Ref. 09

URS OPERATING SERVICES

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January 25, 2011

Mr. Steve Way
On-Scene Coordinator
U.S. Environmental Protection Agency, Region 8
Mail Code: 8EPR-SA
1595 Wynkoop Street
Denver, Colorado 80202-1129

SUBJECT: START 3, EPA Region 8, Contract No. EP-W-05-050, TDD No. 1005-04 Trip Report and Technical Summary – Mogul and Grand Mogul Mines, San Juan County, Colorado.

Dear Mr. Way:

Attached is one copy of the draft Trip Report and Technical Summary conducted at the Mogul and Grand Mogul Mine site in San Juan County, Colorado. Field activities were conducted in June and July of 2010. This document is submitted for your review and comments.

If you have any questions, please call me at 303-291-8269.

Sincerely,

URS OPERATING SERVIC

1260032

Joe Gilbert, PG
Project Manager

cc: Charles W. Baker/U
File/UOS

EPA ACTION BLOCK

- ◯ Approved
- ◯ Approved, TDD to follow
- ◯ Approved as corrected
- ◯ Disapproved
- ◯ Review with ______
- ◯ Original to ______
- ◯ Copy to ______
- ◯ Reply envelope enclosed

Date ______ By ______

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Date ________ By ____________

TRIP REPORT and TECHNICAL SUMMARY

MOGUL AND GRAND MOGUL MINES
Silverton, San Juan County, Colorado

1.0 INTRODUCTION

URS Operating Services, Inc. (UOS) Superfund Technical Assessment and Response Team 3 (START) has been tasked by the U.S. Environmental Protection Agency (EPA), Region 8, under Technical Direction Document (TDD) # 1005-04, to conduct field activities at the Mogul and Grand Mogul Mines (CERCLIS ID No. CON000802803) in Silverton, San Juan County, Colorado. Fieldwork for this Technical Memo was performed in June and July 2010.

This Technical Memo provides a summary of information collected during the site activities. It has been prepared in accordance with TDD No.1005-04. Activities were performed in accordance with the "UOS Generic Quality Assurance Project Plan" (QAPP) (UOS 2005).

2.0 SITE ACTIVITIES

Site visits to the Mogul and Grand Mogul mines were conducted in June and July 2010 (Figure 1). The purpose of the site visit was to gather information needed to evaluate ongoing releases of mine water and acid rock drainage and to assess potential options to mitigate those releases. Site visit tasks were to:

- Record physical and chemical parameters of surface water flows and collect surface water samples near the Mogul and Grand Mogul Mines waste piles to assess surface water and waste pile interactions.
- Characterize waste rock piles identified by the Bureau of Land Management (BLM) and the U.S. Geological Survey (USGS), and estimate waste pile volumes and surface areas.
- Performing test pit investigation in July 2010 to assess potential adit drainage, infiltration, and groundwater flows into and out of the Mogul and Grand Mogul waste piles. (Photo documentation is provided in Appendix A.)

3.0 BACKGROUND

Four main waste piles and associated surface water drainage were assessed during the site visits. One pile is located at the Mogul Mine site, and three of the piles are located at the Grand Mogul Mine site (Figures 2 and 3).

3.1 MOGUL MINE

The Mogul Mine area consists of a large waste rock pile and an open adit (Tables A and B). The Mogul Mine resides in a small glacial depression adjacent to Cement Creek bounded by talus, solifluction deposits, and bedrock outcrops. Cement Creek flows to the north of this depression (Figure 2). Shallow soils have developed within the basin. To the west, or downgradient of the Mogul Mine, a relatively flat, saturated area receives surface and shallow groundwater from seeps and springs throughout the depression. Surface water is channeled along the northeast side of the saturated area, and this channel drains to Cement Creek. An access road runs up to and through the Mogul Mine site area. Though narrow, it is suitable for high clearance vehicles and track-mounted excavation equipment.

