



UTAH DEPARTMENT of
ENVIRONMENTAL QUALITY
**WATER
QUALITY**

*Evaluation of UDEQ Water Quality and
Sediment Data Collected in the San Juan River
following the Gladstone Interim Treatment
Plant Failure*

Data Collected: March 16, 2019 – March 20, 2019

Prepared and Reviewed by:

Utah Department of Environmental Quality, Division of Water Quality

Summary

DEQ collected water and sediment samples at four different locations on the San Juan River in March, 2019. These data were screened against recreational, drinking water, agricultural, and aquatic life criteria and sediment samples were screened against recreational and aquatic life screening values. The tables presented below summarize the sampling effort and the exceedances that occurred. In the tables, blue cells indicate samples that were collected before the estimated arrival of the plume and the orange cells indicate an exceedance of a water quality criterion or a screening value. It should be noted that dissolved metal samples that were taken on March 16, 2019 - before the estimated arrival of the plume - may have been contaminated with particulate matter due to the difficulty of filtering samples with such a high content of sediment. This may have resulted in the number of water quality exceedances observed in these pre-plume samples.

Water quality samples exceeded criteria for lead, aluminum, copper, iron, and selenium; however, the only sample to exceed after the plume arrival was the aquatic life use selenium value. There were no recreational screening value water quality exceedances for total metals or sediment screening value exceedances for recreation and aquatic life.

Standards and Screening Values used in Evaluation of San Juan River Water Quality Samples

The table below summarizes applicable water quality standards for the San Juan River (R317-2-14), Utah's drinking water standards (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 Substance 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. 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.

Analyte	CAS #	Units	Utah WQ Standards (R317-2-14) for San Juan River Uses				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 (agricultural)		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				248		No Data Available	No Data Available	No Data Available	Antimony
Arsenic	7440-38-2	µg/L	10	340	150	186		200 (NAS)	100	2,000	Arsenic
Barium	7440-39-3	µg/L	1000			124,159		No Data Available	No Data Available	No Data Available	Barium
Beryllium	7440-41-7	µg/L	<4			1,242		No Data Available	No Data Available	No Data Available	Beryllium
Cadmium	7440-43-9	µg/L	10	2	0.25	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)	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	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	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	1,242		10 (NAS)	No Data Available	No Data Available	Mercury
Molybdenum	7439-98-7	µg/L				3,104		No Data Available	10	50	Molybdenum
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	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				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)		
pH								6.5-9 (Utah)	4.5-9 (NAS)		

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

Domestic Source Water Quality Criteria - Dissolved Metals

Comparison of San Juan River Water Data with Water Quality Standards (R317-2-14) for Domestic Source Water

The dissolved water concentrations of metals and metalloids were compared to Utah's water quality standards for the Class 1C use of protected for domestic purposes with prior treatment by treatment processes as required by the Utah Division of Drinking Water. There was one exceedance for lead observed in a sample taken before the plume arrived.

