Impacts from Mine-Drainage to Sediment and Water Quality along the San Juan River and Lake Powell in Utah

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1. Introduction

As a result of efforts to evaluate conditions in the Gold King Mine (GKM) an uncontrolled release of metal-laden mine water began on August 5, 2015. The blow-out discharged to Cement Creek, a tributary of the Animas River. An estimated 3 million gallons of contaminated water was released. Models have predicted that this metal contaminated water traveled downstream to the San Juan River and the ultimate fate of released metals likely resides in the sediments of Lake Powell in southeastern Utah.

The primary objectives of this report were identified in the Utah Department of Environmental Quality's (UDEQ) Long Term Monitoring Plan. We evaluate the historical and response-related water and sediment quality to determine whether metal concentrations and loads pose a risk to the beneficial designated uses in the San Juan River (drinking water, recreation, aquatic life, and agriculture) during different hydrologic conditions. Continuously collected surrogates like turbidity and discharge are compared to metal concentrations to attempt to predict metal loads in the future. We further evaluate metal concentration trends to determine the spill-related resuspension in the context of long-term mining and natural impacts and the distribution of contaminant concentrations in the depositional sediments of the San Juan River. Several sediment cores and depositional sediment traps, collected by the United States Geological Survey (USGS) in the San Juan River delta, are examined to assess ongoing contaminant loading and potential changes in watershed mitigation, management, and treatment efforts.

This report presents the data collection, analysis, and interpretation of initial spill-related, incident-response, water quality sampling beginning on August 8, 2015, as well as an extended period of sampling through July 25, 2016 to evaluate the longer-term transport of metal-laden sediments. To provide context, we compare the spill-related results to historical data collected along the Animas, the San Juan River, and their tributaries. This includes a summary of all data collected throughout the Utah portion of the San Juan River watershed and Lake Powell, spatial variations in water quality constituents, temporal trends, and loading characteristics. All water quality and sediment data was screened against human health and ecological standards for risk characterization and are presented in this report. In addition, UDEQ and the USGS are interested in understanding the potential long-term impacts of sediment accumulation deposited in the San Juan River and Lake Powell. Sediment cores collected in 2010 by USGS in Lake Powell and the Escalante River are analyzed and presented. Finally, multiple USGS-deployed sediment traps located in the Upper portion of Lake Powell are presented and analyzed. The goal of this report is to review and quantify water column, particulate, and sediment metal concentrations in the San Juan River, identification of the transport of materials downstream and the fate in Lake Powell, and quantify contributions from other mine- and hydrologic-sources.

2. Data Compilation

UDEQ Spill-Related Water Quality Data

Monitoring and Data Collection

Three distinct phases of monitoring were conducted over the 12-month period after the GKM release. Upon notification of the August 5, 2015 incident UDEQ deployed monitoring crews and began sampling efforts along the San Juan River in Utah. Monitoring began on August 8, 2015 at four locations in an effort to detect the plume of mine waste as it entered Utah (Monitoring Location Identification-*MLID):*

- *MLID 4954000-San Juan River at US160Xing in CO*;
- *MLID 4953990-San Juan River at Town of Montezuma*;
- *MLID 4953250-San Juan River at Sand Island*; and
- *MLID* 4953000-San Juan *River at* Mexican Hat US163 Xing).

The frequency of sampling tapered from multiple samples per day for the first few days to daily samples per week after the release. The monitoring effort was expanded on August 13, 2015, to include an additional site, to identify the transport of the metals-laden release plume into Lake Powell.

- *MLID 4952942* (*San Juan River at Clay Hills boat ramp*).

After a short hiatus on August 20, 2015, daily sampling continued from August 24, 2015 through August 28, 2015. This initial phase of sampling was accompanied by timely analysis and frequent reporting of water quality results to the public, and the development of a long-term monitoring plan. Sampling locations are provided in Figure 1 and denoted by UDEQ MLID number.

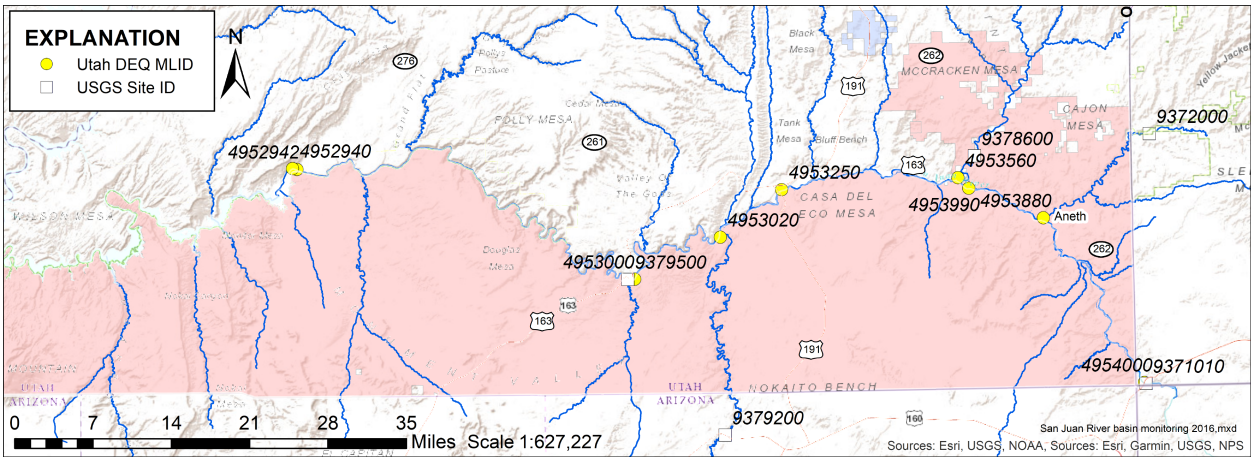

Figure 1 - UDEQ and USGS monitoring locations along the Utah portion of the San Juan River.

Longer-term monitoring began September 22, 2015 and continued through October 15, 2015 with approximately weekly sampling. Sampling activities returned to daily sampling from October 18, 2015 through October 27, 2015. Monitoring locations during these periods were the same five locations described previously. An additional sample was collected on September 23, 2015 from a tributary to the San Juan River (*MLID 4953880–McElmo Creek at U262 Xing near Town of Montezuma*).

To capture spatial and temporal variations in water quality under changing hydrologic conditions such as snowmelt runoff and baseflow, weekly samples were collected from February 16, 2016 through July 25, 2016. The sample locations included those previously described along the San Juan River (*MLID 4954000, 4953990, 4953250, 4953000*, and *4952942*) and three tributaries:

- *MLID 4953880-McElmo Creek at U262 Xing near Town of Montezuma;*
- *MLID 4953560-Montezuma Creek at U163 Xing;* and
- *MLID 4953020-Chinle Creek above Confluence San Juan River.*

Monitoring and reporting to stakeholders and the public about the effects of metals transport on river uses during the 2016 spring runoff event required timely and frequent collection and analysis of water quality samples. Monitoring, cleanup, and remediation activities to-date have been undertaken by multiple sovereign tribes, multi-jurisdictional state agencies, federal agencies, and regional and municipal stakeholder groups. A graphical summary of the entire spill-related sampling and monitoring effort is provided as Figure 2.

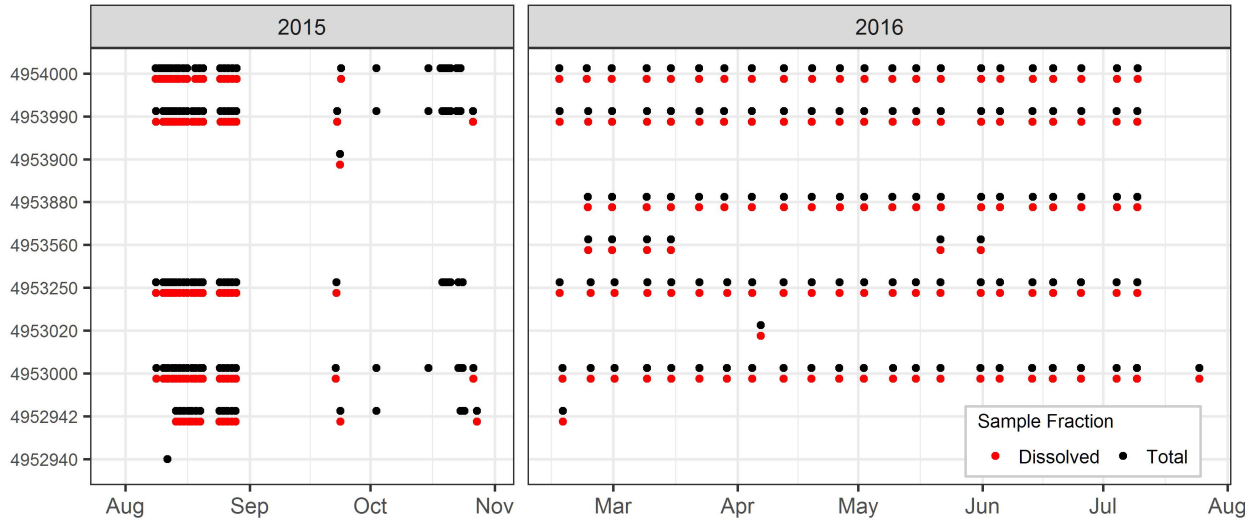

Figure 2 - Time-course of UDEQ spill response and longer-term sampling events for San Juan River monitoring locations in Utah. Monitoring locations are presented on the vertical axis, with sampling dates on the horizontal axis. The two panels depict sampling occasions in 2015 and 2016. Black and red points indicate collections of select metals from total (unfiltered, includes dissolved and particulate) and dissolved (filtered, dissolved only) fractions.

Water Quality Analysis

The initial water quality samples collected in August 2015 were analyzed for both total (dissolved and particulate) and dissolved metals and metalloids. The constituents of concern were generally a combination of metals and metalloids but are referred to in the remainder of this report as metals for simplicity. Subsequent samples collected in September and October, 2015 were most commonly analyzed for total metals with only a few days that included dissolved constituents. Samples collected from February through July of 2016 were typically analyzed for both total and dissolved metals, as well as total nutrients. Samples collected in 2016 also included regular equipment blanks, sample duplicates, and a few field blanks to support quality assurance and control guidelines. A summary of the sample locations monitored during the 2015 and 2016 period as a result of the GKM release is provided in Table 1.

It is expected that many of the dissolved metals released from the GKM and other mines in the Bonita Peak Mining District were rapidly transformed to colloidal forms and became adsorbed to suspended particulates or were otherwise deposited in the stream channel. Therefore, it is imperative to continue to monitor and evaluate the unfiltered or total metals fraction in the future. The USEPA estimates that 80% of the metals released during the GKM incident remain in Animas River sediments and will eventually be transported downstream (EPA 2016a), most likely as suspended particulates of varying grain size.

Table 1 - UDEQ spill-related sampling locations at selected San Juan River and tributary sites.

MLID	UDEQ Location Name	River Kilometers	Collecting Agency	Latitude	Longitude	Min. Sample Date	Max. Sample Date	No. of Date Time Periods	No. of Metals Samples
4954000	San Juan R at US160 Xing in CO	298.74	UDEQ	37.002775	-109.0318	8/8/2015	7/9/2016	57	58
4953880	San Juan R at Mc Elmo Wash	332.89	UDEQ	37.218048	-109.1901	2/23/2016	7/9/2016	21	22
4953990	San Juan R at Town of Montezuma	345.78	UDEQ	37.257788	-109.3098	8/8/2015	7/9/2016	54	57
4953250	San Juan R at Sand Island	377.05	UDEQ	37.260279	-109.6137	8/8/2015	7/9/2016	50	53
4953000	San Juan R at Mexican Hat US163 Xing	421.49	UDEQ	37.146948	-109.8537	8/8/2015	7/25/2016	50	55
4952942	San Juan R at Clay Hills Boat Ramp	510.74	UDEQ	37.293008	-110.3996	8/13/2015	2/17/2016	20	20
4952940	San Juan R ab Lake Powell	511.41	UDEQ	37.294158	-110.4068	8/11/2015	8/11/2015	1	2
4953900	Mc Elmo Ck at Hiway U262 Xing	332.27	UDEQ	37.218048	-109.1901	9/23/2015	9/23/2015	1	1
4953560	Montezuma Ck at U163 Xing	347.8	UDEQ	37.272086	-109.3277	2/23/2016	5/31/2016	6	6
4953020	Chinle Cr above Confluence with San Juan River	390.62	UDEQ	37.199119	-109.7156	4/6/2016	4/6/2016	1	1

Available Historical Water Quality Data

Data Collection and Compilation

Historically, UDEQ has sampled monitoring locations in targeted reaches of the San Juan River and its major Utah tributaries since 1975 (Appendix A; Figure 3; Table 2). Of these, the most recent and data-rich sites on the San Juan River are *MLID 4954000-San Juan River at US160 Xing in CO* and *MLID 4953000-San Juan River at Mexican Hat US163 Xing*.

Historical water quality data was collected and compiled through the publicly available Utah DEQ AWQMS database, the Colorado Department of Environment AWQMS database, and through solicitation of New Mexico Department of the Environment water quality data (K. Pintado, pers. comm.). We created a polygon that covered the Animas River and proximal tributaries to capture records that potentially contributed to and described in-stream water quality. The data was downloaded, compiled, reformatted, and checked for consistencies for further analysis. The process was subsequently repeated for each of the datasets. Only historical surface water quality data was downloaded and analyzed as historical sediment data was not available for the locations highlighted in AWQMS. To date, we have been unable to procure monitoring location and water quality information from the Navajo Nation to corroborate spatial and temporal trends observed in the Utah portion of the San Juan River.

We found that the historical records are generally limited in both space and time along the San Juan River and its tributaries. Historical data availability is primarily based on collection intervals of routine sampling in each state. Utah utilizes a probabilistic survey approach to sample throughout the state on a six year recurring interval. Every six years, 50 randomly selected sampling locations from one of Utah's six UDEQ-defined sub-basins are chosen as sampling locations. This provides a full distribution of the range in topographical, land use, and soil heterogeneity, which can further affect surface water quality conditions. Monitoring locations that are defined as requiring more investigation based on data gaps and/or elevated analytes are subsequently intensively monitored in the UDEQ targeted survey. In

addition, there are a number of site-specific monitoring locations that are assessed based on UDEQ program needs in our programmatic survey. Overall, the probabilistic survey informs UDEQ on the state of Utah's water. The targeted monitoring generally identifies the causes of impairment, and the programmatic monitoring attempts to define the sources of impairment. It appears that a similar monitoring approach is undertaken by each of the state jurisdictions and the Navajo Nation. The monitoring locations compiled through the aforementioned historical data retrieval are shown in Figure 3. A subset of the historical monitoring location data summary is provided in Table 2 and the full set of compiled data is available in Appendix A.

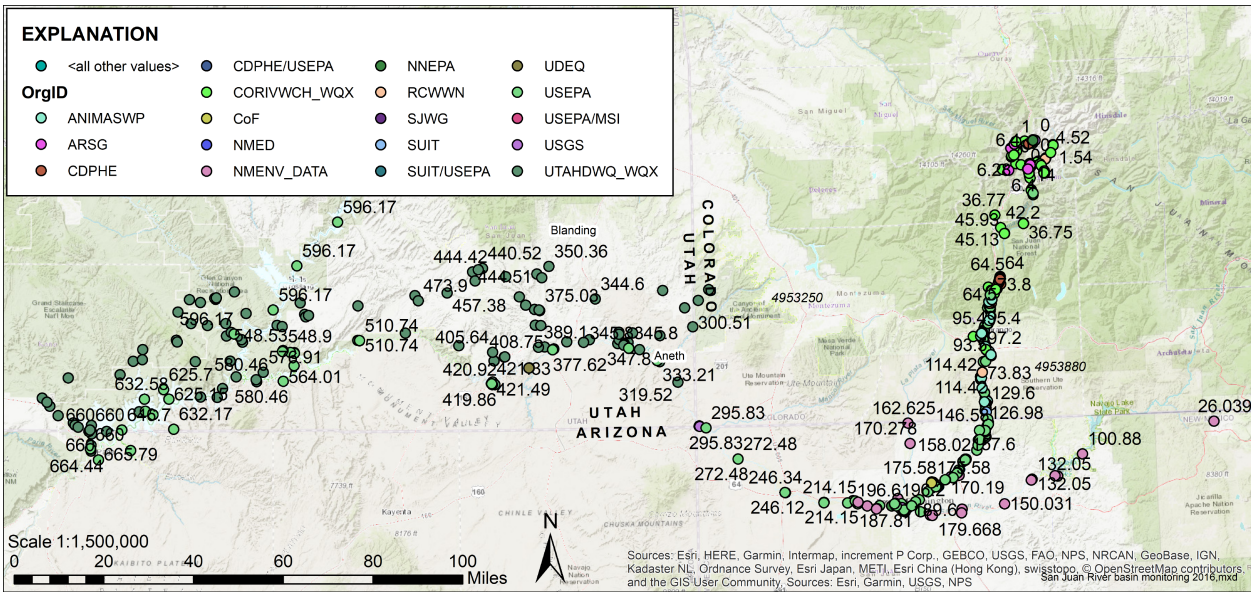

Figure 3 – UDEQ, NMENV, and CODPS historical monitoring locations along the San Juan and Animas Rivers and their associated tributaries. The values for each monitoring location represent the distance from GKM in river kilometers.

Table 2 - UDEQ historical sampling locations at selected San Juan River and tributary sites.

MLID	UDEQ Location Name	River Kilometers	Collecting Agency	Latitude	Longitude	Min. Sample Date	Max. Sample Date	No. of Date Time Periods	No. of Metals Samples
5952450	LAKE POWELL LONE ROCK BEACH EAST 50 M OFF SHORE	666.52	UTAHDWQ_WQX	37.02749	-111.556	9/8/1992	9/8/1992	1	1
4952000	COLORADO R BL GLEN CANYON DAM	664.44	UTAHDWQ_WQX	36.93666	-111.48404	2/4/1976	11/12/1986	46	46
5959240	LAKE POWELL WAHWEAP BAY	661.4	UTAHDWQ_WQX	37.01971	-111.48333	5/18/1992	9/8/1998	87	87
5959510	LAKE POWELL CHA CANYON CHA-1 IN	660	UTAHDWQ_WQX	37.00518	-111.48875	9/14/1988	8/25/1997	72	72
5959490	LAKE POWELL NARROWS NARR	660	UTAHDWQ_WQX	37.00521	-111.48869	5/31/1988	9/2/1997	57	57
5959750	LAKE POWELL MOQUI CANYON MOQUE 1 IN	660	UTAHDWQ_WQX	37.00516	-111.48839	5/31/1988	9/9/1998	143	143
5959430	LAKE POWELL DUNGEON CK DCR-1 IN	660	UTAHDWQ_WQX	37.0051	-111.48869	6/11/1990	9/8/1998	82	82
5959650	LAKE POWELL (DOCKS) BULLFROG MARINA BFMAR-1	660	UTAHDWQ_WQX	37.00519	-111.48848	5/18/1992	9/8/1998	116	116
5959180	LAKE POWELL COVE BAY COVE	660	UTAHDWQ_WQX	37.00519	-111.48902	8/8/1990	6/27/1999	72	72
5959440	LAKE POWELL DUNGEON CK DCR-2 OUT	660	UTAHDWQ_WQX	37.00512	-111.48866	6/11/1990	9/8/1998	43	43
5959840	LAKE POWELL FARLEY CANYON FAR-1 IN	660	UTAHDWQ_WQX	37.00512	-111.4882	6/14/1988	9/17/1998	131	131
5959790	LAKE POWELL HANSEN CK HAN-2 OUT	660	UTAHDWQ_WQX	37.00512	-111.48829	5/31/1994	9/8/1998	66	66
5959820	LAKE POWELL FORGOTTEN CANYON FOR-2 OUT	660	UTAHDWQ_WQX	37.0051	-111.48823	7/27/1992	9/8/1998	60	60
5959390	LAKE POWELL OAK CANYON OAK-1 OUT	660	UTAHDWQ_WQX	37.00521	-111.48869	5/31/1988	9/8/1998	96	96
5959140	LAKE POWELL WAHWEAP PICNIC BEACH WWPB2	660	UTAHDWQ_WQX	37.00514	-111.48914	6/14/1995	5/28/1996	33	33

Available USGS Continuous Discharge and Water Quality Data

Because some of the UDEQ sites had not been sampled in 15 years, UDEQ augmented the historical data with samples collected by other agencies. In addition to regular monitoring of in-situ parameters (discharge, stage height, specific conductance, temperature, pH, turbidity), the U.S. Geological Survey (USGS) also collects water quality samples (Figure 1; Table 2); however, UDEQ was only able to locate one site (*USGS* 03979500-*San Juan River near Bluff, UT*) with an appreciable number of metals results. Cooperative monitoring with the Bureau of Reclamation on Lake Powell was also compiled. For a complete summary of available parameters and summary statistics of UDEQ's data, see Appendix A.

Table 3 - USGS sampling locations at selected San Juan River and tributary sites.

Site ID	USGS Site Name	River Kilometers	Collecting Agency	Latitude	Longitude	Min. Sample Date	Max. Sample Date	No. of Date Time Periods	No. of Metals Samples
09371010	San Juan River at Four Corners, CO	298.53	USGS	37.001	-109.030	12/13/1977	11/30/2016	347	68
09372000	McElmo Cr near Colorado-Utah State Line	298.53	USGS	37.324	-109.016	6/20/1960	4/18/2017	593	49
09379200	Chinle Creek near Mexican Water, AZ	298.53	USGS	36.944	-109.711	5/26/1975	8/29/2000	7	3
09379500	San Juan River near Bluff, UT	420.92	USGS	37.147	-109.865	6/5/1928	4/24/2017	4024	75
371429110382000	San Juan River Inflow at Lake Powell	227.61	USGS	37.241	-109.639	4/14/2024	7/15/2010	8	0
371248110395301	LP 1 San Juan Arm 39 KM Upstream from Main Channel	227.61	USGS	37.213	-109.665	5/31/2014	8/23/2015	7	7
371933109025701	McElmo Creek below Yellow Jacket Canyon	227.61	USGS	37.326	-109.050	3/27/1990	7/12/2005	5	3
371044110540000	San Juan River at Mouth - East Bank	227.61	USGS	37.179	-109.901	4/21/1959	4/21/1959	1	1
09379505	Colorado plus Green plus San Juan (Temp)	420.92	USGS	37.147	-109.864	10/1/1927	9/29/1984	-	-
09379000	Comb Wash near Bluff, UT	298.53	USGS	37.266	-109.675	1/1/1959	9/29/1968	-	-
09378600	Montezuma Creek near Bluff, UT	298.53	USGS	37.300	-109.300	10/1/1985	10/12/1993	-	-
09372200	McElmo Creek near Bluff, UT	298.53	USGS	37.217	-109.183	10/1/1980	10/14/1982	-	-
09368000	San Juan River at Shiprock, NM	246.12	USGS	36.777	-108.683	10/1/1990	8/10/2017	-	-
09365000	San Juan River at Farmington, NM	192.96	USGS	36.723	-108.226	10/1/1990	8/10/2017	-	-
09355500	San Juan River near Archuletta, NM	132.05	USGS	36.802	-107.699	10/1/1991	8/10/2017	-	-
09346400	San Juan River near Carracas, CO	-999	USGS	37.014	-107.312	10/26/1996	8/10/2017	-	-
09364500	Animas River at Farmington, NM	189.6	USGS	36.723	-108.202	10/1/1990	8/10/2017	-	-
09364010	Animas River below Aztec, NM	167.39	USGS	36.818	-108.024	12/19/2002	8/10/2017	-	-
09363500	Animas River near Cedar Hill, NM	129.62	USGS	37.037	-107.875	10/1/1990	8/10/2017	-	-
09362520	Animas River below Durango Pump Plant near Durango, CO	16.35	USGS	37.249	-107.873	3/26/2008	8/10/2017	-	-
09361500	Animas River at Durango, CO	16.35	USGS	37.279	-107.880	10/2/1985	8/10/2017	-	-
09359500	Animas River at Tall Timber Resort above Tacoma, CO	16.35	USGS	37.597	-107.777	8/2/2006	8/10/2017	-	-
09359020	Animas River below Silverton, CO	16.35	USGS	37.790	-107.667	6/9/1994	8/10/2017	-	-
09359010	Mineral Creek at Silverton, CO	12.55	USGS	37.803	-107.672	10/1/1992	8/10/2017	-	-
09358000	Animas River at Silverton, CO	13.9	USGS	37.811	-107.659	10/23/1991	8/10/2017	-	-
09358550	Cement Creek at Silverton, CO	12.55	USGS	37.820	-107.663	10/5/1991	8/10/2017	-	-

3. Sampling Methodology and Laboratory Analysis Comparison

There are a variety of sources of error that can contribute to differences in reported result concentrations. These error sources include temporal and spatial sample heterogeneity, colloid and particulate sample inclusion, sample acidification, sample storage and processing, collection variability, analytical precision, analytical dilutions, and general repeatability. Laboratory analytical methodology can vary between individual constituents, which therefore affect the analytical precision. In this section, we compare 1) metals analysis differences between two field sampling methods (integrated and grab sampling) over five dates at a single site, 2) comparison between laboratory results at five sites on a single date using the grab method, and 3) laboratory result comparison over five dates at a single site for both integrated and grab samples. It is important to note that analytical results that were reported with results qualifiers, such as non-detect or below-reporting-limits were provided with the method detection limit for data analysis.

Comparison of USGS Integrated and UDEQ Grab Sample Methodology Results

In collaboration with the USGS Utah Water Science Center, UDEQ collected concurrent water quality samples at *MLID 4953000-San Juan River at Mexican Hat US163 Xing* (*USGS 09379500-San Juan River near Bluff, UT*) on May 31, 2016, July 25, 2016, April 24, 2017, May 17, 2017, and June 19, 2017. The purpose of these collection events was to compare sampling methods by determining whether there were substantial differences in constituent concentrations between the USGS isokinetic integrated sampling method (USGS, 2006) and the UDEQ grab samples. A second objective was to compare the laboratory analysis results from the USGS National Water Quality Lab (NWQL), the Utah Public Health Laboratory (UPHL), and American West Analytical Laboratories (AWAL).

The USGS collects discharge-weighted, depth-integrated samples in surface waters using isokinetic samplers. Equal discharge increment (EDI) is the most universally applicable discharge-weighted sampling method (USGS, 2006). This method can be used to collect a single composite sample or a series of samples representing each increment of discharge. The EDI method assumes that the concentration of any constituent collected at the centroid of the equal increment of discharge represents the mean concentration in that entire increment of discharge. When using the EDI method and compositing the sample, the total composite sample volume can be estimated on-site before sampling begins because an approximately equal volume (at least the minimum volume shown for the deepest vertical interval) of water is collected at each increment of discharge. The total composite volume can be estimated by multiplying the volume collected at the deepest vertical interval by the number of increments of equal discharge sampled. UDEQ commonly uses a grab sample procedure at a single point in the thalweg or deepest portion of flowing water. This sampling method is based on the presumption that constituent concentrations are consistent throughout the cross-section of the river.

Because the USGS integrated sample incorporates the variability observed in constituent concentrations across the river channel and with depth, this method is considered the most accurate. A key question is the level of uncertainty associated with grab samples because the majority of samples collected since the GKM spill by state jurisdictions, tribes, and municipalities used the grab methodology. Therefore, we compare a split of the May 31, 2016 and July 25, 2016 USGS integrated and UDEQ grab samples that were both analyzed at the UPHL (Figure 4). In addition to UPHL results collected on April 24, 2017, May 17, 2017, and June 19, 2017, we also have NWQL results for USGS integrated and UDEQ grab samples (Figure 4). It should be noted that these samples were split and analyzed separately at UPHL and NWQL.

The UPHL Quality Assurance Project Plan indicates an analytical error between 10 and 25 percent, but this varies between laboratory method, analyte, dilution, and other factors. We used an uncertainty band of 15 percent in an attempt to capture those analytes that deviate between methodological approaches; this 15 percent uncertainty band is conservative, the combined field and laboratory uncertainty is likely significantly broader.

Results indicate that both dissolved and total metal concentrations show reasonably consistent quantitation between methodological approaches of integrated and grab sampling, particularly for the dissolved constituents. There is more variability between methods for the total analytes. These results, presented in Figure 4, are consistent over time with laboratory analysis completed at the UPHL laboratory (blue) or the NWQL laboratory (red).

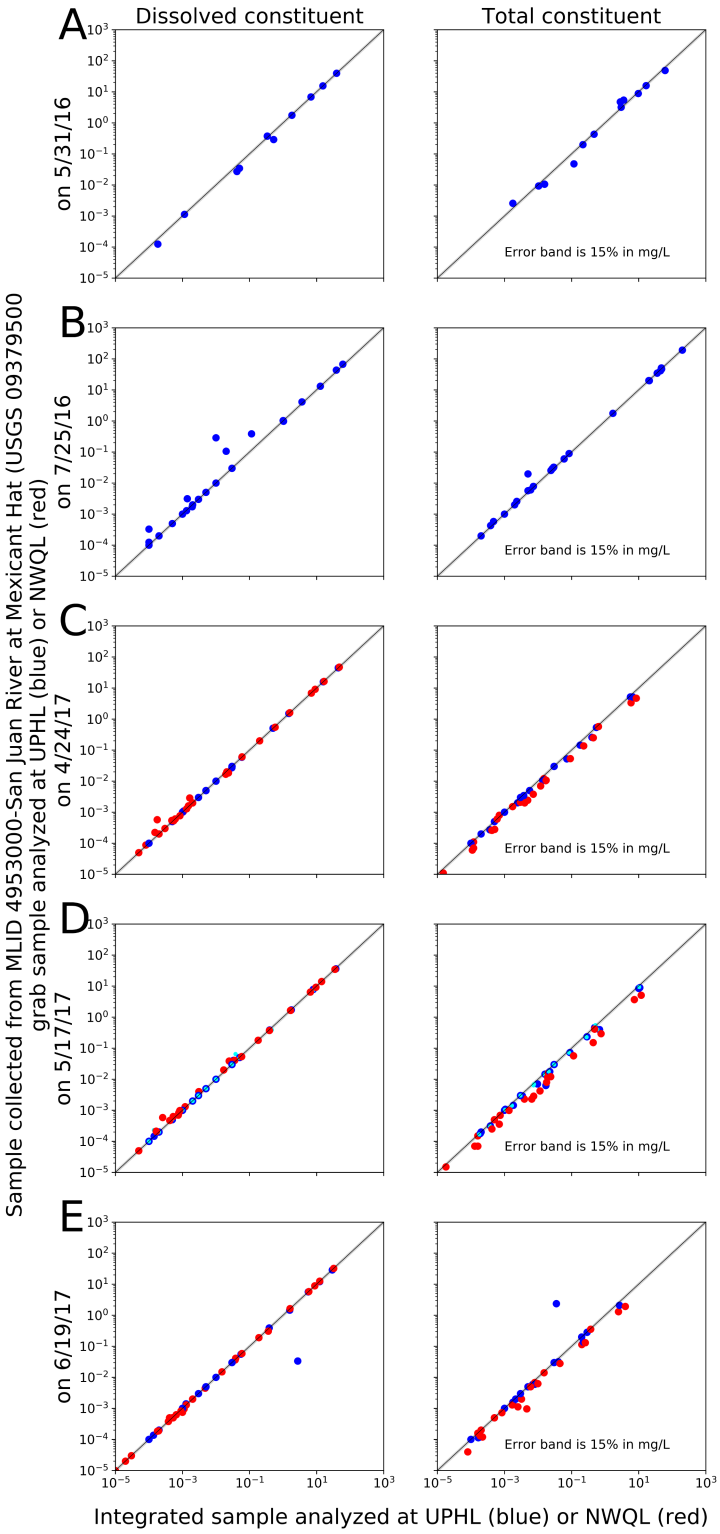

Figure 4 - Comparison of sample method results. USGS integrated and UDEQ grab sample results for both dissolved (left) and total (right) fractions from MLID 4953000. Rows A, B, C, D, and E provide sample results for 5/31/16, 7/25/16, 4/24/17, 5/17/17, and 6/19/17, respectively. The gray error band represents 15% deviation in mg/L and constituents that are outside of the gray band are noted in the upper portion of the figure. Sample results analyzed at the UPHL laboratory are shown in blue, while results analyzed at the NWQL laboratory are shown in red. Turquoise dots in panel (D) represent duplicate analysis.

Because the metal concentration comparison between methodological approaches presented in Figure 4 cover the entire range of analytes, log space is necessary. This limits the visual interpretation of a 15 percent uncertainty band. The comparison between the integrated and grab sample methods for each of the dissolved analytes is presented in Figure 5 and the total sample results are shown in Figure 6. All of the sample dates for each analyte are presented to constrain the range of variability.

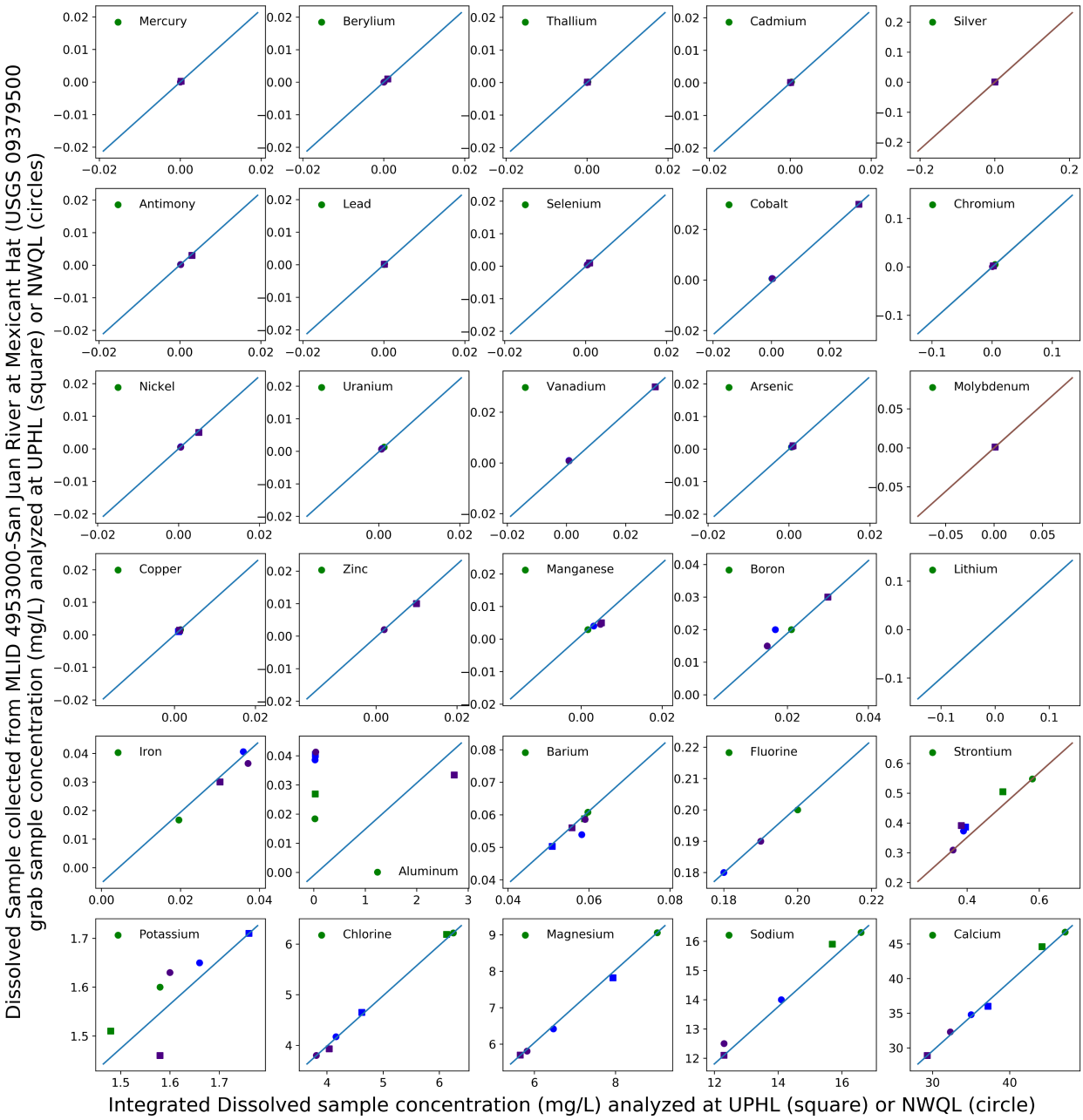

Figure 5 – Analyte matrix comparison of dissolved fraction metal sample results collected at MLID 4953000 using the USGS integrated versus UDEQ grab methods. Each of the five sample dates (5/31/16, 7/25/16, 4/24/17, 5/17/17, and 6/19/17) are shown for each plot, where applicable. Sample results analyzed at the UPHL laboratory are shown as squares, while results analyzed at the NWQL laboratory are shown as circles.

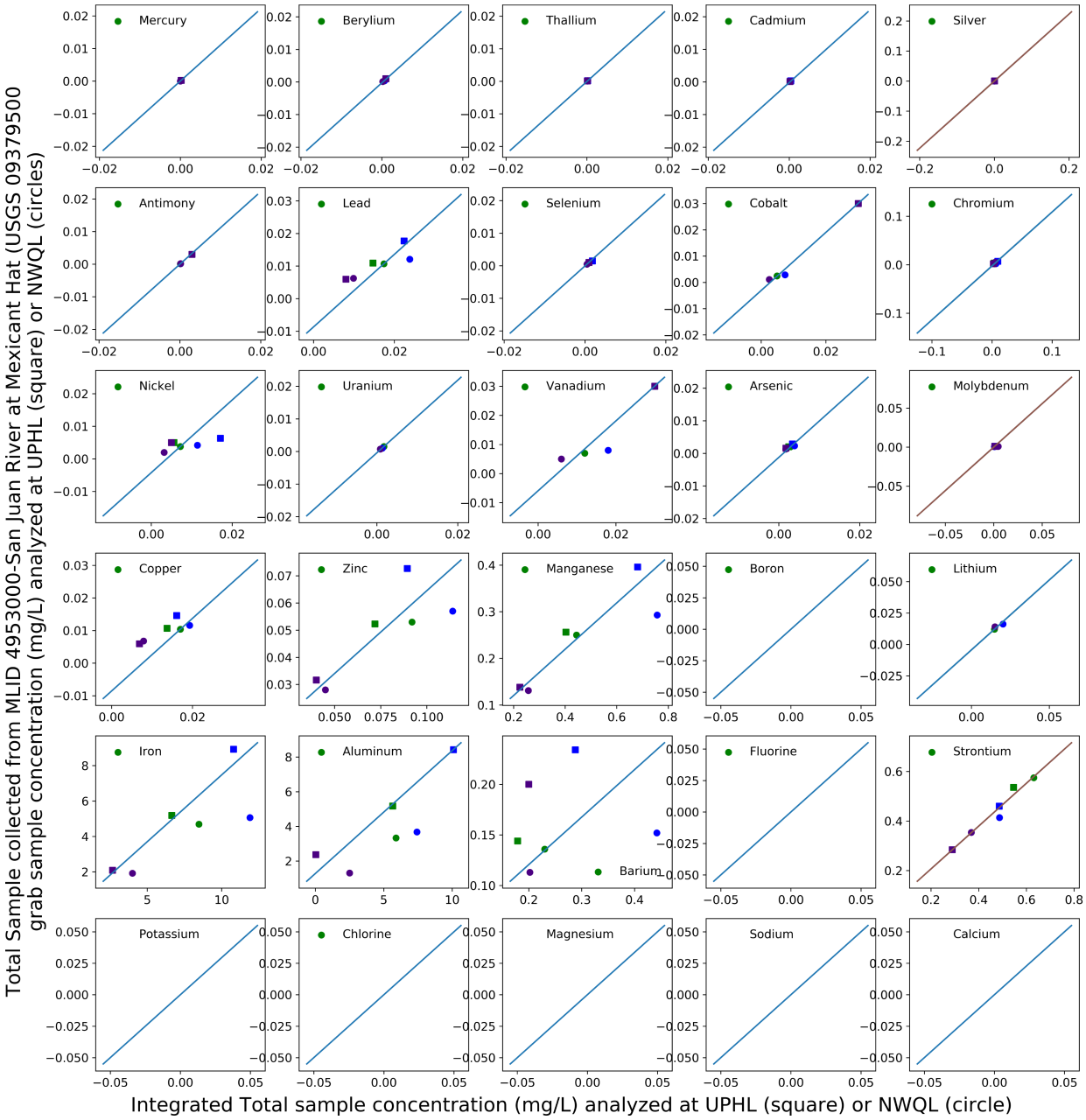

Figure 6 – Analyte matrix comparison of total fraction metal sample results collected at MLID 4953000 using the USGS integrated versus UDEQ grab methods. Each of the five sample dates (5/31/16, 7/25/16, 4/24/17, 5/17/17, and 6/19/17) are shown for each plot, where applicable. Sample results analyzed at the UPHL laboratory are shown as squares, while results analyzed at the NWQL laboratory are shown as circles.

Comparison of Analytical Results between Laboratories

The difference in concentrations of individual analytes between the USGS isokinetic integrated and the UDEQ grab sample methodology appears to be minimal. However, understanding potential differences in reported concentrations among the laboratories (NWQL, UPHL, or AWAL) is also important. During the GKM spill response, UDEQ used both AWAL and UPHL laboratories at different times while the USGS utilized NWQL. A comparison of the results among laboratories is warranted to evaluate the consistency between resulting metal concentrations and potential bias.

UPHL versus AWAL Laboratory Comparison

A series of grab samples at multiple locations throughout the lower San Juan River were collected on a single date April 4, 2016. The monitoring locations from upstream to downstream were (Figure 7):

- *MLID 4954000-San Juan River at US160Xing in CO;*
- *MLID 4953880–McElmo Creek at U262 Xing near Town of Montezuma;*
- *MLID 4953990-San Juan River at Town of Montezuma;*
- *MLID 4953250-San Juan River at Sand Island*; and
- *MLID 4953000-San Juan River at Mexican Hat US163 Xing*.

Each of the samples was sent to the UPHL and a split of the sample was also sent to AWAL. There were fewer analytes examined during the April 4, 2016 monitoring period (Figure 7) than for those shown on Figure 4. However, it is clear that the analyte concentrations are consistent between samples analyzed at AWAL and samples analyzed at UPHL. For the dissolved constituents, only manganese and molybdenum showed deviations outside of the fifteen percent uncertainty band at any of the monitoring locations. A few more deviations were observed in the total fraction, where metals concentration variations between methods increased with distance downstream. Overall, total and dissolved metals concentrations from AWAL and UPHL are broadly comparable, commonly with less than fifteen percent difference in resulting concentration. Similar to the comparison between the integrated and grab methodologies presented in Figure 4, log space visualization is difficult to ascertain the 15 percent uncertainty band.

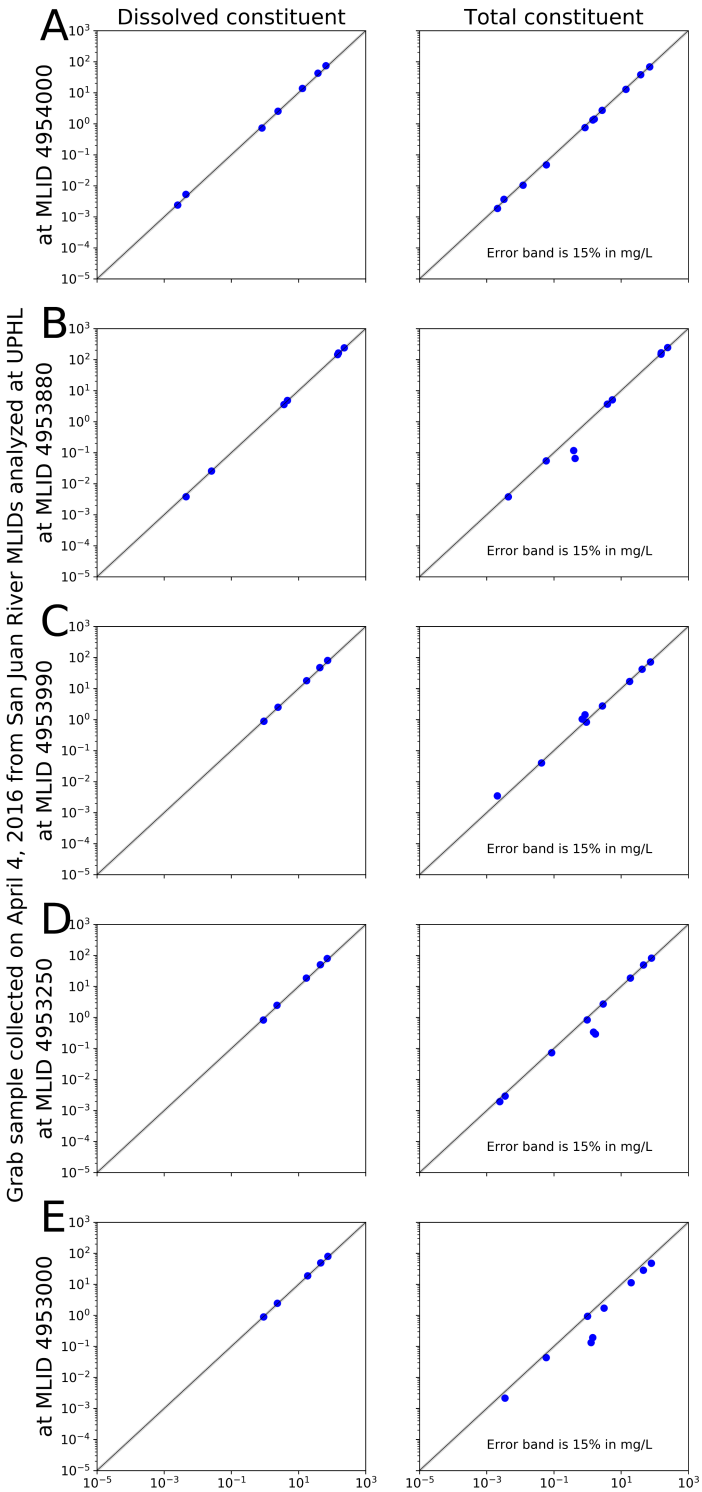

Figure 7 - Comparison of water quality results reported by AWAL and UPHL laboratories for monitoring locations along the Utah portion of the San Juan River. The figures are presented from upstream at the Colorado border to the downstream location above Lake Powell. All samples were collected on April 4, 2016.

UPHL vs NWQL Laboratory Comparison

UDEQ collected water quality samples at a single site, *MLID 4953000-San Juan River at Mexican Hat US163 Xing* (*USGS 09379500-San Juan River near Bluff, UT*) in collaboration with the USGS Utah Water Science Center. These samples were collected on five sampling dates (May 31, 2016, July 25, 2016, April 24, 2017, May 17, 2017, and June 19, 2017) that were sent to UPHL (Figure 8). The April 24, 2017, May 17, 2017, and June 19, 2017 samples were split and sent to NWQL in addition to UPHL. Furthermore, these integrated and grab water quality samples were collected in conjunction with EPA sampling efforts on April 24, 2017, May 17, 2017, and June 19, 2017 at *MLID 4953000-San Juan River at Mexican Hat US163 Xing*. The main comparison in this effort is between pairs of samples analyzed at two different labs (UPHL vs NWQL), collected at a single site on five occasions using either the grab or integrated sampling methods. The comparison between the NWQL and UPHL analytical results for both the integrated and grab samples for each of the dissolved analytes is presented in Figure 9 and the total sample results are shown in Figure 10. All of the sample dates for each analyte are presented to constrain the range of variability.

These results suggest much more variability between the NWQL and UPHL; however, much of this variability is still within the fifteen percent uncertainty between laboratories. Overall, water quality results analyzed at UPHL for both fractions of manganese, antimony, barium, cobalt, and silver under both sampling methods were elevated in relation to concentration results from NWQL. There appears to be more variability at the lower concentrations near the reporting and detection limits, suggesting that precision is diminished at these lower concentrations. As expected, colloid forming manganese is likely to be elevated as shown from previous discussion. The trace metals raise concern with variations; however, they are often sorbed to colloids and can vary up to 500 percent over a diel period (Nimick et al., 2003). The increased number of analytes that are outside of the fifteen percent deviation-band suggest that result variability may increase over time, which may be due to seasonal hydrologic conditions such as cessation of snowmelt and more heterogeneous baseflow conditions, variable source contributions, and terrestrial flushing from the landscape (Figure 8).

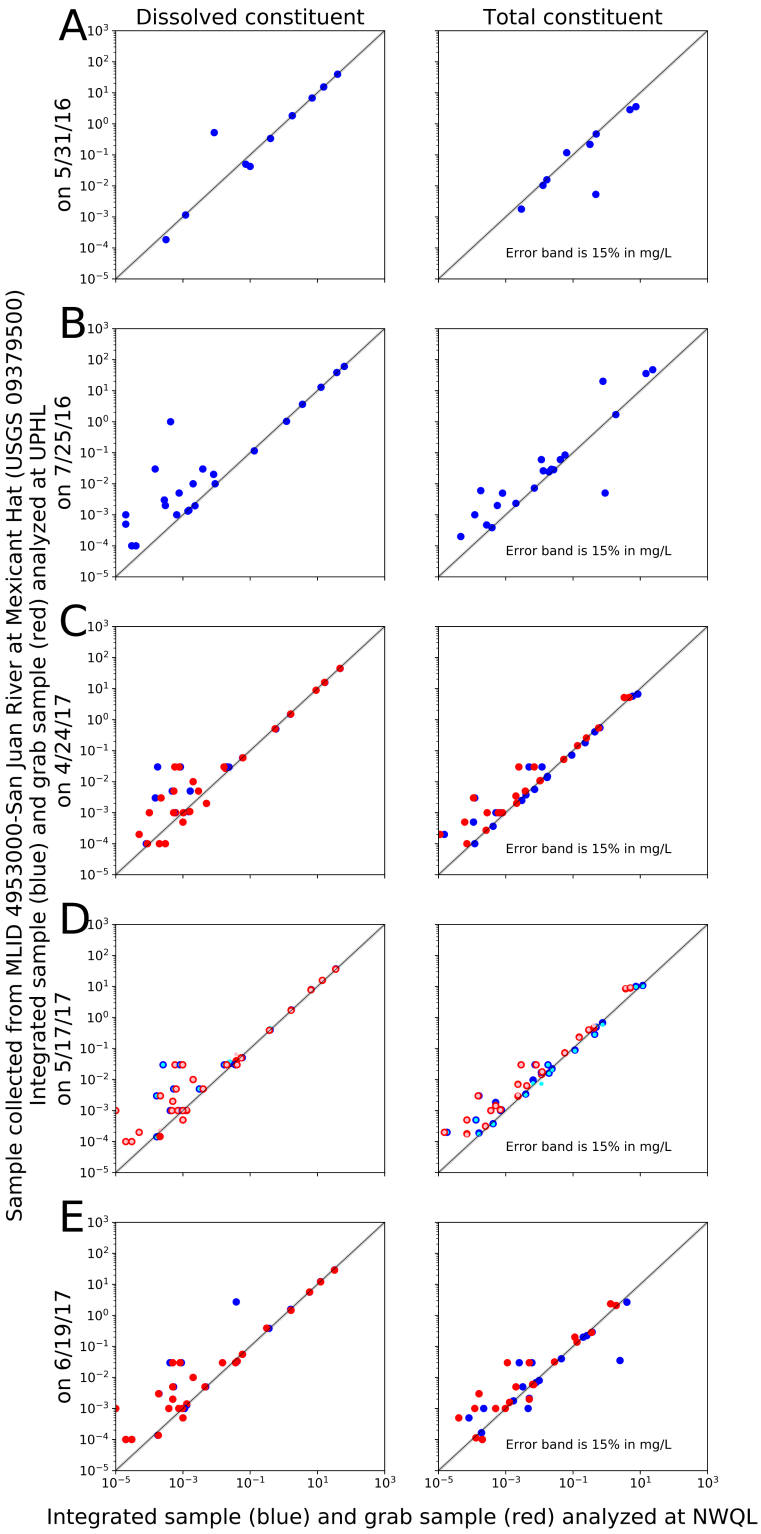

Figure 8 – Comparison of water quality results reported by NWQL and UPHL laboratories. USGS integrated (blue) and grab (red) sample results are all from MLID 4953000. Rows A, B, C, D, and E provide sample results for 5/31/16, 7/25/16, 4/24/17, 5/17/17, and 6/19/17, respectively. The gray error band represents 15% deviation in mg/L and constituents that are outside of the gray band are noted in the upper portion of the figure.

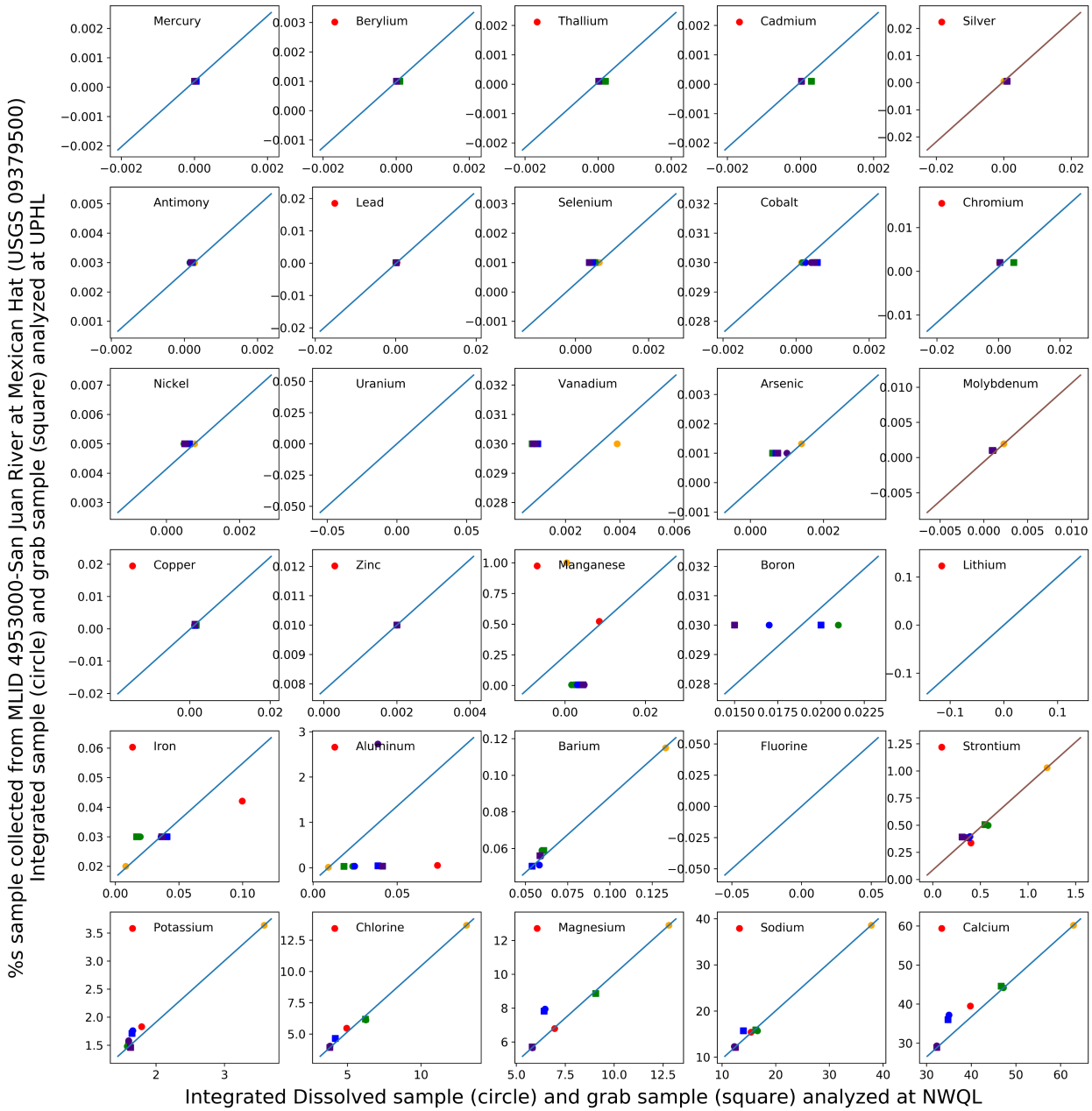

Figure 9 – Laboratory comparison of dissolved fraction metal sample results collected at MLID 4953000 between analyses at NWQL and UPHL for both the USGS integrated (circle) and UDEQ grab (square) methods. Each of the five sample dates (5/31/16, 7/25/16, 4/24/17, 5/17/17, and 6/19/17) are shown for each plot, where applicable.

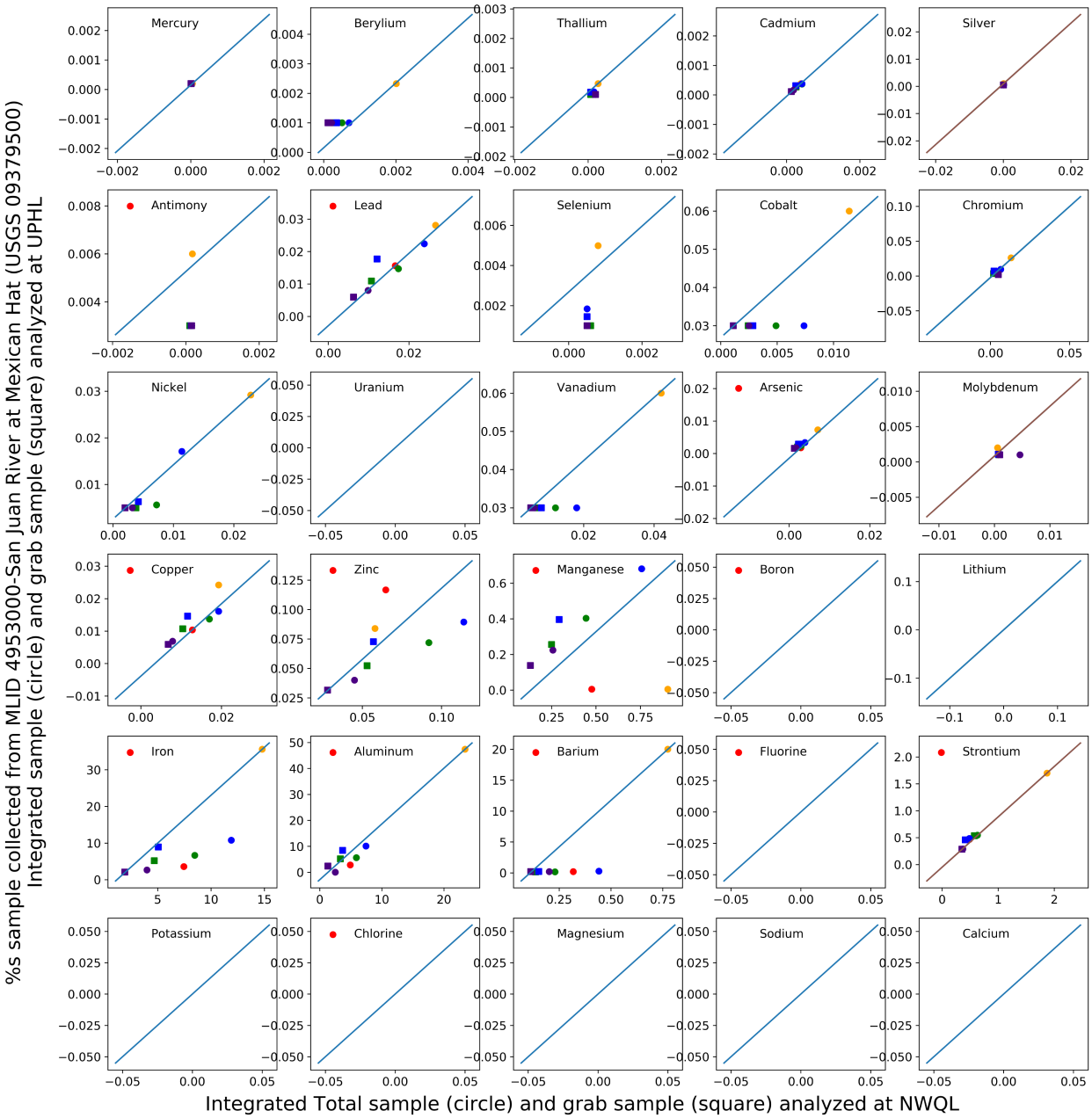

Figure 10 – Laboratory comparison of total fraction metal sample results collected at MLID 4953000 between analyses at NWQL and UPHL for both the USGS integrated (circle) and UDEQ grab (square) methods. Each of the five sample dates (5/31/16, 7/25/16, 4/24/17, 5/17/17, and 6/19/17) are shown for each plot, where applicable.

Overall, laboratory analysis results of metals concentrations collected at *MLID 4953000-San Juan River at Mexican Hat US163 Xing* for five different periods show that sample pairs are comparable between the grab and integrated sampling methods (Figure 4) and generally within five percent variability. The comparison between laboratory results of grab samples collected on a single day at five different monitoring locations and analyzed at UPHL and AWAL (Figure 7) also show good agreement. When we compared laboratory results of both grab and integrated split samples collected at MLID 4953000 over five different periods and analyzed at UPHL and NWQL, there was slightly higher observed variability, particularly at lower concentrations (Figure 8).

4. Assessment and Screening of San Juan River Water Quality

UDEQ collected daily water quality samples during the 3-week interval between August 8, 2015 and August 28, 2015, after the GKM release, at five different locations on the San Juan River. These five locations include monitoring locations (Figure 1):

- *MLID 4954000-San Juan River at US160Xing in CO;*
- *MLID 4953990-San Juan River at Town of Montezuma;*
- *MLID 4953250-San Juan River at Sand Island;*
- *MLID 4953000-San Juan River at Mexican Hat US163 Xing;*
- *MLID 4952942-San Juan River at Clay Hills boat ramp; and*
- *MLID 4952940-San Juan River above Lake Powell.*

When discharge and water quality data indicated that the initial pulse of contamination had passed, UDEQ instituted a generally less intensive weekly monitoring scheme in September and October, 2015. In October, UDEQ's contractor deployed sampling equipment to collect river samples during storm events. These samples indicated that total metal concentrations in the river were generally elevated relative to historic concentrations (when available) during the monsoonal storms in late fall 2015. However, none of the data exceeded health screening values for recreational exposures, as developed by the Utah Department of Health (UDOH) (Table 2). Due to logistical difficulties, only total metals data were available for these storm events, which precluded an evaluation of water quality benchmarks that are based on dissolved metals. UDEQ also collected dissolved and total metals in the water column and macroinvertebrate samples on September 22 and October 26, 2015. In February 2016, UDEQ resumed water quality sampling on a daily to weekly variable time-scale until July 25, 2016. This enabled UDEQ to assess the metals water quality variations along the San Juan River during snowmelt runoff and into summer baseflow-driven hydrologic conditions.

In summary, each of these UDEQ-derived water quality datasets for all UDEQ monitoring locations were compared to recreational, drinking water, agricultural, and aquatic life criteria with exceedances shown in orange in the following tables (Figure 11 to Figure 30). For domestic water use there was a single exceedance, where lead exceeded the standard at the Utah border (*MLID 4954000*) on August 28, 2015 (Figure 11). Aquatic life use aluminum criteria were exceeded at most dates for nearly all of the site locations (Figure 21 to Figure 25). In addition, aquatic life standards for iron, cadmium, copper, lead, and zinc were exceeded on August 11, 2015 or August 28, 2015 at *MLIDs 4954000* or *4953990*. The aquatic life use standard for mercury was exceeded at all sites on both July 4 and July 9, 2016 and was not detected on the other sample dates; however, the analytical method for mercury analysis does not have sufficient sensitivity (MDL of 0.059 µg/L) to assess the standard of 0.012 µg/L. Molybdenum exceeded the agricultural screening value once at the *Montezuma Creek* monitoring location. No other exceedances were identified. No recreational water use screening values or criteria were exceeded from any of the *MLID* locations throughout the period of study (Figure 16 to Figure 20). For agricultural water uses (Figure 26 to Figure 30), aluminum, iron, and manganese exceeded screening levels at *MLID 4954000* on August 28, 2015 and molybdenum on May 31, 2016 at the *Montezuma Creek* monitoring location. The agricultural water use criteria for total dissolved solids (TDS) was exceeded on all days at *McElmo Creek*, most days at *Montezuma Creek*, and on August 16 and August 28, 2015 at *MLID 4952940*.

Water Quality Criteria and Screening Values

Table 4 summarizes applicable water quality standards that apply to the San Juan River (UAC R317-2-14), Utah's drinking water standards (UAC R309-200-5) applicable to public drinking water systems regulated

by the State of Utah, as well as screening values for recreational and agricultural uses. Recreational screening values were developed by the Utah Department of Health's Environmental Epidemiology Program (EEP). These values reflect the water contaminant concentrations that would exceed established Agency for Toxic Substances and Disease Registry (ATSDR) minimal risk levels (MRL), or EPA reference doses (RfD) if an appropriate MRL does not exist, for the most susceptible population: children under the age of five years. These recreational screening values assume an exposure duration of 60 days, with two hours/day spent in the water. The accidental ingestion rate accounts for 50 mL of river water per hour, and total body contact with the water for that two-hour time period. An exceedance of these values does not necessarily indicate that adverse health effects will occur; rather, it is used as guidance for health professionals to further determine the likelihood that adverse health effects may occur due to the exposure. Comparing site concentrations to the UDOH screening levels also provides a method for assessing compliance with Utah's Narrative Standards (UAC R317-2-7.2). Agricultural screening values are derived from National Academy of Science (NAS) Water Quality Criteria, 1972 (the Blue Book). Those guidelines are reprinted in EPA's Guidelines for the Reuse of Waters for Irrigation. Dissolved metal values were used for the assessment of agricultural use waters. Estimated results values below the laboratory's reporting limit are evaluated in this analysis. These results generally show that analytical methods were sufficiently sensitive for the assessment.

Table 4 - Summary of Utah water quality standards in terms of San Juan River uses, Utah drinking water criteria, recreational and agricultural screening values.

Analyte	CAS #	Units	Utah WQ Standards (R317-2-14) for San Juan River Uses [Dissolved metals]				Utah Drinking Water Standards (R309-200-5) [Total Metals]		Recreational Screening Values [Total Metals]	Agricultural Screening Values [Dissolved Metals]			Analyte
			1C (Domestic)	3B (warm water fish) [1-hour]	3B (warm water fish) [4-day]	4 (agriculture)	Maximum Contaminant Level	Action Level		Livestock Water (ug/L)	Long-Term Irrigation Waters (ug/L) [NAS, 1972]	Short-Term Irrigation Waters (ug/L) [NAS, 1972]	
Hardness	-	mg/L								180 mg/L (UA)			Hardness
Aluminum	7429-90-5	µg/L		750	87				620,767	5,000 (NAS)	5,000	20,000	Aluminum
Antimony	7440-36-0	µg/L					6		248	No Data Available	No Data Available	No Data Available	Antimony
Arsenic	7440-38-2	µg/L	10	340	150	100	10		186	200 (NAS)	100	2,000	Arsenic
Barium	7440-39-3	µg/L	1000				2,000		124,159	No Data Available	No Data Available	No Data Available	Barium
Beryllium	7440-41-7	µg/L	<4				4		1,242	No Data Available	No Data Available	No Data Available	Beryllium
Cadmium	7440-43-9	µg/L	10	2	0.25	10	5		62	50 (NAS)	10	50	Cadmium
Calcium	7440-70-2	µg/L								500,000 (UA)	No Data Available	No Data Available	Calcium
Chromium	7440-47-3	µg/L	50	16 (VI); 570 (III)	11 (VI); 74 (III)	100	100		410	1,000 (NAS)	100	1,000	Chromium
Cobalt	7440-48-4	µg/L							7,931	1,000 (NAS)	50	5,000	Cobalt
Copper	7440-50-8	µg/L		13	9	200		1300	6,208	500 (NAS)	200	5,000	Copper
Iron	7439-89-6	µg/L		1000	1000				851,582	Limit Not Considered Necessary (NAS)	5,000	20,000	Iron
Lead	7439-92-1	µg/L	15	65	2.5	100		15	910	100 (NAS)	5,000	10,000	Lead
Magnesium	7439-95-4	µg/L								250,000 (UA)	No Data Available	No Data Available	Magnesium
Manganese	7439-96-5	µg/L							31,040	Limit Not Considered Necessary (NAS)	200	10,000	Manganese
Mercury	7439-97-6	µg/L	2	-	0.012		2		1,242	10 (NAS)	No Data Available	No Data Available	Mercury
Molyebdenum	7439-98-7	µg/L							3,104	No Data Available	10	50	Molyebdenum
Nickel	7440-02-0	µg/L		468	52				17,480	No Data Available	200	2,000	Nickel
Potassium	7440-22-4	µg/L								No Data Available	No Data Available	No Data Available	Potassium
Selenium	7782-49-2	µg/L	50	18.4	4.6	50	50		3,104	50 (NAS)	20	20	Selenium
Silver	7440-22-4	µg/L	50	1.6	-				3,630	No Data Available	No Data Available	No Data Available	Silver
Sodium	7440-23-5	µg/L								1,000,000 (UA)	No Data Available	No Data Available	Sodium
Thallium	7440-28-0	µg/L					2		25	No Data Available	No Data Available	No Data Available	Thallium
Vanadium	7440-62-2	µg/L							6,208	100 (NAS)	100	1,000	Vanadium
Zinc	7440-66-6	µg/L		120	120				217,786	25,000 (NAS)	2,000	10,000	Zinc
TDS		mg/L								1200 (Utah)	500,000-1,000,000 (NAS)		TDS
pH										6.5-9 (Utah)	4.5-9 (NAS)		pH

RMEG: ATSDR Reference Dose Media Evaluation Guide
EMEG: ATSDR Environmental Media Evaluation Guide
RSL: EPA Regional Screening Level

Utah's Class 1C Domestic Source Water Quality Standards (R317-2-14) – Dissolved Metals

Concentrations of dissolved metals were compared to Utah's water quality standards for Class 1C use (protected for domestic purposes with prior treatment (UAC R317-2-14) as required by the Utah Division of Drinking Water. Of the 224 samples evaluated for the metals listed in Table 4, the only exceedence that was observed was for lead in a sample collected at *MLID 4954000–San Juan River at US160 Xing in CO* on August 28, 2015. No other samples exceeded any of the standards for domestic source water in 2015 or 2016. Figure 11 through Figure 15 provide a comparison of the measured water quality samples to Utah's Domestic Source Water Quality Standards.

