U.S. ENVIRONMENTAL PROTECTION AGENCY
POLLUTION/SITUATION REPORT
Rico Argentine Mine - Removal Polrep

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region VIII

Subject: **POLREP #3**
Progress
Rico Argentine Mine
08BU
Rico, CO
Latitude: 37.6927729 Longitude: -108.0303502

To:
From: Steven Way, OSC
Date: 6/5/2013
Reporting Period:

1. Introduction

1.1 Background

Site Number:	08BU	**Contract Number:**	
D.O. Number:		**Action Memo Date:**	1/11/2011
Response Authority:	CERCLA	**Response Type:**	Time-Critical
Response Lead:	PRP	**Incident Category:**	Removal Action
NPL Status:	Non NPL	**Operable Unit:**	OU 1
Mobilization Date:		**Start Date:**	5/31/2011
Demob Date:		**Completion Date:**	
CERCLIS ID:		**RCRIS ID:**	
ERNS No.:		**State Notification:**	
FPN#:		**Reimbursable Account #:**	

1.1.1 Incident Category

CERCLA Time-Critical Removal Action

1.1.2 Site Description

1.1.2.1 Location

The Rico Argentine Mine Site is located north of the town of Rico, in Dolores County, Colorado (Figure 1). The St. Louis Tunnel and the settling ponds area of the Site are located on the east bank of the Dolores River, but the mine workings extend into Telescope Mountain. Mine workings extend to the southeast surface near Silver Creek east of the town of Rico. Additional information is provided in POLREP#2.

1.1.2.2 Description of Threat

Mine water drains from multiple underground mine workings into the St. Louis Tunnel, which discharges to the Dolores River. Reported historic flow rates range from 600 gallons per minute (gpm) to 2200 gpm. Tunnel discharge samples collected between June 2010 and November 2012 contained cadmium concentrations ranging from 13 micrograms per liter (µg/L) to 67 µg/L and zinc concentrations ranging from 2900 µg/L to 11,700 µg/L. A series of ponds were used historically for lime treatment of the mine water before discharging to the Dolores River. Currently untreated, the effluent from the pond system contains cadmium concentrations ranging from 9 µg/L to 52 µg/L and zinc concentrations ranging from 1900 µg/L to 8400 µg/L during this same time period. Lime precipitate sludge that contains heavy metals at percent levels (e.g. 4.4% zinc) is contained in the settling ponds. High water levels in the ponds relative to the top of the dikes increases the potential threat that sludge and metals-laden water will overtop the ponds and flow into the Dolores River. For example, the Pond 18 water level in June 2010 was within one foot of the top of embankment along the Dolores River.

Sensitive ecosystem impacts are potentially occurring due to the ongoing releases to the Dolores River, which is considered a Cold Water Aquatic Life Class 1 by the state of Colorado. The metals concentrations being released into the environment exceed the low flow assimilative capacity of the river segment as determined by the State 2008 Water Quality Assessment (WQA).

In addition, Silver Creek, a tributary to the Dolores River, flows through a portion of the site and is impacted by acid mine drainage. The potential exists for mine water from the Blaine Adit flow to discharge to Silver Creek.

1.1.3 Preliminary Removal Assessment/Removal Site Inspection Results

The ponds area is bound to the west by the Dolores River and U.S. Forest Service land on the east. A portion of many of the ponds sit within U.S. Forest Service land boundaries. The remaining land covers several privately-held mining claims with different owners. In some cases, the ownership of specific parcels is uncertain. In 2000, an emergency removal was performed to address overtopping of one of the ponds. EPA's response consisted of raising and reinforcing the riverside embankment of the pond, adding an additional culvert between the pond and downgradient ponds, and installing overflow riprap as a backup drain path.

