Removal Action Work Plan

Rico-Argentine Mine Site - Rico Tunnels Operable Unit OU01 Rico, Colorado

Environmental Protection Agency, Region 8

for Atlantic Richfield Company

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TABLE OF CONTENTS

TABLES

FIGURES

1.0 OBJECTIVES

The following Work Plan describes the tasks, deliverables, and schedule for the Removal Action at the Rico-Argentine Mine Site - St. Louis Tunnel (Site), which is being conducted under the authority of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The objectives of this Removal Action include:

A. Reduce the releases of hazardous substances from the St. Louis Tunnel adit (also referred to in this Work Plan as "adit") and settling ponds into the Dolores River; and

B. Manage the discharge from the St. Louis Tunnel adit to control and reduce the flow and/or reduce the metals concentrations to levels deemed protective of water quality and aquatic life in the Dolores River.

2.0 REMOVAL ACTION SCOPE

The scope of this removal action includes the following specific actions and tasks further defined with the associated schedules presented in this Work Plan:

A. Collect and summarize current site data and develop the appropriate technical plans to implement actions required in this Work Plan;

B. Manage precipitation solids currently present in the settling ponds below the St. Louis Tunnel discharge, including solids removal and drying;

C. Design and construct a solids repository for management on site of site wastes, including those currently in the settling ponds and potential future solids from water treatment;

D. Investigate the mine workings and associated hydrogeology to: 1) identify means to stabilize the adit opening and consolidate adit flows, 2) determine if it is feasible to significantly reduce the flow of water from the St. Louis Tunnel without increasing the discharge of mine-impacted water elsewhere in the watershed, and 3) identify locations where control structures may be effective in managing water discharged to a water treatment system;

E. Investigate and develop treatment alternatives for St. Louis Tunnel discharge with one alternative being the existing proven lime precipitation technology;

F. Acquire control of the land necessary to implement the required actions; and

G. Design and construct the water management system components that may include hydraulic controls at the adit portal area, structures to prevent water from entering the mine workings, and water treatment systems to meet applicable effluent limits.

3.0 BACKGROUND

3.1 CURRENT SITE CONDITIONS

Location. The Site is defined in the Administrative Order on Consent (AOC) as the complex of tunnels and other facilities at the Rico Argentine Mine, including the Rico Tunnels Operable Unit (RTOU), OU01, located just north of the Town of Rico, Dolores County, Colorado. The Rico Tunnels Operable Unit, OU01, is defined in the AOC as the portion of the Site consisting of an adit known as the St. Louis

Tunnel, and a series of settling ponds located downgradient of the St. Louis Tunnel adit. The Site is located approximately 0.75 mile north of the northern boundary of the Town of Rico in Dolores County, Colorado (see Figures 3-1 and 3-2). This location is in the SW ¼ of Section 24 and the NW ¼ and SW ¼ of Section 25, T 40 N, R 11 W within the U.S. Geological Survey (USGS) Rico 7.5-minute Topographic Quadrangle. Work performed under this Work Plan will generally be limited to the RTOU.

Topography. The RTOU lies at the base of Telescope Mountain (the lower portion of which immediately adjacent to the RTOU is known as CHC Hill) in a relatively flat area adjacent to the Dolores River (See Figure 3-3). Average elevation is approximately 8,800 feet; maximum relief is on the order of 130 feet. At present the active channel and floodplain of the Dolores River are confined to the western portion of the historic floodplain, and are separated from the ponds by contiguous constructed dikes along the east bank of the river.

Climate. Climate is characterized as semi-arid with long, cold snowy winters and short, moderately wet and warm summers. Monthly and annual climatic data has been compiled by the Colorado Climate Center at Colorado State University for Rico station 57017 from 1893 through 1993. The mean annual temperature is 39°F. The warmest months are June, July, and August with monthly mean temperatures of about 55°F. The coldest months are December, January and February with monthly mean temperatures of about 7°F.

Mean annual precipitation in the Rico area is about 27 inches. Most of this precipitation occurs as snowfall in the fall, winter, and early spring, averaging about 173 inches of snow per year. Average total monthly precipitation ranges between about 1.4 and 2 inches, with June the driest month and July and August the wettest months with almost 3 inches per month on average. The driest fall month is November with about 2 inches on average.