The Mogul Mine adit is open and flowing and was observed with a flow of 0.138 cubic feet per second (cfs) (62 gallons per minute [gpm]) as measured by EPA in June of 2010. A Parshall flume has been installed to monitor drainage from the adit, and surface water from the adit has been channelized and flows to the south of the main waste rock pile. A small shed that appears to be used for storage, but is not related to previous mine activities, sits on top of the Mogul Mine waste rock pile. Some scattered mine-related trash exists throughout the site; however, no other significant cultural debris remains.

3.2 GRAND MOGUL MINE

The Grand Mogul Mine site is up-valley and east of the Mogul Mine site. Access to the Grand Mogul Mine is achieved by utilizing either the road that bisects the Mogul Mine site, or another access road that traverses the north wall of the basin (Figure 3). The Grand Mogul Mine consists of three discrete waste rock piles that are spaced throughout the upper Cement Creek basin.

No adit appears to be associated with Pile 1 (Figure 3); its morphology and location suggest that this pile may have been transported from other mine workings to its current location. A grate-covered underhand stope is exposed approximately 60 feet to the north of Pile 2. A collapsed adit exists immediately to the north of Pile 3; however, it is not discernable from the hillside. Small amounts of cultural debris are scattered throughout the basin; however, no significant mine workings aside from the stope at Pile 2 are evident.

The basin in which the Grand Mogul site resides consists of channelized tributaries and Cement Creek. To the west side of the basin, all channel tributaries drain into Cement Creek between Grand Mogul Pile 1 and Pile 2 (Figure 3). At the time of the site visit in June, a large snowfield covered the eastern portion of the basin. Shallow soils and alpine tundra typify the Grand Mogul basin. Basin walls are bounded by steep talus, bedrock outcrops, and solifluction deposits.

3.3 WASTE ROCK PILES – MOGUL

The Mogul Mine site area consists of one adit and a large two-tiered waste rock pile. The waste rock pile is bisected by a four-wheel-drive access road (Photo 1). The upper tier (Tier 1) of the waste rock pile consists of multiple lobes of primarily sulfide-bearing and vein-derived quartz waste rock. Though the individual lobes appear to have supported narrow-gauge ore rails, no cultural debris or rail debris was observed on the waste rock pile. The maximum thickness of the Mogul Mine waste rock pile is estimated at 30 feet, based upon field observation. Grain sizes within the Mogul Mine waste pile range from silty to coarse-grained sand including cobbles and boulders up to approximately 20 inches in diameter.

The lower tier (Tier 2) of the Mogul Mine waste rock pile consists primarily of sulfide-bearing and vein-derived quartz rock. Several outcrops of bedrock were observed in the lower tier, which suggests that the overall thickness of the lower-tier maybe shallow relative to the upper tier (Photo 5). A small spring was observed issuing from the base of the lower tier, and its flow was visually estimated at 2 to 3 gpm.

At the base of Tier 1, the flow was visually estimated at 0.02 cfs (10 gpm) at the time of the site visit. The adit water from the Mogul Mine has been directed around the south side of the waste rock pile in order to sequester flow to prevent infiltration of the main rock pile. The adit discharge is contained in a rubberized plastic channel for approximately half of the distance downslope of the Mogul Mine waste rock pile. From there it joins other basin discharge, is channeled, and enters Cement Creek.

During the July 2010 activities, an approximately 100-foot-long trench was excavated for geologic observation along the northeastern boundary of Tier 1 of the waste pile at the Mogul

Mine. The trench was excavated to a depth of 9 feet below ground surface (bgs) where bedrock was encountered. The eastern extent of the excavation was terminated near the adit portal. A horizontal distance of 20 feet was maintained between the trench and the portal to minimize potential impacts to the portal. The excavation began at the western end and extended to the east, and the excavator remained on the eastern extent of the excavation until backfilling commenced. Excavated materials were returned to the trench following geological logging, and the excavator was used to compact the material. Photo 19 shows the excavated area following reinstatement.

Water was observed entering the trench in the eastern corner closest to the portal. The rate of discharge was low, visually estimated at 2 gallons per minute pooled in the base of the excavation. Photo 18 shows the excavation profile where the spring was observed. Two samples (MMWR01 and MMWR02) were taken of the waste rock for geotechnical and chemical analysis; results are presented in Table 3 and Appendix B.