The St. Louis Tunnel drains historical mine workings extending several thousand feet into Telescope Mountain and Dolores Mountain to the east and southeast, respectively. The St. Louis Tunnel is or was directly hydraulically connected to the mine workings of the former Pigeon, Logan, Wellington, Mountain Spring, Argentine, Blaine, Blackhawk and other mines. The 2008 State WQA reports that flows generally range from 2 to 3.3 cubic feet per second (cfs). The Blaine Mine Adit discharged to Silver Creek as late as 2000 but a coffer dam was installed to direct water to the crosscut that leads to the St. Louis Tunnel. Based on an Atlantic Richfield 2000 sampling report, metals concentrations in the Blaine mine water included 7,000 µg/L cadmium, 5,200 µg/L copper, 844,000 µg/L iron, 505 µg/L lead, 149,000 µg/L manganese, and 230,000 µg/L zinc.

The St. Louis Tunnel discharge treatment historically consisted of a lime addition and precipitation of heavy metals in a series of 19 settling ponds at the Site. As of 1996, the estimated volume of lime-precipitation/metals sludge was in excess of 68,000 cy in 10 settling ponds. The settling ponds are unlined and surrounded by earthen dikes/berms. A portion of the settling ponds system is within the 100-year floodplain of the Dolores River. Recent hydrologic modeling indicates that the upper ponds would not be topped during a 100-year flood event, but the lower ponds would be inundated.

The upper, largest pond, Pond 18, is estimated to contain the largest volume of impounded treatment sludge. It is adjacent to the Dolores River and had little remaining freeboard at the dike along the river. In June 2010, for example, the sludge and water were measured to be less than 12 inches from the top of the dike embankment. During a second inspection in September 2010, beaver damming caused pond water to overtop the lower pond (Pond 5) banks and bypass the outfall structure. Pond 18 was drained by the PRP, Atlantic Richfield Company (AR) in October 2010 and, 7500 cubic yards of lime precipitation solids were removed in 2011.

2. Current Activities

2.1 Operations Section

2.1.1 Narrative

Generally, the actions implemented during the reporting period include managing the settling ponds and associated lime precipitation solids; mine water source controls in the Blaine Adit; wate treatment alternatives development, and investigations required to implement hydraulic cotrols of the St. Louis Tunnel discharge.

2.1.2 Response Actions to Date

Ongoing Monitoring

- Continuous (hourly) flow measurements are made at the St Louis Tunnel Adit (station DR-3) and the outfall (DR-6) to the Dolores River using automated instrumentation.

- Water samples are collected monthly from the St. Louis Tunnel discharge, two points within the pond system (discharge from Ponds 8 and 15), the outfall from the settling pond system to the Dolores River, and five locations in the Dolores River (below Silver Swan, above St. Louis settling pond system, above and below the St. Louis settling pond system outfall, and at USGS gauging station #09165000). The samples are analyzed for total and dissolved metals, alkalinity, hardness, total dissolved solids, total suspended solids, cyanide, salinity, and sulfate.

- Groundwater samples are collected monthly and water levels measured in monitoring wells located throughout the Site. Wells are located upgradient of the Site, along the hillside, along the adit collapse area, within the Pond 16/17 area, within Pond 13, and along pond berms.

Solids Management

- Approximately 7500 cubic yards of lime precipitation solids were removed from Pond 18 during 2011 and placed in drying cells constructed in the Pond 16/17 area. The solids are being monitored for drying and handling characteristics. Approximately 2200 cubic yards of solids were dredged from Pond 15 during September and October 2012 and placed in Pond 13 for draining and temporary storage. Two feet of solids were left in each pond to provide a barrier to reduce infiltration from the ponds to the underlying aquifer and potentially the Dolores River.

- Geotechnical/geologic evaluations of potential solids drying and repository sites were performed in 2011 and 2012. The 2011 investigation identified landslide deposits in the steep slope of CHC Hill that reduces the usability of the initially preferred repository site located north of the pond system. 2012 investigations focused on a potential repository location south of the St. Louis Tunnel and on Pond 13, a relatively empty pond that does not receive St. Louis Tunnel flows.