Facilities/Features. The St. Louis Tunnel adit portal is located at the base of CHC Hill in the north-central portion of the RTOU. Water discharges continuously from the adit, with flows varying seasonally (highest flows in early spring, lower flows in summer, fall, and winter). A roofed masonry block structure is still present at what is believed to be the original portal location. The first approximately 200 feet of the tunnel behind the portal structure have collapsed due to uncontrolled grading on the slope above as described further in Section 3.2 (see Figure 3-3).

A series of constructed ponds occupy most of the central and southern portions of the RTOU, as shown on Figure 3-3. Ponds in the active flow-path are, from upgradient to downgradient: Pond 18, Pond 15, Pond 14, Pond 12, Pond 11, and Ponds 9 through 5. Ponds 13 and 10 are not currently in the normal active flow path of the system. Combined Ponds 16 and 17 have been off-line (i.e., no flow or water storage) for many decades. Ponds 1 through 4 are referenced on historic maps but do not currently receive water discharged from the St. Louis Tunnel.

A soils repository, constructed and operated as part of actions under the Rico Townsite Soils Voluntary Cleanup (VCUP), occupies approximately 2.6 acres at the base of CHC Hill in the north-central portion of the RTOU (see Figure 3-3). This repository accepts soils with elevated lead concentrations removed from the Town of Rico. The repository has a capacity at full build-out of 40,000 cubic yards.

The abandoned metal building and adjacent steel silo of the original lime addition plant are present near the portal of the St. Louis Tunnel (see Figure 3-3). All lime handling, mixing, and feed equipment has been removed from the building and silo.

Utilities. The only active utilities at the RTOU are electric power and telephone lines. Both services are characterized by overhead wires on shared wooden poles. The electrical service provider is San Miguel Power Authority and telephone service is provided by Farmers Telephone Company.

Access. The RTOU is accessed via approximately 0.75 mile of an existing gravel road from Colorado State Highway 145 as shown on Figure 3-3. Highway 145 provides access from Telluride (27 road miles) and Montrose (86 road miles via US Highway 550 and then State Highway 62) to the north and from Cortez (50 road miles) and Durango (92 road miles via US Highway 160 and State Highway 184) to the south (see Figure 3-1).

3.2 SITE HISTORY

Significant mining began in the Rico area in the early 1900s and flourished around the First World War at the Mountain Spring-Wellington mine in CHC Hill just north of the St. Louis Tunnel. Mining in the immediate area was expanded with the driving of the St. Louis Tunnel by the St. Louis Smelting & Refining Company (a division of National Lead Company, presently N.L. Industries) during 1930-1931 to explore for deep ore horizons beneath CHC Hill. Available information documents that the upper ponds were present by at least 1956 and the lower ponds by at least 1979.

During 1955 a sulfuric acid plant was constructed and began operation at the RTOU. Roasting of pyrite ore as part of the process to produce sulfuric acid resulted in the generation of fine silt-to sand-size calcine tailings. The calcine tailings were primarily disposed of in Ponds 16 and 17 (not presently in the active flow path of tunnel discharges), as well as in the bottom of Pond 15 (which is in the existing flow path).

Rico Argentine Mining Company ceased most mining operations in 1971 and allowed deeper workings beneath Silver Creek to flood. During 1973 to 1975, Rico Argentine Mining Company operated a leach heap just northwest of the St. Louis Tunnel, immediately adjacent to the Dolores River. All mining activities by Rico Argentine Mining Company ended in 1976-1977, and exploration work ceased in 1978.

In 1980, the Anaconda Company (Anaconda) acquired Rico Argentine Mining Company's surface and mineral properties in the Rico area. Anaconda conducted exploration drilling from 1980 to 1983, resulting in discovery of a deep molybdenum ore body beneath Silver Creek. Several of these borings were located within the RTOU. Development of this deposit was not deemed economical, and Anaconda never produced ore in Rico. During this same time period, reportedly as described below, Anaconda performed environmental clean-up in the District, including at the RTOU. The acid plant and associated structures at the RTOU were demolished, and the area of the former plant was regraded, capped with a soil cover, and revegetated in 1985 and 1986. Other miscellaneous grading has apparently occurred at various locations in the northern portion of the RTOU.