Domestic Source Water (Dissolved Metals)				No Exceedance		Above Screening Level																						
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	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	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	
4954000	San Juan R @ US160 Xing in CO	3/16/2019	12:31 PM	8,290.0	ND	2.8	189.0	ND	ND	62.8	3.2	ND	12.4	6,790.0	6.4	10.4	144.0	ND	ND	5.3	4.8	3.2	ND	97.2	ND	10.8	22.4	
		3/18/2019	4:52 PM	ND	ND	ND	135.0	ND	ND	87.7	ND	ND	3.3	ND	ND	17.3	2.1	ND	2.2	ND	3.9	2.6	ND	69.3	ND	ND	6.2	
		3/19/2019	1:30 PM	ND	ND	ND	132.0	ND	ND	88.4	ND	ND	ND	ND	ND	ND	18.7	ND	ND	2.3	ND	4.0	3.0	ND	64.9	ND	ND	ND
			10:15 AM	ND	ND	ND	138.0	ND	ND	88.4	ND	ND	ND	ND	ND	ND	19.3	ND	ND	2.5	ND	4.0	2.6	ND	65.6	ND	ND	ND
		3/20/2019	7:30 AM	ND	ND	ND	117.0	ND	ND	85.3	ND	ND	ND	ND	ND	ND	20.0	2.3	ND	2.2	ND	3.9	2.1	ND	58.5	ND	ND	7.5
11:00 AM	ND		ND	ND	121.0	ND	ND	85.5	ND	ND	ND	ND	ND	ND	20.0	ND	ND	2.4	ND	3.9	2.6	ND	59.1	ND	ND	ND		
4953990	San Juan R @ Town of Montezuma	3/18/2019	5:40 PM	ND	ND	ND	156.0	ND	ND	112.0	ND	ND	3.2	ND	ND	31.2	2.1	ND	2.6	ND	4.6	3.3	ND	82.2	ND	ND	ND	
		3/19/2019	2:10 PM	ND	ND	ND	142.0	ND	ND	107.0	ND	ND	3.3	ND	ND	30.5	ND	ND	2.3	ND	4.4	2.8	ND	78.4	ND	ND	ND	
		3/20/2019	8:15 AM	ND	ND	ND	145.0	ND	ND	107.0	ND	ND	ND	ND	ND	ND	32.0	2.6	ND	2.4	ND	4.5	2.9	ND	75.9	ND	ND	ND
11:30 AM	ND		ND	ND	140.0	ND	ND	108.0	ND	ND	ND	ND	ND	ND	31.2	ND	ND	2.4	ND	4.4	3.1	ND	73.5	ND	ND	ND		
4953250	San Juan R @ Sand Island	3/18/2019	6:10 PM	ND	ND	ND	170.0	ND	ND	112.0	ND	ND	ND	ND	ND	34.6	2.1	ND	2.9	ND	4.9	5.2	ND	91.5	ND	ND	ND	
		3/19/2019	2:50 PM	ND	ND	ND	161.0	ND	ND	110.0	ND	ND	3.1	ND	ND	36.1	2.1	ND	2.7	ND	4.9	3.7	ND	83.8	ND	ND	ND	
			12:30 PM	ND	ND	ND	162.0	ND	ND	110.0	ND	ND	ND	ND	ND	36.1	ND	ND	2.7	ND	5.0	3.3	ND	84.3	ND	ND	ND	
		3/20/2019	9:30 AM	ND	ND	ND	141.0	ND	ND	103.0	ND	ND	ND	ND	ND	ND	33.6	ND	ND	2.6	ND	4.8	3.3	ND	75.1	ND	ND	ND
1:00 PM	ND		ND	ND	140.0	ND	ND	109.0	ND	ND	ND	ND	ND	ND	34.8	ND	ND	2.7	ND	4.7	2.9	ND	76.8	ND	ND	ND		
4953000	San Juan R @ Mexican Hat US163 Xing	3/16/2019	10:16 AM	25,800.0	ND	5.0	491.0	2.2	ND	95.9	10.7	13.2	38.2	22,100.0	24.8	22.4	606.0	ND	ND	17.2	7.8	4.5	ND	123.0	ND	29.3	84.5	
		3/18/2019	6:45 PM	ND	ND	ND	176.0	ND	ND	104.0	ND	ND	2.9	ND	ND	28.9	ND	ND	3.1	ND	5.2	4.5	ND	102.0	ND	ND	ND	
		3/19/2019	3:30 PM	ND	ND	ND	173.0	ND	ND	109.0	ND	ND	ND	ND	ND	ND	33.2	ND	ND	2.7	ND	5.1	3.3	ND	84.9	ND	ND	ND
			12:00 PM	ND	ND	ND	173.0	ND	ND	109.0	ND	ND	2.9	ND	ND	ND	33.9	ND	ND	2.6	ND	5.1	4.0	ND	89.6	ND	ND	ND
		3/20/2019	9:55 AM	ND	ND	ND	158.0	ND	ND	110.0	ND	ND	ND	ND	ND	ND	34.8	ND	ND	2.6	ND	4.9	3.8	ND	82.4	ND	ND	ND
12:30 PM	ND		ND	ND	156.0	ND	ND	107.0	ND	ND	4.5	ND	ND	ND	33.6	ND	ND	2.6	ND	5.2	3.5	ND	81.0	ND	ND	9.0		

Aquatic Life Water Quality Criteria

Comparison of San Juan River Water Data with Water Quality Criteria (R317-14-2) for Aquatic Life Use (Warm-water Fishery)

The water concentrations of metals and metalloids were compared to Utah's chronic and acute water quality standards for the Class 3B aquatic life use. Exceedances in the pre-plume samples were observed for aluminum, copper, iron, and lead. One sample taken during the estimated time of plume arrival exceeded for selenium. No other exceedances of aquatic life criteria were observed however the analytical method used for mercury does not have sufficient sensitivity and the detection limit is higher than the standard. Therefore, all nondetect concentrations are too high to determine if the water concentrations comply with the standard and thus remains a significant uncertainty.