- Calcines, a product of roasting ore, are present within Pond 16/17, beneath Pond 13, and at other Site locations. The calcines were sampled and underwent geochemical analysis to determine if drainage from the lime precipitation solids or groundwater flow through the calcines will contribute to leaching of hazardous constituents. The results are being evaluated in combination with groundwater levels, contaminant concentrations in monitoring wells, and proposed Site uses.

Pond Improvements

- Flood dike upgrades along settling ponds were constructed in June 2012 based on 100-year flood modeling (HEC-RAS). Upgrades included addition of dike embankment filter material near seeps, riprap addition near the upper ponds (18 and 15), and elevation of the dike along Pond 9 to increase freeboard relative to flood stage water elevations.

- Geotechnical evaluation of the pond berms was conducted during 2011 and 2012 and the results will be used to design ponds structures if needed for the selected water treatment system.

Hydraulic Controls at St. Louis Tunnel Collapsed Adit Area

- The collapsed portion of the St. Louis Tunnel is overlain by loosely consolidated alluvium that does not support safe mine entry or construction of features to control releases of water from the mine, so AR is conducting a drilling program to locate bedrock in the tunnel. AR contractors drilled into the St. Louis Tunnel at two locations during 2011 but did not encounter bedrock. Two attempts to drill into the tunnel were unsuccessful in 2012. Additional drilling to locate the bedrock within the tunnel will be performed in early summer 2013. The information will be used to develop a plan to access a stable location within the mine for installation of hydraulic controls.

- Wells were drilled along the St. Louis Tunnel collapsed adit area to identify interactions between the mine water and the underlying aquifer. Initial results indicate that there is a groundwater mound and possibly a perched upper aquifer formed by water released from the collapsed adit.

Source Water Investigations

- Underground mine workings investigations were performed during 2011 and 2012 to assess mine water chemistry, flow pathways, structural reliability of workings, and develop recommendations for rehabilitation needed to ensure access and continued transport of water to the St. Louis Tunnel. EPA, Colorado DRMS, and AR supported these efforts.

- A mine workings model was developed by AR contractors using historical mine maps and documents. The model is updated as additional information is discovered.

- Mine water samples were collected from the Argentine Tunnel, Blaine Tunnel, and 517 Shaft (approximately 455 feet below ground surface). All three locations showed highly elevated metals concentrations and low pH. The Argentine Tunnel, which is upslope of the Blaine, contained extremely high metals concentrations, e.g., zinc was measured at 2,460 milligrams per liter (mg/L).

- Mine tracer studies were performed by EPA in October 2011 to assess the flow of water between the Blaine Tunnel, the 517 Shaft, and the St. Louis Tunnel. The results indicated that water flows relatively freely between these locations and that a significant percentage of the metals load reporting to the St. Louis Tunnel originates in the Blaine/Argentine area mine workings.

- Silver Creek tracer studies conducted by EPA, USGS, DRMS and EPA contractors in June and October 2011 identified a loss of flow from Silver Creek in the vicinity of the Blaine Tunnel during the

high-flow period, when flow was estimated to be between 29 cubic feet per second (cfs) to 44 cfs, and during the low-flow period, when flow was estimated to be between 0.7 cfs and 2 cfs. Percent losses ranged from about 5.3 to 9 percent at high flow and 22 to 23 percent at low flow during dry conditions. It is uncertain if the flow loss from Silver Creek enters the mine workings.

- A transducer was installed in the 517 Shaft in the fall of 2011 to measure water level changes at the water surface (approximately 455 feet below ground); however, winter icing conditions over the shaft caused the cable to break and the transducer was lost down the shaft.

