg/L)	2340	2700	2420	2450	2440	2600	2850	2690
Thallium (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Vanadium (µg/L)	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U
Zinc (µg/L)	1150	1090	982	1030	1180	970	1630	968

Location	Carpenter Creek Sampling Point 4							
Sample ID Date Analysis	AQCC4-SW-01 9/15/2014 Dissolved Metals	AQCC4-SW-02 9/16/2014 Dissolved Metals	AQCC4-SW-03 9/17/2014 Dissolved Metals	AQCC4-SW-04 9/18/2014 Dissolved Metals	AQCC4-SW-05 9/19/2014 Dissolved Metals	AQCC4-SW-06 9/25/2014 Dissolved Metals	AQCC4-SW-07 10/1/2014 Dissolved Metals	AQCC4-SW-08 10/10/2014 Dissolved Metals
Aluminum (µg/L)	28.3 J	26.2 J	25.7 J	23.5 J	23.7 J	37.2 J	20.9 J	<20.0 U
Antimony (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Arsenic (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Barium (µg/L)	23.0	24.2	23.1	23.6	23.8	26.6	26.6	24.3
Beryllium (µg/L)	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U
Cadmium (µg/L)	6.58	6.24	5.59	5.50	6.01	5.36	9.20	5.71
Calcium (µg/L)	14900	15000	15200	15400	15800	16800	20700	18800
Chromium (µg/L)	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Cobalt (µg/L)	0.106 J	0.101 J	0.117 J	0.106 J	0.103 J	0.128 J	0.559	0.173 J
Copper (µg/L)	42.8	29.3	27.2	25.9	33.7	32.1	22.8	18.9
Hardness (µg/L)	57	58	59	59	61	64	77	70
Iron (µg/L)	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U
Lead (µg/L)	3.40	2.11	1.58	1.29	1.70	3.13	1.52	0.621
Magnesium (µg/L)	4820	4880	5030	5050	5210	5370	6140	5710
Manganese (µg/L)	378	364	316	317	341	297	894	402
Nickel (µg/L)	2.32	2.35	2.59	2.51	2.67	2.94	3.38	2.61
Potassium (µg/L)	1010	1090	1070	1080	1060	1210	1330	1050
Selenium (µg/L)	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Silver (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Sodium (µg/L)	2260	2370	2310	2290	2350	2670	2750	2560
Thallium (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Vanadium (µg/L)	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U
Zinc (µg/L)	1160	1080	955	974	1200	943	1520	912

Location	Carpenter Creek Sampling Point 5							
Sample ID Date Analysis	AQCC5-SW-01 9/15/2014 Dissolved Metals	AQCC5-SW-02 9/16/2014 Dissolved Metals	AQCC5-SW-03 9/17/2014 Dissolved Metals	AQCC5-SW-04 9/18/2014 Dissolved Metals	AQCC5-SW-05 9/19/2014 Dissolved Metals	AQCC5-SW-06 9/25/2014 Dissolved Metals	AQCC5-SW-07 10/1/2014 Dissolved Metals	AQCC5-SW-08 10/10/2014 Dissolved Metals
Aluminum (µg/L)	<20.0 U	21.6 J	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U
Antimony (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Arsenic (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Barium (µg/L)	22.8	24.6	24.5	25.4	23.2	27.3	25.8	24.7
Beryllium (µg/L)	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U
Cadmium (µg/L)	4.74	4.07	4.01	3.90	4.52	4.14	6.42	4.56
Calcium (µg/L)	15600	15600	15300	15600	16500	17200	19800	18400
Chromium (µg/L)	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Cobalt (µg/L)	0.103 J	<0.100 U	<0.100 U	<0.100 U	0.112 J	<0.100 U	0.417	0.119 J
Copper (µg/L)	16.1	15.8	16.3	17.6	22.6	17.8	18.1	17.9
Hardness (µg/L)	60	60	59	60	63	65	74	69
Iron (µg/L)	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U
Lead (µg/L)	0.914	0.868	0.776	0.697	0.956	0.731	1.21	0.691
Magnesium (µg/L)	5210	5130	5090	5100	5320	5460	6050	5680
Manganese (µg/L)	237	199	188	189	208	160	577	241
Nickel (µg/L)	2.48	2.11	2.02	1.87	2.81	2.24	3.29	2.46
Potassium (µg/L)	966 J	1040	1040	1070	1000	1140	1210	918 J
Selenium (µg/L)	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	1.04 J
Silver (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Sodium (µg/L)	2250	2220	2230	2250	2220	2360	2510	2400
Thallium (µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Vanadium (µg/L)	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U
Zinc (µg/L)	1010	799	770	801	972	827	1240	936

