

# Gold King Mine Release: Utah's Response and Implications for Our Waters

Water Development Commission

June 14, 2016

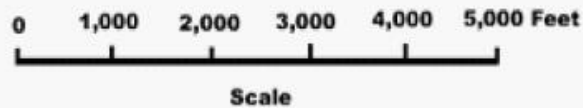
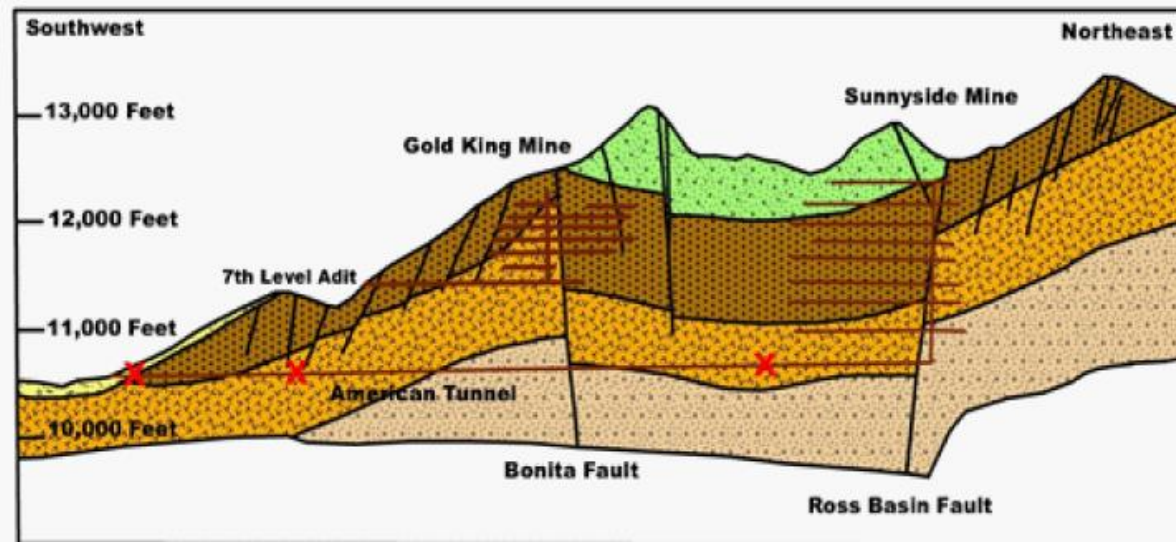
Erica Gaddis, Ph.D.

Utah Department of Environmental Quality



UTAH DEPARTMENT of  
**ENVIRONMENTAL  
QUALITY**

# Anatomy of Gold King Mine



Modified from U. S. Geological Survey  
Professional Paper 535, Plate 6

X Bulkhead

## Legend

### Rock Unit

- Talus and Gai
- Andesite-Rhyodacite
- Upper Rhyodacite Flow
- Lower Rhyodacite Flow
- Rhyodacite Tuff

Cross-Section of Gold King and Sunnyside Mines



8/8/2015 0900 Confluence of Animas and San Juan River Near Farmington, NM

# Utah Monitoring Response Objectives

## ❑ Protect Public Health

- ❑ Address real and perceived public health threats
- ❑ Timely data (24 – 36 hour turnarounds)
- ❑ Appropriate screening values

## ❑ Protect Environment

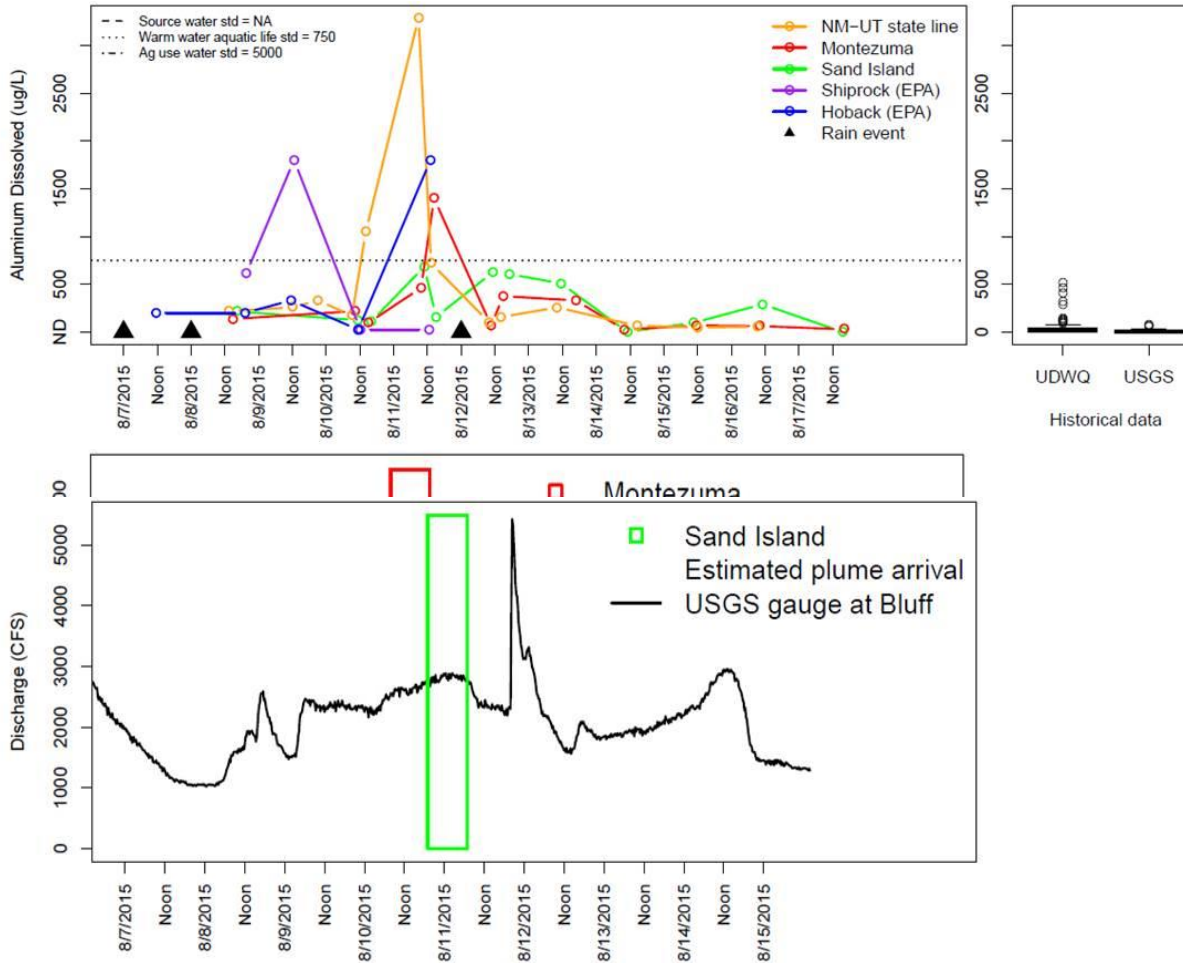
- ❑ Chronic effects on aquatic life associated with legacy metals loading in system
- ❑ Comparison to water quality standards
- ❑ Appropriate background comparison (Pre- and post-plume data)