Aquatic Life Use (Dissolved Metals)																
No Exceedence		Above Screening Level														
				Aluminum	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Nickel	Selenium	Silver	Zinc	
Utah Aquatic Life Use 1-hour				750	340	2	570	13	1,000	65		468	18.4	1.6	120	
Utah Aquatic Life Use 4-hour				87	150	0.25	74	9	1,000	3	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	
4954000	San Juan R @ US160 Xing in CO	3/16/2019	12:31 PM	8290	2.83	ND	3.22	12.4	6790	6.43	ND	5.29	3.22	ND	22.4	
		3/18/2019	4:52 PM	ND	ND	ND	ND	3.26	ND	ND	ND	ND	2.59	ND	6.19	
		3/19/2019	1:30 PM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.98	ND	ND
			10:15 AM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.64	ND	ND
		3/20/2019	7:30 AM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.13	ND
11:00 AM	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.55	ND	ND	
4953990	San Juan R @ Town of Montezuma	3/18/2019	5:40 PM	ND	ND	ND	ND	3.23	ND	ND	ND	ND	3.27	ND	ND	
		3/19/2019	2:10 PM	ND	ND	ND	ND	3.26	ND	ND	ND	ND	2.8	ND	ND	
			8:15 AM	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.91	ND	ND	
		3/20/2019	11:30 AM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.09	ND	ND
3/18/2019	6:10 PM		ND	ND	ND	ND	ND	ND	ND	ND	ND	5.16	ND	ND		
4953250	San Juan R @ Sand Island	3/19/2019	2:50 PM	ND	ND	ND	ND	3.08	ND	ND	ND	ND	3.68	ND	ND	
			12:30 PM	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.25	ND	ND	
		3/20/2019	9:30 AM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.26	ND	ND
			1:00 PM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.93	ND	ND
		3/16/2019	10:16 AM	25800	5.01	ND	10.7	38.2	22100	24.8	ND	17.2	4.46	ND	84.5	
4953000	San Juan R @ Mexican Hat US163 Xing	3/18/2019	6:45 PM	ND	ND	ND	ND	2.89	ND	ND	ND	ND	4.49	ND	ND	
		3/19/2019	3:30 PM	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.29	ND	ND	
			12:00 PM	ND	ND	ND	ND	2.86	ND	ND	ND	ND	4.04	ND	ND	
		3/20/2019	9:55 AM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.75	ND	ND
			12:30 PM	ND	ND	ND	ND	4.53	ND	ND	ND	ND	ND	3.47	ND	9

Recreational Water Screening Values - Total Metals

Comparison of San Juan River Water Data with Recreational Water Screening Values

The Utah Department of Health's Environmental Epidemiology Program (EEP) has generated site-specific recreational screening values for metals and metalloid exposures to the San Juan River waters. These values reflect the water contaminant concentrations that would exceed established Agency for Toxic Substance 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. No metal or metalloid exceeded a recreational screening value. Recreational exposures to San Juan River water is not expected to harm people's health.

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
Cadium	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

Recreational Water Screening Values - Total Metals

Screening Value Calculations

Adapted from standard ATSDR exposure dose equations for ingestion and dermal exposures.

$$C = \frac{ED \times BW_i \times BW_d}{(BW_d \times IR_i \times EF_i \times CF_i) + (BW_i \times P_d \times SA_d \times ET_d \times CF_d)} ; \text{ where}$$

- C Concentration (mg/L) – these calculated values are converted to µg/L for screening values where appropriate.
- ED Exposure dose (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 cm² 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 below)