Domestic Source Water (Dissolved Metals)

	No Exceedence		Above Screening Level																					
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Thallium	Vanadium	Zinc
Domestic Source Screening Values						10	1,000	4	10	50				15		2				50	50			
Monitoring Location	Site Description	Collection Date	Collection Time	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L
4954000	San Juan R @ US160 Xing in CO	8/8/2015	1:23 PM	217.0	0.5	1.3	222.0	0.0	ND	ND	0.1	2.2	95.8	ND	2.9	ND	1.9	ND	3.0	0.7	ND	ND	4.9	15.3
		8/9/2015	12:02 PM	258.0	0.3	0.6	274.0	ND	ND	ND	0.1	2.5	119.0	ND	2.7	ND	2.0	ND	2.6	0.6	0.0	ND	1.8	18.5
			9:02 PM	329.0	0.3	0.9	341.0	0.0	ND	ND	0.1	3.5	198.0	0.3	4.1	ND	1.9	ND	2.4	0.5	ND	ND	2.1	15.4
		8/10/2015	2:06 PM	1,050.0	0.7	1.3	220.0	0.1	ND	ND	0.4	3.4	732.0	1.0	12.8	ND	1.9	0.8	2.7	0.6	0.1	ND	3.6	18.0
			9:11 AM	172.0	0.5	1.0	233.0	ND	ND	ND	0.1	3.2	103.0	0.4	1.6	ND	2.0	ND	2.5	0.6	ND	ND	1.7	19.7
		8/11/2015	8:50 AM	3,290.0	0.4	1.7	451.0	0.1	ND	ND	0.5	4.9	1,520.0	1.1	19.0	0.0	1.7	1.2	3.0	1.0	ND	ND	3.9	19.1
			1:17 PM	720.0	0.1	1.3	334.0	ND	ND	ND	0.2	3.0	366.0	0.3	5.1	ND	1.6	ND	2.9	0.8	ND	ND	2.5	14.9
		8/12/2015	9:50 AM	104.0	0.6	0.9	178.0	ND	ND	ND	0.1	2.4	ND	ND	ND	ND	1.5	ND	2.8	0.8	0.0	ND	1.9	14.8
			12:09 PM	155.0	0.5	1.2	151.0	ND	ND	ND	0.0	2.6	ND	ND	1.8	ND	1.5	ND	2.7	0.7	ND	ND	2.9	16.5
		8/13/2015	10:01 AM	257.0	0.2	1.3	213.0	0.0	ND	ND	0.1	3.7	148.0	0.4	3.2	ND	1.9	ND	2.9	0.9	ND	ND	2.1	21.9
		8/14/2015	8:50 AM	64.8	0.4	1.7	72.3	0.0	ND	ND	0.1	3.9	ND	ND	1.8	ND	3.7	3.1	3.7	1.1	ND	0.0	4.1	ND
		8/15/2015	9:43 AM	47.5	0.4	1.4	65.2	ND	ND	ND	0.1	1.4	ND	ND	ND	ND	2.3	ND	2.6	0.6	ND	ND	2.6	ND
		8/16/2015	9:15 AM	54.4	1.1	0.9	179.0	0.0	ND	ND	ND	2.9	ND	ND	ND	ND	1.7	ND	2.5	0.6	0.2	ND	1.9	12.6
		8/18/2015	9:56 AM	23.9	0.7	1.3	148.0	ND	ND	ND	0.1	2.3	ND	0.3	ND	ND	1.7	ND	2.5	0.6	0.0	ND	1.9	12.3
		8/19/2015	9:30 AM	ND	0.7	1.3	106.0	ND	ND	ND	0.1	1.7	ND	ND	ND	ND	1.7	ND	2.5	0.5	0.0	ND	1.9	8.4
		8/20/2015	9:44 AM	28.4	0.8	1.3	132.0	ND	ND	ND	0.1	1.9	ND	ND	ND	ND	1.8	ND	2.4	0.6	0.1	0.0	1.9	8.1
		8/24/2015	3:10 PM	ND	0.3	1.4	62.4	ND	ND	ND	0.0	2.2	ND	ND	1.9	ND	1.6	1.1	2.6	0.5	ND	ND	2.3	5.5
		8/25/2015	3:30 PM	ND	0.5	1.4	63.4	ND	ND	ND	ND	2.1	ND	ND	1.9	ND	1.6	ND	2.5	0.6	ND	ND	2.5	ND
		8/26/2015	2:50 PM	760.0	0.6	1.5	70.5	0.1	ND	ND	0.3	2.8	554.0	0.5	21.8	ND	1.6	1.1	2.6	0.6	0.1	0.0	3.3	8.0
		8/27/2015	3:40 PM	798.0	0.3	1.0	121.0	0.1	ND	ND	0.4	3.3	605.0	0.5	11.4	ND	3.3	2.0	4.6	0.9	ND	ND	3.4	6.2
		8/28/2015	4:25 PM	20,700.0	0.2	5.6	340.0	1.6	0.3	12.0	9.0	27.7	16,700.0	15.7	413.0	0.0	1.5	12.7	7.9	0.8	0.1	0.2	26.2	72.8
		9/23/2015	6:30 PM	ND	0.7	1.0	81.5	0.1	ND	ND	0.3	1.9	ND	ND	9.3	ND	1.8	1.3	2.9	0.7	0.1	0.1	1.8	ND
		2/16/2016	3:00 PM	319.3	ND	ND	186.9	ND	ND	ND	ND	6.0	155.0	0.5	14.4	ND	1.5	ND	3.1	1.6	ND	ND	ND	22.5
		2/23/2016	10:10 AM	14.9	ND	ND	ND	ND	ND	ND	ND	1.8	ND	ND	ND	ND	1.4	ND	3.1	1.2	ND	ND	ND	ND
		2/29/2016	4:00 PM	10.4	ND	ND	ND	ND	ND	ND	ND	1.7	ND	ND	ND	ND	1.2	ND	2.6	1.1	ND	ND	ND	ND
		3/9/2016	8:20 AM	17.3	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	1.2	ND	2.3	ND	ND	ND	ND	ND
		3/15/2016		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.3	ND	2.2	ND	ND	ND	ND	ND
		3/22/2016	9:30 AM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2	ND	2.2	ND	ND	ND	ND	ND
		3/28/2016	4:50 PM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2	ND	2.2	ND	ND	ND	ND	ND
		4/4/2016	12:20 PM	ND	ND	ND	77.5	ND	ND	ND	ND	2.5	ND	ND	4.5	ND	ND	ND	2.4	ND	ND	ND	ND	5.1
				52.3	ND	ND	ND	ND	ND	ND	ND	2.4	36.2	0.1	5.3	ND	1.4	ND	2.5	ND	ND	ND	ND	ND
		4/12/2016	2:00 PM	31.0	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	1.3	ND	2.0	ND	ND	ND	ND	ND
		4/19/2016	12:25 PM	18.5	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	1.2	ND	1.9	ND	ND	ND	ND	ND
		4/26/2016	11:45 AM	29.3	ND	ND	ND	ND	ND	ND	ND	1.3	ND	ND	ND	ND	1.4	ND	2.0	ND	ND	ND	ND	ND
		5/2/2016	2:00 PM	24.5	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	5.9	ND	1.1	ND	2.2	ND	ND	ND	ND	ND
		5/9/2016	12:30 PM	37.6	ND	ND	ND	ND	ND	ND	ND	1.0	26.4	0.1	5.6	ND	1.1	ND	1.7	ND	ND	ND	ND	ND
		5/15/2016	12:15 PM	50.0	ND	ND	211.7	ND	ND	ND	ND	1.9	51.1	0.2	ND	ND	1.1	ND	1.8	ND	ND	ND	ND	18.6
		5/21/2016	3:30 PM	23.4	ND	ND	ND	ND	ND	ND	ND	ND	45.7	0.1	7.7	ND	1.5	ND	2.1	ND	ND	ND	ND	ND
		5/31/2016	4:15 PM	48.1	ND	ND	ND	ND	ND	ND	ND	1.2	39.9	0.2	5.1	ND	ND	ND	1.8	ND	ND	ND	ND	ND
		6/5/2016	10:30 AM	72.1	ND	ND	ND	ND	ND	ND	ND	1.3	88.1	0.5	7.5	ND	ND	ND	1.7	ND	ND	ND	ND	ND
		6/13/2016	12:30 PM	63.4	ND	ND	ND	ND	ND	ND	ND	1.4	77.5	0.6	8.3	ND	ND	ND	1.6	ND	ND	ND	ND	ND
		6/18/2016	3:30 PM	49.9	ND	ND	123.4	ND	ND	ND	ND	1.3	57.3	0.5	ND	ND	ND	ND	1.6	ND	ND	ND	ND	16.1
		6/25/2016	2:45 PM	15.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.6	ND	ND	ND	ND	ND
		7/4/2016	11:45 AM	36.5	3.0	1.0	229.0	1.0	0.1	2.0	30.0	1.7	27.1	0.1	5.0	0.2	1.0	5.0	NS	1.0	0.5	0.1	30.0	24.0
		7/9/2016	2:45 PM	20.4	3.0	1.0	112.0	1.0	0.1	2.0	30.0	1.0	20.0	0.1	5.7	0.2	1.1	5.0	NS	1.0	0.5	0.1	30.0	10.0

Figure 11 - Domestic source water screening table for analytes measured at MLID 4954000 - San Juan River at US160 Xing in CO.

Domestic Source Water (Dissolved Metals)

	No Exceedence		Above Screening Level

Monitoring Location	Site Description	Collection Date	Collection Time	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Thallium	Vanadium	Zinc
		Domestic Source Screening Values				10	1,000	4	10	50				15		2				50	50			
				ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L
4953990	San Juan R @ Town of Montezuma	8/8/2015	2:54 PM	136.0	0.7	1.1	223.0	0.0	ND	ND	0.1	2.7	ND	ND	ND	ND	2.6	0.8	3.8	1.1	0.0	ND	2.5	21.0
		8/10/2015	2:58 PM	94.5	1.3	0.9	200.0	0.0	ND	ND	0.1	2.5	ND	0.3	ND	ND	2.3	ND	2.6	0.6	0.3	ND	2.0	14.6
			10:13 AM	218.0	0.7	0.9	262.0	ND	ND	ND	0.1	3.2	144.0	0.5	3.2	ND	2.0	ND	2.7	0.6	0.1	ND	2.1	17.3
		8/11/2015	9:44 AM	462.0	0.6	1.2	314.0	ND	ND	ND	0.1	2.7	227.0	ND	3.3	ND	1.7	ND	2.6	0.7	0.0	ND	2.2	12.9
			2:20 PM	1,400.0	0.1	1.3	298.0	0.0	ND	ND	0.2	3.5	668.0	0.5	10.0	ND	1.7	1.0	3.0	0.7	ND	ND	2.7	14.3
		8/12/2015	10:37 AM	67.5	0.8	1.1	202.0	0.0	ND	ND	ND	2.5	ND	ND	ND	ND	1.7	ND	2.7	0.8	0.0	ND	1.7	13.5
			2:04 PM	375.0	0.8	0.9	176.0	ND	ND	ND	0.1	4.3	296.0	ND	2.3	ND	1.6	ND	2.8	0.7	0.0	ND	2.0	15.9
		8/13/2015	10:46 AM	330.0	1.9	1.3	240.0	0.1	ND	ND	0.2	3.8	192.0	ND	5.3	ND	1.9	1.0	2.6	1.0	0.2	0.0	3.1	32.7
		8/14/2015	9:55 AM	24.8	0.6	1.3	85.1	0.0	ND	ND	0.1	3.8	ND	ND	ND	ND	2.8	1.8	3.5	1.0	0.0	0.0	3.1	ND
		8/15/2015	10:30 AM	68.1	0.6	1.6	73.6	0.0	ND	ND	0.2	4.4	ND	ND	3.4	ND	2.4	1.1	3.2	0.9	0.1	ND	3.5	ND
		8/16/2015	10:02 AM	61.8	0.8	1.2	145.0	0.1	ND	ND	0.1	3.0	ND	ND	ND	ND	2.0	ND	3.0	0.7	0.3	0.1	2.2	9.8
		8/17/2015	4:07 PM	27.3	0.3	1.2	80.4	ND	ND	ND	0.1	1.9	ND	ND	2.4	ND	2.0	ND	2.8	0.6	ND	ND	2.2	ND
		8/18/2015	8:41 AM	24.6	1.0	1.2	197.0	0.0	ND	ND	0.1	3.4	ND	0.3	ND	ND	2.1	ND	2.6	0.6	0.1	0.1	2.3	14.8
		8/19/2015	8:15 AM	ND	0.9	1.2	141.0	ND	ND	ND	0.1	1.7	ND	ND	ND	ND	2.0	ND	2.7	0.6	0.1	0.0	2.3	9.6
		8/20/2015	8:59 AM	ND	1.0	1.4	128.0	ND	ND	ND	0.1	1.9	ND	ND	ND	ND	1.8	ND	2.6	0.7	ND	ND	2.1	6.6
		8/24/2015	4:30 PM	126.0	0.3	1.4	67.8	ND	ND	ND	0.1	2.3	ND	ND	4.9	ND	1.7	0.8	2.8	0.6	ND	ND	2.9	ND
		8/25/2015	4:20 PM	ND	0.3	1.3	68.2	ND	ND	ND	0.1	2.6	ND	ND	2.0	ND	1.8	0.9	2.7	0.6	ND	ND	2.7	10.0
		8/26/2015	3:30 PM	818.0	0.4	1.5	77.1	0.1	ND	ND	0.3	2.9	601.0	0.5	26.5	ND	1.8	1.1	3.0	0.6	ND	ND	3.8	5.4
		8/27/2015	2:50 PM	139.0	0.4	1.4	71.1	ND	ND	ND	0.2	2.1	ND	ND	4.0	ND	2.1	ND	2.8	0.7	ND	ND	2.7	ND
		8/28/2015	3:35 PM	487.0	0.3	1.1	161.0	0.0	ND	ND	0.3	4.0	414.0	0.4	11.5	ND	2.7	1.6	6.5	0.8	ND	ND	2.8	191.0
		9/22/2015	5:30 PM	ND	0.3	1.3	75.0	ND	ND	ND	0.1	3.3	ND	ND	1.7	ND	1.8	1.4	2.9	0.6	ND	ND	2.8	5.9
		10/26/2015	2:00 PM	ND	0.9	1.0	109.0	ND	ND	ND	0.6	1.3	ND	ND	2.0	ND	1.8	0.8	3.3	0.6	ND	ND	1.9	ND
		2/16/2016	4:15 PM	231.2	ND	ND	161.7	ND	ND	ND	ND	3.5	109.0	0.3	8.8	ND	1.7	ND	3.5	1.4	ND	ND	ND	18.1
		2/23/2016	6:00 PM	18.5	3.5	ND	ND	ND	ND	ND	ND	1.7	ND	0.2	ND	ND	1.8	ND	3.5	1.6	ND	ND	ND	ND
		2/29/2016	5:30 PM	22.4	ND	ND	ND	ND	ND	ND	ND	1.4	ND	ND	ND	ND	1.4	ND	2.8	ND	ND	ND	ND	ND
		3/9/2016	10:00 AM	34.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.3	ND	2.4	ND	ND	ND	ND	ND
		3/15/2016		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	2.4	ND	ND	ND	ND	ND
		3/22/2016	10:55 AM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	2.4	ND	ND	ND	ND	ND
		3/28/2016	3:45 PM	ND	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	1.3	ND	2.2	ND	ND	ND	ND	ND
		4/4/2016	2:00 PM	ND	ND	ND	76.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.5	ND	ND	ND	ND	ND
				ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	1.5	ND	2.5	ND	ND	ND	ND	ND
		4/12/2016	1:00 PM	26.2	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	1.3	ND	2.1	ND	ND	ND	ND	ND
		4/19/2016	11:10 AM	50.9	ND	ND	ND	ND	ND	ND	ND	1.5	29.7	ND	8.2	ND	1.3	ND	2.0	1.4	ND	ND	ND	ND
		4/26/2016	10:30 AM	18.1	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	1.3	ND	2.2	ND	ND	ND	ND	ND
		5/2/2016	1:00 PM	16.7	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	1.1	ND	2.1	ND	ND	ND	ND	ND
		5/9/2016	2:15 PM	45.9	ND	ND	ND	ND	ND	ND	ND	1.1	29.2	0.1	ND	ND	1.3	ND	1.9	ND	ND	ND	ND	ND
		5/15/2016	11:00 AM	92.9	ND	ND	296.9	ND	ND	ND	ND	2.9	74.8	0.2	ND	ND	1.3	ND	2.1	ND	ND	ND	ND	18.5
		5/21/2016	2:15 PM	29.4	ND	ND	ND	ND	ND	ND	ND	ND	46.5	0.1	7.8	ND	1.4	ND	2.1	ND	ND	ND	ND	ND
		5/31/2016	3:15 PM	40.4	ND	ND	ND	ND	ND	ND	ND	1.1	33.9	0.1	ND	ND	ND	ND	1.8	ND	ND	ND	ND	ND
		6/5/2016	9:30 AM	77.0	ND	ND	ND	ND	ND	ND	ND	1.3	77.6	0.5	6.8	ND	ND	ND	1.7	ND	ND	ND	ND	ND
		6/13/2016	11:30 AM	54.2	ND	ND	ND	ND	ND	ND	ND	1.3	67.1	0.5	7.6	ND	ND	ND	1.6	ND	ND	ND	ND	ND
		6/18/2016	2:15 PM	47.0	ND	ND	227.1	ND	ND	ND	ND	1.9	57.8	0.5	5.7	ND	1.0	ND	1.6	ND	ND	ND	ND	27.5
		6/25/2016	2:00 PM	15.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.6	ND	ND	ND	ND	ND
		7/4/2016	11:00 AM	10.0	3.0	1.0	100.0	1.0	0.1	2.0	30.0	1.0	20.0	0.1	5.0	0.2	1.0	5.0	NS	1.0	0.5	0.1	30.0	10.0
		7/9/2016	1:45 PM	18.2	3.0	1.0	110.0	1.0	0.1	2.0	30.0	1.0	20.0	0.1	5.0	0.2	1.2	5.0	NS	1.0	0.5	0.1	30.0	11.0

Figure 12 - Domestic source water screening table for analytes measured at MLID 4953990 - San Juan River at Town of Montezuma.

Domestic Source Water (Dissolved Metals)

	No Exceedence		Above Screening Level

Monitoring Location	Site Description	Collection Date	Collection Time	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Thallium	Vanadium	Zinc
			Domestic Source Screening Values			10	1,000	4	10	50				15		2				50	50			
				ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L
4953250	San Juan R @ Sand Island	8/8/2015	4:19 PM	214.0	1.4	1.0	294.0	0.1	ND	ND	0.1	3.9	104.0	ND	2.6	ND	3.3	1.0	4.1	1.4	0.1	ND	2.2	19.0
		8/10/2015	11:15 AM	124.0	1.2	0.9	192.0	ND	ND	ND	0.1	2.1	ND	0.3	ND	ND	2.4	ND	2.9	0.7	0.3	ND	1.8	13.7
			3:58 PM	108.0	0.6	1.1	184.0	ND	ND	ND	0.1	2.0	ND	0.3	ND	ND	2.3	ND	2.7	0.5	ND	ND	1.9	13.2
		8/11/2015	3:01 PM	158.0	0.3	1.0	251.0	ND	ND	ND	0.1	2.7	89.2	ND	ND	ND	1.9	ND	2.8	0.7	ND	ND	2.1	14.9
			10:53 AM	684.0	1.2	1.2	278.0	0.1	ND	ND	0.2	2.9	328.0	ND	4.1	ND	1.9	0.8	2.7	0.7	0.3	0.0	2.6	13.7
		8/12/2015	11:12 AM	623.0	1.1	1.4	205.0	0.0	ND	ND	0.2	3.4	310.0	ND	4.5	ND	1.9	ND	2.9	0.8	0.1	ND	2.6	14.5
			2:57 PM	605.0	1.8	1.4	260.0	0.1	ND	ND	0.2	3.0	314.0	ND	5.2	ND	1.8	0.9	2.8	0.8	0.2	ND	2.3	13.2
		8/13/2015	11:28 AM	509.0	0.7	1.3	156.0	0.0	ND	ND	0.2	3.1	275.0	ND	8.9	ND	1.6	ND	3.0	0.7	ND	ND	3.7	20.4
		8/14/2015	11:02 AM	ND	1.0	2.0	78.6	0.1	ND	ND	0.1	3.3	ND	ND	7.0	ND	5.3	2.4	3.3	1.1	0.2	0.1	5.9	4.9
		8/15/2015	11:31 AM	95.2	1.1	1.8	83.5	0.0	ND	ND	0.1	2.3	ND	ND	ND	ND	3.9	0.8	3.5	1.1	0.3	0.1	3.5	ND
		8/16/2015	11:06 AM	290.0	0.4	1.2	149.0	0.0	ND	ND	0.1	3.9	202.0	ND	3.9	ND	2.0	ND	2.9	0.7	0.0	ND	2.0	10.5
		8/17/2015	3:33 PM	ND	0.4	1.5	87.1	ND	ND	ND	0.2	2.1	ND	ND	ND	ND	2.7	1.3	3.1	0.6	ND	ND	2.8	ND
		8/18/2015	11:22 AM	ND	0.6	1.5	138.0	ND	ND	ND	0.1	2.3	ND	0.4	1.6	ND	1.9	ND	2.9	0.6	ND	ND	2.4	12.3
		8/19/2015	12:33 PM	32.9	0.5	1.3	122.0	ND	ND	ND	0.1	1.9	ND	ND	1.8	ND	2.0	ND	2.8	0.6	ND	ND	2.5	8.7
		8/20/2015	7:21 AM	24.4	0.3	1.4	138.0	ND	ND	ND	0.1	2.3	ND	ND	ND	ND	1.9	ND	2.6	0.6	ND	ND	2.6	9.1
		8/24/2015	1:55 PM	410.0	0.3	1.6	79.6	ND	ND	ND	0.1	2.8	265.0	ND	9.4	ND	1.8	0.9	2.9	0.6	ND	ND	3.8	6.4
		8/25/2015	2:25 PM	ND	0.3	1.5	77.5	ND	ND	ND	0.0	2.3	ND	ND	1.6	ND	1.9	ND	2.8	0.6	ND	ND	3.0	ND
		8/26/2015	1:30 PM	ND	0.3	1.5	75.4	ND	ND	ND	0.1	2.5	ND	ND	2.4	ND	1.8	0.9	2.8	0.6	ND	ND	3.2	5.3
		8/27/2015	1:55 PM	293.0	0.4	1.4	81.5	ND	ND	ND	0.2	2.6	199.0	ND	8.4	ND	1.9	0.9	2.9	0.6	0.0	ND	3.1	ND
		8/28/2015	2:45 PM	ND	0.4	0.8	151.0	ND	ND	ND	0.1	3.3	ND	ND	ND	ND	3.1	1.2	5.3	0.9	ND	ND	2.0	ND
		9/22/2015	1:55 PM	ND	0.6	1.4	77.8	ND	ND	ND	0.1	3.7	ND	0.3	1.7	ND	1.8	1.2	2.8	0.6	0.1	0.0	2.9	ND
		2/16/2016	5:00 PM	128.5	ND	1.0	104.8	ND	ND	ND	ND	2.7	71.7	0.2	ND	ND	1.7	ND	3.3	1.5	ND	ND	ND	ND
		2/24/2016	8:40 AM	34.8	ND	ND	ND	ND	ND	5.4	ND	2.0	57.2	0.2	6.9	ND	1.6	ND	3.0	1.3	ND	ND	ND	ND
		3/1/2016	8:15 AM	60.1	ND	ND	ND	ND	ND	ND	ND	1.3	44.2	ND	ND	ND	1.4	ND	2.7	1.3	ND	ND	ND	ND
		3/9/2016	12:10 PM	10.0	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	1.3	ND	2.4	ND	ND	ND	ND	ND
		3/15/2016	11:00 AM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5	ND	2.6	ND	ND	ND	ND	ND
		3/22/2016	11:40 AM	10.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	2.4	ND	ND	ND	ND	ND
		3/29/2016	9:50 AM	16.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	2.2	ND	ND	ND	ND	ND
		4/4/2016	2:40 PM	ND	ND	ND	78.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.3	ND	ND	ND	ND	ND
				14.6	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	1.5	ND	2.5	ND	ND	ND	ND	ND
		4/12/2016	10:30 AM	18.2	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	1.4	ND	2.0	ND	ND	ND	ND	ND
		4/19/2016	10:17 AM	16.0	ND	ND	ND	ND	ND	ND	ND	1.3	ND	ND	ND	ND	1.2	ND	2.1	ND	ND	ND	ND	ND
		4/26/2016	10:00 AM	12.7	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	1.4	ND	2.3	ND	ND	ND	ND	ND
		5/2/2016	12:00 PM	15.9	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	1.2	ND	2.1	ND	ND	ND	ND	ND
		5/9/2016	2:45 PM	35.1	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	1.4	ND	2.1	ND	ND	ND	ND	ND
		5/15/2016	10:15 AM	32.0	ND	ND	172.6	ND	ND	ND	ND	1.9	29.2	0.1	ND	ND	1.1	ND	1.8	ND	ND	ND	ND	18.9
		5/21/2016	1:15 PM	25.4	ND	1.0	ND	ND	ND	ND	ND	ND	44.8	0.1	ND	ND	1.5	ND	2.0	ND	ND	ND	ND	ND
		5/31/2016	2:00 PM	34.8	ND	ND	ND	ND	ND	ND	ND	1.1	25.5	0.1	ND	ND	ND	ND	1.8	ND	ND	ND	ND	ND
		6/5/2016	8:25 AM	62.9	ND	ND	ND	ND	ND	ND	ND	1.3	60.1	0.4	ND	ND	ND	ND	1.7	ND	ND	ND	ND	ND
		6/13/2016	10:30 AM	68.4	ND	ND	ND	ND	ND	ND	ND	1.2	84.1	0.6	6.8	ND	1.0	ND	1.8	ND	ND	0.2	ND	ND
		6/18/2016	1:45 PM	41.0	ND	ND	ND	ND	ND	ND	ND	ND	39.2	0.3	ND	ND	ND	ND	1.6	ND	ND	ND	ND	ND
		6/25/2016	1:00 PM	15.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.6	ND	ND	ND	ND	ND
		7/4/2016	10:15 AM	10.0	3.0	1.0	100.0	1.0	0.1	2.0	30.0	1.0	20.0	0.1	5.0	0.2	1.1	5.0	NS	1.0	0.5	0.1	30.0	10.0
		7/9/2016	1:00 PM	16.1	3.0	1.0	141.0	1.0	0.1	2.0	30.0	1.0	20.0	0.1	5.0	0.2	1.3	5.0	NS	1.0	0.5	0.1	30.0	15.2

Figure 13 - Domestic source water screening table for analytes measured at MLID 4953250 - San Juan River at Sand Island.

Domestic Source Water (Dissolved Metals)

	No Exceedence		Above Screening Level

Monitoring Location	Site Description	Collection Date	Collection Time	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Thallium	Vanadium	Zinc
		Domestic Source Screening Values				10	1,000	4	10	50				15		2				50	50			
				ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L
4953000	San Juan R @ Mexican Hat US163 Xing	8/8/2015	5:40 PM	264.0	1.4	1.6	308.0	0.0	ND	ND	0.1	4.0	144.0	ND	2.8	ND	3.2	0.9	4.2	0.9	0.1	ND	3.1	14.2
		8/10/2015	4:44 PM	149.0	1.3	1.4	265.0	ND	ND	ND	0.1	2.5	ND	0.3	ND	ND	2.6	ND	3.4	0.8	0.2	ND	6.7	18.5
			11:53 AM	325.0	0.4	1.9	299.0	ND	ND	ND	0.1	3.0	140.0	0.3	2.6	ND	2.4	ND	3.4	0.6	0.0	ND	7.6	17.6
		8/11/2015	11:31 AM	907.0	1.4	2.0	391.0	0.0	ND	ND	0.2	3.1	382.0	ND	4.6	ND	2.5	0.8	3.3	0.8	0.2	0.0	7.8	12.4
			3:43 PM	1,790.0	1.2	1.6	445.0	0.1	ND	ND	0.3	5.3	787.0	0.6	11.6	ND	2.0	1.0	3.1	0.8	0.2	0.0	4.6	17.4
		8/12/2015	5:50 PM	105.0	2.2	1.8	185.0	0.1	ND	ND	0.1	3.2	ND	ND	ND	ND	2.6	ND	3.2	1.2	0.3	ND	4.3	16.1
			5:06 PM	125.0	1.4	1.6	245.0	0.0	ND	ND	0.1	3.3	ND	ND	ND	ND	2.3	ND	3.1	0.9	0.2	ND	3.1	14.2
		8/13/2015	12:05 PM	293.0	1.6	2.1	201.0	ND	ND	ND	0.1	3.5	143.0	ND	3.5	ND	2.3	0.8	3.3	1.2	0.2	ND	7.1	19.8
		8/14/2015	11:43 AM	120.0	1.0	2.3	157.0	0.0	ND	ND	0.2	5.9	ND	ND	2.4	ND	5.9	1.8	4.3	1.6	0.2	0.2	8.1	ND
		8/15/2015	12:04 PM	135.0	1.0	1.7	117.0	0.0	ND	ND	0.6	8.6	ND	ND	7.4	ND	3.3	1.7	3.6	1.2	0.2	0.1	5.7	6.2
		8/16/2015	11:58 AM	84.3	0.4	1.4	194.0	0.0	ND	ND	0.1	3.9	ND	ND	ND	ND	2.3	ND	3.5	0.8	0.0	ND	3.3	13.8
		8/17/2015	3:04 PM	52.3	0.8	1.6	108.0	ND	ND	ND	0.1	2.9	ND	ND	ND	ND	2.6	1.2	3.4	0.9	0.2	0.0	3.4	ND
		8/18/2015	11:55 AM	123.0	1.6	1.4	258.0	ND	ND	ND	0.1	3.1	ND	0.5	4.0	ND	2.1	ND	3.1	0.6	0.1	0.0	3.0	20.4
		8/19/2015	1:03 PM	83.3	0.4	1.5	219.0	ND	ND	ND	0.1	2.9	ND	0.3	3.5	ND	2.0	ND	3.0	0.7	ND	ND	3.2	9.3
		8/20/2015	6:56 AM	50.4	0.4	1.4	200.0	ND	ND	ND	0.1	2.2	ND	ND	ND	ND	2.0	ND	2.8	0.6	ND	ND	3.0	8.4
		8/24/2015	1:10 PM	39.9	0.4	1.5	87.4	ND	ND	ND	0.1	1.9	ND	ND	1.6	ND	1.9	ND	3.0	0.7	0.0	ND	3.3	4.8
		8/25/2015	1:40 PM	308.0	0.3	1.5	82.3	ND	ND	ND	0.1	2.6	185.0	0.4	6.4	ND	1.7	ND	2.9	0.6	ND	ND	3.8	6.2
		8/26/2015	1:00 PM	ND	0.3	1.5	81.0	ND	ND	ND	0.1	2.4	ND	ND	ND	ND	1.9	ND	2.8	0.6	ND	ND	3.3	ND
		8/27/2015	1:15 PM	386.0	0.6	1.6	83.3	0.0	ND	ND	0.2	2.5	222.0	0.3	11.3	ND	2.1	1.5	3.0	0.8	0.1	0.1	4.2	6.7
		8/28/2015	2:00 PM	ND	0.6	1.2	186.0	ND	ND	ND	0.1	2.9	ND	ND	ND	ND	4.1	2.0	5.1	2.9	ND	ND	4.5	ND
		9/22/2015	9:56 AM	ND	0.4	1.4	90.1	ND	ND	ND	0.1	2.1	ND	0.5	ND	ND	1.8	ND	3.1	0.7	0.0	ND	3.3	ND
				ND	0.3	1.3	93.3	ND	ND	ND	0.1	1.8	ND	ND	ND	ND	1.9	1.3	3.1	0.7	ND	ND	2.5	ND
		10/26/2015	4:15 PM	ND	0.6	1.1	114.0	0.0	ND	ND	0.2	1.3	ND	ND	ND	ND	1.9	ND	3.5	0.8	0.1	0.0	2.5	ND
		2/17/2016	9:00 AM	57.7	ND	1.0	ND	ND	ND	ND	ND	2.0	37.2	0.1	ND	ND	1.7	ND	3.0	1.6	ND	ND	ND	ND
		2/24/2016	9:20 AM	ND	ND	ND	ND	ND	ND	ND	ND	1.3	ND	ND	ND	ND	1.6	ND	2.9	1.3	ND	ND	ND	ND
		3/1/2016	9:00 AM	21.6	ND	1.1	ND	ND	ND	ND	ND	1.4	ND	ND	ND	ND	1.6	ND	2.7	1.3	ND	ND	ND	ND
			9:10 AM	16.9	ND	1.0	ND	ND	ND	ND	ND	2.0	ND	ND	ND	ND	1.4	ND	2.7	1.0	ND	ND	ND	11.3
		3/9/2016	11:30 AM	17.7	ND	ND	ND	ND	ND	ND	ND	1.6	ND	ND	ND	ND	1.4	ND	2.5	ND	ND	ND	ND	ND
		3/15/2016	11:45 AM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5	ND	3.3	ND	ND	ND	ND	ND
		3/22/2016	12:25 PM	10.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5	ND	2.5	ND	ND	ND	ND	ND
		3/29/2016	8:55 AM	16.8	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	1.4	ND	2.2	ND	ND	ND	ND	ND
		4/4/2016	3:30 PM	ND	ND	ND	79.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.3	ND	ND	ND	ND	ND
				ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	1.5	ND	2.5	ND	ND	ND	ND	ND
		4/12/2016	11:15 AM	19.0	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	1.5	ND	2.1	ND	ND	ND	ND	ND
		4/19/2016	9:33 AM	150.4	ND	ND	119.8	ND	ND	ND	ND	1.3	83.5	ND	ND	ND	1.3	ND	2.4	ND	ND	ND	ND	ND
		4/26/2016	8:30 AM	ND	ND	ND	ND	ND	ND	ND	ND	1.6	ND	ND	ND	ND	1.7	ND	2.3	ND	ND	ND	ND	ND
		5/2/2016	11:00 AM	16.3	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	1.1	ND	2.1	ND	ND	ND	ND	ND
		5/9/2016	6:00 PM	35.4	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	1.6	ND	2.3	ND	ND	ND	ND	ND
		5/15/2016	9:30 AM	34.0	ND	ND	179.7	ND	ND	ND	ND	2.2	29.9	0.1	ND	ND	1.1	ND	1.8	ND	ND	ND	ND	18.8
		5/21/2016	12:45 PM	19.9	ND	ND	ND	ND	ND	ND	ND	ND	26.9	ND	ND	ND	1.5	ND	2.1	ND	ND	ND	ND	ND
		5/31/2016	11:30 AM	34.5	ND	ND	ND	ND	ND	ND	ND	1.1	27.2	0.1	ND	ND	ND	ND	1.8	ND	ND	ND	ND	ND
		6/5/2016	7:00 AM	81.1	ND	ND	ND	ND	ND	ND	ND	1.5	88.8	0.5	5.5	ND	1.0	ND	1.8	ND	ND	ND	ND	ND
		6/13/2016	9:50 AM	78.1	ND	ND	ND	ND	ND	ND	ND	1.6	101.0	0.7	7.0	ND	1.1	ND	1.9	ND	ND	0.3	ND	ND
		6/18/2016	1:00 PM	48.9	ND	ND	ND	ND	ND	ND	ND	1.3	49.2	0.3	5.7	ND	ND	ND	1.6	ND	ND	ND	ND	ND
		6/25/2016	12:30 PM	14.8	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	ND	ND	1.6	ND	ND	ND	ND	ND
		7/4/2016	9:30 AM	85.0	3.0	1.0	297.0	1.0	0.1	2.0	30.0	2.3	72.8	0.2	5.0	0.2	1.3	5.0	NS	1.0	0.5	0.1	30.0	30.1
		7/9/2016	12:15 PM	20.6	3.0	1.0	147.0	1.0	0.1	2.0	30.0	1.1	20.0	0.1	5.0	0.2	1.2	5.0	NS	1.0	0.5	0.1	30.0	16.1

Figure 14 - Domestic source water screening table for analytes measured at MLID 4953000 - San Juan River at Mexican Hat US163 Xing.

Domestic Source Water (Dissolved Metals)

	No Exceedence		Above Screening Level

Monitoring Location	Site Description	Collection Date	Collection Time	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Thallium	Vanadium	Zinc
			Domestic Source Screening Values			10	1,000	4	10	50				15		2				50	50			
				ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L
4953880	McElmo Creek at U262 xing near Town of Montezuma Creek	2/23/2016	5:35 PM	ND	ND	1.1	ND	ND	ND	ND	ND	1.6	ND	ND	12.7	ND	3.0	ND	6.8	2.0	ND	ND	ND	ND
		2/29/2016	5:00 PM	69.6	ND	ND	ND	ND	ND	ND	ND	2.1	24.7	ND	20.1	ND	3.2	ND	5.3	2.5	ND	ND	ND	ND
		3/9/2016	9:05 AM	ND	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	18.6	ND	3.0	ND	5.0	2.0	ND	ND	ND	ND
		3/15/2016	9:20 AM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.6	ND	3.1	ND	4.5	ND	ND	ND	ND	ND
		3/22/2016	10:30 AM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.7	ND	3.3	ND	4.6	1.2	ND	ND	ND	ND
		3/28/2016	5:40 PM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	27.5	ND	3.7	ND	5.1	ND	ND	ND	ND	ND
		4/4/2016	1:30 PM	ND	ND	ND	42.9	ND	ND	ND	ND	ND	ND	ND	25.6	ND	4.5	ND	4.7	ND	ND	ND	ND	ND
				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	25.7	ND	3.8	ND	4.8	ND	ND	ND	ND	ND
		4/12/2016		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	46.7	ND	5.4	ND	4.2	1.7	ND	ND	ND	ND
		4/19/2016	11:40 AM	ND	ND	ND	ND	ND	ND	ND	ND	1.5	ND	0.1	43.3	ND	4.6	ND	5.1	2.3	ND	ND	ND	ND
		4/26/2016	11:00 AM	ND	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	69.1	ND	5.5	ND	5.8	ND	ND	ND	ND	ND
		5/2/2016	1:30 PM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	14.1	ND	3.9	ND	5.5	1.1	ND	ND	ND	ND
		5/9/2016	2:00 PM	ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	29.3	ND	4.9	ND	5.7	1.1	ND	ND	ND	ND
		5/15/2016	11:30 AM	ND	ND	ND	ND	ND	ND	ND	ND	1.3	ND	0.1	31.1	ND	4.5	ND	6.0	1.0	ND	ND	ND	ND
		5/21/2016	2:45 PM	ND	ND	1.1	ND	ND	ND	ND	ND	1.5	ND	ND	12.9	ND	4.0	ND	5.7	ND	ND	ND	ND	ND
		5/31/2016	4:00 PM	ND	ND	1.1	ND	ND	ND	ND	ND	1.4	ND	ND	16.1	ND	4.1	ND	5.5	ND	ND	ND	ND	ND
		6/5/2016	9:45 AM	ND	ND	1.4	ND	ND	ND	ND	ND	ND	ND	ND	11.6	ND	3.9	ND	5.4	ND	ND	ND	ND	ND
		6/13/2016	12:00 PM	ND	ND	1.5	ND	ND	ND	ND	ND	1.6	ND	0.2	8.6	ND	4.2	ND	5.3	ND	ND	ND	ND	12.3
		6/18/2016	2:45 PM	ND	ND	1.4	ND	ND	ND	ND	ND	1.2	ND	0.2	13.7	ND	4.9	ND	5.4	ND	ND	ND	ND	ND
		6/25/2016	2:15 PM	ND	ND	1.6	ND	ND	ND	ND	ND	1.5	ND	0.2	13.0	ND	5.2	ND	5.5	ND	ND	ND	ND	ND
		7/4/2016	11:15 AM	66.6	3.0	1.6	224.0	1.0	0.1	2.0	30.0	3.8	77.5	0.2	8.1	0.2	4.7	5.0	NS	1.4	0.5	0.1	30.0	13.4
		7/9/2016	2:00 PM	22.2	3.0	1.7	184.0	1.0	0.1	2.0	30.0	1.2	25.0	0.2	9.8	0.2	3.9	5.0	NS	1.0	0.5	0.1	30.0	10.0
4953560	Montezuma Creek at U163 xing	2/23/2016	6:30 PM	ND	ND	2.9	106.3	ND	ND	ND	ND	2.9	ND	ND	ND	ND	3.6	ND	6.3	3.6	ND	ND	ND	ND
		2/29/2016	5:40 PM	ND	ND	3.1	242.1	ND	ND	ND	ND	3.9	ND	ND	6.3	ND	4.8	ND	8.7	4.1	ND	ND	ND	ND
		3/9/2016	9:40 AM	12.2	ND	2.5	125.7	ND	ND	ND	ND	2.8	ND	ND	9.9	ND	5.4	ND	7.5	3.5	ND	ND	ND	ND
		3/15/2016	10:20 AM	ND	ND	2.4	127.5	ND	ND	ND	ND	1.9	ND	ND	58.6	ND	5.9	ND	8.5	ND	ND	ND	ND	ND
		5/21/2016	1:45 PM	68.8	ND	3.9	183.8	ND	ND	ND	ND	3.0	39.4	ND	7.0	ND	6.2	ND	7.2	1.0	ND	ND	ND	ND
		5/31/2016	2:45 PM	ND	ND	3.5	216.7	ND	ND	ND	ND	4.0	ND	ND	ND	ND	10.7	ND	11.3	3.3	ND	ND	ND	ND
4952940	San Juan R @ Clay Hills	8/13/2015	2:42 PM	643.0	0.2	1.8	411.0	0.1	ND	ND	0.3	4.4	388.0	0.9	13.8	ND	2.2	1.1	3.1	0.9	ND	ND	5.0	19.2
		8/14/2015	2:33 PM	38.5	0.3	1.9	121.0	ND	ND	ND	0.1	3.6	ND	ND	ND	ND	3.3	1.3	3.7	1.1	0.0	ND	5.4	ND
		8/15/2015	2:30 PM	119.0	0.3	1.8	136.0	ND	ND	ND	0.1	2.6	ND	ND	ND	ND	4.3	0.9	3.6	1.2	ND	ND	5.5	ND
		8/16/2015	2:46 PM	925.0	0.3	1.7	319.0	0.0	ND	ND	0.3	5.3	490.0	0.5	9.6	ND	2.8	0.8	4.2	0.9	ND	ND	5.7	20.6
		8/17/2015	1:03 PM	101.0	0.3	1.6	132.0	ND	ND	ND	0.3	4.7	ND	ND	2.7	ND	2.6	1.4	3.9	0.7	ND	ND	4.8	ND
		8/18/2015	1:45 PM	53.2	0.6	1.6	279.0	ND	ND	ND	0.1	2.6	ND	0.3	ND	ND	2.2	ND	3.5	0.6	0.0	ND	3.6	20.5
		8/19/2015	3:09 PM	74.8	0.6	1.6	331.0	ND	ND	ND	0.1	2.2	ND	ND	1.6	ND	2.2	0.9	3.4	0.6	ND	ND	4.0	15.3
		8/24/2015	10:37 AM	33.8	1.0	1.8	124.0	ND	ND	ND	0.1	2.1	ND	ND	2.0	ND	2.5	0.8	3.0	0.6	0.1	ND	4.7	ND
		8/25/2015	11:15 AM	44.8	0.7	1.6	118.0	ND	ND	ND	0.1	2.1	ND	ND	ND	ND	2.0	0.9	3.1	0.6	ND	ND	4.6	ND
		8/26/2015	10:05 AM	ND	0.3	1.6	117.0	ND	ND	ND	0.1	2.4	ND	ND	ND	ND	2.1	ND	2.9	0.5	ND	ND	4.6	ND
		8/27/2015	10:35 AM	707.0	0.7	2.9	165.0	0.1	ND	ND	0.4	2.6	296.0	0.3	10.1	ND	2.4	1.5	4.9	1.2	0.1	0.0	12.6	6.8
		8/28/2015	10:25 AM	493.0	0.5	1.6	338.0	ND	ND	ND	0.3	2.8	216.0	ND	7.8	ND	3.1	1.2	7.2	1.3	ND	ND	6.1	ND
		9/23/2015	1:45 PM	68.3	0.7	1.6	136.0	ND	ND	ND	0.1	1.8	ND	ND	4.6	ND	2.2	1.3	3.2	0.6	0.1	0.0	4.0	ND
		10/27/2015	2:45 PM	1,100.0	0.6	1.6	152.0	0.1	ND	ND	1.1	2.3	774.0	0.5	16.1	ND	2.4	1.2	4.4	0.9	ND	ND	5.0	ND
4952942		2/17/2016	10:30 AM	162.9	ND	1.1	112.5	ND	ND	ND	ND	2.3	77.5	0.2	5.5	ND	1.7	ND	3.1	1.7	ND	ND	ND	11.9

Figure 15 - Domestic source water screening table for analytes measured at MLIDs 4953880 - McElmo Creek at U262 Xing near Town of Montezuma Creek, 4953560 – Montezuma Creek at U163 Xing, and 4952942 – San Juan River at Clay Hills.

Utah's Drinking Water Systems Standards (R309-200-5) – Dissolved Metals

None of the public water systems regulated by the State of Utah have surface water intakes directly from the San Juan River. The consumer's exposure to elevated levels of these metals through public drinking water supply is expected to be minimal. Nonetheless, the Utah Division of Drinking Water reviewed total metals data collected in two community water systems located near the San Juan River (*Mexican Hat Special Services District* and *Bluff Water Works Service District*). The data of the finished water delivered to consumers were examined for exceedances of drinking water maximum contaminant levels or action levels (UAC R309-200-5). The data do not indicate that the drinking water quality in these water systems has been affected by the GKM spill. Data and analysis are presented on the Utah DEQ Gold King Mine Release website. It is noted that the copper results within *Mexican Hat's* distribution system are above the action level. Most often, plumbing conveyance pipes and not the source water is the cause of copper contamination. It is suspected that *Mexican Hat's* high copper results in the distribution system may be a result of the slightly corrosive nature of the treated water from its water treatment plant. The past samples taken at the well sources did not show elevated copper levels. It is unlikely the elevated copper levels are caused by the well sources or the GKM release. However, it should be noted that many U.S. rivers are increasing in salinity and therefore, the potential for corrosion in water distribution systems. Between 1992 and 2012, the USGS found that the Upper Colorado River Basin (UCRB) had a greater than 85 percent likelihood of an increasing trend in chloride, the ratio of chloride to sulfate, and the Larson ratio (Stets et al., 2017).

Utah's Recreational Exposure Water Screening Value Comparison – Total Metals

The Utah Department of Health's Environmental Epidemiology Program (EEP) has generated site-specific recreational screening values for total metals and metalloid exposures to the San Juan River waters (Table 5). These values reflect the water contaminant concentrations that would exceed established ATSDR minimal risk levels (MRL), or EPA reference doses (RfD) if an appropriate MRL does not exist, for the most susceptible population: children under the age of five years.

No metal or metalloid exceeded a recreational screening value for any of the samples collected in 2015 or 2016. Based on these comparisons, recreational exposures to San Juan River water and sediment are not expected to harm people's health. A summary of the calculated recreational screening values is provided in Table 5 and Table 6. The Utah DEQ Long Term Monitoring Plan provides a more detailed explanation of the exposure calculation assumptions.

Table 5 - Summary of Utah recreational screening values.

Summary of Recreational Screening Values						
Contaminant	**CV (µg/L)**	**Source**	**MRL (mg/kg/day)**	**Type**	**Screening Value**	**Units**
Aluminum	10,000	I. EMEG	1.00E+00	Chronic	620,767	µg/L
Antimony	4	RMEG	4.00E-04	RfD	248	µg/L
Arsenic	3	C. EMEG	3.00E-04	Chronic	186	µg/L
Barium	2,000	I. EMEG	2.00E-01	Chronic	124,159	µg/L
Beryllium	20	C. EMEG	2.00E-03	Chronic	1,242	µg/L
Cadmium	5	I. EMEG	1.00E-04	Chronic	62	µg/L
Chromium	60	Cr(VI) RSL	9.00E-04	Cr(VI) Chr.	410	µg/L
Cobalt	100	I. EMEG	1.00E-02	Intermediate	7,931	µg/L
Copper	100	I. EMEG	1.00E-02	Intermediate	6,208	µg/L
Iron	14,000	RSL	8.75E-01	UDOH	851,582	µg/L
Lead	15	RSL	9.37E-04	UDOH	910	µg/L
Manganese	500	RMEG	5.00E-02	RfD	31,040	µg/L
Mercury	0.63	RSL	2.00E-03	Intermediate	1,242	µg/L
Molybdenum	50	RMEG	5.00E-03	RfD	3,104	µg/L
Nickel	200	RMEG	2.00E-02	RfD	17,480	µg/L
Selenium	50	RMEG	5.00E-03	Chronic	3,104	µg/L
Silver	50	RMEG	5.00E-03	RfD	3,630	µg/L
Thallium	0.2	RSL	4.00E-05	PPRTV subchronic RfD	25	µg/L
Vanadium	100	I. EMEG	1.00E-02	Intermediate	6,208	µg/L
Zinc	3,000	I. EMEG	3.00E-01	Chronic	217,786	µg/L

I. EMEG - ASTDR Intermediate Environmental Media Evaluation Guide (15 day to 1 year exposure)
C. EMEG - ASTDR Chronic Environmental Media Evaluation Guide (greater than 1 year exposure)
RMEG - ASTDR Reference Dose Media Evaluation Guide
RSL – USEPA Regional Screening Level
RfD – USEPA Reference dose
PPRTV – USEPA Provisional Peer Reviewed Toxicity Values

Recreational screening value calculations are adapted from standard ATSDR exposure dose equations for ingestion and dermal exposures using the following calculation.

$$C = \frac{RfD \times BW_I \times BW_D}{(BW_D \times IR_I \times EF_I \times CF_I) + (BW_I \times P_D \times SA_D \times ET_D \times CF_D)}\text{; where}$$

C	Concentration (mg/L) – these calculated values are converted to µg/L for screening values where appropriate.
RfD	ATSDR Minimal Risk Level (MRL) or EPA Reference Dose (RfD), (mg/kg/day)
BW_i	Child body weight for ingestion (16 kg)
BW_d	Child body weight for dermal (30kg)
IR_i	Intake rate for ingestion (0.1 L/day)
EF_i	Exposure factor for ingestion (0.1644 = 60 days/year)
CF_i	Conversion factor, ingestion (1 for mg/L entries)
SA_d	Surface area (whole body, which is 8,750 cm^2 for children)
ET_d	Exposure time (2 hour/day)
CF_d	Conversion factor, dermal (0.001 for mg/L)
P_d	Permeability coefficient (see Table 6)

Table 6 - List of permeability coefficients used in calculation of Utah recreational screening values.

Permeability coefficients	
Aluminum	1.00E-03 (EPA Dermal Exposure Assessment; EPA RAGS part E Exhibit 3-1)
Antimony	1.00E-03
Arsenic	1.00E-03
Barium	1.00E-03
Beryllium	1.00E-03
Cadmium	1.00E-03
Chromium VI	2.00E-03
Cobalt	4.00E-04 (EPA RAGS part E Exhibit 3-1)
Copper	1.00E-03
Iron	N/A
Lead	4.00E-06
Manganese	1.00E-03
Mercury	1.00E-03 (EPA RAGS part E Exhibit 3-1)
Molybdenum	1.00E-03 (Table 8 from a contractor-derived HHRA for CalDOT; EPA RAGS part E Exhibit 3-1)
Nickel	2.00E-04
Selenium	1.00E-03
Silver	6.00E-04
Thallium	1.00E-03
Vanadium	1.00E-03
Zinc	6.00E-04

Figure 16 through Figure 20 provide a comparison of the measured water quality samples to Utah's Recreation Water Screening values.

Recreational Water (Total Metals)

No Exceedence | Above Screening Level

Monitoring Location	Site Description	Collection Date	Collection Time	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
		Recreational Screening Values		620,767	248	186	124,159	1,242	62	410	7,931	6,208	851,582	910	31,040	1,242	3,104	17,480	3,104	3,630	25	6,208	217,786
				ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
4954000	San Juan R @ US160 Xing in CO	8/8/2015	1:23 PM	47,400	0.3	12.5	1,300.0	3.4	1.3	23.9	22.8	41.4	24,800	44.5	2,320.0	0.1	0.8	40.5	1.1	0.3	0.4	61.2	147.0
		8/9/2015	6:00 PM	24,600	0.5	10.0	532.0	1.8	0.7	13.7	12.4	47.6	24,100	111.0	870.0	0.0	1.3	16.8	0.7	0.8	0.2	37.8	138.0
			12:02 PM	33,900	0.5	12.3	702.0	2.6	0.9	17.4	16.8	59.3	29,400	151.0	1,100.0	0.1	1.4	23.0	1.1	1.1	0.4	50.5	160.0
			3:05 PM	26,700	0.6	13.5	606.0	2.1	0.7	14.2	13.5	63.0	28,600	185.0	942.0	0.1	1.6	18.2	1.0	1.3	0.3	41.6	172.0
			9:02 PM	31,000	0.4	9.6	554.0	2.3	0.6	15.5	14.7	49.7	26,500	83.5	887.0	0.0	1.0	18.4	0.7	0.6	0.3	41.5	137.0
		8/10/2015	2:06 PM	43,700	0.2	12.3	889.0	4.0	0.9	23.7	25.4	69.7	39,100	69.3	1,390.0	0.1	0.6	30.8	1.0	0.4	0.4	53.4	897.0
			9:11 AM	39,900	0.2	11.0	1,730.0	4.0	1.2	21.0	24.8	69.6	35,400	73.5	1,450.0	0.1	0.5	29.7	0.9	0.5	0.4	48.2	668.0
		8/11/2015	8:50 AM	77,000	0.2	19.9	1,230.0	6.7	1.2	29.5	37.0	104.0	54,800	82.2	1,930.0	0.2	0.6	39.4	1.4	0.6	0.9	69.4	223.0
			1:17 PM	56,900	0.2	14.2	971.0	5.0	0.9	21.8	27.3	76.7	40,300	62.6	1,440.0	0.1	0.6	29.6	1.1	0.4	0.7	51.8	159.0
		8/12/2015	9:50 AM	31,100	0.2	11.1	766.0	3.2	0.9	16.1	18.6	43.7	22,600	47.4	1,250.0	0.1	0.8	28.9	1.0	0.3	0.5	43.7	131.0
			12:09 PM	28,500	0.3	9.2	683.0	2.5	0.6	13.2	14.5	34.3	18,100	35.8	1,130.0	0.1	0.5	22.0	0.8	0.2	0.3	41.4	96.2
		8/13/2015	10:01 AM	38,700	0.2	12.0	1,110.0	5.6	0.9	14.9	28.9	79.3	31,100	66.5	1,670.0	0.2	0.5	28.9	1.2	0.4	0.6	51.0	177.0
		8/14/2015	8:50 AM	44,300	0.4	12.5	918.0	4.9	1.0	23.7	27.1	70.5	39,100	64.3	1,360.0	0.1	0.8	34.5	1.3	0.4	0.7	60.0	197.0
		8/15/2015	9:43 AM	14,200	0.3	4.7	262.0	1.1	0.4	8.8	6.2	18.2	12,300	17.4	368.0	0.0	1.1	8.8	0.6	0.1	0.2	25.7	58.9
		8/16/2015	9:15 AM	9,500	0.8	4.9	358.0	0.9	0.3	6.2	5.7	14.9	10,000	15.8	338.0	0.0	1.2	10.3	0.9	0.3	0.2	16.1	215.0
		8/18/2015	9:56 AM	3,640	0.2	2.0	121.0	0.2	ND	2.1	1.6	6.2	3,300	4.3	126.0	0.0	1.4	2.6	0.6	0.0	ND	6.8	15.4
		8/19/2015	9:30 AM	4,070	0.2	2.1	122.0	0.2	ND	2.5	1.8	6.2	3,520	4.2	127.0	ND	1.4	2.8	0.6	0.0	ND	7.8	18.0
		8/20/2015	9:44 AM	3,650	0.2	2.0	119.0	0.3	ND	2.3	1.7	6.2	3,290	3.8	119.0	ND	1.4	2.7	0.6	0.0	ND	7.0	15.7
		8/24/2015	3:10 PM	1,760	0.2	2.0	89.6	0.1	ND	ND	0.8	3.5	1,530	1.5	58.8	ND	1.4	1.5	0.6	ND	ND	4.6	8.3
		8/25/2015	3:30 PM	1,500	0.3	1.9	85.9	0.1	ND	ND	0.6	3.3	1,310	1.2	49.8	ND	1.5	1.2	0.6	ND	ND	4.5	7.4
		8/26/2015	2:50 PM	1,540	0.6	1.6	82.0	0.1	ND	ND	0.6	3.2	1,140	1.3	47.6	ND	1.8	1.4	0.6	0.1	0.1	3.8	7.5
		8/27/2015	3:40 PM	117,000	0.1	31.6	3,010.0	16.3	3.5	65.7	78.6	164.0	116,000	185.0	5,570.0	0.5	1.1	105.0	2.2	1.1	1.2	124.0	564.0
		8/28/2015	4:25 PM	196,000	0.4	35.9	4,030.0	20.0	3.5	98.5	116.0	264.0	164,000	215.0	6,630.0	0.6	0.5	147.0	2.1	1.6	1.6	154.0	674.0
		9/23/2015	6:30 PM	5,120	1.2	1.9	222.0	0.7	0.3	2.9	4.2	11.3	5,250	10.8	407.0	ND	1.2	5.3	0.6	0.0	0.0	10.9	37.9
		10/2/2015	12:00 PM	183,000	0.4	20.2	5,400.0	17.3	5.2	123.0	148.0	333.0	178,000	228.0	10,800.0	1.1	0.5	204.0	1.9	6.7	2.4	178.0	862.0
		10/15/2015		34,400	0.8	9.9	751.0	2.6	1.0	22.6	22.3	59.5	38,100	44.0	1,280.0	0.1	0.9	73.7	1.0	0.4	0.7	49.7	176.0
		10/18/2015		39,000	0.3	10.3	971.0	2.9	1.2	27.4	27.8	65.3	44,200	50.7	1,660.0	0.1	1.0	44.4	1.0	0.4	0.9	57.2	197.0
		10/19/2015	12:00 AM	23,900	0.3	7.4	533.0	1.6	0.6	16.8	14.6	39.1	25,000	25.6	866.0	0.1	1.1	24.1	0.9	0.2	0.5	37.3	109.0
			12:00 PM	166,000	0.2	31.4	2,120.0	15.5	6.0	88.9	104.0	201.0	163,000	181.0	8,110.0	0.9	1.4	168.0	2.4	1.3	2.6	149.0	742.0
		10/20/2015		248,000	0.3	34.1	1,360.0	31.7	13.7	116.0	162.0	244.0	181,000	226.0	13,300.0	1.3	0.6	281.0	3.1	3.1	2.6	128.0	1,150.0
			12:01 AM	202,000	0.4	31.6	638.0	53.3	24.9	73.7	254.0	194.0	44,600	369.0	30,300.0	1.6	0.3	368.0	3.7	4.9	1.2	31.0	1,160.0
		10/21/2015	12:00 AM	230,000	0.4	33.9	3,360.0	39.5	20.1	104.0	212.0	296.0	114,000	355.0	20,400.0	1.6	0.4	375.0	3.9	4.3	1.6	76.3	1,250.0
		10/22/2015	12:00 PM	94,800	0.1	25.3	3,300.0	10.6	4.6	49.9	69.4	131.0	85,200	155.0	6,350.0	0.4	1.6	108.0	1.9	1.1	1.0	88.1	439.0
		10/23/2015	12:00 AM	138,000	0.1	25.6	4,630.0	15.9	4.1	65.6	107.0	219.0	118,000	200.0	7,000.0	1.0	3.0	136.0	2.1	1.5	1.3	102.0	526.0
			12:00 PM	189,000	0.2	34.6	6,530.0	18.6	7.1	98.0	141.0	308.0	164,000	283.0	11,800.0	1.2	2.2	198.0	3.1	2.0	2.3	157.0	886.0
		2/16/2016	3:00 PM	70,180	ND	5.9	890.0	5.1	ND	37.1	31.6	82.6	51,500	56.7	1,426.9	ND	ND	40.4	16.5	ND	ND	70.8	202.0
		2/23/2016	10:10 AM	2,475	ND	1.5	226.6	2.1	0.4	4.5	ND	16.3	1,250	9.8	921.6	ND	ND	7.5	ND	ND	ND	ND	58.1
		2/29/2016	4:00 PM	3,282	ND	1.8	120.1	ND	0.1	6.2	ND	6.0	3,312	4.3	129.0	ND	1.1	ND	ND	ND	ND	ND	23.4
		3/9/2016	8:20 AM	2,887	ND	2.0	106.0	ND	0.1	5.8	ND	6.0	2,970	4.8	144.1	ND	ND	ND	ND	ND	ND	ND	28.8
		3/15/2016		1,544	ND	ND	ND	ND	ND	4.3	ND	4.7	1,640	3.2	101.3	ND	1.1	ND	ND	ND	ND	ND	18.3
		3/22/2016	9:30 AM	528	ND	1.7	ND	ND	ND	5.0	ND	3.6	659	2.3	64.0	ND	ND	ND	ND	ND	ND	ND	ND
		3/28/2016	4:50 PM	256	ND	ND	ND	ND	ND	8.0	ND	2.3	356	1.3	41.9	ND	ND	ND	ND	ND	ND	ND	ND
		4/4/2016	12:20 PM	1,590	ND	ND	107.0	ND	ND	ND	ND	3.3	1,440	2.1	59.5	ND	ND	ND	ND	ND	ND	ND	12.1
				1,408	ND	ND	ND	ND	ND	7.8	ND	3.7	1,320	1.9	47.4	ND	1.3	ND	ND	ND	ND	ND	10.4
		4/12/2016	2:00 PM	674	ND	1.5	100.9	ND	0.3	ND	ND	10.5	1,310	9.2	283.1	ND	ND	ND	ND	ND	ND	ND	63.0
		4/19/2016	12:25 PM	2,047	ND	1.2	123.9	ND	0.2	ND	ND	9.7	7,060	9.5	244.9	ND	ND	ND	ND	ND	ND	ND	49.5
		4/26/2016	11:45 AM	3,183	ND	1.9	110.4	ND	0.2	2.7	ND	9.8	4,100	7.8	169.0	ND	ND	ND	ND	ND	ND	ND	42.8
		5/2/2016	2:00 PM	6,177	ND	2.4	162.9	ND	0.3	3.8	ND	9.9	6,260	10.1	263.3	ND	ND	5.4	ND	ND	ND	ND	55.5
		5/9/2016	12:30 PM	1,369	ND	2.4	118.7	ND	0.8	ND	ND	22.5	2,270	23.2	690.2	ND	ND	ND	ND	ND	ND	ND	184.3
		5/15/2016	12:15 PM	13,830	ND	4.5	359.6	ND	0.5	7.7	ND	19.9	15,800	22.3	628.6	ND	ND	10.7	ND	ND	0.2	ND	97.7
		5/21/2016	3:30 PM	22,722	ND	5.6	523.6	1.9	0.6	16.0	ND	39.9	25,700	35.1	824.0	ND	ND	20.2	3.1	ND	ND	39.9	161.3
		5/31/2016	4:15 PM	3,257	ND	2.0	168.8	ND	ND	ND	ND	8.1	4,080	9.8	256.7	ND	ND	ND	ND	ND	ND	ND	ND
		6/5/2016	10:30 AM	4,133	ND	2.6	160.8	ND	0.3	2.7	ND	14.5	5,630	23.6	365.7	ND	ND	ND	ND	ND	ND	ND	89.0
		6/13/2016	12:30 PM	2,578	ND	1.7	127.6	ND	0.2	ND	ND	8.3	3,840	15.2	205.6	ND	ND	ND	ND	ND	0.1	ND	49.1
		6/18/2016	3:30 PM	2,251	ND	1.4	147.8	ND	0.1	ND	ND	4.9	2,490	9.9	154.1	ND	1.0	ND	ND	ND	ND	ND	28.9
		6/25/2016	2:45 PM	1,655	ND	1.4	128.2	ND	0.1	ND	ND	4.3	1,860	5.8	111.8	ND	ND	ND	ND	ND	ND	ND	24.2
		7/4/2016	11:45 AM	8,310	3.0	2.1	184.0	1.0	0.1	4.2	30.0	13.0	8,720	9.7	193.0	0.2	1.0	5.0	1.0	0.5	0.1	30.0	41.5
		7/9/2016	2:45 PM	1,500	3.0	1.3	117.0	1.0	0.1	2.0	30.0	3.3	1,700	3.4	68.9	0.2	1.0	5.0	1.0	0.5	0.1	30.0	15.3

Figure 16 - Recreational water screening table for analytes measured at MLID 4954000 - San Juan River at US160 Xing in CO.

Recreational Water (Total Metals)

No Exceedence | Above Screening Level

Monitoring Location	Site Description	Collection Date	Collection Time	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
		Recreational Screening Values		620,767	248	186	124,159	1,242	62	410	7,931	6,208	851,582	910	31,040	1,242	3,104	17,480	3,104	3,630	25	6,208	217,786
				ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
4953990	San Juan R @ Town of Montezuma	8/8/2015	2:54 PM	67,300	0.4	20.2	1,590.0	6.4	2.5	38.8	41.1	82.4	50,400	91.5	3,010.0	0.2	1.3	75.8	1.9	0.7	1.2	82.8	286.0
		8/10/2015	2:58 PM	39,100	0.2	11.8	1,700.0	3.7	0.9	22.1	23.2	67.3	35,800	75.8	1,400.0	0.1	0.9	29.6	1.1	0.7	0.4	49.0	658.0
			10:13 AM	32,300	0.2	11.5	1,960.0	2.7	0.7	17.3	18.3	56.4	29,700	79.3	1,130.0	0.1	0.8	23.5	0.9	0.5	0.3	43.8	821.0
		8/11/2015	9:44 AM	52,800	0.3	12.6	918.0	4.3	1.0	23.1	25.1	67.9	40,200	62.9	1,410.0	0.1	0.8	29.3	1.2	0.6	0.7	55.2	166.0
			2:20 PM	54,700	0.2	15.0	1,060.0	5.2	1.0	24.2	29.1	80.3	44,700	70.2	1,570.0	0.1	0.6	32.4	1.2	0.5	0.7	58.4	183.0
		8/12/2015	10:37 AM	31,500	0.2	10.2	720.0	3.6	0.9	14.7	19.5	51.7	24,400	49.1	1,190.0	0.1	0.5	22.7	1.1	0.5	0.5	38.6	131.0
			2:04 PM	35,000	0.3	10.7	725.0	4.0	0.9	17.0	19.5	51.4	26,500	54.1	1,120.0	0.1	0.4	27.7	1.1	0.3	0.6	40.8	144.0
		8/13/2015	10:46 AM	23,700	0.2	10.1	722.0	3.6	0.7	9.3	17.3	47.9	17,800	44.3	1,270.0	0.1	0.7	19.3	0.9	0.3	0.3	34.2	109.0
		8/14/2015	9:55 AM	62,000	0.4	16.0	1,400.0	7.0	1.4	29.9	39.8	106.0	54,300	90.8	2,060.0	0.2	0.7	48.4	1.5	0.5	1.0	76.4	265.0
		8/15/2015	10:30 AM	29,200	0.3	8.5	566.0	2.7	0.8	15.5	15.0	39.3	24,900	36.5	862.0	0.1	1.1	18.7	0.9	0.2	0.4	43.3	114.0
		8/16/2015	10:02 AM	13,600	0.2	5.6	517.0	1.2	0.3	7.6	7.1	21.1	13,200	19.5	435.0	0.0	1.0	10.1	0.9	0.2	0.2	21.6	238.0
		8/17/2015	4:07 PM	4,160	0.4	2.6	141.0	0.4	0.3	2.4	1.9	6.9	3,510	6.1	150.0	0.0	1.5	3.1	0.7	0.1	0.1	8.0	20.2
		8/18/2015	8:41 AM	4,450	0.8	2.7	131.0	0.4	ND	2.8	2.1	7.1	3,920	5.4	162.0	0.0	1.7	3.4	0.7	0.1	0.1	9.2	20.5
		8/19/2015	8:15 AM	4,330	0.2	2.3	123.0	0.3	ND	2.4	1.6	6.0	3,430	4.2	122.0	ND	1.6	2.8	0.6	0.1	0.0	8.2	15.5
		8/20/2015	8:59 AM	3,650	0.3	2.0	115.0	0.2	ND	2.3	1.4	5.6	3,120	3.6	109.0	ND	1.6	2.5	0.6	0.1	0.0	7.2	13.9
		8/24/2015	4:30 PM	2,170	0.2	2.0	96.4	0.1	ND	ND	0.9	3.8	1,950	1.8	67.1	ND	1.6	1.8	0.6	ND	ND	5.7	10.6
		8/25/2015	4:20 PM	1,500	0.3	1.8	91.8	0.1	ND	ND	0.7	3.3	1,320	1.3	53.3	ND	1.7	1.4	0.6	ND	ND	5.1	9.0
		8/26/2015	3:30 PM	1,250	0.2	1.6	91.5	0.1	ND	ND	0.7	3.2	978	1.5	61.2	ND	1.2	1.4	0.5	ND	0.0	3.7	8.8
		8/27/2015	2:50 PM	22,200	0.1	8.4	474.0	2.1	0.6	9.7	11.8	31.7	19,200	27.8	1,150.0	0.0	0.8	15.2	0.7	0.2	0.1	30.7	102.0
		8/28/2015	3:35 PM	191,000	0.1	40.1	4,520.0	22.0	4.6	93.8	119.0	232.0	173,000	281.0	8,390.0	0.7	0.7	141.0	2.5	1.8	1.4	167.0	1,010.0
		9/22/2015	5:30 PM	1,300	0.6	1.7	105.0	0.1	ND	ND	0.7	2.9	1,290	1.8	62.2	ND	1.9	1.6	0.7	0.1	0.1	4.2	9.3
		10/2/2015	12:00 PM	14,100	0.2	4.5	435.0	1.1	0.3	17.1	9.0	20.6	13,800	16.5	606.0	0.0	0.9	15.0	0.6	0.2	0.2	22.5	68.5
		10/15/2015		14,800	0.2	5.1	313.0	0.9	0.3	8.0	7.3	19.4	14,700	15.5	417.0	0.0	1.0	12.2	0.7	0.1	0.2	21.5	58.1
		10/19/2015	12:00 AM	5,790	0.3	2.9	190.0	0.4	ND	3.5	3.2	9.2	5,880	5.8	236.0	ND	1.4	6.0	0.7	0.1	0.1	10.2	26.3
			12:00 PM	15,200	0.2	5.4	320.0	1.0	0.4	6.4	7.7	18.8	11,500	14.2	596.0	0.0	0.9	11.6	0.8	0.1	0.2	18.4	52.4
		10/20/2015	12:00 AM	53,800	0.2	13.9	1,250.0	5.1	1.6	20.7	25.8	57.7	42,900	72.1	2,000.0	0.2	0.6	41.2	1.6	0.4	0.8	45.4	175.0
			12:00 PM	35,800	0.2	11.0	881.0	3.1	1.3	17.2	18.3	44.3	29,900	48.0	1,340.0	0.2	0.9	34.2	1.7	0.3	0.7	39.4	134.0
		10/21/2015	12:00 AM	30,200	0.2	10.1	689.0	2.5	0.8	11.0	13.6	32.6	21,300	33.0	1,210.0	0.2	0.7	20.8	1.3	0.2	0.5	31.3	89.1
		10/22/2015	12:00 PM	94,300	0.2	25.4	2,440.0	8.9	4.5	58.0	64.4	113.0	83,900	140.0	4,480.0	0.6	1.0	127.0	2.5	0.9	1.3	99.8	458.0
		10/23/2015		223,000	0.2	33.1	6,480.0	20.2	8.4	111.0	150.0	245.0	165,000	308.0	11,300.0	0.9	1.2	231.0	2.7	1.9	2.2	138.0	924.0
			12:00 AM	273	0.6	10.6	4,400.0	0.3	10.3	ND	67.4	4.9	ND	1.2	23,900.0	1.3	3.8	78.7	2.6	0.8	0.3	15.7	84.6
		10/26/2015	2:00 PM	45,800	0.1	10.5	771.0	2.7	0.8	24.9	21.3	54.9	42,500	39.3	1,120.0	0.1	0.6	30.7	0.9	0.2	0.6	53.5	140.0
		2/16/2016	4:15 PM	81,859	ND	12.7	929.0	5.9	ND	39.7	34.1	92.9	60,100	67.4	1,628.7	ND	ND	43.8	33.0	ND	ND	80.2	222.9
		2/23/2016	6:00 PM	1,703	ND	1.8	136.2	1.1	0.3	3.4	ND	13.0	1,490	9.1	496.2	ND	ND	5.3	1.3	ND	ND	ND	36.4
		2/29/2016	5:30 PM	3,441	ND	1.6	123.0	ND	0.1	5.7	ND	6.1	3,360	4.5	137.6	ND	1.1	ND	1.1	ND	ND	ND	22.7
		3/9/2016	10:00 AM	3,198	ND	2.5	115.4	ND	0.1	6.2	ND	5.7	3,300	4.6	133.9	ND	1.0	ND	ND	ND	ND	ND	24.1
		3/15/2016		2,224	ND	ND	102.7	ND	ND	5.0	ND	5.3	2,310	3.3	99.5	ND	1.5	ND	ND	ND	ND	ND	15.9
		3/22/2016	10:55 AM	429	ND	1.6	ND	ND	ND	6.2	ND	3.1	590	2.2	82.4	ND	ND	ND	ND	ND	ND	ND	ND
		3/28/2016	3:45 PM	211	ND	ND	ND	ND	ND	8.5	ND	3.3	315	1.5	41.0	ND	ND	ND	ND	ND	ND	ND	ND
		4/4/2016	2:00 PM	843	ND	ND	92.9	ND	ND	ND	ND	2.1	692	ND	42.7	ND	ND	ND	ND	ND	ND	ND	8.2
				1,424	ND	ND	ND	ND	ND	7.6	ND	3.5	1,040	1.6	40.2	ND	1.4	ND	ND	ND	ND	ND	ND
		4/12/2016	1:00 PM	692	ND	1.3	ND	ND	0.3	ND	ND	10.7	1,410	9.3	275.2	ND	ND	ND	ND	ND	ND	ND	60.2
		4/19/2016	11:10 AM	1,692	ND	1.9	148.4	ND	0.4	ND	ND	11.6	5,520	11.7	403.3	ND	ND	ND	1.2	ND	ND	ND	63.8
		4/26/2016	10:30 AM	4,534	ND	2.4	160.9	ND	0.2	4.0	ND	11.6	5,790	8.9	210.8	ND	1.2	7.0	ND	ND	ND	ND	45.3
		5/2/2016	1:00 PM	3,269	ND	1.8	138.9	ND	0.1	2.3	ND	6.8	3,730	5.8	154.3	ND	1.1	ND	ND	ND	ND	ND	29.4
		5/9/2016	2:15 PM	3,002	ND	3.0	160.6	ND	1.1	ND	ND	30.5	3,980	29.7	901.1	ND	ND	ND	ND	ND	ND	ND	216.7
		5/15/2016	11:00 AM	39,563	ND	8.5	598.7	2.9	0.5	18.3	ND	47.8	39,200	39.1	1,135.3	ND	ND	23.5	1.7	ND	0.5	40.2	798.8
		5/21/2016	2:15 PM	21,740	ND	5.5	500.3	1.8	0.6	13.9	ND	36.6	24,200	31.4	782.2	ND	ND	16.8	2.9	ND	ND	37.5	145.4
		5/31/2016	3:15 PM	3,501	ND	2.0	160.3	ND	ND	2.0	ND	8.0	4,200	9.5	243.8	ND	ND	ND	ND	ND	ND	ND	ND
		6/5/2016	9:30 AM	5,163	ND	3.0	200.3	ND	0.4	3.3	ND	16.9	6,640	28.6	433.8	ND	ND	ND	ND	ND	ND	ND	98.4
		6/13/2016	11:30 AM	3,432	ND	1.9	128.6	ND	0.2	2.2	ND	9.0	4,710	14.5	216.9	ND	ND	ND	ND	ND	0.1	ND	49.5
		6/18/2016	2:15 PM	2,756	ND	1.6	147.5	ND	0.2	2.1	ND	6.3	3,390	12.2	186.7	ND	ND	ND	ND	ND	ND	ND	35.6
		6/25/2016	2:00 PM	467	ND	1.0	ND	ND	ND	ND	ND	3.7	560	4.9	110.2	ND	ND	ND	ND	ND	ND	ND	19.4
		7/4/2016	11:00 AM	10,500	3.0	2.8	NS	1.0	0.2	5.7	30.0	15.4	11,600	13.0	302.0	0.2	1.0	6.4	1.0	0.5	0.2	30.0	52.5
		7/9/2016	1:45 PM	2,390	3.0	1.7	124.0	1.0	0.1	2.0	30.0	4.8	2,700	4.9	101.0	0.2	1.0	5.0	1.0	0.5	0.1	30.0	21.8

Figure 17 - Recreational water screening table for analytes measured at MLID 4953990 – San Juan River at Town of Montezuma.