# UDEQ Sampling Sites



# Dissolved Aluminum



# Water Quality Screening

Analyte	CAS #	Units	Utah WQ Standards (R317-2-14) for Juan River Uses				San (Dissolved 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)			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	100	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	10	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	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	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	910	100 (NAS)	5,000	10,000		Lead
Magnesium	7439-96-4	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	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					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



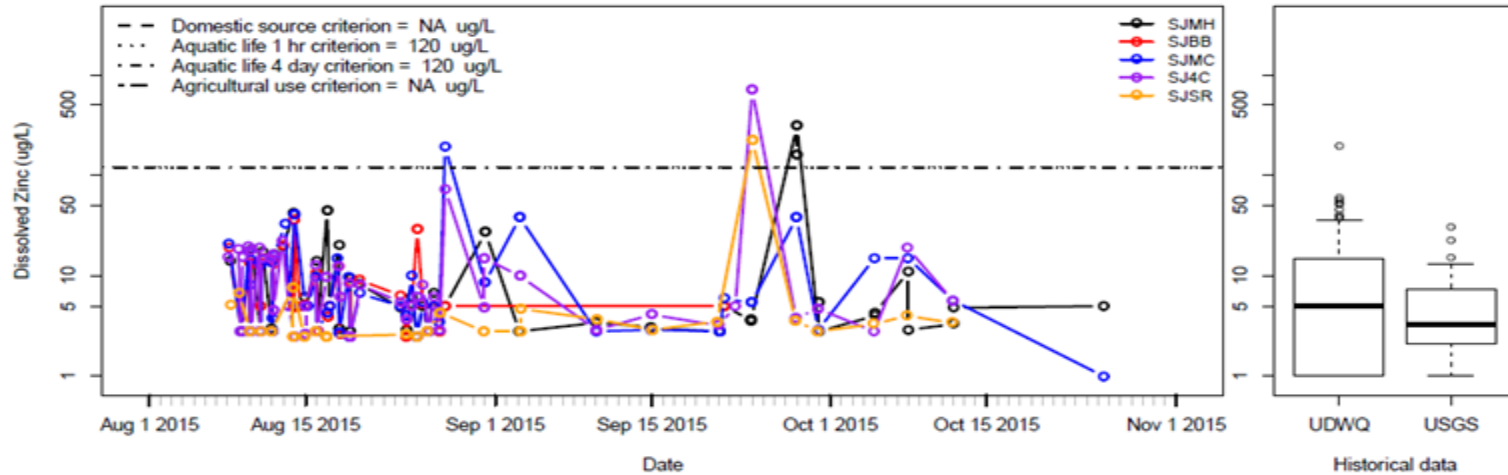
# Aquatic Life Uses

		No Exceedence			Above Screening Level			Prior to Plume Arrival			Estimated Plume Arrival						Post Plume Arrival											
		Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc			
Utah Aquatic Life Use Criteria 1-hr		750		340			2		570		13	1000	65					468		18.4	1.6				120			
Utah Aquatic Life Use Criteria 4-day		87		150			0.25		74		9	1000	2.5			0.01		52		4.6					120			
Monitoring Location	Site Description	Collection Date	Collection Time	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	mg/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L			
4954000	San Juan R @ US160 Xing in CO	8/8/2015	1:23:00 PM	47400	0.524	1.34	222	0.0369	ND	51.5	ND	0.127	2.24	95.8	ND	7.95	2.94	ND	1.87	ND	2.96	0.722	ND	32.2	ND	4.86	15.3	
		8/9/2015	12:02:00 PM	33900	0.341	0.628	274	ND	ND	50.6	ND	0.0817	2.48	119	ND	6.86	2.69	ND	2.01	ND	2.61	0.563	0.03	28.5	ND	1.76	18.5	
		8/9/2015	3:05:00 PM	26700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		8/9/2015	6:00:00 PM	24600	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		8/9/2015	9:02:00 PM	31000	0.347	0.946	341	0.0356	ND	48	ND	0.139	3.47	198	0.274	6.3	4.14	ND	1.94	ND	2.38	0.535	ND	30	ND	2.07	15.4	
		8/10/2015	9:11:00 AM	39900	0.458	0.994	233	ND	ND	44.6	ND	0.0673	3.21	103	0.391	6.01	1.64	ND	2.03	ND	2.51	0.582	ND	34.1	ND	1.74	19.7	
		8/10/2015	2:06:00 PM	43700	0.711	1.3	220	0.0905	ND	44.2	ND	0.407	3.35	732	1.04	6.02	12.8	ND	1.92	0.838	2.72	0.645	0.06	35.1	ND	3.64	18	
		8/11/2015	8:50:00 AM	77000	0.364	1.72	451	0.102	ND	39.8	ND	0.488	4.85	1520	1.1	5.05	19	0.02	1.65	1.19	3	0.972	ND	43.7	ND	3.9	19.1	
		8/11/2015	1:17:00 PM	56900	0.0516	1.33	334	ND	ND	41.7	ND	0.155	3.03	366	0.27	5.11	5.1	ND	1.58	ND	2.91	0.76	ND	37	ND	2.46	14.9	
		8/12/2015	9:50:00 AM	31100	0.586	0.879	178	ND	ND	52.1	ND	0.0614	2.39	ND	ND	7.2	ND	ND	1.47	ND	2.79	0.782	0.03	30.3	ND	1.9	14.8	
		8/12/2015	2:04:00 PM	28500	0.548	1.21	151	ND	ND	47.9	ND	0.0478	2.61	ND	ND	6.97	1.82	ND	1.48	ND	2.74	0.728	ND	27.3	ND	2.87	16.5	
		8/13/2015	10:01:00 AM	38700	0.158	1.25	213	0.0299	ND	48.3	ND	0.122	3.67	148	0.373	6.48	3.16	ND	1.89	ND	2.87	0.858	ND	42.5	ND	2.1	21.9	
		8/14/2015	2:33:00 PM	44300	0.421	1.7	72.3	0.0382	ND	53.4	ND	0.133	3.86	ND	ND	6.61	1.8	ND	3.65	3.14	3.66	1.1	ND	52.4	0.0385	4.11	ND	
		8/15/2015	12:04:00 PM	14200	0.445	1.36	65.2	ND	ND	52.8	ND	0.052	1.35	ND	ND	7.91	ND	ND	2.25	ND	2.61	0.608	ND	25.9	ND	2.61	ND	
		8/16/2015	9:15:00 AM	9500	1.12	0.88	179	0.041	ND	53.9	ND	ND	2.91	ND	ND	8.18	ND	ND	1.72	ND	2.54	0.595	0.19	26.1	ND	1.92	12.6	
		8/18/2015	9:56:00 AM	3640	0.689	1.31	148	ND	ND	57.5	ND	0.0869	2.27	ND	0.287	9.82	ND	ND	1.74	ND	2.5	0.585	0.04	33.4	ND	1.88	12.3	
		8/19/2015	9:30:00 AM	4070	0.682	1.34	106	ND	ND	57.1	ND	0.0697	1.7	ND	ND	9.98	ND	ND	1.72	ND	2.54	0.538	0.03	34.1	ND	1.91	8.44	
		8/20/2015	9:44:00 AM	3650	0.764	1.32	132	ND	ND	57	ND	0.0772	1.85	ND	ND	9.55	ND	ND	1.76	ND	2.44	0.631	0.1	33.8	0.0385	1.93	8.1	
		8/24/2015	3:10:00 PM	1760	0.273	1.36	62.4	ND	ND	50	ND	0.048	2.18	ND	ND	8.95	1.92	ND	1.56	1.08	2.64	0.538	ND	32.6	ND	2.31	5.49	
		8/25/2015	3:30:00 PM	1500	0.481	1.42	63.4	ND	ND	47.8	ND	ND	2.11	ND	ND	8.74	1.88	ND	1.58	ND	2.52	0.579	ND	31.8	ND	2.52	ND	
		8/26/2015	2:50:00 PM	1540	0.563	1.47	70.5	0.0621	ND	47.5	ND	0.308	2.75	554	0.458	8.82	21.8	ND	1.57	1.05	2.61	0.622	0.07	32.2	0.0304	3.29	8	
		8/27/2015	3:40:00 PM	117000	0.335	1.01	121	0.0635	ND	65.9	ND	0.383	3.3	605	0.527	10.2	11.4	ND	3.32	2.04	4.58	0.943	ND	49.2	ND	3.41	6.22	
		8/28/2015	4:25:00 PM	196000	0.249	5.55	340	1.58	0.261	59.4	12	9.01	27.7	16700	15.7	10	413	0.04	1.45	12.7	7.89	0.821	0.09	89.6	0.18	26.2	72.8	
		9/23/2015	6:30:00 PM	5120	0.724	0.985	81.5	0.105	ND	60.8	ND	0.253	1.88	ND	ND	10.9	9.31	ND	1.82	1.31	2.87	0.666	0.13	35	0.115	1.84	ND	
		10/2/2015		183000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/15/2015	12:00:00 PM	34400	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/18/2015		39000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/19/2015	12:00:01 AM	23900	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/19/2015	12:00:00 PM	166000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/20/2015	12:01:00 AM	202000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/20/2015	12:00:00 PM	248000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/21/2015	12:00:01 AM	230000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		10/22/2015	12:00:00 PM	94800	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
10/23/2015	12:00:10 AM	138000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
10/23/2015	12:00:00 PM	189000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
GK06	San Juan R @ McElmo Wash	9/23/2015	10:40:00 AM	3350	0.402	1.1	60.6	ND	ND	165	ND	0.165	1.11	ND	ND	73.6	2.44	0.02	2.59	2.01	4.49	0.631	0.03	65.4	ND	1.43	ND	