As part of the investigation for a potential repository location, two test pits (Test Pit 1 and Test Pit 2, Figure 2) were excavated in an area adjacent to the waste rock. Water was not observed in either trench at depths of 7 feet bgs in Test Pit 1and 5 feet bgs in Test Pit 2. The depth of the test pits was limited by the presence of shallow bedrock. A sample was collected from Test Pit 1 (MMTP01) for geotechnical and chemical analysis. The results are presented in Appendix B. No sample was collected from Test Pit 1 as the observed lithology was similar to that of Test Pit 2. Mine workings were not disturbed during these excavations and care was taken to restore conditions to those prior to excavation. Photos 20 through 23 show Test Pit details.

3.4 WASTE ROCK PILES – GRAND MOGUL

The Grand Mogul Mine area contains three main waste rock piles; Pile 1, Pile 2, and Pile 3 (Table A, Figure 3).

3.4.1 Waste Rock Pile 1

Waste rock Pile 1 is the smallest of the three piles at Grand Mogul and consists of a single pile with a maximum thickness visually estimated at 15 feet (Table A, Photo 12). Pile 1 is also referred to in the BLM report (BLM 2006) as the "Lower Waste Pile." This pile is flat-lying and is contained within a small tributary channel of Cement Creek. Geologically, rocks found in this pile consist of mineralized waste bedrock and sulfide-bearing and vein-derived quartz. A small spring emanates from the downgradient base of this pile and had an estimated discharge of approximately 1 gpm in a westward direction at the time of the site visit. Grain sizes of waste rock within the rock pile consist of silty to coarse sand and waste rock cobbles up to approximately 12 inches in diameter.

3.4.2 Waste Rock Pile 2

Grand Mogul waste rock Pile 2 is referred to as the "Grand Mogul Stope Complex" by the BLM (BLM 2006) (Table B, Photos 10, 11, and 15). It consists of two large lobes of mineralized waste rock that lie beneath a four-wheel drive access road (Figure 3). Immediately to the north of the waste rock piles is an underhand mine stope that has a large grate over it. The maximum thickness of the two main waste rock pile lobes is estimated at 25 feet. Grain sizes of waste rock within the two lobes consist of silty to coarse sand and waste rock cobbles up to approximately 12 inches in diameter.

Surface water was observed flowing past the toe of Pile 2 from Pile 3 (Figure 3). Additional input from a seep within Pile 2 may contribute to this flow but it was not discernable during field observation. Surface water flow near the base of Pile 2 was visually estimated at approximately 20 gpm to the south and west at the time of the site visit.

3.4.3 Waste Rock Pile 3

Waste rock Pile 3 is the largest of the Grand Mogul Mine piles, and at the time of the site visit, its northwestern and northeastern flanks were partially covered with snow. The pile consists of a large multi-lobe pile and a smaller eastern lobe (Figure 3) (Table A, Photos 9, 13, and 16). The rock pile is typified by mineralized bedrock cobbles with grain sizes ranging between fine sand and pea-gravel-sized waste rock. Large cobbles of waste rock are also present within and on top of the pile. A spring was observed issuing from the toe of Pile 3. The seep was flowing at an estimated rate of 12 gpm to the south and west.

A trench (Trench 2) was excavated into the northeastern extent of the pile in an attempt to discern the location of the collapsed adit portal and assess the potential presence of other seeps entering the waste pile along this edge (Photo 27). The trench extended 25 feet to the southwest of the suspected location of the mine adit to a depth of 15 feet. Bedrock was encountered at the bottom of the excavation along its entire length. Waste rock and natural talus were encountered along the trench with waste rock being prevalent in the eastern 15 feet, and then natural rock being encountered along the remaining 10 feet. The trench walls began to fail when talus was encountered, and at this point the excavation was terminated at the eastern extent of the trench. A seep was encountered on the northern wall of the excavation. The seep was observed at between 4 and 8 feet bgs and was approximately 4 feet in width. The discharge from the seep was very low, visually estimated to be less than 1 gpm. It is likely that the seep is associated with the adit. Further investigation of this location was not undertaken due to the instability of the talus slope adjacent to the excavation.