As part of the acquisition of Rico Argentine Mining Company's surface and mineral properties in 1980 a pre-existing National Pollutant Discharge Elimination System (NPDES) permit (No. CO-0029793) was transferred to Anaconda. In 1983 water from the Blaine Mine on Silver Creek (outfall 002 under the original NPDES permit) was redirected to the St. Louis Tunnel and the Blaine Tunnel (or adit) became zero discharge. In 1984 the Anaconda Company began operation of a new slaked lime addition plant to treat mine water discharge from the St. Louis Tunnel as it entered the ponds system. Between 1984 and 1995, multiple property owners continued the slaked lime addition to the tunnel discharge to improve water treatment and solids removal. Reportedly, around 1996 use of the slaked lime system was discontinued and mechanical components were removed (the plant building is still present at the site). The NPDES permit expired in 1999.

In 2001, Atlantic Richfield reportedly collected the dispersed surface flows from the tunnel portal collapse area into a common channel, diverted the flow through a Parshall flume, and re-routed it to Pond 18. Atlantic Richfield also cleared and maintained existing hydraulic facilities/structures and constructed new controlled overflows (spillways) in the ponds flow system at various times over the past approximately 10 years. In 2002, EPA-Region 8 performed an Emergency Removal Action to prevent overflow from pond 18 into the Dolores River. In the fall of 2010, Atlantic Richfield performed actions to provide for additional normal freeboard and spillway capacity at Pond 18.

4.0 SUMMARY OF PREVIOUS WORK

The following series of investigations and related activities relevant to tasks described in this Work Plan have been completed by Atlantic Richfield. Copies of this existing information and reports obtained or developed by or for Atlantic Richfield regarding water treatment (e.g., treatability studies, technology reviews, water quality, solids handling, hydrogeology, etc.) applicable to the Site will be submitted to EPA prior to April 1, 2011. In addition, mine maps and site models related to the underground mine workings and analysis of mine water flow paths within the mine workings and discharges from the St. Louis Tunnel and other mine openings at the Site will be submitted to EPA. Work plan tasks described below may be modified based on review of these documents. Technical summaries of these reports and study findings with supporting data and observations will be presented as supporting information in related plans and designs required in this Work Plan.

Site Topographic Mapping and Surveying. Topographic mapping of the Site from aerial photography is available from 1980 (Intrasearch – 5-foot contour interval; Anaconda Company site datum), 1994 (Olympus – 2-foot contour interval), and 2004 (Aerodata – 2-foot contour interval). Ground surveying of various locations and features has also been conducted at various times, including in association with soil lead VCUP operations at the staging area and Soil Lead Repository site immediately north of the St. Louis Tunnel, and to support ongoing improvements to the hydraulic functioning and safety of the existing ponds system.

Surface Water and Groundwater Monitoring. Monitoring of surface water flow and quality at and in the vicinity of the RTOU has occurred at varying locations and frequencies since 1978. A more regular program of surface water sampling and analysis was implemented in 1999, followed by adoption of a formal, regulatory Sampling and Analysis Plan in 2003. A total of 21 sampling events were conducted from 2001 through 2006 by Atlantic Richfield, ranging from a minimum of two to a maximum of eight events per year. The CDPHE conducted groundwater sampling and analysis in 2002 and 2003. Atlantic Richfield conducted groundwater monitoring from 2004 to 2007.

Geochemical Sampling and Analysis of Pond Bottom Settled Solids. As part of a broader study to characterize and develop recommendations for upgrades to the prior lime addition treatment system, Kathleen Paser performed detailed field sampling and field and laboratory geochemical analyses of the settled treatment solids in Ponds 18, 11, 9, and 5 (Paser 1996).

Tunnel Discharge Treatability Studies. Alternative methods for treating discharge were investigated, including the previously used lime amendment. Lime addition rates were evaluated for their potential to achieve potential water quality discharge standards, and solids production rates were characterized.