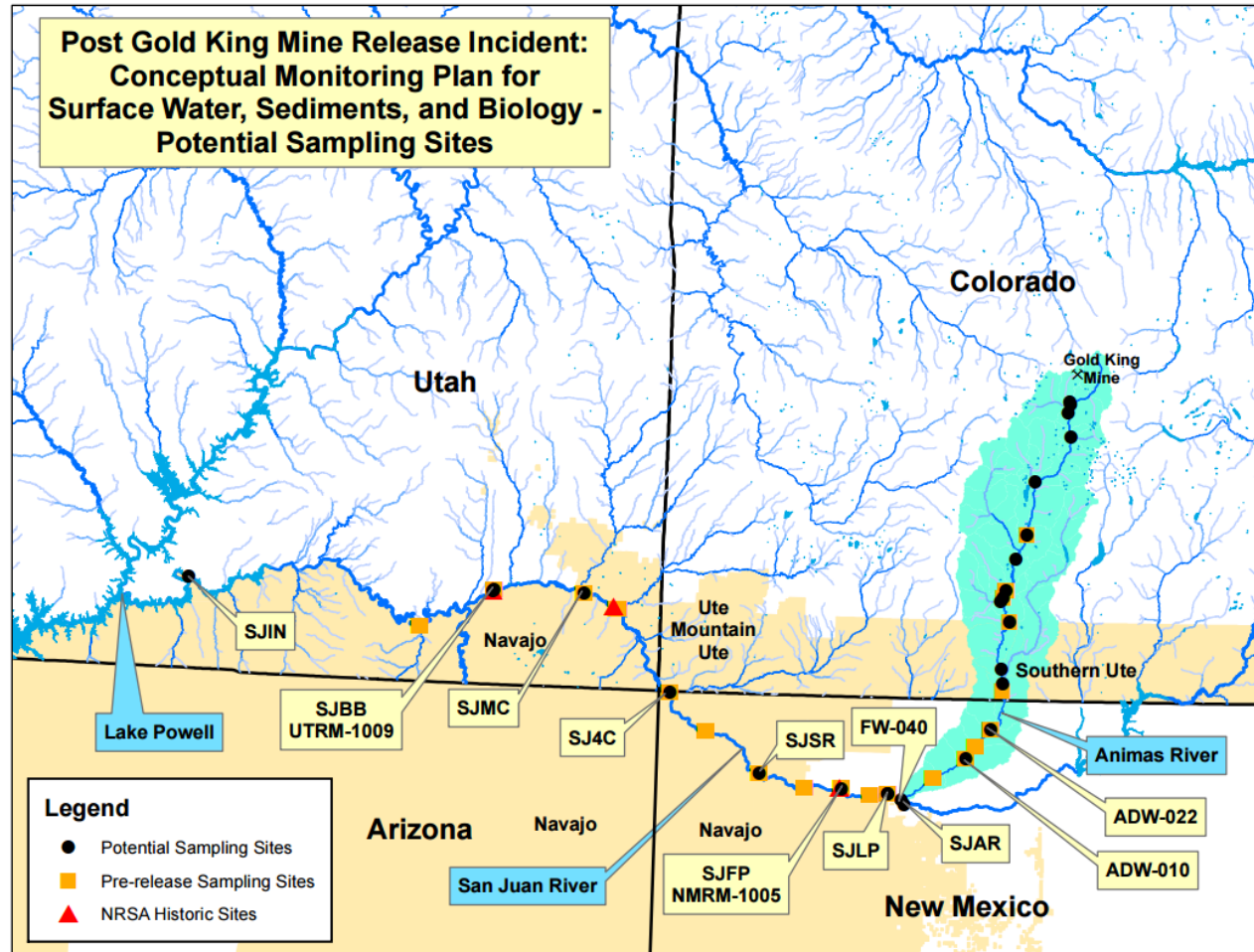
# San Juan River – Storm Influence



# San Juan River Aquatic Life Impairments

## Exceedances:

- Aluminum
- Cadmium
- Copper
- Iron
- Lead
- Mercury



# Bonita Peak Mining District



Figure 7.—Photograph showing the seepage outflow from the drain pipe at the American Tunnel at Gladstone, Colorado, as it appeared on September 3, 2015, with about 100 gpm of acid water flowing out.