The trench was then extended toward the west. No seeps were encountered along the western extent; talus was encountered after approximately 20 horizontal feet from the origin to the final extent of 110 feet from the origin. Depth to bedrock was approximately 15 feet bgs at the origin, reducing to approximately 8 feet bgs at the northwestern extent.

No mining structures were encountered or disturbed during the excavation. Reinstated materials were consolidated using the weight of the excavator.

A test pit (Test Pit 3) was excavated to 4 feet deep to determine to the depth of cover in the area adjacent to Grand Mogul Mine Pile 2. No water was observed in this trench. Care was taken to restore site conditions to those prior to excavation.

3.5 VOLUME ESTIMATION

Volumes for the Mogul and Grand Mogul waste piles were estimated using data gathered during the site visit and were analyzed in a Geographic Information System (GIS).

During the site visit, the salient lobes and thickest portions within each waste pile were identified, their central points were located with a DGPS, and their thicknesses at their highest point were estimated. The boundary of the waste rock pile was also surveyed using a DGPS in order to provide area estimates and a base footprint for each waste pile.

DGPS measurements were converted to a 3D surface, a convex hull, in a GIS. A GIS was then used to summarize the interior volume of the convex hull, and to determine its 3D surface area. The 2D footprint area was also calculated from collected DGPS data and was summarized in the same GIS. Waste rock volumes and areas are presented in Table A.

TABLE A
Volume Estimates – Waste Piles

Mine	Pile Number	BLM* Name	3D Surface Area (ft^2)	Footprint Area (ft^2)	Volume (yds^3)	BLM* Volume (yds^3)
Mogul	1	--	106,068.5	101,590.6	41,374.7	--
Grand Mogul	1	Lower Waste Pile	8,449.7	4,187.2	845.0	--
Grand Mogul	2	Stope Complex	22,539.8	19,751.9	6,925.9	8,000
Grand Mogul	3	Eastern Waste Pile	42,754.6	39,041.0	18,750.2	9,000

ft^2 – square feet
yds^3 – cubic yards
* "Removal Preliminary Assessment Report, Grand Mogul Mine, Silverton, CO" BLM 2006

3.6 WATER PARAMETERS AND ANALYTICAL DATA

During the site visit in June 2010, field water parameters were collected at various points both upgradient and downgradient of all waste rock piles to determine if there was any influence by the waste rock on surface water discharge. Field parameters gathered during the site visit are presented in Table B and summarized in Figures 2 and 3.

Three water samples were collected at the Mogul Mine site and analyzed for total and dissolved metals using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and atomic emission spectroscopy (AES) analyses (Table 1). These results are compared to EPA Region 8 data, which were also collected in June of 2010 during a separate sampling event (Table 2). The results are reported in Appendix B. Sample locations are detailed in Figures 2 and 3.

TABLE B
Field Parameters from UOS Site Visit June 2010

Location	pH	Conductivity (mS/m)	Temp °C	Est. Flow Rate (gpm)
MMSW01	3.82	569.00	12.90	10
MMSW02	4.01	820.00	10.50	3
MMSW03	4.50	814.00	10.40	10
Mogul Adit	4.61	969.00	7.50	62
Grand Mogul Pile 1 spring	4.78	157.30	10.20	1
Cement Creek Confluence	5.21	168.40	8.10	1,000
Surface Water near Grand Mogul Pile 2	3.86	166.30	11.30	20

TABLE B
Field Parameters from UOS Site Visit June 2010

Location	pH	Conductivity (mS/m)	Temp °C	Est. Flow Rate (gpm)
Grand Mogul Pile 3 spring	3.92	146.40	8.90	12
Cement Creek Upgradient	5.38	115.10	8.40	1,000
Mogul Toe	2.67	--	--	3

gpm – gallons per minute
mS/M = milliSiemens per meter
*Parshall Flume Measurement, EPA June 2010

3.7 WASTE ROCK SAMPLING

Additional waste rock data was available for Mogul Mine Pile 1 and for the Grand Mogul Mine Pile 3 (USGS 2007). Table 4 compares metals concentrations and Synthetic Precipitation Leaching Procedure (SPLP – EPA-1312 Leach) waste rock concentrations of samples collected at the site in 1997 and in June 2010.