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

Recreational Water Screening Values - Total Metals

Recreational Water (Total Metals)																							
				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
4954000	San Juan R @ US160 Xing in CO	3/16/2019	12:31 PM	160,000.0	ND	23.3	2,460.0	11.3	2.2	60.0	75.1	211.0	136,000.0	158.0	3,970.0	ND	ND	85.5	4.1	ND	ND	126.0	487.0
		3/18/2019	4:52 PM	32,600.0	ND	6.9	604.0	2.6	0.7	14.8	16.1	53.8	27,700.0	30.9	850.0	ND	ND	20.3	3.1	ND	ND	35.8	116.0
		3/19/2019	1:30 PM	29,700.0	ND	4.9	555.0	2.3	ND	14.4	14.5	44.1	25,600.0	27.0	756.0	ND	ND	20.7	2.5	ND	ND	33.0	112.0
			10:15 AM	33,600.0	ND	5.8	657.0	2.6	0.6	17.0	16.5	52.9	29,100.0	31.0	901.0	ND	ND	24.2	3.4	ND	ND	34.6	133.0
		3/20/2019	7:30 AM	21,700.0	ND	5.1	469.0	ND	0.5	11.3	12.2	35.5	20,500.0	24.4	686.0	ND	ND	19.1	2.9	ND	ND	28.8	106.0
11:00 AM	18,000.0		ND	4.7	412.0	ND	ND	9.7	10.3	33.3	17,400.0	21.5	604.0	ND	ND	15.1	2.5	ND	ND	30.9	90.4		
4953990	San Juan R @ Town of Montezuma	3/18/2019	5:40 PM	34,400.0	ND	7.6	640.0	2.7	0.6	15.7	16.8	49.8	29,400.0	33.0	891.0	ND	ND	21.8	4.6	ND	ND	37.5	123.0
		3/19/2019	2:10 PM	33,800.0	ND	5.4	637.0	2.7	0.6	15.3	16.5	49.3	28,200.0	31.1	877.0	ND	ND	23.4	3.5	ND	ND	34.6	119.0
		3/20/2019	8:15 AM	57,400.0	ND	10.5	1,280.0	5.4	1.5	32.5	37.1	105.0	53,500.0	70.8	2,260.0	ND	ND	54.5	3.3	ND	ND	68.0	306.0
			11:30 AM	22,800.0	ND	4.6	451.0	ND	ND	12.5	11.8	35.6	20,200.0	22.2	632.0	ND	ND	18.2	2.9	ND	ND	37.2	93.6
4953250	San Juan R @ Sand Island	3/18/2019	6:10 PM	53,900.0	ND	11.1	945.0	3.8	0.9	24.3	25.0	72.6	45,100.0	47.9	1,370.0	ND	ND	34.1	5.8	ND	ND	58.2	179.0
		3/19/2019	2:50 PM	37,000.0	ND	7.6	673.0	2.6	0.6	14.8	15.5	46.7	29,900.0	32.7	888.0	ND	ND	22.7	3.9	ND	ND	38.4	110.0
			12:30 PM	34,300.0	ND	8.5	844.0	3.0	0.8	14.8	18.2	52.9	28,400.0	38.0	1,220.0	ND	ND	24.5	4.5	ND	ND	38.0	121.0
		3/20/2019	9:30 AM	35,600.0	ND	8.6	996.0	3.5	0.9	20.0	20.7	55.9	29,600.0	42.8	1,430.0	ND	ND	31.0	3.9	ND	ND	47.8	154.0
			1:00 PM	30,100.0	ND	7.3	745.0	2.7	0.7	16.8	15.9	44.6	27,300.0	32.5	993.0	ND	ND	25.2	3.4	ND	ND	48.3	118.0
4953000	San Juan R @ Mexican Hat US163 Xing	3/16/2019	10:16 AM	191,000.0	ND	23.3	3,220.0	14.4	3.0	67.4	89.6	240.0	161,000.0	199.0	5,150.0	0.4	ND	113.0	5.1	ND	2.1	135.0	629.0
		3/18/2019	6:45 PM	74,000.0	ND	14.0	1,290.0	5.8	1.2	29.2	34.9	106.0	59,800.0	74.6	1,900.0	ND	ND	42.6	5.5	ND	ND	68.4	240.0
		3/19/2019	3:30 PM	32,300.0	ND	7.9	731.0	3.1	0.7	15.8	18.0	51.0	27,600.0	36.6	1,010.0	ND	ND	24.6	3.4	ND	ND	40.7	122.0
			12:00 PM	45,600.0	ND	8.1	833.0	3.4	0.7	18.9	21.1	58.1	35,900.0	42.1	1,180.0	ND	ND	29.2	4.1	ND	ND	47.1	144.0
			9:55 AM	32,500.0	ND	7.8	717.0	2.6	0.6	16.4	16.9	47.7	27,600.0	34.0	989.0	ND	ND	24.0	3.8	ND	ND	42.3	121.0
		3/20/2019	12:30 PM	30,700.0	ND	6.3	745.0	3.0	0.7	16.3	18.0	50.2	26,100.0	35.6	1,040.0	ND	ND	26.8	3.2	ND	ND	50.9	124.0