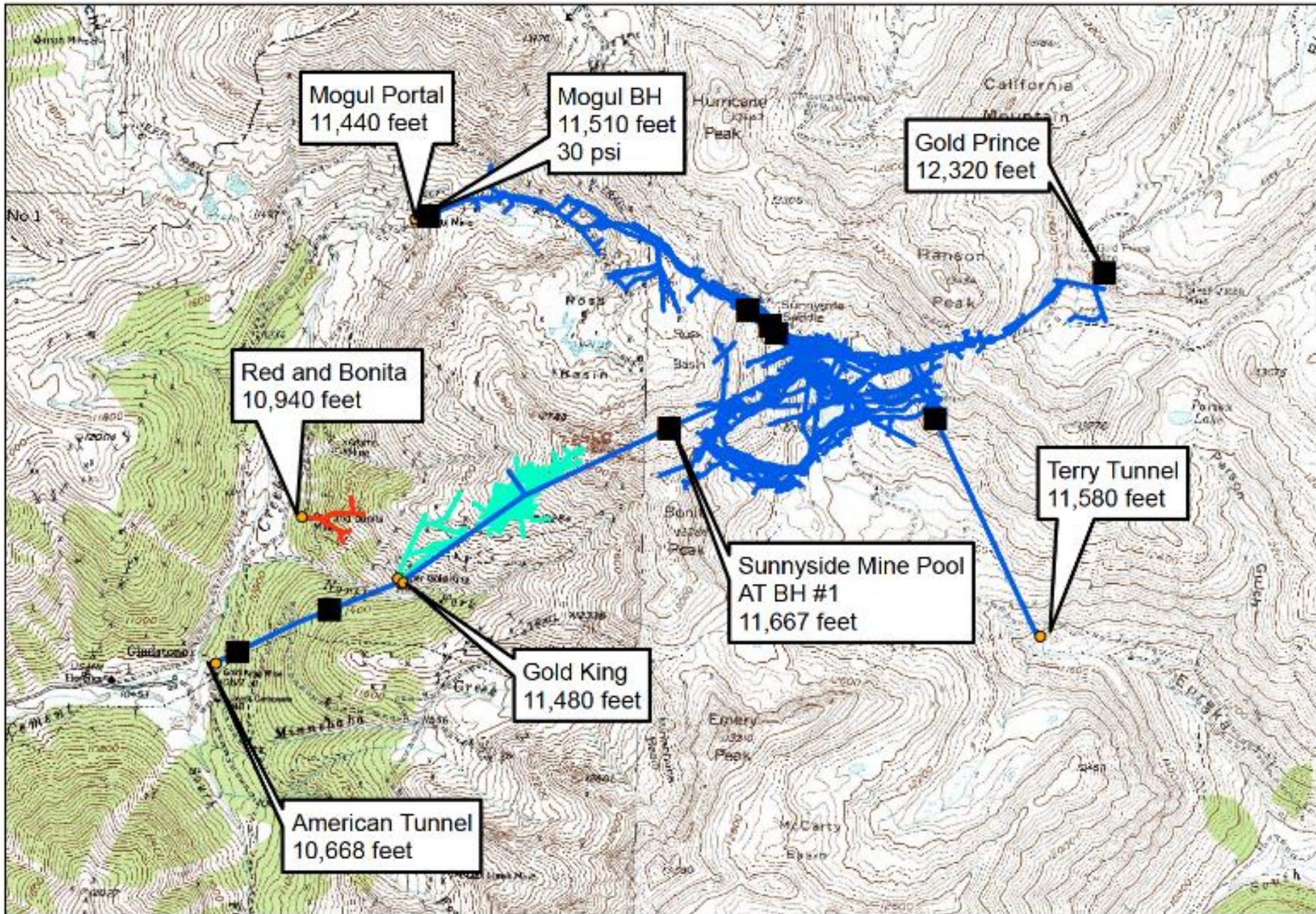
Figure 12.—Photograph taken on September 15, 2015, of drainage from the Silver Ledge Mine, which is located south of the Gold King Mine.



Figure 11.—Photograph showing acid drainage flowing out of the Red and Bonita Mine on September 3, 2015.

- ❑ Proposed superfund site
- ❑ 48 historic mines near Silverton, CO
- ❑ Public comments accepted through June 6, 2016

sediments throughout the mining district and the Animas River. Based on historic information for 32 of the mine sites, there are an estimated 248,000 cubic yards of waste rock and a cumulative estimated acid flow of approximately 3,740 gallons per minute or 5.4 million gallons per day. Contaminants found in these sources and in the surface water include arsenic, cadmium, copper, manganese, zinc, lead and aluminum. These contaminants impact fisheries that are harvested for human consumption, as well as wetlands and habitat for the threatened Canadian Lynx.



## Mine and Pool Elevations

0 0.15 0.3 0.6 0.9 1.2 Miles

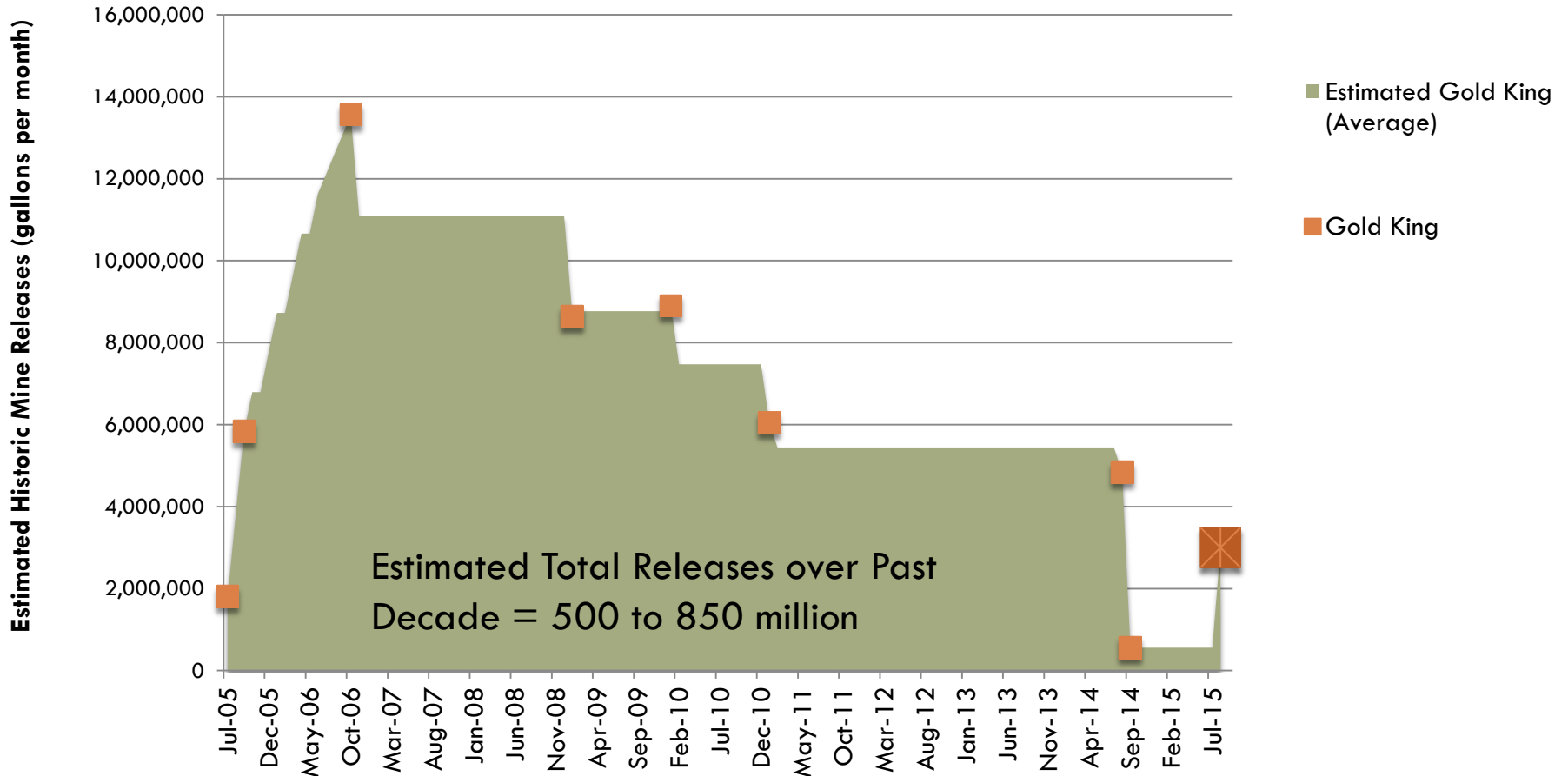
Approximation of Mine Portal Elevations  
and Mine Pool Elevations  
Created for AIRSC