4.0 LIST OF REFERENCES

Bureau of Land Management (BLM). 2006. "Removal Preliminary Assessment Report, Grand Mogul Mine, Silverton, CO." BLM National Science and Technology Center. November 2006.

U.S. Geological Survey (USGS). 2007. Integrated Investigations of Environmental Effects of Historical Mining in the Animas River Watershed. San Juan County, Colorado Professional Paper 1651. Volume 1.

URS Operating Services, Inc. (UOS). 2005. "Generic Quality Assurance Project Plan" for the Superfund Technical Assessment and Response Team 2, Region 8. June 13, 2005.

Figure 1 – title

Figure 2 – title

Figure 3 – title

TABLE 1
Surface Water Sample Results
June 2010

Analyte	Sample ID Location	MMSW01 MM Waste Rock Seep Below Toe of Pile	MMSW02 MM Adit Flow Toe of Waste Pile	MMSW03 MM Adit flow Mid Waste Rock Pile
Aluminum (µg/L)	Dissolved	4,400	2,200	2,000
	Total	4,200	2,200	2,100
Antimony (µg/L)	Dissolved	<0.14	<0.14	<0.14
	Total	0.12J	0.35J	0.17J
Arsenic (µg/L)	Dissolved	<0.42	<0.42	0.94J
	Total	0.34J	1.9J	2.8J
Barium (µg/L)	Dissolved	8.2	8.7	8.7
	Total	7.5	9.2	8.9
Beryllium (µg/L)	Dissolved	1.9J	3.1	2.9
	Total	1.6	3.1	3.2
Cadmium (µg/L)	Dissolved	35	33	33
	Total	35	34	34
Calcium (µg/L)	Dissolved	58,000	140,000	140,000
	Total	55,000	130,000	130,000
Chromium (µg/L)	Dissolved	<1	<1	<1
	Total	1.5J	<0.5	<0.5
Cobalt (µg/L)	Dissolved	10	18	18
	Total	9.9	18	18
Copper (µg/L)	Dissolved	590	43	26
	Total	600	47	26
Iron (µg/L)	Dissolved	4,900	8,800	15,000
	Total	4,700	11,000	24,000
Lead (µg/L)	Dissolved	51	140	130
	Total	50	140	140
Magnesium (µg/L)	Dissolved	5,200	8,200	8,300
	Total	5,200	8,600	8,700
Manganese (µg/L)	Dissolved	7,600	20,000	19,000
	Total	7,700B	18,000	20,000

TABLE 1, cont.
UOS START Surface Water Sample Results
June 2010

Analyte	Sample ID Location	MMSW01 MM Waste Rock Seep Below Toe of Pile	MMSW02 MM Adit Flow Toe of Waste Pile	MMSW03 MM Adit flow Mid Waste Rock Pile
Mercury (µg/L)	Dissolved	0.042J B	0.038J B	0.045J B
	Total	<0.027	0.027J	0.052J
Nickel (µg/L)	Dissolved	10	11	9.4J
	Total	9.8	11	11
Potassium (µg/L)	Dissolved	660J	1,400J	1,600J
	Total	810J	1,800J	1,900J
Selenium (µg/L)	Dissolved	2.1J	<1.4	<4.9
	Total	<0.7	<0.7	<0.7
Silver (µg/L)	Dissolved	0.13J	<0.03	3.4J
	Total	0.26J	0.093J	0.036J
Sodium (µg/L)	Dissolved	2,500B	4,600B	4,800B
	Total	2,800B	5,100B	6,400B
Thallium (µg/L)	Dissolved	0.11J B	0.14J B	0.15J B
	Total	0.072J	0.15J	0.15J
Vanadium (µg/L)	Dissolved	<0.28	<0.28	<0.28
	Total	<0.14	<0.14	0.15J
Zinc (µg/L)	Dissolved	11,000	20,000	19,000
	Total	11,000	19,000	20,000
pH		3.82	2.67	4.5
Conductivity (µS/m)		569	820	814
Flow (cfs)		0.02228	0.006684	0.02228

MM = Mogul Mine
µg/L = Micrograms per Liter
cfs = Cubic feet per second
µS/m = Microsiemens per meter
B = The analyte was detected in the blank
J = The associated numerical value is an estimated quantity between the detection limit and the quantitation limit.