Notes:

AQCC1	Aquafix, Belt Creek Sampling Point 1	<	less than detection limit
AQCC2	Aquafix, Belt Creek Sampling Point 2	D	The reported value is from a dilution
AQCC3	Aquafix, Belt Creek Sampling Point 3	U	Element was analyzed for but not detected above the Method Detection Limit
AQCC4	Aquafix, Belt Creek Sampling Point 4	J	Estimated because quality control criteria were not met
AQCC5	Aquafix, Belt Creek Sampling Point 5		
SW	Surface Water		
µg/L	micrograms per liter		

TABLE 4-3
BELT CREEK SURFACE WATER ANALYTICAL RESULTS

Location		Belt Creet Sampling Point 1								Belt Creek Sampling Point 2							
Sample ID		AQBC1-SW-01	AQBC1-SW-02	AQBC1-SW-03	AQBC1-SW-04	AQBC1-SW-05	AQBC1-SW-06	AQBC1-SW-07	AQBC1-SW-08	AQBC2-SW-01	AQBC2-SW-02	AQBC2-SW-03	AQBC2-SW-04	AQBC2-SW-05	AQBC2-SW-06	AQBC2-SW-07	AQBC2-SW-08
Date		9/15/2014	9/16/2014	9/17/2014	9/18/2014	9/19/2014	9/25/2014	10/1/2014	10/10/2014	9/15/2014	9/16/2014	9/17/2014	9/18/2014	9/19/2014	9/25/2014	10/1/2014	10/10/2014
Analysis		Dissolved Metals	Dissolved Metals	Dissolved Metals	Dissolved Metals	Dissolved Metals	Dissolved Metals	Dissolved Metals	Dissolved Metals	Dissolved Metals	Dissolved Metals	Dissolved Metals	Dissolved Metals	Dissolved Metals	Dissolved Metals	Dissolved Metals	Dissolved Metals
Aluminum	(µg/L)	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U
Antimony	(µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Arsenic	(µg/L)	<0.500 U	0.519 J	<0.500 U	0.557 J	<0.500 U	0.609 J	<0.500 U	0.817 J	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	0.575 J	<0.500 U	0.579 J
Barium	(µg/L)	108	111	113	111	110	118	106	107	83.9	90.8	83.2	66.3	70.1	99.1	89.7	89.3
Beryllium	(µg/L)	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U
Cadmium	(µg/L)	0.213	0.179 J	0.196 J	0.167 J	0.152 J	0.185 J	0.430	0.173 J	1.32	1.17	1.51	2.06	2.23	1.04	1.64	1.27
Calcium	(µg/L)	18900	19400	19300	19600	19600	20200	19100	20300	18000	18400	17900	17900	18100	19400	19400	19900
Chromium	(µg/L)	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Cobalt	(µg/L)	<0.100 U	<0.100 U	<0.100 U	<0.100 U	<0.100 U	<0.100 U	<0.100 U	<0.100 U	<0.100 U	<0.100 U	<0.100 U	<0.100 U	<0.100 U	<0.100 U	0.128 U	<0.100 U
Copper	(µg/L)	2.20	1.01	0.592 J	0.861 J	0.712 J	1.18	1.98	0.706 J	9.6	5.9	7.8	10.7	10.4	5.33	5.32	6.04
Hardness	(µg/L)	72	73	73	74	74	77	73	77	69	70	68	68	69	74	74	76
Iron	(µg/L)	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U
Lead	(µg/L)	0.567	0.323	0.168 J	0.226	0.201	0.444	0.409	0.207	0.866	0.443	0.773	0.723	0.651	1.2	0.391	1.96
Magnesium	(µg/L)	5920	5960	6010	6060	6150	6470	6130	6450	5720	5780	5630	5630	5730	6180	6120	6300
Manganese	(µg/L)	33.7	22.9	19.3	19.1	19.5	20.9	50.4	32.1	78.8	66.5	78.9	106	110	53.4	164	81.7
Nickel	(µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	0.66 J	0.583 J	0.749 J	1.2	1.12	<0.500 U	0.78 J	<0.500 U
Potassium	(µg/L)	808 J	908 J	886 J	882 J	851 J	992 J	960 J	699 J	815 J	924 J	911 J	957 J	926 J	1020	1000	746 J
Selenium	(µg/L)	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Silver	(µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Sodium	(µg/L)	1560	1620	1600	1600	1630	1760	2100	1700	1730	1790	1780	1910	1920	1860	2150	1850
Thallium	(µg/L)	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U	<0.500 U
Vanadium	(µg/L)	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U
Zinc	(µg/L)	77.4	66.1	66.9	65.7	60.8	56.1	118	91	324	245	305	425	512	225	365	280