(b) (6)  
4/17/2014



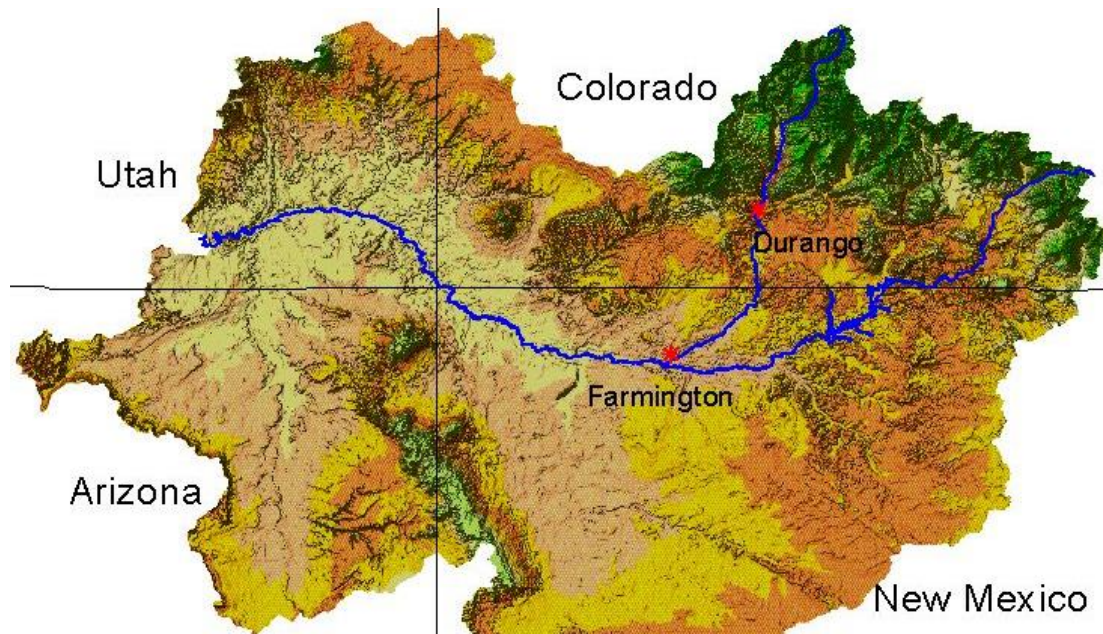
# Cumulative Releases Over a Decade

## Estimated Historic Mine Releases (gallons per month)



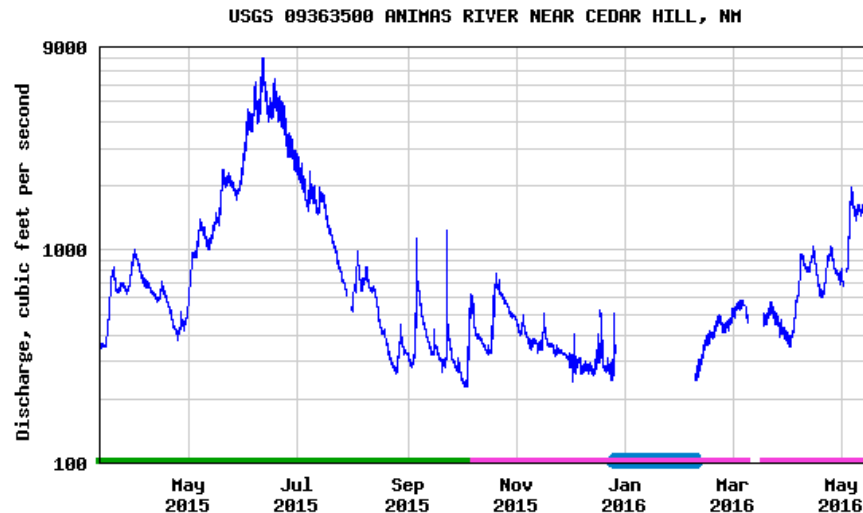
# Utah's Long-term Plan Study Objectives

- ❑ Determine if metals pose a risk to the San Juan River or Lake Powell
- ❑ Provide timely information upon which to evaluate risk
- ❑ Understand trends in metal loading to Lake Powell
- ❑ Determine the relative importance of Bonita Peak Mining District sources

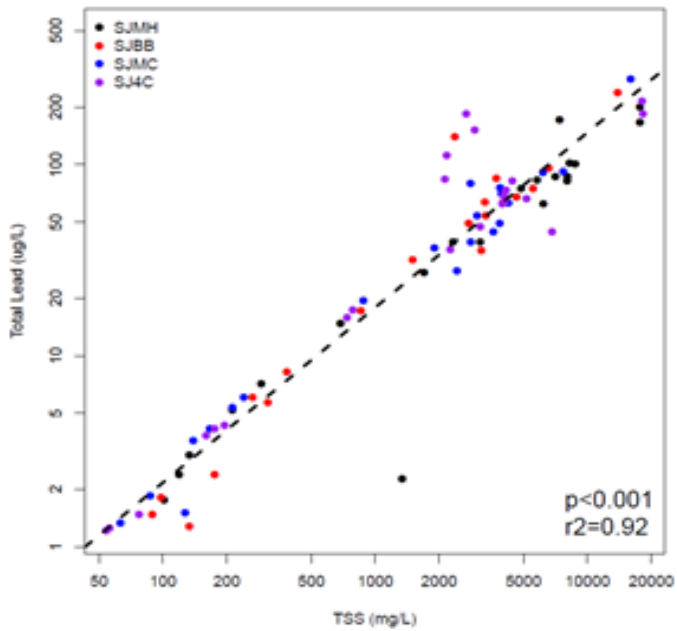


# Spring Runoff Monitoring

- ❑ Majority of 400,000 kg of heavy metals released remains in the Animas River
- ❑ Like to be mobilized during high flows (spring runoff)
- ❑ Animas River spring runoff flows are 10x higher than storm flows in Fall 2015
- ❑ EPA monitoring data collected during monsoonal storm events show elevated concentrations of metals that exceed Utah water quality criteria