Recreational Water (Total Metals)

	No Exceedence		Above Screening Level																				
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
		Recreational Screening Values		620,767	248	186	124,159	1,242	62	410	7,931	6,208	851,582	910	31,040	1,242	3,104	17,480	3,104	3,630	25	6,208	217,786
Monitoring Location	Site Description	Collection Date	Collection Time	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
4953250	San Juan R @ Sand Island	8/8/2015	4:19 PM	55,700	0.4	15.9	1,090.0	5.2	2.0	32.4	34.3	80.8	47,800	74.7	1,700.0	0.2	1.8	65.8	2.1	0.6	1.3	64.7	242.0
		8/10/2015	11:15 AM	27,000	0.3	13.2	1,530.0	2.3	0.8	15.9	15.6	60.0	28,500	140.0	1,090.0	0.1	1.4	22.1	1.0	1.2	0.3	44.3	664.0
			3:58 PM	28,700	0.3	10.7	726.0	2.6	0.7	16.1	17.3	54.7	27,700	84.7	1,170.0	0.1	0.9	22.3	0.9	0.5	0.2	40.9	960.0
		8/11/2015	3:01 PM	48,700	0.3	12.0	900.0	4.2	1.0	21.0	23.6	64.2	36,800	63.4	1,400.0	0.1	0.9	28.0	1.1	0.4	0.6	51.5	163.0
			10:53 AM	47,800	0.2	11.5	913.0	3.9	1.0	21.7	22.6	61.6	37,000	63.5	1,310.0	0.1	0.7	27.7	0.9	0.4	0.6	52.7	167.0
		8/12/2015	11:12 AM	45,400	0.2	14.9	971.0	5.2	0.9	20.0	27.9	76.7	34,600	67.4	1,670.0	0.1	0.3	30.3	1.1	0.4	0.6	51.4	176.0
			2:57 PM	30,600	0.3	10.3	718.0	3.6	0.7	13.6	19.2	53.4	23,700	49.1	1,190.0	0.1	0.5	21.7	0.9	0.5	0.4	38.0	126.0
		8/13/2015	11:28 AM	19,300	0.2	8.8	661.0	2.5	0.7	8.8	13.6	33.6	12,900	35.6	1,190.0	0.1	0.9	18.8	1.1	0.5	0.3	32.9	92.7
		8/14/2015	11:02 AM	66,300	0.5	16.8	1,460.0	7.5	1.4	29.8	41.8	116.0	58,200	96.0	2,160.0	0.3	0.6	49.2	1.6	0.6	1.1	77.4	288.0
		8/15/2015	11:31 AM	37,600	0.4	11.2	826.0	4.1	1.0	20.7	22.2	57.6	32,300	54.0	1,230.0	0.2	1.1	27.8	1.4	0.5	0.6	53.5	160.0
		8/16/2015	11:06 AM	24,600	0.3	7.9	1,360.0	2.3	0.5	13.6	12.1	33.8	23,300	31.6	642.0	0.1	1.1	18.0	1.1	0.5	0.4	32.5	632.0
		8/17/2015	3:33 PM	10,200	0.5	5.0	300.0	1.0	0.3	6.3	5.9	17.0	10,200	17.2	414.0	0.0	1.3	10.2	0.9	0.2	0.2	17.0	55.5
		8/18/2015	11:22 AM	7,320	0.8	3.3	184.0	0.5	ND	4.2	3.2	10.1	6,240	8.2	239.0	0.0	1.6	5.2	0.7	0.1	0.0	13.1	32.3
		8/19/2015	12:33 PM	5,980	0.3	2.6	159.0	0.4	ND	3.4	2.4	7.8	4,810	6.1	166.0	ND	1.7	3.7	0.6	0.1	0.1	10.4	21.2
		8/20/2015	7:21 AM	5,770	0.6	2.9	167.0	0.4	ND	3.2	2.4	7.7	4,700	5.7	174.0	ND	1.6	3.9	0.7	0.1	0.2	10.5	21.6
		8/24/2015	1:55 PM	2,210	0.2	2.3	115.0	0.2	ND	ND	1.0	4.3	1,890	2.4	80.7	ND	1.6	1.7	0.6	ND	ND	5.8	46.5
		8/25/2015	2:25 PM	2,070	0.2	2.2	108.0	0.2	ND	1.6	0.8	3.8	1,760	1.8	62.5	ND	1.8	1.6	0.6	ND	ND	5.8	12.8
		8/26/2015	1:30 PM	1,620	0.3	1.8	95.1	0.1	ND	ND	0.7	3.4	1,240	1.5	52.4	ND	1.7	1.5	0.5	ND	ND	4.8	6.6
		8/27/2015	1:55 PM	1,250	0.9	1.8	93.6	0.1	ND	ND	0.6	3.0	1,100	1.3	47.9	ND	1.8	1.4	0.5	0.1	ND	5.7	7.8
		8/28/2015	2:45 PM	125,000	0.1	31.8	3,630.0	17.1	4.5	69.5	83.8	180.0	115,000	238.0	6,800.0	0.6	0.9	114.0	2.2	1.6	1.0	131.0	738.0
		9/22/2015	1:55 PM	1,720	0.6	1.8	114.0	0.2	ND	ND	0.9	3.3	1,680	2.2	67.8	ND	1.6	1.9	0.6	0.0	0.0	5.2	10.5
		10/19/2015	12:00 PM	16,500	0.3	6.6	425.0	1.1	0.4	8.4	7.5	17.9	13,000	14.8	644.0	0.0	1.1	13.1	0.8	0.1	0.3	22.4	52.3
			12:00 AM	11,000	0.9	4.3	301.0	0.6	0.3	6.2	5.1	14.0	10,000	9.9	437.0	ND	1.4	8.9	0.6	0.1	0.2	17.3	40.5
		10/20/2015	12:00 PM	71,800	0.2	22.3	1,550.0	5.8	1.9	27.4	32.7	74.6	53,900	86.8	2,530.0	0.2	0.5	49.9	1.7	0.5	1.0	61.3	221.0
			12:00 AM	85,700	0.2	25.9	1,880.0	5.8	2.1	35.0	35.9	75.0	55,100	90.1	3,090.0	0.2	0.4	56.5	1.2	0.5	1.1	72.3	216.0
		10/21/2015		67,200	0.2	21.2	1,320.0	4.7	2.0	32.4	30.4	72.4	56,800	76.3	2,040.0	0.2	1.0	58.5	2.0	0.5	1.2	68.2	234.0
		10/23/2015	12:00 AM	69,800	1.2	18.3	1,470.0	5.8	2.0	40.3	38.3	98.8	62,800	73.1	2,520.0	0.3	1.6	61.3	2.6	0.6	1.0	87.2	241.0
		10/24/2015		200,000	0.2	32.1	4,180.0	20.4	4.4	95.3	109.0	266.0	171,000	218.0	6,630.0	0.6	0.9	143.0	3.3	1.7	2.3	162.0	564.0
		2/16/2016	5:00 PM	68,001	ND	12.0	952.0	5.5	ND	36.0	30.0	78.5	51,600	59.0	1,478.9	ND	ND	39.5	22.2	ND	ND	68.9	197.7
		2/24/2016	8:40 AM	1,580	ND	1.7	150.9	1.2	0.3	4.0	ND	11.7	1,140	7.6	591.5	ND	ND	5.5	ND	ND	ND	ND	33.1
		3/1/2016	8:15 AM	3,321	ND	1.2	122.5	ND	0.1	4.3	ND	6.6	3,080	5.1	187.8	ND	1.0	ND	ND	ND	ND	ND	25.5
		3/9/2016	12:10 PM	3,731	ND	2.2	158.7	ND	0.2	8.2	ND	7.7	3,920	6.4	196.4	ND	1.2	ND	ND	ND	ND	ND	30.7
		3/15/2016	11:00 AM	1,900	ND	1.8	ND	ND	ND	5.2	ND	4.5	1,950	2.8	77.0	ND	1.4	ND	ND	ND	ND	ND	12.1
		3/22/2016	11:40 AM	545	ND	1.1	ND	ND	ND	5.5	ND	3.3	679	2.3	87.6	ND	ND	ND	ND	ND	ND	ND	ND
		4/4/2016	2:40 PM	1,710	ND	ND	119.0	ND	ND	ND	ND	3.5	1,510	2.4	85.6	ND	ND	ND	ND	ND	ND	ND	14.0
				295	ND	ND	ND	ND	ND	ND	ND	2.9	338	1.9	73.4	ND	1.2	ND	ND	ND	ND	ND	ND
		4/12/2016	10:30 AM	777	ND	1.7	105.7	ND	0.4	ND	ND	12.3	1,490	10.1	371.8	ND	ND	ND	ND	ND	ND	ND	69.0
		4/19/2016	10:17 AM	1,003	ND	1.2	116.4	ND	0.3	ND	ND	9.8	5,820	9.7	266.1	ND	ND	ND	ND	ND	0.1	ND	53.9
		4/26/2016	10:00 AM	735	ND	1.4	ND	ND	0.2	ND	ND	6.4	1,210	5.2	151.5	ND	ND	ND	ND	ND	ND	ND	23.2
		5/2/2016	12:00 PM	2,069	ND	1.6	110.0	ND	ND	ND	ND	5.1	2,660	4.0	97.2	ND	1.1	ND	ND	ND	ND	ND	21.5
		5/9/2016	2:45 PM	17,997	ND	5.6	369.4	1.3	1.2	10.8	ND	39.3	20,700	47.0	1,006.1	ND	ND	12.7	1.1	ND	0.2	ND	225.4
		5/15/2016	10:15 AM	7,336	ND	3.2	213.1	ND	0.4	5.1	ND	15.4	10,000	16.3	421.1	ND	ND	7.6	ND	ND	0.2	ND	72.9
		5/21/2016	1:15 PM	32,813	ND	6.9	678.7	2.3	0.7	20.7	ND	52.6	35,100	42.0	1,067.7	ND	ND	23.6	4.2	ND	0.6	55.0	192.2
		5/31/2016	2:00 PM	4,624	ND	4.8	377.1	ND	ND	5.6	ND	18.2	10,800	20.5	539.4	ND	1.6	8.7	ND	ND	ND	ND	91.8
		6/5/2016	8:25 AM	6,370	ND	4.0	212.9	ND	0.5	4.0	ND	22.1	8,250	47.6	635.4	ND	1.0	5.8	ND	ND	ND	ND	131.8
		6/13/2016	10:30 AM	3,713	ND	2.1	152.1	ND	0.2	2.4	ND	10.0	5,320	15.8	230.7	ND	ND	ND	ND	ND	0.2	ND	50.5
		6/18/2016	1:45 PM	3,464	ND	1.9	165.5	ND	0.2	2.7	ND	6.7	3,950	11.0	190.2	ND	1.0	ND	ND	ND	0.1	ND	36.0
		6/25/2016	1:00 PM	2,325	ND	1.7	149.7	ND	0.1	ND	ND	5.3	2,560	7.7	154.2	ND	1.1	ND	ND	ND	ND	ND	27.5
		7/4/2016	10:15 AM	15,400	3.0	4.2	2,500.0	1.0	0.4	9.0	30.0	22.1	18,700	20.6	470.0	0.2	1.0	12.3	1.0	0.5	0.3	30.0	79.4
		7/9/2016	1:00 PM	2,080	3.0	1.6	130.0	1.0	0.1	2.0	30.0	4.9	2,390	5.1	113.0	0.2	1.0	5.0	1.0	0.5	0.1	30.0	21.0

Figure 18 - Recreational water screening table for analytes measured at MLID 4953250 – San Juan River at Sand Island.

Recreational Water (Total Metals)

	No Exceedence		Above Screening Level																				
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
		Recreational Screening Values		620,767	248	186	124,159	1,242	62	410	7,931	6,208	851,582	910	31,040	1,242	3,104	17,480	3,104	3,630	25	6,208	217,786
Monitoring Location	Site Description	Collection Date	Collection Time	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
4953000	San Juan R @ Mexican Hat US163 Xing	8/8/2015	5:40 PM	63,400	1.3	16.3	1,540.0	7.2	1.5	29.4	41.5	103.0	51,900	86.7	2,800.0	0.2	1.3	47.8	1.4	0.6	0.8	70.5	261.0
		8/10/2015	4:44 PM	80,600	0.3	22.7	1,910.0	6.1	1.3	36.8	32.8	69.8	38,100	171.0	2,430.0	0.1	0.7	58.4	1.3	1.1	0.4	83.3	815.0
			11:53 AM	90,800	0.2	20.6	2,300.0	7.6	1.5	43.1	40.2	72.8	43,400	82.1	3,230.0	0.1	0.7	70.9	1.4	0.4	0.6	80.0	843.0
		8/11/2015	11:31 AM	111,000	0.2	22.2	2,430.0	8.1	1.4	43.5	38.5	74.3	47,300	102.0	2,710.0	0.2	0.6	64.6	1.3	0.6	0.8	88.4	209.0
			3:43 PM	56,400	0.3	13.3	1,350.0	5.1	1.1	23.5	25.3	61.0	35,900	75.1	1,660.0	0.1	0.8	34.2	0.9	0.5	0.6	57.2	168.0
		8/12/2015	5:50 PM	71,400	0.2	22.7	2,010.0	8.7	1.6	28.5	40.1	82.4	38,600	101.0	3,070.0	0.2	0.2	51.7	1.5	0.5	0.6	78.5	210.0
			5:06 PM	54,700	0.8	17.5	1,350.0	6.8	1.2	23.2	33.2	80.8	37,500	82.9	2,170.0	0.1	0.3	38.9	1.2	0.5	0.6	63.7	190.0
		8/13/2015	12:05 PM	44,700	1.9	16.5	1,450.0	5.4	1.3	18.3	25.0	49.5	21,600	62.5	1,840.0	0.1	0.7	39.2	1.6	0.5	0.4	66.1	145.0
		8/14/2015	11:43 AM	124,000	1.1	37.2	4,320.0	15.2	3.7	51.1	59.6	84.2	46,900	166.0	5,630.0	0.4	0.9	111.0	2.4	1.1	1.0	115.0	270.0
		8/15/2015	12:04 PM	63,700	1.2	16.8	1,620.0	7.3	1.5	29.8	35.5	79.0	45,100	86.7	2,330.0	0.2	1.0	47.8	1.6	0.6	0.9	75.5	220.0
		8/16/2015	11:58 AM	34,300	0.2	10.0	892.0	2.9	0.6	17.1	16.3	40.2	25,600	39.4	976.0	0.1	0.8	24.0	1.0	0.2	0.4	40.5	294.0
		8/17/2015	3:04 PM	16,800	0.7	6.9	496.0	2.1	0.4	8.2	9.8	24.3	13,500	27.1	641.0	0.1	1.1	14.1	1.0	0.3	0.3	26.2	72.6
		8/18/2015	11:55 AM	17,400	1.2	5.4	281.0	1.2	0.2	10.0	6.3	16.3	13,000	14.7	373.0	0.0	1.4	12.1	0.9	0.2	0.2	25.4	55.4
		8/19/2015	1:03 PM	7,110	0.2	3.1	187.0	0.5	ND	3.8	2.7	8.5	5,210	7.2	182.0	ND	1.5	4.8	0.7	0.1	0.1	12.0	23.0
		8/20/2015	6:56 AM	5,790	0.2	2.9	161.0	0.3	ND	3.1	2.0	6.8	4,330	5.2	136.0	ND	1.6	3.2	0.6	0.0	0.0	10.4	18.7
		8/24/2015	1:10 PM	3,410	0.2	2.4	132.0	0.2	ND	1.7	1.3	5.0	3,280	3.0	90.2	ND	1.6	2.2	0.6	ND	ND	7.4	15.6
		8/25/2015	1:40 PM	2,890	0.2	2.5	122.0	0.2	ND	1.8	1.1	4.4	2,390	2.4	74.4	ND	1.7	1.9	0.6	ND	ND	7.3	12.0
		8/26/2015	1:00 PM	2,190	0.6	2.0	107.0	0.1	ND	ND	0.8	3.7	1,520	1.8	58.0	ND	1.9	1.7	0.5	0.1	0.1	5.5	9.1
		8/27/2015	1:15 PM	2,860	0.1	2.4	117.0	0.2	ND	2.5	1.5	4.1	2,040	2.3	102.0	ND	1.6	3.3	0.5	ND	ND	9.1	11.0
		8/28/2015	2:00 PM	163,000	0.2	45.0	4,610.0	14.0	6.3	104.0	84.5	138.0	110,000	200.0	7,390.0	0.4	0.8	184.0	5.7	1.5	1.6	141.0	588.0
		9/22/2015	9:56 AM	2,530	0.8	2.3	140.0	0.2	ND	1.9	1.3	4.3	2,470	3.0	90.5	ND	1.8	2.6	0.8	0.1	0.1	6.7	14.1
				3,480	0.3	2.6	149.0	0.2	ND	2.1	1.5	5.6	3,280	3.4	97.3	ND	1.7	3.0	0.7	ND	ND	7.6	16.8
		10/2/2015	12:00 PM	4,550	1.1	2.3	188.0	0.3	ND	3.2	1.9	6.8	3,910	3.6	95.5	0.1	1.5	5.2	0.7	0.2	0.1	8.2	15.8
		10/15/2015		40,800	0.9	12.3	1,150.0	3.1	1.2	28.7	27.4	56.3	46,300	46.1	1,720.0	0.2	1.1	44.6	0.9	0.3	0.8	58.6	191.0
		10/23/2015		74,700	0.2	17.8	2,270.0	6.2	1.6	32.4	33.0	46.2	29,400	67.8	2,760.0	0.3	0.8	62.7	1.7	0.4	0.5	61.1	169.0
			12:00 AM	38,100	0.9	11.3	1,230.0	2.9	1.2	20.8	17.7	29.8	20,800	37.0	1,300.0	0.7	1.3	38.1	2.6	0.3	0.4	47.2	113.0
		10/24/2015		118,000	0.1	25.9	3,850.0	12.7	2.5	44.0	55.3	81.0	50,400	130.0	4,610.0	0.4	0.4	91.4	1.6	0.8	0.7	79.7	240.0
		10/26/2015	4:15 PM	43,700	0.1	9.9	676.0	2.8	0.8	23.9	20.4	56.6	39,800	39.2	1,060.0	0.1	0.7	28.8	1.0	0.3	0.6	51.8	140.0
		2/17/2016	9:00 AM	70,228	ND	12.8	845.0	ND	ND	34.2	ND	79.3	51,300	59.9	1,514.5	ND	ND	38.7	25.9	ND	ND	72.8	194.2
		2/24/2016	9:20 AM	2,268	ND	1.5	160.0	1.3	0.3	3.9	ND	13.6	1,360	10.8	637.0	ND	ND	5.1	ND	ND	ND	ND	33.4
		3/1/2016	9:00 AM	3,766	ND	1.4	130.4	ND	0.1	4.8	ND	7.4	3,360	5.0	170.7	ND	1.1	ND	ND	ND	ND	ND	23.4
			9:10 AM	2,078	ND	1.1	104.1	ND	0.1	3.7	ND	6.5	2,030	4.0	134.9	ND	ND	ND	ND	ND	ND	ND	18.6
		3/9/2016	11:30 AM	4,030	ND	1.9	140.2	ND	0.2	8.2	ND	7.6	4,170	6.4	228.1	ND	1.1	ND	ND	ND	ND	ND	31.6
		3/15/2016	11:45 AM	2,385	ND	ND	105.8	ND	ND	5.6	ND	5.4	2,330	3.1	87.1	ND	1.5	ND	ND	ND	0.2	ND	15.2
		3/22/2016	12:25 PM	1,759	ND	1.5	111.2	ND	ND	6.2	ND	4.2	1,850	2.7	78.9	ND	1.2	ND	ND	ND	ND	ND	ND
		4/4/2016	3:30 PM	1,430	ND	ND	118.0	ND	ND	ND	ND	3.5	1,280	ND	58.6	ND	ND	ND	ND	ND	ND	ND	10.6
				193	ND	ND	ND	ND	ND	ND	ND	2.2	133	1.2	43.5	ND	1.3	ND	ND	ND	ND	ND	ND
		4/12/2016	11:15 AM	845	ND	1.5	102.2	ND	0.4	ND	ND	11.2	1,430	9.4	360.9	ND	ND	ND	ND	ND	ND	ND	58.9
		4/19/2016	9:33 AM	2,755	ND	3.0	262.4	ND	0.4	ND	ND	7.6	17,100	11.3	706.9	ND	ND	ND	ND	ND	0.1	ND	48.4
		4/26/2016	8:30 AM	5,230	ND	2.6	169.4	ND	0.2	4.3	ND	10.5	6,010	8.1	202.9	ND	1.2	5.9	1.0	ND	ND	ND	36.1
		5/2/2016	11:00 AM	2,601	ND	1.8	131.3	ND	0.1	ND	ND	5.8	2,760	4.4	120.6	ND	1.0	ND	ND	ND	ND	ND	21.9
		5/9/2016	6:00 PM	1,957	ND	3.6	181.0	ND	1.1	ND	ND	24.5	2,900	26.3	1,021.5	ND	ND	ND	ND	ND	ND	ND	195.2
		5/15/2016	9:30 AM	6,971	ND	3.1	201.7	ND	0.4	4.8	ND	14.8	8,150	16.4	453.8	ND	ND	7.0	ND	ND	0.2	ND	72.0
		5/21/2016	12:45 PM	36,080	ND	6.7	842.0	2.9	0.9	21.1	ND	58.8	34,800	50.8	1,593.0	ND	ND	30.6	4.3	ND	0.8	53.8	224.2
		5/31/2016	11:30 AM	4,727	ND	2.6	198.3	ND	ND	2.8	ND	9.3	5,410	10.6	288.6	ND	ND	ND	ND	ND	ND	ND	47.6
		6/5/2016	7:00 AM	7,153	ND	4.1	243.7	ND	0.6	4.6	ND	24.0	9,660	41.5	605.0	ND	1.0	6.8	ND	ND	ND	ND	148.6
		6/13/2016	9:50 AM	4,117	ND	2.4	172.8	ND	0.2	2.6	ND	10.6	6,410	18.5	263.7	ND	ND	ND	ND	ND	0.2	ND	58.0
		6/18/2016	1:00 PM	3,486	ND	2.1	185.1	ND	0.2	3.0	ND	7.5	4,460	13.6	242.8	ND	1.1	ND	ND	ND	0.2	ND	47.1
		6/25/2016	12:30 PM	2,944	ND	1.8	177.3	ND	0.1	ND	ND	5.7	3,060	7.6	161.4	ND	1.1	ND	ND	ND	0.1	ND	28.4
		7/4/2016	9:30 AM	25,600	0.1	6.2	2,500.0	1.7	0.6	14.6	10.7	28.6	28,100	30.2	835.0	0.2	1.1	18.7	1.1	0.2	0.4	36.4	101.0
		7/9/2016	12:15 PM	2,420	3.0	1.7	130.0	1.0	0.1	2.0	30.0	5.0	2,620	4.8	109.0	0.2	1.0	5.0	1.0	0.5	0.1	30.0	20.4

Figure 19 - Recreational water screening table for analytes measured at MLID 4953000 – San Juan River at Mexican Hat US163 Xing.

Recreational Water (Total Metals)

	No Exceedence		Above Screening Level																					
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
		Recreational Screening Values		620,767	248	186	124,159	1,242	62	410	7,931	6,208	851,582	910	31,040	1,242	3,104	17,480	3,104	3,630	25	6,208	217,786
Monitoring Location	Site Description	Collection Date	Collection Time	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
4953880	McElmo Creek at U262 xing near Town of Montezuma Creek	2/23/2016	5:35 PM	1,124	ND	1.3	ND	ND	0.3	4.7	ND	5.4	1,680	4.8	313.5	ND	1.3	6.6	1.2	ND	ND	ND	10.5
		2/29/2016	5:00 PM	2,249	ND	ND	ND	ND	ND	5.3	ND	3.0	2,050	2.2	105.4	ND	2.6	5.1	1.3	ND	ND	ND	ND
		3/9/2016	9:05 AM	385	ND	ND	ND	ND	ND	5.6	ND	1.9	359	0.4	33.6	ND	2.7	ND	ND	ND	ND	ND	20.2
		3/15/2016	9:20 AM	4,814	ND	2.2	ND	ND	0.2	7.4	ND	6.9	5,700	4.9	182.9	ND	3.4	9.0	1.5	ND	0.1	ND	20.4
		3/22/2016	10:30 AM	715	ND	1.3	ND	ND	0.2	6.1	ND	3.3	1,300	3.1	165.1	ND	1.6	6.3	1.1	ND	ND	ND	ND
		3/28/2016	5:40 PM	103	ND	ND	ND	ND	ND	9.4	ND	1.7	179	0.4	55.0	ND	3.3	ND	ND	ND	ND	ND	ND
		4/4/2016	1:30 PM	427	ND	ND	52.3	ND	ND	ND	ND	ND	385	ND	58.9	ND	4.4	2.3	ND	ND	ND	ND	ND
				65	ND	ND	ND	ND	ND	7.6	ND	1.5	117	0.3	54.4	ND	3.8	ND	1.3	ND	ND	ND	ND
		4/12/2016		29	ND	ND	ND	ND	ND	ND	ND	1.1	54	0.1	51.9	ND	5.0	ND	1.1	ND	ND	ND	ND
		4/19/2016	11:40 AM	151	ND	ND	ND	ND	ND	ND	ND	1.5	144	0.6	77.4	ND	4.4	5.1	1.9	ND	ND	ND	ND
		4/26/2016	11:00 AM	16	ND	ND	ND	ND	ND	ND	ND	ND	38	0.1	69.9	ND	5.6	ND	1.4	ND	ND	ND	ND
		5/2/2016	1:30 PM	322	ND	1.2	ND	ND	ND	ND	ND	1.3	349	0.3	60.0	ND	3.9	ND	ND	ND	ND	ND	ND
		5/9/2016	2:00 PM	46	ND	1.0	ND	ND	ND	ND	ND	1.9	84	0.1	47.2	ND	4.6	ND	1.2	ND	ND	ND	ND
		5/15/2016	11:30 AM	78	ND	1.0	ND	ND	ND	ND	ND	1.2	163	0.2	53.2	ND	4.3	ND	ND	ND	ND	ND	ND
		5/21/2016	2:45 PM	2,191	ND	1.7	ND	ND	ND	ND	ND	ND	1,850	1.8	228.0	ND	3.9	ND	ND	ND	ND	ND	ND
		5/31/2016	4:00 PM	697	ND	1.4	ND	ND	ND	ND	ND	ND	634	0.7	94.8	ND	4.1	ND	ND	ND	ND	ND	ND
		6/5/2016	9:45 AM	1,616	ND	2.0	ND	ND	ND	ND	ND	ND	1,210	1.3	161.1	ND	3.8	ND	ND	ND	ND	ND	ND
		6/13/2016	12:00 PM	2,809	ND	2.4	ND	ND	ND	ND	ND	3.3	3,050	2.5	258.5	ND	4.1	ND	ND	ND	0.1	ND	ND
		6/18/2016	2:45 PM	883	ND	1.6	ND	ND	ND	ND	ND	1.4	784	0.8	91.6	ND	4.5	ND	ND	ND	ND	ND	ND
		6/25/2016	2:15 PM	491	ND	1.6	ND	ND	ND	ND	ND	1.1	407	0.5	76.4	ND	5.3	ND	ND	ND	ND	ND	ND
		7/4/2016	11:15 AM	20,400	3.0	10.1	2,500.0	1.3	0.9	12.9	30.0	23.4	26,200	27.4	1,530.0	0.2	4.5	21.8	2.1	0.5	0.4	38.5	77.7
		7/9/2016	2:00 PM	4,010	3.0	2.9	111.0	1.0	0.2	2.7	30.0	4.8	4,020	5.2	342.0	0.2	2.3	5.5	1.1	0.5	0.1	30.0	15.9
4953560	Montezuma Creek at U163 xing	2/23/2016	6:30 PM	1,823	ND	3.4	149.8	ND	ND	3.7	ND	5.3	843	3.6	198.6	ND	1.7	ND	3.1	ND	ND	ND	ND
		2/29/2016	5:40 PM	1,078	ND	3.1	173.3	ND	ND	4.3	ND	4.0	561	1.0	34.2	ND	3.8	ND	3.5	ND	ND	ND	ND
		3/9/2016	9:40 AM	1,459	ND	2.1	126.4	ND	ND	5.4	ND	3.3	682	0.7	28.3	ND	4.4	ND	2.5	ND	ND	ND	ND
		3/15/2016	10:20 AM	77	ND	2.2	123.9	ND	ND	4.1	ND	2.8	51	ND	62.7	ND	6.0	ND	1.2	ND	ND	ND	ND
		5/21/2016	1:45 PM	58,196	ND	13.0	1,334.7	3.6	ND	25.1	ND	31.7	33,100	37.8	1,046.7	ND	1.0	26.7	5.1	ND	0.5	57.7	102.8
		5/31/2016	2:45 PM	550	ND	3.6	217.0	ND	ND	ND	ND	ND	274	ND	10.9	ND	10.4	ND	3.1	ND	ND	ND	ND
4952940	San Juan R @ Clay Hills	8/13/2015	2:42 PM	42,900	0.1	18.4	1,760.0	7.4	1.5	15.6	32.3	68.8	23,000	83.4	2,960.0	0.2	0.6	35.7	1.4	0.5	0.4	64.3	162.0
		8/14/2015	2:33 PM	73,900	0.4	21.7	2,040.0	7.2	2.2	33.8	35.1	59.7	34,700	89.2	2,900.0	0.2	1.0	62.9	1.8	0.7	0.7	84.5	198.0
		8/15/2015	2:30 PM	154,000	0.3	36.6	4,170.0	16.6	2.9	55.3	63.1	93.2	54,000	175.0	5,740.0	0.3	0.7	110.0	2.4	0.9	1.0	116.0	294.0
		8/16/2015	2:46 PM	91,000	0.2	22.0	2,250.0	8.2	1.5	40.5	45.4	104.0	64,500	105.0	2,850.0	0.2	0.6	65.8	1.9	0.5	1.1	89.8	477.0
		8/17/2015	1:03 PM	26,200	0.5	9.8	920.0	3.4	0.7	11.3	16.2	39.4	18,300	43.8	1,240.0	0.1	1.0	20.8	1.1	0.5	0.4	40.7	105.0
		8/18/2015	1:45 PM	29,300	0.3	7.8	570.0	2.1	0.5	15.3	12.6	31.0	22,200	29.5	749.0	0.1	0.7	19.9	0.9	0.2	0.3	40.0	92.6
		8/19/2015	3:09 PM	24,000	0.2	7.5	437.0	1.5	0.4	14.2	9.4	23.8	18,600	22.4	547.0	0.0	1.0	18.2	0.8	0.1	0.3	34.3	76.9
		8/24/2015	10:37 AM	5,130	0.5	3.0	176.0	0.3	ND	2.7	1.8	6.4	3,860	4.1	130.0	ND	1.6	3.2	0.6	0.0	0.0	11.1	19.0
		8/25/2015	11:15 AM	4,870	0.2	2.8	188.0	0.3	ND	2.9	1.9	6.4	3,860	4.1	138.0	ND	1.6	3.7	0.6	0.0	ND	11.1	18.6
		8/26/2015	10:05 AM	5,170	0.3	3.3	186.0	0.4	ND	2.7	1.9	6.3	3,770	4.2	131.0	ND	1.7	3.3	0.7	0.0	ND	11.4	18.6
		8/27/2015	10:35 AM	61,300	0.1	20.9	2,110.0	7.3	1.7	36.3	40.5	38.7	24,100	66.7	3,310.0	0.1	ND	81.9	1.3	0.2	0.2	99.3	159.0
		8/28/2015	10:25 AM	64,800	0.1	22.8	1,880.0	6.0	2.4	47.4	35.6	35.8	23,400	61.8	2,930.0	0.2	0.6	85.9	2.1	0.2	0.2	90.4	171.0
		9/23/2015	1:45 PM	6,800	0.5	3.2	239.0	0.4	ND	3.8	2.5	11.2	5,520	6.0	156.0	ND	1.7	6.5	0.7	0.1	0.1	13.1	24.6
		10/2/2015	12:00 PM	33,000	0.3	6.7	587.0	2.4	0.6	21.6	17.1	46.7	28,800	28.7	898.0	0.1	0.6	24.6	0.9	0.2	0.4	41.8	120.0
		10/23/2015		476	0.7	35.2	5,110.0	ND	2.8	ND	7.3	6.8	159	0.4	15,400.0	1.8	15.9	8.2	4.0	ND	0.1	20.6	8.2
		10/24/2015	12:00 AM	198	0.6	12.2	5,730.0	0.1	6.0	ND	38.6	4.1	113	0.3	18,000.0	1.4	4.0	35.9	1.7	ND	0.1	8.5	72.0
			12:00 PM	1,360	1.0	26.2	7,600.0	1.1	10.7	7.1	99.8	9.1	5,910	3.9	22,100.0	1.4	4.9	104.0	4.4	ND	0.6	13.4	287.0
		10/27/2015	2:45 PM	130,000	0.1	21.9	1,790.0	8.9	1.8	61.6	52.5	131.0	99,300	99.9	2,980.0	0.2	0.6	73.4	1.6	0.6	1.4	117.0	315.0
4952942		2/17/2016	10:30 AM	47,903	ND	6.5	628.0	ND	ND	23.6	ND	53.2	35,100	40.7	954.4	ND	ND	24.9	13.9	ND	ND	53.7	129.6

Figure 20 - Recreational water screening table for analytes measured at MLIDs 4953880 - McElmo Creek at U262 Xing near Town of Montezuma Creek, 4953560 – Montezuma Creek at U163 Xing, and 4952942 – San Juan River at Clay Hills.

Utah's Class 3B Aquatic Life Use (Warm-Water Fishery) (R317-2-14) – Dissolved Metals

The dissolved water concentrations of metals and metalloids were compared to Utah's chronic and acute water quality standards for the Class 3B aquatic life use. In the UAC R317-2-14, the chronic standard refers to the 4-day average concentration, and the acute standard refers to the 1-hour average concentration. All of Utah's aquatic life criteria are based on dissolved fractions, with the exception of aluminum, which is based on the total recoverable fraction. For the pH and hardness of the San Juan River, only the acute aluminum standard is applicable. The acute aluminum standard was exceeded at all sampling locations and on all dates in 2015 and almost all 2016 dates, with the exception of a few samples at *McElmo Creek* and *Montezuma Creek*. The 2016 maximum dissolved aluminum concentrations were not as high as the 2015 results where values exceeded 100,000 micrograms per liter (µg/L) at *MLID 4954000-San Juan River at US160Xing in CO* on August 27 and 28, October 2, and October 19, 20, 21, and 23; at *MLID 4953990-San Juan River at Town of Montezuma* on August 28 and October 23; at *MLID 4953250-San Juan River at Sand Island* on August 28 and October 24; at *MLID 4953000-San Juan River at Mexican Hat US163 Xing* on August 11, August 28, and October 24; and at *MLID 4952942-San Juan River at Clay Hills boat ramp* on August 15 and October 27. Some of these exceedances correlate with an increase in discharge.

The chronic aquatic life standards for iron and mercury were exceeded at *MLID 4954000-San Juan River at US160Xing in CO* on August 11 and August 28, 2015. The chronic standards for lead, cadmium, and copper were exceeded on August 28, 2015. Acute and chronic zinc concentrations were exceeded on August 28, 2015 at *MLID 4953990-San Juan River at Town of Montezuma*. No other exceedances of the zinc standards were observed. Furthermore, mercury concentrations exceeded the chronic standard at *MLIDs 4954000, 4953990, 4953250, 4953000, and 4953880* on July 4 and 9, 2016. At *MLID 4953880*, mercury exceeded the chronic standard on September 23, 2015, which was the only day that this site was sampled in 2015. It should be noted that the analytical method used for mercury analysis does not have sufficient sensitivity and the method detection limit (MDL) of 0.059 µg/L is higher than the standard of 0.012 µg/L. Therefore, all non-detect concentrations are potentially too high to determine if the water concentrations comply with the standard and this remains a significant uncertainty. Figure 21 through Figure 25 provide a comparison of the measured water quality samples to Utah's Aquatic Life Use Water Quality Standards.

Aquatic Life Use (Dissolved Metals)

	No Exceedence		Above Screening Level																				
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
		Utah Aquatic Life Use 1-hour		750		340			2	570		13	1000	65				468	18.4	1.6			120
		Utah Aquatic Life Use 4-hour		87		150			0.25	74		9	1000	2.5		0.012		52	4.6				120
Monitoring Location	Site Description	Collection Date	Collection Time	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
4954000	San Juan R @ US160 Xing in CO	8/8/2015	1:23 PM	47,400	0.5	1.3	222.0	0.0	ND	ND	0.1	2.2	95.8	ND	2.9	ND	1.9	ND	0.7	ND	ND	4.9	15.3
		8/9/2015	12:02 PM	33,900	0.3	0.6	274.0	ND	ND	ND	0.1	2.5	119.0	ND	2.7	ND	2.0	ND	0.6	0.0	ND	1.8	18.5
			3:05 PM	26,700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			6:00 PM	24,600	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			9:02 PM	31,000	0.3	0.9	341.0	0.0	ND	ND	0.1	3.5	198.0	0.3	4.1	ND	1.9	ND	0.5	ND	ND	2.1	15.4
		8/10/2015	9:11 AM	39,900	0.5	1.0	233.0	ND	ND	ND	0.1	3.2	103.0	0.4	1.6	ND	2.0	ND	0.6	ND	ND	1.7	19.7
			2:06 PM	43,700	0.7	1.3	220.0	0.1	ND	ND	0.4	3.4	732.0	1.0	12.8	ND	1.9	0.8	0.6	0.1	ND	3.6	18.0
		8/11/2015	8:50 AM	77,000	0.4	1.7	451.0	0.1	ND	ND	0.5	4.9	1,520.0	1.1	19.0	0.0	1.7	1.2	1.0	ND	ND	3.9	19.1
			1:17 PM	56,900	0.1	1.3	334.0	ND	ND	ND	0.2	3.0	366.0	0.3	5.1	ND	1.6	ND	0.8	ND	ND	2.5	14.9
		8/12/2015	9:50 AM	31,100	0.6	0.9	178.0	ND	ND	ND	0.1	2.4	ND	ND	ND	ND	1.5	ND	0.8	0.0	ND	1.9	14.8
			12:09 PM	28,500	0.5	1.2	151.0	ND	ND	ND	0.0	2.6	ND	ND	1.8	ND	1.5	ND	0.7	ND	ND	2.9	16.5
		8/13/2015	10:01 AM	38,700	0.2	1.3	213.0	0.0	ND	ND	0.1	3.7	148.0	0.4	3.2	ND	1.9	ND	0.9	ND	ND	2.1	21.9
		8/14/2015	8:50 AM	44,300	0.4	1.7	72.3	0.0	ND	ND	0.1	3.9	ND	ND	1.8	ND	3.7	3.1	1.1	ND	0.0	4.1	ND
		8/15/2015	9:43 AM	14,200	0.4	1.4	65.2	ND	ND	ND	0.1	1.4	ND	ND	ND	ND	2.3	ND	0.6	ND	ND	2.6	ND
		8/16/2015	9:15 AM	9,500	1.1	0.9	179.0	0.0	ND	ND	ND	2.9	ND	ND	ND	ND	1.7	ND	0.6	0.2	ND	1.9	12.6
		8/18/2015	9:56 AM	3,640	0.7	1.3	148.0	ND	ND	ND	0.1	2.3	ND	0.3	ND	ND	1.7	ND	0.6	0.0	ND	1.9	12.3
		8/19/2015	9:30 AM	4,070	0.7	1.3	106.0	ND	ND	ND	0.1	1.7	ND	ND	ND	ND	1.7	ND	0.5	0.0	ND	1.9	8.4
		8/20/2015	9:44 AM	3,650	0.8	1.3	132.0	ND	ND	ND	0.1	1.9	ND	ND	ND	ND	1.8	ND	0.6	0.1	0.0	1.9	8.1
		8/24/2015	3:10 PM	1,760	0.3	1.4	62.4	ND	ND	ND	0.0	2.2	ND	ND	1.9	ND	1.6	1.1	0.5	ND	ND	2.3	5.5
		8/25/2015	3:30 PM	1,500	0.5	1.4	63.4	ND	ND	ND	ND	2.1	ND	ND	1.9	ND	1.6	ND	0.6	ND	ND	2.5	ND
		8/26/2015	2:50 PM	1,540	0.6	1.5	70.5	0.1	ND	ND	0.3	2.8	554.0	0.5	21.8	ND	1.6	1.1	0.6	0.1	0.0	3.3	8.0
		8/27/2015	3:40 PM	117,000	0.3	1.0	121.0	0.1	ND	ND	0.4	3.3	605.0	0.5	11.4	ND	3.3	2.0	0.9	ND	ND	3.4	6.2
		8/28/2015	4:25 PM	196,000	0.2	5.6	340.0	1.6	0.3	12.0	9.0	27.7	16,700.0	15.7	413.0	0.0	1.5	12.7	0.8	0.1	0.2	26.2	72.8
		9/23/2015	6:30 PM	5,120	0.7	1.0	81.5	0.1	ND	ND	0.3	1.9	ND	ND	9.3	ND	1.8	1.3	0.7	0.1	0.1	1.8	ND
		10/2/2015	12:00 PM	183,000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/15/2015		34,400	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/18/2015		39,000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/19/2015	12:00 AM	23,900	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			12:00 PM	166,000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/20/2015		248,000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			12:01 AM	202,000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/21/2015	12:00 AM	230,000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/22/2015	12:00 PM	94,800	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/23/2015	12:00 AM	138,000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			12:00 PM	189,000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		2/16/2016	3:00 PM	70,180	ND	ND	186.9	ND	ND	ND	ND	6.0	155.0	0.5	14.4	ND	1.5	ND	1.6	ND	ND	ND	22.5
		2/23/2016	10:10 AM	2,475	ND	ND	ND	ND	ND	ND	ND	1.8	ND	ND	ND	ND	1.4	ND	1.2	ND	ND	ND	ND
		2/29/2016	4:00 PM	3,282	ND	ND	ND	ND	ND	ND	ND	1.7	ND	ND	ND	ND	1.2	ND	1.1	ND	ND	ND	ND
		3/9/2016	8:20 AM	2,887	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	1.2	ND	ND	ND	ND	ND	ND
		3/15/2016		1,544	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.3	ND	ND	ND	ND	ND	ND
		3/22/2016	9:30 AM	528	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	ND	ND
		3/28/2016	4:50 PM	256	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	ND	ND
		4/4/2016	12:20 PM	1,590	ND	ND	77.5	ND	ND	ND	ND	2.5	ND	ND	4.5	ND	ND	ND	ND	ND	ND	ND	5.1
				1,408	ND	ND	ND	ND	ND	ND	ND	2.4	36.2	0.1	5.3	ND	1.4	ND	ND	ND	ND	ND	ND
		4/12/2016	2:00 PM	674	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	1.3	ND	ND	ND	ND	ND	ND
		4/19/2016	12:25 PM	2,047	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	1.2	ND	ND	ND	ND	ND	ND
		4/26/2016	11:45 AM	3,183	ND	ND	ND	ND	ND	ND	ND	1.3	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND
		5/2/2016	2:00 PM	6,177	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	5.9	ND	1.1	ND	ND	ND	ND	ND	ND
		5/9/2016	12:30 PM	1,369	ND	ND	ND	ND	ND	ND	ND	1.0	26.4	0.1	5.6	ND	1.1	ND	ND	ND	ND	ND	ND
		5/15/2016	12:15 PM	13,830	ND	ND	211.7	ND	ND	ND	ND	1.9	51.1	0.2	ND	ND	1.1	ND	ND	ND	ND	ND	18.6
		5/21/2016	3:30 PM	22,722	ND	ND	ND	ND	ND	ND	ND	ND	45.7	0.1	7.7	ND	1.5	ND	ND	ND	ND	ND	ND
		5/31/2016	4:15 PM	3,257	ND	ND	ND	ND	ND	ND	ND	1.2	39.9	0.2	5.1	ND	ND	ND	ND	ND	ND	ND	ND
		6/5/2016	10:30 AM	4,133	ND	ND	ND	ND	ND	ND	ND	1.3	88.1	0.5	7.5	ND	ND	ND	ND	ND	ND	ND	ND
		6/13/2016	12:30 PM	2,578	ND	ND	ND	ND	ND	ND	ND	1.4	77.5	0.6	8.3	ND	ND	ND	ND	ND	ND	ND	ND
		6/18/2016	3:30 PM	2,251	ND	ND	123.4	ND	ND	ND	ND	1.3	57.3	0.5	ND	ND	ND	ND	ND	ND	ND	ND	16.1
		6/25/2016	2:45 PM	1,655	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		7/4/2016	11:45 AM	8,310	3.0	1.0	229.0	1.0	0.1	2.0	30.0	1.7	27.1	0.1	5.0	0.2	1.0	5.0	1.0	0.5	0.1	30.0	24.0
		7/9/2016	2:45 PM	1,500	3.0	1.0	112.0	1.0	0.1	2.0	30.0	1.0	20.0	0.1	5.7	0.2	1.1	5.0	1.0	0.5	0.1	30.0	10.0

Figure 21 – Aquatic life use water screening table for analytes measured at MLID 4954000 – San Juan River at US160 Xing in CO.

Aquatic Life Use (Dissolved Metals)

	No Exceedence		Above Screening Level																				
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
		Utah Aquatic Life Use 1-hour		750		340			2	570		13	1000	65				468	18.4	1.6			120
		Utah Aquatic Life Use 4-hour		87		150			0.25	74		9	1000	2.5		0.012		52	4.6				120
Monitoring Location	Site Description	Collection Date	Collection Time	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
4953990	San Juan R @ Town of Montezuma	8/8/2015	2:54 PM	67,300	0.7	1.1	223.0	0.0	ND	ND	0.1	2.7	ND	ND	ND	ND	2.6	0.8	1.1	0.0	ND	2.5	21.0
		8/10/2015	10:13 AM	32,300	0.7	0.9	262.0	ND	ND	ND	0.1	3.2	144.0	0.5	3.2	ND	2.0	ND	0.6	0.1	ND	2.1	17.3
			2:58 PM	39,100	1.3	0.9	200.0	0.0	ND	ND	0.1	2.5	ND	0.3	ND	ND	2.3	ND	0.6	0.3	ND	2.0	14.6
		8/11/2015	9:44 AM	52,800	0.6	1.2	314.0	ND	ND	ND	0.1	2.7	227.0	ND	3.3	ND	1.7	ND	0.7	0.0	ND	2.2	12.9
			2:20 PM	54,700	0.1	1.3	298.0	0.0	ND	ND	0.2	3.5	668.0	0.5	10.0	ND	1.7	1.0	0.7	ND	ND	2.7	14.3
		8/12/2015	10:37 AM	31,500	0.8	1.1	202.0	0.0	ND	ND	ND	2.5	ND	ND	ND	ND	1.7	ND	0.8	0.0	ND	1.7	13.5
			2:04 PM	35,000	0.8	0.9	176.0	ND	ND	ND	0.1	4.3	296.0	ND	2.3	ND	1.6	ND	0.7	0.0	ND	2.0	15.9
		8/13/2015	10:46 AM	23,700	1.9	1.3	240.0	0.1	ND	ND	0.2	3.8	192.0	ND	5.3	ND	1.9	1.0	1.0	0.2	0.0	3.1	32.7
		8/14/2015	9:55 AM	62,000	0.6	1.3	85.1	0.0	ND	ND	0.1	3.8	ND	ND	ND	ND	2.8	1.8	1.0	0.0	0.0	3.1	ND
		8/15/2015	10:30 AM	29,200	0.6	1.6	73.6	0.0	ND	ND	0.2	4.4	ND	ND	3.4	ND	2.4	1.1	0.9	0.1	ND	3.5	ND
		8/16/2015	10:02 AM	13,600	0.8	1.2	145.0	0.1	ND	ND	0.1	3.0	ND	ND	ND	ND	2.0	ND	0.7	0.3	0.1	2.2	9.8
		8/17/2015	4:07 PM	4,160	0.3	1.2	80.4	ND	ND	ND	0.1	1.9	ND	ND	2.4	ND	2.0	ND	0.6	ND	ND	2.2	ND
		8/18/2015	8:41 AM	4,450	1.0	1.2	197.0	0.0	ND	ND	0.1	3.4	ND	0.3	ND	ND	2.1	ND	0.6	0.1	0.1	2.3	14.8
		8/19/2015	8:15 AM	4,330	0.9	1.2	141.0	ND	ND	ND	0.1	1.7	ND	ND	ND	ND	2.0	ND	0.6	0.1	0.0	2.3	9.6
		8/20/2015	8:59 AM	3,650	1.0	1.4	128.0	ND	ND	ND	0.1	1.9	ND	ND	ND	ND	1.8	ND	0.7	ND	ND	2.1	6.6
		8/24/2015	4:30 PM	2,170	0.3	1.4	67.8	ND	ND	ND	0.1	2.3	ND	ND	4.9	ND	1.7	0.8	0.6	ND	ND	2.9	ND
		8/25/2015	4:20 PM	1,500	0.3	1.3	68.2	ND	ND	ND	0.1	2.6	ND	ND	2.0	ND	1.8	0.9	0.6	ND	ND	2.7	10.0
		8/26/2015	3:30 PM	1,250	0.4	1.5	77.1	0.1	ND	ND	0.3	2.9	601.0	0.5	26.5	ND	1.8	1.1	0.6	ND	ND	3.8	5.4
		8/27/2015	2:50 PM	22,200	0.4	1.4	71.1	ND	ND	ND	0.2	2.1	ND	ND	4.0	ND	2.1	ND	0.7	ND	ND	2.7	ND
		8/28/2015	3:35 PM	191,000	0.3	1.1	161.0	0.0	ND	ND	0.3	4.0	414.0	0.4	11.5	ND	2.7	1.6	0.8	ND	ND	2.8	191.0
		9/22/2015	5:30 PM	1,300	0.3	1.3	75.0	ND	ND	ND	0.1	3.3	ND	ND	1.7	ND	1.8	1.4	0.6	ND	ND	2.8	5.9
		10/2/2015	12:00 PM	14,100	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/15/2015		14,800	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/19/2015	12:00 AM	5,790	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			12:00 PM	15,200	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/20/2015	12:00 AM	53,800	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			12:00 PM	35,800	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/21/2015	12:00 AM	30,200	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/22/2015	12:00 PM	94,300	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/23/2015	12:00 AM	273	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			12:00 PM	223,000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/26/2015	2:00 PM	45,800	0.9	1.0	109.0	ND	ND	ND	0.6	1.3	ND	ND	2.0	ND	1.8	0.8	0.6	ND	ND	1.9	ND
		2/16/2016	4:15 PM	81,859	ND	ND	161.7	ND	ND	ND	ND	3.5	109.0	0.3	8.8	ND	1.7	ND	1.4	ND	ND	ND	18.1
		2/23/2016	6:00 PM	1,703	3.5	ND	ND	ND	ND	ND	ND	1.7	ND	0.2	ND	ND	1.8	ND	1.6	ND	ND	ND	ND
		2/29/2016	5:30 PM	3,441	ND	ND	ND	ND	ND	ND	ND	1.4	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND
		3/9/2016	10:00 AM	3,198	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.3	ND	ND	ND	ND	ND	ND
		3/15/2016		2,224	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND
		3/22/2016	10:55 AM	429	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND
		3/28/2016	3:45 PM	211	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	1.3	ND	ND	ND	ND	ND	ND
		4/4/2016	2:00 PM	843	ND	ND	76.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
				1,424	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	1.5	ND	ND	ND	ND	ND	ND
		4/12/2016	1:00 PM	692	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	1.3	ND	ND	ND	ND	ND	ND
		4/19/2016	11:10 AM	1,692	ND	ND	ND	ND	ND	ND	ND	1.5	29.7	ND	8.2	ND	1.3	ND	1.4	ND	ND	ND	ND
		4/26/2016	10:30 AM	4,534	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	1.3	ND	ND	ND	ND	ND	ND
		5/2/2016	1:00 PM	3,269	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	1.1	ND	ND	ND	ND	ND	ND
		5/9/2016	2:15 PM	3,002	ND	ND	ND	ND	ND	ND	ND	1.1	29.2	0.1	ND	ND	1.3	ND	ND	ND	ND	ND	ND
		5/15/2016	11:00 AM	39,563	ND	ND	296.9	ND	ND	ND	ND	2.9	74.8	0.2	ND	ND	1.3	ND	ND	ND	ND	ND	18.5
		5/21/2016	2:15 PM	21,740	ND	ND	ND	ND	ND	ND	ND	ND	46.5	0.1	7.8	ND	1.4	ND	ND	ND	ND	ND	ND
		5/31/2016	3:15 PM	3,501	ND	ND	ND	ND	ND	ND	ND	1.1	33.9	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
		6/5/2016	9:30 AM	5,163	ND	ND	ND	ND	ND	ND	ND	1.3	77.6	0.5	6.8	ND	ND	ND	ND	ND	ND	ND	ND
		6/13/2016	11:30 AM	3,432	ND	ND	ND	ND	ND	ND	ND	1.3	67.1	0.5	7.6	ND	ND	ND	ND	ND	ND	ND	ND
		6/18/2016	2:15 PM	2,756	ND	ND	227.1	ND	ND	ND	ND	1.9	57.8	0.5	5.7	ND	1.0	ND	ND	ND	ND	ND	27.5
		6/25/2016	2:00 PM	467	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		7/4/2016	11:00 AM	10,500	3.0	1.0	100.0	1.0	0.1	2.0	30.0	1.0	20.0	0.1	5.0	0.2	1.0	5.0	1.0	0.5	0.1	30.0	10.0
		7/9/2016	1:45 PM	2,390	3.0	1.0	110.0	1.0	0.1	2.0	30.0	1.0	20.0	0.1	5.0	0.2	1.2	5.0	1.0	0.5	0.1	30.0	11.0

Figure 22 – Aquatic life use water screening table for analytes measured at MLID 4953990 – San Juan River at Town of Montezuma.

Aquatic Life Use (Dissolved Metals)

	No Exceedence		Above Screening Level																					
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
		Utah Aquatic Life Use 1-hour		750		340			2	570		13	1000	65				468	18.4	1.6			120
		Utah Aquatic Life Use 4-hour		87		150			0.25	74		9	1000	2.5		0.012		52	4.6				120
Monitoring Location	Site Description	Collection Date	Collection Time	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
4953250	San Juan R @ Sand Island	8/8/2015	4:19 PM	55,700	1.4	1.0	294.0	0.1	ND	ND	0.1	3.9	104.0	ND	2.6	ND	3.3	1.0	1.4	0.1	ND	2.2	19.0
		8/10/2015	11:15 AM	27,000	1.2	0.9	192.0	ND	ND	ND	0.1	2.1	ND	0.3	ND	ND	2.4	ND	0.7	0.3	ND	1.8	13.7
			3:58 PM	28,700	0.6	1.1	184.0	ND	ND	ND	0.1	2.0	ND	0.3	ND	ND	2.3	ND	0.5	ND	ND	1.9	13.2
		8/11/2015	10:53 AM	47,800	1.2	1.2	278.0	0.1	ND	ND	0.2	2.9	328.0	ND	4.1	ND	1.9	0.8	0.7	0.3	0.0	2.6	13.7
			3:01 PM	48,700	0.3	1.0	251.0	ND	ND	ND	0.1	2.7	89.2	ND	ND	ND	1.9	ND	0.7	ND	ND	2.1	14.9
		8/12/2015	11:12 AM	45,400	1.1	1.4	205.0	0.0	ND	ND	0.2	3.4	310.0	ND	4.5	ND	1.9	ND	0.8	0.1	ND	2.6	14.5
			2:57 PM	30,600	1.8	1.4	260.0	0.1	ND	ND	0.2	3.0	314.0	ND	5.2	ND	1.8	0.9	0.8	0.2	ND	2.3	13.2
		8/13/2015	11:28 AM	19,300	0.7	1.3	156.0	0.0	ND	ND	0.2	3.1	275.0	ND	8.9	ND	1.6	ND	0.7	ND	ND	3.7	20.4
		8/14/2015	11:02 AM	66,300	1.0	2.0	78.6	0.1	ND	ND	0.1	3.3	ND	ND	7.0	ND	5.3	2.4	1.1	0.2	0.1	5.9	4.9
		8/15/2015	11:31 AM	37,600	1.1	1.8	83.5	0.0	ND	ND	0.1	2.3	ND	ND	ND	ND	3.9	0.8	1.1	0.3	0.1	3.5	ND
		8/16/2015	11:06 AM	24,600	0.4	1.2	149.0	0.0	ND	ND	0.1	3.9	202.0	ND	3.9	ND	2.0	ND	0.7	0.0	ND	2.0	10.5
		8/17/2015	3:33 PM	10,200	0.4	1.5	87.1	ND	ND	ND	0.2	2.1	ND	ND	ND	ND	2.7	1.3	0.6	ND	ND	2.8	ND
		8/18/2015	11:22 AM	7,320	0.6	1.5	138.0	ND	ND	ND	0.1	2.3	ND	0.4	1.6	ND	1.9	ND	0.6	ND	ND	2.4	12.3
		8/19/2015	12:33 PM	5,980	0.5	1.3	122.0	ND	ND	ND	0.1	1.9	ND	ND	1.8	ND	2.0	ND	0.6	ND	ND	2.5	8.7
		8/20/2015	7:21 AM	5,770	0.3	1.4	138.0	ND	ND	ND	0.1	2.3	ND	ND	ND	ND	1.9	ND	0.6	ND	ND	2.6	9.1
		8/24/2015	1:55 PM	2,210	0.3	1.6	79.6	ND	ND	ND	0.1	2.8	265.0	ND	9.4	ND	1.8	0.9	0.6	ND	ND	3.8	6.4
		8/25/2015	2:25 PM	2,070	0.3	1.5	77.5	ND	ND	ND	0.0	2.3	ND	ND	1.6	ND	1.9	ND	0.6	ND	ND	3.0	ND
		8/26/2015	1:30 PM	1,620	0.3	1.5	75.4	ND	ND	ND	0.1	2.5	ND	ND	2.4	ND	1.8	0.9	0.6	ND	ND	3.2	5.3
		8/27/2015	1:55 PM	1,250	0.4	1.4	81.5	ND	ND	ND	0.2	2.6	199.0	ND	8.4	ND	1.9	0.9	0.6	0.0	ND	3.1	ND
		8/28/2015	2:45 PM	125,000	0.4	0.8	151.0	ND	ND	ND	0.1	3.3	ND	ND	ND	ND	3.1	1.2	0.9	ND	ND	2.0	ND
		9/22/2015	1:55 PM	1,720	0.6	1.4	77.8	ND	ND	ND	0.1	3.7	ND	0.3	1.7	ND	1.8	1.2	0.6	0.1	0.0	2.9	ND
		10/19/2015	12:00 PM	16,500	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			12:00 AM	11,000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/20/2015	12:00 PM	71,800	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			12:00 AM	85,700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/21/2015		67,200	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/23/2015	12:00 AM	69,800	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/24/2015		200,000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		2/16/2016	5:00 PM	68,001	ND	1.0	104.8	ND	ND	ND	ND	2.7	71.7	0.2	ND	ND	1.7	ND	1.5	ND	ND	ND	ND
		2/24/2016	8:40 AM	1,580	ND	ND	ND	ND	ND	5.4	ND	2.0	57.2	0.2	6.9	ND	1.6	ND	1.3	ND	ND	ND	ND
		3/1/2016	8:15 AM	3,321	ND	ND	ND	ND	ND	ND	ND	1.3	44.2	ND	ND	ND	1.4	ND	1.3	ND	ND	ND	ND
		3/9/2016	12:10 PM	3,731	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	1.3	ND	ND	ND	ND	ND	ND
		3/15/2016	11:00 AM	1,900	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5	ND	ND	ND	ND	ND	ND
		3/22/2016	11:40 AM	545	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND
		3/29/2016	9:50 AM	1,975	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND
		4/4/2016	2:40 PM	1,710	ND	ND	78.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
				295	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	1.5	ND	ND	ND	ND	ND	ND
		4/12/2016	10:30 AM	777	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND
		4/19/2016	10:17 AM	1,003	ND	ND	ND	ND	ND	ND	ND	1.3	ND	ND	ND	ND	1.2	ND	ND	ND	ND	ND	ND
		4/26/2016	10:00 AM	735	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND
		5/2/2016	12:00 PM	2,069	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	1.2	ND	ND	ND	ND	ND	ND
		5/9/2016	2:45 PM	17,997	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND
		5/15/2016	10:15 AM	7,336	ND	ND	172.6	ND	ND	ND	ND	1.9	29.2	0.1	ND	ND	1.1	ND	ND	ND	ND	ND	18.9
		5/21/2016	1:15 PM	32,813	ND	1.0	ND	ND	ND	ND	ND	ND	44.8	0.1	ND	ND	1.5	ND	ND	ND	ND	ND	ND
		5/31/2016	2:00 PM	4,624	ND	ND	ND	ND	ND	ND	ND	1.1	25.5	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
		6/5/2016	8:25 AM	6,370	ND	ND	ND	ND	ND	ND	ND	1.3	60.1	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
		6/13/2016	10:30 AM	3,713	ND	ND	ND	ND	ND	ND	ND	1.2	84.1	0.6	6.8	ND	1.0	ND	ND	ND	0.2	ND	ND
		6/18/2016	1:45 PM	3,464	ND	ND	ND	ND	ND	ND	ND	ND	39.2	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
		6/25/2016	1:00 PM	2,325	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		7/4/2016	10:15 AM	15,400	3.0	1.0	100.0	1.0	0.1	2.0	30.0	1.0	20.0	0.1	5.0	0.2	1.1	5.0	1.0	0.5	0.1	30.0	10.0
		7/9/2016	1:00 PM	2,080	3.0	1.0	141.0	1.0	0.1	2.0	30.0	1.0	20.0	0.1	5.0	0.2	1.3	5.0	1.0	0.5	0.1	30.0	15.2

Figure 23 – Aquatic life use water screening table for analytes measured at MLID4953250 – San Juan River at Sand Island.

Aquatic Life Use (Dissolved Metals)

	No Exceedence		Above Screening Level																				
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
		Utah Aquatic Life Use 1-hour		750		340			2	570		13	1000	65				468	18.4	1.6			120
		Utah Aquatic Life Use 4-hour		87		150			0.25	74		9	1000	2.5		0.012		52	4.6				120
Monitoring Location	Site Description	Collection Date	Collection Time	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
4953000	San Juan R @ Mexican Hat US163 Xing	8/8/2015	5:40 PM	63,400	1.4	1.6	308.0	0.0	ND	ND	0.1	4.0	144.0	ND	2.8	ND	3.2	0.9	0.9	0.1	ND	3.1	14.2
		8/10/2015	11:53 AM	90,800	0.4	1.9	299.0	ND	ND	ND	0.1	3.0	140.0	0.3	2.6	ND	2.4	ND	0.6	0.0	ND	7.6	17.6
			4:44 PM	80,600	1.3	1.4	265.0	ND	ND	ND	0.1	2.5	ND	0.3	ND	ND	2.6	ND	0.8	0.2	ND	6.7	18.5
		8/11/2015	11:31 AM	111,000	1.4	2.0	391.0	0.0	ND	ND	0.2	3.1	382.0	ND	4.6	ND	2.5	0.8	0.8	0.2	0.0	7.8	12.4
			3:43 PM	56,400	1.2	1.6	445.0	0.1	ND	ND	0.3	5.3	787.0	0.6	11.6	ND	2.0	1.0	0.8	0.2	0.0	4.6	17.4
		8/12/2015	5:06 PM	54,700	1.4	1.6	245.0	0.0	ND	ND	0.1	3.3	ND	ND	ND	ND	2.3	ND	0.9	0.2	ND	3.1	14.2
			5:50 PM	71,400	2.2	1.8	185.0	0.1	ND	ND	0.1	3.2	ND	ND	ND	ND	2.6	ND	1.2	0.3	ND	4.3	16.1
		8/13/2015	12:05 PM	44,700	1.6	2.1	201.0	ND	ND	ND	0.1	3.5	143.0	ND	3.5	ND	2.3	0.8	1.2	0.2	ND	7.1	19.8
		8/14/2015	11:43 AM	124,000	1.0	2.3	157.0	0.0	ND	ND	0.2	5.9	ND	ND	2.4	ND	5.9	1.8	1.6	0.2	0.2	8.1	ND
		8/15/2015	12:04 PM	63,700	1.0	1.7	117.0	0.0	ND	ND	0.6	8.6	ND	ND	7.4	ND	3.3	1.7	1.2	0.2	0.1	5.7	6.2
		8/16/2015	11:58 AM	34,300	0.4	1.4	194.0	0.0	ND	ND	0.1	3.9	ND	ND	ND	ND	2.3	ND	0.8	0.0	ND	3.3	13.8
		8/17/2015	3:04 PM	16,800	0.8	1.6	108.0	ND	ND	ND	0.1	2.9	ND	ND	ND	ND	2.6	1.2	0.9	0.2	0.0	3.4	ND
		8/18/2015	11:55 AM	17,400	1.6	1.4	258.0	ND	ND	ND	0.1	3.1	ND	0.5	4.0	ND	2.1	ND	0.6	0.1	0.0	3.0	20.4
		8/19/2015	1:03 PM	7,110	0.4	1.5	219.0	ND	ND	ND	0.1	2.9	ND	0.3	3.5	ND	2.0	ND	0.7	ND	ND	3.2	9.3
		8/20/2015	6:56 AM	5,790	0.4	1.4	200.0	ND	ND	ND	0.1	2.2	ND	ND	ND	ND	2.0	ND	0.6	ND	ND	3.0	8.4
		8/24/2015	1:10 PM	3,410	0.4	1.5	87.4	ND	ND	ND	0.1	1.9	ND	ND	1.6	ND	1.9	ND	0.7	0.0	ND	3.3	4.8
		8/25/2015	1:40 PM	2,890	0.3	1.5	82.3	ND	ND	ND	0.1	2.6	185.0	0.4	6.4	ND	1.7	ND	0.6	ND	ND	3.8	6.2
		8/26/2015	1:00 PM	2,190	0.3	1.5	81.0	ND	ND	ND	0.1	2.4	ND	ND	ND	ND	1.9	ND	0.6	ND	ND	3.3	ND
		8/27/2015	1:15 PM	2,860	0.6	1.6	83.3	0.0	ND	ND	0.2	2.5	222.0	0.3	11.3	ND	2.1	1.5	0.8	0.1	0.1	4.2	6.7
		8/28/2015	2:00 PM	163,000	0.6	1.2	186.0	ND	ND	ND	0.1	2.9	ND	ND	ND	ND	4.1	2.0	2.9	ND	ND	4.5	ND
		9/22/2015	9:56 AM	2,530	0.4	1.4	90.1	ND	ND	ND	0.1	2.1	ND	0.5	ND	ND	1.8	ND	0.7	0.0	ND	3.3	ND
				3,480	0.3	1.3	93.3	ND	ND	ND	0.1	1.8	ND	ND	ND	ND	1.9	1.3	0.7	ND	ND	2.5	ND
		10/2/2015	12:00 PM	4,550	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/15/2015		40,800	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/23/2015	12:00 AM	38,100	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			12:00 PM	74,700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/24/2015	12:00 AM	118,000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/26/2015	4:15 PM	43,700	0.6	1.1	114.0	0.0	ND	ND	0.2	1.3	ND	ND	ND	ND	1.9	ND	0.8	0.1	0.0	2.5	ND
		2/17/2016	9:00 AM	70,228	ND	1.0	ND	ND	ND	ND	ND	2.0	37.2	0.1	ND	ND	1.7	ND	1.6	ND	ND	ND	ND
		2/24/2016	9:20 AM	2,268	ND	ND	ND	ND	ND	ND	ND	1.3	ND	ND	ND	ND	1.6	ND	1.3	ND	ND	ND	ND
		3/1/2016	9:00 AM	3,766	ND	1.1	ND	ND	ND	ND	ND	1.4	ND	ND	ND	ND	1.6	ND	1.3	ND	ND	ND	ND
			9:10 AM	2,078	ND	1.0	ND	ND	ND	ND	ND	2.0	ND	ND	ND	ND	1.4	ND	1.0	ND	ND	ND	11.3
		3/9/2016	11:30 AM	4,030	ND	ND	ND	ND	ND	ND	ND	1.6	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND
		3/15/2016	11:45 AM	2,385	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5	ND	ND	ND	ND	ND	ND
		3/22/2016	12:25 PM	1,759	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5	ND	ND	ND	ND	ND	ND
		3/29/2016	8:55 AM	501	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND
		4/4/2016	3:30 PM	1,430	ND	ND	79.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
				193	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	1.5	ND	ND	ND	ND	ND	ND
		4/12/2016	11:15 AM	845	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	1.5	ND	ND	ND	ND	ND	ND
		4/19/2016	9:33 AM	2,755	ND	ND	119.8	ND	ND	ND	ND	1.3	83.5	ND	ND	ND	1.3	ND	ND	ND	ND	ND	ND
		4/26/2016	8:30 AM	5,230	ND	ND	ND	ND	ND	ND	ND	1.6	ND	ND	ND	ND	1.7	ND	ND	ND	ND	ND	ND
		5/2/2016	11:00 AM	2,601	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	1.1	ND	ND	ND	ND	ND	ND
		5/9/2016	6:00 PM	1,957	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	1.6	ND	ND	ND	ND	ND	ND
		5/15/2016	9:30 AM	6,971	ND	ND	179.7	ND	ND	ND	ND	2.2	29.9	0.1	ND	ND	1.1	ND	ND	ND	ND	ND	18.8
		5/21/2016	12:45 PM	36,080	ND	ND	ND	ND	ND	ND	ND	ND	26.9	ND	ND	ND	1.5	ND	ND	ND	ND	ND	ND
		5/31/2016	11:30 AM	4,727	ND	ND	ND	ND	ND	ND	ND	1.1	27.2	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
		6/5/2016	7:00 AM	7,153	ND	ND	ND	ND	ND	ND	ND	1.5	88.8	0.5	5.5	ND	1.0	ND	ND	ND	ND	ND	ND
		6/13/2016	9:50 AM	4,117	ND	ND	ND	ND	ND	ND	ND	1.6	101.0	0.7	7.0	ND	1.1	ND	ND	ND	0.3	ND	ND
		6/18/2016	1:00 PM	3,486	ND	ND	ND	ND	ND	ND	ND	1.3	49.2	0.3	5.7	ND	ND	ND	ND	ND	ND	ND	ND
		6/25/2016	12:30 PM	2,944	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		7/4/2016	9:30 AM	25,600	3.0	1.0	297.0	1.0	0.1	2.0	30.0	2.3	72.8	0.2	5.0	0.2	1.3	5.0	1.0	0.5	0.1	30.0	30.1
		7/9/2016	12:15 PM	2,420	3.0	1.0	147.0	1.0	0.1	2.0	30.0	1.1	20.0	0.1	5.0	0.2	1.2	5.0	1.0	0.5	0.1	30.0	16.1

Figure 24 – Aquatic life use water screening table for analytes measured at MLID 4953000– San Juan River at Mexican Hat US162 Xing.