TABLE 2
EPA Region 8 Surface Water Sample Results
June 2010

Analyte	Sample ID / Location	CC01F Basin Flow Above GM	CC01C Waste Seep From Pile 3	CC01H Basin Flow Below GM Piles 2 and 3	CC01S CC between GM Pile 1 and Pile 2	CC01t CC below GM Piles 2 and 3	CC02i Drainage Above CC GM Pile 1	CC02D MM Adit Flow at Flume	MtD-1 Waste Rock Seep Toe of MM Waste Pile	MtD-2 MM Adit flow at Toe of Waste Rock	MtD-3 MM Drainage Above CC	CCOPP-12 Below MM and GM
Aluminum (µg/L)	Dissolved	<100	1,930	396	1,250	702	715	2,390	1,180	3,360	3,500	470
	Total	248	1,990	698	1,470	1,070	731	2,520	1,180	3,350	3,490	568
Arsenic (µg/L)	Dissolved	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
	Total	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Beryllium (µg/L)	Dissolved	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	3.5	<1.0	1.7	1.2	<1.0
	Total	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	3.6	<1.0	1.6	1.1	<1.0
Cadmium (µg/L)	Dissolved	1.9	14.9	5.5	5.7	5.2	4.2	38.9	12.2	37.1	28.9	3.1
	Total	2.1	15.9	5.1	6.1	5.3	4.5	40.3	11.5	37.3	27.7	3.1
Calcium (µg/L)	Dissolved	18,100	11,800	16,900	25,000	20,700	22,100	168,000	27,100	74,000	43,500	13,000
Chromium (µg/L)	Dissolved	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	Total	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Copper (µg/L)	Dissolved	27.2	295	141	57.5	88.4	33.7	22.3	87.9	529	491	56.9
	Total	44.2	292	140	61.5	95	35.8	22.6	85.1	533	485	57
Iron (µg/L)	Dissolved	<100	2,510	<100	<100	<100	144	22,000	395	8,830	4,320	<100
	Total	<100	2,700	752	<100	374	207	26,100	1,450	11,500	5,740	305
Lead (µg/L)	Dissolved	<1.0	36.5	3	2	2.9	2.6	153	31	87.2	45.4	3.1
	Total	11.5	40.2	11.7	3.5	8.3	3.6	168	40.6	98.2	50.6	5
Magnesium (µg/L)	Dissolved	1,740	2,140	1,890	3,720	2,720	2,940	10,200	2,160	5,880	3,800	1,440
Manganese (µg/L)	Dissolved	148	1,670	449	2,170	1,230	76.2	24,100	3,350	10,800	4,970	552
	Total	157	1,730	455	2,270	1,310	80.1	25,400	3,550	11,400	5,290	585
Nickel (µg/L)	Dissolved	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	8.8	4.3	7.3	7.5	<4.0
	Total	<4.0	4.7	<4.0	5.7	4.1	4.9	12.2	4.9	8.1	8.7	<4.0
Potassium (µg/L)	Dissolved	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	1,840	<1,000	<1,000	<1,000	<1,000
Selenium (µg/L)	Dissolved	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.4	<1.0	1	<1.0	<1.0
	Total	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.6	<1.0	1.3	<1.0	<1.0
Silver (µg/L)	Dissolved	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Total	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