# Real-time Water Quality Information





---

# Drinking water systems

## ❑ Public Systems

- ❑ Mexican Hat, Bluff, Sand Island
- ❑ Sample public drinking water systems for metals during peak spring runoff
- ❑ Sampling at wells prior to treatment and finished water
- ❑ Division of Drinking Water (UDEQ) will coordinate with facilities

## ❑ Private Systems

- ❑ Up to 7 private wells sampled with preference to wells that are influenced by river
- ❑ Division of Drinking Water (UDEQ) will coordinate with San Juan County



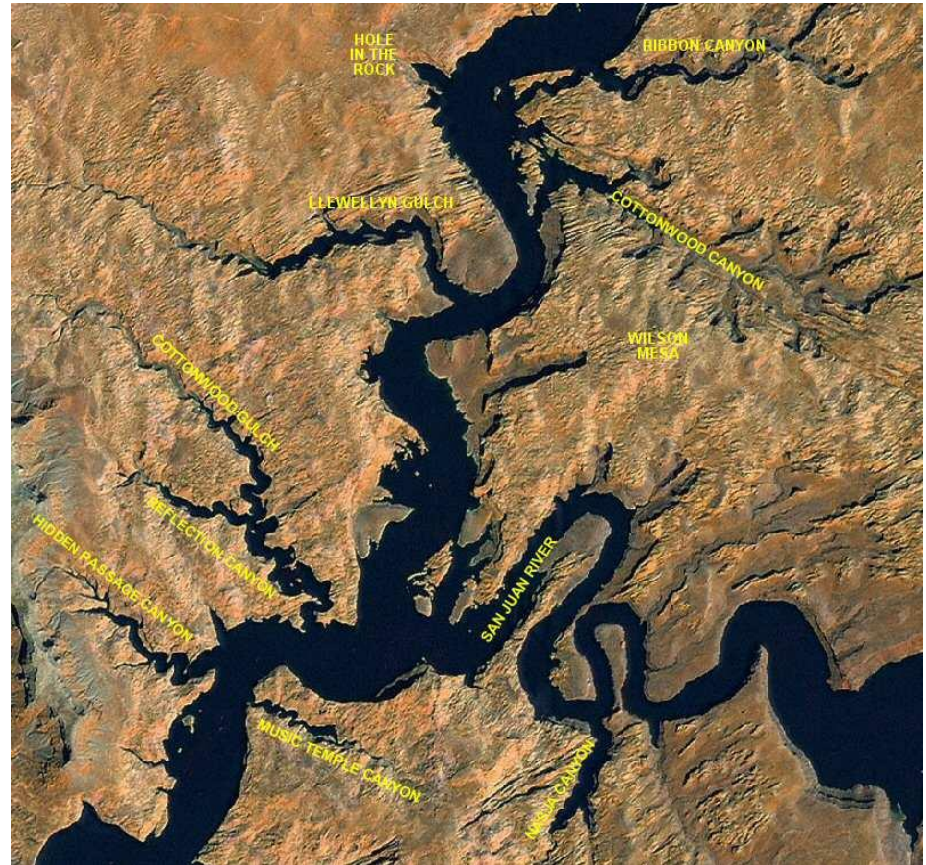
# Long-term effects on Lake Powell

## San Juan Arm, Lake Powell

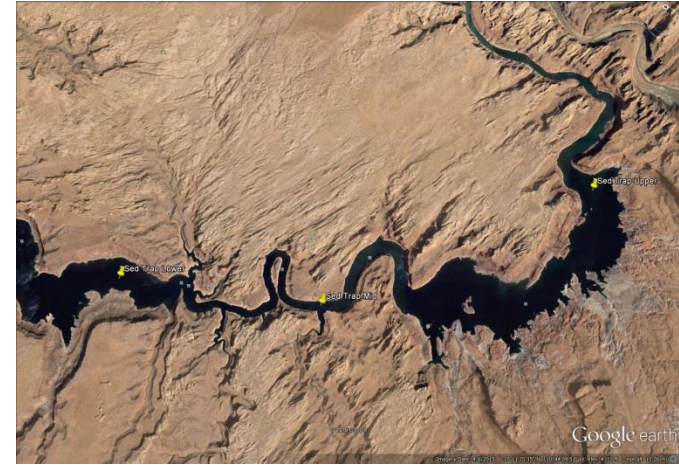
- ❑ Depositional area for historic and current mine releases in San Juan system

## Historic releases:

- ❑ Estimated release of 8.6 million tons of tailings discharged to river system over life of the mines
- ❑ EPA estimates 5.5 million gallons per day of releases
- ❑ 1974 – 116,000 tons
- ❑ 1978 - 500 million gallon release