Whole Effluent Toxicity (WET) Testing. Laboratory studies were conducted to evaluate the potential of treated effluent to meet WET requirements associated with a point-source surface water discharge permit. The primary objective of these studies was to identify the probable sources of toxicity in St. Louis Ponds discharge water to the indicator species (*Ceriodaphnia dubia*).

Mixing Zone Evaluation. Field surveys and flow measurements were utilized to confirm that discharges from the St. Louis Ponds would adequately mix with the receiving stream (Dolores River) during low flows within regulatory distances. The methodology and results of the mixing zone evaluation are presented in Technical Memorandum on Mixing Zone Analysis for the St. Louis Ponds Discharge, Rico, Colorado, July 1, 2008 (Atlantic Richfield Company 2008).

Water Quality Assessment. A Water Quality Assessment (WQA) issued by the Colorado Department of Public Health and Environment (CDPHE) in 2008 is expected to be the basis for the water quality discharge permit for the water treatment system (CDPHE 2008). Atlantic Richfield provided input on the preliminary draft, followed by several years of additional watershed sampling, laboratory analysis, and data evaluation that were incorporated into the 2008 WQA.

Solids Handling, Dewatering, and Disposal Studies. Both existing and lime-amended solids were studied in laboratory (vacuum filter, column settling/consolidation), pilot-scale (field dewatering cells; small-scale field solids generation), and full-scale (Pond 18 dewatering and solids removal) tests, in order to identify and evaluate methods for settling, relocating, dewatering, and safely storing treatment solids

Site Geologic/Geotechnical and Groundwater Investigations/Exploration. Geologic, geotechnical, and groundwater conditions at the RTOU have been investigated by site geologic reconnaissance and mapping, field exploration (including monitoring wells, exploratory borings, and test pits), geotechnical laboratory testing, and groundwater sampling and analyses on a number of occasions from 1981 to 2004.

Soil Lead Repository Design and Construction. Studies were completed to identify a feasible location for a repository to contain lead-bearing soils removed from yards/lots in the Town of Rico under the Townsite Soils VCUP. The repository was designed, permitted, and initial construction completed by 2005. Though the future use of this repository is dedicated to soil from the Town of Rico, its design and regulatory requirements are similar to what is anticipated for the repository for water treatment solids disposal to be developed under this Work Plan.

Mine Mapping of Underground Workings and Geologic Structures. Existing mapping is available and any computerized three dimensional mapping that has been developed or can be developed from existing mine plans will be provided and used in the reconnaissance phase of the mine source water investigation. This information will be used to assist with identifying areas of potential influent water to the mines including near surface workings, major geologic structures, flow paths within the workings, and other features of the mine system that may be relevant to developing alternatives for source controls.

5.0 TASK DESCRIPTIONS

The Removal Action will be conducted in accordance with the following plans and the plans referenced in subsequent sections.

- A site-specific health and safety plan will be prepared, submitted, and implemented for all on-site activities.
- A sampling and analysis plan and quality assurance project plan shall be prepared and approved prior to all sampling activities.
- A construction quality assurance/quality control (QA/QC) plan will be prepared and approved prior to construction activities

5.1 TASK A – PRE-DESIGN AND ONGOING SITE MONITORING

A surface water monitoring program will be implemented to further characterize the seasonal water quality and flow rates of the St. Louis Tunnel discharge, selected locations within the ponds system, the St. Louis Ponds outfall, and several locations along the mainstem Dolores River. The objective of this task is to assist in determining site conditions that will affect the design and implementation of various elements of the removal action and related site investigations. Water quality and flow monitoring will be conducted in accordance with an EPA-approved Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP).

Additional sampling that may be needed to ensure the drying facility, repository, and other removal actions do not adversely affect groundwater and surface water will be identified by EPA and implemented under an approved SAP/QAPP.

5.1.1 Subtask A1 – Ongoing Water Quality and Flow Monitoring

Ongoing flow data will be collected at the St. Louis Tunnel discharge and outfall flumes beginning April 1, 2011 and continuing to June 31, 2012. Data recorders will be used to record parameter measurements at least twice daily. Additional water quality parameter data will be collected as needed to support design and operating condition criteria during this period. Following this period, continued monitoring will be performed, but the requirements may be adjusted pending approval by EPA. Data will be downloaded quarterly, at a minimum, maintained in a site database, and provided to EPA.