Aquatic Life Use (Dissolved Metals)

	No Exceedence		Above Screening Level																				
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
			Utah Aquatic Life Use 1-hour	**750**		**340**			**2**	**570**		**13**	**1000**	**65**				**468**	**18.4**	**1.6**			**120**
			Utah Aquatic Life Use 4-hour	**87**		**150**			**0.25**	**74**		**9**	**1000**	**2.5**		**0.012**		**52**	**4.6**				**120**
Monitoring Location	**Site Description**	**Collection Date**	**Collection Time**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**
4953880	McElmo Creek at U262 xing near Town of Montezuma Creek	2/23/2016	5:35 PM	1,124	ND	1.1	ND	ND	ND	ND	ND	1.6	ND	ND	12.7	ND	3.0	ND	2.0	ND	ND	ND	ND
		2/29/2016	5:00 PM	2,249	ND	ND	ND	ND	ND	ND	ND	2.1	24.7	ND	20.1	ND	3.2	ND	2.5	ND	ND	ND	ND
		3/9/2016	9:05 AM	385	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	18.6	ND	3.0	ND	2.0	ND	ND	ND	ND
		3/15/2016	9:20 AM	4,814	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.6	ND	3.1	ND	ND	ND	ND	ND	ND
		3/22/2016	10:30 AM	715	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.7	ND	3.3	ND	1.2	ND	ND	ND	ND
		3/28/2016	5:40 PM	103	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	27.5	ND	3.7	ND	ND	ND	ND	ND	ND
		4/4/2016	1:30 PM	427	ND	ND	42.9	ND	ND	ND	ND	ND	ND	ND	25.6	ND	4.5	ND	ND	ND	ND	ND	ND
				65	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	25.7	ND	3.8	ND	ND	ND	ND	ND	ND
		4/12/2016		29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	46.7	ND	5.4	ND	1.7	ND	ND	ND	ND
		4/19/2016	11:40 AM	151	ND	ND	ND	ND	ND	ND	ND	1.5	ND	0.1	43.3	ND	4.6	ND	2.3	ND	ND	ND	ND
		4/26/2016	11:00 AM	16	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	69.1	ND	5.5	ND	ND	ND	ND	ND	ND
		5/2/2016	1:30 PM	322	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	14.1	ND	3.9	ND	1.1	ND	ND	ND	ND
		5/9/2016	2:00 PM	46	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	29.3	ND	4.9	ND	1.1	ND	ND	ND	ND
		5/15/2016	11:30 AM	78	ND	ND	ND	ND	ND	ND	ND	1.3	ND	0.1	31.1	ND	4.5	ND	1.0	ND	ND	ND	ND
		5/21/2016	2:45 PM	2,191	ND	1.1	ND	ND	ND	ND	ND	1.5	ND	ND	12.9	ND	4.0	ND	ND	ND	ND	ND	ND
		5/31/2016	4:00 PM	697	ND	1.1	ND	ND	ND	ND	ND	1.4	ND	ND	16.1	ND	4.1	ND	ND	ND	ND	ND	ND
		6/5/2016	9:45 AM	1,616	ND	1.4	ND	ND	ND	ND	ND	ND	ND	ND	11.6	ND	3.9	ND	ND	ND	ND	ND	ND
		6/13/2016	12:00 PM	2,809	ND	1.5	ND	ND	ND	ND	ND	1.6	ND	0.2	8.6	ND	4.2	ND	ND	ND	ND	ND	12.3
		6/18/2016	2:45 PM	883	ND	1.4	ND	ND	ND	ND	ND	1.2	ND	0.2	13.7	ND	4.9	ND	ND	ND	ND	ND	ND
		6/25/2016	2:15 PM	491	ND	1.6	ND	ND	ND	ND	ND	1.5	ND	0.2	13.0	ND	5.2	ND	ND	ND	ND	ND	ND
		7/4/2016	11:15 AM	20,400	3.0	1.6	224.0	1.0	0.1	2.0	30.0	3.8	77.5	0.2	8.1	0.2	4.7	5.0	1.4	0.5	0.1	30.0	13.4
		7/9/2016	2:00 PM	4,010	3.0	1.7	184.0	1.0	0.1	2.0	30.0	1.2	25.0	0.2	9.8	0.2	3.9	5.0	1.0	0.5	0.1	30.0	10.0
4953560	Montezuma Creek at U163 xing	2/23/2016	6:30 PM	1,823	ND	2.9	106.3	ND	ND	ND	ND	2.9	ND	ND	ND	ND	3.6	ND	3.6	ND	ND	ND	ND
		2/29/2016	5:40 PM	1,078	ND	3.1	242.1	ND	ND	ND	ND	3.9	ND	ND	6.3	ND	4.8	ND	4.1	ND	ND	ND	ND
		3/9/2016	9:40 AM	1,459	ND	2.5	125.7	ND	ND	ND	ND	2.8	ND	ND	9.9	ND	5.4	ND	3.5	ND	ND	ND	ND
		3/15/2016	10:20 AM	77	ND	2.4	127.5	ND	ND	ND	ND	1.9	ND	ND	58.6	ND	5.9	ND	ND	ND	ND	ND	ND
		5/21/2016	1:45 PM	58,196	ND	3.9	183.8	ND	ND	ND	ND	3.0	39.4	ND	7.0	ND	6.2	ND	1.0	ND	ND	ND	ND
		5/31/2016	2:45 PM	550	ND	3.5	216.7	ND	ND	ND	ND	4.0	ND	ND	ND	ND	10.7	ND	3.3	ND	ND	ND	ND
4952940	San Juan R @ Clay Hills	8/13/2015	2:42 PM	42,900	0.2	1.8	411.0	0.1	ND	ND	0.3	4.4	388.0	0.9	13.8	ND	2.2	1.1	0.9	ND	ND	5.0	19.2
		8/14/2015	2:33 PM	73,900	0.3	1.9	121.0	ND	ND	ND	0.1	3.6	ND	ND	ND	ND	3.3	1.3	1.1	0.0	ND	5.4	ND
		8/15/2015	2:30 PM	154,000	0.3	1.8	136.0	ND	ND	ND	0.1	2.6	ND	ND	ND	ND	4.3	0.9	1.2	ND	ND	5.5	ND
		8/16/2015	2:46 PM	91,000	0.3	1.7	319.0	0.0	ND	ND	0.3	5.3	490.0	0.5	9.6	ND	2.8	0.8	0.9	ND	ND	5.7	20.6
		8/17/2015	1:03 PM	26,200	0.3	1.6	132.0	ND	ND	ND	0.3	4.7	ND	ND	2.7	ND	2.6	1.4	0.7	ND	ND	4.8	ND
		8/18/2015	1:45 PM	29,300	0.6	1.6	279.0	ND	ND	ND	0.1	2.6	ND	0.3	ND	ND	2.2	ND	0.6	0.0	ND	3.6	20.5
		8/19/2015	3:09 PM	24,000	0.6	1.6	331.0	ND	ND	ND	0.1	2.2	ND	ND	1.6	ND	2.2	0.9	0.6	ND	ND	4.0	15.3
		8/24/2015	10:37 AM	5,130	1.0	1.8	124.0	ND	ND	ND	0.1	2.1	ND	ND	2.0	ND	2.5	0.8	0.6	0.1	ND	4.7	ND
		8/25/2015	11:15 AM	4,870	0.7	1.6	118.0	ND	ND	ND	0.1	2.1	ND	ND	ND	ND	2.0	0.9	0.6	ND	ND	4.6	ND
		8/26/2015	10:05 AM	5,170	0.3	1.6	117.0	ND	ND	ND	0.1	2.4	ND	ND	ND	ND	2.1	ND	0.5	ND	ND	4.6	ND
		8/27/2015	10:35 AM	61,300	0.7	2.9	165.0	0.1	ND	ND	0.4	2.6	296.0	0.3	10.1	ND	2.4	1.5	1.2	0.1	0.0	12.6	6.8
		8/28/2015	10:25 AM	64,800	0.5	1.6	338.0	ND	ND	ND	0.3	2.8	216.0	ND	7.8	ND	3.1	1.2	1.3	ND	ND	6.1	ND
		9/23/2015	1:45 PM	6,800	0.7	1.6	136.0	ND	ND	ND	0.1	1.8	ND	ND	4.6	ND	2.2	1.3	0.6	0.1	0.0	4.0	ND
		10/2/2015	12:00 PM	33,000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/23/2015		476	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/24/2015	12:00 AM	198	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			12:00 PM	1,360	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/27/2015	2:45 PM	130,000	0.6	1.6	152.0	0.1	ND	ND	1.1	2.3	774.0	0.5	16.1	ND	2.4	1.2	0.9	ND	ND	5.0	ND
4952942		2/17/2016	10:30 AM	47,903	ND	1.1	112.5	ND	ND	ND	ND	2.3	77.5	0.2	5.5	ND	1.7	ND	1.7	ND	ND	ND	11.9

Figure 25 – Aquatic life use water screening table for analytes measured at MLIDs 4953880 - McElmo Creek at U262 Xing near Town of Montezuma Creek, 4953560 – Montezuma Creek at U163 Xing, and 4952942 – San Juan River at Clay Hills.

Utah's Agricultural Uses Water Screening Value Comparison – Dissolved Metals

The dissolved water concentrations of metals and metalloids were compared to Utah's Class 4 use water quality standards and UDOH screening levels for agricultural uses including irrigation of crops and stock watering. Results were below the standards and screening values for most metals and metalloids. For *MLID 4954000-San Juan River at US160Xing in CO*, aluminum, iron, and manganese constituents were exceeded on August 28, 2015. The Utah agricultural water quality standard for total dissolved solids (TDS) was exceeded on most sampling dates at monitoring locations *McElmo Creek* and *Montezuma Creek*, which are tributary sites, and the furthermost downstream sampling site on the San Juan River, *MLID 4952942-San Juan River at Clay Hills boat ramp*. Total dissolved solids were concluded to be unrelated to the release of GKM wastes because the concentrations are lower at the sampling location upstream of the Utah state line. Additionally, one exceedance of the molybdenum agricultural use criteria was observed on May 31, 2016 at *MLID 4953560–Montezuma Creek at U163 Xing*. The Utah Department of Agriculture and Food (UDAF) has analyzed the data and compared them to current toxicological knowledge and scientific data concerning animal and plant life safety. UDAF found no long-term exposure potential risks from the use of water for livestock or crop irrigation. Figure 26 through Figure 30 provide a comparison of the measured water quality samples to Utah's Agricultural Use water quality standards and screening values.

Agricultural Water (Dissolved Metals)

No Exceedence | Above Screening Level

Monitoring Location	Site Description	Collection Date	Collection Time	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc	TDS
Livestock Water Screening Value				5,000		200			50	500	1,000	1,000	500		100	250,000		10			50		1,000		100	25,000	1,200
Irrigation Water Short-Term				20,000		2,000			50		1,000	5,000	5,000	20,000	10,000		10,000		50	2,000	20				1,000	10,000	
Irrigation Water Long-Term				5,000		100			10		100	50	200	5,000	5,000		200		10	200	20				100	2,000	500,000
Utah DWQ Agriculutral Use Criteria						100			10		100		200		100						50						1,200
				ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg/L
4954000	San Juan R @ US160 Xing in CO	8/8/2015	1:23 PM	217.0	0.5	1.3	222.0	0.0	ND	51.5	ND	0.1	2.2	95.8	ND	7.9	2.9	ND	1.9	ND	0.7	ND	32.2	ND	4.9	15.3	460.0
		8/9/2015	12:02 PM	258.0	0.3	0.6	274.0	ND	ND	50.6	ND	0.1	2.5	119.0	ND	6.9	2.7	ND	2.0	ND	0.6	0.0	28.5	ND	1.8	18.5	400.0
			3:05 PM	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	350.0
			6:00 PM	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	410.0
			9:02 PM	329.0	0.3	0.9	341.0	0.0	ND	46.0	ND	0.1	3.5	198.0	0.3	6.3	4.1	ND	1.9	ND	0.5	ND	30.0	ND	2.1	15.4	430.0
		8/10/2015	9:11 AM	172.0	0.5	1.0	233.0	ND	ND	44.6	ND	0.1	3.2	103.0	0.4	6.0	1.6	ND	2.0	ND	0.6	ND	34.1	ND	1.7	19.7	380.0
			2:06 PM	1,050.0	0.7	1.3	220.0	0.1	ND	44.2	ND	0.4	3.4	732.0	1.0	6.0	12.8	ND	1.9	0.8	0.6	0.1	35.1	ND	3.6	18.0	490.0
		8/11/2015	8:50 AM	3,290.0	0.4	1.7	451.0	0.1	ND	39.8	ND	0.5	4.9	1,520.0	1.1	5.1	19.0	0.0	1.7	1.2	1.0	ND	43.7	ND	3.9	19.1	380.0
			1:17 PM	720.0	0.1	1.3	334.0	ND	ND	41.7	ND	0.2	3.0	366.0	0.3	5.1	5.1	ND	1.6	ND	0.8	ND	37.0	ND	2.5	14.9	290.0
		8/12/2015	9:50 AM	104.0	0.6	0.9	178.0	ND	ND	52.1	ND	0.1	2.4	ND	ND	7.2	ND	ND	1.5	ND	0.8	0.0	30.3	ND	1.9	14.8	620.0
			12:09 PM	155.0	0.5	1.2	151.0	ND	ND	47.9	ND	0.0	2.6	ND	ND	7.0	1.8	ND	1.5	ND	0.7	ND	27.3	ND	2.9	16.5	450.0
		8/13/2015	10:01 AM	257.0	0.2	1.3	213.0	0.0	ND	48.3	ND	0.1	3.7	148.0	0.4	6.5	3.2	ND	1.9	ND	0.9	ND	42.5	ND	2.1	21.9	450.0
		8/14/2015	8:50 AM	64.8	0.4	1.7	72.3	0.0	ND	53.4	ND	0.1	3.9	ND	ND	6.6	1.8	ND	3.7	3.1	1.1	ND	52.4	0.0	4.1	ND	720.0
		8/15/2015	9:43 AM	47.5	0.4	1.4	65.2	ND	ND	52.8	ND	0.1	1.4	ND	ND	7.9	ND	ND	2.3	ND	0.6	ND	25.9	ND	2.6	ND	580.0
		8/16/2015	9:15 AM	54.4	1.1	0.9	179.0	0.0	ND	53.9	ND	ND	2.9	ND	ND	8.2	ND	ND	1.7	ND	0.6	0.2	26.1	ND	1.9	12.6	980.0
		8/18/2015	9:56 AM	23.9	0.7	1.3	148.0	ND	ND	57.5	ND	0.1	2.3	ND	0.3	9.8	ND	ND	1.7	ND	0.6	0.0	33.4	ND	1.9	12.3	220.0
		8/19/2015	9:30 AM	ND	0.7	1.3	106.0	ND	ND	57.1	ND	0.1	1.7	ND	ND	10.0	ND	ND	1.7	ND	0.5	0.0	34.1	ND	1.9	8.4	280.0
		8/20/2015	9:44 AM	28.4	0.8	1.3	132.0	ND	ND	57.0	ND	0.1	1.9	ND	ND	9.6	ND	ND	1.8	ND	0.6	0.1	33.8	0.0	1.9	8.1	930.0
		8/24/2015	3:10 PM	ND	0.3	1.4	62.4	ND	ND	50.0	ND	0.0	2.2	ND	ND	9.0	1.9	ND	1.6	1.1	0.5	ND	32.6	ND	2.3	5.5	280.0
		8/25/2015	3:30 PM	ND	0.5	1.4	63.4	ND	ND	47.8	ND	ND	2.1	ND	ND	8.7	1.9	ND	1.6	ND	0.6	ND	31.8	ND	2.5	ND	284.0
		8/26/2015	2:50 PM	760.0	0.6	1.5	70.5	0.1	ND	47.5	ND	0.3	2.8	554.0	0.5	8.8	21.8	ND	1.6	1.1	0.6	0.1	32.2	0.0	3.3	8.0	288.0
		8/27/2015	3:40 PM	798.0	0.3	1.0	121.0	0.1	ND	65.9	ND	0.4	3.3	605.0	0.5	10.2	11.4	ND	3.3	2.0	0.9	ND	49.2	ND	3.4	6.2	440.0
		8/28/2015	4:25 PM	20,700.0	0.2	5.6	340.0	1.6	0.3	59.4	12.0	9.0	27.7	16,700.0	15.7	10.0	413.0	0.0	1.5	12.7	0.8	0.1	89.6	0.2	26.2	72.8	530.0
		9/23/2015	6:30 PM	ND	0.7	1.0	81.5	0.1	ND	60.8	ND	0.3	1.9	ND	ND	10.9	9.3	ND	1.8	1.3	0.7	0.1	35.0	0.1	1.8	ND	NS
		10/15/2015	12:00 AM	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	660.0
		2/16/2016	3:00 PM	319.3	ND	ND	186.9	ND	ND	66.2	ND	ND	6.0	155.0	0.5	10.9	14.4	ND	1.5	ND	1.6	ND	62.9	ND	ND	22.5	490.0
		2/23/2016	10:10 AM	14.9	ND	ND	ND	ND	ND	67.9	ND	ND	1.8	ND	ND	12.5	ND	ND	1.4	ND	1.2	ND	44.8	ND	ND	ND	394.0
		2/29/2016	4:00 PM	10.4	ND	ND	ND	ND	ND	71.1	ND	ND	1.7	ND	ND	13.7	ND	ND	1.2	ND	1.1	ND	39.2	ND	ND	ND	386.0
		3/9/2016	8:20 AM	17.3	ND	ND	ND	ND	ND	64.9	ND	ND	1.0	ND	ND	12.0	ND	ND	1.2	ND	ND	ND	34.2	ND	ND	ND	358.0
		3/15/2016		ND	ND	ND	ND	ND	ND	71.9	ND	ND	ND	ND	ND	13.4	ND	ND	1.3	ND	ND	ND	37.0	ND	ND	ND	376.0
		3/22/2016	9:30 AM	ND	ND	ND	ND	ND	ND	67.4	ND	ND	ND	ND	ND	13.1	ND	ND	1.2	ND	ND	ND	35.6	ND	ND	ND	382.0
		3/28/2016	4:50 PM	ND	ND	ND	ND	ND	ND	70.8	ND	ND	ND	ND	ND	12.6	ND	ND	1.2	ND	ND	ND	38.1	ND	ND	ND	360.0
		4/4/2016	12:20 PM	ND	ND	ND	77.5	ND	ND	65.0	ND	ND	2.5	ND	ND	13.0	4.5	ND	ND	ND	ND	ND	37.5	ND	ND	5.1	NS
				52.3	ND	ND	ND	ND	ND	74.1	ND	ND	2.4	36.2	0.1	13.7	5.3	ND	1.4	ND	ND	ND	42.5	ND	ND	ND	392.0
		4/12/2016	2:00 PM	31.0	ND	ND	ND	ND	ND	59.8	ND	ND	1.1	ND	ND	10.7	ND	ND	1.3	ND	ND	ND	28.0	ND	ND	ND	294.0
		4/19/2016	12:25 PM	18.5	ND	ND	ND	ND	ND	66.6	ND	ND	1.1	ND	ND	12.8	ND	ND	1.2	ND	ND	ND	41.3	ND	ND	ND	378.0
		4/26/2016	11:45 AM	29.3	ND	ND	ND	ND	ND	67.4	ND	ND	1.3	ND	ND	12.0	ND	ND	1.4	ND	ND	ND	31.1	ND	ND	ND	332.0
		5/2/2016	2:00 PM	24.5	ND	ND	ND	ND	ND	69.8	ND	ND	1.2	ND	ND	12.2	5.9	ND	1.1	ND	ND	ND	37.3	ND	ND	ND	348.0
		5/9/2016	12:30 PM	37.6	ND	ND	ND	ND	ND	50.2	ND	ND	1.0	26.4	0.1	8.2	5.6	ND	1.1	ND	ND	ND	18.5	ND	ND	ND	248.0
		5/15/2016	12:15 PM	50.0	ND	ND	211.7	ND	ND	57.1	ND	ND	1.9	51.1	0.2	8.9	ND	ND	1.1	ND	ND	ND	25.2	ND	ND	18.6	300.0
		5/21/2016	3:30 PM	23.4	ND	ND	ND	ND	ND	41.9	ND	ND	ND	45.7	0.1	6.6	7.7	ND	1.5	ND	ND	ND	19.9	ND	ND	ND	232.0
		5/31/2016	4:15 PM	48.1	ND	ND	ND	ND	ND	38.5	ND	ND	1.2	39.9	0.2	6.4	5.1	ND	ND	ND	ND	ND	14.6	ND	ND	ND	176.0
		6/5/2016	10:30 AM	72.1	ND	ND	ND	ND	ND	31.2	ND	ND	1.3	88.1	0.5	5.2	7.5	ND	ND	ND	ND	ND	11.6	ND	ND	ND	164.0
		6/13/2016	12:30 PM	63.4	ND	ND	ND	ND	ND	31.4	ND	ND	1.4	77.5	0.6	5.0	8.3	ND	ND	ND	ND	ND	11.7	ND	ND	ND	152.0
		6/18/2016	3:30 PM	49.9	ND	ND	123.4	ND	ND	32.1	ND	ND	1.3	57.3	0.5	5.1	ND	ND	ND	ND	ND	ND	12.1	ND	ND	16.1	172.0
		6/25/2016	2:45 PM	15.8	ND	ND	ND	ND	ND	33.1	ND	ND	ND	ND	ND	5.3	ND	ND	ND	ND	ND	ND	12.8	ND	ND	ND	164.0
		7/4/2016	11:45 AM	36.5	3.0	1.0	229.0	1.0	0.1	36.5	2.0	30.0	1.7	27.1	0.1	5.6	5.0	0.2	1.0	5.0	1.0	0.5	16.3	0.1	30.0	24.0	188.0
		7/9/2016	2:45 PM	20.4	3.0	1.0	112.0	1.0	0.1	44.9	2.0	30.0	1.0	20.0	0.1	7.4	5.7	0.2	1.1	5.0	1.0	0.5	21.6	0.1	30.0	10.0	236.0

Figure 26 – Agricultural water screening table for analytes measured at MLID 4954000 – San Juan River at US160 Xing in CO.

Agricultural Water (Dissolved Metals)

	No Exceedence		Above Screening Level																									
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc	TDS
Livestock Water Screening Value				**5,000**		**200**			**50**	**500**	**1,000**	**1,000**	**500**		**100**	**250,000**		**10**			**50**		**1,000**		**100**	**25,000**	**1,200**
Irrigation Water Short-Term				**20,000**		**2,000**			**50**		**1,000**	**5,000**	**5,000**	**20,000**	**10,000**		**10,000**		**50**	**2,000**	**20**				**1,000**	**10,000**	
Irrigation Water Long-Term				**5,000**		**100**			**10**		**100**	**50**	**200**	**5,000**	**5,000**		**200**		**10**	**200**	**20**				**100**	**2,000**	**500,000**
Utah DWQ Agriculutral Use Criteria						**100**			**10**		**100**		**200**		**100**						**50**						**1,200**
Monitoring Location	**Site Description**	**Collection Date**	**Collection Time**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**mg/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**mg/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**mg/L**	**ug/L**	**ug/L**	**ug/L**	**mg/L**
4953990	San Juan R @ Town of Montezuma	8/8/2015	2:54 PM	136.0	0.7	1.1	223.0	0.0	ND	71.5	ND	0.1	2.7	ND	ND	9.9	ND	ND	2.6	0.8	1.1	0.0	43.5	ND	2.5	21.0	610.0
		8/10/2015	10:13 AM	218.0	0.7	0.9	262.0	ND	ND	49.8	ND	0.1	3.2	144.0	0.5	7.7	3.2	ND	2.0	ND	0.6	0.1	32.1	ND	2.1	17.3	610.0
			2:58 PM	94.5	1.3	0.9	200.0	0.0	ND	48.6	ND	0.1	2.5	ND	0.3	7.4	ND	ND	2.3	ND	0.6	0.3	31.8	ND	2.0	14.6	460.0
		8/11/2015	9:44 AM	462.0	0.6	1.2	314.0	ND	ND	44.6	ND	0.1	2.7	227.0	ND	6.5	3.3	ND	1.7	ND	0.7	0.0	37.1	ND	2.2	12.9	460.0
			2:20 PM	1,400.0	0.1	1.3	298.0	0.0	ND	44.8	ND	0.2	3.5	668.0	0.5	6.6	10.0	ND	1.7	1.0	0.7	ND	38.3	ND	2.7	14.3	620.0
		8/12/2015	10:37 AM	67.5	0.8	1.1	202.0	0.0	ND	48.3	ND	ND	2.5	ND	ND	7.2	ND	ND	1.7	ND	0.8	0.0	31.9	ND	1.7	13.5	560.0
			2:04 PM	375.0	0.8	0.9	176.0	ND	ND	48.9	ND	0.1	4.3	296.0	ND	7.5	2.3	ND	1.6	ND	0.7	0.0	33.8	ND	2.0	15.9	460.0
		8/13/2015	10:46 AM	330.0	1.9	1.3	240.0	0.1	ND	49.4	ND	0.2	3.8	192.0	ND	8.1	5.3	ND	1.9	1.0	1.0	0.2	32.9	0.0	3.1	32.7	370.0
		8/14/2015	9:55 AM	24.8	0.6	1.3	85.1	0.0	ND	55.1	ND	0.1	3.8	ND	ND	7.8	ND	ND	2.8	1.8	1.0	0.0	53.0	0.0	3.1	ND	480.0
		8/15/2015	10:30 AM	68.1	0.6	1.6	73.6	0.0	ND	55.0	ND	0.2	4.4	ND	ND	8.6	3.4	ND	2.4	1.1	0.9	0.1	35.8	ND	3.5	ND	440.0
		8/16/2015	10:02 AM	61.8	0.8	1.2	145.0	0.1	ND	57.5	ND	0.1	3.0	ND	ND	9.4	ND	ND	2.0	ND	0.7	0.3	30.3	0.1	2.2	9.8	1,170.0
		8/17/2015	4:07 PM	27.3	0.3	1.2	80.4	ND	ND	60.2	ND	0.1	1.9	ND	ND	11.6	2.4	ND	2.0	ND	0.6	ND	29.4	ND	2.2	ND	790.0
		8/18/2015	8:41 AM	24.6	1.0	1.2	197.0	0.0	ND	62.7	ND	0.1	3.4	ND	0.3	12.7	ND	ND	2.1	ND	0.6	0.1	35.4	0.1	2.3	14.8	280.0
		8/19/2015	8:15 AM	ND	0.9	1.2	141.0	ND	ND	63.1	ND	0.1	1.7	ND	ND	13.7	ND	ND	2.0	ND	0.6	0.1	37.7	0.0	2.3	9.6	310.0
		8/20/2015	8:59 AM	ND	1.0	1.4	128.0	ND	ND	62.7	ND	0.1	1.9	ND	ND	13.4	ND	ND	1.8	ND	0.7	ND	37.5	ND	2.1	6.6	370.0
		8/24/2015	4:30 PM	126.0	0.3	1.4	67.8	ND	ND	55.9	ND	0.1	2.3	ND	ND	12.8	4.9	ND	1.7	0.8	0.6	ND	38.4	ND	2.9	ND	364.0
		8/25/2015	4:20 PM	ND	0.3	1.3	68.2	ND	ND	55.9	ND	0.1	2.6	ND	ND	13.2	2.0	ND	1.8	0.9	0.6	ND	37.6	ND	2.7	10.0	332.0
		8/26/2015	3:30 PM	818.0	0.4	1.5	77.1	0.1	ND	57.6	ND	0.3	2.9	601.0	0.5	14.3	26.5	ND	1.8	1.1	0.6	ND	38.4	ND	3.8	5.4	340.0
		8/27/2015	2:50 PM	139.0	0.4	1.4	71.1	ND	ND	47.9	ND	0.2	2.1	ND	ND	10.4	4.0	ND	2.1	ND	0.7	ND	36.6	ND	2.7	ND	250.0
		8/28/2015	3:35 PM	487.0	0.3	1.1	161.0	0.0	ND	95.0	ND	0.3	4.0	414.0	0.4	11.4	11.5	ND	2.7	1.6	0.8	ND	60.3	ND	2.8	191.0	610.0
		9/22/2015	5:30 PM	ND	0.3	1.3	75.0	ND	ND	70.3	ND	0.1	3.3	ND	ND	17.4	1.7	ND	1.8	1.4	0.6	ND	41.4	ND	2.8	5.9	NS
		10/15/2015	12:00 AM	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	700.0
		10/26/2015	2:00 PM	ND	0.9	1.0	109.0	ND	ND	74.9	ND	0.6	1.3	ND	ND	15.2	2.0	ND	1.8	0.8	0.6	ND	41.0	ND	1.9	ND	NS
		2/16/2016	4:15 PM	231.2	ND	ND	161.7	ND	ND	76.6	ND	ND	3.5	109.0	0.3	18.3	8.8	ND	1.7	ND	1.4	ND	72.7	ND	ND	18.1	574.0
		2/23/2016	6:00 PM	18.5	3.5	ND	ND	ND	ND	81.4	ND	ND	1.7	ND	0.2	21.3	ND	ND	1.8	ND	1.6	ND	52.5	ND	ND	ND	508.0
		2/29/2016	5:30 PM	22.4	ND	ND	ND	ND	ND	80.2	ND	ND	1.4	ND	ND	20.3	ND	ND	1.4	ND	ND	ND	46.4	ND	ND	ND	488.0
		3/9/2016	10:00 AM	34.3	ND	ND	ND	ND	ND	73.9	ND	ND	ND	ND	ND	17.9	ND	ND	1.3	ND	ND	ND	40.1	ND	ND	ND	438.0
		3/15/2016		ND	ND	ND	ND	ND	ND	81.2	ND	ND	ND	ND	ND	19.7	ND	ND	1.4	ND	ND	ND	42.0	ND	ND	ND	452.0
		3/22/2016	10:55 AM	ND	ND	ND	ND	ND	ND	78.4	ND	ND	ND	ND	ND	18.8	ND	ND	1.4	ND	ND	ND	41.6	ND	ND	ND	454.0
		3/28/2016	3:45 PM	ND	ND	ND	ND	ND	ND	75.8	ND	ND	1.0	ND	ND	16.9	ND	ND	1.3	ND	ND	ND	40.6	ND	ND	ND	410.0
		4/4/2016	2:00 PM	ND	ND	ND	76.7	ND	ND	72.9	ND	ND	ND	ND	ND	17.4	ND	ND	ND	ND	ND	ND	42.9	ND	ND	ND	NS
				ND	ND	ND	ND	ND	ND	80.1	ND	ND	1.1	ND	ND	18.0	ND	ND	1.5	ND	ND	ND	47.5	ND	ND	ND	452.0
		4/12/2016	1:00 PM	26.2	ND	ND	ND	ND	ND	62.9	ND	ND	1.2	ND	ND	12.4	ND	ND	1.3	ND	ND	ND	30.6	ND	ND	ND	322.0
		4/19/2016	11:10 AM	50.9	ND	ND	ND	ND	ND	69.1	ND	ND	1.5	29.7	ND	15.7	8.2	ND	1.3	ND	1.4	ND	39.2	ND	ND	ND	404.0
		4/26/2016	10:30 AM	18.1	ND	ND	ND	ND	ND	71.8	ND	ND	1.2	ND	ND	14.4	ND	ND	1.3	ND	ND	ND	37.0	ND	ND	ND	366.0
		5/2/2016	1:00 PM	16.7	ND	ND	ND	ND	ND	73.4	ND	ND	1.1	ND	ND	15.8	ND	ND	1.1	ND	ND	ND	38.1	ND	ND	ND	388.0
		5/9/2016	2:15 PM	45.9	ND	ND	ND	ND	ND	52.0	ND	ND	1.1	29.2	0.1	9.5	ND	ND	1.3	ND	ND	ND	20.9	ND	ND	ND	270.0
		5/15/2016	11:00 AM	92.9	ND	ND	296.9	ND	ND	68.8	ND	ND	2.9	74.8	0.2	12.1	ND	ND	1.3	ND	ND	ND	44.1	ND	ND	18.5	404.0
		5/21/2016	2:15 PM	29.4	ND	ND	ND	ND	ND	45.9	ND	ND	ND	46.5	0.1	7.5	7.8	ND	1.4	ND	ND	ND	22.0	ND	ND	ND	240.0
		5/31/2016	3:15 PM	40.4	ND	ND	ND	ND	ND	39.1	ND	ND	1.1	33.9	0.1	6.9	ND	ND	ND	ND	ND	ND	15.7	ND	ND	ND	174.0
		6/5/2016	9:30 AM	77.0	ND	ND	ND	ND	ND	31.5	ND	ND	1.3	77.6	0.5	5.3	6.8	ND	ND	ND	ND	ND	12.3	ND	ND	ND	168.0
		6/13/2016	11:30 AM	54.2	ND	ND	ND	ND	ND	33.2	ND	ND	1.3	67.1	0.5	5.4	7.6	ND	ND	ND	ND	ND	12.4	ND	ND	ND	162.0
		6/18/2016	2:15 PM	47.0	ND	ND	227.1	ND	ND	33.1	ND	ND	1.9	57.8	0.5	5.4	5.7	ND	1.0	ND	ND	ND	12.8	ND	ND	27.5	172.0
		6/25/2016	2:00 PM	15.1	ND	ND	ND	ND	ND	33.3	ND	ND	ND	ND	ND	5.4	ND	ND	ND	ND	ND	ND	13.2	ND	ND	ND	166.0
		7/4/2016	11:00 AM	10.0	3.0	1.0	100.0	1.0	0.1	39.5	2.0	30.0	1.0	20.0	0.1	6.7	5.0	0.2	1.0	5.0	1.0	0.5	16.9	0.1	30.0	10.0	196.0
		7/9/2016	1:45 PM	18.2	3.0	1.0	110.0	1.0	0.1	45.7	2.0	30.0	1.0	20.0	0.1	8.5	5.0	0.2	1.2	5.0	1.0	0.5	22.1	0.1	30.0	11.0	240.0

Figure 27 – Agricultural water screening table for analytes measured at MLID 4953990 – San Juan River at Town of Montezuma.

Agricultural Water (Dissolved Metals)

No Exceedence | Above Screening Level

Monitoring Location	Site Description	Collection Date	Collection Time	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc	TDS
Livestock Water Screening Value				5,000		200			50	500	1,000	1,000	500		100	250,000		10			50		1,000		100	25,000	1,200
Irrigation Water Short-Term				20,000		2,000			50		1,000	5,000	5,000	20,000	10,000		10,000		50	2,000	20				1,000	10,000	
Irrigation Water Long-Term				5,000		100			10		100	50	200	5,000	5,000		200		10	200	20				100	2,000	500,000
Utah DWQ Agriculutral Use Criteria						100			10		100		200		100						50						1,200
				ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg/L
4953250	San Juan R @ Sand Island	8/8/2015	4:19 PM	214.0	1.4	1.0	294.0	0.1	ND	73.7	ND	0.1	3.9	104.0	ND	9.2	2.6	ND	3.3	1.0	1.4	0.1	51.2	ND	2.2	19.0	640.0
		8/10/2015	11:15 AM	124.0	1.2	0.9	192.0	ND	ND	53.2	ND	0.1	2.1	ND	0.3	8.4	ND	ND	2.4	ND	0.7	0.3	28.4	ND	1.8	13.7	370.0
			3:58 PM	108.0	0.6	1.1	184.0	ND	ND	48.4	ND	0.1	2.0	ND	0.3	7.8	ND	ND	2.3	ND	0.5	ND	30.6	ND	1.9	13.2	490.0
		8/11/2015	10:53 AM	684.0	1.2	1.2	278.0	0.1	ND	45.8	ND	0.2	2.9	328.0	ND	6.9	4.1	ND	1.9	0.8	0.7	0.3	36.8	0.0	2.6	13.7	390.0
			3:01 PM	158.0	0.3	1.0	251.0	ND	ND	45.3	ND	0.1	2.7	89.2	ND	6.7	ND	ND	1.9	ND	0.7	ND	36.6	ND	2.1	14.9	360.0
		8/12/2015	11:12 AM	623.0	1.1	1.4	205.0	0.0	ND	46.8	ND	0.2	3.4	310.0	ND	7.0	4.5	ND	1.9	ND	0.8	0.1	37.8	ND	2.6	14.5	450.0
			2:57 PM	605.0	1.8	1.4	260.0	0.1	ND	46.6	ND	0.2	3.0	314.0	ND	7.1	5.2	ND	1.8	0.9	0.8	0.2	33.5	ND	2.3	13.2	410.0
		8/13/2015	11:28 AM	509.0	0.7	1.3	156.0	0.0	ND	53.6	ND	0.2	3.1	275.0	ND	8.2	8.9	ND	1.6	ND	0.7	ND	29.2	ND	3.7	20.4	450.0
		8/14/2015	11:02 AM	ND	1.0	2.0	78.6	0.1	ND	53.2	ND	0.1	3.3	ND	ND	8.3	7.0	ND	5.3	2.4	1.1	0.2	49.5	0.1	5.9	4.9	630.0
		8/15/2015	11:31 AM	95.2	1.1	1.8	83.5	0.0	ND	55.7	ND	0.1	2.3	ND	ND	8.4	ND	ND	3.9	0.8	1.1	0.3	46.7	0.1	3.5	ND	540.0
		8/16/2015	11:06 AM	290.0	0.4	1.2	149.0	0.0	ND	55.8	ND	0.1	3.9	202.0	ND	10.2	3.9	ND	2.0	ND	0.7	0.0	36.3	ND	2.0	10.5	1,020.0
		8/17/2015	3:33 PM	ND	0.4	1.5	87.1	ND	ND	62.4	ND	0.2	2.1	ND	ND	11.2	ND	ND	2.7	1.3	0.6	ND	30.0	ND	2.8	ND	930.0
		8/18/2015	11:22 AM	ND	0.6	1.5	138.0	ND	ND	66.4	ND	0.1	2.3	ND	0.4	12.8	1.6	ND	1.9	ND	0.6	ND	36.0	ND	2.4	12.3	260.0
		8/19/2015	12:33 PM	32.9	0.5	1.3	122.0	ND	ND	64.5	ND	0.1	1.9	ND	ND	12.9	1.8	ND	2.0	ND	0.6	ND	36.1	ND	2.5	8.7	340.0
		8/20/2015	7:21 AM	24.4	0.3	1.4	138.0	ND	ND	61.2	ND	0.1	2.3	ND	ND	12.4	ND	ND	1.9	ND	0.6	ND	36.1	ND	2.6	9.1	330.0
		8/24/2015	1:55 PM	410.0	0.3	1.6	79.6	ND	ND	57.5	ND	0.1	2.8	265.0	ND	12.8	9.4	ND	1.8	0.9	0.6	ND	38.6	ND	3.8	6.4	344.0
		8/25/2015	2:25 PM	ND	0.3	1.5	77.5	ND	ND	55.9	ND	0.0	2.3	ND	ND	12.7	1.6	ND	1.9	ND	0.6	ND	37.8	ND	3.0	ND	380.0
		8/26/2015	1:30 PM	ND	0.3	1.5	75.4	ND	ND	56.0	ND	0.1	2.5	ND	ND	13.1	2.4	ND	1.8	0.9	0.6	ND	37.5	ND	3.2	5.3	352.0
		8/27/2015	1:55 PM	293.0	0.4	1.4	81.5	ND	ND	52.4	ND	0.2	2.6	199.0	ND	13.3	8.4	ND	1.9	0.9	0.6	0.0	36.4	ND	3.1	ND	344.0
		8/28/2015	2:45 PM	ND	0.4	0.8	151.0	ND	ND	85.6	ND	0.1	3.3	ND	ND	14.3	ND	ND	3.1	1.2	0.9	ND	51.3	ND	2.0	ND	580.0
		9/22/2015	1:55 PM	ND	0.6	1.4	77.8	ND	ND	66.4	ND	0.1	3.7	ND	0.3	16.4	1.7	ND	1.8	1.2	0.6	0.1	39.0	0.0	2.9	ND	NS
		2/16/2016	5:00 PM	128.5	ND	1.0	104.8	ND	ND	77.7	ND	ND	2.7	71.7	0.2	18.8	ND	ND	1.7	ND	1.5	ND	70.7	ND	ND	ND	570.0
		2/24/2016	8:40 AM	34.8	ND	ND	ND	ND	ND	83.0	5.4	ND	2.0	57.2	0.2	23.3	6.9	ND	1.6	ND	1.3	ND	53.4	ND	ND	ND	526.0
		3/1/2016	8:15 AM	60.1	ND	ND	ND	ND	ND	80.0	ND	ND	1.3	44.2	ND	20.7	ND	ND	1.4	ND	1.3	ND	47.0	ND	ND	ND	476.0
		3/9/2016	12:10 PM	10.0	ND	ND	ND	ND	ND	73.1	ND	ND	1.0	ND	ND	17.9	ND	ND	1.3	ND	ND	ND	40.6	ND	ND	ND	434.0
		3/15/2016	11:00 AM	ND	ND	ND	ND	ND	ND	82.9	ND	ND	ND	ND	ND	20.3	ND	ND	1.5	ND	ND	ND	48.6	ND	ND	ND	466.0
		3/22/2016	11:40 AM	10.1	ND	ND	ND	ND	ND	79.6	ND	ND	ND	ND	ND	19.3	ND	ND	1.4	ND	ND	ND	43.1	ND	ND	ND	466.0
		3/29/2016	9:50 AM	16.1	ND	ND	ND	ND	ND	76.8	ND	ND	ND	ND	ND	17.7	ND	ND	1.4	ND	ND	ND	41.8	ND	ND	ND	416.0
		4/4/2016	2:40 PM	ND	ND	ND	78.0	ND	ND	71.0	ND	ND	ND	ND	ND	17.1	ND	ND	ND	ND	ND	ND	44.6	ND	ND	ND	NS
				14.6	ND	ND	ND	ND	ND	79.3	ND	ND	1.0	ND	ND	18.7	ND	ND	1.5	ND	ND	ND	50.1	ND	ND	ND	456.0
		4/12/2016	10:30 AM	18.2	ND	ND	ND	ND	ND	62.0	ND	ND	1.2	ND	ND	12.5	ND	ND	1.4	ND	ND	ND	31.3	ND	ND	ND	324.0
		4/19/2016	10:17 AM	16.0	ND	ND	ND	ND	ND	67.9	ND	ND	1.3	ND	ND	14.5	ND	ND	1.2	ND	ND	ND	37.4	ND	ND	ND	368.0
		4/26/2016	10:00 AM	12.7	ND	ND	ND	ND	ND	74.4	ND	ND	1.2	ND	ND	15.2	ND	ND	1.4	ND	ND	ND	40.8	ND	ND	ND	414.0
		5/2/2016	12:00 PM	15.9	ND	ND	ND	ND	ND	73.1	ND	ND	1.2	ND	ND	15.2	ND	ND	1.2	ND	ND	ND	38.6	ND	ND	ND	392.0
		5/9/2016	2:45 PM	35.1	ND	ND	ND	ND	ND	53.0	ND	ND	1.0	ND	ND	9.7	ND	ND	1.4	ND	ND	ND	22.0	ND	ND	ND	260.0
		5/15/2016	10:15 AM	32.0	ND	ND	172.6	ND	ND	56.6	ND	ND	1.9	29.2	0.1	10.5	ND	ND	1.1	ND	ND	ND	23.1	ND	ND	18.9	296.0
		5/21/2016	1:15 PM	25.4	ND	1.0	ND	ND	ND	45.1	ND	ND	ND	44.8	0.1	7.6	ND	ND	1.5	ND	ND	ND	23.6	ND	ND	ND	244.0
		5/31/2016	2:00 PM	34.8	ND	ND	ND	ND	ND	39.2	ND	ND	1.1	25.5	0.1	6.9	ND	ND	ND	ND	ND	ND	15.4	ND	ND	ND	208.0
		6/5/2016	8:25 AM	62.9	ND	ND	ND	ND	ND	30.9	ND	ND	1.3	60.1	0.4	5.2	ND	ND	ND	ND	ND	ND	12.2	ND	ND	ND	166.0
		6/13/2016	10:30 AM	68.4	ND	ND	ND	ND	ND	33.3	ND	ND	1.2	84.1	0.6	5.3	6.8	ND	1.0	ND	ND	ND	13.0	0.2	ND	ND	166.0
		6/18/2016	1:45 PM	41.0	ND	ND	ND	ND	ND	32.1	ND	ND	ND	39.2	0.3	5.2	ND	ND	ND	ND	ND	ND	12.5	ND	ND	ND	174.0
		6/25/2016	1:00 PM	15.0	ND	ND	ND	ND	ND	33.4	ND	ND	ND	ND	ND	5.5	ND	ND	ND	ND	ND	ND	13.3	ND	ND	ND	170.0
		7/4/2016	10:15 AM	10.0	3.0	1.0	100.0	1.0	0.1	42.2	2.0	30.0	1.0	20.0	0.1	6.8	5.0	0.2	1.1	5.0	1.0	0.5	18.0	0.1	30.0	10.0	224.0
		7/9/2016	1:00 PM	16.1	3.0	1.0	141.0	1.0	0.1	44.7	2.0	30.0	1.0	20.0	0.1	8.4	5.0	0.2	1.3	5.0	1.0	0.5	21.3	0.1	30.0	15.2	236.0

Figure 28 – Agricultural water screening table for analytes measured at MLID 4953250 – San Juan River at Sand Island.

Agricultural Water (Dissolved Metals)

	No Exceedence		Above Screening Level																									
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc	TDS
Livestock Water Screening Value				5,000		200			50	500	1,000	1,000	500		100	250,000		10			50		1,000		100	25,000	1,200
Irrigation Water Short-Term				20,000		2,000			50		1,000	5,000	5,000	20,000	10,000		10,000		50	2,000	20				1,000	10,000	
Irrigation Water Long-Term				5,000		100			10		100	50	200	5,000	5,000		200		10	200	20				100	2,000	500,000
Utah DWQ Agriculutral Use Criteria						100			10		100		200		100						50						1,200
Monitoring Location	Site Description	Collection Date	Collection Time	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg/L
4953000	San Juan R @ Mexican Hat US163 Xing	8/8/2015	5:40 PM	264.0	1.4	1.6	308.0	0.0	ND	49.2	ND	0.1	4.0	144.0	ND	5.8	2.8	ND	3.2	0.9	0.9	0.1	62.6	ND	3.1	14.2	730.0
		8/10/2015	11:53 AM	325.0	0.4	1.9	299.0	ND	ND	44.6	ND	0.1	3.0	140.0	0.3	7.8	2.6	ND	2.4	ND	0.6	0.0	43.6	ND	7.6	17.6	590.0
			4:44 PM	149.0	1.3	1.4	265.0	ND	ND	44.2	ND	0.1	2.5	ND	0.3	7.9	ND	ND	2.6	ND	0.8	0.2	41.9	ND	6.7	18.5	660.0
		8/11/2015	11:31 AM	907.0	1.4	2.0	391.0	0.0	ND	37.2	ND	0.2	3.1	382.0	ND	6.7	4.6	ND	2.5	0.8	0.8	0.2	51.3	0.0	7.8	12.4	980.0
			3:43 PM	1,790.0	1.2	1.6	445.0	0.1	ND	43.6	ND	0.3	5.3	787.0	0.6	7.2	11.6	ND	2.0	1.0	0.8	0.2	41.4	0.0	4.6	17.4	600.0
		8/12/2015	5:06 PM	125.0	1.4	1.6	245.0	0.0	ND	59.8	ND	0.1	3.3	ND	ND	7.9	ND	ND	2.3	ND	0.9	0.2	42.1	ND	3.1	14.2	450.0
			5:50 PM	105.0	2.2	1.8	185.0	0.1	ND	48.9	ND	0.1	3.2	ND	ND	7.2	ND	ND	2.6	ND	1.2	0.3	48.7	ND	4.3	16.1	470.0
		8/13/2015	12:05 PM	293.0	1.6	2.1	201.0	ND	ND	42.6	ND	0.1	3.5	143.0	ND	7.2	3.5	ND	2.3	0.8	1.2	0.2	44.4	ND	7.1	19.8	490.0
		8/14/2015	11:43 AM	120.0	1.0	2.3	157.0	0.0	ND	46.2	ND	0.2	5.9	ND	ND	10.5	2.4	ND	5.9	1.8	1.6	0.2	68.0	0.2	8.1	ND	760.0
		8/15/2015	12:04 PM	135.0	1.0	1.7	117.0	0.0	ND	53.7	ND	0.6	8.6	ND	ND	9.0	7.4	ND	3.3	1.7	1.2	0.2	51.9	0.1	5.7	6.2	710.0
		8/16/2015	11:58 AM	84.3	0.4	1.4	194.0	0.0	ND	57.7	ND	0.1	3.9	ND	ND	9.0	ND	ND	2.3	ND	0.8	0.0	40.2	ND	3.3	13.8	1,380.0
		8/17/2015	3:04 PM	52.3	0.8	1.6	108.0	ND	ND	59.3	ND	0.1	2.9	ND	ND	10.3	ND	ND	2.6	1.2	0.9	0.2	37.3	0.0	3.4	ND	880.0
		8/18/2015	11:55 AM	123.0	1.6	1.4	258.0	ND	ND	65.3	ND	0.1	3.1	ND	0.5	11.9	4.0	ND	2.1	ND	0.6	0.1	35.8	0.0	3.0	20.4	320.0
		8/19/2015	1:03 PM	83.3	0.4	1.5	219.0	ND	ND	65.7	ND	0.1	2.9	ND	0.3	12.8	3.5	ND	2.0	ND	0.7	ND	38.4	ND	3.2	9.3	350.0
		8/20/2015	6:56 AM	50.4	0.4	1.4	200.0	ND	ND	66.4	ND	0.1	2.2	ND	ND	12.6	ND	ND	2.0	ND	0.6	ND	36.9	ND	3.0	8.4	320.0
		8/24/2015	1:10 PM	39.9	0.4	1.5	87.4	ND	ND	61.0	ND	0.1	1.9	ND	ND	13.6	1.6	ND	1.9	ND	0.7	0.0	39.8	ND	3.3	4.8	456.0
		8/25/2015	1:40 PM	308.0	0.3	1.5	82.3	ND	ND	57.6	ND	0.1	2.6	185.0	0.4	12.7	6.4	ND	1.7	ND	0.6	ND	38.4	ND	3.8	6.2	336.0
		8/26/2015	1:00 PM	ND	0.3	1.5	81.0	ND	ND	56.2	ND	0.1	2.4	ND	ND	12.6	ND	ND	1.9	ND	0.6	ND	37.6	ND	3.3	ND	356.0
		8/27/2015	1:15 PM	386.0	0.6	1.6	83.3	0.0	ND	56.9	ND	0.2	2.5	222.0	0.3	12.9	11.3	ND	2.1	1.5	0.8	0.1	37.2	0.1	4.2	6.7	300.0
		8/28/2015	2:00 PM	ND	0.6	1.2	186.0	ND	ND	73.3	ND	0.1	2.9	ND	ND	15.9	ND	ND	4.1	2.0	2.9	ND	70.9	ND	4.5	ND	730.0
		9/22/2015	9:56 AM	ND	0.4	1.4	90.1	ND	ND	74.2	ND	0.1	2.1	ND	0.5	18.3	ND	ND	1.8	ND	0.7	0.0	43.4	ND	3.3	ND	NS
				ND	0.3	1.3	93.3	ND	ND	75.2	ND	0.1	1.8	ND	ND	18.0	ND	ND	1.9	1.3	0.7	ND	40.3	ND	2.5	ND	NS
		10/15/2015	12:00 AM	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	900.0
		10/26/2015	4:15 PM	ND	0.6	1.1	114.0	0.0	ND	79.7	ND	0.2	1.3	ND	ND	15.0	ND	ND	1.9	ND	0.8	0.1	44.0	0.0	2.5	ND	NS
		2/17/2016	9:00 AM	57.7	ND	1.0	ND	ND	ND	77.2	ND	ND	2.0	37.2	0.1	18.7	ND	ND	1.7	ND	1.6	ND	69.5	ND	ND	ND	582.0
		2/24/2016	9:20 AM	ND	ND	ND	ND	ND	ND	85.1	ND	ND	1.3	ND	ND	22.9	ND	ND	1.6	ND	1.3	ND	54.7	ND	ND	ND	530.0
		3/1/2016	9:00 AM	21.6	ND	1.1	ND	ND	ND	80.7	ND	ND	1.4	ND	ND	20.5	ND	ND	1.6	ND	1.3	ND	46.6	ND	ND	ND	486.0
			9:10 AM	16.9	ND	1.0	ND	ND	ND	80.2	ND	ND	2.0	ND	ND	20.6	ND	ND	1.4	ND	1.0	ND	47.5	ND	ND	11.3	476.0
		3/9/2016	11:30 AM	17.7	ND	ND	ND	ND	ND	73.1	ND	ND	1.6	ND	ND	17.7	ND	ND	1.4	ND	ND	ND	40.4	ND	ND	ND	430.0
		3/15/2016	11:45 AM	ND	ND	ND	ND	ND	ND	87.9	ND	ND	ND	ND	ND	21.8	ND	ND	1.5	ND	ND	ND	66.0	ND	ND	ND	458.0
		3/22/2016	12:25 PM	10.4	ND	ND	ND	ND	ND	82.1	ND	ND	ND	ND	ND	19.9	ND	ND	1.5	ND	ND	ND	44.5	ND	ND	ND	470.0
		3/29/2016	8:55 AM	16.8	ND	ND	ND	ND	ND	75.0	ND	ND	1.0	ND	ND	17.4	ND	ND	1.4	ND	ND	ND	40.7	ND	ND	ND	414.0
		4/4/2016	3:30 PM	ND	ND	ND	79.1	ND	ND	74.5	ND	ND	ND	ND	ND	18.6	ND	ND	ND	ND	ND	ND	45.8	ND	ND	ND	NS
				ND	ND	ND	ND	ND	ND	80.0	ND	ND	1.1	ND	ND	18.9	ND	ND	1.5	ND	ND	ND	49.4	ND	ND	ND	476.0
		4/12/2016	11:15 AM	19.0	ND	ND	ND	ND	ND	64.2	ND	ND	1.1	ND	ND	13.2	ND	ND	1.5	ND	ND	ND	33.4	ND	ND	ND	340.0
		4/19/2016	9:33 AM	150.4	ND	ND	119.8	ND	ND	65.4	ND	ND	1.3	83.5	ND	14.3	ND	ND	1.3	ND	ND	ND	39.2	ND	ND	ND	368.0
		4/26/2016	8:30 AM	ND	ND	ND	ND	ND	ND	75.7	ND	ND	1.6	ND	ND	16.2	ND	ND	1.7	ND	ND	ND	43.7	ND	ND	ND	416.0
		5/2/2016	11:00 AM	16.3	ND	ND	ND	ND	ND	71.3	ND	ND	1.2	ND	ND	14.4	ND	ND	1.1	ND	ND	ND	37.5	ND	ND	ND	380.0
		5/9/2016	6:00 PM	35.4	ND	ND	ND	ND	ND	57.6	ND	ND	1.1	ND	ND	10.5	ND	ND	1.6	ND	ND	ND	24.7	ND	ND	ND	282.0
		5/15/2016	9:30 AM	34.0	ND	ND	179.7	ND	ND	56.1	ND	ND	2.2	29.9	0.1	10.7	ND	ND	1.1	ND	ND	ND	23.9	ND	ND	18.8	300.0
		5/21/2016	12:45 PM	19.9	ND	ND	ND	ND	ND	46.9	ND	ND	ND	26.9	ND	8.2	ND	ND	1.5	ND	ND	ND	24.8	ND	ND	ND	250.0
		5/31/2016	11:30 AM	34.5	ND	ND	ND	ND	ND	39.4	ND	ND	1.1	27.2	0.1	6.8	ND	ND	ND	ND	ND	ND	15.5	ND	ND	ND	200.0
		6/5/2016	7:00 AM	81.1	ND	ND	ND	ND	ND	31.8	ND	ND	1.5	88.8	0.5	5.4	5.5	ND	1.0	ND	ND	ND	12.3	ND	ND	ND	166.0
		6/13/2016	9:50 AM	78.1	ND	ND	ND	ND	ND	33.0	ND	ND	1.6	101.0	0.7	5.3	7.0	ND	1.1	ND	ND	ND	13.3	0.3	ND	ND	166.0
		6/18/2016	1:00 PM	48.9	ND	ND	ND	ND	ND	32.5	ND	ND	1.3	49.2	0.3	5.2	5.7	ND	ND	ND	ND	ND	12.4	ND	ND	ND	176.0
		6/25/2016	12:30 PM	14.8	ND	ND	ND	ND	ND	33.6	ND	ND	1.0	ND	ND	5.4	ND	ND	ND	ND	ND	ND	13.3	ND	ND	ND	172.0
		7/4/2016	9:30 AM	85.0	3.0	1.0	297.0	1.0	0.1	48.0	2.0	30.0	2.3	72.8	0.2	7.9	5.0	0.2	1.3	5.0	1.0	0.5	20.2	0.1	30.0	30.1	258.0
		7/9/2016	12:15 PM	20.6	3.0	1.0	147.0	1.0	0.1	43.7	2.0	30.0	1.1	20.0	0.1	8.1	5.0	0.2	1.2	5.0	1.0	0.5	20.5	0.1	30.0	16.1	230.0

Figure 29 – Agricultural water screening table for analytes measured at MLID 4953000 – San Juan River at Mexican Hat US162 Xing.

Agricultural Water (Dissolved Metals)

	No Exceedence		Above Screening Level																									
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc	TDS
Livestock Water Screening Value				**5,000**		**200**			**50**	**500**	**1,000**	**1,000**	**500**		**100**	**250,000**		**10**			**50**		**1,000**		**100**	**25,000**	**1,200**
Irrigation Water Short-Term				**20,000**		**2,000**			**50**		**1,000**	**5,000**	**5,000**	**20,000**	**10,000**		**10,000**		**50**	**2,000**	**20**				**1,000**	**10,000**	
Irrigation Water Long-Term				**5,000**		**100**			**10**		**100**	**50**	**200**	**5,000**	**5,000**		**200**		**10**	**200**	**20**				**100**	**2,000**	**500,000**
Utah DWQ Agriculutral Use Criteria						**100**			**10**		**100**		**200**		**100**						**50**						**1,200**
Monitoring Location	**Site Description**	**Collection Date**	**Collection Time**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**mg/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**mg/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**mg/L**	**ug/L**	**ug/L**	**ug/L**	**mg/L**
4953880	McElmo Creek at U262 xing near Town of Montezuma Creek	2/23/2016	5:35 PM	ND	ND	1.1	ND	ND	ND	213.7	ND	ND	1.6	ND	ND	114.8	12.7	ND	3.0	ND	2.0	ND	118.6	ND	ND	ND	1,718.0
		2/29/2016	5:00 PM	69.6	ND	ND	ND	ND	ND	244.0	ND	ND	2.1	24.7	ND	142.0	20.1	ND	3.2	ND	2.5	ND	146.0	ND	ND	ND	2,042.0
		3/9/2016	9:05 AM	ND	ND	ND	ND	ND	ND	254.0	ND	ND	1.2	ND	ND	156.0	18.6	ND	3.0	ND	2.0	ND	167.0	ND	ND	ND	2,180.0
		3/15/2016	9:20 AM	ND	ND	ND	ND	ND	ND	229.0	ND	ND	ND	ND	ND	115.0	8.6	ND	3.1	ND	ND	ND	112.0	ND	ND	ND	1,698.0
		3/22/2016	10:30 AM	ND	ND	ND	ND	ND	ND	231.0	ND	ND	ND	ND	ND	118.0	9.7	ND	3.3	ND	1.2	ND	118.0	ND	ND	ND	1,754.0
		3/28/2016	5:40 PM	ND	ND	ND	ND	ND	ND	265.0	ND	ND	ND	ND	ND	159.0	27.5	ND	3.7	ND	ND	ND	170.0	ND	ND	ND	2,154.0
		4/4/2016	1:30 PM	ND	ND	ND	42.9	ND	ND	229.0	ND	ND	ND	ND	ND	145.0	25.6	ND	4.5	ND	ND	ND	153.0	ND	ND	ND	NS
				ND	ND	ND	ND	ND	ND	239.0	ND	ND	ND	ND	ND	146.0	25.7	ND	3.8	ND	ND	ND	163.0	ND	ND	ND	2,014.0
		4/12/2016		ND	ND	ND	ND	ND	ND	213.0	ND	ND	ND	ND	ND	141.0	46.7	ND	5.4	ND	1.7	ND	171.0	ND	ND	ND	2,262.0
		4/19/2016	11:40 AM	ND	ND	ND	ND	ND	ND	272.0	ND	ND	1.5	ND	0.1	181.0	43.3	ND	4.6	ND	2.3	ND	217.0	ND	ND	ND	2,562.0
		4/26/2016	11:00 AM	ND	ND	ND	ND	ND	ND	248.0	ND	ND	1.2	ND	ND	176.0	69.1	ND	5.5	ND	ND	ND	225.0	ND	ND	ND	2,340.0
		5/2/2016	1:30 PM	ND	ND	ND	ND	ND	ND	206.0	ND	ND	ND	ND	ND	139.0	14.1	ND	3.9	ND	1.1	ND	158.0	ND	ND	ND	1,746.0
		5/9/2016	2:00 PM	ND	ND	ND	ND	ND	ND	203.0	ND	ND	1.1	ND	ND	136.0	29.3	ND	4.9	ND	1.1	ND	166.0	ND	ND	ND	1,870.0
		5/15/2016	11:30 AM	ND	ND	ND	ND	ND	ND	183.0	ND	ND	1.3	ND	0.1	121.0	31.1	ND	4.5	ND	1.0	ND	144.0	ND	ND	ND	1,660.0
		5/21/2016	2:45 PM	ND	ND	1.1	ND	ND	ND	183.0	ND	ND	1.5	ND	ND	112.0	12.9	ND	4.0	ND	ND	ND	124.0	ND	ND	ND	1,482.0
		5/31/2016	4:00 PM	ND	ND	1.1	ND	ND	ND	166.0	ND	ND	1.4	ND	ND	104.0	16.1	ND	4.1	ND	ND	ND	115.0	ND	ND	ND	1,370.0
		6/5/2016	9:45 AM	ND	ND	1.4	ND	ND	ND	151.0	ND	ND	ND	ND	ND	92.2	11.6	ND	3.9	ND	ND	ND	102.0	ND	ND	ND	1,278.0
		6/13/2016	12:00 PM	ND	ND	1.5	ND	ND	ND	162.0	ND	ND	1.6	ND	0.2	89.6	8.6	ND	4.2	ND	ND	ND	95.8	ND	ND	12.3	1,218.0
		6/18/2016	2:45 PM	ND	ND	1.4	ND	ND	ND	164.0	ND	ND	1.2	ND	0.2	95.4	13.7	ND	4.9	ND	ND	ND	102.0	ND	ND	ND	1,340.0
		6/25/2016	2:15 PM	ND	ND	1.6	ND	ND	ND	150.0	ND	ND	1.5	ND	0.2	96.7	13.0	ND	5.2	ND	ND	ND	114.0	ND	ND	ND	1,386.0
		7/4/2016	11:15 AM	66.6	3.0	1.6	224.0	1.0	0.1	167.0	2.0	30.0	3.8	77.5	0.2	77.8	8.1	0.2	4.7	5.0	1.4	0.5	94.5	0.1	30.0	13.4	1,190.0
		7/9/2016	2:00 PM	22.2	3.0	1.7	184.0	1.0	0.1	157.0	2.0	30.0	1.2	25.0	0.2	80.5	9.8	0.2	3.9	5.0	1.0	0.5	82.8	0.1	30.0	10.0	1,100.0
4953560	Montezuma Creek at U163 xing	2/23/2016	6:30 PM	ND	ND	2.9	106.3	ND	ND	157.0	ND	ND	2.9	ND	ND	98.9	ND	ND	3.6	ND	3.6	ND	217.0	ND	ND	ND	1,648.0
		2/29/2016	5:40 PM	ND	ND	3.1	242.1	ND	ND	164.0	ND	ND	3.9	ND	ND	116.0	6.3	ND	4.8	ND	4.1	ND	366.0	ND	ND	ND	2,146.0
		3/9/2016	9:40 AM	12.2	ND	2.5	125.7	ND	ND	134.0	ND	ND	2.8	ND	ND	84.7	9.9	ND	5.4	ND	3.5	ND	370.0	ND	ND	ND	1,940.0
		3/15/2016	10:20 AM	ND	ND	2.4	127.5	ND	ND	139.0	ND	ND	1.9	ND	ND	78.5	58.6	ND	5.9	ND	ND	ND	512.7	ND	ND	ND	2,232.0
		5/21/2016	1:45 PM	68.8	ND	3.9	183.8	ND	ND	59.7	ND	ND	3.0	39.4	ND	17.7	7.0	ND	6.2	ND	1.0	ND	203.0	ND	ND	ND	790.0
		5/31/2016	2:45 PM	ND	ND	3.5	216.7	ND	ND	77.4	ND	ND	4.0	ND	ND	39.9	ND	ND	10.7	ND	3.3	ND	419.0	ND	ND	ND	1,528.0
4952940	San Juan R @ Clay Hills	8/13/2015	2:42 PM	643.0	0.2	1.8	411.0	0.1	ND	52.3	ND	0.3	4.4	388.0	0.9	7.5	13.8	ND	2.2	1.1	0.9	ND	47.0	ND	5.0	19.2	500.0
		8/14/2015	2:33 PM	38.5	0.3	1.9	121.0	ND	ND	51.1	ND	0.1	3.6	ND	ND	8.2	ND	ND	3.3	1.3	1.1	0.0	49.8	ND	5.4	ND	570.0
		8/15/2015	2:30 PM	119.0	0.3	1.8	136.0	ND	ND	43.1	ND	0.1	2.6	ND	ND	9.0	ND	ND	4.3	0.9	1.2	ND	66.3	ND	5.5	ND	920.0
		8/16/2015	2:46 PM	925.0	0.3	1.7	319.0	0.0	ND	52.7	ND	0.3	5.3	490.0	0.5	9.5	9.6	ND	2.8	0.8	0.9	ND	58.2	ND	5.7	20.6	1,480.0
		8/17/2015	1:03 PM	101.0	0.3	1.6	132.0	ND	ND	53.2	ND	0.3	4.7	ND	ND	8.8	2.7	ND	2.6	1.4	0.7	ND	44.5	ND	4.8	ND	1,020.0
		8/18/2015	1:45 PM	53.2	0.6	1.6	279.0	ND	ND	60.6	ND	0.1	2.6	ND	0.3	9.9	ND	ND	2.2	ND	0.6	0.0	38.3	ND	3.6	20.5	410.0
		8/19/2015	3:09 PM	74.8	0.6	1.6	331.0	ND	ND	65.7	ND	0.1	2.2	ND	ND	11.4	1.6	ND	2.2	0.9	0.6	ND	38.1	ND	4.0	15.3	390.0
		8/24/2015	10:37 AM	33.8	1.0	1.8	124.0	ND	ND	62.4	ND	0.1	2.1	ND	ND	12.8	2.0	ND	2.5	0.8	0.6	0.1	39.7	ND	4.7	ND	344.0
		8/25/2015	11:15 AM	44.8	0.7	1.6	118.0	ND	ND	63.0	ND	0.1	2.1	ND	ND	13.3	ND	ND	2.0	0.9	0.6	ND	40.9	ND	4.6	ND	392.0
		8/26/2015	10:05 AM	ND	0.3	1.6	117.0	ND	ND	59.3	ND	0.1	2.4	ND	ND	12.2	ND	ND	2.1	ND	0.5	ND	38.7	ND	4.6	ND	400.0
		8/27/2015	10:35 AM	707.0	0.7	2.9	165.0	0.1	ND	44.2	ND	0.4	2.6	296.0	0.3	11.7	10.1	ND	2.4	1.5	1.2	0.1	45.4	0.0	12.6	6.8	570.0
		8/28/2015	10:25 AM	493.0	0.5	1.6	338.0	ND	ND	239.0	ND	0.3	2.8	216.0	ND	35.5	7.8	ND	3.1	1.2	1.3	ND	65.9	ND	6.1	ND	1,310.0
		9/23/2015	1:45 PM	68.3	0.7	1.6	136.0	ND	ND	77.8	ND	0.1	1.8	ND	ND	17.3	4.6	ND	2.2	1.3	0.6	0.1	41.3	0.0	4.0	ND	NS
		10/27/2015	2:45 PM	1,100.0	0.6	1.6	152.0	0.1	ND	75.8	ND	1.1	2.3	774.0	0.5	14.1	16.1	ND	2.4	1.2	0.9	ND	58.3	ND	5.0	ND	NS
4952942		2/17/2016	10:30 AM	162.9	ND	1.1	112.5	ND	ND	79.1	ND	ND	2.3	77.5	0.2	21.0	5.5	ND	1.7	ND	1.7	ND	67.5	ND	ND	11.9	568.0

Figure 30 – Agricultural water screening table for analytes measured at MLIDs 4953880 - McElmo Creek at U262 Xing near Town of Montezuma Creek, 4953560 – Montezuma Creek at U163 Xing, and 4952942 – San Juan River at Clay Hill.

5. Assessment and Screening of San Juan River and Lake Powell Sediment Data

Assessment and Screening of San Juan River Sediment Data

San Juan River Assessment and Screening

UDEQ collected sediment samples from up to five sites on nine different days between August, 2015 and February, 2016, on the San Juan River plus one sample collected at *McElmo Creek*. The monitoring locations included:

- *MLID 495400 – San Juan River at US160 Xing in CO*;
- *MLID 4953990 – San Juan River at Town of Montezuma*;
- *MLID 4953900 – McElmo Cr at U262 Xing near Town of Montezuma*;
- *MLID 4953250 – San Juan River at Sand Island*;
- M*LID 4953000 – San Juan River at Mexican Hat US163Xing*; and
- *MLID 4952942 – San Juan River at Clay Hills.*

The sampling sites were selected in the field to be representative of depositional environments in the river. The first round of sediment samples on August 8, 2015, was collected before the predicted arrival of the GKM spill to Utah. The second sampling round on August 15, 2015 was collected after the contaminated water had started crossing into Utah. Additional sediment samples were collected on August 19, 2015, September 22 and 23, 2015, October 26 and 27, 2015, and February 16 and 17, 2016.

At each site, ten sub-samples of the top (approximately) one centimeter of sediment were collected and combined for laboratory analyses at each sampling site. Sediments were analyzed for metals and are reported in dry weight concentrations. Table 7 compares the sediment concentrations to human health–based screening values for soil because sediment-specific screening values are unavailable. The screening-level analyses show that sediment concentrations were lower than the health-based screening values for soil, which indicate that health effects to people from exposure to these pollutants in sediment are unlikely (Table 7). UDAF also reviewed the sediment data and found it difficult to predict adverse effects to the health of livestock and use of irrigation waters. Storm events or natural spring runoff waters may vary the amount of elements found in waters. The colloidal portion of the contamination from the GKM was expected to travel slower and more dispersed than the dissolved water contamination due to settling and re-entrainment in upstream sections of the San Juan River system, including in the Animas River, during transport downstream to Utah.

Overall, none of the sediment samples collected in the San Juan River exceeded the Utah health-based screening value for water ingestion for any of the metals (Figure 31). However, manganese and selenium did show samples elevated above the EPA Region 3 freshwater sediment screening values for aquatic life (Figure 32). Manganese barely exceeded the EPA value at *MLID 4953900-San Juan River at McElmo Wash* on September 23, 2015. Selenium was slightly above the EPA value at each of the San Juan River monitoring locations on February 17, 2016; however, the sediment concentration was significantly higher at *MLID 4953990-San Juan River at Town of Montezuma*. Figure 31 provides the comparison of the observed sediment concentrations throughout the San Juan River relative to the Utah Human Health Screening values for soils for each analyte. Health-based screening values are taken from the Agency for Toxic Substance and Disease Registry (ATSDR). As is most appropriate for recreational exposures, ATSDR Environmental Media Evaluation Guideline (EMEG) health-based child intermediate exposure (>14 days up to one year) comparison values, were chosen first if available, followed by ATSDR EMEG

health-based child chronic exposure (>1 year) comparison values. In the absence of EMEGs, ATSDR child Reference Dose Media Evaluation Guidelines (RMEGs), based upon EPA RfDs, were used. In the absence of RMEGs, EPA risk-based Regional Screening Levels (RSLs) were used. Aquatic life screening values come from EPA Region 3 and are considered to be benchmarks protective of aquatic life uses (EPA Freshwater Sediment Screening Benchmarks 2006) (Figure 32).