Notes:

AQBC1	Aquafix, Belt Creek Sampling Point 1	<	less than detection limit
AQBC2	Aquafix, Belt Creek Sampling Point 2	D	The reported value is from a dilution
SW	Surface Water	U	Element was analyzed for but not detected above the Method Detection Limit
µg/L	micrograms per liter	J	Estimated because quality control criteria were not met

TABLE 4-4
SIH'MEM CREEK SEDIMENTS ANALYTICAL RESULTS

Location		Sih'mem Creek Sampling Point 3
Sample ID		AQSC3-SD-L-001
Date		10/15/2014
Analysis		Total Metals
Aluminum	(mg/kg)	3570 D
Antimony	(mg/kg)	1.73 D
Arsenic	(mg/kg)	30.7 D
Barium	(mg/kg)	491 D
Beryllium	(mg/kg)	<0.998 U
Cadmium	(mg/kg)	7.44 D
Calcium	(mg/kg)	2410 D
Chromium	(mg/kg)	12.5 D
Cobalt	(mg/kg)	8.78 D
Copper	(mg/kg)	1190 D
Iron	(mg/kg)	40600 D
Lead	(mg/kg)	3890 D
Magnesium	(mg/kg)	1820 D
Manganese	(mg/kg)	3170 D
Nickel	(mg/kg)	6.47 D
Potassium	(mg/kg)	1260 D
Selenium	(mg/kg)	<0.998 U
Silver	(mg/kg)	34.9 D
Sodium	(mg/kg)	<125 U
Thallium	(mg/kg)	<0.499 U
Vanadium	(mg/kg)	24.2 D
Zinc	(mg/kg)	1410 D

Notes:

AQSC3	Aquafix, Sih'mem Creek Sampling Point 3
SD	Sediment
mg/kg	milligrams per kilogram dry weight
ID	Identification
<	less than detection limit
D	The reported value is from a dilution
U	Element was analyzed for but not detected above the Method Detection Limit