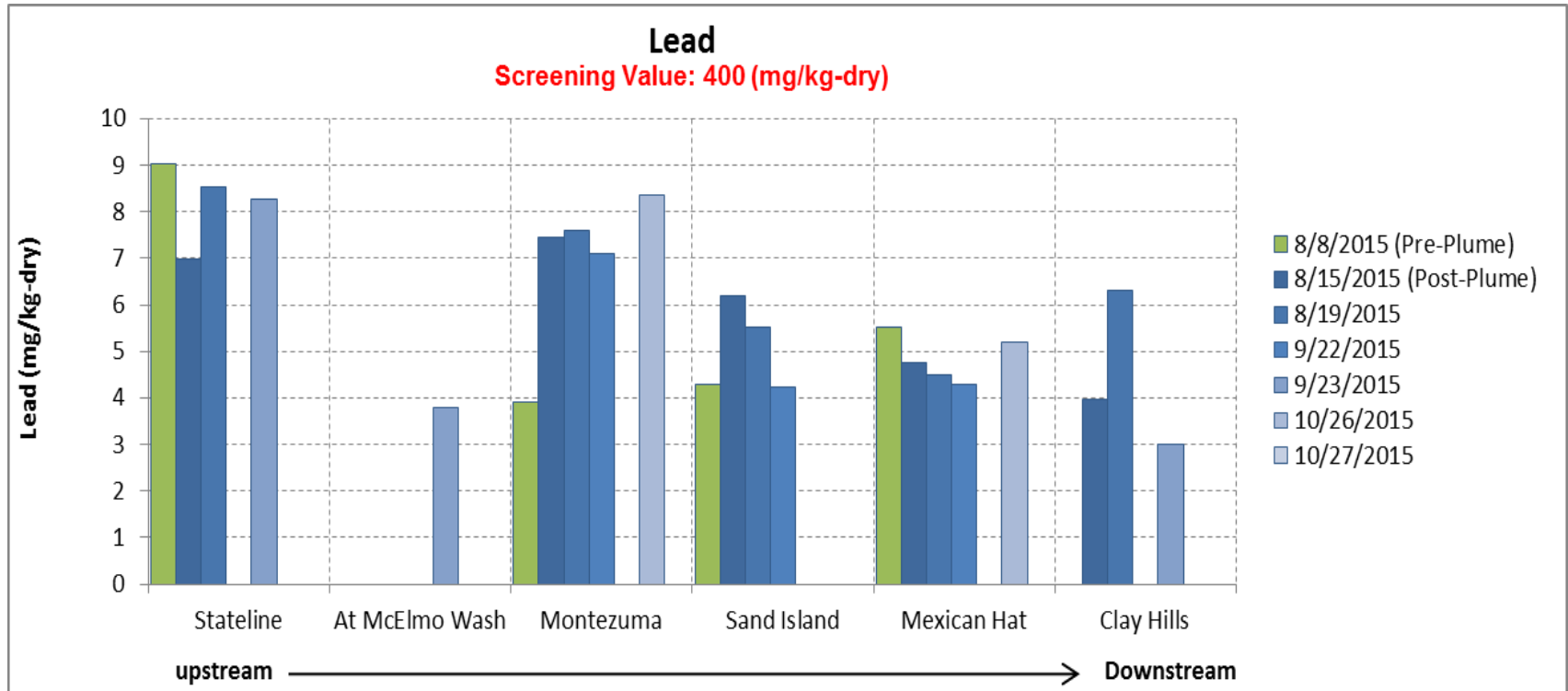


# Sediment transport



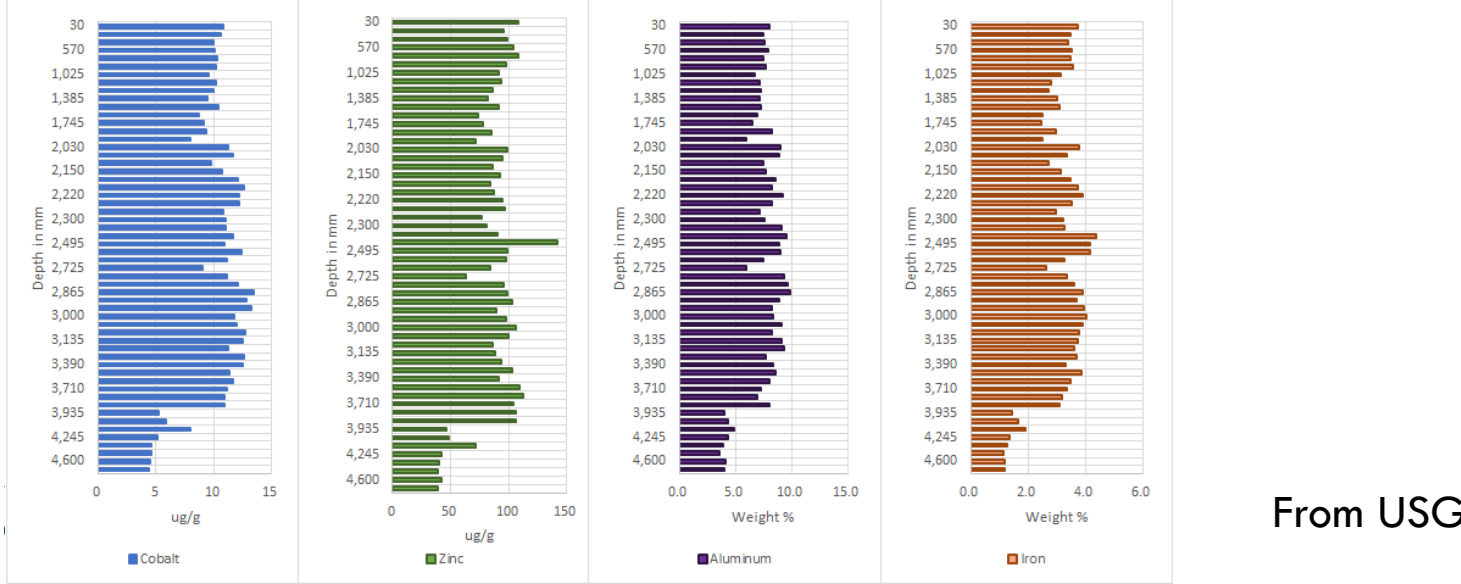
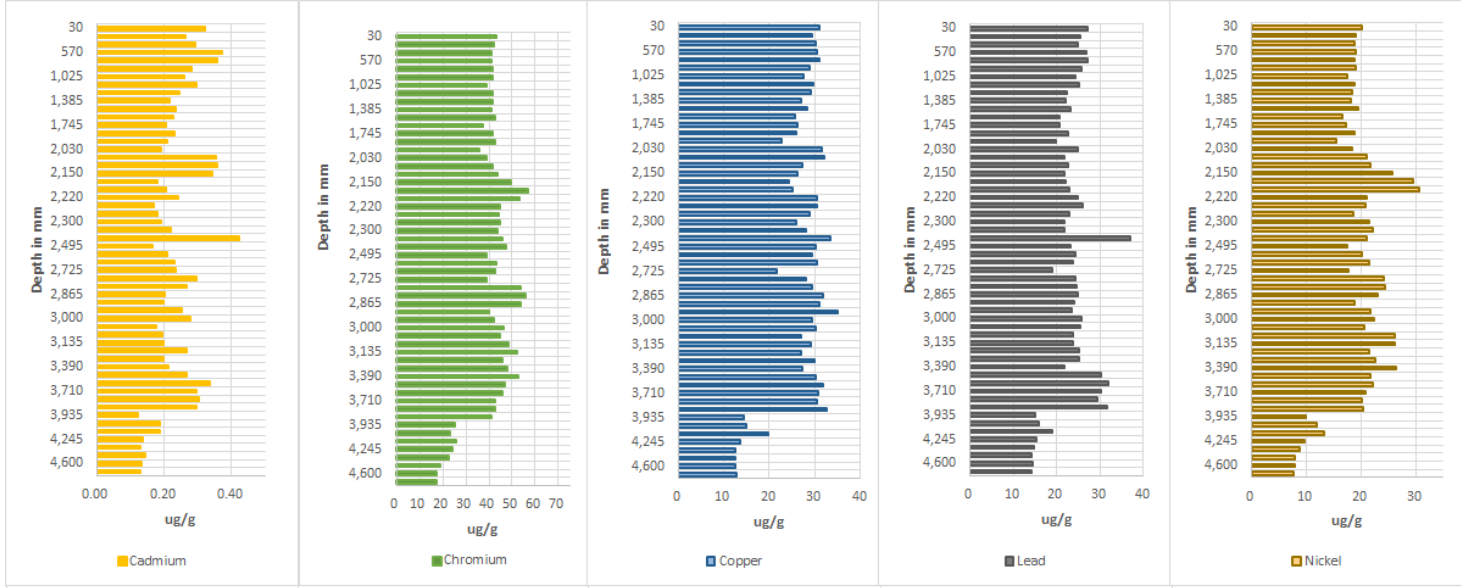
- ❑ Sediment monitoring in San Juan River (UDEQ) and Lake Powell (USGS)