Table 7 - Human Health–Based and Aquatic Life Screening Values for Soils

Analyte	CAS #	Units	Soil Health-Based Comparison Value (CV) for Water Ingestion (ppm)/(mg/kg) [Total Metals]	EPA Region 3 Freshwater Sediment Screening Values for Aquatic Life
Aluminum	7429-90-5	mg/kg	50,000	-
Antimony	7440-36-0	mg/kg	20	-
Arsenic	7440-38-2	mg/kg	15	9.8
Barium	7440-39-3	mg/kg	10,000	-
Beryllium	7440-41-7	mg/kg	100	-
Cadmium	7440-43-9	mg/kg	25	0.99
Chromium	7440-47-3	mg/kg	250	43.4
Cobalt	7440-48-4	mg/kg	500	50
Copper	7440-50-8	mg/kg	500	31.6
Iron	7439-89-6	mg/kg	55,000	20000
Lead	7439-92-1	mg/kg	400	35.8
Manganese	7439-96-5	mg/kg	2,500	460
Mercury	7439-97-6	mg/kg	9.4	0.18
Molybdenum	7439-98-7	mg/kg	250	
Nickel	7440-02-0	mg/kg	1,000	22.7
Nitrite	14797-65-0	mg/kg	5,000	
Selenium	7782-49-2	mg/kg	250	2
Silver	7440-22-4	mg/kg	250	1
Thallium	7440-28-0	mg/kg	0.78	
Vanadium	7440-62-2	mg/kg	500	-
Zinc	7440-66-6	mg/kg	15,000	121

Sediment Screening Values (Sediment Metals)

No Exceedence | Above Screening Level

Monitoring Location	Site Description	Collection Date	Collection Time	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Vanadium	Zinc
			Utah Health-Based comparison Value for Recreational Exposure*	50,000	20	15	10,000	100	25	250	500	500	55,000	400	2,500	9.40	1,000	250	250	500	15,000
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
4952942	San Juan R @ Clay Hills	8/15/2015	14:30	6160	NS	1.5	251	0.309	0.146	6.31	2.07	2.83	6040	3.96	176	0.00334	3.68	NS	NS	13.7	16.5
		8/19/2015	15:09	14400	NS	2.99	181	0.552	0.201	12.4	3.81	5.56	10400	6.31	262	0.00655	8.02	NS	NS	22	25.1
		9/23/2015	13:50	2770	NS	1.22	215	0.162	0.0648	3.24	1.41	NS	3760	2.99	171	NS	NS	NS	NS	8.18	11.5
		10/27/2015	14:45	2720	NS	1.1	163	0.178	0.087	3.09	1.48	1.85	5190	NS	138	0.00211	2.52	NS	NS	6.74	10.4
			15:00	3250	NS	1.37	221	0.195	0.0945	3.68	1.71	2.42	5030	NS	147	0.00205	2.9	NS	0.0778	8.55	11.9
		2/17/2016	10:30	7651	NS	2.1	203.4	0.5	NS	15.3	3.6	7	8008	7.2	269.7	NS	11.1	2.4	NS	12.9	23.2
4953000	San Juan R @ Mexican Hat US163 Xing	8/8/2015	17:40	8780	NS	2.7	271	0.423	0.165	7.72	2.65	5.01	7630	5.52	218	NS	4.09	NS	0.0679	18.9	26.1
		8/15/2015	12:04	7480	NS	2.2	213	0.374	0.145	8.76	2.49	3.76	7210	4.75	192	NS	4.5	NS	0.0458	16.9	24.5
		9/22/2015	9:56	6350	NS	2.26	411	0.272	0.112	5.61	2.15	3.11	5900	4.3	169	0.0019	3.44	NS	NS	14.6	18.4
			9:56	3950	NS	2.04	175	0.19	0.0897	3.33	1.7	2.33	4250	NS	132	0.00215	2.23	NS	NS	9.15	13.3
		10/26/2015	16:15	5300	NS	2.49	171	0.327	0.166	5.23	2.71	4.4	7790	5.19	207	0.00375	4.87	NS	NS	12.7	17.6
		2/17/2016	9:00	3728	NS	1.6	137.5	NS	NS	4.6	2.1	3.8	4708	4.5	166.2	NS	4	2.4	NS	8	14.7
4953250	San Juan R @ Sand Island	8/8/2015	16:19	7140	NS	2.13	232	0.321	0.127	5.79	2.12	3.73	6340	4.28	198	NS	2.85	NS	0.0553	15.2	18.9
		8/15/2015	11:31	10600	NS	2.78	297	0.451	0.17	9.53	3.19	6.35	9630	6.2	223	0.00284	4.96	NS	0.0243	22.9	26.7
		9/22/2015	13:59	4250	NS	2.49	518	0.226	0.0796	2.32	2.18	2.53	7750	4.24	198	0.00301	2.15	NS	NS	7.43	20.6
		2/16/2016	17:00	5460	NS	2	191.1	NS	NS	5	3.1	6.2	6999	6.5	232.7	NS	5.4	2.7	NS	11	21.7
4953900	McElmo Cr @ U262 Xing near Town of Montezuma	9/23/2015	10:52	4920	NS	2.59	280	0.249	0.127	3.82	1.61	2.27	5210	3.78	461	0.00473	2.23	NS	NS	10.1	13.6
4953990	San Juan R @ Town of Montezuma	8/8/2015	14:54	6140	NS	1.74	279	0.291	0.122	5.02	1.76	3.43	5530	3.9	156	NS	2.8	NS	NS	13.5	18.5
		8/15/2015	10:30	14600	NS	3.16	199	0.566	0.239	13.9	4.23	7.94	12100	7.46	241	0.00569	6.67	NS	0.0315	26.7	33.1
		9/22/2015	17:55	10400	NS	3.04	161	0.437	0.173	8.65	3.26	5.34	8070	7.09	223	0.006	5.07	NS	0.0286	19.7	25.6
		10/26/2015	14:00	10400	NS	3.23	175	0.54	0.242	10.4	4.35	7.69	11800	8.36	267	0.00757	7.98	NS	0.0367	21.4	26.7
		2/16/2016	16:15	8214	NS	2.9	234.3	0.6	0.1	7.6	4.7	9.5	11077	9.6	279.7	NS	8.3	3.8	NS	16.7	31.5
4954000	San Juan R @ US160 Xing in CO	8/8/2015	13:23	16600	NS	3.76	200	0.675	0.309	14.2	4.12	8.65	11400	9.03	280	0.00182	8.11	NS	0.0443	29.4	40.1
		8/15/2015	9:43	12900	NS	3.2	217	0.541	0.203	12.1	4.14	8.26	11900	6.99	240	0.00535	6.4	NS	0.0339	25.3	32
		8/19/2015	8:15	16200	NS	3.37	147	0.627	0.237	11.6	4.36	9.9	11800	8.52	246	0.0228	7.07	NS	0.0504	26.4	34.3
			9:30	14100	NS	3.06	198	0.551	0.185	10.4	3.79	6.59	10700	7.6	212	0.00761	6.22	NS	0.0302	23.1	30.6
			12:33	10000	NS	2.31	228	0.381	0.146	6.76	2.77	4.74	8270	5.51	191	0.00565	4.19	NS	0.038	17	23.7
			13:03	6470	NS	2.06	564	0.289	0.111	5.13	2.53	3.45	7200	4.48	182	0.00368	3.6	NS	NS	16.2	18.7
		9/23/2015	18:35	12600	NS	3.31	313	0.535	0.254	12.1	3.76	6.63	10900	8.27	251	0.00345	6.25	NS	0.045	28.1	28.8
		2/16/2016	15:00	4179	NS	1.9	135.9	NS	NS	5.5	2.7	4.6	5628	5.1	185.6	NS	5.5	2.1	NS	10.5	16.9

Figure 31 - Summary of Sediment Data in the San Juan River and Comparison to Health-Based Screening Values

Sediment Screening Values (Sediment Metals)

No Exceedence | Above Screening Level

Monitoring Location	Site Description	Collection Date	Collection Time	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Vanadium	Zinc
	EPA Region 3 Freshwater Sediment Screening Values for Aquatic Life					9.8			0.99	43.4	50	31.6	20,000	35.8	460	0.18	22.27	2	1		121
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
4952942	San Juan R @ Clay Hills	8/15/2015	14:30	6160	NS	1.5	251	0.309	0.146	6.31	2.07	2.83	6040	3.96	176	0.00334	3.68	NS	NS	13.7	16.5
		8/19/2015	15:09	14400	NS	2.99	181	0.552	0.201	12.4	3.81	5.56	10400	6.31	262	0.00655	8.02	NS	NS	22	25.1
		9/23/2015	13:50	2770	NS	1.22	215	0.162	0.0648	3.24	1.41	NS	3760	2.99	171	NS	NS	NS	NS	8.18	11.5
		10/27/2015	14:45	2720	NS	1.1	163	0.178	0.087	3.09	1.48	1.85	5190	NS	138	0.00211	2.52	NS	NS	6.74	10.4
			15:00	3250	NS	1.37	221	0.195	0.0945	3.68	1.71	2.42	5030	NS	147	0.00205	2.9	NS	0.0778	8.55	11.9
		2/17/2016	10:30	7651	NS	2.1	203.4	0.5	NS	15.3	3.6	7	8008	7.2	269.7	NS	11.1	2.4	NS	12.9	23.2
4953000	San Juan R @ Mexican Hat US163 Xing	8/8/2015	17:40	8780	NS	2.7	271	0.423	0.165	7.72	2.65	5.01	7630	5.52	218	NS	4.09	NS	0.0679	18.9	26.1
		8/15/2015	12:04	7480	NS	2.2	213	0.374	0.145	8.76	2.49	3.76	7210	4.75	192	NS	4.5	NS	0.0458	16.9	24.5
		9/22/2015	9:56	6350	NS	2.26	411	0.272	0.112	5.61	2.15	3.11	5900	4.3	169	0.0019	3.44	NS	NS	14.6	18.4
			9:56	3950	NS	2.04	175	0.19	0.0897	3.33	1.7	2.33	4250	NS	132	0.00215	2.23	NS	NS	9.15	13.3
		10/26/2015	16:15	5300	NS	2.49	171	0.327	0.166	5.23	2.71	4.4	7790	5.19	207	0.00375	4.87	NS	NS	12.7	17.6
		2/17/2016	9:00	3728	NS	1.6	137.5	NS	NS	4.6	2.1	3.8	4708	4.5	166.2	NS	4	2.4	NS	8	14.7
4953250	San Juan R @ Sand Island	8/8/2015	16:19	7140	NS	2.13	232	0.321	0.127	5.79	2.12	3.73	6340	4.28	198	NS	2.85	NS	0.0553	15.2	18.9
		8/15/2015	11:31	10600	NS	2.78	297	0.451	0.17	9.53	3.19	6.35	9630	6.2	223	0.00284	4.96	NS	0.0243	22.9	26.7
		9/22/2015	13:59	4250	NS	2.49	518	0.226	0.0796	2.32	2.18	2.53	7750	4.24	198	0.00301	2.15	NS	NS	7.43	20.6
		2/16/2016	17:00	5460	NS	2	191.1	NS	NS	5	3.1	6.2	6999	6.5	232.7	NS	5.4	2.7	NS	11	21.7
4953900	McElmo Cr @ U262 Xing near Town of Montezuma	9/23/2015	10:52	4920	NS	2.59	280	0.249	0.127	3.82	1.61	2.27	5210	3.78	461	0.00473	2.23	NS	NS	10.1	13.6
4953990	San Juan R @ Town of Montezuma	8/8/2015	14:54	6140	NS	1.74	279	0.291	0.122	5.02	1.76	3.43	5530	3.9	156	NS	2.8	NS	NS	13.5	18.5
		8/15/2015	10:30	14600	NS	3.16	199	0.566	0.239	13.9	4.23	7.94	12100	7.46	241	0.00569	6.67	NS	0.0315	26.7	33.1
		9/22/2015	17:55	10400	NS	3.04	161	0.437	0.173	8.65	3.26	5.34	8070	7.09	223	0.006	5.07	NS	0.0286	19.7	25.6
		10/26/2015	14:00	10400	NS	3.23	175	0.54	0.242	10.4	4.35	7.69	11800	8.36	267	0.00757	7.98	NS	0.0367	21.4	26.7
		2/16/2016	16:15	8214	NS	2.9	234.3	0.6	0.1	7.6	4.7	9.5	11077	9.6	279.7	NS	8.3	3.8	NS	16.7	31.5
4954000	San Juan R @ US160 Xing in CO	8/8/2015	13:23	16600	NS	3.76	200	0.675	0.309	14.2	4.12	8.65	11400	9.03	280	0.00182	8.11	NS	0.0443	29.4	40.1
		8/15/2015	9:43	12900	NS	3.2	217	0.541	0.203	12.1	4.14	8.26	11900	6.99	240	0.00535	6.4	NS	0.0339	25.3	32
		8/19/2015	8:15	16200	NS	3.37	147	0.627	0.237	11.6	4.36	9.9	11800	8.52	246	0.0228	7.07	NS	0.0504	26.4	34.3
			9:30	14100	NS	3.06	198	0.551	0.185	10.4	3.79	6.59	10700	7.6	212	0.00761	6.22	NS	0.0302	23.1	30.6
			12:33	10000	NS	2.31	228	0.381	0.146	6.76	2.77	4.74	8270	5.51	191	0.00565	4.19	NS	0.038	17	23.7
			13:03	6470	NS	2.06	564	0.289	0.111	5.13	2.53	3.45	7200	4.48	182	0.00368	3.6	NS	NS	16.2	18.7
		9/23/2015	18:35	12600	NS	3.31	313	0.535	0.254	12.1	3.76	6.63	10900	8.27	251	0.00345	6.25	NS	0.045	28.1	28.8
		2/16/2016	15:00	4179	NS	1.9	135.9	NS	NS	5.5	2.7	4.6	5628	5.1	185.6	NS	5.5	2.1	NS	10.5	16.9

Figure 32 - Summary of Sediment Data in the San Juan River and Comparison to Aquatic Life Screening Values

2010 USGS Lake Powell Core Screening Assessment

Because of concerns from resource managers about the potential health impacts to humans and aquatic wildlife from contaminated sediment historically transported to Lake Powell, the USGS collected and analyzed sediment cores in 2001 at the Colorado River delta and in 2010 and 2011 for the San Juan and Escalante River deltas of Lake Powell to assess the presence of trace elements and organic compounds (Hart et al., 2005; Hornewer, 2014). Since this report is centered on the San Juan River, we will focus on the results from the San Juan River delta cores and will be generally referred to as Lake Powell cores. Sediment cores were collected from three locations in Lake Powell in 2010. Out of the 57 major and trace elements analyzed, most were detected at concentrations greater than minimum reporting levels in the sediment core subsamples and composited samples, with the exception of organochlorine pesticides and polychlorinated biphenyls, which were not detected in any samples (Hornewer 2014).

Concentrations of total metals in core sediments were analyzed at the U.S. Geological Survey-Water Resources Discipline-National Research Program laboratory in Boulder, Colorado and reported by Hornewer (2014). The sediment concentrations were then compared to Utah's sediment screening levels as described previously for the San Juan River sediment samples. The USGS collected three separate Lake Powell cores in a downstream transect as: Core 1 – upstream (USGS 371312110364200), Core 2 – midstream (USGS 371425110382600), and Core 3 – downstream (USGS 371545110410700). The cores were segregated by depth with 23, 37, and 56 non-linear subsamples for Cores 1, 2, and 3, respectively. In addition, water samples were collected at each core location near the sediment-water interface and analyzed. Figure 33 provides the locations of the three USGS sediment cores collected in 2010. The sediment screening tables for Lake Powell sediment cores 1, 2, and 3 are presented as Figure 34, Figure 35, and Figure 36, respectively.

Figure 33 - Locations of the USGS 2010 sediment core locations in the upstream, midreach, and downstream locations.

Each of the subsamples were evaluated for the metals listed in Table 7, the only exceedance of the human health screening value that was observed was for aluminum in nearly all of the samples in each of the three cores. Only a few samples collected from depths below 4 meters from the sediment/water interface in the downstream Core 3 exceeded the human health screening values for iron. No other samples exceeded any of the screening values. Figure 34 through Figure 36 provide the comparison of the observed sediment concentrations for each of the 2010 USGS Lake Powell sediment cores relative to the Utah Human Health and Aquatic Life Screening values for soils for each analyte.

Sediment /Soil (Total Metals)

No Exceedence	Above Human Health	Above Aquatic Life

Monitoring Location	Site Description	Collection Date	Collection Time	Core Number	Subsample depth (mm)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Sulfate	Thallium	Vanadium	Zinc
Utah Health-Based comparison Value for Recreational Exposure (Soil Values)*						50000	20	15	10,000	100	25	-	250	500	500	55,000	400	-	2,500	9.4	250	1,000	-	250	250	-	-	0.78	500	15,000
EPA Region 3 Freshwater Sediment Screening Values for Aquatic Life								10			1		43	50	32	20,000	36		460	0.2		23		2	1					121
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
371312110364200	San Juan River Delta Core 1 (Upper) @ Lake Powell	8/12/2010	9:40	1	170	79782	0.8	5.5	353.8	2.271	0.115	25763	45.5	11.9	24.4	36973	20.8	18932	464	NS	0.80	23.4	21527	< 0.9	NS	3169	NS	0.6002	85.2	75.0
		8/12/2010	9:40	1	245	95542	0.9	7.2	387.8	2.557	0.359	26332	47.7	12.0	37.7	40358	30.4	13811	543	NS	1.39	22.0	22038	1.1	NS	3464	NS	0.7161	101.6	126.9
		8/12/2010	9:40	1	315	82829	0.9	5.7	364.8	2.183	0.119	13603	36.2	12.6	32.4	42494	23.5	11125	442	NS	1.16	17.5	13182	< 0.9	NS	3528	NS	0.5650	107.4	91.7
		8/12/2010	9:40	1	375	76562	0.8	6.4	336.4	2.177	0.121	13078	35.6	11.9	31.2	40850	22.5	10382	405	NS	1.29	16.5	11777	< 0.7	NS	3662	NS	0.5651	100.5	87.0
		8/12/2010	9:40	1	410	78150	0.8	5.8	357.4	2.230	0.180	23836	42.9	12.4	29.6	38120	22.5	14392	468	NS	1.18	20.5	16577	< 0.7	NS	3294	NS	0.6173	96.9	93.4
		8/12/2010	9:40	1	460	79561	0.9	6.3	369.1	2.403	0.182	30084	45.1	11.8	27.9	47165	22.1	16930	492	NS	1.20	22.3	19698	0.9	NS	3706	NS	0.6313	91.8	86.5
		8/12/2010	9:40	1	490	81567	0.9	6.2	396.9	2.385	0.235	28730	40.8	11.2	29.3	39121	23.2	15329	486	NS	1.51	19.6	18223	< 0.8	NS	3842	NS	0.6603	102.3	92.2
		8/12/2010	9:40	1	515	81133	1.0	5.9	269.4	2.425	0.104	24686	49.2	11.7	27.7	39425	21.1	17067	481	NS	0.82	21.4	22806	< 0.8	NS	3283	NS	0.6153	88.9	72.9
		8/12/2010	9:40	1	515	91159	0.9	5.9	267.8	2.538	0.094	26357	45.8	11.7	28.0	40635	20.6	17073	499	NS	0.67	20.8	23732	< 0.8	NS	3006	NS	0.6231	87.4	76.2
		8/12/2010	9:40	1	570	81128	0.9	6.5	410.8	2.212	0.160	13111	37.0	11.4	30.4	32551	21.9	10192	449	NS	1.81	17.0	15145	< 0.8	NS	3739	NS	0.5998	97.6	90.4
		8/12/2010	9:40	1	625	82921	0.8	7.4	397.9	2.363	0.227	24582	42.3	11.2	48.6	31330	24.6	12540	509	NS	2.49	19.9	17673	< 0.8	NS	3047	NS	0.7591	108.5	96.1
		8/12/2010	9:40	1	745	76025	0.9	6.8	391.1	2.243	0.319	39244	43.7	11.3	26.4	37543	22.9	13564	496	NS	1.46	21.0	16919	< 0.7	NS	3553	NS	0.6636	97.3	85.7
		8/12/2010	9:40	1	745	84795	0.9	6.8	420.2	2.224	0.247	40750	43.2	11.2	27.5	36888	24.1	13892	521	NS	1.86	21.8	18768	< 0.9	NS	3241	NS	0.6743	95.9	92.0
		8/12/2010	9:40	1	810	83531	0.9	6.4	477.1	2.002	0.182	32072	42.3	11.4	29.7	36545	22.1	12591	493	NS	1.55	20.0	18707	< 0.8	NS	6316	NS	0.6506	89.8	85.6
		8/12/2010	9:40	1	870	78232	0.9	6.5	445.5	2.107	0.197	27537	41.4	11.7	29.5	31997	22.6	12466	471	NS	1.41	20.0	17774	< 0.9	NS	4833	NS	0.6349	92.0	85.2
		8/12/2010	9:40	1	935	85101	0.9	6.9	491.7	2.123	0.180	14343	42.1	13.4	32.3	33805	24.2	10548	448	NS	1.66	19.8	16900	< 0.7	NS	4685	NS	0.6648	105.8	92.9
		8/12/2010	9:40	1	1000	70567	0.9	6.5	406.0	2.458	0.192	17200	43.3	12.2	30.6	42157	24.6	10648	475	NS	1.31	20.0	16050	1.5	NS	3806	NS	0.6382	100.9	93.3
		8/12/2010	9:40	1	1080	77321	0.9	7.1	380.9	2.539	0.232	40949	46.4	11.2	25.7	38535	21.2	20370	544	NS	1.50	22.7	23048	< 0.7	NS	2919	NS	0.7023	100.3	90.8
		8/12/2010	9:40	1	1125	71072	1.0	8.0	561.7	2.144	0.440	34913	41.5	11.2	36.0	29630	44.8	12760	635	NS	1.50	19.9	20452	< 0.8	NS	5849	NS	0.6917	92.6	160.8
		8/12/2010	9:40	1	1155	42287	0.7	6.1	570.4	1.298	0.492	23660	25.4	7.4	31.4	16971	29.9	6967	424	NS	1.60	13.1	19120	< 0.7	NS	9941	NS	0.5146	51.4	108.7
		8/12/2010	9:40	1	1155	51659	0.8	6.1	587.8	1.352	0.480	25202	25.7	7.8	32.0	19423	28.9	7219	441	NS	1.47	13.5	20040	< 0.7	NS	7659	NS	0.5017	48.3	113.4
		8/12/2010	9:40	1	1220	34902	0.5	2.6	601.2	0.795	0.075	14725	12.4	3.3	9.1	8450	13.3	3643	223	NS	1.40	5.4	19926	< 0.9	NS	9081	NS	0.3816	21.8	40.8
		8/12/2010	9:40	1	1480	27323	0.4	2.0	561.5	0.651	0.071	11872	7.2	2.2	6.5	5793	11.3	2886	191	NS	0.66	3.8	18096	< 0.9	NS	7891	NS	0.3595	17.8	26.2

Figure 34 - Sediment screening of USGS San Juan River delta of Lake Powell sediment core number 1 (upstream location, USGS 371312110364200) completed on August 12, 2010 at 9:40. Lake Powell water surface elevation was 1108.36 m during the time of coring with a water depth of 10 m. The coring location was 64.9 km above the confluence with Colorado River at 37.22000, -110.61162. All data are reported in Hornewer, 2014.

Sediment /Soil (Total Metals)

No Exceedence | Above Human Health | Above Aquatic Life

Monitoring Location	Site Description	Collection Date	Collection Time	Core Number	Subsample depth (mm)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Sulfate	Thallium	Vanadium	Zinc
Utah Health-Based comparison Value for Recreational Exposure (Soil Values)*						50000	20	15	10,000	100	25	-	250	500	500	55,000	400	-	2,500	9.4	250	1,000	-	250	250	-	-	0.78	500	15,000
EPA Region 3 Freshwater Sediment Screening Values for Aquatic Life								10			1		43	50	32	20,000	36		460	0.2		23		2	1					121
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
371425110382600	San Juan River Delta Core 2 (Mid) @ Lake Powell	8/12/2010	15:00	2	275	90956	1.0	7.4	413.3	2.436	0.290	35644	55.6	11.9	26.1	34439	22.0	19056	579	NS	1.44	26.8	22730	< 0.9	NS	2838	NS	0.7437	112.1	88.1
		8/12/2010	15:00	2	790	52479	0.9	6.0	608.8	1.573	0.498	31531	31.9	8.2	31.7	23330	34.2	8869	590	NS	2.63	14.1	19455	1.7	NS	8873	NS	0.5545	59.1	127.6
		8/12/2010	15:00	2	1690	32585	0.4	2.6	572.0	0.739	0.077	13556	11.6	3.3	8.9	8932	12.9	3529	233	NS	0.64	5.4	19165	< 0.6	NS	6463	NS	0.3757	24.6	32.0
		8/12/2010	15:00	2	1750	22253	0.2	1.6	456.3	0.496	0.025	7210	3.4	1.4	3.4	3406	8.1	1231	126	NS	0.71	1.8	14008	< 0.7	NS	5000	NS	0.2530	8.0	11.8
		8/12/2010	15:00	2	1750	24053	0.2	1.5	504.4	0.500	0.031	9339	3.7	1.5	3.3	3193	8.5	1431	135	NS	0.48	1.8	14387	< 0.8	NS	5845	NS	0.2566	8.5	12.3
		8/12/2010	15:00	2	1795	40228	0.4	3.1	503.1	0.885	0.091	11598	12.1	3.8	8.8	9839	16.1	3841	194	NS	0.74	7.2	17746	< 0.7	NS	6123	NS	0.4161	27.0	45.7
		8/12/2010	15:00	2	1795	42581	0.5	3.5	557.3	0.915	0.095	15833	15.6	4.6	11.0	12934	15.7	4990	258	NS	0.56	7.8	20069	< 0.7	NS	6367	NS	0.4645	34.0	42.3
		8/12/2010	15:00	2	1840	61960	0.7	4.9	490.4	1.517	0.196	21357	28.3	7.2	19.2	21332	21.6	8028	361	NS	1.19	13.2	17822	< 0.7	NS	5448	NS	0.5565	57.5	68.7
		8/12/2010	15:00	2	1875	67561	0.8	5.9	481.3	1.747	0.220	27191	34.8	8.6	22.6	24502	21.2	10588	438	NS	1.52	16.5	19970	< 0.8	NS	4924	NS	0.6145	68.3	76.1
		8/12/2010	15:00	2	1925	91767	0.9	7.5	448.3	2.095	0.285	27099	49.1	10.7	27.4	33003	24.8	13168	512	NS	1.77	22.3	18604	1.0	NS	3206	NS	0.7203	106.3	98.7
		8/12/2010	15:00	2	2022	82639	0.9	7.1	472.4	1.845	0.247	35017	44.6	9.8	27.1	29523	23.3	13384	496	NS	1.68	20.3	20128	< 0.8	NS	4326	NS	0.6702	88.5	89.3
		8/12/2010	15:00	2	2055	81115	0.9	6.5	496.1	1.887	0.237	27342	42.2	9.9	27.2	28483	22.3	12112	434	NS	2.65	19.1	18199	< 0.9	NS	4512	NS	0.6523	87.5	85.7
		8/12/2010	15:00	2	2145	78504	0.9	7.0	517.7	1.888	0.263	40977	47.1	9.7	27.1	27109	21.8	13940	490	NS	2.13	21.9	19480	< 0.8	NS	5171	NS	0.6630	88.3	83.4
		8/12/2010	15:00	2	2195	55615	0.8	5.8	487.2	1.493	0.285	49832	36.0	7.4	23.7	19764	17.8	13442	412	NS	2.17	18.5	18921	0.7	NS	6434	NS	0.6063	63.1	61.9
		8/12/2010	15:00	2	2195	55265	0.8	5.8	506.0	1.489	0.270	49236	37.0	7.7	24.3	20760	17.9	13311	404	NS	1.96	18.7	19542	0.8	NS	6683	NS	0.5875	63.9	62.6
		8/12/2010	15:00	2	2235	54013	0.8	6.1	483.6	1.450	0.224	48119	36.4	8.4	24.1	21655	18.6	13436	438	NS	1.21	19.1	18396	0.8	NS	6787	NS	0.6383	63.1	67.9
		8/12/2010	15:00	2	2310	67188	0.8	6.6	472.2	1.740	0.164	56880	43.5	8.9	22.8	24830	19.1	15874	499	NS	1.36	21.1	20321	< 0.8	NS	5395	NS	0.5273	65.0	68.6
		8/12/2010	15:00	2	2310	64911	0.8	6.7	471.6	1.575	0.190	61593	44.4	9.8	24.3	26560	19.3	17184	521	NS	1.77	22.2	21145	0.7	NS	5795	NS	0.5682	69.7	73.1
		8/12/2010	15:00	2	2370	58617	0.7	5.3	484.5	1.752	0.161	54103	38.4	8.2	21.2	21855	16.8	15186	489	NS	0.61	17.7	21697	1.0	NS	6645	NS	0.5076	54.3	55.7
		8/12/2010	15:00	2	2415	66836	0.8	6.1	436.8	1.713	0.135	57926	41.1	8.8	22.5	23959	16.8	17129	546	NS	0.68	20.8	20987	< 0.8	NS	4670	NS	0.5014	60.2	59.3
		8/12/2010	15:00	2	2495	98851	1.0	7.2	505.3	2.606	0.204	40824	52.7	11.6	28.8	34665	28.0	18050	607	NS	1.02	25.2	22909	0.8	NS	3299	NS	0.7544	98.5	93.9
		8/12/2010	15:00	2	2575	66992	0.9	6.0	616.4	1.534	0.232	34707	39.1	9.1	27.4	24021	21.5	11214	470	NS	1.41	18.4	21070	< 0.9	NS	7265	NS	0.6318	66.3	76.9
		8/12/2010	15:00	2	2625	65068	0.8	5.9	555.5	1.664	0.192	45914	37.4	8.6	26.5	22723	20.0	13458	499	NS	1.24	17.8	20708	0.9	NS	6712	NS	0.5638	61.6	73.3
		8/12/2010	15:00	2	2705	72343	0.9	6.3	512.4	1.787	0.179	48950	39.6	10.1	30.4	32076	20.0	14277	547	NS	1.34	18.1	19906	< 0.8	NS	5852	NS	0.5995	65.7	69.1
		8/12/2010	15:00	2	2725	81782	1.0	7.0	537.6	2.087	0.254	34168	46.8	11.2	31.6	37192	24.0	12995	489	NS	0.86	21.7	19277	< 0.7	NS	4956	NS	0.7098	93.5	89.8
		8/12/2010	15:00	2	2750	81728	0.9	7.0	445.4	2.395	0.216	47904	43.8	10.5	28.7	38568	22.2	16533	540	NS	4.08	21.8	22964	< 0.8	NS	3974	NS	0.6611	85.4	87.8
		8/12/2010	15:00	2	2780	82909	0.9	7.9	376.6	2.238	0.179	50894	49.4	12.0	27.4	37695	21.4	19107	611	NS	1.24	26.1	23568	< 0.8	NS	3165	NS	0.6751	94.4	88.7
		8/12/2010	15:00	2	2815	86798	0.9	7.4	494.6	2.281	0.366	25605	45.6	11.3	34.4	40032	38.5	14245	502	NS	0.97	20.7	20056	< 0.9	NS	2998	NS	0.6829	107.1	146.5
		8/12/2010	15:00	2	2890	80694	1.0	6.6	542.9	1.906	0.316	25473	42.0	11.2	33.4	38964	29.0	11246	526	NS	2.83	19.2	18079	< 0.8	NS	4748	NS	0.6401	89.8	111.2
		8/12/2010	15:00	2	2890	73687	0.9	6.5	524.6	1.916	0.294	25954	42.1	11.0	33.0	37270	28.2	11333	544	NS	1.38	19.2	17320	< 0.7	NS	5305	NS	0.6629	92.7	111.8
		8/12/2010	15:00	2	2935	82083	0.8	7.7	400.6	2.260	0.225	43459	45.1	10.8	26.1	39319	22.7	16441	549	NS	1.81	22.1	21852	< 0.9	NS	3202	NS	0.6321	84.4	85.8
		8/12/2010	15:00	2	2970	83868	0.8	6.9	419.2	2.335	0.239	41736	40.8	10.2	24.0	35705	23.0	15086	450	NS	1.50	19.3	19074	< 0.9	NS	2571	NS	0.6544	87.1	83.3
		8/12/2010	15:00	2	2985	70998	0.8	6.1	426.6	1.888	0.273	47251	40.8	10.2	26.2	33858	20.4	15699	487	NS	1.05	18.8	18402	< 0.8	NS	3538	NS	0.5848	80.3	80.7
		8/12/2010	15:00	2	3025	81533	0.9	6.6	464.1	2.096	0.185	41896	46.4	11.2	27.2	34391	22.2	16771	517	NS	1.37	22.2	19913	< 0.7	NS	3479	NS	0.6281	87.8	80.1
		8/12/2010	15:00	2	3090	89399	0.9	10.0	378.7	2.430	0.168	54646	61.9	13.4	24.0	46898	21.9	23315	594	NS	0.81	32.7	25430	< 0.6	NS	2409	NS	0.6589	95.1	84.4
		8/12/2010	15:00	2	3185	86236	0.9	7.1	431.2	2.299	0.301	27740	44.8	11.2	32.7	40769	31.8	13374	495	NS	0.98	20.7	18327	< 0.7	NS	3027	NS	0.6779	97.9	115.0
		8/12/2010	15:00	2	3375	88669	0.8	7.2	429.4	2.301	0.333	33244	45.4	11.4	32.1	40894	29.8	13989	525	NS	0.94	21.3	19380	< 0.8	NS	3381	NS	0.6725	102.4	120.9

Figure 35 - Sediment screening of USGS San Juan River delta of Lake Powell sediment core number 2 (mid length location, USGS 371425110382600) completed on August 12, 2010 at 15:00. Lake Powell water surface elevation was 1108.36 m during the time of coring with a water depth of 12 m. The coring location was 60.8 km above the confluence with Colorado River at 37.24030, -110.64045. All data are reported in Hornewer, 2014.

Sediment /Soil (Total Metals)

No Exceedence | Above Human Health | Above Aquatic Life

Monitoring Location	Site Description	Collection Date	Collection Time	Core Number	Subsample depth (mm)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Sulfate	Thallium	Vanadium	Zinc
Utah Health-Based comparison Value for Recreational Exposure (Soil Values)*						50000	20	15	10,000	100	25	-	250	500	500	55,000	400	-	2,500	9.4	250	1,000	-	250	250	-	-	0.78	500	15,000
EPA Region 3 Freshwater Sediment Screening Values for Aquatic Life								10			1		43	50	32	20,000	36		460	0.2		23		2	1					121
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
371545110410700	San Juan River Delta Core 3 (Lower) @ Lake Powell	8/12/2010	17:00	3	30	79723	0.9	7.0	489.7	2.172	0.321	35543	43.2	10.8	30.9	37288	27.1	13305	546	NS	1.15	20.1	19203	< 0.9	NS	4401	NS	0.6333	88.3	107.6
		8/12/2010	17:00	3	210	74359	0.9	6.6	517.5	1.954	0.263	34482	41.8	10.5	29.3	34677	25.3	12423	515	NS	1.08	19.0	19151	< 0.7	NS	5131	NS	0.6469	83.8	96.1
		8/12/2010	17:00	3	390	75524	0.9	6.7	529.0	1.991	0.291	34527	41.2	10.0	30.1	33938	24.9	12496	527	NS	1.19	18.9	19269	< 0.9	NS	5420	NS	0.5982	84.7	98.7
		8/12/2010	17:00	3	570	79109	0.9	6.9	515.1	1.941	0.373	36515	41.1	10.0	30.4	34962	26.8	13303	564	NS	1.13	18.9	19270	< 0.8	NS	5030	NS	0.6555	89.8	103.5
		8/12/2010	17:00	3	750	74533	0.9	7.0	524.1	1.952	0.356	35532	41.6	10.2	31.1	34545	27.1	12553	541	NS	1.38	18.8	18915	< 0.6	NS	4939	NS	0.6377	87.0	108.6
		8/12/2010	17:00	3	930	77036	0.9	6.8	508.5	1.973	0.280	33745	41.6	10.2	29.0	35744	25.6	12776	520	NS	1.29	19.0	18685	< 0.8	NS	4265	NS	0.6474	88.0	97.6
		8/12/2010	17:00	3	1025	67514	0.8	6.3	505.8	1.782	0.259	33250	39.0	9.5	27.6	31402	24.4	11746	493	NS	1.31	17.5	18052	< 0.7	NS	5425	NS	0.6046	78.8	91.6
		8/12/2010	17:00	3	1115	71398	0.9	6.6	526.7	1.878	0.297	35080	41.7	10.1	29.6	27987	25.0	12616	532	NS	1.51	18.8	18760	0.7	NS	5213	NS	0.6618	83.6	93.2
		8/12/2010	17:00	3	1205	72500	0.8	6.1	557.0	1.788	0.244	36069	41.7	9.9	29.2	26982	22.2	12692	531	NS	1.11	18.4	19285	0.9	NS	5632	NS	0.6302	81.5	86.1
		8/12/2010	17:00	3	1385	71008	0.9	6.2	547.0	1.694	0.218	31562	41.0	9.4	27.1	30232	22.2	11867	488	NS	1.08	18.2	18914	1.0	NS	5550	NS	0.6254	76.7	82.4
		8/12/2010	17:00	3	1565	72018	0.9	6.6	527.7	1.724	0.235	32562	42.9	10.4	28.2	31016	23.1	12514	493	NS	1.60	19.6	18991	< 0.7	NS	5375	NS	0.6797	83.7	90.9
		8/12/2010	17:00	3	1745	68628	0.8	5.7	543.6	1.604	0.226	35198	37.2	8.7	25.7	24796	20.6	12096	455	NS	1.23	16.5	18620	< 0.7	NS	6321	NS	0.6056	69.6	73.5
		8/12/2010	17:00	3	1745	64510	0.8	6.0	521.1	1.649	0.207	34644	41.4	9.1	26.3	24521	20.7	11540	430	NS	1.31	17.2	21315	< 0.7	NS	6352	NS	0.6273	70.0	78.0
		8/12/2010	17:00	3	1895	82263	0.9	6.3	491.6	1.890	0.230	32312	42.8	9.3	25.9	29542	22.8	14021	456	NS	2.08	18.9	19896	0.8	NS	4643	NS	0.6578	89.7	85.0
		8/12/2010	17:00	3	1950	59804	0.8	5.4	562.8	1.467	0.210	35786	35.7	8.0	22.8	25127	19.8	11908	434	NS	1.09	15.4	19737	< 0.7	NS	6782	NS	0.5501	63.6	71.4
		8/12/2010	17:00	3	2030	89355	0.8	5.9	406.7	2.198	0.191	21647	39.1	11.2	31.7	37727	24.8	13129	452	NS	1.45	18.4	16391	0.7	NS	2910	NS	0.6678	103.9	98.4
		8/12/2010	17:00	3	2075	89112	0.8	6.0	417.9	2.426	0.356	27134	41.6	11.7	32.2	33272	21.8	14468	456	NS	1.05	21.0	18518	1.0	NS	3334	NS	0.6726	97.3	94.9
		8/12/2010	17:00	3	2130	74950	1.1	7.8	481.6	1.964	0.357	44947	43.5	9.7	27.2	27022	22.5	14964	506	NS	2.34	21.6	20334	1.4	NS	4828	NS	0.7468	88.1	85.7
		8/12/2010	17:00	3	2150	76565	0.9	7.5	425.4	2.006	0.344	43567	49.6	10.7	26.2	31493	21.8	16042	487	NS	2.23	25.7	20331	1.0	NS	3492	NS	0.7709	103.0	92.5
		8/12/2010	17:00	3	2180	85247	0.9	9.2	394.1	2.251	0.180	55375	57.1	12.1	24.3	34582	22.2	19928	593	NS	1.61	29.5	25190	< 0.8	NS	2621	NS	0.6931	95.1	84.3
		8/12/2010	17:00	3	2180	82598	0.9	8.6	388.8	2.370	0.204	54840	53.2	12.6	25.1	37140	23.0	19790	598	NS	1.48	30.6	24806	1.1	NS	2612	NS	0.6823	92.6	87.5
		8/12/2010	17:00	3	2220	92440	1.0	6.8	461.2	2.212	0.242	24850	44.7	12.1	30.6	38976	24.7	14557	493	NS	1.04	21.1	18853	< 0.9	NS	3216	NS	0.6581	98.6	94.6
		8/12/2010	17:00	3	2220	82470	1.0	6.9	416.8	2.366	0.169	23306	44.1	12.1	30.5	35266	25.9	13732	480	NS	1.36	20.9	18162	< 0.7	NS	3153	NS	0.6796	104.3	96.6
		8/12/2010	17:00	3	2265	71394	1.0	6.8	657.8	1.734	0.179	26668	44.6	10.8	29.0	29457	23.0	10643	480	NS	1.57	18.5	18175	< 0.8	NS	5913	NS	0.6295	81.9	77.1
		8/12/2010	17:00	3	2300	75683	0.9	7.2	429.3	2.008	0.190	39122	43.6	11.0	26.0	32360	21.8	15207	595	NS	1.34	21.6	19277	< 0.9	NS	3751	NS	0.6282	87.5	81.3
		8/12/2010	17:00	3	2350	91152	0.9	6.8	465.1	2.188	0.220	33200	45.6	11.0	28.1	32758	21.9	15413	547	NS	1.49	22.1	18703	< 0.7	NS	3203	NS	0.7078	99.2	89.8
		8/12/2010	17:00	3	2420	94971	0.9	8.4	441.8	2.289	0.422	22588	47.4	11.6	33.5	43851	37.0	13558	504	NS	1.48	21.1	19346	0.8	NS	3369	NS	0.7194	110.1	142.0
		8/12/2010	17:00	3	2495	88311	0.8	6.1	394.5	2.166	0.166	15446	38.8	10.9	30.1	41418	23.3	11656	377	NS	1.30	17.5	15708	< 0.8	NS	3618	NS	0.6368	103.2	98.6
		8/12/2010	17:00	3	2535	89482	0.9	6.7	431.9	2.335	0.210	21691	43.1	12.4	29.4	41749	24.4	13550	465	NS	1.76	20.2	18641	< 1.6	NS	3739	NS	0.6770	104.5	97.6
		8/12/2010	17:00	3	2600	74112	1.0	7.8	533.3	1.762	0.230	38591	42.6	11.2	30.5	32502	23.9	14288	621	NS	2.00	21.4	20283	1.1	NS	6925	NS	0.7170	89.8	83.9
		8/12/2010	17:00	3	2725	59809	0.9	5.8	550.3	1.534	0.232	50853	39.1	9.0	21.6	26157	18.9	13105	531	NS	0.75	17.8	21380	< 0.8	NS	8431	NS	0.5549	62.0	63.1
		8/12/2010	17:00	3	2810	93461	0.9	7.4	410.5	2.574	0.295	31741	53.9	11.1	28.1	33469	24.4	14020	573	NS	1.92	24.3	21485	< 0.8	NS	2951	NS	0.7713	110.8	95.4
		8/12/2010	17:00	3	2810	96000	0.9	7.8	414.8	2.532	0.267	33055	55.9	12.1	29.5	36027	24.6	14977	625	NS	2.01	24.3	22179	0.7	NS	2621	NS	0.7693	113.4	98.9
		8/12/2010	17:00	3	2865	98658	0.9	7.4	425.1	2.709	0.202	20979	53.5	13.4	31.9	38825	25.0	13571	522	NS	1.55	23.1	19950	< 0.7	NS	2722	NS	0.7017	112.0	102.5
		8/12/2010	17:00	3	2925	88227	0.9	6.9	478.7	2.019	0.198	14947	40.2	12.8	31.0	36800	24.0	10622	466	NS	1.38	18.8	15925	< 0.6	NS	4839	NS	0.6487	99.5	89.7
		8/12/2010	17:00	3	2955	82280	0.9	7.0	433.7	2.309	0.253	22261	42.2	13.2	35.0	39202	23.4	10966	493	NS	3.28	21.8	17601	< 0.8	NS	4026	NS	0.7444	109.6	97.4
		8/12/2010	17:00	3	3000	83782	0.8	7.6	391.5	2.109	0.279	25334	46.3	11.7	29.3	40247	25.8	14074	506	NS	2.26	22.3	18800	1.4	NS	3541	NS	0.7012	109.2	106.0
		8/12/2010	17:00	3	3070	90514	0.8	6.7	392.2	2.550	0.176	14578	44.8	12.0	30.3	38853	25.5	11706	460	NS	1.39	20.5	16564	< 0.8	NS	2871	NS	0.6603	108.3	99.4
		8/12/2010	17:00	3	3135	82246	0.9	9.1	389.2	2.212	0.196	36553	48.4	12.7	27.1	37826	23.7	16835	612	NS	1.38	26.2	22349	0.7	NS	3975	NS	0.6599	96.4	86.1
		8/12/2010	17:00	3	3135	90712	0.9	8.9	394.5	2.400	0.197	38235	52.2	12.5	29.2	37287	23.8	17587	612	NS	1.38	26.1	25138	< 0.7	NS	3442	NS	0.6533	96.4	88.6
		8/12/2010	17:00	3	3220	93386	0.9	7.2	416.1	2.233	0.268	30402	45.6	11.2	27.1	36090	25.1	13964	526	NS	1.56	21.5	19720	0.9	NS	3511	NS	0.6910	101.5	93.8
		8/12/2010	17:00	3	3295	77265	1.0	6.9	360.4	2.368	0.197	19906	48.1	12.6	30.0	36704	25.1	11835	450	NS	1.41	22.6	16827	< 0.7	NS	3119	NS	0.6990	109.8	103.0
		8/12/2010	17:00	3	3390	83128	0.9	7.9	415.4	2.077	0.214	55564	52.7	12.5	27.3	32873	21.9	18963	541	NS	1.15	26.5	21364	0.7	NS	3737	NS	0.6449	92.1	91.0
		8/12/2010	17:00	3	3530	85365	0.9	7.3	396.3	2.275	0.267	25510	46.7	11.3	30.2	38552	30.1	14115	485	NS	1.19	21.6	19328	< 0.8	NS	3599	NS	0.6768	101.5	109.3
		8/12/2010	17:00	3	3620	79787	0.9	7.7	461.8	2.156	0.335	33328	45.7	11.6	31.9	34716	31.8	14895	575	NS	1.38	22.2	19163	< 0.7	NS	4530	NS	0.6643	98.7	112.0
		8/12/2010	17:00	3	3710	72779	0.9	7.5	475.7	2.077	0.294	39237	42.5	11.2	30.8	33273	30.3	14231	595	NS	1.19	20.7	19334	< 0.8	NS	5760	NS	0.6605	90.5	104.0
		8/12/2010	17:00	3	3820	68990	0.9	7.0	509.9	1.853	0.303	39414	42.5	10.9	30.5	31794	29.3	13215	579	NS	1.07	20.1	19028	< 0.8	NS	6361	NS	0.6275	80.4	105.6
		8/12/2010	17:00	3	3820	80376	1.0	7.0	496.1	2.008	0.297	41725	41.3	10.9	32.6	30917	31.5	14415	618	NS	1.98	20.4	19481	0.9	NS	5272	NS	0.6415	86.4	106.4
		8/12/2010	17:00	3	3935	39935	0.6	3.5	538.1	1.004	0.122	32011	25.3	5.2	14.4	14092	15.1	8639	373	NS	0.82	10.0	17993	< 0.7	NS	9960	NS	0.4012	39.1	46.3
		8/12/2010	17:00	3	4070	43090	0.6	3.9	554.0	1.103	0.188	35070	23.1	5.8	15.0	16454	15.9	9218	380	NS	0.52	11.8	20605	< 0.9	NS	10943	NS	0.4658	37.1	48.2
		8/12/2010	17:00	3	4105	48271	0.7	4.6	566.1	1.182	0.189	33022	25.8	8.0	19.7	19052	18.9	9153	409	NS	1.80	13.3	20909	< 0.9	NS	9832	NS	0.4981	44.9	71.7
		8/12/2010	17:00	3	4245	42569	0.6	3.6	590.0	1.147	0.137	31303	24.4	5.2	13.6	13659	15.3	8127	346	NS	0.82	9.6	20499	< 0.8	NS	10811	NS	0.4257	34.0	42.4
		8/12/2010	17:00	3	4405	38565	0.6	3.5	582.3	1.022	0.131	27979	22.7	4.6	12.7	12636	14.7	7586	342	NS	0.53	8.7	19577	< 0.8	NS	10213	NS	0.4192	32.2	40.0
		8/12/2010	17:00	3	4515	35458	0.5	3.6	563.4	0.888	0.145	25472	19.1	4.6	12.5	11514	14.3	6371	310	NS	0.58	7.9	19325	1.5	NS	8533	NS	0.3765	30.1	38.5
		8/12/2010	17:00	3	4600	40371	0.5	3.4	551.7	0.863	0.131	22044	17.2	4.5	12.7	11916	14.5	6394	294	NS	1.01	7.9	20460	< 0.8	NS	8402	NS	0.4061	28.2	42.1
		8/12/2010	17:00	3	4600	40066	0.5	3.7	521.0	0.982	0.128	23096	17.4	4.4	12.8	11667	14.2	5731	294	NS	0.95	7.6	21496	< 0.9	NS	7236	NS	0.3930	28.0	38.7

Figure 36 - Sediment screening of USGS San Juan River delta of Lake Powell sediment core number 3 (downstream location, USGS 371545110410700) completed on August 12, 2010 at 17:00. Lake Powell water surface elevation was 1108.36 m during the time of coring with a water depth of 19 m. The coring location was 53.9 km above the confluence with Colorado River at 37.26256, -110.68518. All data reported in Hornewer, 2014.

USGS Sediment Trap Screening

Immediately after the GKM spill, the USGS began a program with UDEQ to capture and evaluate sediment as it was deposited in the San Juan River delta of Lake Powell. The sediment traps have been configured in a downstream transect (Figure 37), similar to the locations of the 2010 USGS Lake Powell sediment cores. To date, the USGS has completed seven separate San Juan River delta sediment trap deployments and laboratory results from four have been completed and evaluated. The sediment traps were deployed from:

1) August 23, 2015 to November 19, 2015 at only the upstream location,
2) April 27, 2016 to May 17, 2016 at each of the upstream, midstream, and downstream locations,
3) May 17, 2016 to July 14, 2016 at each of the upstream, midstream, and downstream locations,
4) July 14, 2016 to October 26, 2016 at each of the upstream, midstream, and downstream locations,
5) April 5, 2017 to July 11, 2017 at each of the upstream, midstream, and downstream locations,
6) July 11, 2017 to September 7, 2017 at each of the upstream, midstream, and downstream locations,
7) September 7, 2017 to November 15, 2017 at each of the upstream, midstream, and downstream locations, and
8) November 15, 2017 to approximately April, 2018 at each of the upstream, midstream, and downstream locations.

If there was enough sediment that was collected in the trap, the sediment column was segregated by depth; however, limited sediment of less than ten centimeters collected in either of the 2016 sediment traps did not provide enough sample to effectively subdivide the layers.

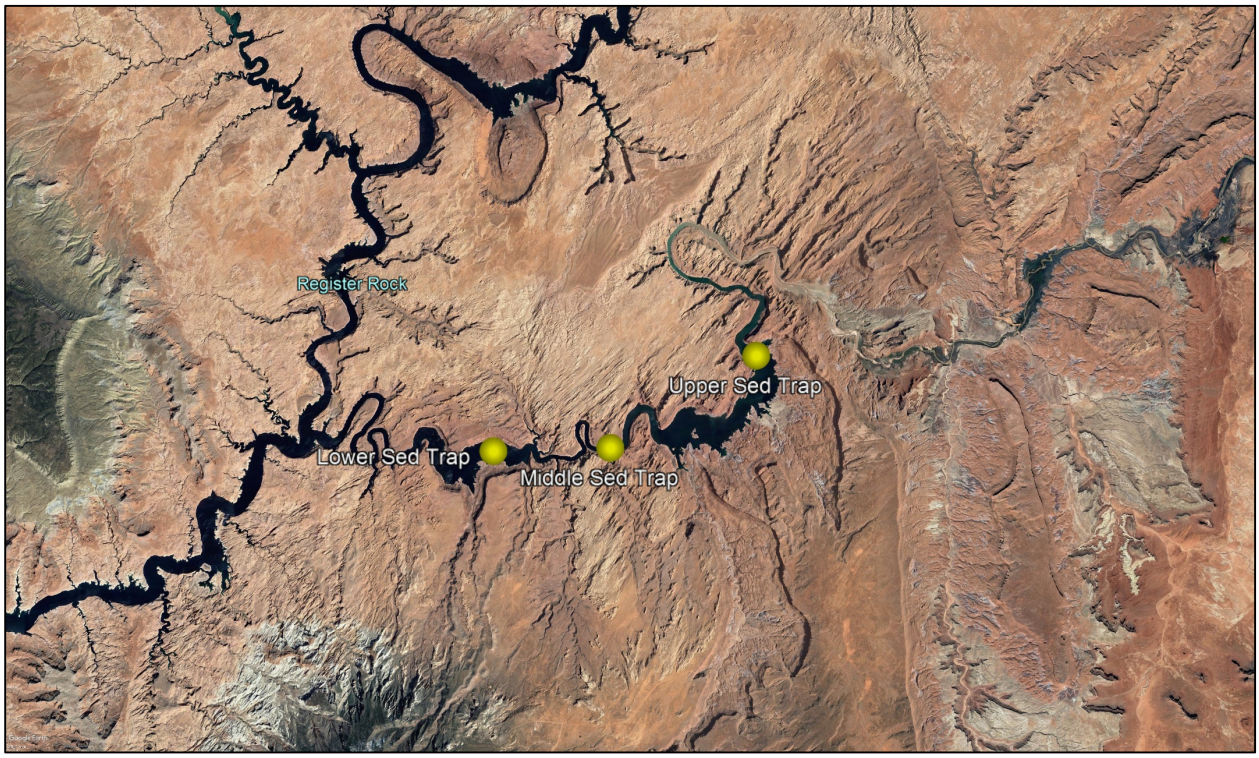

Figure 37 - Locations of the USGS deployed upstream, midreach, and downstream sediment trap monitoring locations.

Sediment trap 1 deployed from August 23, 2015 to November 19, 2015 at only the upstream location collected the most sediment by far with over 1.5 m of sediment deposited. It should be noted that the sediment trap was full and therefore, some portion of the later deployment period was not captured in the sediment trap. This accumulation of sediment provided the opportunity to subdivide the section by depth into 11 subgroups. The sediment traps deployed at each of the three locations (upstream, midstream, and downstream) from April 27, 2016 to May 17, 2016 (deployment 2) only collected 6.5 mm of sediment. Due to the limited amount of collected sample, the sample was not subdivided and the data are considered preliminary by the USGS because of the inability to conduct quality assurance and quality control due to small sample size. The sediment traps under deployment 3 from May 17, 2016 to July 14, 2016 at each of the three locations (upstream, midstream, and downstream) only collected approximately 13 mm of sediment. The upper sampling location was subdivided due to visual color banding, although the midstream and downstream locations did not show stratification and therefore, were not subdivided.

Concentrations of total metals and metalloids in sediments collected in the 1.5 ft long sediment traps were analyzed at the U.S. Geological Survey-Water Resources Discipline-National Research Program laboratory in Boulder, Colorado. It should be noted that for deployment 1, there was sufficient sediment accumulation to perform a series of quality assurance and quality control analyses. There were two blanks (Azain blank), a laboratory spike (SSAR-1), and a replicate for the 10 to 16 centimeter interval. The sediment concentrations were then compared to human health and aquatic life screening values as described previously.

Overall, nearly all of the depth-based sub-samples in each of the sediment traps were elevated in aluminum above the human health sediment screening level provided in Table 7. Manganese exceeded the value listed in Table 7, for all locations in deployment 2 and the midstream location of deployment 3. No other exceedances in the sediment trap results were observed. The sediment screening tables for San Juan River sediment trap deployments 1, 2, 3, and 4 are presented as Figure 38 through Figure 41, respectively.

Sediment /Soil (Total Metals)

No Exceedence | Above Human Health | Above Aquatic Life | Above Both

Lab Number	Field Number / Site Description	Upper Depth	Lower Depth	Sample Description	Rep	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Sulfate	Thallium	Vanadium	Zinc
Method						C_ICP16	C_ICPAES_MS_42	C_ICPAES_MS_42	C_As Hyd	C_ICP16	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICP16	C_ICP16	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICP16	C_ICPAES_MS_42	C_ICP16	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICP16	C_ICPAES_MS_42	C_ICP16	C_ICPAES_MS_42	C_Se Hyd	C_ICPAES_MS_42	C_ICP16	C_ICPAES_MS_42	NS	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42
Utah Health-Based comparison Value for Recreational Exposure (Soil Values)*						50,000	50,000	20	15	15	10,000	10,000	100	25	-	-	250	250	500	500	55,000	55,000	400	-	-	2,500	2,500	9.4	250	1,000	-	-	250	250	-	-	-	0.78	500	15,000
EPA Region 3 Freshwater Sediment Screening Values for Aquatic Life									10	10				1			43	43	50	50	20,000	20,000	36			460	460	0.2		23			2	1						121
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
C-408791	LPST.N#15.16.20	16	20	Deployed 23.Aug.15 to 19.Nov.15	1	100000	89900	0.95	7	6.9	401	399	2.7	0.1	30100	29800	<100	44	11.5	25.1	36100	33100	22.8	17200	16900	569	532	0.03	0.94	26	21500	22300	0.3	<1	2200	2200	NS	0.6	94	75
C-408792	LPST.N#15.5.10	5	10	Deployed 23.Aug.15 to 19.Nov.15	1	93200	85700	1.4	7	7.8	434	434	2.4	0.2	36300	35500	<100	41	10.7	25.2	33800	30300	22.5	16600	16100	557	511	0.03	1.22	23.6	21300	22200	0.3	<1	2700	2700	NS	0.7	85	79
C-408793	LPST.N#15.10.16	10	16	Deployed 23.Aug.15 to 19.Nov.15	1	97200	99200	0.95	6	6.3	456	504	2.4	0.2	25900	23700	<100	44	12.2	38.1	37400	37100	24.2	13700	14700	571	589	0.03	1.35	25.3	18900	22500	0.3	<1	2800	3100	NS	0.6	98	101
C-408794	LPST.N#15.20.24	20	24	Deployed 23.Aug.15 to 19.Nov.15	1	98100	93500	1.01	7	7.2	421	434	2.2	0.2	31600	30100	<100	47	12	29.6	36400	35100	23.4	15700	15900	568	564	0.03	1.17	25.6	20500	22100	0.3	<1	2500	2600	NS	0.7	95	85
C-408795	LPST.N#25.42.48	42	48	Deployed 23.Aug.15 to 19.Nov.15	1	102000	98400	1.22	8	7.8	439	466	2.5	0.2	32500	30600	<100	49	12.3	28.8	38300	36500	25	15400	15800	592	583	0.04	1.16	26.4	19700	21400	0.3	<1	2500	2500	NS	0.6	94	90
C-408796	LPST.N#15.37.42	37	42	Deployed 23.Aug.15 to 19.Nov.15	1	103000	90200	0.85	7	6.7	444	433	2.6	0.2	29100	31500	<100	41	12.2	25.1	39300	34700	24.3	16500	14300	590	561	0.04	1.16	22.6	20300	20400	0.3	<1	2500	2300	NS	0.6	86	83
C-408797	LPST.N#15.28.32	28	32	Deployed 23.Aug.15 to 19.Nov.15	1	100000	94600	0.96	7	7.3	446	466	2.2	0.2	30500	30800	<100	48	12.2	29.4	38200	36800	24	15000	14700	585	594	0.04	1.21	23.9	20000	20400	0.3	<1	2800	2700	NS	0.7	95	97
C-408798	LPST.N#15.24.28	24	28	Deployed 23.Aug.15 to 19.Nov.15	1	99500	98900	1.03	7	6.9	428	487	2.4	0.2	32000	30300	<100	48	12.5	29.9	38400	38500	24.5	15700	16000	567	622	0.04	1.25	25.4	20000	21300	0.3	<1	2600	2800	NS	0.7	100	95
C-408799	LPST.N#15.0.5	0	5	Deployed 23.Aug.15 to 19.Nov.15	1	89500	82400	1.03	8	6.8	392	402	2.4	0.3	38400	39300	<100	45	10.8	23.5	31800	29400	22.1	18400	17200	490	490	0.03	1.55	24.5	21500	21800	0.5	<1	2500	2400	NS	0.7	89	80
C-408800	LPST.N#15.32.37	32	37	Deployed 23.Aug.15 to 19.Nov.15	1	102000	92500	0.98	7	7.2	441	452	2.7	0.2	30900	32300	<100	46	12.7	26.7	38900	36200	24.5	16200	15000	579	575	0.04	1.14	24.1	20300	21100	0.3	<1	2500	2400	NS	0.6	92	86
C-408801	Azain Blank	-10	-5	Blank	1	<100	<100	0.16	<1	<0.6	<10	<5	<0.1	<0.1	<100	<100	<100	<1	0.1	<0.5	500	600	1	<100	<100	<100	4	<0.01	8.2	1.4	<100	<100	<0.2	<1	<100	<100	NS	<0.1	<2	<1
C-408802	KK Azain Blank	-10	-5	Blank	1	<100	<100	0.17	<1	<0.6	<10	<5	<0.1	<0.1	<100	<100	<100	3	0.1	<0.5	700	600	1.1	<100	<100	<100	4	<0.01	7.45	0.6	<100	<100	<0.2	<1	<100	<100	NS	<0.1	<2	2
C-408803	SSAR-1	-5	0	Laboratory Spike	1	61900	54300	5.64	16	16.3	737	785	2	3.2	10600	10600	<100	13	7.3	386	43500	39900	885	4200	4200	3100	3325	2.45	12.6	8.5	28200	27400	2.2	4	13300	12200	NS	1.3	52	616
C-408804	LPST.N#15.1016.1	10	16	Deployed 23.Aug.15 to 19.Nov.15	1	99600	93000	0.91	6	6.4	464	472	2.4	0.3	24000	24000	<100	48	12.2	33.3	38500	36800	24.2	14300	13500	572	571	0.03	1.35	23.1	19500	20700	0.3	<1	2900	2800	NS	0.7	91	96

Figure 38 - Sediment screening of USGS sediment trap deployed from August 23, 2015 through November 19, 2015 at the uppermost Lake Powell location only. Multiple analyses methods were utilized for many of the individual analytes and are represented separately.

Sediment /Soil (Total Metals)

No Exceedence | Above Human Health | Above Aquatic Life | Above Both

Lab Number	Field Number / Site Description	Upper Depth	Lower Depth	Sample Description	Rep	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Sulfate	Thallium	Vanadium	Zinc
Method						C_ICPAES_MS_55	C_ICPAES_MS_55	C_ICPAES_MS_55	C_ICPAES_MS_55	C_ICPAES_MS_55	C_ICPAES_MS_55	C_ICPAES_MS_55	C_ICPAES_MS_55	C_ICPAES_MS_55	C_ICPAES_MS_55	C_ICPAES_MS_55	C_ICPAES_MS_55	C_ICPAES_MS_55	C_ICPAES_MS_55	-	C_ICPAES_MS_55	C_ICPAES_MS_55	C_ICPAES_MS_55	-	C_ICPAES_MS_55	-	-	C_ICPAES_MS_55	C_ICPAES_MS_55	C_ICPAES_MS_55
Utah Health-Based comparison Value for Recreational Exposure (Soil Values)*						50,000	20	15	10,000	100	25	-	250	500	500	55,000	400	-	2,500	9.4	250	1,000	-	250	250	-	-	0.78	500	15,000
EPA Region 3 Freshwater Sediment Screening Values for Aquatic Life								10			1		43	50	32	20,000	36		460	0.2		23		2	1					121
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
C-424999	Upper San Juan	0	6.5	Deployed 4/27/2016 Retrieved 5/17/2016	1	77800	1.4	<30	608	<5	<0.2	30000	45	19.5	28	32900	23	15500	7250	NS	3	34	21000	NS	<1	NS	NS	0.5	90	129
C-425000	Mid San Juan	0	6.5	Deployed 4/27/2016 Retrieved 5/17/2016	1	65300	2	<30	673	<5	0.3	43000	41	23	35	27200	19	16700	15600	NS	8	30	20000	NS	<1	NS	NS	<0.5	98	163
C-425001	Lower San Juan	0	6.5	Deployed 4/27/2016 Retrieved 5/17/2016	1	49100	1.1	<30	431	<5	<0.2	60000	211	14	114	19800	16	14800	3800	NS	4	98	18000	NS	<1	NS	NS	<0.5	54	203

Figure 39 - Sediment screening of USGS sediment trap deployed from April 27, 2016 through May 17, 2016 at each of the three Lake Powell locations (upstream, midlength, and downstream).

Sediment /Soil (Total Metals)

No Exceedence | Above Human Health | Above Aquatic Life | Above Both

Lab Number	Field Number / Site Description	Upper Depth	Lower Depth	Sample Description	Rep	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Sulfate	Thallium	Vanadium	Zinc
				Method		C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_Hg CVAA	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_Se Hyd	C_ICPAES_MS_42	C_ICPAES_MS_42	NS	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42
				Utah Health-Based comparison Value for Recreational Exposure (Soil Values)*		50,000	20	15	10,000	100	25	-	250	500	500	55,000	400	-	2,500	9.4	250	1,000	-	250	250	-	-	0.78	500	15,000
				EPA Region 3 Freshwater Sediment Screening Values for Aquatic Life		-	-	10	-	-	1	-	43	50	32	20,000	36	-	460	0.2	-	23	-	2	1	-	-	-	-	121
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
C-423244	Upper San Juan 1	0.0	4.2	Upper San Juan Arm deployed 5/17/21016 retrieved 7/14/2016	1	94500	1.13	9	464	2.4	0.3	26600	51	12.4	25.9	35600	38.5	14000	561	NS	1.55	21.1	22800	NS	<1	2800	NS	0.6	107	165
C-423245	Upper San Juan 2	4.2	8.4	deployed 5/17/21016 retrieved 7/14/2016	1	92300	1.09	9	490	2.3	0.3	34900	52	12.3	25.1	35200	43.4	13500	564	NS	1.55	20.6	22000	NS	<1	2600	NS	0.7	107	175
C-423246	Upper San Juan 3	8.4	12.7	(Bottom) Upper San Juan Arm deployed 5/17/21016 retrieved 7/14/2016	1	93500	1.07	7	432	2.8	0.3	20500	53	11.9	23.9	34300	30.7	13900	537	NS	1.31	21.7	23200	NS	<1	2500	NS	0.7	105	118
C-423247	Mid San Juan	0.0	12.7	Mid San Juan Arm deployed 5/17/21016 retrieved 7/14/2016	1	89900	1.2	11	529	2.5	0.3	25100	51	14.2	24.5	34700	47.5	14200	2935	NS	1.61	22.3	22500	NS	<1	3600	NS	0.7	109	164
C-423248	Lower San Juan	0.0	12.7	Lower San Juan Arm deployed 5/17/21016 retrieved 7/14/2016	1	74100	0.97	9	501	1.8	0.2	65100	45	11.7	21.8	29700	42.8	12800	1786	NS	1.57	19.5	19700	NS	<1	4500	NS	0.6	92	131

Figure 40 - Sediment screening of USGS sediment trap deployed from May 17, 2016 through July 14, 2016 at each of the three Lake Powell locations (upstream, midlength, and downstream). It should be noted that the upstream location was subdivided into three separate depth band.

Sediment /Soil (Total Metals)

No Exceedence | Above Human Health | Above Aquatic Life

Lab Number	Field Number / Site Description	Upper Depth	Lower Depth	Sample Description (C_ICPOES_MS-49)	Rep	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Sulfate	Thallium	Vanadium	Zinc
				Method		C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_Hg CVAA	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42	C_Se Hyd	C_ICPAES_MS_42	C_ICPAES_MS_42	NS	C_ICPAES_MS_42	C_ICPAES_MS_42	C_ICPAES_MS_42
				Utah Health-Based comparison Value for Recreational Exposure (Soil Values)*		50,000	20	15	10,000	100	25	-	250	500	500	55,000	400	-	2,500	9.4	250	1,000	-	250	250	-	-	0.78	500	15,000
				EPA Region 3 Freshwater Sediment Screening Values for Aquatic Life		-	-	10	-	-	1	-	43	50	32	20,000	36	-	460	0.2	-	23	-	2	1	-	-	-	-	121
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
C-423244*	Upper San Juan 1	0.0	8.0	Upper San Juan Arm deployed 5/17/21016 retrieved 7/14/2016	1	97000	1.12	9.4	467	2.91	0.32	26500	60	12.9	30.6	41200	41.4	14900	616	0.034	1.53	23.2	22400	1.4	0.15	2900	1000	0.73	116	156
C-435330	Upper San Juan#p1	0.0	8.0	Deployed July 14 Retrieved October 26 2016	1	91500	1.07	5.6	428	2.78	1.13	36400	54.6	13	28.6	37900	26.7	15900	794	0.035	1.48	23.7	22300	1.5	0.05	2900	1900	0.69	107	115
C-435331	Mid San Juan#p1	0.0	8.0	Deployed July 14 Retrieved October 26 2016	1	88400	1.11	7.6	424	2.59	0.18	35400	50.7	12.6	26.8	35200	23.4	16400	877	0.035	1.54	22.1	23600	1.4	<0.01	3300	1000	0.68	95.4	88.6
C-435332	Lower San Juan#p1	0.0	8.0	Deployed July 14 Retrieved October 26 2016	1	93000	1.11	9.2	437	2.9	0.26	30800	53.8	13.3	28.5	37300	27.9	15400	1270	0.046	2.06	24	22000	1.7	<0.01	2900	1500	0.75	116	117
Lab Number	Field Number / Site Description	Upper Depth	Lower Depth	Sample Description (C_ICPOES_MS-60)	Rep	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
C-423244*	Upper San Juan 1	0.0	8.0	Upper San Juan Arm deployed 5/17/21016 retrieved 7/14/2016	1	91000	1.2	12	483	<5	0.3	27300	52	13.2	36	40100	42	15000	544	NS	<2	28	21600	<5	<1	NS	1000	0.8	112	149
C-435330	Upper San Juan#p1	0.0	8.0	Deployed July 14 Retrieved October 26 2016	1	88200	1	9	437	<5	0.3	37900	49	14.3	33	38000	28	16000	785	NS	<2	29	21500	<5	<1	NS	2000	0.8	103	114
C-435331	Mid San Juan#p1	0.0	8.0	Deployed July 14 Retrieved October 26 2016	1	81800	1.1	7	432	<5	<0.2	36900	46	13.2	31	34300	24	15900	841	NS	<2	26	22100	<5	<1	NS	1000	0.7	92	83
C-435332	Lower San Juan#p1	0.0	8.0	Deployed July 14 Retrieved October 26 2016	1	91200	1.2	10	461	<5	0.3	32800	54	14.8	36	37900	28	16000	1300	NS	2	30	21700	<5	<1	NS	1700	0.7	111	114

Figure 41 - Sediment screening of USGS sediment trap deployed from July 14, 2016 through October 26, 2016 at each of the three Lake Powell locations (upstream, midlength, and downstream).

6. Spatial and Temporal Water Quality Trends

Temporal Trends in Total and Dissolved Analyte Concentrations in Utah

In response to the GKM spill and long-term monitoring, UDEQ tracked and analyzed spatial and temporal variations in total and dissolved metal concentrations in the San Juan River and its tributaries from August 8, 2015, to July 25, 2016, using data collected by both UDEQ and EPA. This analysis focused on samples collected at seven sites on the San Juan River:

- *MLID 4954000-San Juan River at US160Xing in CO;*
- *MLID 4953900-San Juan River at McElmo Wash;*
- *MLID 4953990-San Juan River at Town of Montezuma;*
- *MLID 4953250-San Juan River at Sand Island;*
- *MLID 4953000-San Juan River at Mexican Hat US163 Xing;*
- *MLID 4952942-San Juan River at Clay Hills boat ramp*; and
- *MLID 4952940-San Juan River above Lake Powell.*

Total and dissolved concentrations of all metals were plotted through time at these seven sites. UDEQ realized soon after the GKM spill that six metals of concern appeared to be associated with the GKM release: cadmium, copper, lead, mercury, nickel, and zinc. Subsequent studies and interpretation focused on these metals. The spatial and temporal trends of these concentrations are presented in Figure 42 through Figure 46. However, a number of other metals were analyzed and are included in Appendix B. The concentrations of each analyte were compared to applicable water quality standards and to historical data collected by UDEQ and USGS when available. However, historical observations were collected opportunistically and may or may not adequately reflect background variability in metal concentrations. Additional time series plots for all metals are available in Appendix B.

Initial analyses by UDEQ estimated plume arrival at the Utah border in the evening of Sunday, August 9, 2015. UDEQ water quality data support this estimate based on peak metal concentrations. However, EPA (EPA 2017) estimated plume arrival in Utah as early as August 7, with the highest concentrations estimated to have occurred on August 8 and 9. Immediately following the release, UDEQ identified several dissolved metals during initial sampling (August 8 through 28, 2015) that demonstrated increasing concentrations followed by decreases that suggest the arrival and passing of the plume including: cadmium, copper, lead, mercury, nickel, and zinc. Sampling was initiated and continued during the hydrograph recession associated with the GKM release and concurrent additions from the Navajo Reservoir. EPA estimates that 100 percent of the dissolved metals associated with the GKM release were adsorbed to colloidal materials before the plume's arrival in the San Juan River. Nonetheless, UDEQ observed elevated concentrations of dissolved metals during the week following the release. Some of the metal pollution may have either remained in dissolved form, transformed back to dissolved form during transport downstream, or it could have been derived from other sources. This is consistent with the fact that UDEQ plume concentration data were predominately within historical observations. Most total metals concentrations during initial sampling (August 8 through 28, 2015) also follow a pattern consistent with estimated plume arrival and travel through Utah. Concentrations of nearly all total metals displayed a recession-based decrease until August 27, 2015, when a precipitation event rapidly increased San Juan River discharge by nearly an order of magnitude. At this point, concentrations of nearly all total metals increased to levels generally greater than those observed in early sampling, particularly at locations downstream of *MLID 4953250-San Juan River at Sand Island*. Concentrations increasing in spite of dilution are remarkable, suggesting that the metals loads increased more than ten-fold and further

implies that concentrations of these metals are primarily derived from some form of precipitation-derived runoff response as opposed to a relatively constant source load. Total molybdenum, antimony, and to a lesser degree thallium concentrations did not increase in response to this precipitation event. Instead, concentrations of these analytes increased from August 8 through August 26, 2015 and remained elevated until the August 27, 2015 event occurred, when concentrations decreased, implying that their concentrations are primarily the result of dilution effects associated with variability in discharge. This is important because the different concentration trend patterns between the individual metal analytes demonstrate that certain constituents are flushed into the river during precipitation events while others are not. Overall, these patterns suggest that UDEQ began sampling during the plume on August 8, 2015 and that the initial plume was dispersed and largely passed through UDEQ's sampling locations by about August 26, 2015. As with dissolved metal concentrations, observed total metal concentrations were largely within, but occasionally exceeded, the range of historic observations in the San Juan River. These trends make it difficult to determine which results were directly a function of the GKM spill response.

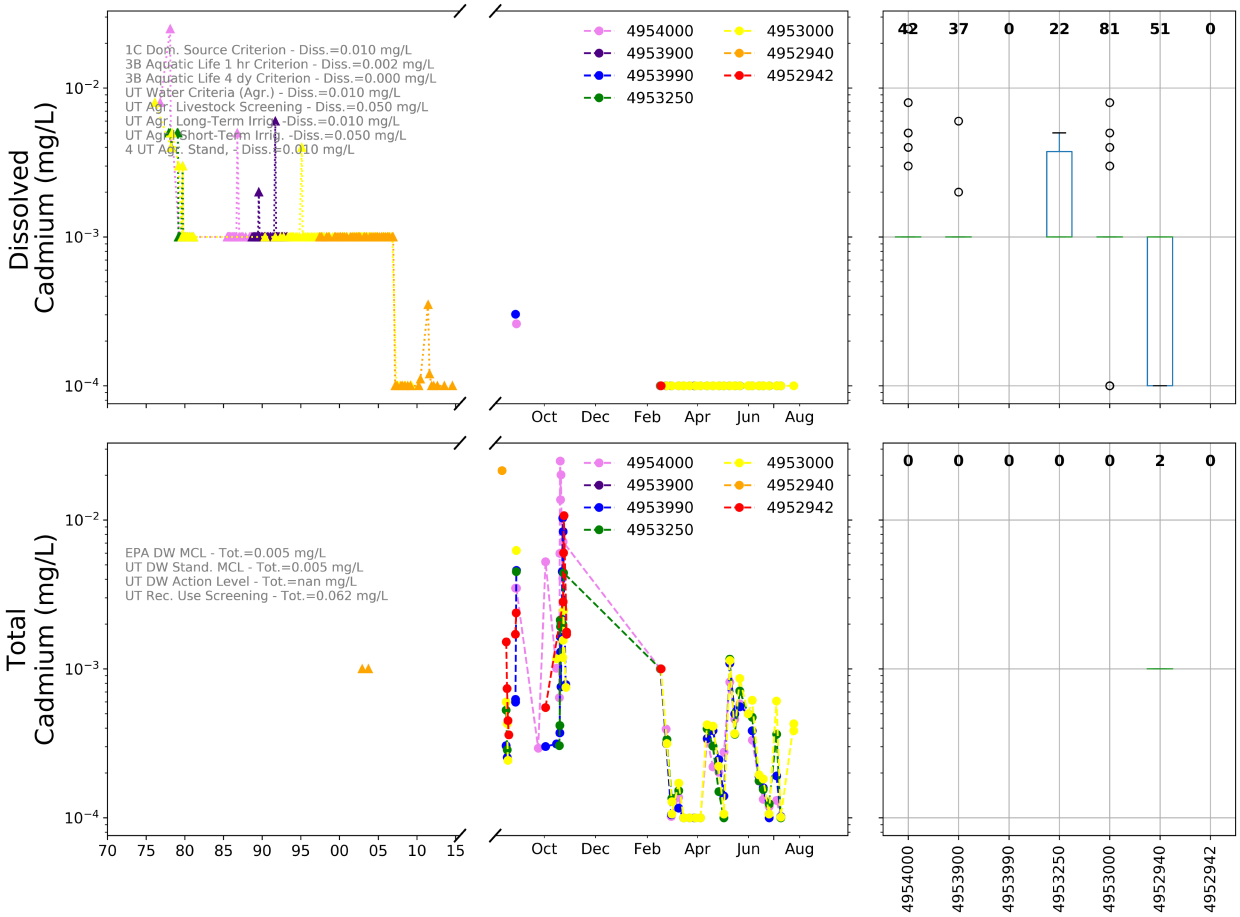

Figure 42 - Dissolved and total cadmium concentration for historical (1970 through 2015) and the spill-related and long-term monitoring period between August 8, 2015 and December 31, 2016. The range in historical concentration variability is presented in the boxplots in the right panel. Similar graphs presenting additional metals are available in Appendix B.