Historic and current flow, conductivity, and pH data will be evaluated to identify temporal and seasonal trends and to assist in the system investigations and designs performed for other tasks.

River flow/runoff at the USGS Dolores River gauging station downstream of Rico (Gauge No. 09165000) will be evaluated regularly to identify and document representative seasonal flow rates.

5.1.2 Subtask A2 – Seasonal Water Quality and Flow Monitoring

Seasonal flow data and water quality samples will be collected from the St. Louis Tunnel discharge and outfall flumes, selected locations within the Ponds system, and select locations in the Dolores River. Sample locations are listed on Table 5-1 and shown on Figure 5-3. These locations have been sampled historically so existing water quality data can be compared to historical water quality in addition to comparisons against state water quality standards and proposed Colorado Discharge Permit System (CDPS) discharge standards.

Monthly samples will be collected from the Dolores River downstream of the proposed mixing zone in the Dolores River and analyzed for hardness. The hardness values will be used to supplement the data available at the time of the WQA. The WQA identified the available hardness data as limited, and more current data will be used to confirm the analysis of the hardness condition of the water body.

Seasonal monitoring will be performed during the following timeframes:

- Low Flow (January/February)
- Peak Flow (April/May)
- Moderate to Low Flow (October/November)

Samples will be analyzed in the field for pH, temperature, and conductivity. Samples will be analyzed at a laboratory for alkalinity, hardness, total dissolved solids, total suspended solids, sulfate, and total and dissolved metals. The list of proposed analyses is shown on Table 5-2. These analytes were selected to assist in evaluation and development of water treatment system design and demonstrate compliance with anticipated permit requirements based on the water quality assessment (CDPHE WQCD 2003). Additional analyses may be added as needed to meet these purposes. Sampling procedures, analytical methods, and other sampling requirements will be specified in the SAP/QAPP.

Historical and current water quality data will be evaluated to identify temporal and seasonal trends and assist in water treatment, mine workings, and portal flow consolidation studies and designs.

5.2 TASK B – MANAGEMENT OF PRECIPITATION SOLIDS IN THE UPPER SETTLING PONDS

The primary objective for this task is to reduce releases of hazardous substances from the pond system and increase the pond capacity to provide adequate detention time and space for future accumulation of settled solids.

The objective will be met by removing solids from the ponds and stabilizing the ponds to ensure appropriate protection against flooding or erosion associated with Dolores River flood stage flows. A Solids Removal Plan will be developed to describe removal, drying, and placement of solids in an on-site repository. The drying facility(ies) will be designed and constructed, and solids will be managed in accordance with the Solids Removal Plan. Pond stability will be evaluated and necessary upgrades implemented to prevent the release of pond contents. Pond stability work may be performed in conjunction with work described in Task F. Detailed plans for accomplishing these tasks are described below. Interim management and/or treatment of waste streams generated as part of the Removal Action will be performed, as needed, to ensure that there are no increases in hazardous substance in the on-going releases to the Dolores River and that water quality is protected during these actions.

If the initial scoping of water treatment alternatives includes technologies that do not require solids disposal or that would result in significantly different solids properties, the portions of this task related to solids generated by future water treatment may be postponed, modified, or deleted at the discretion of EPA.

Background

Solids have accumulated in the upper ponds as a result of precipitation and settling of metal complexes by natural processes and by addition of lime to the St. Louis Tunnel discharge from 1984 to 1995. Additional solids may be generated as a result of future water treatment at the site.

Atlantic Richfield reports that an inventory of existing solids was performed in 2001 by precision surveying utilizing a sampling boat outfitted with a survey prism and depth sounding rods. The reported calculated volumes of solids based on the field surveys were as follows:

- Pond 18 – 20,000 cubic yards
- Pond 15 – 11,000 cubic yards
- Pond 14 – 2,600 cubic yards
- Pond 13 – not inventoried due to unsafe surface access

- Ponds 11 and 12 – 10,600 cubic yards

The solids volumes shown above are estimated quantities and do not include additional solids that have likely been deposited since the time of this study. Pond 18 solids volume may have been reduced to during a subsequent in-situ dewatering test performed by Atlantic Richfield.