# Lead in Sediment



- ❑ Health based concentration: 400 mg/kg
- ❑ Aquatic Life screening value: 37 mg/kg

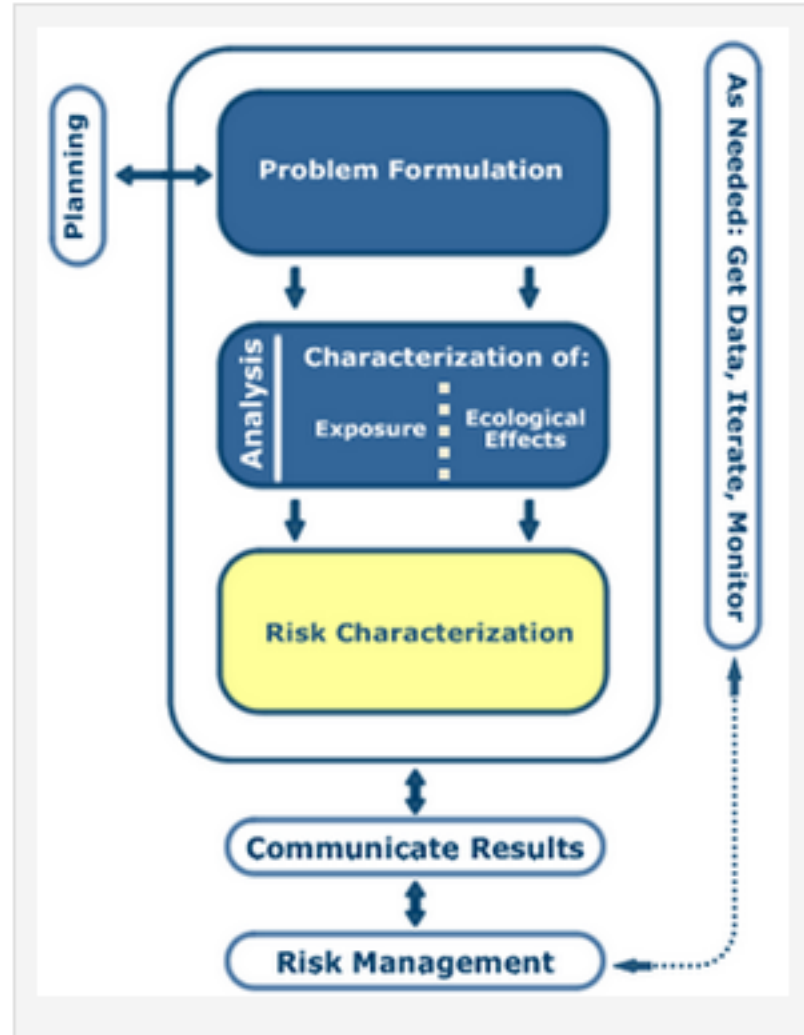
# Lake Powell - San River Arm Core 3



# Ecological and Human Health Risk Assessment

Assess the potential for adverse effects to invertebrates, fish, birds and mammals from exposure via food items using pollutant concentrations measured in invertebrates and water.

Assess the potential human health risk presented by use of the San Juan River for culinary water, recreation, or agricultural activities using water and sediment data.



# Long-term Work Plan Elements

## Water Quality Monitoring to Inform Public and Protect Uses of San Juan River

- Task 1: Surface Water Quality Monitoring
- Task 2: Real-time Reporting of Water Quality Conditions

## Drinking Water Quality Monitoring

- Task 3: Public Drinking Water Systems Monitoring
- Task 4: Private Well Monitoring

## Metals Load Analysis and Source Characterization

- Task 5: Total Metals Load Analysis
- Task 6: Inventory of Sources in the San Juan River Watershed

## Accumulation of Metals in San Juan River and Lake Powell

- Task 7: Sediment sampling in San Juan River and Tributaries
- Task 8: Sediment Traps in Lake Powell
- Task 9: Sediment Core Study in Lake Powell

## Assessing Impacts on Human Health and Aquatic Life Uses

- Task 10: Ecological Risk Assessment
- Task 11: Human Health Risk Assessment

## Coordination and Outreach

- Task 12: Inter-agency Partnership and Collaboration
- Task 13: Public Information and Stakeholder Outreach

<b>Long-term Monitoring Plan Total Costs</b>	<b>\$1.2 million</b>
EPA Funding for Utah Long-term Plan	\$465,000
EPA Funding for Utah's Spring Runoff activities	~\$180,000
UDEQ lab allocation and staff contributions	\$250,000
Match from other agencies	\$120,000 (tentative)
Water Quality Board interim funding	\$200,000 (prefer to return)
Defer long-term work elements	TBD

# More Information

## deq.utah.gov/Topics/Water/goldkingmine/



Help me find...

[| DEQ Home](#) | [A-Z Index](#) | [Calendar](#) | [Contacts](#) | [Divisions](#) | [EZ Records Search](#) | [Interactive Map](#) | [Payment Portal](#) | [Search DEQ](#) | [Site Map](#) |



### DEQ Main Menu

[Boards](#)

[Businesses](#)

[Certification/Training](#)

[Compliance/Monitoring](#)

[Fees/Grants/Funds](#)

[Forms](#)

[Laws/Rules](#)

[Locations](#)

[News/Notices](#)

[Permits](#)

[Pollutants](#)

[Programs/Services](#)

[Topics](#)

[Workgroups](#)

[DEQ Home](#) > [Gold King Mine](#)

## Gold King Mine Release

[| Data and Analysis](#) | [Photo Gallery](#) | [Sampling Sites Map](#) | [Long Term Monitoring Plan](#) |

[| Updates](#) | [Press Releases](#) | [Background](#) | [Animas, San Juan Spring Runoff Preparedness Plan](#) |

### Updates

#### Update April 12, 2016

DEQ continues to collect weekly water quality samples in the San Juan River. Thus far, none of the samples collected during spring runoff show exceedances of any screening values for recreational uses, aquatic life, agricultural uses, or drinking water. DEQ will notify the public on this website should any samples exceed any screening values. Otherwise, DEQ will be posting raw and summary data bi-weekly beginning in mid-April.

#### Update March 21, 2016

DEQ has drafted a Long Term Monitoring and Assessment Plan for the San Juan River and Lake Powell in response to the August 5, 2015 Gold King Mine Spill that occurred in the upper watershed. The Plan consists of 13 tasks that are designed to assess the potential risks to human health, recreation, aquatic life and agriculture.

#### Update March 4, 2016

The Water Quality Board authorized \$200,000 of hardship grant funds to monitor the San Juan River during spring runoff event. There are concerns of a second wave of metal pollution originating from the Gold King Mine release that could be remobilized when the spring melt increases stream flows. The Division of Water Quality is developing a long-term monitoring plan to include:

- monitoring during high flow events;
- placement of instrumentation to provide for continuous monitoring of turbidity; and
- evaluation of the legacy effects of metals released from mines in the San Juan River watershed on Utah's waters, including Lake Powell sediments.

#### Update February 10, 2016

DEQ continues to evaluate the effects of the August 5th release from the Gold King Mine on Utah's waters. As reported, data indicate