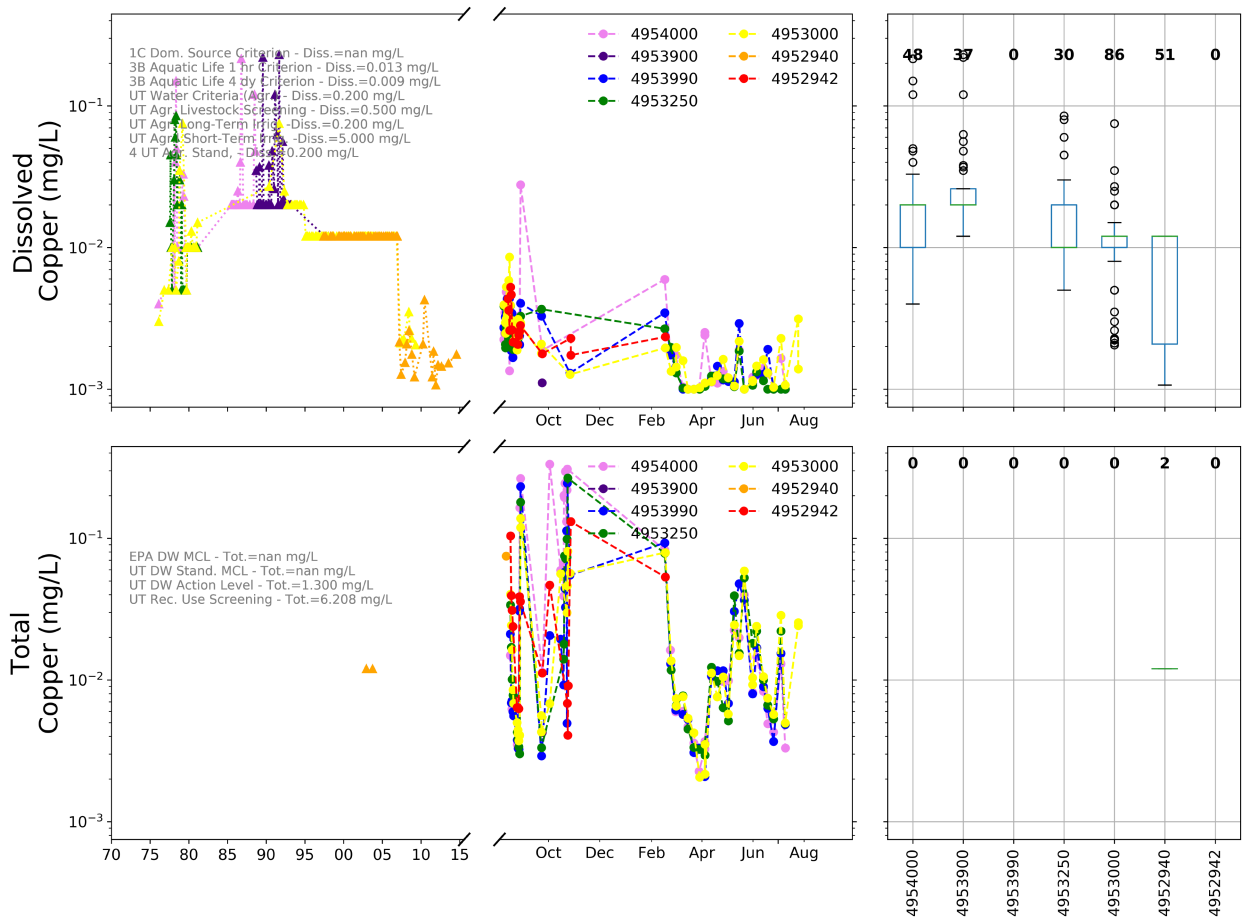

Figure 43 - Dissolved and total copper concentration for historical (1970 through 2015) and the spill-related and long-term monitoring period between August 8, 2015 and December 31, 2016. The range in historical concentration variability is presented in the boxplots in the right panel.

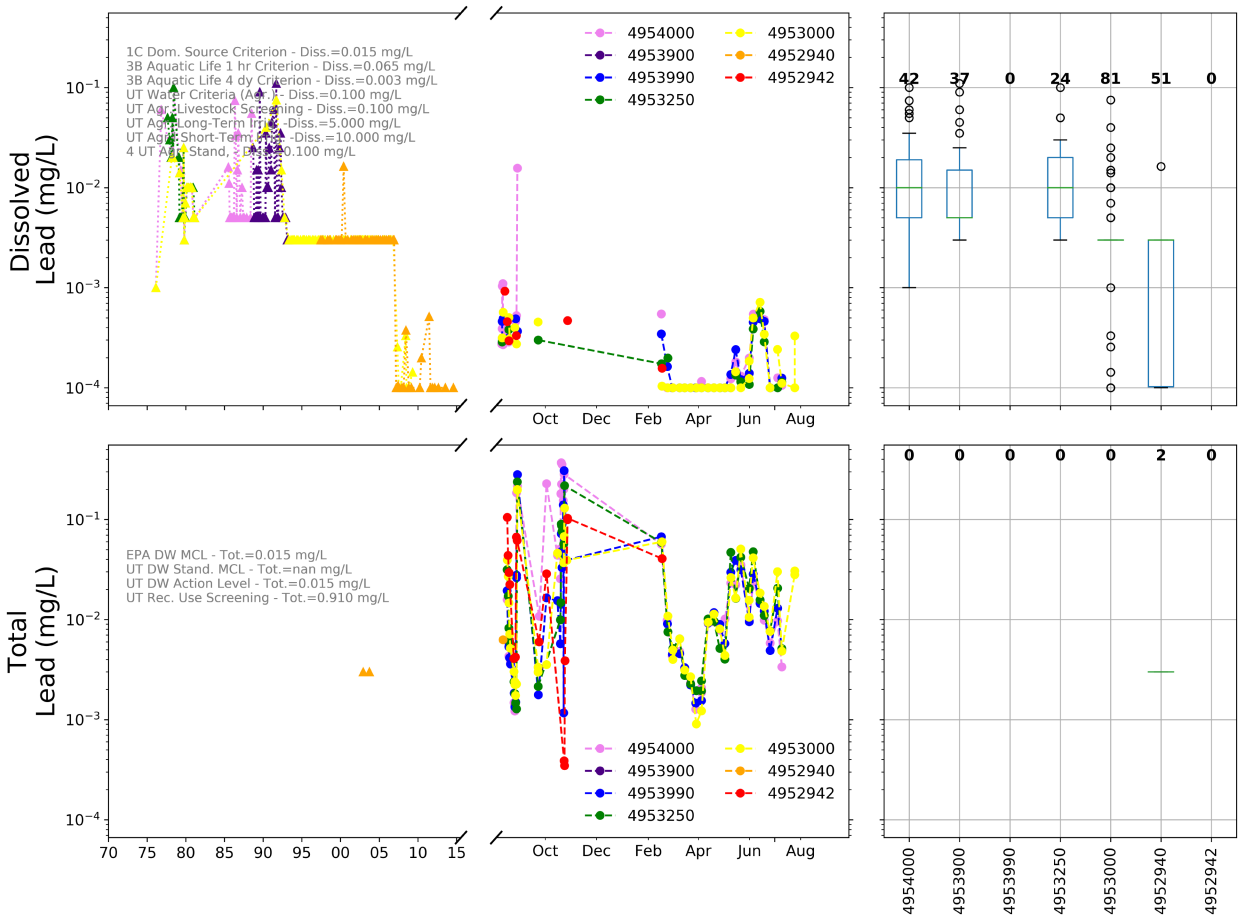

Figure 44 - Dissolved and total lead concentration for historical (1970 through 2015) and the spill-related and long-term monitoring period between August 8, 2015 and December 31, 2016. The range in historical concentration variability is presented in the boxplots in the right panel.

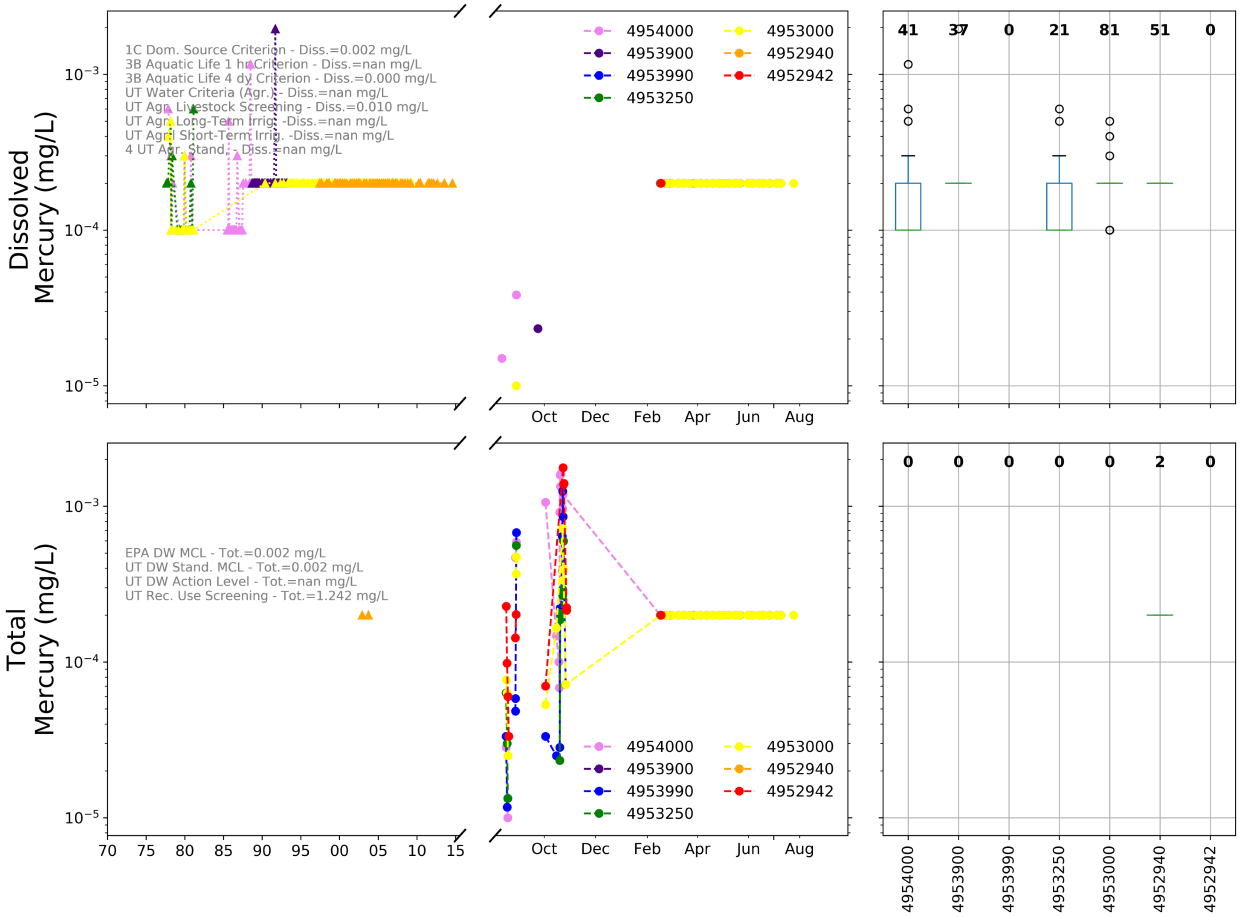

Figure 45 - Dissolved and total mercury concentration for historical (1970 through 2015) and the spill-related and long-term monitoring period between August 8, 2015 and December 31, 2016. The range in historical concentration variability is presented in the boxplots in the right panel.

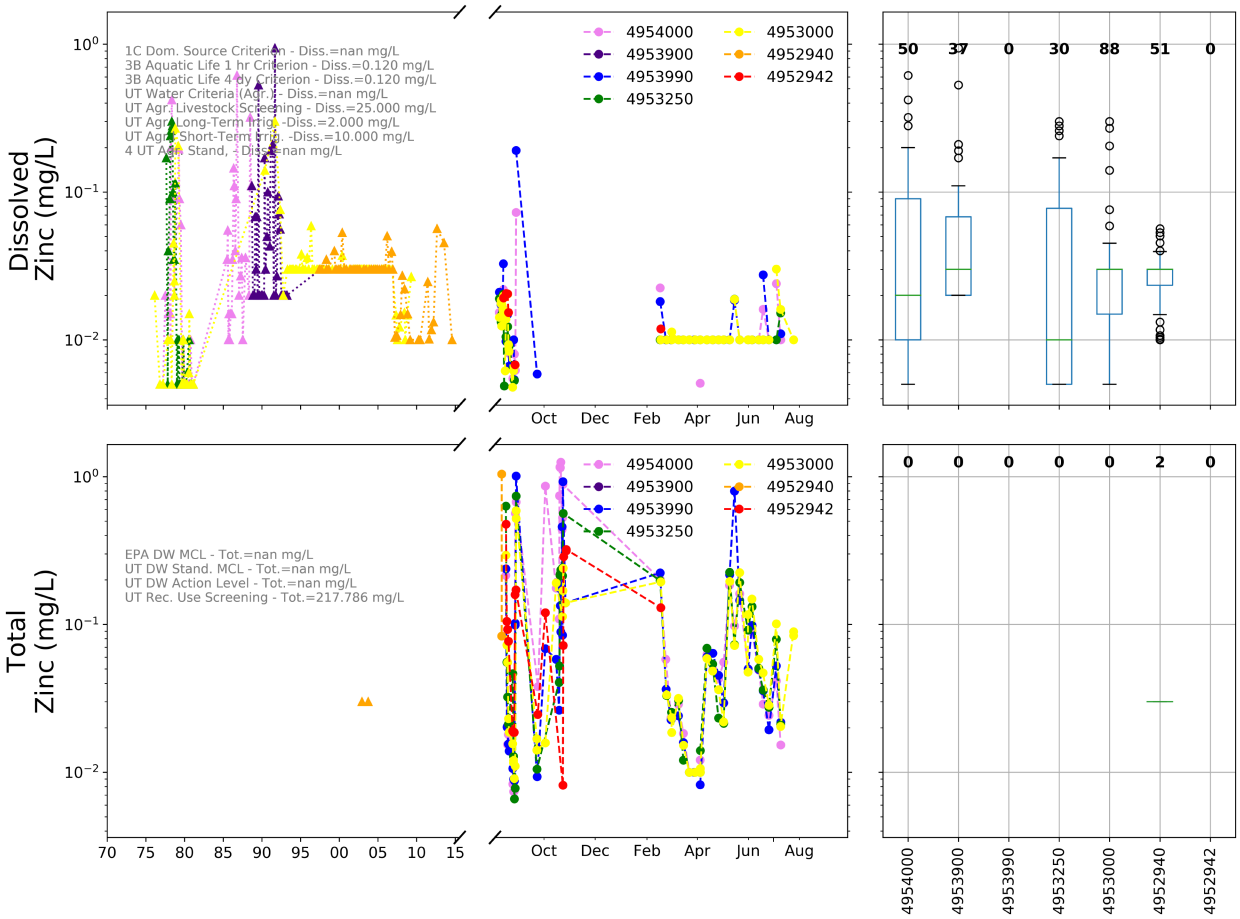

Figure 46 - Dissolved and total zinc concentration for historical (1970 through 2015) and the spill-related and long-term monitoring period between August 8, 2015 and December 31, 2016. The range in historical concentration variability is presented in the boxplots in the right panel.

Following the presumed receding limb of the plume, longer-term sampling (September 22, 2015 through October 26, 2015) showed additional subsequent elevated total and dissolved metal concentrations. These samples showed increases in metal concentrations beyond ranges observed during the plume and often beyond the range of historical observations, with significant spikes in total concentrations of several metals including lead, nickel, and zinc on August 27 and 28, 2015 and September 21 and 23, 2015. Note that the data showing spikes in dissolved metals concentration were collected by EPA. UDEQ did not collect dissolved metals data in September or October, 2015, and therefore these data could not be independently verified. These concentration peaks appear to correspond with high discharge events at the *USGS 09371010-San Juan River at Four Corners, CO* and *USGS 09379500-San Juan River near Bluff, UT* gauging stations. The peaks in total metal concentrations observed in UDEQ's data are fairly consistent with EPA's estimate of plume arrival and peak timing in Utah. However, UDEQ's data suggest the possibility of a longer tail in the passing of the plume, the potential for lingering impacts via resuspension of GKM release associated sediment and metal contaminants, and the possibility that historically deposited sediment and metal contaminants associated with either GKM or other historic mining activities in the watershed continue to impact the San Juan River. An analysis of the presence of abandoned mine sites within the watershed and their potential contributions of metal contaminants to the San Juan River is currently ongoing. In addition, the University of Utah in cooperation with UDEQ is analyzing water quality in streams and tributaries throughout the watershed to identify natural versus mining impacted sources and their overall contributions. This will be used to distinguish between the

impacts of the August 5, 2015 GKM release, historical releases from high-elevation mining locations, and natural geologic sources.

Sample collection was resumed in February, 2016 with both the dissolved and total fraction of metals incorporated into the sampling plan. Sampling continued throughout July, 2016 to further characterize water quality trends during snowmelt runoff and baseflow conditions. Some of the metals including silver, beryllium, cobalt, mercury, nickel, antimony, selenium, and vanadium display limited variability in the dissolved fraction with concentrations near the minimum detection limit (MDL) and only minor spikes in the total metals during June 2016. Dissolved iron, manganese, lead, and zinc are of lower concentration during most of this sampling period with increases that coincide with monsoonal events in the later summer. Alternatively, strontium, magnesium, molybdenum, and other salts are highly correlated with discharge conditions displaying decreasing concentrations during snowmelt runoff and increasing during the monsoonal period. Analytes like aluminum, arsenic, barium, cadmium copper, iron, potassium, manganese, lead, and zinc show increases in the total concentration during the snowmelt runoff period and decrease during baseflow conditions, only to increase again during late-summer and fall monsoonal events. These trends are likely driven by high elevation runoff and subsurface discharge providing the temporal flow contributions and associated water quality downstream. The water quality is likely associated and sourced from the proliferation of mining activity in these high elevation areas and their associated mineralized porphyritic zones and intrusive formations. However, some of these contributions may be sourced from lake and reservoir contributions like the Navajo Reservoir on the Upper San Juan River. Calcium, magnesium, sodium, strontium, and chloride displayed no major change until there was a decrease in discharge during the baseflow period and the subsequent monsoonal increase in surface water discharge. These results suggest that the strong flushing component of effervescent salts from the terrestrial landscape. Erosive behavior of near stream geomorphic features and high clay content soils exhibited during intense precipitation events may also be responsible for these salt contributions. Stets et al. (2017) conducted a nationwide study that elucidated the association between increasing river salinity and corrosion potential from data over the period of 1992 through 2012, which could impact drinking water systems as a function of elevated lead, chloride, and other constituents.

Temporal Trends in USGS Collected Discharge

As described above, metal concentrations in the San Juan River system appear to be strongly impacted by variations in stream flow. Therefore, discharge measurements concurrent with water quality sampling are important for understanding potential sources and drivers of metal contamination. UDEQ relies on high frequency (15-minute) USGS monitoring gauges distributed throughout the state. This section describes the spatial variability in streamflow along the San Juan River and how the streamflow has varied over time. This analysis is used to determine if any major changes in the hydrologic regime has occurred.

While the USGS has operated a number of site-specific gauges for project-based information on hydrology, there are currently only two active monitoring gauges on the Utah portion of the San Juan River, USGS 09371010 – San Juan River at Four Corners, CO and USGS 09379500 – San Juan River Near Bluff, UT. Additional active gauges on tributaries to the San Juan River in Utah include USGS 09372000 – McElmo Creek Near Colorado-Utah State Line, and USGS 09379200 – Chinle Creek Near Mexican Water, AZ. There are also several inactive gauges that provided historical daily discharge values, including: USGS 09372200 – McElmo Creek Near Bluff, UT, USGS 09378600 – Montezuma Creek Near Bluff, UT, and USGS 09379000 – Comb Wash Near Bluff, UT. For perspective, Figure 47 provides a comparison of the historical continuous discharge for the above listed, Utah-based USGS monitoring gauges as well as discharge recorded over the period from 2007 through present. This provides a visual representation of the flow variability throughout the system both historically and since 2008. Overall,

Figure 48 shows the generally increasing discharge with distance downstream but it also indicates that the response in precipitation events and other flow mitigation activities such as reservoir variations between

hydrographs. Refer to Figure 1 for the spatial locations of each of the USGS monitoring gauges presented in Figure 47.

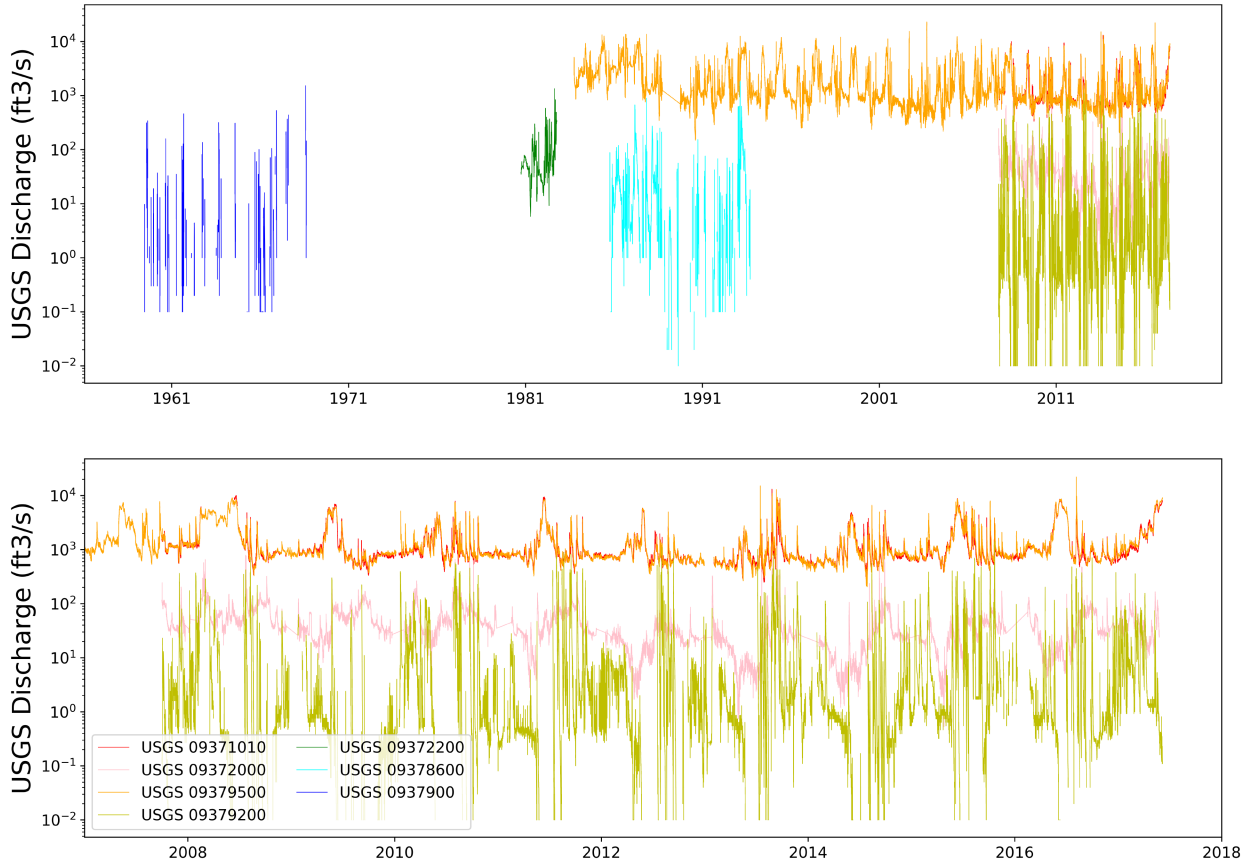

Figure 47 - Continuous discharge as recorded by USGS gages throughout the San Juan River watershed.

The historical range and magnitude of the *McElmo Creek near Bluff* gauge (*USGS 09372200*) is similar to the currently measured *McElmo Creek* location (*USGS 09372000*) near the Utah and Colorado border. This suggests limited increase or decrease in discharge between monitoring locations, although this cannot be directly determined with the data collected over different time periods, and that elevation-based differences in evaporation and transpiration occur. However, it is difficult to directly compare the results between locations without knowing the change in hydrologic conditions over the intervening 26 years.

Discharge from the USGS monitoring locations in the Utah portion of the San Juan River at Four Corners and Bluff (*USGS 09371010* and *09379500*, respectively) are remarkably similar over long-term temporal scales. Periods of sustained high discharge such as the 2008 snowmelt runoff, periods of high variability, monsoonal events like 2013 and 2015, or sustained low flow baseflow periods during winter months show variability of less than ten percent. A more detailed comparison of the discharge between these locations and the transport lag time is further discussed later in terms of Figure 49.

High flow periods in the San Juan River co-occur with low discharge in the Colorado portion of McElmo Creek and Chinle Creek tributaries. Long-term sustained snowmelt over a large catchment area combined with flow management at Navajo Reservoir likely moderate flow fluctuations in the San Juan River. In contrast, the southern tributaries may not sustain a long-term snowpack and therefore, become low flow or ephemeral without impacting overall flow patterns in the San Juan River. This means that tributary discharge contributions and therefore loads are likely limited during snowmelt runoff conditions and

negligible relative to the San Juan River. The tributaries are generally one to six orders of magnitude less than the San Juan River. However, during relatively low streamflow conditions in the San Juan River, the tributaries could potentially provide higher metal loads if sources are present in these tributaries. To put the previously described discharge variability of the Utah portion of the San Juan River and associated tributaries into perspective, UDEQ evaluated the system-wide discharge over the entire San Juan River, the Animas River, and their major tributaries.

Figure 48 provides a series of hydrographs for each of the continuously monitoring USGS gauges throughout the system. These results show that there is an increase in discharge with distance downstream, as expected. There is also a phase shift in peak events like during snowmelt runoff and the August 2016 monsoonal events where sites higher in the watershed have observed streamflow peaks before downstream locations. The Carracas, CO gauge (*USGS 09346400*) is similar to the discharge record for the Animas at Farmington, NM (*USGS 09364500*), suggesting that the area contributing recharge is similar in size and meteorological conditions. *USGS 09355500* at Archuleta, NM displays a well moderated discharge record with relatively consistent flow patterns, indicative of the influence from the Navajo Reservoir. The increase in discharge from the reservoir during the 2016 snowmelt runoff period is persistent in the downstream records from the lower San Juan River stream gauges.

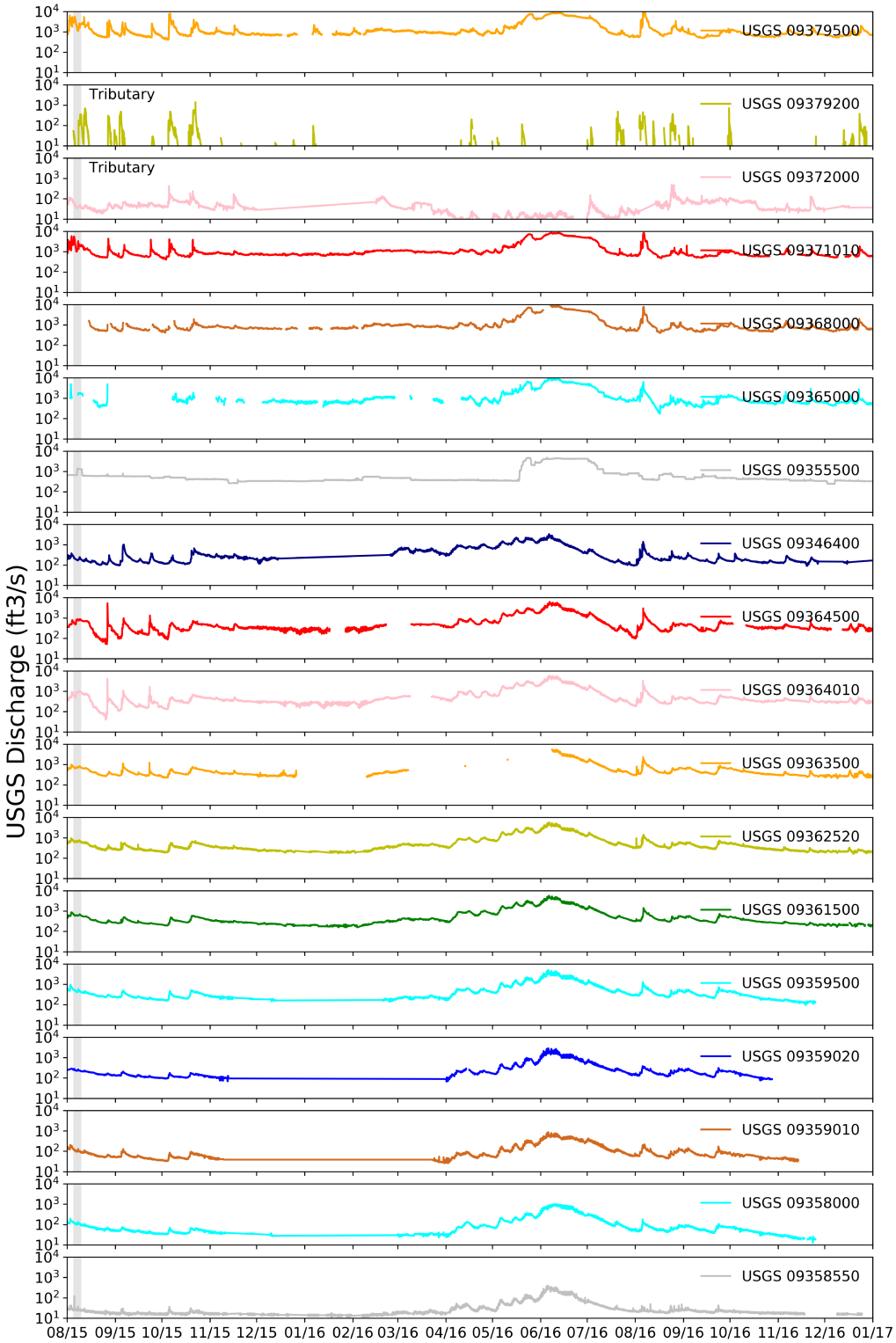

Figure 48 - Discharge hydrographs for each of the USGS monitoring locations throughout the San Juan River, the Animas River, and major tributaries. Panels are organized from downstream at the top to headwater gauges near the Animas headwaters at the bottom of the figure. Gray box indicates GKM Spill period.

Discharge Variability between Monitoring Locations in Utah

Because discharge was not consistently measured with concurrent water quality samples and continuous discharge was not co-located with monitoring locations, interpretation and estimation of discharge from other locations is necessary to begin to evaluate solute and contaminant loading. However, it is necessary to characterize transport lag times between stream gauges to estimate discharge at sampling sites for further loading estimates. UDEQ used six primary monitoring locations along the San Juan River for water quality monitoring; however, there are only two currently operating USGS monitoring locations in this area. The USGS stream gauges are 126 km apart over the 216 km reach of the San Juan River in Utah. Stream gauges range between zero and 90 km from individual UDEQ monitoring locations. To evaluate flow-weighted changes in metal concentration at each stream gauge, one can simply use the closest stream gauge proximal to the monitoring location or use distance-weighted interpolation between stream gauges to estimate site-specific discharge. However, the uncertainty associated with these methodologies should be evaluated. UDEQ used the two USGS stream gauges in Utah (*USGS 09371010 - San Juan River at Four Corners, CO* and *USGS 09379500 - San Juan River at Bluff, UT*) to compare the hydrographs during different hydrologic flow regimes and therefore, discharge ranges. The hydrograph from the Four Corners location is then shifted forward in time until temporal variations in discharge are optimized and deviations between the hydrographs are minimized. Figure 49 shows the different hydrographs for each site under different flow conditions in the first column of panels and the optimized shift in the second column of panels. Each row represents a different type of flow regime.

It is expected that discharge increases downstream and that precipitation events and snowmelt runoff can have site-specific effects which increase the deviation between the locations. However, by minimizing the temporal trends, we are able to better understand the lag time associated with transport in the San Juan River. The lag time ranges between 12.5 and 20 hours for discharge at 8,000 and 2,000 cubic feet per second, respectively. In addition, in-stream discharge and velocity are highly variable among sites.

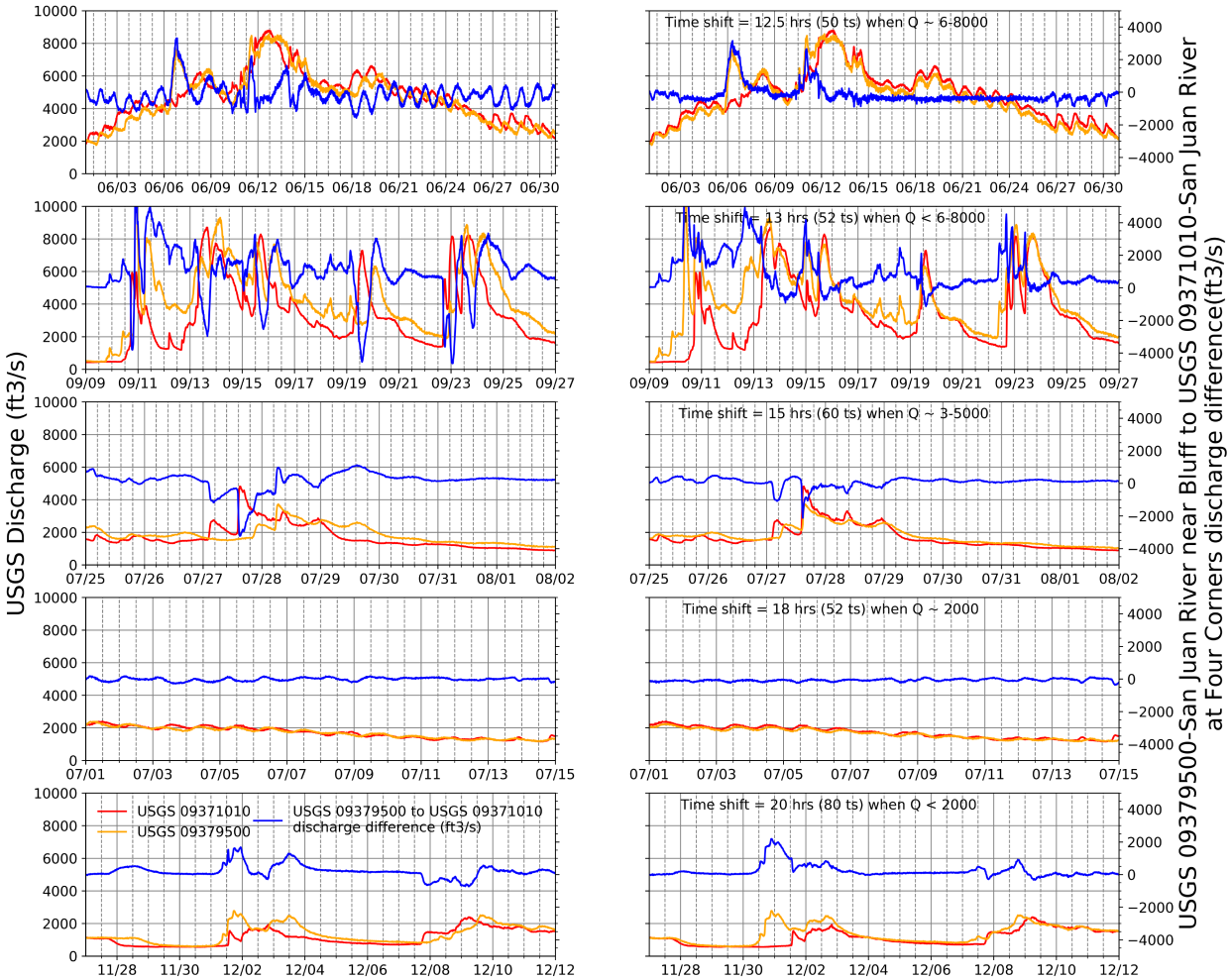

Figure 49 – Comparison of discharge between Four Corners and Bluff gages for different time periods and the optimized time shift to minimize the difference in discharge between locations. Time shifts range between 10 and 17 hours.

It is obvious from Figure 49 that discharge between sites can vary for a number of reasons including additional contributions, withdrawals, evapotranspiration, localized precipitation, runoff, hyporheic exchange, and water resource management conditions. In addition, deviations extend over a range of discharge magnitudes. The first row in Figure 49 shows that the differences between discharge at each location was generally minimized over the 4,000 – 8,000 ft3/s range with the exception of the precipitation events occurring downstream of Four Corners on June 6 and June 11, 2016. However, diurnal variations begin to increase at discharge less than 4,000 ft^3/s, again indicating that the lag shift is applicable over a relatively small range in discharge.

The second row shows that erratic monsoonal events are difficult to capture, although some distinctions in behavior are observed. The very large deviations are minimized and somewhat positively biased. Again, this dataset shows a large dynamic change in discharge, vastly different changes in transport conditions, velocity distribution, and therefore lag times.

The third row in Figure 49 shows that most of the differences in discharge are minimized over the 2,000 – 5,000 ft^3/s range. However, the fourth row shows an overall decreasing trend in discharge overlain with diurnal discharge variability due to evapotranspiration response and potentially, discharge-related management operations. Overall, a reasonable shift was found at the 2,000 ft^3/s discharge. Although at

these low flows, like in rows three and five, specific precipitation event location and magnitude are important. Differences in the shape of the peak event can define how those events arrived; whether through upstream streamflow contributions or from terrestrial runoff from the landscape. However, a reasonable estimate for the phase shift was approximated.

Overall, there is an increase in phase shift as discharge decreases. This is expected because as discharge decreases, the velocity distribution decreases in these wide shallow rivers. Therefore, the transport time and river celerity increases. This same type of approach can be taken from the Utah example and applied throughout the Animas and upper San Juan River to better understand transport time and the variability under different hydrologic regimes; however, this is outside the scope of this report.

Spatial Trends in Total and Dissolved Analyte Concentrations throughout the Animas and San Juan River System

The temporal concentration trends for the primary metals of interest (cadmium, copper, lead, mercury, nickel, and zinc) are shown for each of the UDEQ monitoring locations in Figure 42 through Figure 46. However, the concentration monitored at each UDEQ location relative to the system-wide concentration range and variability between locations helps to understand trends, major inputs, and expected range in the San Juan River for each analyte. Figure 50 through Figure 55 provides both the dissolved and total analyte concentration for the primary metals of interest along the Animas River, the upper San Juan River, the lower San Juan River, major tributaries, and Lake Powell. Additional figures showing the spatial variations in metals throughout the system are provided in Appendix C.

There are several interesting features of the dataset. Both the dissolved and total metal analytes generally show a decrease in concentration from Cement Creek and the Upper Animas River moving downstream, as expected. An increase in concentration is evident in the San Juan River, particularly in the Utah portion of the river, with decreasing concentrations to Lake Powell. We also see that the high elevation samples near the GKM location display significantly lower concentration bounds that are nearly three orders of magnitude less than downstream monitoring locations. This is important because it shows the broad range in potential concentrations possible throughout the system under similar laboratory analytical methods. Future watershed monitoring plans should incorporate consistent laboratory analytical methods, particularly the near-detection precision of observations in high-elevation catchment samples.

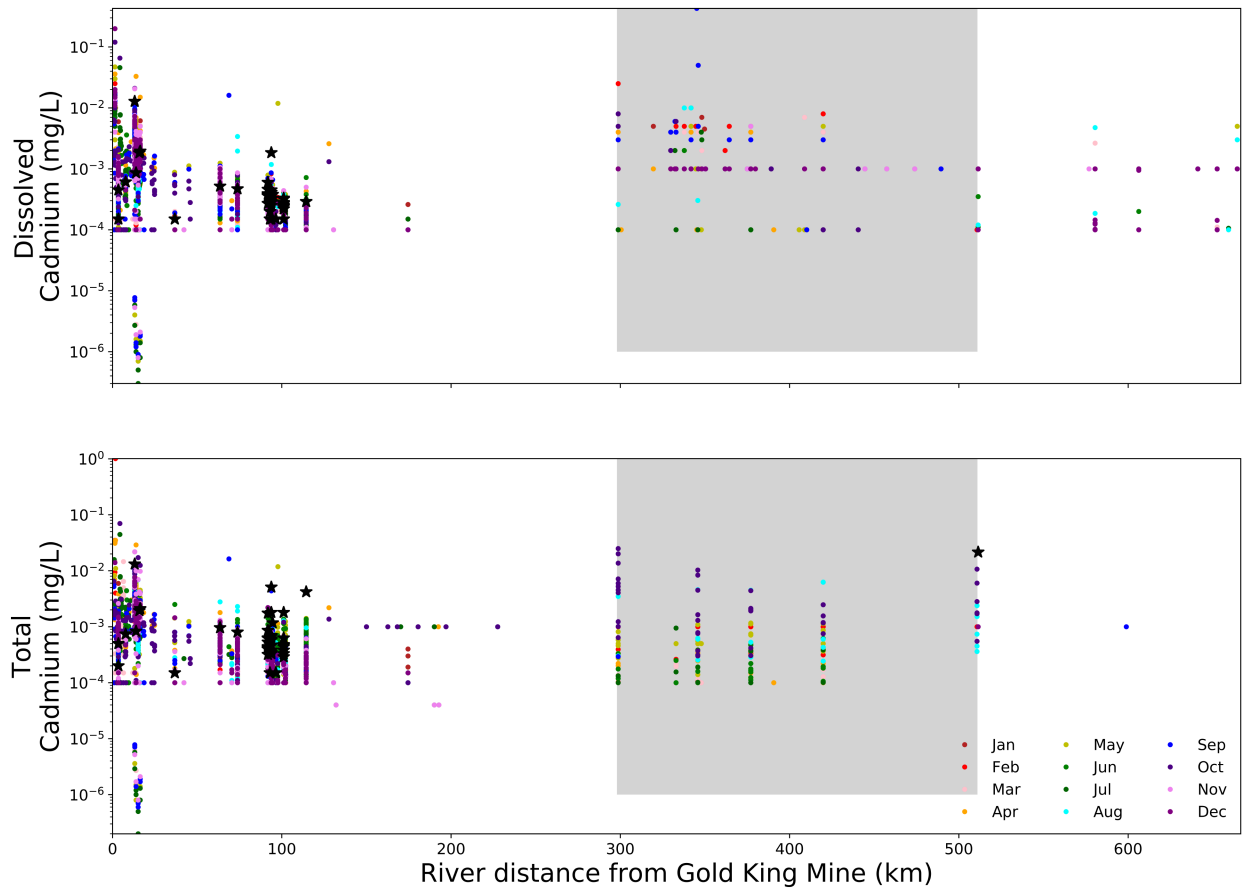

Figure 50 – Dissolved and total cadmium concentration throughout the entire catchment relative to distance from the Gold King Mine. The monitoring locations include the Gold King Mine and upper Animas River through Lake Powell and all of the major tributaries. Samples are colored according to numerical month and the gray box represents the Utah portion of San Juan River. Stars signify GKM sampling between August 5 and 15, 2015.

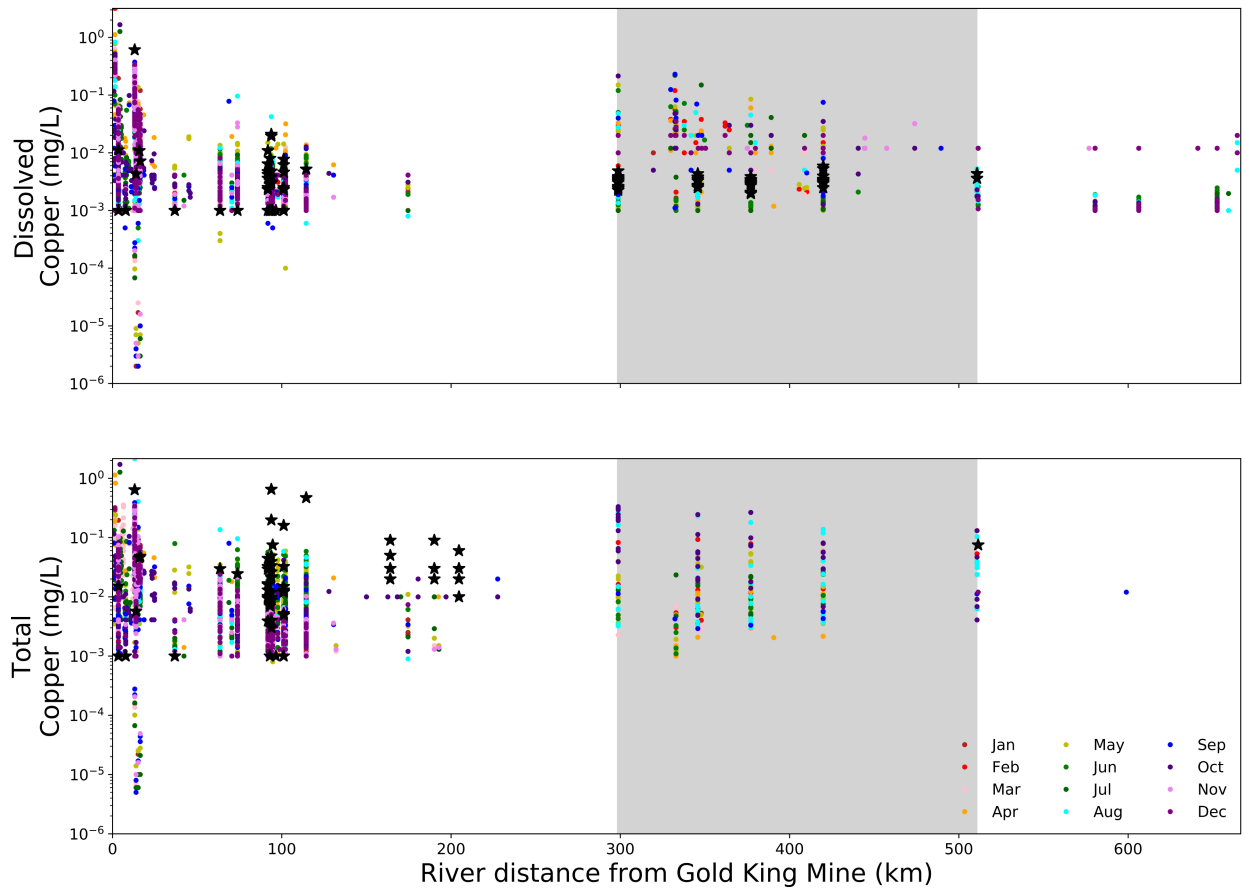

Figure 51 – Dissolved and total copper concentration throughout the entire catchment relative to distance from the Gold King Mine. The monitoring locations include the Gold King Mine and upper Animas River through Lake Powell and all of the major tributaries. Samples are colored according to numerical month and the gray box represents the Utah portion of San Juan River. Stars signify GKM sampling between August 5 and 15, 2015.

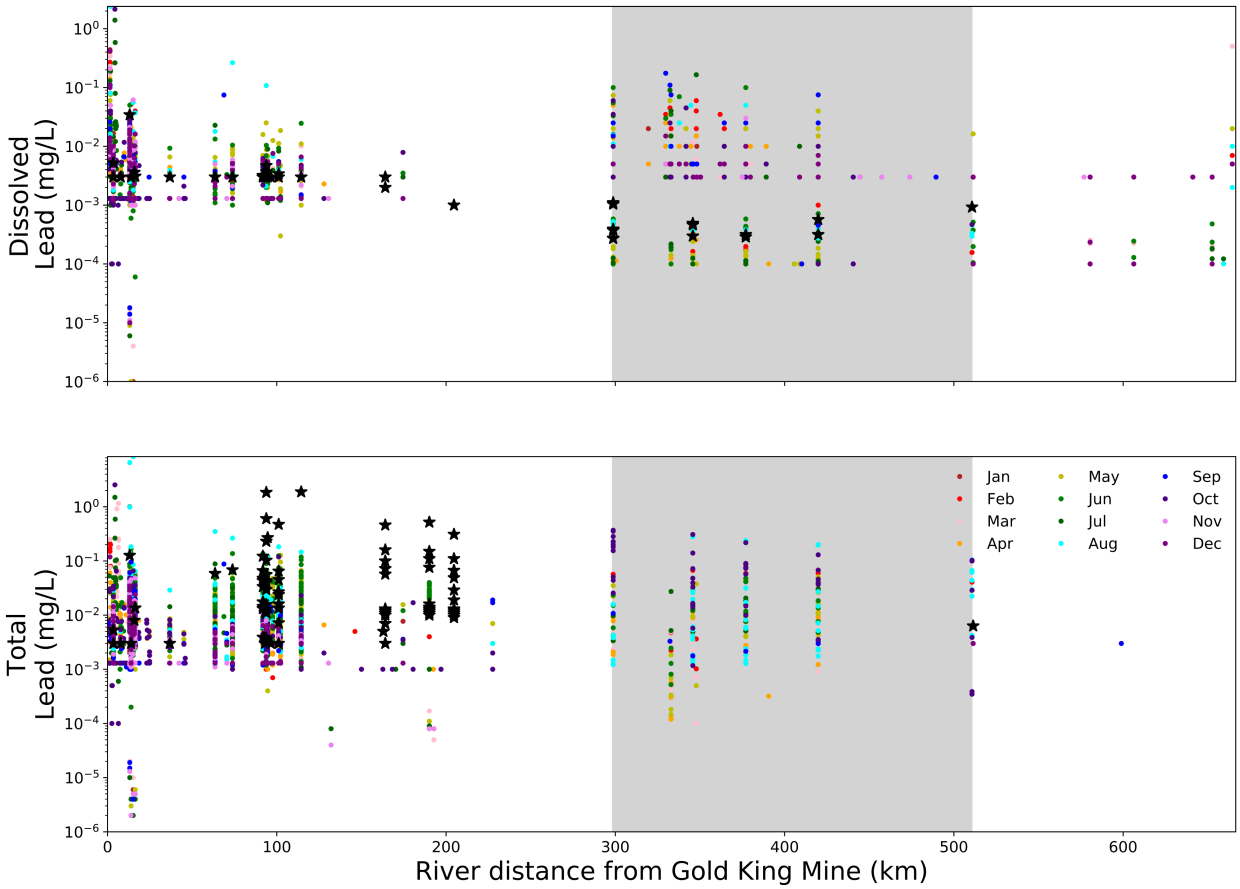

Figure 52 – Dissolved and total lead concentration throughout the entire catchment relative to distance from the Gold King Mine. The monitoring locations include the Gold King Mine and upper Animas River through Lake Powell and all of the major tributaries. Samples are colored according to numerical month and the gray box represents the Utah portion of San Juan River. Stars signify GKM sampling between August 5 and 15, 2015.

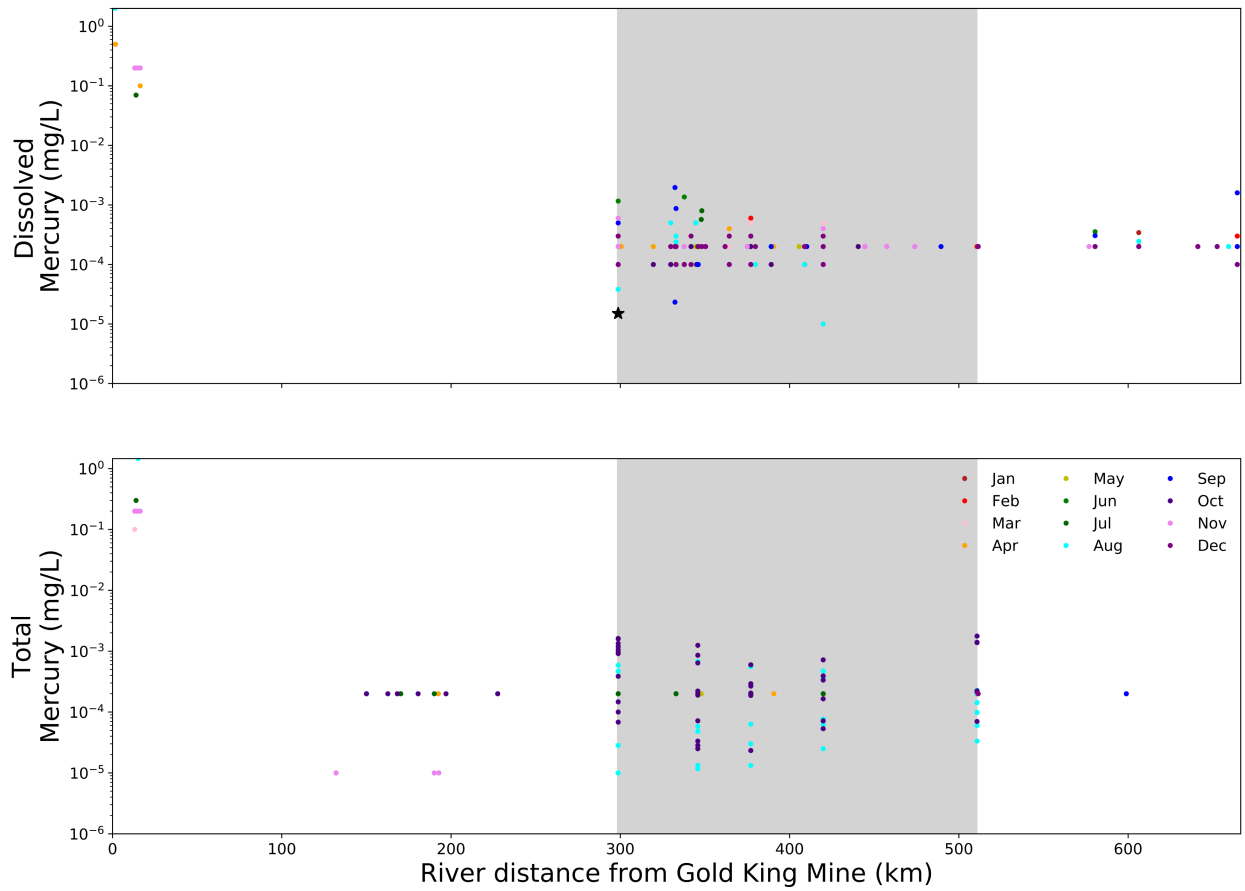

Figure 53 – Dissolved and total mercury concentration throughout the entire catchment relative to distance from the Gold King Mine. The monitoring locations include the Gold King Mine and upper Animas River through Lake Powell and all of the major tributaries. Samples are colored according to numerical month and the gray box represents the Utah portion of San Juan River. Stars signify GKM sampling between August 5 and 15, 2015.

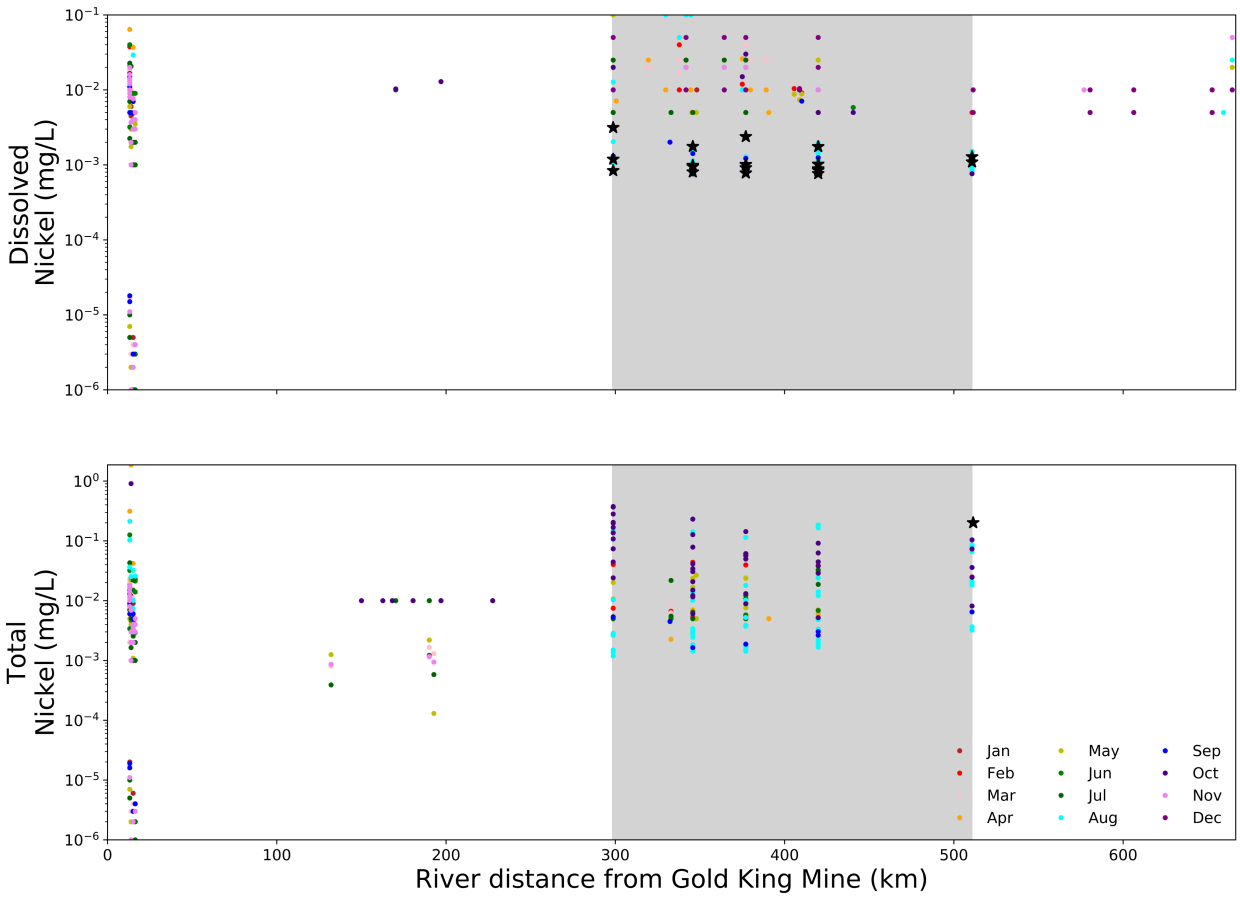

Figure 54 – Dissolved and total nickel concentration throughout the entire catchment relative to distance from the Gold King Mine. The monitoring locations include the Gold King Mine and upper Animas River through Lake Powell and all of the major tributaries. Samples are colored according to numerical month and the gray box represents the Utah portion of San Juan River. Stars signify GKM sampling between August 5 and 15, 2015.

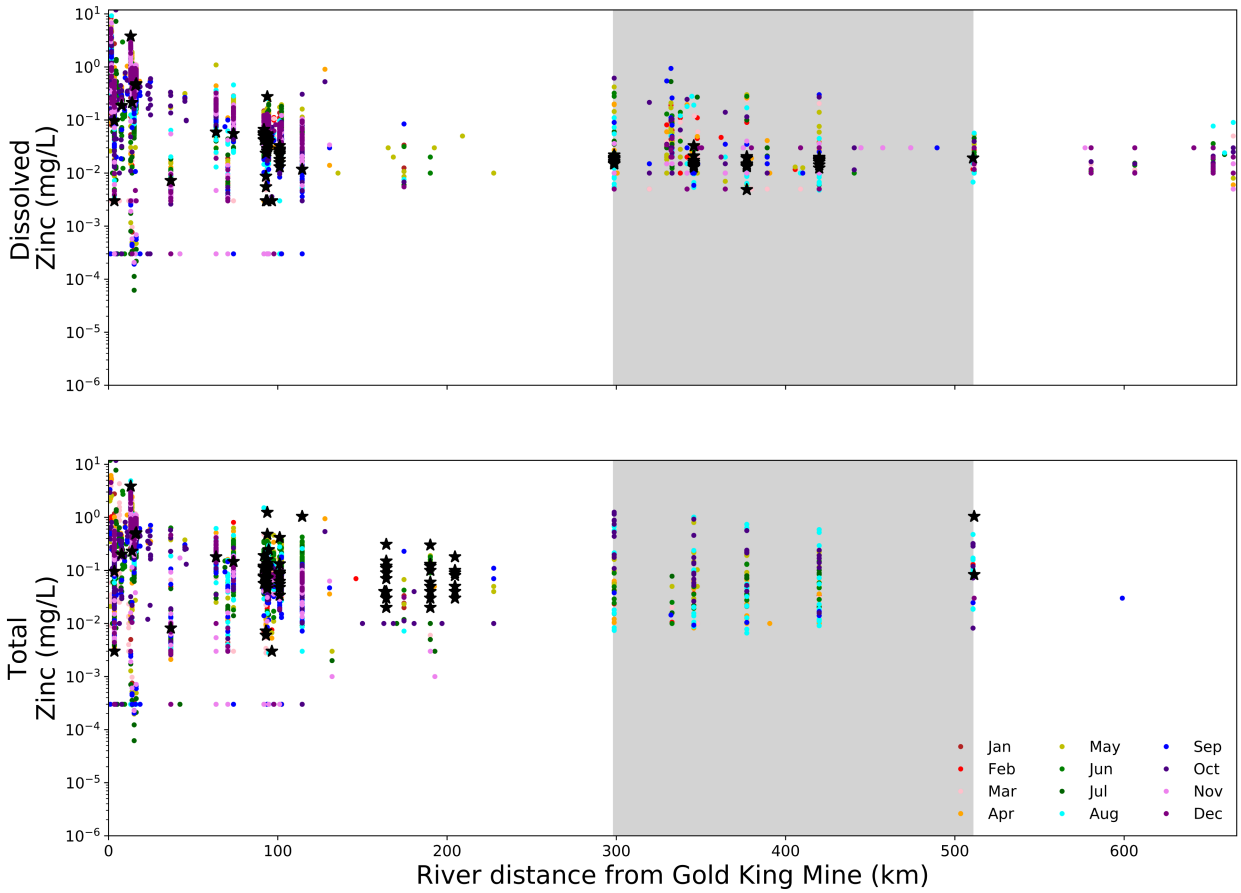

Figure 55 – Dissolved and total zinc concentration throughout the entire catchment relative to distance from the Gold King Mine. The monitoring locations include the Gold King Mine and upper Animas River through Lake Powell and all of the major tributaries. Samples are colored according to numerical month and the gray box represents the Utah portion of San Juan River. Stars signify GKM sampling between August 5 and 15, 2015.

Porphyry deposits such as those in the Bonita Peak Mining District where Gold King Mine is located are typically mined for minerals that are abundant in iron-sulfides. The iron-sulfides under the presence of oxygen forms sulfuric acid, depressing the pH, forming ferrous hydroxide, and inducing acidic mine drainage.

Gold King mine water is acidic at a pH generally around 3.0 with elevated dissolved metals concentrations including; arsenic, cadmium, copper, cobalt, lead, molybdenum, nickel, selenium, silver, and zinc. When the GKM spill occurred on August 5, 2015, it was released into Cement Creek with a pH of less than 4.5. The Animas River both upstream and downstream of Cement Creek is buffered by bedrock with significant carbonates and chlorites, which moderates the pH to alkaline levels. The GKM spill plume was neutralized, with increased pH, as it moved through the Animas and was generally at a neutral pH by river kilometer 100 (EPA, 2017). Increased pH values accelerate the acid mine drainage solute oxidation causing precipitation and colloid production, typically consisting of iron- and aluminum-hydroxides (i.e.: $FeOH_3$ and $AlOH_3$). The colloidal development generally forms a bright orange or yellow precipitate, which is an iron-oxyhydroxide commonly referred to as “yellow boy”.

The Gold King Mine release effectively acted as an in-stream chemical reactor with spatial and temporally dynamic mineral phase production (EPA, 2017). The rapid pH-based reaction kinetics favored iron precipitation. Metals in solution within the water column bind to charged iron and aluminum-oxide precipitates, fine-grained sediments, clays, and organic matter to form more chemically stable solid

forms. These same reactions continuously occur in the Bonita Peak mining district where more than 300 mines that were in production since at least 1870 have been identified.

We evaluated the current and historical water quality data for pH to see the range in expected pH at different reaches throughout the system (Figure 56). The pH was observed to range between 1.5 to about 12, generally at the upstream headwaters near GKM. However, the pH typically ranges between 6 and 9 at most locations throughout the system, indicating the wide variability in diurnal pH values and associated sampling time. It is important to note that at pH values greater than 7, many key metals are predominately sorbed to hydrous ferrous oxides (HFO) (Figure 56 inset).

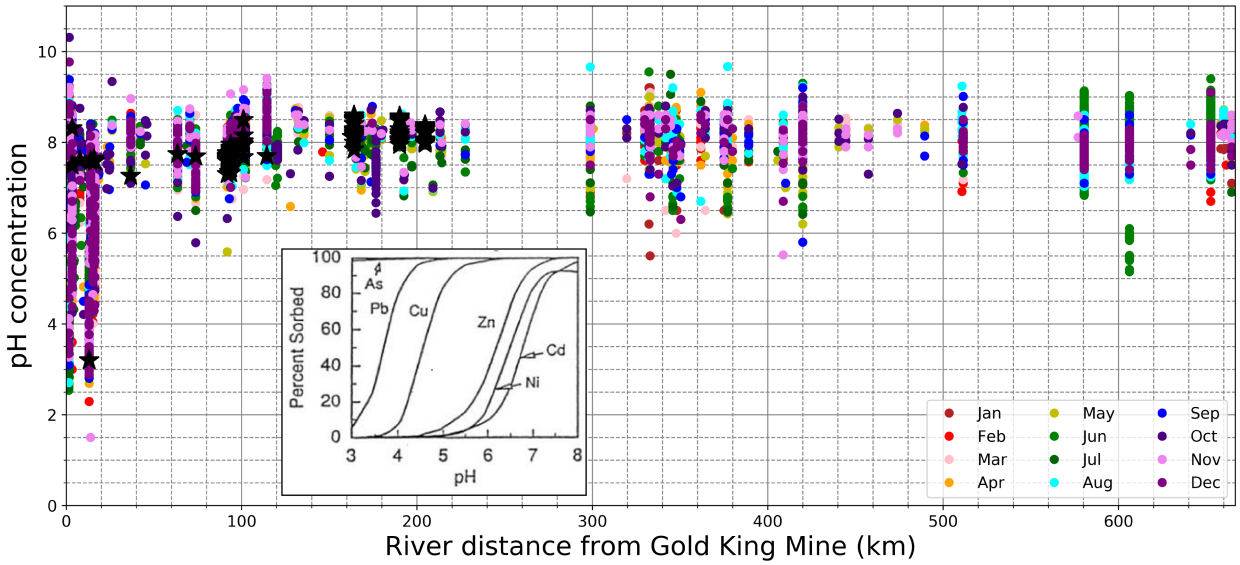

Figure 56 – Measured pH concentration variability from Gold King Mine through Lake Powell. pH is the key factor affecting metals solubility with solution mixture and concentration strength as secondary factors. The inset displays the pH-dependent solubility of individual metals with hydrous ferrous oxides (HFO) concentration of 1.0 g/L (from Smith, 1999).

When pH varies, the sorption capacity of individual metals change, as indicated on Figure 56 inset. Surface water temperature changes diurnally due to incident solar radiation, atmospheric heat exchange, and groundwater/surface water exchange. Furthermore, the temperature-dependent solubility of gases leads to high nighttime concentrations. Photosynthetic activity occurs during the day, producing dissolved oxygen and at night, respiration consumes dissolved oxygen and produces carbon dioxide, decreasing pH. Because aquatic respiration changes on a diurnal cycle, the associated response in dissolved oxygen and carbon dioxide drive changes in pH. Therefore, solar driven biological response is the key parameter in diel solar cycle pH changes. Since sorption activities of metals are in large part a response to changing pH, a better understanding of diel pH cycling and associated metals concentration is warranted.

We further investigated the system-wide pH data to determine if pH varies throughout a diel period and whether the associated metals concentration is correlated (Figure 57). Our results indicate that pH was highly variable throughout the diel period and when plotted relative to time of day, indicate a random data cluster. We compared these pH results to individual total and dissolved ion concentrations in the water column with minimal informational value. This suggests that pH for each of the monitoring locations in Utah is dependent on dynamic, in-stream processing as opposed to source control and it is dispersed between a pH of about 7 to 9 throughout the day. The pH controls on ion sorption, desorption do not appear to show a direct response in metals concentration for any of the site locations.

Figure 57 - Diel variability in dissolved and total zinc concentration and the associated pH for Utah-based monitoring locations along the San Juan River. GKM samples between August 5 and 15, 2015 are presented with black stars. Colors represent sample location as described in the legend.

Diurnal pH response does not appear to be a primary control in metals solubility and the associated water quality response in the San Juan River. The metal concentration in the water column is most likely a function of sediment sorption and desorption processes but also variability in sediment transport and deposition rates. Additional metals are compared to diurnal pH in-situ measurements and presented in Appendix D.

Metals Concentration as a Function of Continuous Proxies in Utah

A primary objective of UDEQ was to estimate individual metal loads into Utah to assess watershed-wide fate and transport. Metals concentration is often collected at a point-in-time that is under constantly varying flow and other environmental conditions. Therefore, simply assuming metals concentration behavior between sampling points may lead to incorrect interpretations. One means to minimize the uncertainty in these estimates is to use continuously measured proxies like discharge, specific conductance, pH, and turbidity from a nearby stream gauge to regress the relationship with the point-in-time concentration and determine how concentration changes as a function of continuously monitored in-situ proxies. If a reasonable fit is obtained, then continuous metals concentration can effectively be estimated using the regression equation and continuous proxy values.

Analyses of water quality trends in the San Juan River were complicated by snowmelt runoff and storm runoff events with subsequent increases in discharge. The high discharge associated with snowmelt runoff predominately diluted in-stream concentrations of total and dissolved metals while monsoonal storm

events in large part increased the rate of transport of metal contaminants. Together, these factors would cause a spring reduction in metal loading and a fall increase in metal loading. However, terrestrial runoff from these monsoonal events may also have contributed additional loads of metal contamination to the San Juan River from other sources within the watershed, including the GKM. The relative contribution of metal contamination from the GKM release versus other possible sources is currently unknown, although efforts to evaluate natural versus mining related source identification are currently underway. UDEQ analyzed the relationship between total and dissolved metal concentrations at each of the Utah stream monitoring locations:

- *MLID 4954000-San Juan River at US160Xing in CO;*
- *MLID 4953900-San Juan River at McElmo Wash;*
- *MLID 4953990-San Juan River at Town of Montezuma;*
- *MLID 4953250-San Juan River at Sand Island;*
- *MLID 4953000-San Juan River at Mexican Hat US163 Xing;*
- *MLID 4952942-San Juan River at Clay Hills boat ramp;* and
- *MLID 4952940-San Juan River above Lake Powell*)

with continuous stream discharge measurements collected at nearby USGS gauging stations:

- *USGS 09371010 – San Juan River at Four Corners, CO* and
- *USGS 09379500 – San Juan River Near Bluff, UT*).

Dissolved concentrations of most metals were negatively correlated with continuous discharge (Figure 58), particularly arsenic, calcium, sodium, potassium, magnesium, and strontium. Dissolved constituents like lead, nickel, selenium, titanium, and zinc show a positive correlation with discharge, consistent to previously presented daily results in the UDEQ Long Term Monitoring Plan.

UDEQ's goal is to determine individual analyte loads in Utah and further assess metal mass fate and transport through the San Juan River. Only the San Juan River monitoring locations in Utah are analyzed and compared with the closest USGS gauging station locations (Figure 58; Appendix E). Metals loading estimates for monitoring stations throughout the Animas and San Juan River systems are outside the scope of this report but were evaluated in EPA (2017). The Utah monitoring locations are presented from cool to warm colors moving downstream. Plots show individual regressions of metal concentrations against stream discharge for each monitoring location by color and the average regression for all of the combined Utah monitoring locations for that parameter and continuous proxy comparison in black. Overall, we see reasonable regressions for silver, arsenic, beryllium, cadmium, manganese, lead, selenium, strontium, thallium, and vanadium. Also, potassium, magnesium, and sodium display fair regressions, as expected with the major salt ions (Figure 58). The comparison of metals concentration to other continuously monitored surrogates is presented in Appendix E. Continuous specific conductance as well as temperature, turbidity, and pH each present a fairly linear relationship while discharge and stage height are best represented with exponential relationships.