Based on reported Atlantic Richfield testing of recovered minimally disturbed core samples, the settled solids were estimated to have a weighted average percent solids density (weight of dry solids/total wet weight) of 12.9 percent and an average specific gravity of 2.42. Assuming these parameters, Atlantic Richfield estimated that there are a total of approximately 12.4 million pounds of solids (dry weight) present in the ponds system. Relatively few settled solids were observed below Pond 11 and those ponds were not included in the 2001 inventory. These numbers are estimates because the sludge properties may have changed since 2001.

5.2.1 Subtask B1 – Develop Initial Solids Removal Plan

A Solids Removal Plan will be prepared to describe removal, drying, and placement of solids in an on-site repository. The Solids Removal Plan will focus on management of solids currently in the ponds and creating the infrastructure for long-term solids management. Long-term solids management will be addressed more thoroughly, if necessary, as part of the water treatment design and operations and maintenance plan.

The following sections provide the approach to developing the Solids Removal Plan. The plan may be amended as additional information becomes available. Plan modifications will be approved by EPA prior to implementation.

5.2.1.1 Compile, Review, and Evaluate Existing and New Data

Data from previous site investigations and laboratory testing of accumulated solids in the upper ponds will be compiled, reviewed for relevance to the planned initial removal, and evaluated to support development of appropriate removal means and methods.

Additional data needed to support the Solids Removal Plan will be identified and collected. Potential data needs include updated site and solids conditions, geotechnical surveys, and hydrologic/hydrogeologic analysis.

5.2.1.2 Evaluate Removal and Drying Alternatives for Current Pond Contents

The following removal and drying alternatives have been evaluated by Atlantic Richfield or used at the site. The evaluation may be updated in the Solids Removal Plan based on more current data. Other methods and technologies, such as dewatering bags/geotextile tubes, for drying saturated solids may be appropriate under the conditions at the Site. An analysis of such alternatives will be presented in the Solids Removal Plan.

Removal. Two previously identified alternatives will be further evaluated to arrive at one or more acceptable procedures to remove and transport solids from the subject ponds. The preferred alternative is use of conventional earthmoving equipment, which will involve the following steps: 1) routing incoming flow around the pond from which solids are to be removed to the next downgradient pond in the flow path; 2) decanting and pumping off surface water from the pond, allowing initial solids consolidation in place; 3) excavation with conventional earthmoving equipment; and 4) truck hauling to a temporary on-site drying facility.

If the preferred alternative proves infeasible for solids to be removed from beneath the groundwater table, then a dredging alternative would be further evaluated. This alternative would involve the following steps: 1) routing incoming flow around the pond from which solids are to be removed to the next downgradient pond in the flow path; 2) suction dredging from a floating, shallow draft barge with an appropriately designed, continuously agitating suction head; and 3) conveying via pipeline to a temporary on-site combined decant (initial consolidation) and drying facility. If necessary to prove out the feasibility of the dredging alternative, a dredging contractor may be engaged to perform field-scale trial removal at one or more ponds.

Other removal methods will be identified, evaluated, and implemented as needed to accomplish the required work.

Drying. There is not enough flat ground available to allow all solids in Ponds 18, 15, 14, 12, and 11 to be removed and dried at one time, so solids removal and drying will begin with Pond 18 and proceed sequentially through the other upper ponds, as necessary. By using the space in the Pond 16 and 17 area, drying of solids removed from Pond 18 should be completed in 2011. This expectation is due to the prior and ongoing consolidation of solids resulting from removal of surface water from Pond 18 for 10 months in 2001-2002 during a field-scale test of solids removal and again beginning in October 2010 to perform maintenance on the outlet facilities. Solids from Ponds 15, 14, 12, and 11 will be removed in stages over a 1- to 2-year period to complete the initial removal. The dried solids will then be transferred to the solids repository when repository construction is complete.