- A base flow test was conducted by EPA and its contractors, DRMS, and AR to determine the amount of water that flows from the Blaine Tunnel to the 517 Shaft via the Humboldt Drift. The four day operation, conducted from July 9 through 12, 2012, involved pumping the pooled mine water from the Blaine Adit level to the 517 Shaft via 6 inch piping , then measuring flow into the tunnel behind the coffer dam. Estimated base flow in the Blaine Tunnel ranged from 10 to 20 gpm at the time of pumping, substantially lower than other historical accounts of flow (e.g. 200 gpm) within the Blaine system. The extent to which the lower flow was due to diversion of Blaine Tunnel water to the Number 3 Shaft or other pathways or to the exceptionally low snow pack in the 2011/2012 winter is unknown.

- A coffer dam upgrade was constructed approximately 350 feet inside the Blaine Adit by the property owner to ensure that acid mine water does not discharge from the portal to Silver Creek and continues to flow to the 517 Shaft. However, evidence of corrosion of the dam was observed when the mine pool was drained for work in the adit in 2012.

- The Blaine and 517 adit portals were reconstructed in 2012 to provide structurally safe conditions to enter the adit. Rock debris on the portal roof (shed) was causing the existing timbers to bow and break. The DRMS contractor performed this work.

- Two blockages that impeded flow in the Humboldt Drift between the coffer dam and the Argentine Shaft were removed by DRMS contractors; however, additional blockages remain.

- A flume was installed in the Blaine Tunnel to measure the flow of water from the tunnel to the 517 Shaft via the Humboldt Drift. A pressure transducer was installed to measure flow through the flume and readings began in October 2012.

Water Treatment Studies

- A pilot-scale in-situ water treatment test was conducted from September to November 2012. Potassium carbonate and sodium hydroxide were injected into the 517 Shaft to treat water from the Blaine/Argentine mine workings, resulting in improved discharge water quality at the St. Louis Tunnel. Cadmium and zinc concentrations at the St. Louis Tunnel discharge point were reduced by approximately 40 percent to 13.4 µg/L total cadmium concentration and 2600 µg/L total zinc concentration during the test.

- A pilot-scale constructed wetland water treatment test was initiated in November 2012. The passive treatment system contains a rock drain for manganese removal and a constructed wetland. Initial results indicate that the system was successful in removing the primary contaminants (95 percent removal of cadmium and 90 percent removal of zinc resulting in approximately 0.64 µg/L cadmium concentration and 228 µg/L zinc concentration) and the results were used to design a demonstration-scale test for 2013.

- Bench-scale ion exchange water treatment tests were conducted on Blaine Tunnel and St. Louis Tunnel waters during 2012, and ion exchange resins effective for removing contaminants from each water source were identified.

2.1.3 Enforcement Activities, Identity of Potentially Responsible Parties (PRPs)

- A Unilateral Administrative Order (UAO) was issued to the Atlantic Richfield Company (ARCO) in May 2011 to implement the Removal Action specified in the Work Plan.

2.1.4 Progress Metrics

Waste Stream	***Medium***	***Quantity***	***Manifest #***	***Treatment***	***Disposal***
Pond 18 precipitation solids	Precipitates	7500 cy	NA	NA	Pond 16/17 drying cells
Pond 15 precipitation solids	Precipitates	2200 cy	NA	NA	Pond 13