Agricultural Screening Values – Dissolved Metals

Comparison of San Juan River Water Data with Screening Values for Agricultural Uses (Stock watering and Irrigation)

The dissolved water concentrations of metals and metalloids were compared to screening values, including Utah’s water quality standards for the Class 4 protected for agricultural uses including irrigation of crops and stock watering. Exceedances for aluminum, iron, and manganese were observed, but only in pre-plume samples.

Agricultural Water (Dissolved Metals)																						
		No Exceedence	Above Screening Level																			
				Aluminum	Arsenic	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Sodium	Vanadium	Zinc	
Livestock Water Screening Value				5,000	200	50	500	1,000	1,000	500		100	250,000		10			50	1,000,000	100	25,000	
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
Utah DWQ Agricultural Use Criteria					100	10		100		200		100						50				
Monitoring Location	Site Description	Collection Date	Collection Time	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	mg/L	ug/L	ug/L	
4954000	San Juan R @ US160 Xing in CO	3/16/2019	12:31 PM	8,290.0	2.8	ND	62.8	3.2	ND	12.4	6,790.0	6.4	10.4	144.0	ND	ND	5.3	3.2	97.2	10.8	22.4	
		3/18/2019	4:52 PM	ND	ND	ND	87.7	ND	ND	3.3	ND	ND	17.3	2.1	ND	2.2	ND	2.6	69.3	ND	6.2	
		3/19/2019	1:30 PM	ND	ND	ND	88.4	ND	ND	ND	ND	ND	ND	18.7	ND	ND	2.3	ND	3.0	64.9	ND	ND
			10:15 AM	ND	ND	ND	88.4	ND	ND	ND	ND	ND	ND	19.3	ND	ND	2.5	ND	2.6	65.6	ND	ND
		3/20/2019	11:00 AM	ND	ND	ND	85.5	ND	ND	ND	ND	ND	ND	20.0	ND	ND	2.4	ND	2.6	59.1	ND	ND
4953990	San Juan R @ Town of Montezuma	3/18/2019	5:40 PM	ND	ND	ND	112.0	ND	ND	3.2	ND	ND	31.2	2.1	ND	2.6	ND	3.3	82.2	ND	ND	
		3/19/2019	2:10 PM	ND	ND	ND	107.0	ND	ND	3.3	ND	ND	30.5	ND	ND	2.3	ND	2.8	78.4	ND	ND	
		3/20/2019	8:15 AM	ND	ND	ND	107.0	ND	ND	ND	ND	ND	ND	32.0	2.6	ND	2.4	ND	2.9	75.9	ND	ND
			11:30 AM	ND	ND	ND	108.0	ND	ND	ND	ND	ND	ND	31.2	ND	ND	2.4	ND	3.1	73.5	ND	ND
4953250	San Juan R @ Sand Island	3/18/2019	6:10 PM	ND	ND	ND	112.0	ND	ND	ND	ND	ND	34.6	2.1	ND	2.9	ND	5.2	91.5	ND	ND	
		3/19/2019	2:50 PM	ND	ND	ND	110.0	ND	ND	3.1	ND	ND	36.1	2.1	ND	2.7	ND	3.7	83.8	ND	ND	
			12:30 PM	ND	ND	ND	110.0	ND	ND	ND	ND	ND	ND	36.1	ND	ND	2.7	ND	3.3	84.3	ND	ND
		3/20/2019	9:30 AM	ND	ND	ND	103.0	ND	ND	ND	ND	ND	33.6	ND	ND	2.6	ND	3.3	75.1	ND	ND	
4953000	San Juan R @ Mexican Hat US163 Xing	3/16/2019	10:16 AM	25,800.0	5.0	ND	95.9	10.7	13.2	38.2	22,100.0	24.8	22.4	606.0	ND	ND	17.2	4.5	123.0	29.3	84.5	
		3/18/2019	6:45 PM	ND	ND	ND	104.0	ND	ND	2.9	ND	ND	28.9	ND	ND	3.1	ND	4.5	102.0	ND	ND	
		3/19/2019	12:00 PM	ND	ND	ND	109.0	ND	ND	2.9	ND	ND	33.9	ND	ND	2.6	ND	4.0	89.6	ND	ND	
			3:30 PM	ND	ND	ND	109.0	ND	ND	ND	ND	ND	33.2	ND	ND	2.7	ND	3.3	84.9	ND	ND	
		3/20/2019	9:55 AM	ND	ND	ND	110.0	ND	ND	ND	ND	ND	34.8	ND	ND	2.6	ND	3.8	82.4	ND	ND	
			12:30 PM	ND	ND	ND	107.0	ND	ND	4.5	ND	ND	33.6	ND	ND	2.6	ND	3.5	81.0	ND	9.0	