TABLE 4-5
CARPENTER CREEK SEDIMENTS ANALYTICAL RESULTS

Location		Carpenter Creek Sampling Point 1	Carpenter Creek Sampling Point 2		Carpenter Creek Sampling Point 3	Carpenter Creek Sampling Point 4	Carpenter Creek Sampling Point 5
Sample ID		AQCC1-SD-L-001	AQCC2-SD-L-001	AQCC2-SD-L-001 D	AQCC3-SD-L-001	AQCC4-SD-L-001	AQCC5-SD-L-001
Date		10/15/2014	10/15/2014	10/15/2014	10/15/2014	10/15/2014	10/15/2014
Analysis		Total Metals	Total Metals	Total Metals	Total Metals	Total Metals	Total Metals
Aluminum	(mg/kg)	3060 D	3520 D	3390 D	4210 D	4170 D	4810 D
Antimony	(mg/kg)	2.57 D	2.65 D	2.42 D	1.63 D	0.731 JD	0.682 JD
Arsenic	(mg/kg)	60.3 D	53.1 D	55 D	34.7 D	17.7 D	17.0 D
Barium	(mg/kg)	90.9 D	78.5 D	98.7 D	126 D	73.8 D	87.0 D
Beryllium	(mg/kg)	<0.983 U	<0.992 U	<0.991 U	<0.998 U	<0.990 U	<0.992 U
Cadmium	(mg/kg)	18.0 D	15.7 D	11.7 D	14.1 D	9.7 D	12.1 D
Calcium	(mg/kg)	2130 D	2240 D	2310 D	2400 D	2080 D	2260 D
Chromium	(mg/kg)	8.27 D	7.99 D	7.43 D	8.38 D	8.61 D	7.79 D
Cobalt	(mg/kg)	11.5 D	9.89 D	9.19 D	8.68 D	14.8 D	10.1 D
Copper	(mg/kg)	3350 D	3630 D	3150 D	1820 D	1230 D	1030 D
Iron	(mg/kg)	42300 D	42200 D	37800 D	30200 D	17700 D	21000 D
Lead	(mg/kg)	8940 D	9320 D	8140 D	4760 D	2380 D	2670 D
Magnesium	(mg/kg)	1990 D	1950 D	2080 D	2890 D	3230 D	3470 D
Manganese	(mg/kg)	3790 D	3130 D	3040 D	3430 D	3270 D	3150 D
Nickel	(mg/kg)	9.31 D	8.90 D	9.61 D	9.14 D	10.5 D	11.1 D
Potassium	(mg/kg)	881 D	968 D	887 D	950 D	705 D	646 D
Selenium	(mg/kg)	<0.983 U	<0.992 U	<0.991 U	<0.998 U	<0.990 U	<0.992 U
Silver	(mg/kg)	48.6 D	51.5 D	48.1 D	27.2 D	6.51 D	9.6 D
Sodium	(mg/kg)	<123 U	<124 U	<124 U	<125 U	<124 U	<124 U
Thallium	(mg/kg)	0.514 JD	<0.496 U	NR	<0.499 U	<0.495 U	<0.496 U
Vanadium	(mg/kg)	26.2 D	25.2 D	23.2 D	25.1 D	20.2 D	21.1 D
Zinc	(mg/kg)	2230 D	2350 D	1890 D	2100 D	1540 D	1840 D

Notes:

AQCC1	Aquafix, Belt Creek Sampling Point 1	<	less than detection limit
AQCC2	Aquafix, Belt Creek Sampling Point 2	D	The reported value is from a dilution
AQCC3	Aquafix, Belt Creek Sampling Point 3	U	Element was analyzed for but not detected above the Method Detection Limit
AQCC4	Aquafix, Belt Creek Sampling Point 4	J	Estimated because quality control criteria were not met
AQCC5	Aquafix, Belt Creek Sampling Point 5	ID	Identification
SD	Sediment	NR	Not Reported
mg/kg	milligrams per kilogram dry weight		