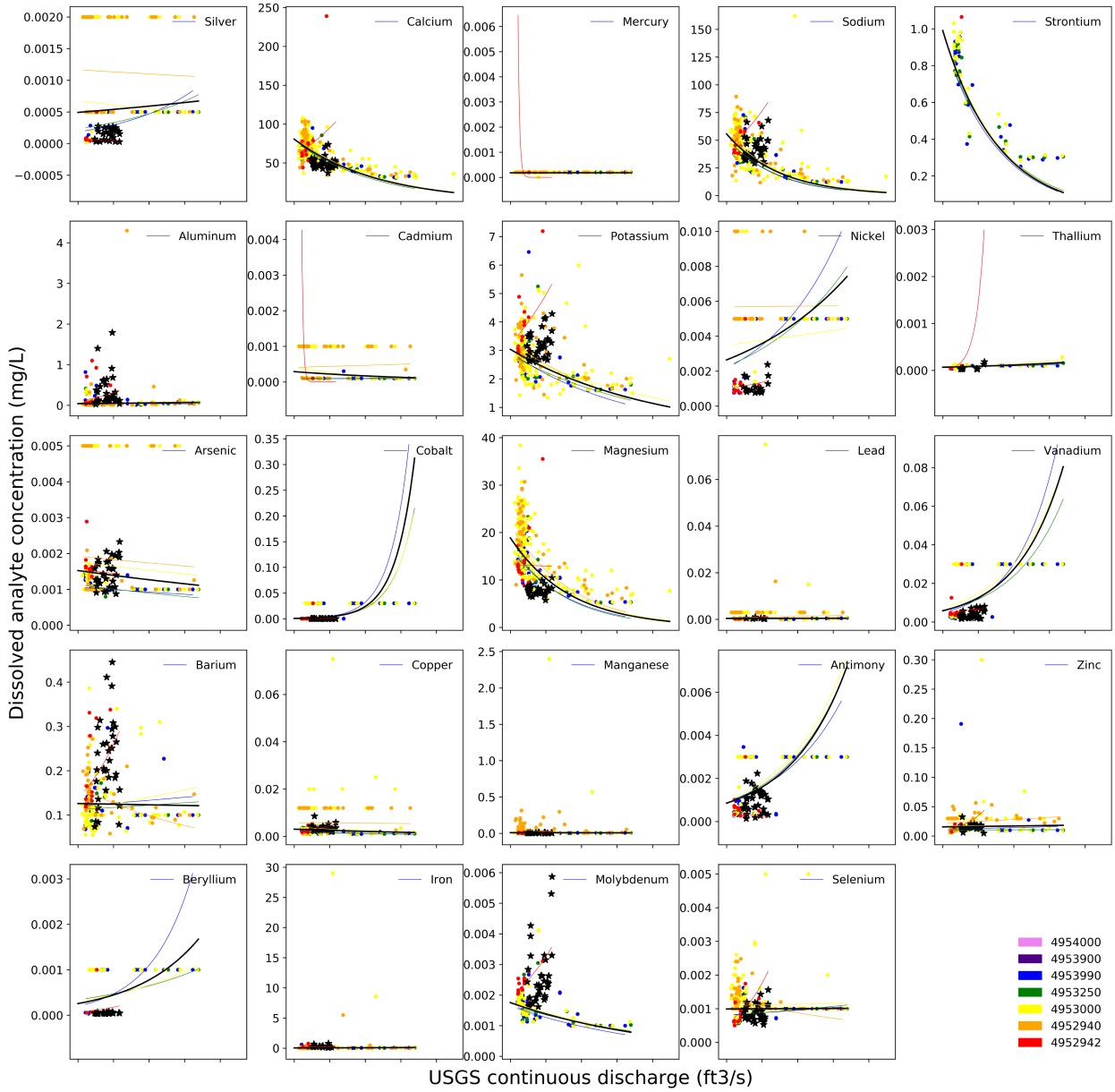

Figure 58 – Comparison of dissolved analyte concentration relative to discharge. The sampling location is provided in the legend in the lower right and logarithmic regressions are shown for individual locations.

Load Duration Curves Relative to Utah Assessment Criteria

To corroborate analyte loading estimates and attempt to limit uncertainty in loading estimates, UDEQ also developed load duration curves for each Utah numeric water quality criterion. For each monitoring location in the Utah portion of the San Juan River, UDEQ appended point-in-time concentration data to the nearest continuous USGS surrogates. We then sorted and ranked the data according to the discharge value so that we could calculate the percent probability of exceedance. The percent probability of exceedance is calculated as:

$$P_{exc} = 100 * \left(\frac{rank}{n+1}\right).$$

The assessment criterion concentration is extracted for each standard and analyte and multiplied by the continuous discharge to estimate the continuous load for each standard / element combination. In

addition, the product of the observational concentration for each analyte and continuous discharge is used to estimate the observed load for each metal. The observational loads for each analyte are calculated to compare with the criteria-based load duration curves. In Figure 59, we show the load duration curve for each monitoring location (solid line) using the state-based numeric criteria of each analyte relative to the percent probability of exceedance. In this example, we use the Utah Class 3B – Acute Aquatic Life (1-hour) numeric criteria. The observational loads are presented as stars. Furthermore, the least-squares exponential regression of the observed data is used to predict the metal loads over the continuous period of record and better understand loading processes (Figure 59). Additional plots are provided in Appendix F for all of the water quality numeric criteria assigned to the San Juan River.

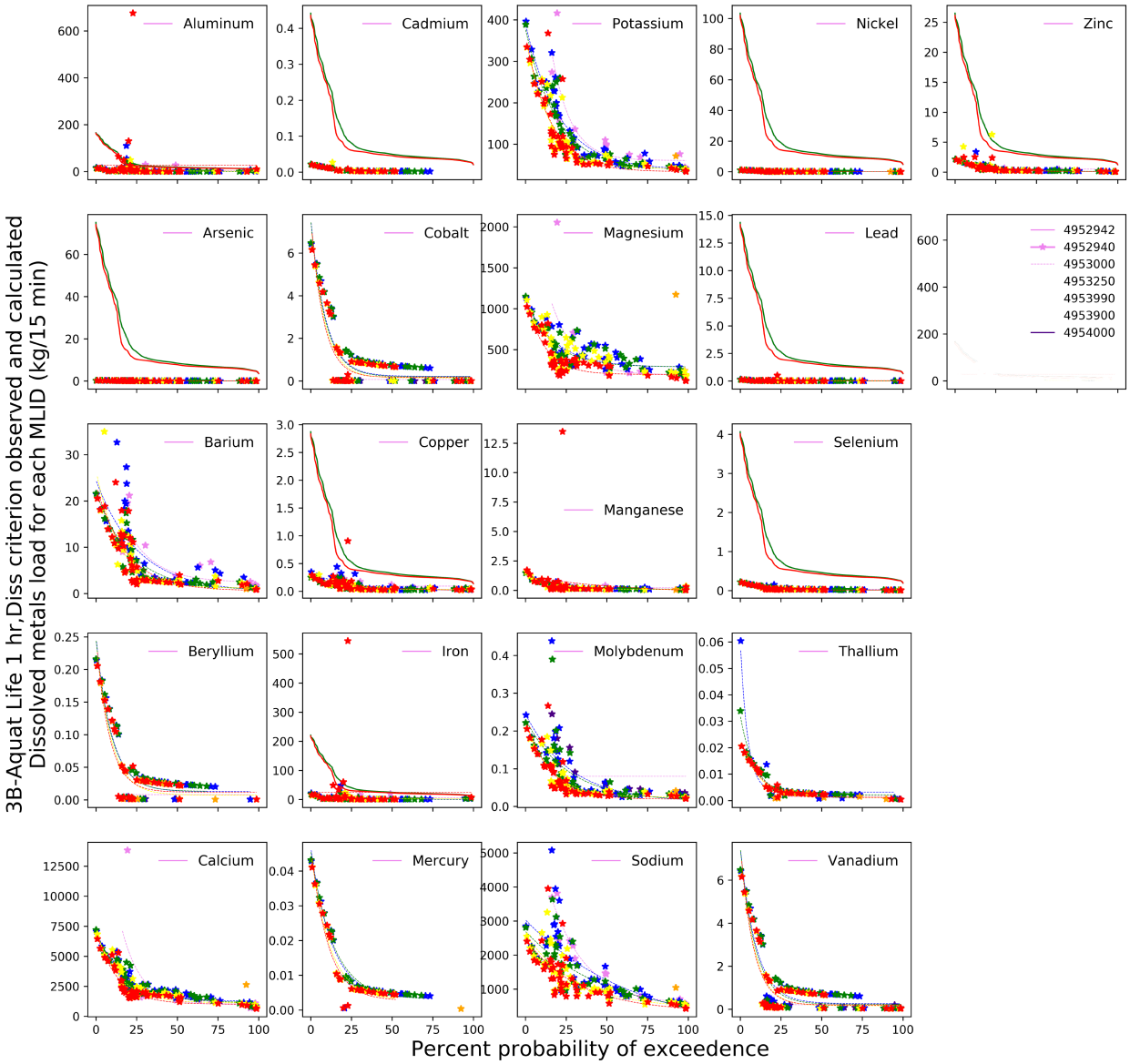

Figure 59 – Load duration curves (LDC) displaying the percent probability of exceedence of the dissolved analyte criterion load for each monitoring location. Each of the solid lines represents a different monitoring location LDC. The assessment criterion is the Utah Class 3B – acute (1 hour) Aquatic Life standard. In addition, estimated loads from observational water quality data are compared to the LDC and shown with stars for each monitoring location. Finally, exponential and linear regressions are developed on the observed loads to estimate the continuous load for each analyte.

The matrix of plots in Figure 59 show the numeric criteria load duration curve, where applicable, with solid lines that are color coded according to MLID with warm colors representing upstream and cool colors representing downstream locations. For example, cobalt does not display a load duration curve for the Utah Class 3B – Acute Aquatic Life (1-hour) criteria because there is currently no numeric criteria set for the State of Utah (Table 4). Arsenic has a criterion for this standard of 0.34 mg/L and it is obvious that the majority of samples exceed this value. Similarly, exceedances of iron and copper were observed at MLID 4954000 for these criteria. Similar matrix plots are provided in Appendix F for all of the water quality numeric criterion assigned to the San Juan River.

Estimated Metals Loading in Utah

As previously described, our results present multiple ways to estimate continuous metal concentrations using a variety of continuous proxy regressions (discharge, stage height, specific conductance, pH, temperature, and turbidity). However, some of the regression-based estimates lacked robust relationships. Another means to calculate the continuous load was to use a load duration curve approach to use exceedance probabilities to estimate individual metal loads. Although, not all metals have a standard assigned and therefore, are not applicable to estimate the loads. Therefore, a reasonable estimate of the metals load over time for each Utah-based monitoring load can best be analyzed by comparing the range between each of the measurement techniques. Figure 60 through Figure 65 present the regression-based load estimates over time for each of the continuous surrogates, in addition to continuous discharge estimates for that location. Additional regression-based load estimates for all of the metal analytes is presented in Appendix G. We see that the estimated load from discharge and stage height are fairly consistent and are typically one to six orders of magnitude greater than estimates using specific conductance or turbidity. Therefore, it is important to identify the loading estimate based on the veracity of the metal to continuous proxy correlation. In addition, some the analytes in the total fraction appear to be bimodal with very high and very low load estimates. This is a direct function of the poor regression and loading results should not be used for quantitative analysis.

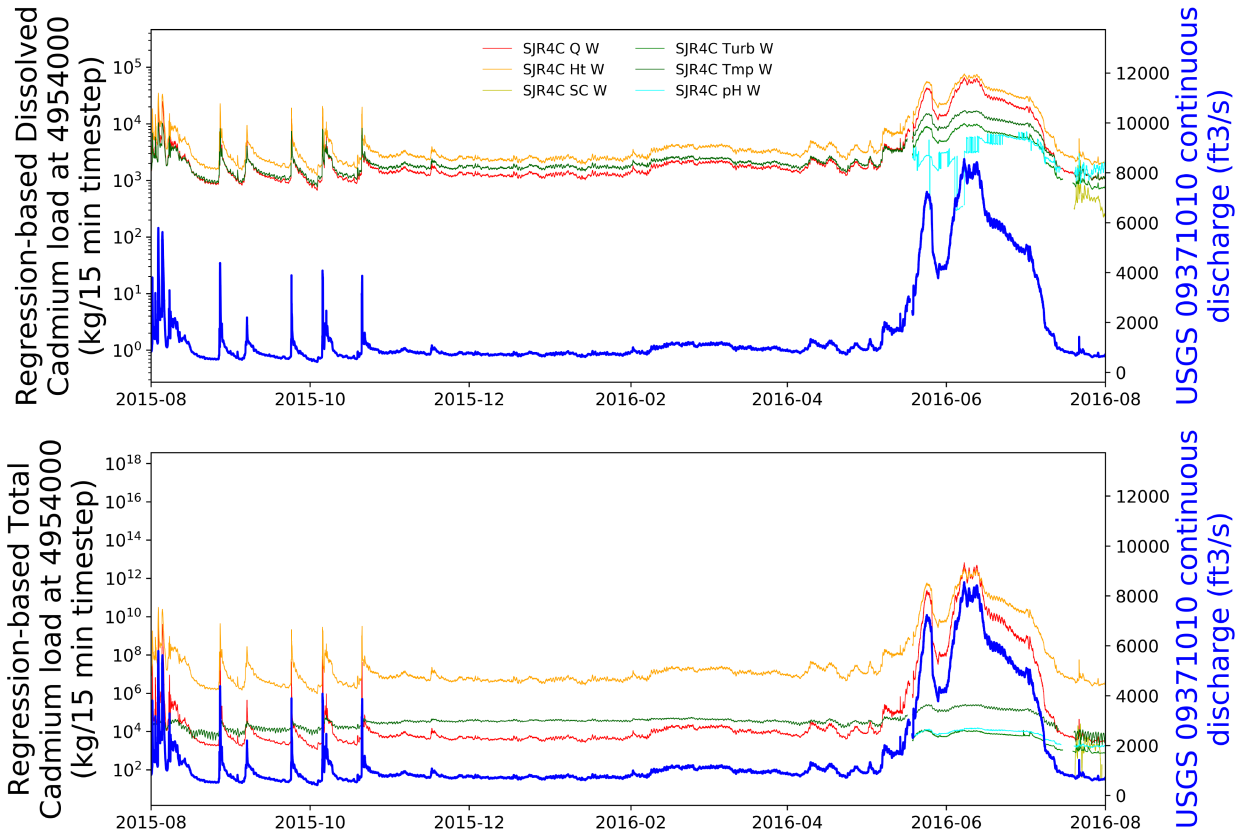

Figure 60 - Dissolved and total continuously estimated cadmium loads calculated from each of the monitored surrogates (discharge, stage height, specific conductance, turbidity, water temperature, and pH) at MLID 4954000. Continuous discharge is also presented.

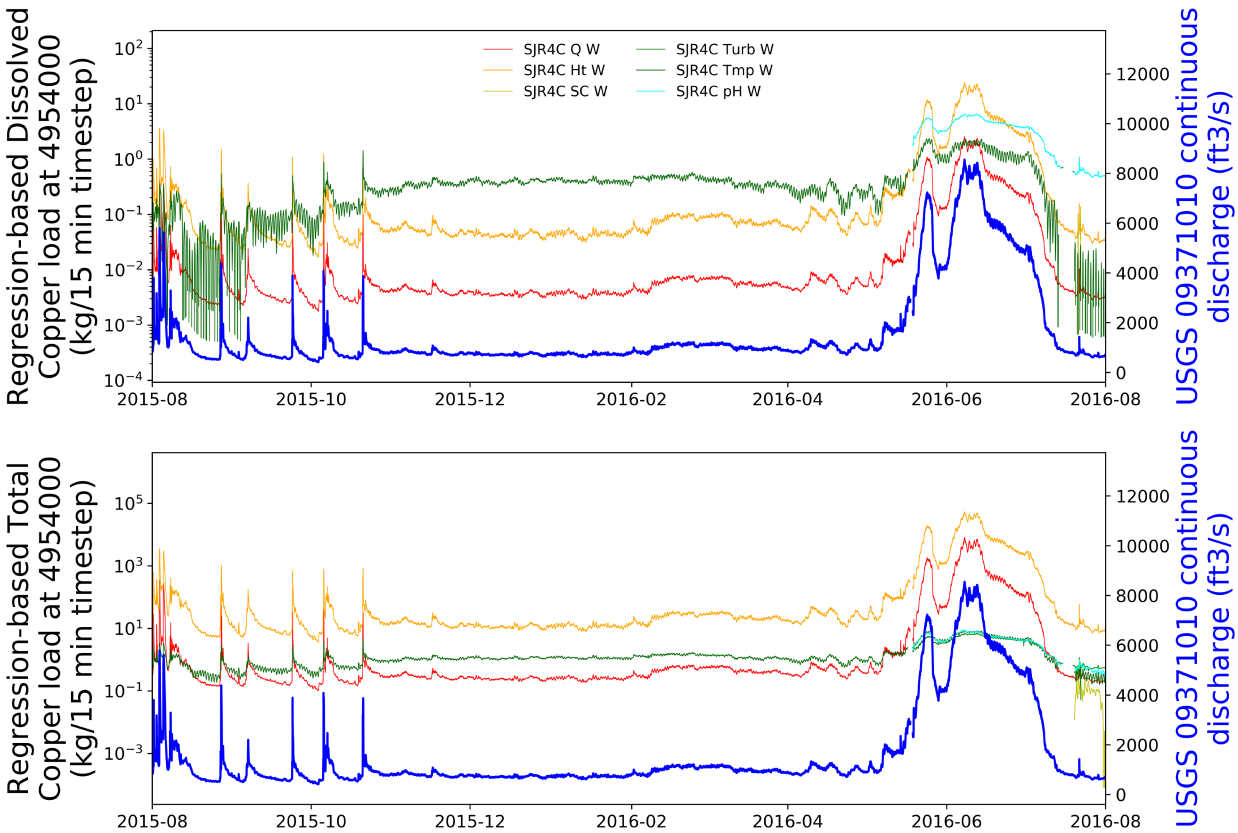

Figure 61 - Dissolved and total continuously estimated copper loads calculated from each of the monitored surrogates (discharge, stage height, specific conductance, turbidity, water temperature, and pH) at MLID 4954000. Continuous discharge is also presented.

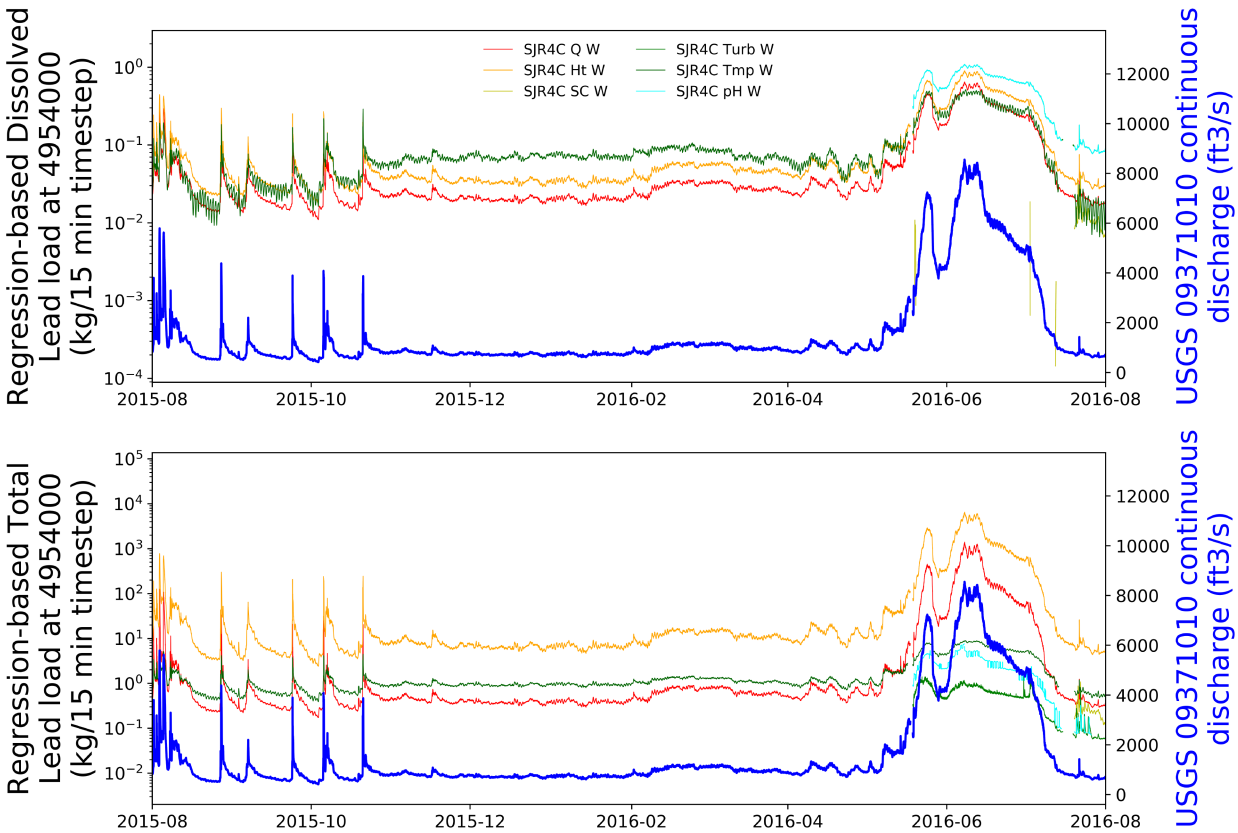

Figure 62 - Dissolved and total continuously estimated lead loads calculated from each of the monitored surrogates (discharge, stage height, specific conductance, turbidity, water temperature, and pH) at MLID 4954000. Continuous discharge is also presented.

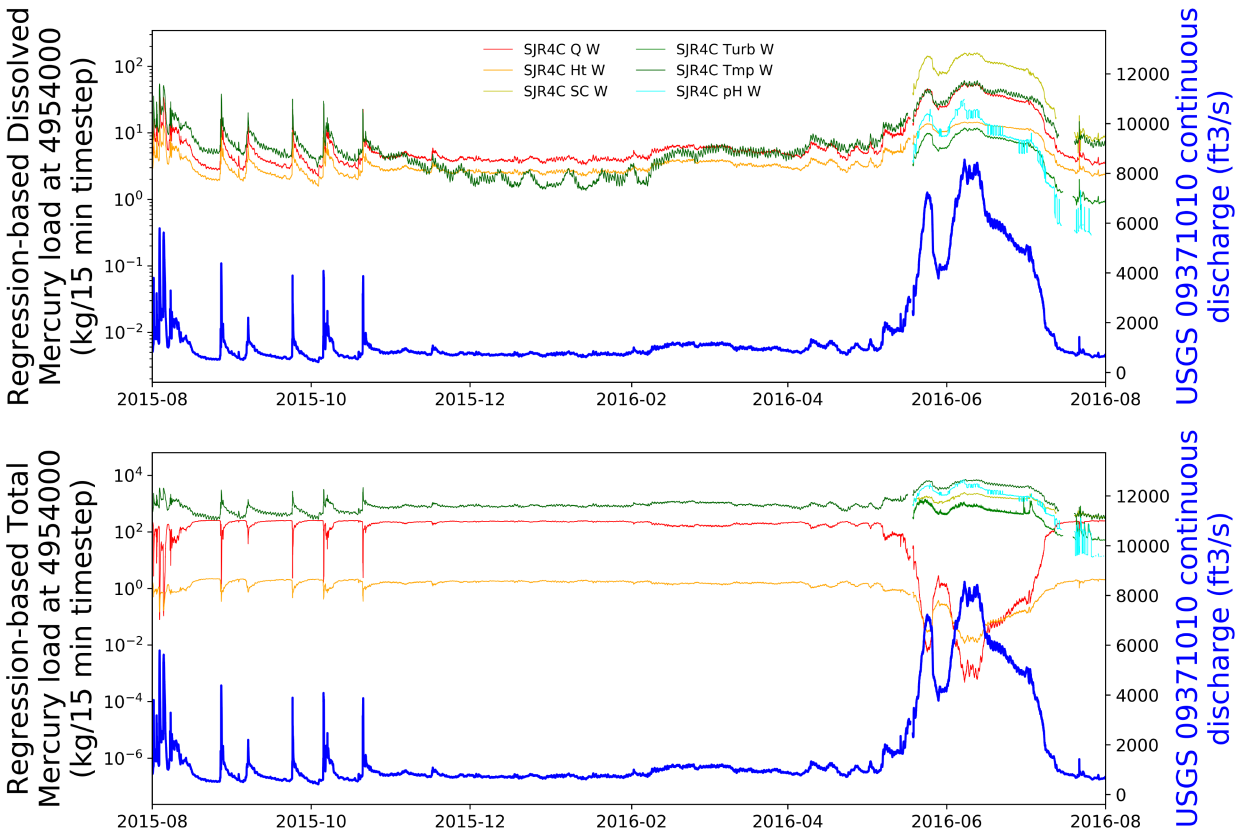

Figure 63 - Dissolved and total continuously estimated mercury loads calculated from each of the monitored surrogates (discharge, stage height, specific conductance, turbidity, water temperature, and pH) at MLID 4954000. Continuous discharge is also presented.

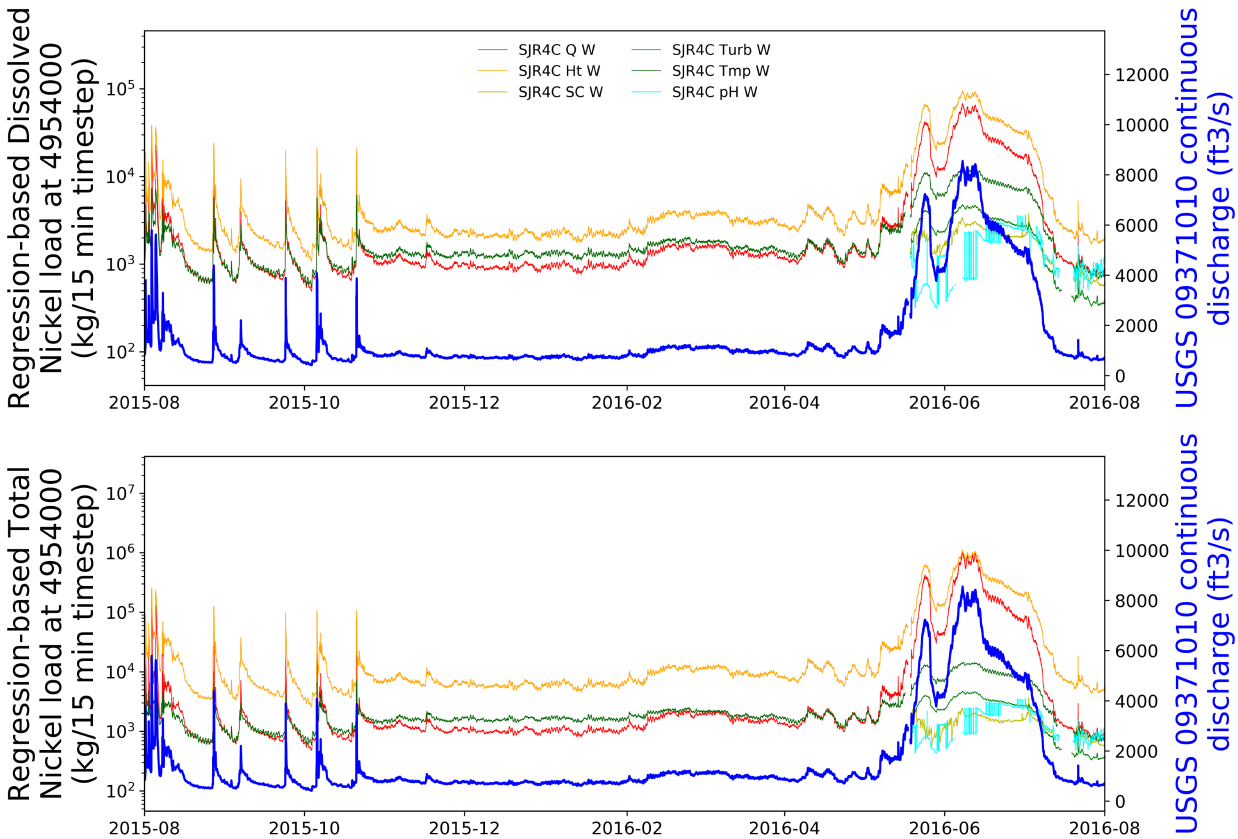

Figure 64 - Dissolved and total continuously estimated nickel loads calculated from each of the monitored surrogates (discharge, stage height, specific conductance, turbidity, water temperature, and pH) at MLID 4954000. Continuous discharge is also presented.

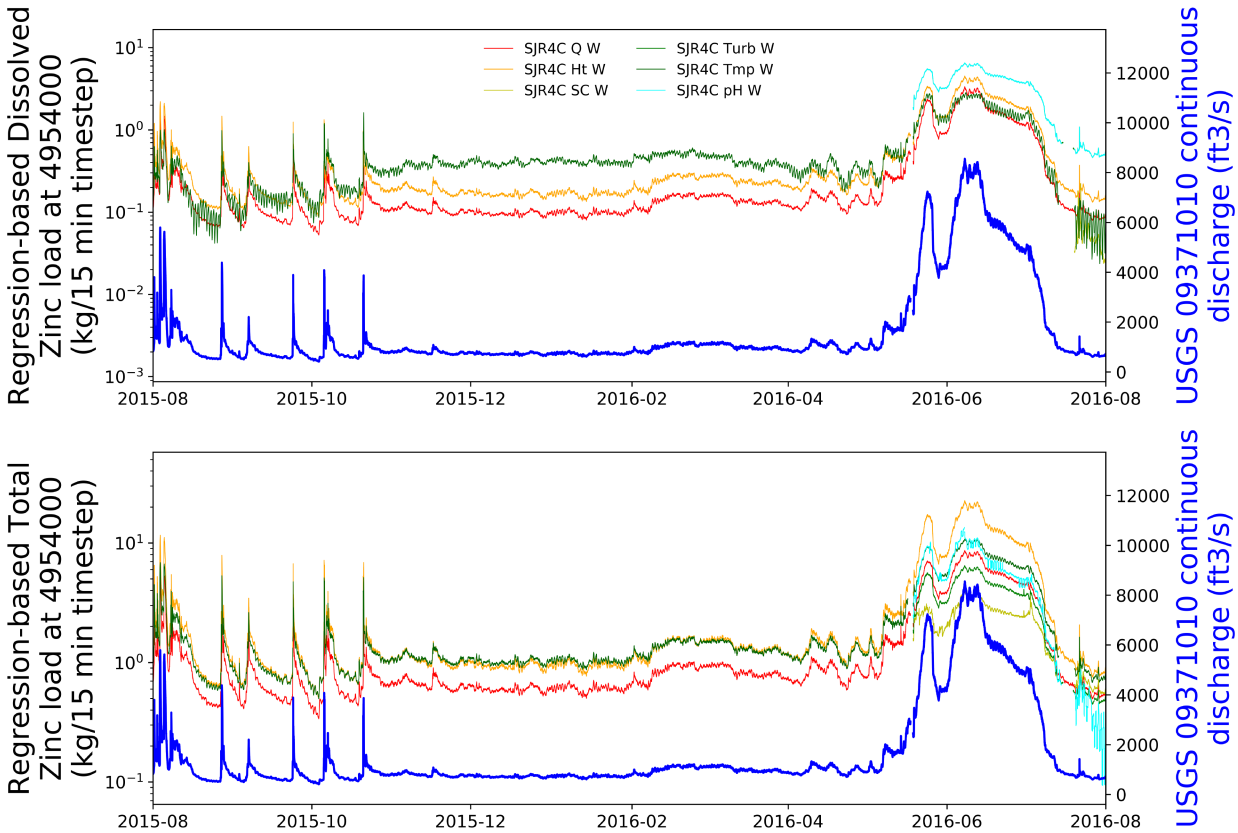

Figure 65 - Dissolved and total continuously estimated zinc loads calculated from each of the monitored surrogates (discharge, stage height, specific conductance, turbidity, water temperature, and pH) at MLID 4954000. Continuous discharge is also presented.

In addition to estimating the continuous metals load for each analyte using the regression-based approach, we also estimated individual metals loads using the load duration curve approach. Our approach was to calculate the percent probability of exceedence relative to regulatory standards for each beneficial use. The observational loads are subsequently estimated and provide a visual representation of criterion exceedences for each metal. We then fit the observational loads to a least-fit regression over the percent probability of exceedence. Using this information at every data point in time, we were able to calculate the continuous load. Finally, we present the estimated loads for each metal analyte over time estimated from each beneficial use for each site location. Examples of the primary analytes (cadmium, copper, lead, mercury, nickel, and zinc) loads for the dissolved standard criterion at MLID 4954000-San Juan River at US160Xing in CO are presented in Figure 66 through Figure 71. Additional plots for each of the estimated loads determined using the standard load duration curve criterion are presented in Appendix H.

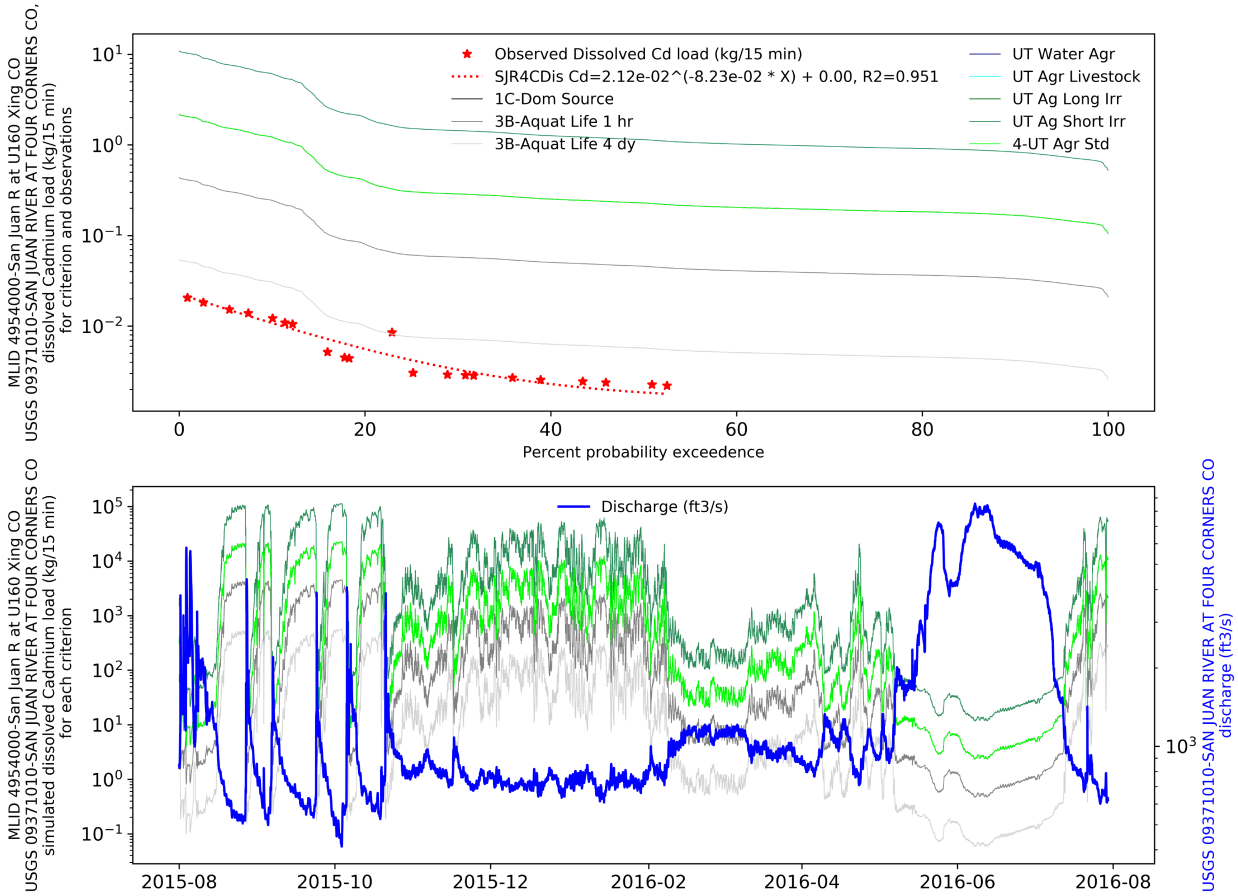

Figure 66 –Standard load duration curve (LDC) estimates for each dissolved beneficial use for cadmium are compared to estimated observed loads and the least squares regression. This example is for MLID 4954000-San Juan River at US160Xing in CO. The regression is then applied to each criterion for the estimated load over time, relative to continuous discharge.

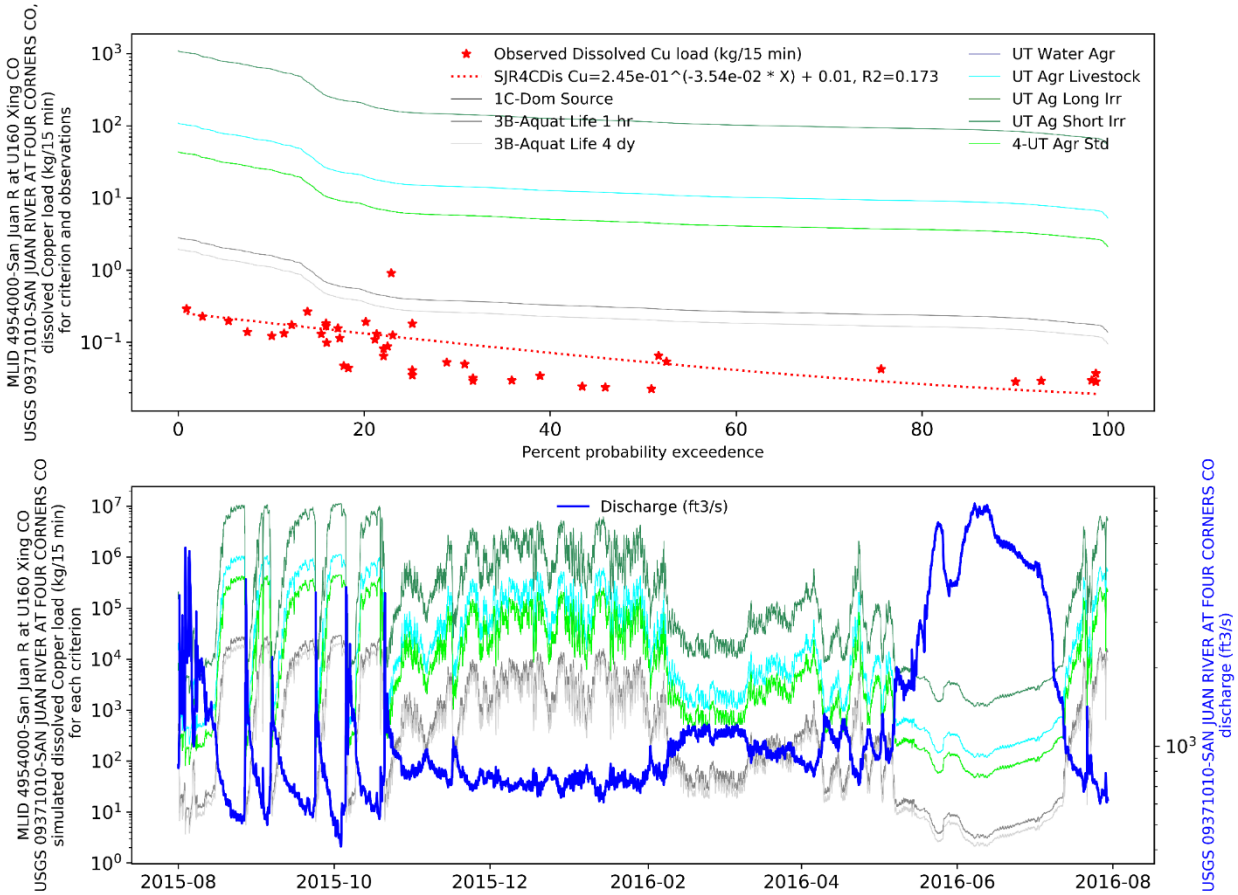

Figure 67 – Standard load duration curve (LDC) estimates for each dissolved beneficial use for copper are compared to estimated observed loads and the least squares regression. This example is for MLID 4954000-San Juan River at US160Xing in CO. The regression is then applied to each criterion for the estimated load over time, relative to continuous discharge.

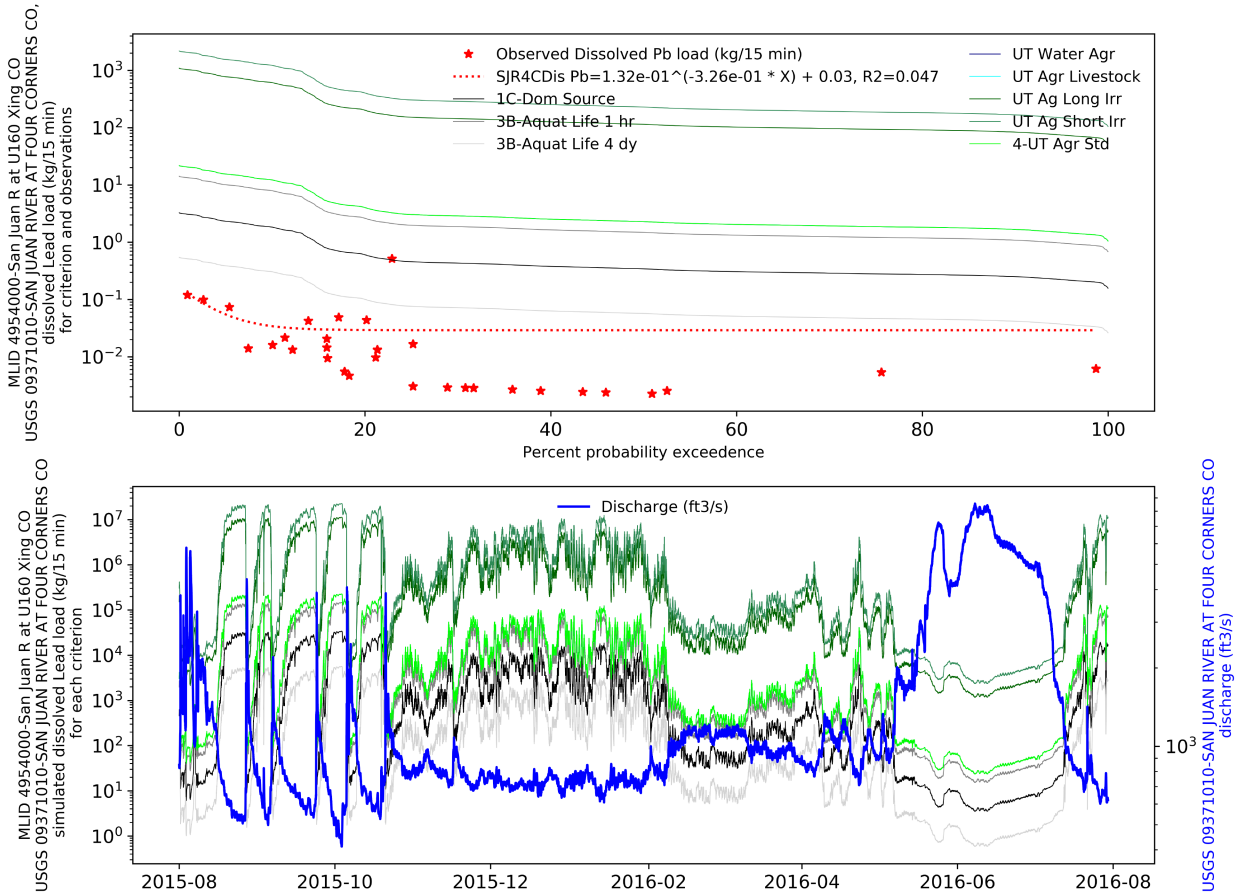

Figure 68 – Standard load duration curve (LDC) estimates for each dissolved beneficial use for lead are compared to estimated observed loads and the least squares regression. This example is for MLID 4954000-San Juan River at US160Xing in CO. The regression is then applied to each criterion for the estimated load over time, relative to continuous discharge.

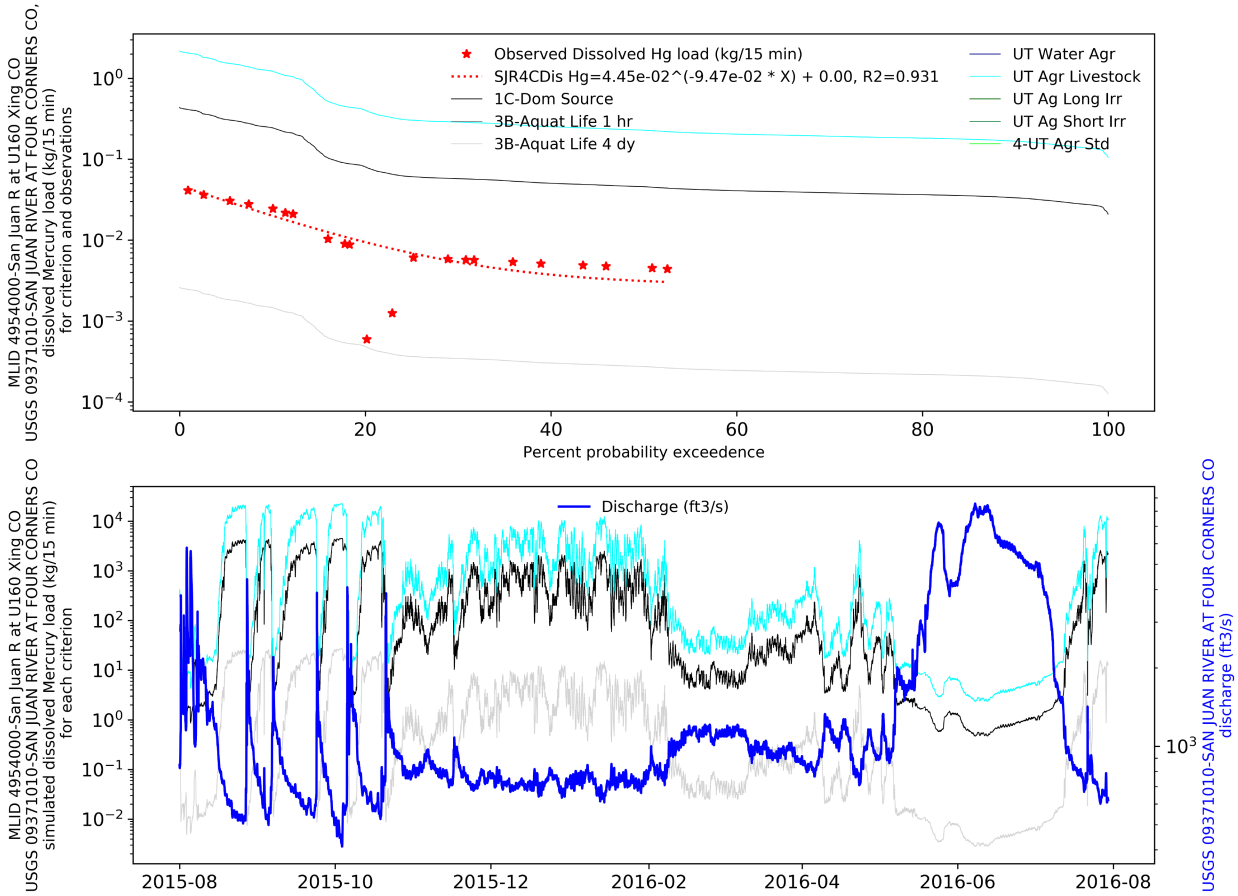

Figure 69 – Standard load duration curve (LDC) estimates for each dissolved beneficial use for mercury are compared to estimated observed loads and the least squares regression. This example is for MLID 4954000-San Juan River at US160Xing in CO. The regression is then applied to each criterion for the estimated load over time, relative to continuous discharge.

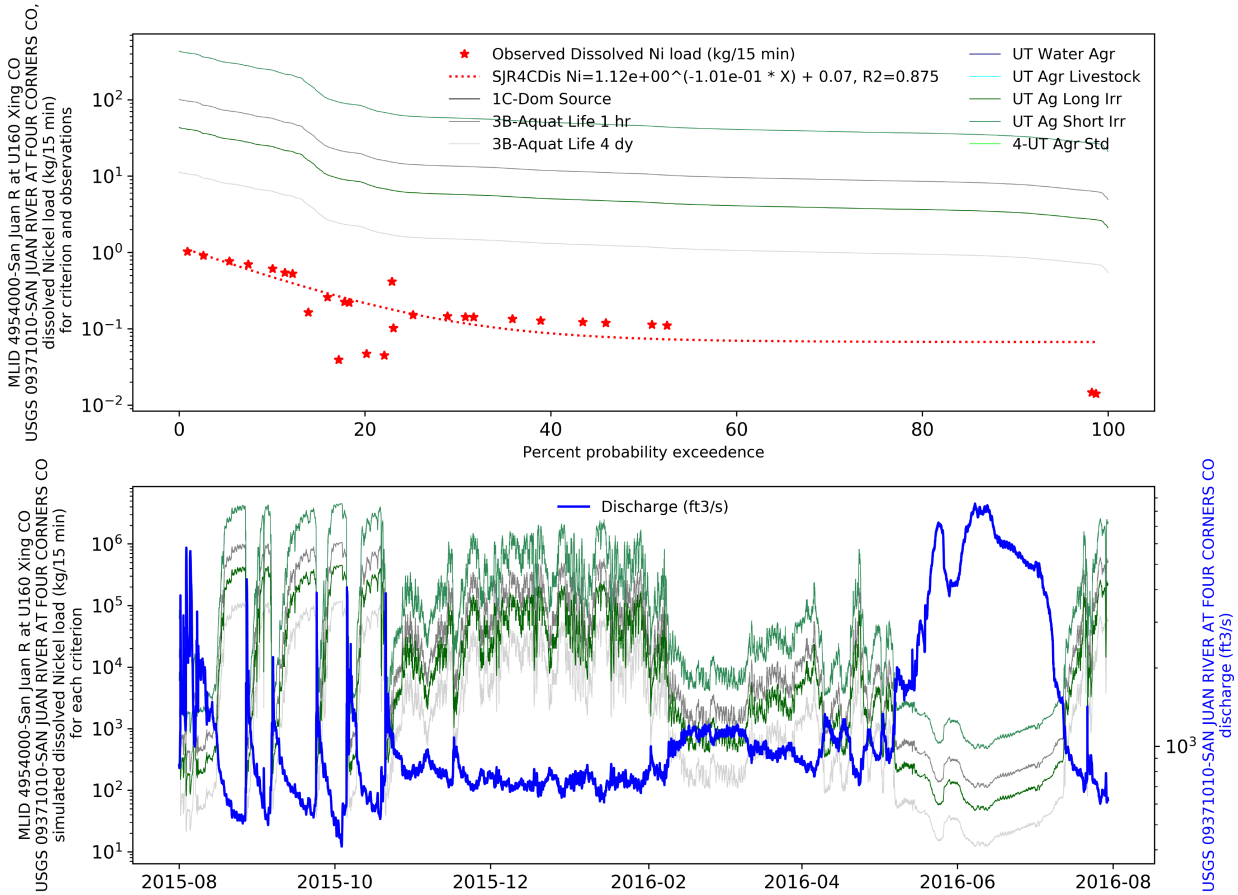

Figure 70 – Standard load duration curve (LDC) estimates for each dissolved beneficial use for nickel are compared to estimated observed loads and the least squares regression. This example is for MLID 4954000-San Juan River at US160Xing in CO. The regression is then applied to each criterion for the estimated load over time, relative to continuous discharge.

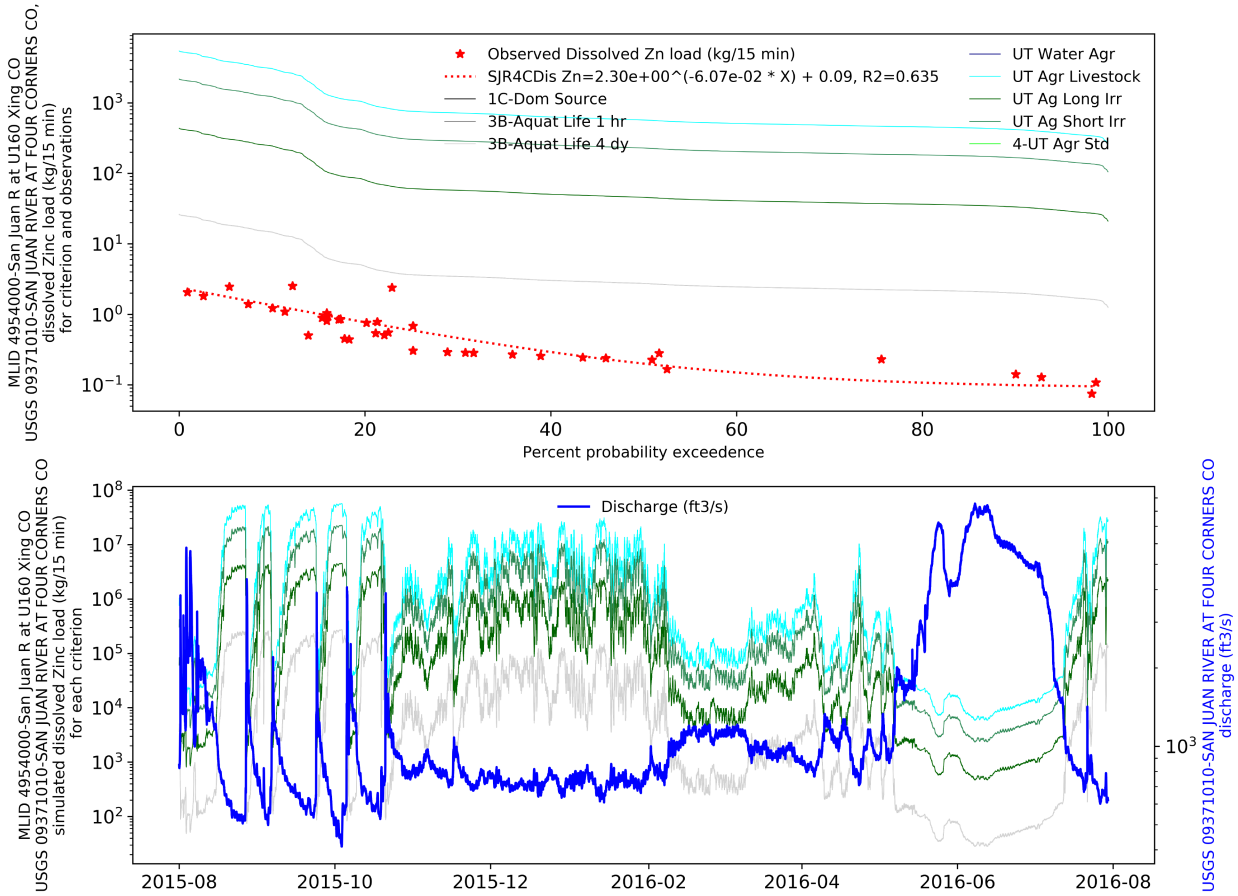

Figure 71 – Standard load duration curve (LDC) estimates for each dissolved beneficial use for zinc are compared to estimated observed loads and the least squares regression. This example is for MLID 4954000-San Juan River at US160Xing in CO. The regression is then applied to each criterion for the estimated load over time, relative to continuous discharge.

Cumulative Historic Mine Discharge Estimates

The GKM release represents a small fraction of the total estimated releases from the 48 abandoned mines in the Bonita Peak Mining District in Colorado over the past 100 years and more (EPA, 2017). The USGS estimated that 8.6 million tons of tailings have made their way to the riverine environment over the life of the mines (DOI 2015). Previous releases from GKM itself are also significant over the past decade. Figure 72 shows a cumulative estimate based on periodic releases from GKM discharge values reported by EPA in the *Summary Report: EPA Internal Review of the August 5, 2015 Gold King Mine Blowout* (EPA 2015a). Based on these flow estimates, the total cumulative discharge from GKM exceeds 750 million gallons since 2005, not accounting for releases from adjacent mines (Figure 72). In a letter to the State of Colorado, EPA proposed to add the Bonita Peak Mining District to the National Priorities List for the U.S. Comprehensive Environmental Response, Compensation & Liability Act. EPA estimated that the collective ongoing discharge from the Bonita Peak Mining District averages 5.5 million gallons per day (EPA 2016c, Letter from EPA to Colorado regarding Proposed Listing of the "Bonita Peak Mining District" site on EPA's Superfund National Priorities List). In September 2016, the Bonita Peak Mining District was officially added to the Superfund National Priorities List by the EPA. Recognizing that the final resting place of metals and metal laden sediment from current and historical mine drainage since the mid-1960s is in the sediments of Lake Powell, UDEQ is interested in understanding the historic releases of metals

from the Bonita Peak Mining District and assessing the effect of legacy metals contamination on Utah's waters.

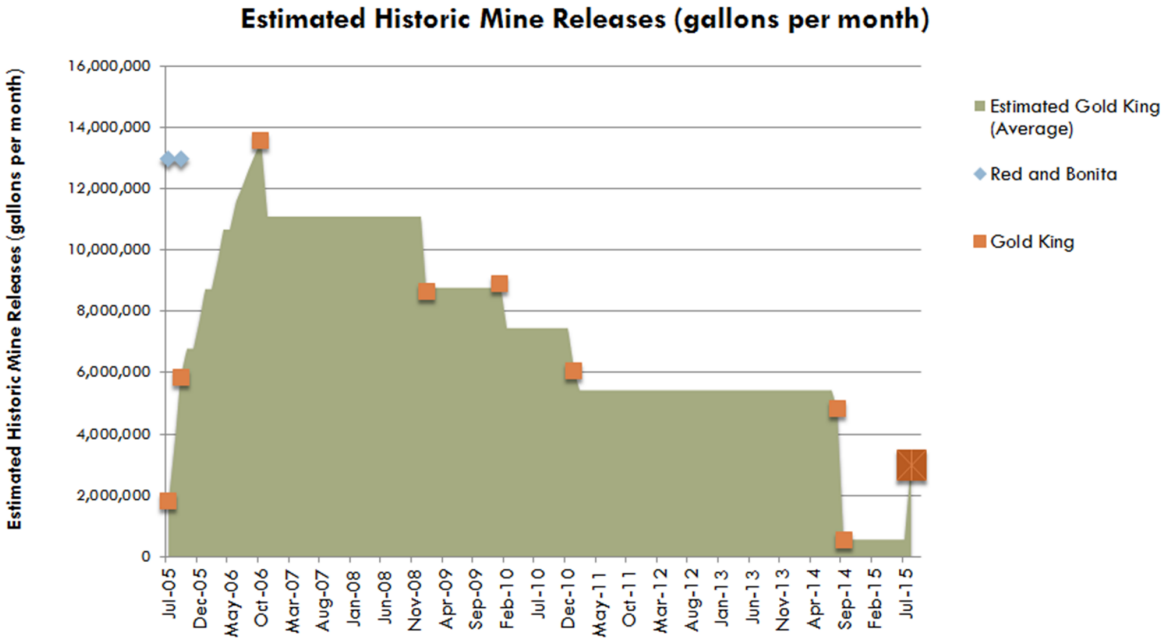

Figure 72 - Estimated historic cumulative discharge and release events from the Gold King Mine.

7. Sediment Trends in the San Juan River and Lake Powell

San Juan River Sediment Analysis

Unfortunately, a limited number of sediment samples have been collected in the Utah portion of the San Juan River and they have all been collected since the 2015 GKM spill event. However, UDEQ was able to identify general trends in the data that demonstrate the utility of further sediment sampling and analysis. Continued sediment sampling at multiple locations throughout the lower San Juan River on a regular frequency would further refine our hypotheses of sediment concentration variability, transport, deposition rates, and ultimately sediment fate.

UDEQ grab samples of sediments appear to indicate that the GKM spill transported a higher mass of sediment downstream with metal concentrations that were elevated. At the *MLID 4954000-San Juan River at US160Xing in CO* site, sediment metal concentrations were generally similar between the pre- and post-plume arrival samples, with the exception of mercury, which increased over an order of magnitude before decreasing to pre-plume concentrations by the end of August 2015 (Figure 73 through Figure 78; Appendix I). The metal concentrations in sediment at *Montezuma Creek* and *MLID 4953250-San Juan River at Sand Island* of aluminum, arsenic, beryllium, cobalt, copper, cadmium, chromium, iron, lead, manganese, vanadium, and zinc all increase by approximately a factor of two after the pollutant plume was predicted to arrive in Utah. The sediment metal concentrations then consistently decreased for the next sampling round approximately one month later. However, these same patterns were not consistently exhibited in the sediment samples from the downstream locations of *MLID 4953000-San Juan River at Mexican Hat US163 Xing* and *MLID 4952940-San Juan River above Lake Powell*. Metal concentrations in sediment at these locations did not always increase after the predicted plume arrival. For instance, beryllium concentrations in San Juan River sediment were lower post-plume at the *MLID 4954000-San Juan River at US160Xing in CO* site, increased at the *MLID 4953990-San Juan River at Town of Montezuma* and *MLID 4953250-San Juan River at Sand Island* sites, and were lower post-plume at the *MLID 4953000-San Juan River at Mexican Hat US163 Xing* site. In addition, no pre-plume sediment sample is available for the *MLID 4952940-San Juan River above Lake Powell* site to conduct a pre-plume comparison. Furthermore, late-fall sediment metals concentrations were variable with some locations displaying higher concentrations than during the GKM plume, which may suggest event-based sediment transport. The lack of consistent patterns of metals contamination in sediments at the lower San Juan sites (*MLID 4953000-San Juan River at Mexican Hat US163 Xing* and *MLID 4952940-San Juan River above Lake Powell*) clearly indicate that additional analyses over time are necessary to better understand how sediment is transported in the San Juan River system and the implications to metals concentrations.

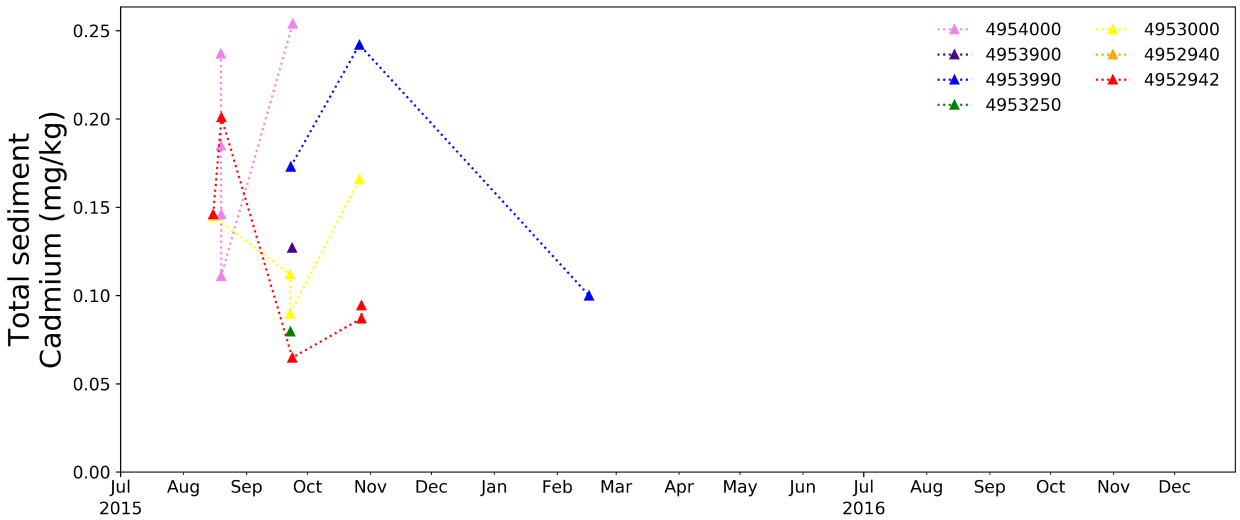

Figure 73 - Sediment cadmium concentrations in the San Juan River before and after the GKM plume entered Utah.

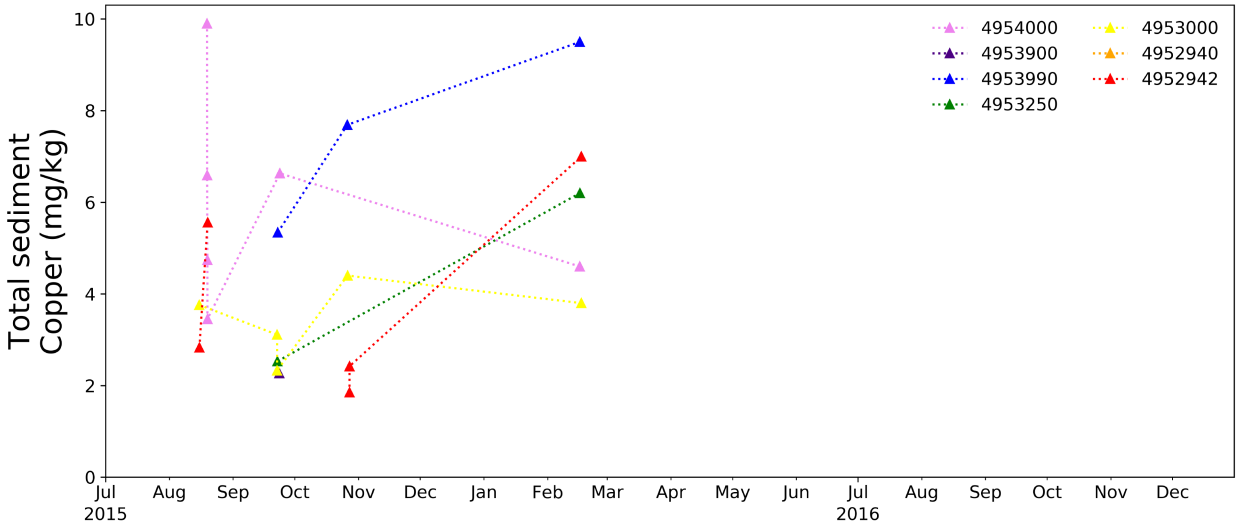

Figure 74 - Sediment copper concentrations in the San Juan River before and after the GKM plume entered Utah.

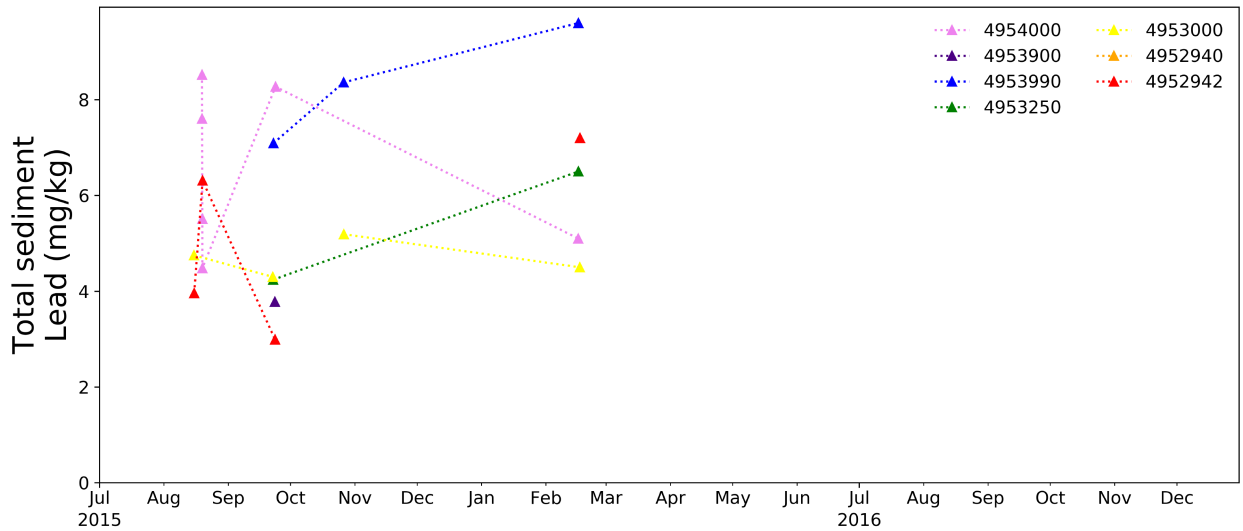

Figure 75 - Sediment lead concentrations in the San Juan River before and after the GKM plume entered Utah.

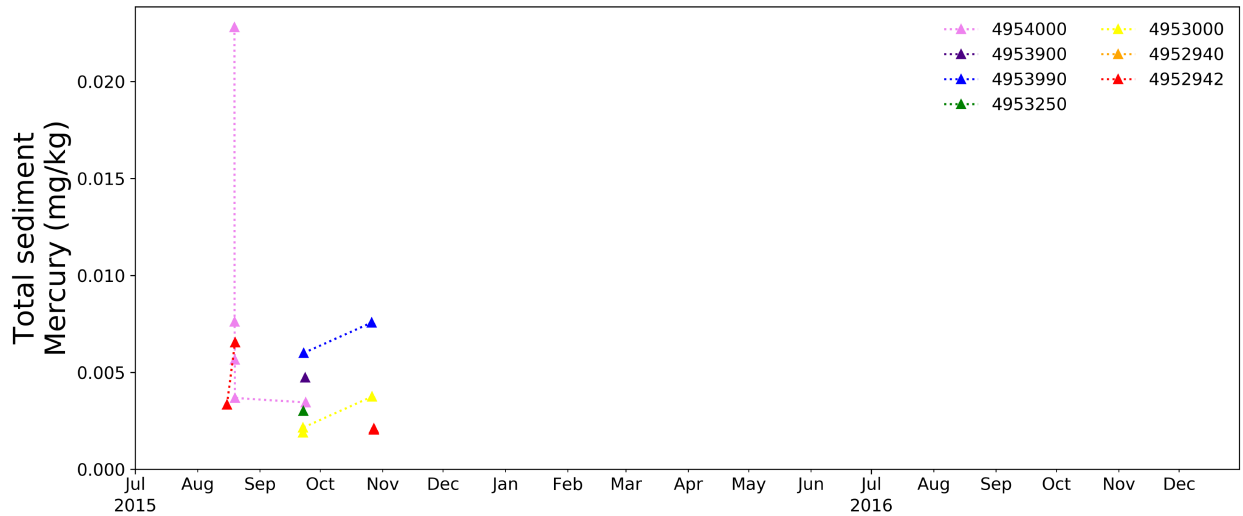

Figure 76 - Sediment mercury concentrations in the San Juan River before and after the GKM plume entered Utah.

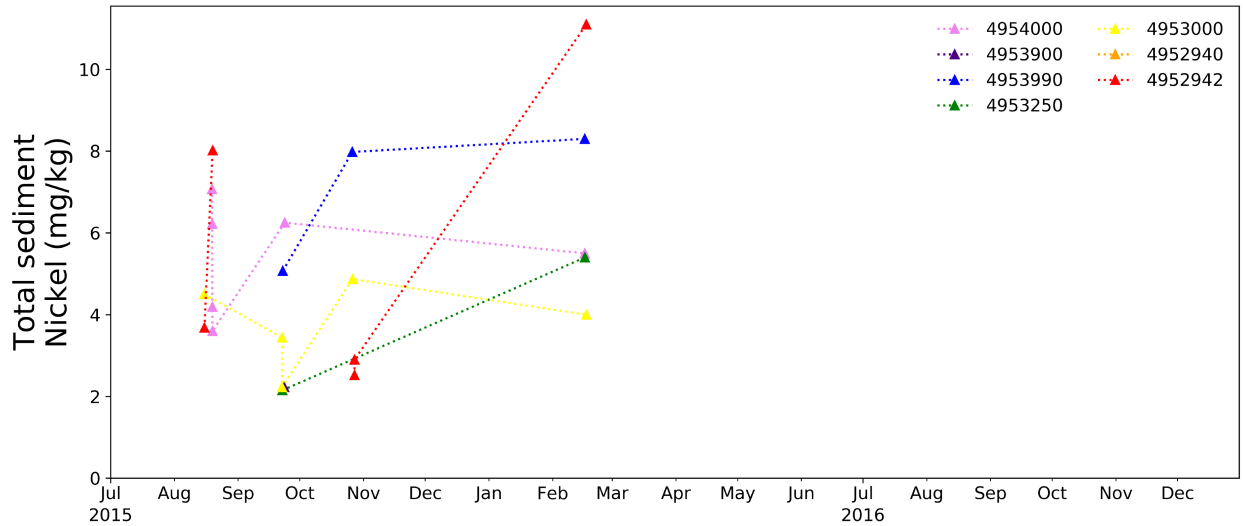

Figure 77 - Sediment nickel concentrations in the San Juan River before and after the GKM plume entered Utah.

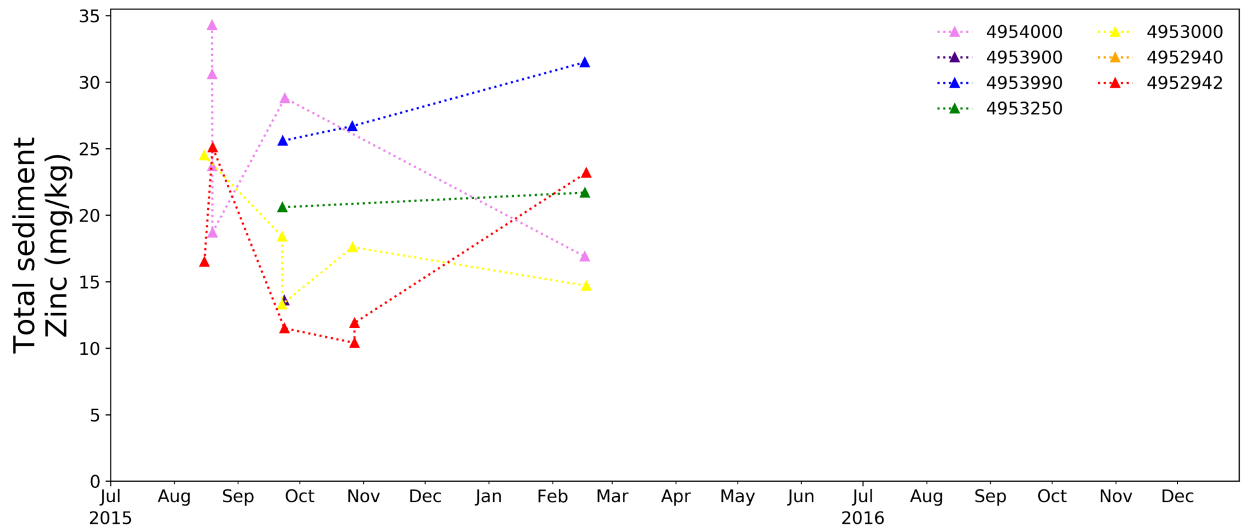

Figure 78 - Sediment zinc concentrations in the San Juan River before and after the GKM plume entered Utah.