2.2 Planning Section

2.2.1 Anticipated Activities

2.2.1.1 Planned Response Activities

- Monthly surface water quality sampling and ongoing flow measurements will continue. Groundwater quality sampling and water level measurements will be conducted monthly at select well locations.
- Solids removal from Ponds 11 and 12 using a suction dredge system will occur in 2013.
- A solids repository location has been identified and conceptual designs will be prepared in 2013.
- A drilling program is scheduled to begin in early summer 2013 to locate bedrock along the St. Louis Tunnel. When the location of bedrock is confirmed, a plan to access the St. Louis Tunnel for installation of hydraulic control measures will be developed.
- The remaining blockage will be removed from the Blaine Tunnel to ensure that acid mine drainage within the Blaine Tunnel continues flowing to the St. Louis Tunnel via the Humboldt Drift to the 517 Shaft rather than being released to Silver Creek. This work will be managed by DRMS.
- The 517 Shaft injection test will be continued with a high-flow test that will begin in late May or early June 2013. The 2013 test will use sodium hydroxide in addition to potassium carbonate in an attempt to treat not only water from the Blaine-Argentine mine workings but also water that enters the underground system at other locations. The work will be directed by AMEC supported by AECI, both AR contractors. EPA will provide in-mine support.
- The pilot-scale passive treatment system will be continued through spring runoff 2013, then dismantled. A report regarding the effectiveness and applicability of the system will be prepared by AR and submitted to EPA.
- A passive treatment demonstration project designed to treat 30 gallons per minute of St. Louis Tunnel discharge will be installed early summer and operational by September. The system will include a rock drain for manganese removal and a constructed wetland for removal of other metals.

2.2.1.2 Next Steps

- Coordinate with the County and USDA FS on the repository location and plans for construction.
- Hydraulic controls to control discharges from the St. Louis Tunnel will be designed and construction beginning in 2014.
- A water treatment conceptual/30 percent design will be completed by April 2014. At this time, potential components of a water treatment system include an active lime treatment system, in-situ treatment, passive treatment (including rock drain, constructed wetlands, bioreactor), and ion exchange. Active lime treatment is the default system if the other components are not adequate to meet potential discharge criteria.
- Develop a water quality assessment data report to support the establishing of effluent limits.

2.2.2 Issues

2.3 Logistics Section

No information available at this time.

2.4 Finance Section

No information available at this time.

2.5 Other Command Staff

No information available at this time.

3. Participating Entities

Colorado Division of Reclamation and Mining Safefty (DRMS) has been funded by EPA to provide DRMS personnel to support the underground investigation and adit rehabilitation oversight.

4. Personnel On Site

AECOM is the lead technical contractor for AR. AECOM personnel and contractors performed the geotechnical and hydrological investigations at the Site during 2011 and 2012.

AMEC Environment & Infrastructure, Inc. personnel, AR consultants, were on Site from mid- 2012 through the present (April 2013) to conduct the Argentine Shaft injection pilot test and the passive water treatment pilot test.

Anderson Engineering Consultants, Inc. (AECI) is the lead construction contractor for AR. They maintain office facilities in Rico, perform monthly sampling and inspections, perform or contract for construction services, and provide for safe operations for all Site personnel. AECI contracted with Flare Construction for general construction services and with various other contractors for drilling, dredging, and other specialty efforts.

Atlantic Richfield (AR)/British Petroleum (BP) maintains one or two personnel in Rico to provide oversight during fall and summer investigation and construction operations.

Colorado Division of Reclamation Mining and Safety (DRMS) provided support for the 2011 and 2012 mine investigations and tracer studies, the Blaine Tunnel and 517 Shaft portal construction, the Blaine Tunnel coffer dam improvements, blockage removal, and flume installation. DRMS contractor Ken Bethers Construction performed the 517 Tunnel and Blaine Tunnel portal rehabilitation and blockage removal work.

The EPA OSC was on Site for various activities including Site water quality and geotechnical evaluations, pond solids removal, the 2011 and 2012 mine investigations/tracer studies, the 2012 base flow test, portions of the 2012 injection and passive treatment tests. An EPA regional hydrologist was on Site during both of the 2011 tracer events.

EPA's START contractor provided oversight and sampling teams throughout the project. The START contractor and subcontractor MSI supported the June and October 2011 tracer studies. START and subcontractor Environmental Restoration, Inc. (ER) provided underground support for the June 2012 base flow test. START also provided underground support for the 517 Shaft investigation and injection tests and the Blaine Tunnel flume installation.

USGS provided a hydrologist for the June and October 2011 tracer studies.

5. Definition of Terms

No information available at this time.

6. Additional sources of information

6.1 Internet location of additional information/report

www.epaosc.org

6.2 Reporting Schedule

7. Situational Reference Materials

No information available at this time.