Sediment Screening Values – Sediment Metals

Comparison of San Juan River Sediment Data with Screening Values for Recreational Exposure and Aquatic Life

Sediment 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). No exceedances of the screening values for both recreation and aquatic life were observed.

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

Recreational Sediment Screening Values (Sediment Metals)																							
No Exceedence		Above Screening Level																					
				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		
Monitoring Location	Site Description	Collection Date	Collection Time	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		
4954000	San Juan R @ US160 Xing in CO	3/16/2019	12:40 PM	1160	ND	6.11	44.8	ND	ND	ND	1.28	ND	3260	3.2	108	ND	ND	ND	ND	ND	ND	ND	
		3/18/2019	4:52 PM	5460	ND	1.93	142	ND	ND	ND	2.72	ND	6770	4.46	183	ND	ND	ND	ND	ND	12.5	ND	
		3/19/2019	1:30 PM	5310	ND	1.84	131	ND	ND	ND	2.97	ND	7790	4.88	199	ND	ND	ND	ND	ND	12.9	ND	ND
			10:15 AM	5650	ND	1.93	124	ND	ND	ND	2.88	ND	6810	4.42	196	ND	ND	ND	ND	ND	12.9	ND	ND
		3/20/2019	7:30 AM	5220	ND	2.04	111	ND	ND	ND	3.06	ND	7310	4.64	209	ND	ND	ND	ND	ND	12.5	ND	ND
4953990	San Juan R @ Town of Montezuma	3/18/2019	5:40 PM	11700	ND	2.85	185	0.596	ND	ND	4.99	ND	12800	7.34	292	ND	ND	ND	ND	20.9	34.6	ND	
		3/19/2019	2:10 PM	11200	ND	2.72	183	ND	ND	ND	5.03	ND	12900	7.38	305	ND	ND	ND	ND	ND	21.8	35.8	ND
			8:15 AM	10900	ND	3.16	183	ND	ND	ND	5.3	ND	12700	7.5	281	ND	ND	ND	ND	ND	22.8	34.8	ND
		3/20/2019	11:00 AM	6020	ND	2.04	169	ND	ND	ND	3.17	ND	7910	5.12	216	ND	ND	ND	ND	ND	14.2	21.6	ND
			6:10 PM	7110	ND	1.97	139	ND	ND	ND	2.69	ND	7420	4.65	215	ND	ND	ND	ND	ND	13.8	19	ND
4953250	San Juan R @ Sand Island	3/19/2019	2:50 PM	5400	ND	2.07	224	ND	ND	ND	2.52	ND	7330	4.91	190	ND	ND	ND	ND	15.3	ND	ND	
			12:30 PM	4570	ND	1.67	142	ND	ND	ND	2.5	ND	6440	4.24	191	ND	ND	ND	ND	11.1	ND	ND	
		3/20/2019	9:30 AM	5990	ND	1.75	154	ND	ND	ND	2.72	ND	7240	4.74	193	ND	ND	ND	ND	ND	12.5	ND	ND
			1:00 PM	11200	ND	2.27	201	0.531	ND	ND	3.63	ND	10500	5.93	249	ND	ND	ND	ND	ND	19.8	26.6	ND
		3/16/2019	11:48 AM	2220	ND	1.8	38.2	ND	ND	ND	1.48	ND	4000	3.58	137	ND	ND	ND	ND	ND	18.9	ND	ND
4953000	San Juan R @ Mexican Hat US163 Xing	3/18/2019	6:45 PM	7040	ND	2.02	187	ND	ND	ND	2.88	ND	8010	4.82	210	ND	ND	ND	ND	15.3	20.9	ND	
		3/19/2019	3:30 PM	2450	ND	1.13	57.5	ND	ND	ND	1.48	ND	3210	ND	133	ND	ND	ND	ND	ND	ND	ND	ND
			12:00 PM	5960	ND	1.79	127	ND	ND	ND	2.71	ND	6760	4.54	201	ND	ND	ND	ND	ND	12.4	ND	ND
		3/20/2019	9:55 AM	4710	ND	1.62	187	ND	ND	ND	2.13	ND	6500	3.98	156	ND	ND	ND	ND	ND	12.9	ND	ND
			12:30 PM	4320	ND	1.23	60.3	ND	ND	ND	1.64	ND	4430	ND	134	ND	ND	ND	ND	ND	8.07	ND	ND