TABLE 4-6
BELT CREEK SEDIMENTS ANALYTICAL RESULTS

Location		Belt Creet Sampling Point 1	Belt Creek Sampling Point 2
Sample ID		AQBC1-SD-L-001	AQBC2-SD-L-001
Date		10/15/2014	10/15/2014
Analysis		Total Metals	Total Metals
Aluminum	(mg/kg)	7140 D	5030 D
Antimony	(mg/kg)	<0.498 U	1.61 D
Arsenic	(mg/kg)	9.42 D	19.3 D
Barium	(mg/kg)	266 D	218 D
Beryllium	(mg/kg)	<0.997 U	<1.00 U
Cadmium	(mg/kg)	2.36 D	10.9 D
Calcium	(mg/kg)	2950 D	3150 D
Chromium	(mg/kg)	14.4 D	8.91 D
Cobalt	(mg/kg)	6.27 D	11.1 D
Copper	(mg/kg)	21.7 D	999 JD
Iron	(mg/kg)	18200 D	28800 D
Lead	(mg/kg)	250 D	2700 D
Magnesium	(mg/kg)	4990 D	3280 D
Manganese	(mg/kg)	1290 D	3170 D
Nickel	(mg/kg)	20.4 D	13.6 D
Potassium	(mg/kg)	874 D	768 D
Selenium	(mg/kg)	<0.997 U	<1.00 U
Silver	(mg/kg)	2.13 D	20.1 D
Sodium	(mg/kg)	<125 U	<125 U
Thallium	(mg/kg)	1.22 D	<0.501 U
Vanadium	(mg/kg)	11.6 D	27.1 D
Zinc	(mg/kg)	880 D	1220 D

Notes:

AQBC1	Aquafix, Belt Creek Sampling Point 1
AQBC2	Aquafix, Belt Creek Sampling Point 2
SD	Sediment
mg/kg	milligrams per kilogram dry weight
<	less than detection limit
D	The reported value is from a dilution
U	Element was analyzed for but not detected above the Method Detection Limit
J	Estimated because quality control criteria were not met
ID	Identification

TABLE 4-7
DISSOLVED METALS CONCENTRATIONS IN SIH'MEM CREEK

Analyte [1] (dissolved metals)	SC1		SC2				SC3	
	Minimum	Maximum	at pH 11.5	at pH 9.6	at pH 7.4	at pH 4.8	Minimum	Maximum
Aluminum (µg/L)	1,300	1,480	<20	<20	<100	1,650	29	3,620
Cadmium (µg/L)	709	749	2	8	592	693	6	249
Copper (µg/L)	7,060	9,050	21	11	67	6,890	44	3,220
Iron (µg/L)	31,100	35,300	<100	<100	<500	28,200	<100	2,750
Lead (µg/L)	606	684	3	3	4	841	4	720
Manganese (µg/L)	101,000	149,000	446	6,010	133,000	143,000	438	40,600
Zinc (µg/L)	132,000	148,000	350	398	71,600	142,000	994	41,000

Notes:

SC1	Sampling Point at Silver Dyke Adit (pipe discharge)
SC2	Sampling Point at first precipitation basin outlet
SC3	Sampling Point on Sih'mem Creek before the confluence of Carpenter Creek
(µg/L)	micrograms per liter
1	All dissolved metal concentrations are measured in µg/L. Data provides range of measured concentrations for the September 15 to October 10, 2014 period of record.
<	Less than

TABLE 4-8
BIOREACTOR DISCHARGE ANALYTICAL RESULTS

Location		Bioreactor Sampling Point 1			Bioreactor Sampling Point 2		
Sample ID		AQBR1-SW-01	AQBR1-SW-02	AQBR1-SW-03	AQBR2-SW-01	AQBR2-SW-02	AQBR2-SW-03
Date		9/25/2014	10/1/2014	10/10/2014	9/25/2014	10/1/2014	10/10/2014
Chloride	(mg/L)	NR	15.3 JD	<5.0 U	NR	41.3 D	5.8 JD
Sulfate as SO_4	(mg/L)	NR	1650 D	1910 D	NR	1520 D	1860 D
COD	(mg/L)	65	96	61	46	87	66

Notes:

AQBR	Aquafix Bioreactor
COD	Chemical Oxygen Demand
mg/L	Milligrams per liter
NR	No analytical result available
SW	Surface water
D	The reported value is from a dilution
U	Element was analyzed for but not detected above the Method Detection Limit
J	Estimated because quality control criteria were not met
ID	Identification
<	Less than

APPENDIX A

FIELD NOTES

APPENDIX B

WATER QUALITY PARAMETER DATA

APPENDIX C

LABORATORY ANALYTICAL RESULTS