USGS Sediment Trap Analysis

The ultimate fate of sediment transported downstream from the San Juan River watershed in which the GKM spill occurred is Lake Powell, a reservoir in southeastern Utah that has been accumulating sediment from the watershed since its formation in 1963 behind Glen Canyon Dam. Following the spill, sediment traps were deployed by USGS at the terminus of the San Juan River in Lake Powell to assess recent and ongoing deposition and sediment metal concentrations. The traps are designed to capture sediment as it falls to the bottom of the reservoir. Sediment traps have been deployed seven times, including 1) August 23, 2015 through November 19, 2015 at the upstream location, 2) April 27, 2016 through May 17, 2016 at the upstream, midstream, and downstream locations, 3) May 17, 2016 through July 14, 2016 at the upstream, midstream, and downstream locations, 4) from July 14, 2016 through October 26, 2016, 5) March 2017 through June 2017, 6) June 2017 through September 2017, and 7) September 2017 through present at all three locations (Figure 37).

At the time of retrieval in November 2015, the 48 cm-tall trap was completely full and showed extensive layering, which may signal upstream sediment transport, unique storm events in the watershed, anthropogenic influences, or substantial reworking of the streambed sediment (Figure 79). Interestingly, the sediment package from the April 2016 and May 2016 deployments only amounted to 0.6 cm and 1.3 cm, respectively. The July 2016 deployment resulted in 2.5 to 6.4 cm of deposition. The April 2017 depl0yment had 5.0 cm in the upper trap and 0.5 cm in the lower trap. Sediment from the traps has been analyzed for up to 58 metals and metalloids for the August 2015, April 2016, and May 2016 deployments. Samples from the November 2016 are currently being analyzed. Additional sediment traps continue to be re-deployed in this area to capture sediments transported downstream during different hydrologic periods, typically snowmelt runoff and monsoon events separately.

Figure 79 - Sediment trap deployed in San Juan River Delta, August–September, 2015.

Each of the sediment trap deployments involved slight variations in laboratory analysis. For example, some analytical methods are good for refractory elements like zircon, reasonable for sodium, but not as robust for volatiles while other methods are reasonable for all but the refractory elements. Therefore, multiple laboratory analyses were run on the bulk of the samples collected. In addition, several of the metals were analyzed as a percent weight or as a concentration, depending on the deployment. However, a comparison of the individual analytes between each of the four available sediment trap deployments can be completed. Figure 80 provides a boxplot of all of the subsamples from each of the deployments that have been analyzed. It should be noted that the August 23 - November 19, 2015 deployment is at the upstream location only with 11 subsamples or depth intervals. The April 27 through May 17, 2016 deployment includes the upstream, midstream, and downstream locations with a single subsample for each of the three locations. The deployment from May 17 - July 14, 2016 includes the upstream, midstream, and downstream locations with three subsamples at the upstream location and one subsample at each of the midstream and downstream locations (Figure 37).

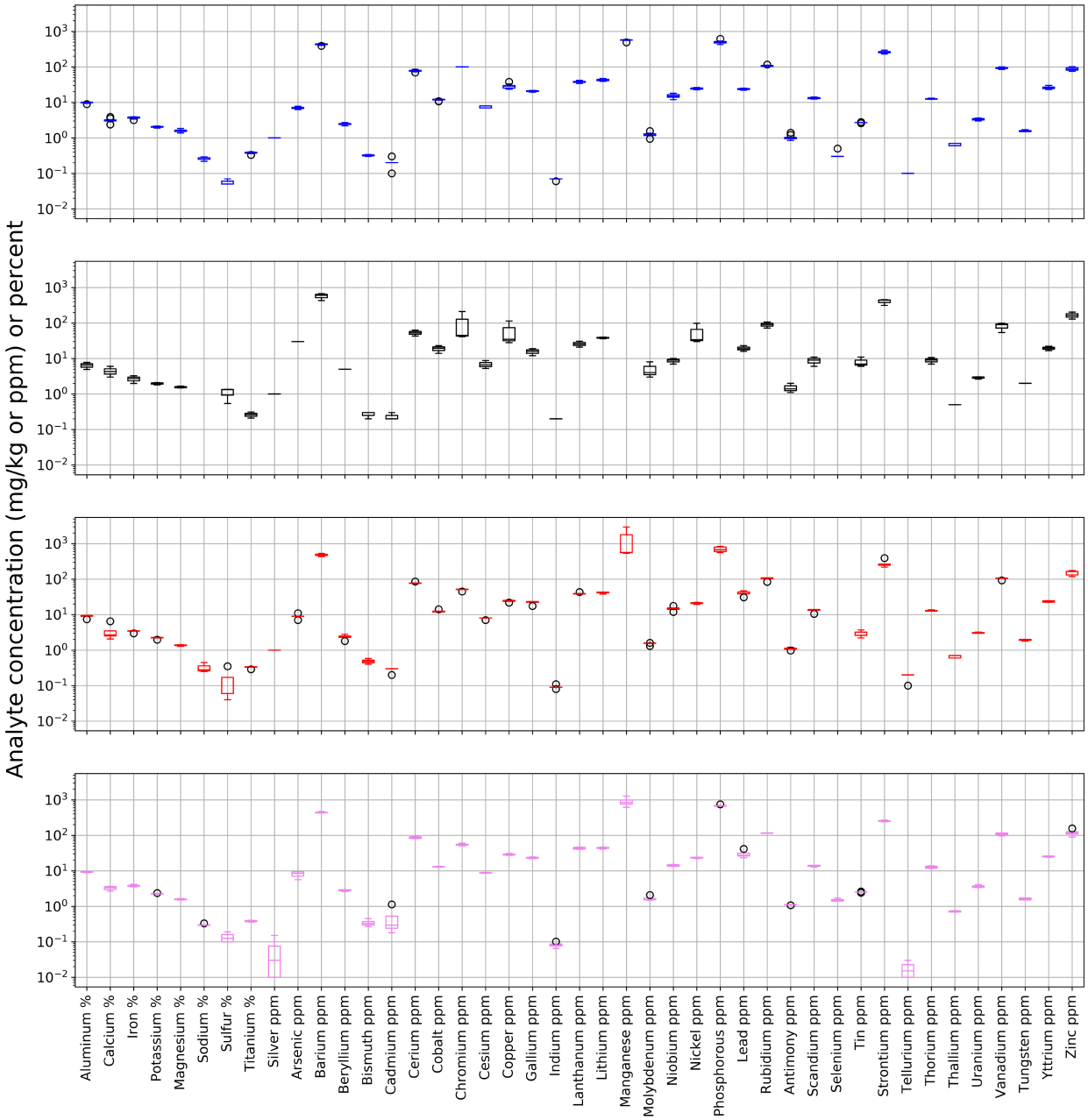

Figure 80 - Boxplots of the four USGS sediment traps analyzed to date 1) August 23 - November 19, 2015 at the upstream location only, 2) April 27 - May 17, 2016 at the upstream, midstream, and downstream locations, 3) May 17 - July 14, 2016 at the upstream, midstream, and downstream locations, and 4) July 14 – October 26, 2016 at the upstream, midstream, and downstream locations. The boxplots represent the variability between 11 subsamples for the August 2015 deployment at only the upstream location, a single subsample for each of the three locations for the April 2016 deployment, five subsamples between the three locations for the May 2016 deployment, and a single sample for each of the three locations during the July 2016 deployment.

For the UDEQ analysis, we compiled a consistent subset of the measured analytes during each of the deployments for comparative purposes (Figure 81). A direct comparison of the analytes by percent weight or concentration versus depth between each of the three sediment trap deployments is shown. The blue represents the August 2015 deployment results and is the deepest sediment package at 48 cm. The red bars represent the April 2016 deployment, the yellow bars represent the May 2016 deployment, and the

pink bars represent the July 2016 deployment. Depths with darker shading indicate that duplicate samples were collected at that depth.

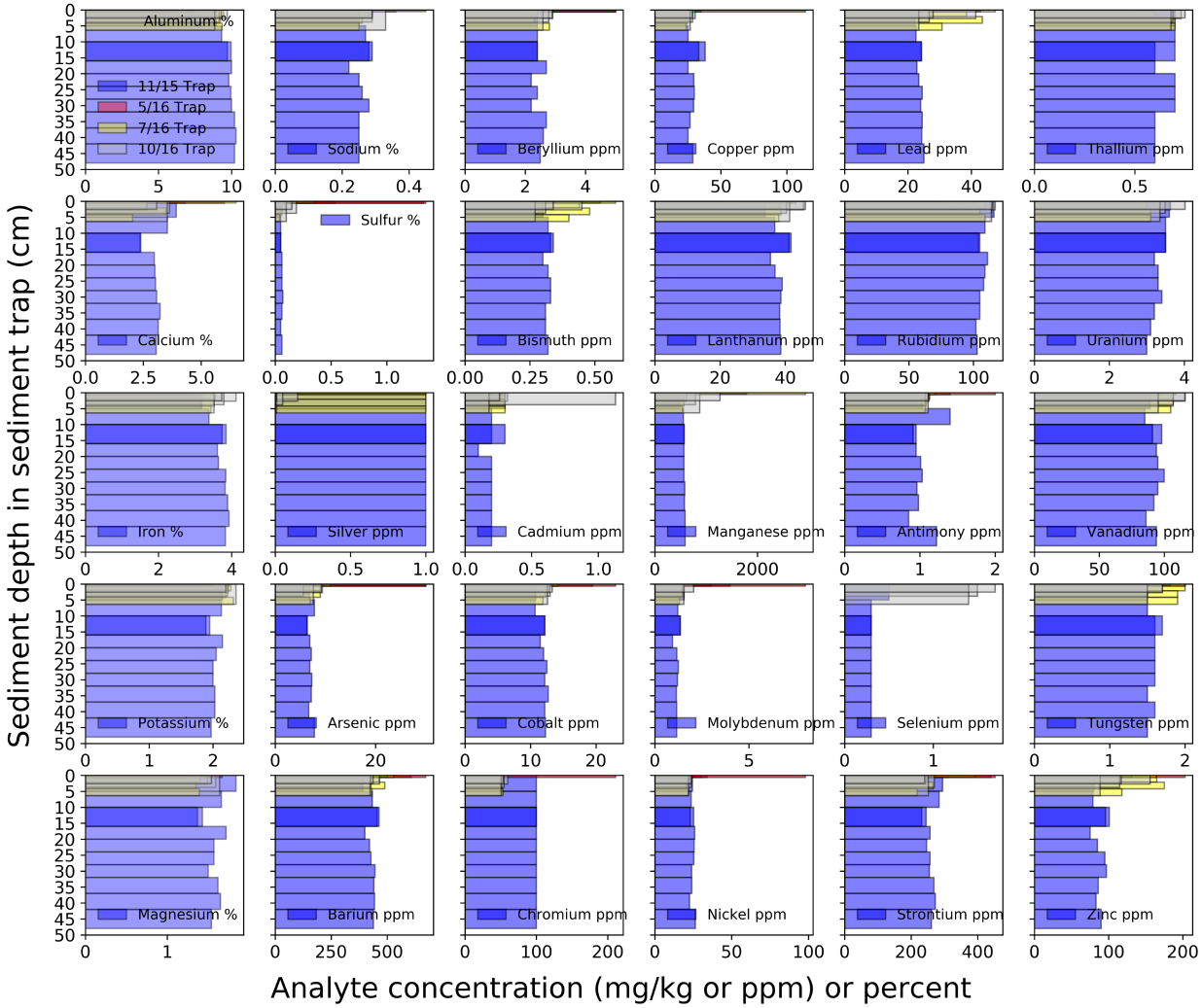

Figure 81 - Comparison of metal analytes by percent weight or concentration versus depth for each of the four sediment trap deployments. The blue represents the August 2015 deployment results, red represents the April 2016 deployment, yellow represents the May 2016 deployment, and silver is July 2016 deployment. Darker shading indicates duplicate samples collected at that depth or multiple locations for the same deployment.

From Figure 81, it is easy to see that iron and magnesium are relatively consistent with depth. However, nearly all of the other constituents show peaked concentrations at the top of the column, particularly, antimony, bismuth, cadmium, copper, molybdenum, lead, and zinc. This may suggest redox-active processes are occurring as deposition increases and that once buried, the concentrations begin to decline. Typically, the later deployments indicate results that are consistent with previous deployments such as, iron, magnesium, and potassium. However, the May 2016 deployment does indicate much higher concentrations for sulfur, arsenic, beryllium, cobalt, nickel, and strontium.

The lighter bands of the same color (i.e.: pink rather than red) indicate upstream locations with colors darkening with the addition of multiple sampling locations. It appears that for the April 2016 deployment barium, cobalt, copper, molybdenum, and especially nickel decrease with distance downstream. This suggests that these metals are preferentially sorbed to coarser grain mineralogy and colloids that are deposited rapidly at upstream locations. For the May 2016 deployment, shown in yellow, the three

subsamples are representative of the upstream location and the lighter, wider bands are the midstream and downstream locations. For this period, it appears that the three depths show nearly consistent results for all the analytes at the upstream location. It also shows that the upstream, midstream, and downstream concentrations are generally about the same for each of the analytes. Exceptions are the increase in strontium, sulfur, and potentially cobalt with distance downstream.

Overall, there is correlated and corroborated evidence of an increase in metals concentration at depth intervals with dark organic banding, suggesting that increased metal sorption and cation exchange processes are prevalent in fine-grain, silty, and organic sediment. There is also a consistent decrease in concentration below or deposited prior to these fine-grained sediments leading to ion exchange processes under reducing conditions as a dominant theory. In addition, the April 2016 and, to a lesser degree, the May 2016 deployments, suggest that spring runoff may not produce nearly as much sediment as monsoon events.

Analysis of Sediment cores collected from Lake Powell

Evaluation of metals concentration with depth in each core

Because of concerns from resource managers about the potential health impacts to humans and aquatic wildlife from contaminated sediment transported to Lake Powell, the USGS collected and analyzed sediment cores in 2010 and 2011 in the San Juan and Escalante River deltas of Lake Powell to assess the presence of trace elements and organic compounds. Sediment cores were collected from three locations in the San Juan River in 2010. Out of the 57 major and trace elements analyzed, most were detected at concentrations greater than minimum reporting levels in the sediment core subsamples and composited samples, with the exception of organochlorine pesticides and polychlorinated biphenyls, which were not detected in any samples (Hornewer 2014).

UDEQ also examined the metal concentrations measured in the three cores (Figure 33) from the San Juan arm of Lake Powell collected in 2010 (Hornewer 2014). Figure 82 provides the distribution of sediment concentration observed in each of the cores. Two of the three cores show a marked increase in metals concentration at depth (e.g., approximately 3.9 meters deep at downstream Core 3; Figure 83). USGS estimates that the sediment deposition in the San Juan arm of Lake Powell is at least 0.5 meter per year (Hornewer 2014). Based on the almost 0.5 meter of deposition in the sediment trap collected after only 4 months in the fall of 2015, deposition rates can be substantially higher. Assuming a deposition rate of 0.5 to 1.0 meter, the 4.5-meter core in the San Juan arm of Lake Powell may represent 5 to 10 years of sediment deposition. Concentrations of metals (e.g., aluminum, cobalt, chromium, copper, iron, lead, manganese, vanadium, and zinc) in the USGS cores were generally higher than the surficial sediment samples collected in August and October 2015, from the San Juan River but still within the same order of magnitude. The differences between the concentrations measured in the USGS cores and UDEQ sediments cannot be interpreted with substantial confidence due to the small sample size and lack of age dating. Additional, age-dated sediment cores to a much deeper depth are needed to assess sediment pollutant concentrations over time and potential sources that contributed that sediment package.

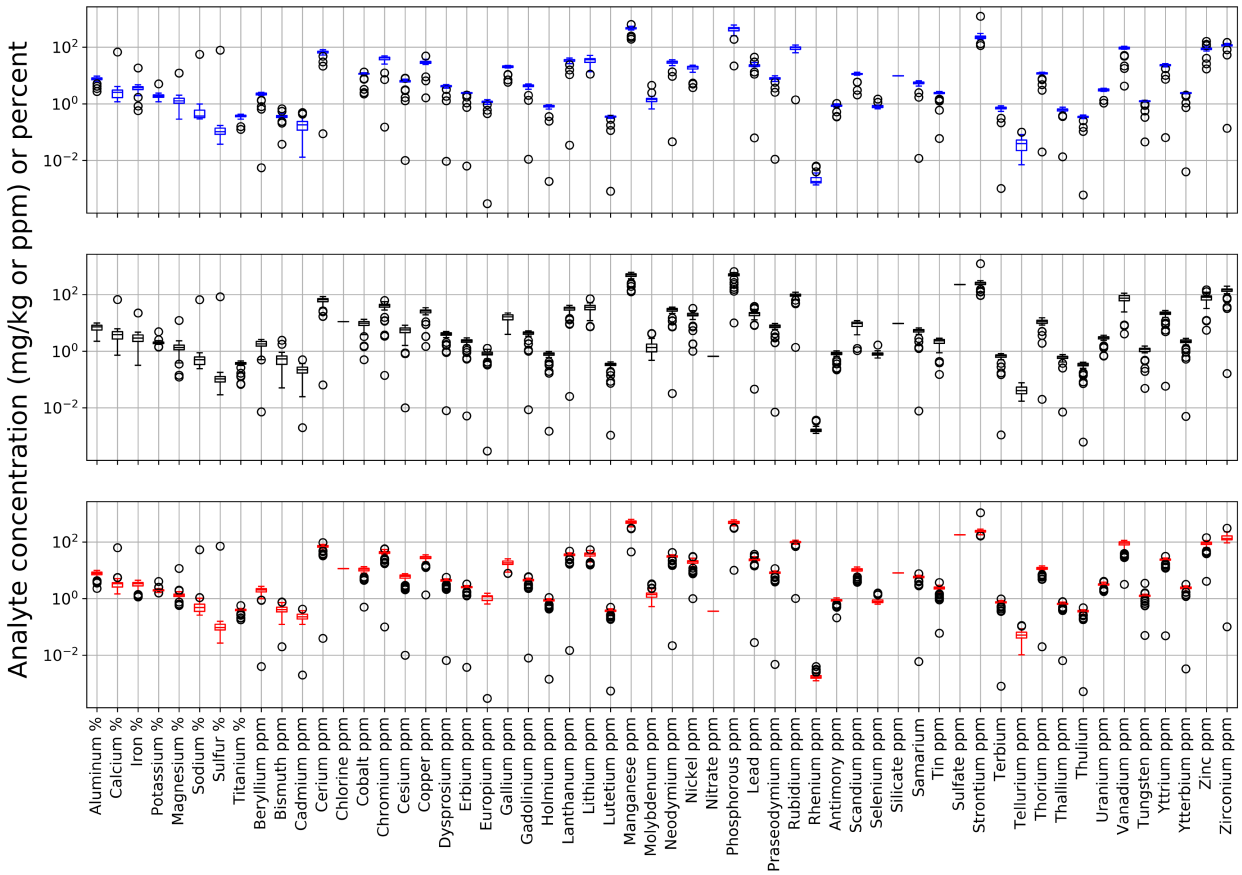

Figure 82 – Boxplot comparison of the analyte variability from the 2010 USGS sediment cores in the San Juan arm for the 1) upper, 2) mid reach, and 3) downstream locations.

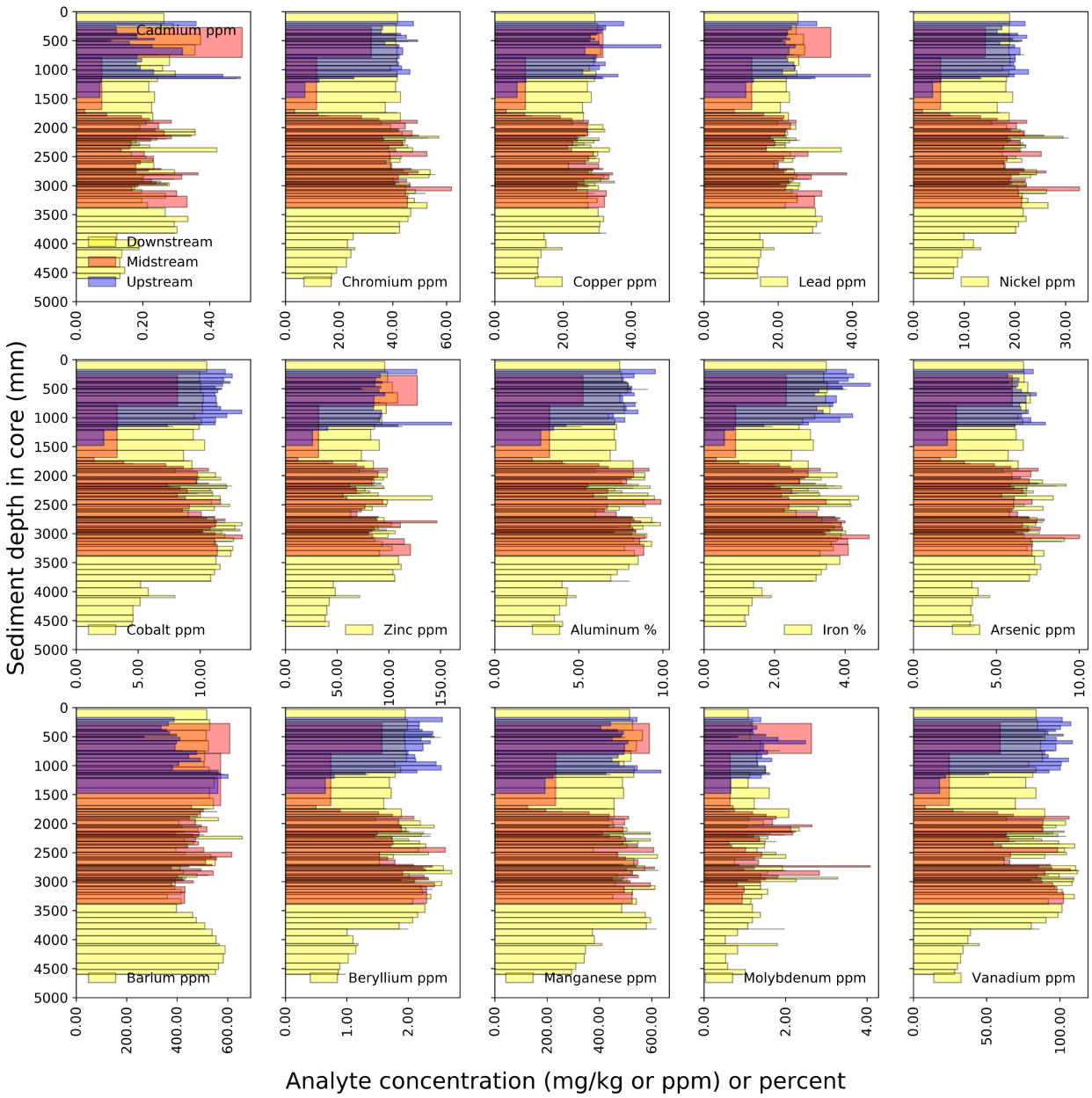

Figure 83 – Analysis of key metals concentrations with depth from the 2010 USGS sediment cores collected in the San Juan arm of Lake Powell. Downstream locations are in yellow, midstream location depths are in red, and the upstream depths are shown in blue. Darker shading indicates multiple samples at the same depth.

Analysis of the aluminum concentration as a function of depth revealed a general decrease in concentration with depth, particularly for upstream core location 1 and downstream core location 3 (Figure 84).

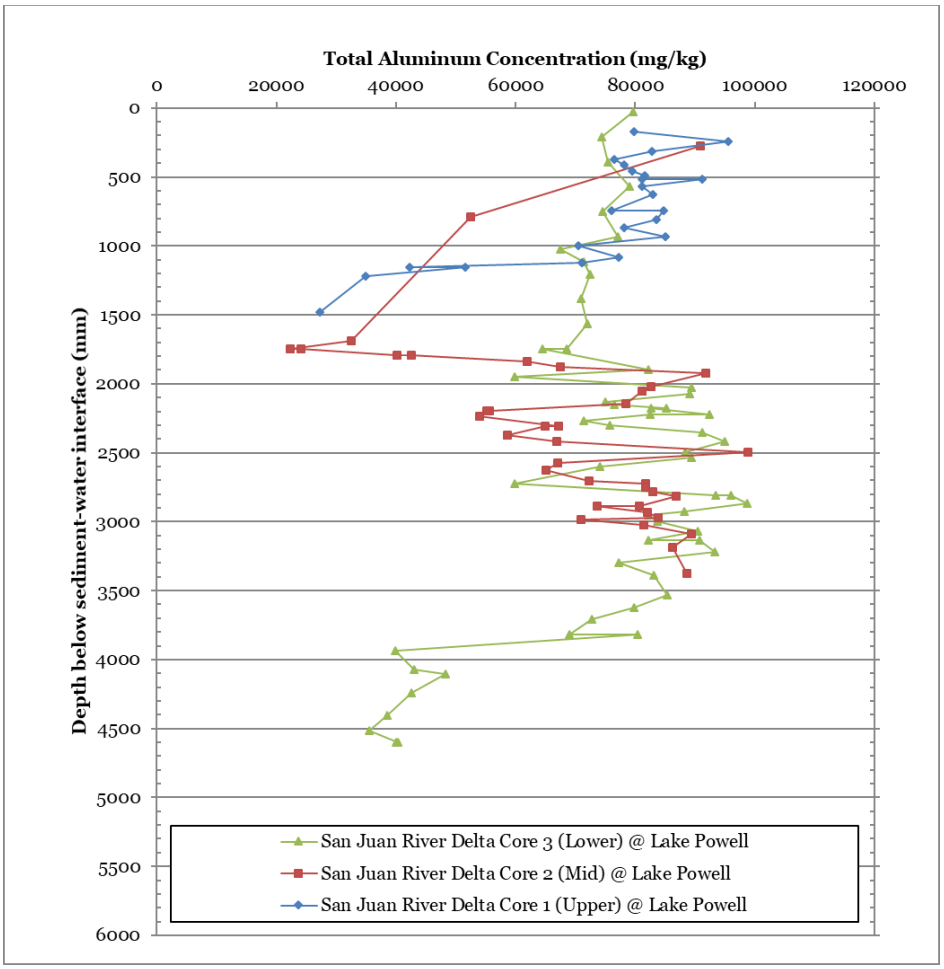

Figure 84 – Comparison of the total aluminum concentration (mg/kg) as a function of depth for each of the USGS 2010 San Juan River sediment cores.

Midstream core 2 displays a decrease in concentration for the first half of the core and then an increase to near streambed concentrations. Although, the upper portion of the core was a composite of multiple depths suggesting poor sample extraction or potential lack of sample. Upstream core 1 appears consistent with downstream core 3 near the stream-sediment interface to a depth of about 1000 mm. Concentrations from the two cores fluctuate 5.6 ± 6.1 percent. Downstream core 3 is also consistent with midstream location core 2 from a depth of about 1700 mm to the maximum of 3500 mm with similar spikes and decreases in concentration at similar depths. The variation in concentrations for cores 2 and 3 at this depth range is 8.9 ± 21 percent, which is simply due to slight differences in exact depth. These large fluctuations suggest different source contributions that are either event-driven or inter-annual. The resulting variability could also be organic deposition affecting the redox potential and influencing associated chemical concentrations. Midstream core 2 is generally consistent with upstream core 1 to approximately 1700 mm. It is difficult to directly compare the total aluminum concentration with depth between each of the three core locations because Lake Powell water depth steadily increased from core 1 to core 3 and would be expected to preferentially deposit coarser to finer grain sizes. In addition, aggradation and degradation of sediment and subsequent transport may also cause heterogeneity in analyte concentrations with depth. However, similar deposition patterns among cores (Figure 84) suggest variation in source contributions drives heterogeneity.

Metals concentration relative to interpreted grain size with depth in each core

Metals preferentially adsorb to fine-grain particles and organics, resulting in a potential relationship between metal concentrations and sediment grain size. Therefore, UDEQ further attempted to compare these analyte concentrations over depth with sediment grain size to determine if specific changes in concentration with depth correlated to a change in grain size. The data provided in Hornewer (2014) did not explicitly offer grain size distribution for each of the analyzed sub-samples with depth. Therefore, UDEQ used professional judgement to decipher and interpret the potential range and mean grain size for each of the subsamples (Figure 85). Our results suggest that there is a possibility of increasing concentrations of most analytes correlated to increasing grain size, which is contrary to expectations. However, this is not necessarily consistent throughout the entire sediment package nor between analytes. In addition, the expected grain-size gradient at each core location is confounded with the spatial depositional gradients associated with where the river enters the lake and the variability in lake level. This analysis should be considered a preliminary evaluation of the correlation between sediment concentration and grain size. Future analysis of the sediment package should be completed to better define this interpretation.

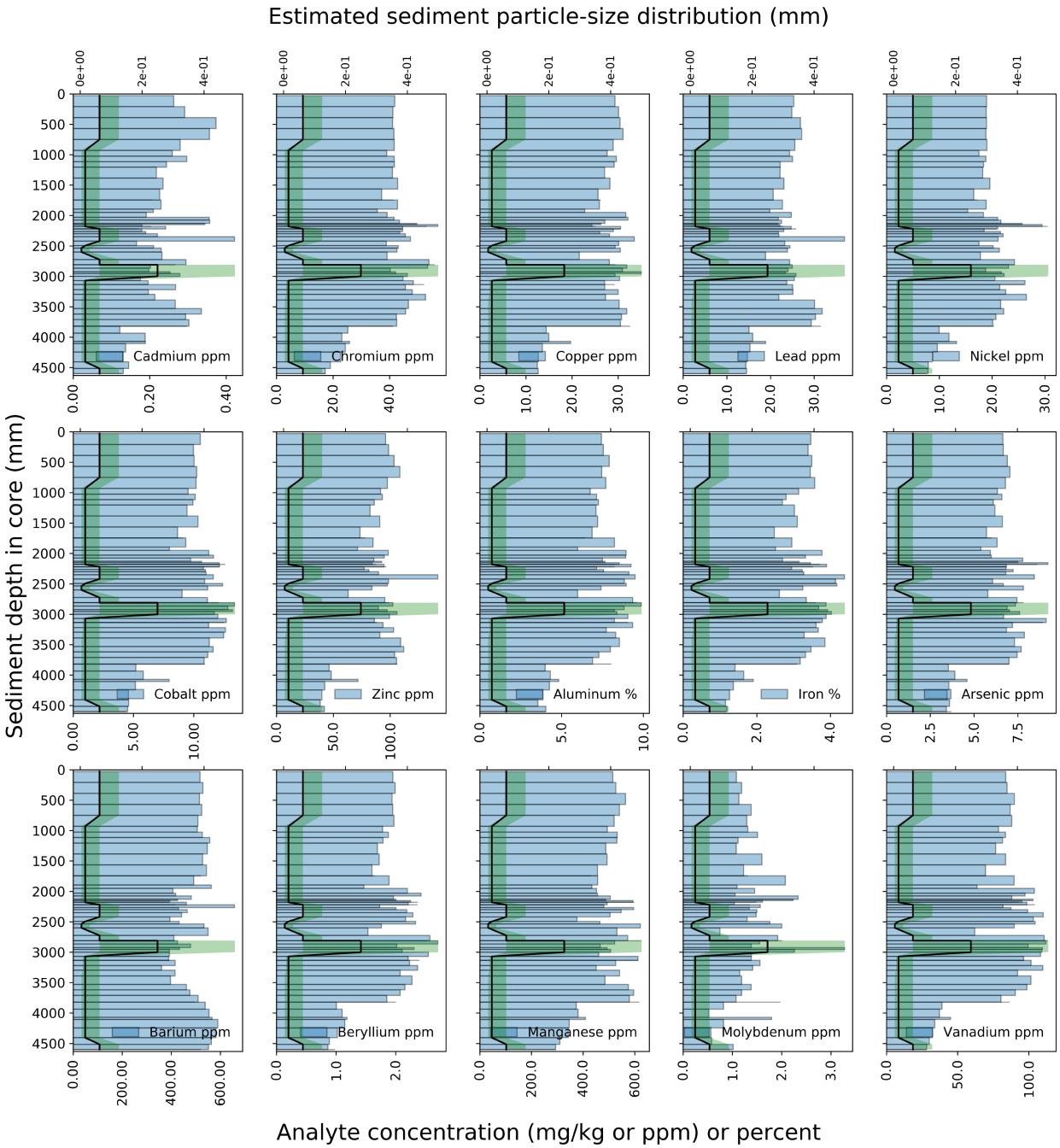

Figure 85 – Metals concentration versus depth for selected elements from the 2010 USGS downstream (Core 3) San Juan River delta sediment core. The estimated approximate grain size range as a function of depth is presented in green and the median is denoted by the black line.

Comparison of individual metals concentration to aluminum as a function of depth in each core

EPA (2017) found that the ratio of lead to aluminum could be used as a signature of the GKM release. UDEQ built upon this approach and calculated the ratio of multiple constituent concentrations to aluminum concentrations as a means of identifying a potential GKM release signature and evaluating the potential for changes in source contribution of sediment through time. An apparent shift in the constituent:aluminum ratio for multiple elements at about 3.9 m (Figure 86) suggests a change in sediment source contributions at that depth. Multiple analytes such as sodium, selenium, barium, and

potassium show a marked decrease in their ratio to aluminum with more recently deposited material; however, vanadium, nickel, antimony, chromium, and copper indicate an increase. More importantly, the specific excursions might be exhibited by boron, molybdenum, and tungsten analytes. It is important to evaluate the constituent:aluminum ratio for all analytes over the entire core length because the reaction kinetics and in-stream processing of individual analytes are not on the same temporal scale.

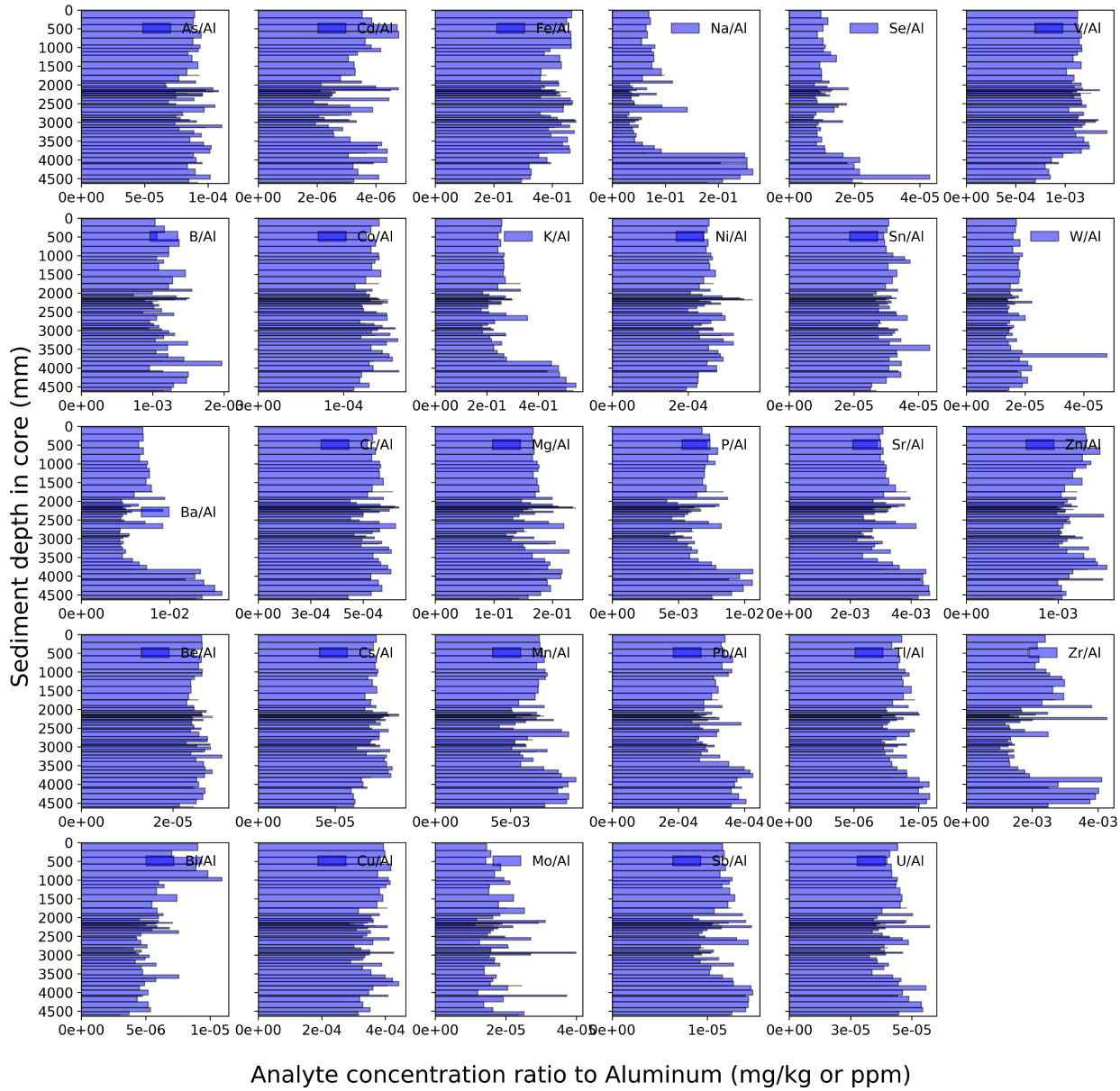

Figure 86 - Ratio of metals concentration to aluminum concentration versus sediment depth for selected metals from the 2010 USGS San Juan River delta downstream (Core 3) sediment core.

Qualitative age dating of core sections based on repeated bathymetric surveys

As we have shown, it is important to understand the historical metals loading with respect to the GKM release and the deposition of the metal mass in the Lake Powell repository. However, to characterize the impacts of release events or watershed-based mitigation activities on water quality, it is important to define the deposition rate and apparent age of components of the sediment package in Lake Powell. To accomplish this, UDEQ utilized historical bathymetric survey elevation data presented in Hornewer (2014) to identify how longitudinal changes in streambed elevation changed over time in the San Juan

delta of Lake Powell. The elevation data presented in Figure 87 includes bathymetric surveys compiled for 1956 (prior to Glen Canyon Dam), 1986, 2003, 2004, and 2011 collected from the Grand Canyon Monitoring and Research Center. In addition, elevation data for the San Juan delta streambed for 1963 (when Lake Powell began to fill) and 1986 is included from Ferrari (1986). The 2010 USGS San Juan arm of Lake Powell sediment cores are overlain on top of each of the bathymetric surveys in Figure 87.

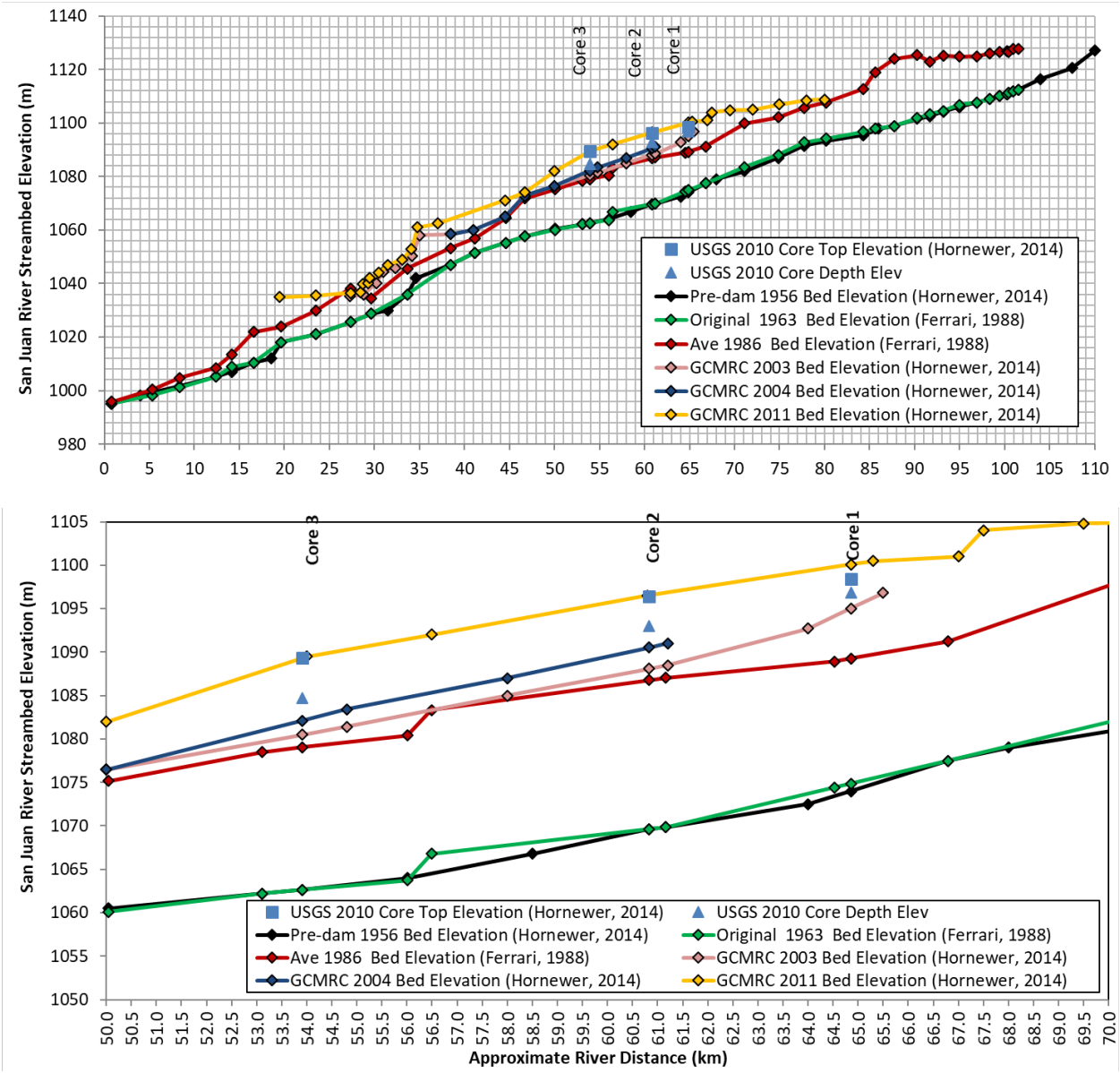

Figure 87 – A) bathymetric surveys completed in the San Juan delta of Lake Powell from 1956, 1963, 1986, 2003, 2004, and 2011 (Hornewer, 2014; Ferrari, 1986). The 2010 USGS sediment cores (Hornewer, 2014) are superimposed on the figure and labeled accordingly. B) Higher spatial resolution of the core locations.

The elevation data were compiled with the associated river distance data for each of the surveys. In most cases, equivalent river distances between the bathymetric survey and the core locations were not evaluated and therefore, elevation estimates were interpolated for specific core locations. The basic elevation and depth information for each core is presented in Table 8.

Table 8 - Core elevation and depth information.

Explanation	Core 3	Core2	Core1
Core top elevation (m)	1089.37	1096.37	1098.37
Depth to primary concentration change (m)	3.94	1.75	1.08
Primary concentration change elevation (m)	1085.44	1094.62	1097.29
Core Bottom elevation (m)	1084.69	1092.96	1096.87

The streambed elevation for each of the bathymetric surveys at each of the core locations is presented in Table 9. In some cases, the elevation was interpolated as necessary between adjacent bathymetric elevations during the same study to get the elevation during that year at each of the core locations. Also note that the 2004 survey did not extend to the core 1 river distance upstream.

Table 9 - Bathymetric survey elevations for each core location.

Explanation	Core 3	Core2	Core1
1956 elevation (m)	1062.65	1069.64	1074.00
1963 elevation (m)	1062.65	1069.64	1074.86
1986 elevation (m)	1079.04	1086.78	1089.26
2003 elevation (m)	1080.49	1088.10	1095.04
2004 elevation (m)	1082.12	1090.54	
2011 elevation (m)	1089.50	1096.50	1100.11

The sedimentation rate was linearly estimated as the difference in bathymetric elevation at a point location over the time interval between surveys and is presented in Table 10.

Table 10 - Estimated sedimentation rates between bathymetric surveys.

Explanation	Core 3	Core2	Core1
1-Rate 1956-1963 (m/yr)	0.00	0.00	0.12
2-Rate 1963-1986 (m/yr)	0.71	0.75	0.63
3-Rate 1986-2003 (m/yr)	0.09	0.08	0.34
4-Rate 2003-2004 (m/yr)	1.63	2.44	
5-Rate 2004-2011 (m/yr)	1.05	0.85	
7-Rate 2003-2011 (m/yr)	1.13	1.05	0.63
6-Ave rate 1956-2011 (m/yr)	0.49	0.49	0.47

The estimated age date associated with the primary concentration change in each of the cores using the different rates to estimate the date is presented in Table 11. Effectively, UDEQ used the difference between the elevation of the concentration change and the last bathymetric survey elevation, divided this by the most recent sedimentation rate and added the total to the last bathymetric year. The bolded numbers are the most reasonable estimates based on the closest surveys bracketing the core. For core 1, the 2004 data was not available and the sedimentation rate was estimated over the 2003 to 2011 period.

Table 11 - Estimated age dates for primary concentration change in each of the cores.

Explanation	Core 3	Core2	Core1
Primary concentration age from rate 5 (yr)	**2007.15**	**2008.80**	
Primary concentration age from rate 4 (yr)	2006.03	2005.67	
Primary concentration age from rate 7 (yr)	2007.39	2009.21	**2006.56**
Primary concentration age from rate 3 (yr)	2060.71	2087.28	2009.63
Primary concentration age from rate 6 (yr)	2009.68	2014.16	2010.28

Finally, if we take the range and average in these age dates for the concentration change in each of the cores, we get an approximate age range as presented in Table 12. However, this incorporates much older sedimentation rates as well.

Table 12– Best estimate of age range and apparent age for the three USGS 2010 sediment cores in the San Juan delta of Lake Powell.

Explanation	Core 3	Core2	Core1
Minimum approximate age	2006.03	2005.67	2006.56
Maximum approximate age	2009.68	2014.16	2010.28
Best approximate age	2007.56	2009.46	2008.82

The sediment depth, associated elevation, and estimated age for each of the sub-samples from each of the 2010 USGS San Juan delta cores is presented in Figure 88. Now that we have a preliminary estimate of the associated age for sediment cores with depth, a viable next step is to evaluate potential watershed mitigation efforts that might have contributed to water quality variations. The following remediation efforts occurring specifically in the Bonita Mining District include the following (Finger et al., 2007; Guerard et al., 2007; Reclamation, 2015):

- 1991 – Sunnyside Mine closed
- 1993 – American Tunnel, Sunnyside Mine bulkhead installed
- 1996 – CODOH consent decree for discontinuation of Sunnyside Mine perpetual water treatment
- 1996 – American Tunnel bulkhead closed
- 1996-2003 – Mineral Creek remedial actions
- 1996-1997 – Drain acidic pond and remove Longfellow-Kohler waste pile
- 2003 - Bulkhead seal in Kohler adit
- 1997 – Bulkheads installed at Sunnyside, Gold Prince, Ransom mines, and other locations
- 1999 – ARSG ranks Silver Ledge the worst, followed by Mogul Mine
- 2000 – AMD from Mogul Mine, potentially from 1997 bulkhead at Sunnyside
- 2002 – Increased discharge from Red, Bonita, and Gold King Mines
- 1993 – American Tunnel, Sunnyside Mine second bulkhead installed
- 2003 – Bulkheads installed in Mogul and Koehler mines, increased discharge from Red, Bonita, and Gold King Mines
- 2003 – Gladstone treatment ceases operation
- 2008 – DRMS rerouted Gold King Mine drainage into lined channel/trough
- 2009 – DRMS closes all four Gold King Mine portals but small discharge from Level 7 adit

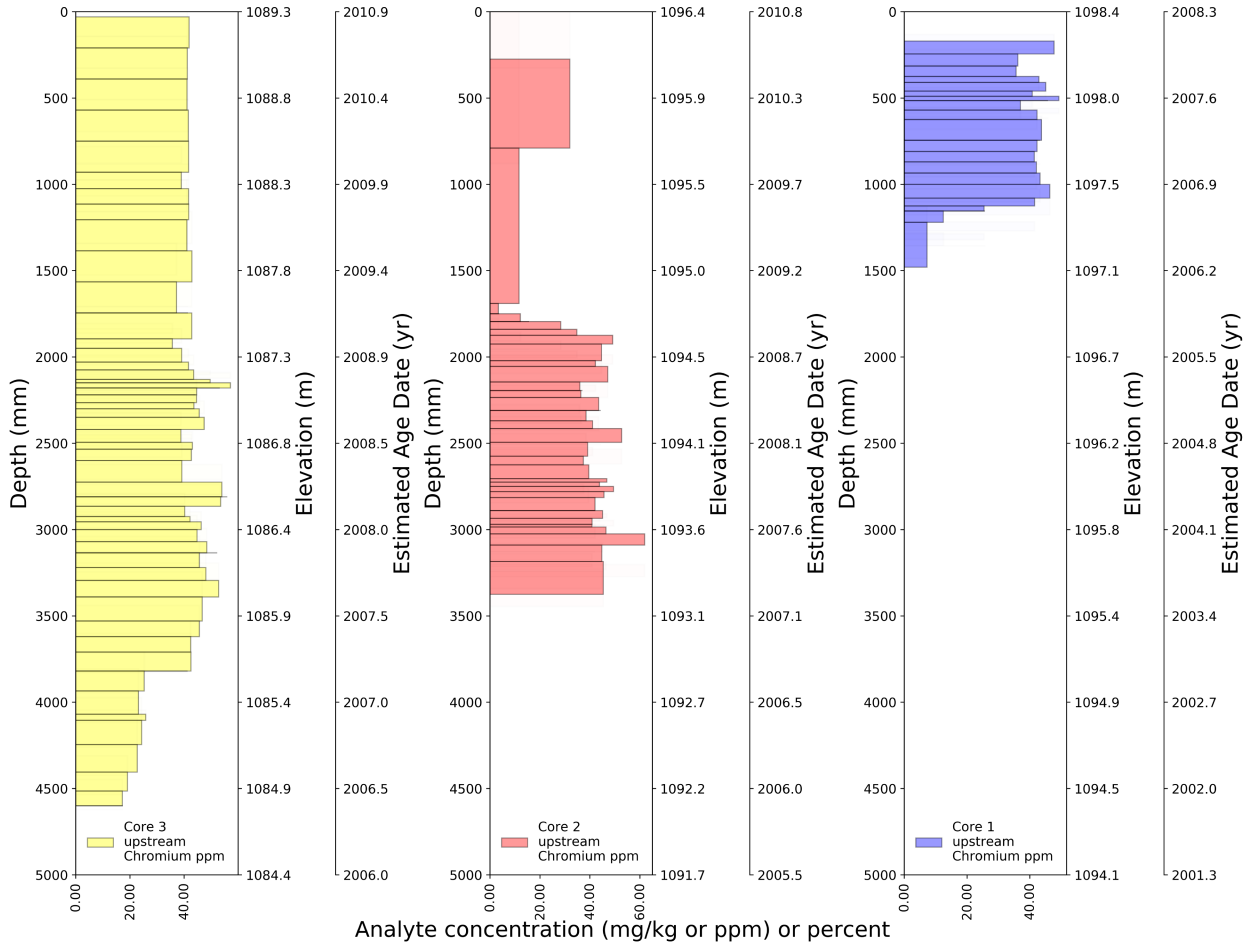

Figure 88 - Estimated age dating of the 2010 USGS San Juan River delta cores. Apparent ages are based on repeated bathymetric surveys throughout the San Juan River delta to provide the elevation context relative to the sediment cores.

It appears that increased discharge and deleterious water quality effects were noted in adjacent mines due to bulkhead installations after a period of approximately 3 years or more. However, it should be noted that this does not include the transport time and fate of water quality and sediment effects to the lower San Juan River and Lake Powell. This may potentially add an additional one to two years for the effects on sediment quality to be observed in the San Juan River delta. Therefore, UDEQ's first-order estimate of age dating the primary concentration change observed in the 2010 USGS sediment cores suggest dates of around mid-2006 to early-2008. Observed effects on sediment metal concentrations in Lake Powell may be observed 3 to 6 years later, particularly with bulkhead installations, although, may be within a year if wastewater treatment cessation drives the change in sediment concentration. This suggests that activities between 2000 and 2008 may be responsible for the concentration increases observed.

It is not likely that waste rock removal, diversion of flow around waste piles, settling ponds, and similar activities would cause these changes as they have the primary motivation of removing mass from the system. It is expected that activities such as bulkhead installations that may increase hydrologic head and result in increased discharge from adjacent adits or the cessation of waste treatment facilities may be the culprit. Therefore, the 2003 bulkhead installations at the Mogul and Koehler mines, which increased discharge from the Red, Bonita, and Gold King Mines or the 2003 cessation of the Gladstone treatment operations are the most likely causes of concentration changes in the San Juan River sediment cores.

Comparison of GKM spill-related sediment trap results to 2010 USGS core results

A significant question that arises is whether metals concentrations in the San Juan River are primarily the result of the Gold King Mine spill or a function of long-term, pre-spill conditions. If we examine the

metals concentrations in terms of magnitude for the 2010 USGS cores with the metals concentrations in the sediment traps, we can begin to answer this question. The first trap was deployed from August through November 2015, immediately after the GKM spill. Figure 89 presents analyte concentrations relative to depth for selected metals in the sediment traps and subsequently, the sediment cores. The initial sediment trap deployment had the most deposition and is therefore, the deepest. The sediment cores show location differences by color, not temporal differences since they were collected over the same time for each deployment. The data suggest that several analytes show different concentrations in the sediment trap data than shown in the cores (Figure 89.) For example, chromium was roughly 100 mg/L, whereas the sediment cores reached a maximum concentration around 50 mg/L. Other constituents that were generally higher in the sediment traps were aluminum and manganese. However, barium concentration was generally decreased in the sediment traps relative to the sediment cores.

For the spring runoff samples, sediment lead concentrations at approximately 50 mg/L were much greater than the 30 mg/L on average observed in the sediment cores. This suggests sediment transport during the spring runoff increased concentrations relative to those immediately after the GKM spill. We see similar spring runoff increases with arsenic (~11 from 7 mg/L), beryllium (~5 from 2.5 mg/L), cobalt (~24 from 12 mg/L), molybdenum (~8 from 1.5 mg/L), and zinc (~170 from 100 mg/L). In some cases, the early spring runoff samples showed higher concentrations but in other constituents, the summer baseflow sediment trap resulted in higher concentrations. These combined results suggest sediment metal concentrations captured from recent sediment traps, spring runoff 2016 in particular, are elevated compared to previously collected sediment cores. Therefore, it appears that GKM sediments with high metals concentrations are displayed in Lake Powell sediments.

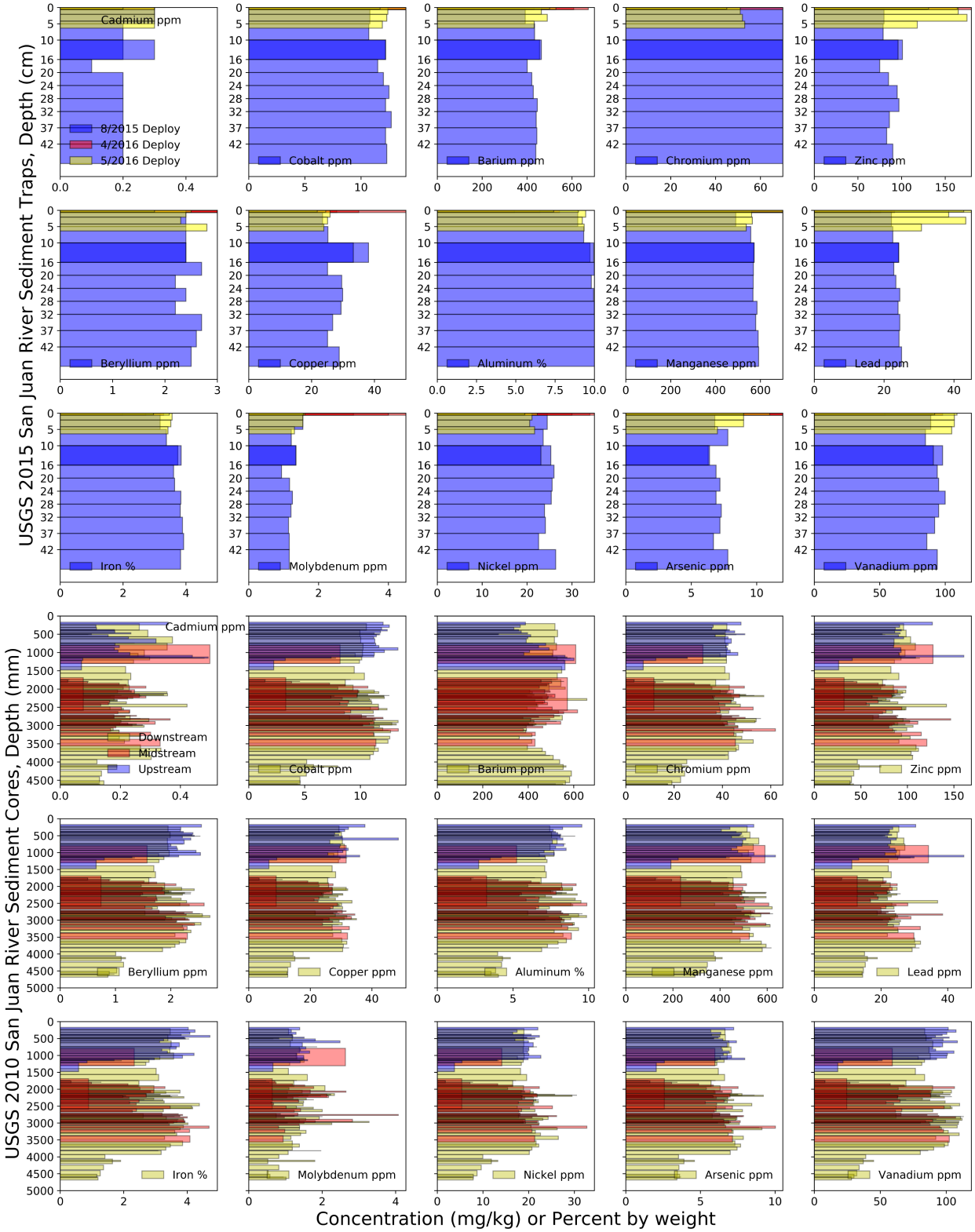

Figure 89 – Comparison of 2010 USGS sediment core concentration as a function of depth for selected metals with the USGS sediment traps. For both sets of data, the concentration of selected metals is plotted against the sediment depth.

A key question is why the initial sediment trap had such a significantly higher depositional rate than any of the other sediment trap deployments. While total period of deployment, inter-deployment variability, and spatial positioning of the sediment trap could provide further detail on the observed sediment rate, it is reasonable to assume that a major precipitation event may be responsible. If we look at the monthly precipitation recorded in the region, particularly from August through November 2015, we see much higher than average percentage precipitation. For example, In August 2015, the Colorado Basin River Forecast Center reports that there was 300 to 500% above average precipitation occurring in the Animas River basin (Figure 90). This suggests that the reason the first sediment trap was so full, was the above average precipitation, specifically from the Lower Animas but also to some degree from New Mexico's La Plata watershed.

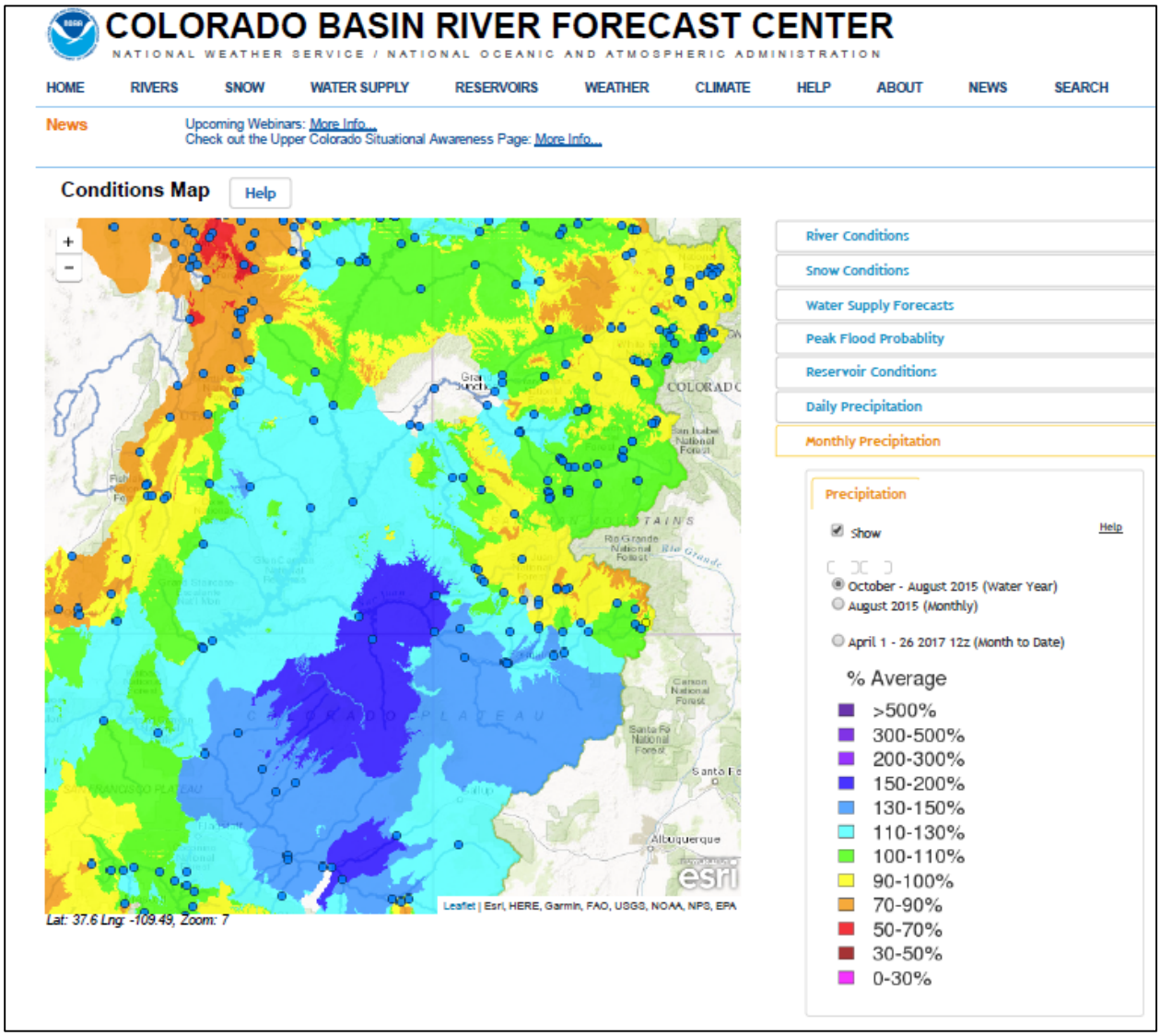

Figure 90 – Colorado River Basin Forecast Center monthly precipitation for the region during August 2015. Note the increase above average in the Lower Animas River. Data source https://www.cbrfc.noaa.gov/ accessed on November 20, 2017.

8. Potential Soil and Bedrock Source Contributions

UDEQ has collected and analyzed spatial and temporal in-stream water quality data to better understand the metals loading throughout the system and evaluate consistencies and deviations throughout Utah. We have also evaluated the sediment and water quality data in the context of the influence of the GKM spill event on the sediment in the San Juan River and the fate of San Juan River sediment through sediment traps. Furthermore, we have provided a description of the evolution of these transported sediments over time through a 2010 USGS sediment coring study. However, understanding the spatial bedrock source contributions on San Juan River sediments is crucial for developing mitigation strategies and future management efforts.

UDEQ compiled soil metal chemistry results for different soil types distributed throughout the San Juan River watershed including the Mancos Shale, the Moenkopi Formation, the Morrison Formation, and the Chinle Formation (Tuttle et al, 2007; Cadigan, 1971; Newman, 1962). We then compare the results between soil types for individual metals analytes to determine if there is substantial variability between soil types and the potential for source identification. Figure 91 provides the average concentration for each of these described bedrock and terrestrial source locations for a summary of analytes and the range in concentrations is provided with error bars. Note that the Mancos Shale is represented by multiple datasets (Hanksville Pits, Regional GGNCA, Candy Lane Trenches, and Elephant Skin Wash Trenches) as described in Tuttle et al. (2007). The purpose of this figure is to show that even in log-scale, relatively large deviations in concentration between soil types, which can aid in identification and fingerprinting source components. Several key components are provided in Panel B to elucidate the main differences and similarities between locations.

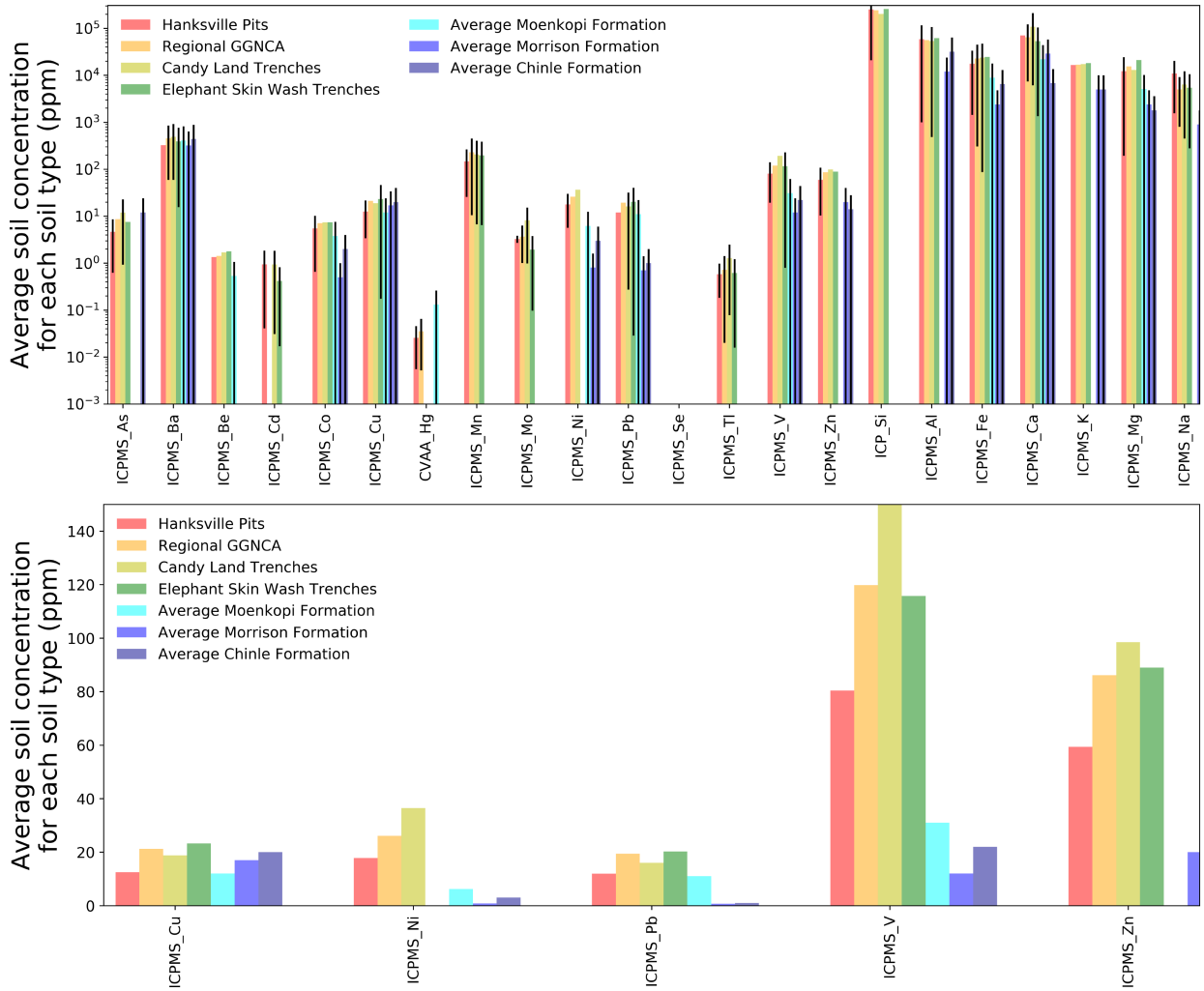

Figure 91 –Average soil concentration in formations and geologic materials observed throughout the San Juan River watershed for selected metals. Error bars in A) represent the variability in analyte concentration for each of the soil formations. Panel B) provides a summarized version of panel A) in linear scale for key metals that show higher range in concentration. Mancos Shale is represented by Hanksville Pits, Regional GGNCA, Candy Lane Trenches, and Elephant Skin Wash Trenches.

UDEQ then compared observational sediment concentration at multiple locations throughout the study reach relative to concentrations for each of the soil groups. Our idea was that if the observed sediment concentration is less than soil, the soil contribution may not impact in-stream concentrations and the values would be below the 1:1 line. If they are higher, this could mean that the specific soil formation might be influential and observational concentrations would be located above the 1:1 line. Furthermore, the individual dots are colored by sample month to determine if there is seasonal variability in overall metals, indicating controlling hydrologic regimes. Finally, any observed San Juan River sediment concentrations that are elevated relative to the terrestrial soil and bedrock source are labeled on Figure 92. These 1:1 plots for additional monitoring locations are also provided in Appendix J.

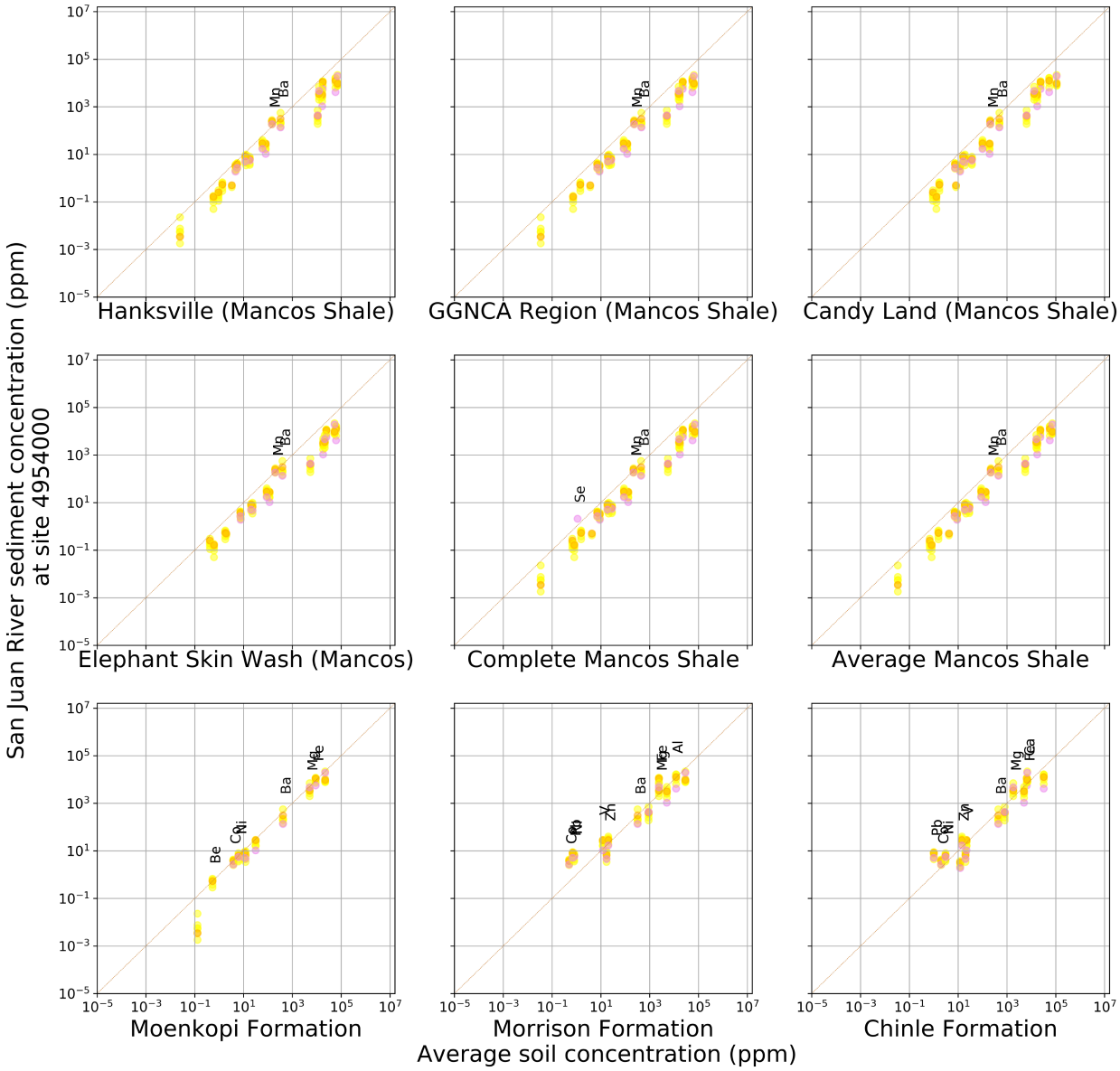

Figure 92 – Comparison between average soil formation concentration to observed sediment concentration from samples collected throughout the San Juan River. The color represents the month that the sample was collected with cooler to warmer colors representing the month of the year. Observed concentrations greater than the average soil concentration fall to the left of the 1:1 line and are labeled for convenience.

While EPA (2017) reports that a distinct geochemical signature is evident from the Bonita Peak mining district, particularly lead, the deviation between concentrations of different soil types shows that local soil leaching may also be a factor. We hypothesize that while mapped soil distributions are obvious sources, the erosive dissection of streams and channels and subsurface leaching can also promote geochemical signatures of these metals.

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