TABLE 2, cont.
EPA Region 8 Surface Water Sample Results
June 2010

Analyte	Sample ID / Location	CC01F Basin Flow Above GM	CC01C Waste Seep From Pile 3	CC01H Basin Flow Below GM Piles 2 and 3	CC01S CC between GM Pile 1 and Pile 2	CC01t CC below GM Piles 2 and 3	CC02i Drainage Above CC GM Pile 1	CC02D MM Adit Flow at Flume	MtD-1 Waste Rock Seep Toe of MM Waste Pile	MtD-2 MM Adit flow at Toe of Waste Rock	MtD-3 MM Drainage Above CC	CCOPP-12 Below MM and GM
Sodium (µg/L)	Dissolved	830	569	988	932	1,060	1,140	5,430	1,870	3,000	2,120	622
Zinc (µg/L)	Dissolved	370	3,210	1,120	1,070	978	1,290	22,900	4,400	14,900	8,190	731
	Total	379	3,350	1,110	1,060	1,050	1,290	24,500	4,550	15,400	8,910	735
pH		5.72	3.45	5.53	5.13	5.27	3.92	3.58	3.6	3.02	3.15	5.07
Conductivity (mS/cm)		129	208	134	205	167	191	785	248	928	604	110
Flow (cfs)		4.61	--	5.58	2.51	8.26	--	0.138	--	--	0.394	24.5

CC = Cement Creek
GM = Grand Mogul Mine
MM = Mogul Mine
µg/L = Micrograms per liter
ms/cm = MilliSeimens per centimeter
cfs = Cubic feet per second

TABLE 3
Metal Results for Waste Rock Samples

Sample ID	35B (AMLI Mine #35)		35C (AMLI Mine #35)		MMWR01	MMWR02
Sample Source	USGS 2007 Sample Taken in 1997		USGS 2007 Sample Taken in 1997		START 2010	
Location Description	Grand Mogul Waste Rock Pile 3		Grand Mogul Waste Rock Pile 3		Trench at Mogul Mine	Trench at Grand Mogul Mine Pile 3
Analysis / Analyte	ICP-AES (mg/kg)	SPLP (EPA Method 1312) (µg/L)	ICP-AES (mg/kg)	SPLP (EPA Method 1312) (µg/L)	ICP-AES (mg/kg)	ICP-AES (mg/kg)
Aluminum	48,000	1,800	42,000	2,000		
Arsenic	79	30	80	30	50	28
Barium	390	57	310	27		
Beryllium	2	10	2	10		
Cadmium	120	52	140	55		
Calcium	1,700	1,300	1,600	1,300		
Chromium	12	10	8	10		
Cobalt	4	10	4	10		
Copper	1,900	350	1,800	350		
Iron	45,000	1,200	44,000	770		
Lead	24,000	8,200		8,100	908	597
Magnesium	4,200	3,100	4,000	3,300		
Manganese	3,000	2,400	2,600	2,600		

TABLE 3, cont.
Metal Results for Waste Rock Samples

Sample ID	35B (AMLI Mine #35)		35C (AMLI Mine #35)		MMWR01	MMWR02
Sample Source	USGS 2007 Sample Taken in 1997		USGS 2007 Sample Taken in 1997		START 2010	
Location Description	Grand Mogul Waste Rock Pile 3		Grand Mogul Waste Rock Pile 3		Trench at Mogul Mine	Trench at Grand Mogul Mine Pile 3
Analysis / Analyte	ICP-AES (mg/kg)	SPLP (EPA Method 1312) (µg/L)	ICP-AES (mg/kg)	SPLP (EPA Method 1312) (µg/L)	ICP-AES (mg/kg)	ICP-AES (mg/kg)
Molybdenum	36	20	38	20		
Nickel	6	10	6	10		
Phosphorous	1,300	3,900	1,300	3,600		
Potassium	22,000	1,800	19,000	1,700		
Silver	63		64			
Sodium	1,700	370	1,400	170		
Sulfate		81,300		79,900		
Tin	17		18			
Titanium	900	50	800	50		
Vanadium	77	10	75	10		
Zinc	30,000	10,000	34,000	10,000	279	565

mg/kg = Milligrams per kilogram
µg/L = Micrograms per Liter