Sediment Screening Values – Sediment Metals

Aquatic Life Sediment Screening Values (Sediment Metals)																		
No Exceedence		Above Screening Level																
				Arsenic	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	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		
Monitoring Location	Site Description	Collection Date	Collection Time	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		
4954000	San Juan R @ US160 Xing in CO	3/16/2019	12:40 PM	6.11	ND	ND	1.28	ND	3260	3.2	108	ND	ND	ND	ND	ND		
		3/18/2019	4:52 PM	1.93	ND	ND	2.72	ND	6770	4.46	183	ND	ND	ND	ND	ND	ND	
		3/19/2019	1:30 PM	1.84	ND	ND	2.97	ND	7790	4.88	199	ND	ND	ND	ND	ND	ND	
			10:15 AM	1.93	ND	ND	2.88	ND	6810	4.42	196	ND	ND	ND	ND	ND	ND	
		3/20/2019	7:30 AM	2.04	ND	ND	3.06	ND	7310	4.64	209	ND	ND	ND	ND	ND	ND	ND
			11:00 AM	2.04	ND	ND	3.17	ND	7910	5.12	216	ND	ND	ND	ND	ND	ND	21.6
4953990	San Juan R @ Town of Montezuma	3/18/2019	5:40 PM	2.85	ND	ND	4.99	ND	12800	7.34	292	ND	ND	ND	ND	ND	34.6	
		3/19/2019	2:10 PM	2.72	ND	ND	5.03	ND	12900	7.38	305	ND	ND	ND	ND	ND	35.8	
		3/20/2019	8:15 AM	3.16	ND	ND	5.3	ND	12700	7.5	281	ND	ND	ND	ND	ND	ND	34.8
			11:30 AM	2.68	ND	ND	4.71	ND	11400	6.99	283	ND	ND	ND	ND	ND	ND	33.3
4953250	San Juan R @ Sand Island	3/18/2019	6:10 PM	1.97	ND	ND	2.69	ND	7420	4.65	215	ND	ND	ND	ND	ND	19	
		3/19/2019	2:50 PM	2.07	ND	ND	2.52	ND	7330	4.91	190	ND	ND	ND	ND	ND	ND	
			12:30 PM	1.67	ND	ND	2.5	ND	6440	4.24	191	ND	ND	ND	ND	ND	ND	
		3/20/2019	9:30 AM	1.75	ND	ND	2.72	ND	7240	4.74	193	ND	ND	ND	ND	ND	ND	ND
			1:00 PM	2.27	ND	ND	3.63	ND	10500	5.93	249	ND	ND	ND	ND	ND	ND	26.6
4953000	San Juan R @ Mexican Hat US163 X	3/16/2019	11:48 AM	1.8	ND	ND	1.48	ND	4000	3.58	137	ND	ND	ND	ND	ND	18.9	
		3/18/2019	6:45 PM	2.02	ND	ND	2.88	ND	8010	4.82	210	ND	ND	ND	ND	ND	ND	20.9
		3/19/2019	3:30 PM	1.13	ND	ND	1.48	ND	3210	ND	133	ND	ND	ND	ND	ND	ND	ND
			12:00 PM	1.79	ND	ND	2.71	ND	6760	4.54	201	ND	ND	ND	ND	ND	ND	ND
		3/20/2019	9:55 AM	1.62	ND	ND	2.13	ND	6500	3.98	156	ND	ND	ND	ND	ND	ND	ND
			12:30 PM	1.23	ND	ND	1.64	ND	4430	ND	134	ND	ND	ND	ND	ND	ND	ND