5.2.1.3 Drying Facility Siting and Layout

The following key issues and criteria will be addressed in the siting and layout of the solids drying facilities:

- An interim drying facility will likely be needed for staging and drying solids removed from Pond 18 in 2011 while Atlantic Richfield completes the final design and construction of a permanent drying facility (to be constructed in conjunction with the solids repository) that can be used for subsequent pond removals and long-term operational needs;

- Adequate area will be needed to spread treatment solids in a relatively thin lift to promote more rapid enhanced drying (dewatering and consolidation);

- Seasonal high groundwater elevations will be identified at potential drying facility locations and the existing grade will be above seasonal high groundwater or there should be an ability to raise grade with earth fill; and

- Final elevation and grade of a drainage system should allow gravity discharge from the drying facility to an approved water treatment system or leachate treatment system.

Atlantic Richfield prefers that the Ponds16 and 17 area be used for the interim drying facility. This location is preferred due to its close proximity to ponds containing the most solids, and includes a significant amount of flat ground. At least three alternative locations for the interim drying bed and permanent enhanced drying facility will be considered, including the existing Pond 13, the flat area immediately north of the treatment ponds system, and the existing dry Ponds 16 and 17 area (see Figure 5-1). The alternatives will be compared and preferred locations selected for both the interim and permanent facility based on technical feasibility, constructability, potential for integrating the interim and final facilities, and compatibility with other treatment system components and operations. The potential to convert the interim facility to a permanent facility will also be considered in the evaluation.

5.2.1.4 Drying Facility Design

Key issues to be addressed during the design of the drying facilities will include:

- Analysis of subgrade conditions, including bearing capacity and potential for total and differential settlement under equipment, system component, and treatment solids loads; and

- Evaluation of the ability to dry the solids given site conditions and the components needed to accomplish drying.

The major components of the drying facilities to be designed include:

- Engineered controls (site grading, ditches, berms) to prevent storm water run-on to the site facilities and manage direct precipitation runoff from the site.

- Provision for managing direct precipitation, high groundwater, and dewatering discharge from the facility. (If Pond 13 is the selected alternative for the enhanced drying facility, a stable permanent breach of the existing Pond 13 embankment will be required to allow gravity drainage to the pond system.)

- A sacrificial trafficking layer, if needed, to facilitate placing and spreading treatment solids in the dewatering/consolidation cells.

- Cell divider/equipment access berms.

- A filter-protected drainage layer, if needed, to promote rapid downward drainage (and resultant dewatering and consolidation) of placed treatment solids.

- Provision for treating drying facility leachate, if necessary, and monitoring the effect of the leachate treatment stream on the pond system at the point of entry.

Design analyses will include bearing capacity utilizing standard foundation engineering calculations and consolidation/settlement utilizing standard calculations, or if necessary depending on the subgrade conditions, the SIGMA/W software by Geo-Slope International. If necessary based on the design analyses (particularly in the case that Pond 13 is the selected alternative), the use of reinforcement-grade geotextile and/or geogrid will be considered to provide an adequately stable subgrade for the facility.

Calculations will be performed to evaluate the potential for downward drainage from the placed treatment solids to the underlying alluvial aquifer. These calculations will be made with standard infiltration/seepage equations, flow nets, or utilizing the SEEP/W software by Geo-Slope International. If a constructed drainage layer is required to promote adequate dewatering and consolidation of the treatment solids, hydraulic calculations based on Darcy's equation will be used to size, slope, and select the appropriate gradation for the drainage layer; collection and conveyance piping will be sized and sloped based on standard pipe flow equations. A filter layer will be designed to protect the drainage layer from clogging by movement of the fine-grained treatment solids into the coarse-grained drainage material. The filter compatibility of the drainage layer with the underlying subgrade will also be checked and the drainage material gradation adjusted or a second filter layer designed if necessary. Filter compatibility and design will be based on the current methodologies practiced by the Natural Resources Conservation Service (NRCS), U.S. Bureau of Reclamation (Bureau), and/or U.S. Army Corps of Engineers (COE).

5.2.1.5 Solids Removal Process

Based on the field investigations and related laboratory testing conducted in 2001-2002 and subsequent observations at the RTOU, the initial solids removal may involve the following sequential steps and methods. (Referenced 2001-2002 study results will be summarized in the Solids Removal Plan.)

1. Divert pond inflow utilizing an appropriate combination of berming, ditching, and piping. (Flow through Pond 18 was diverted in Fall 2010.)

2. Remove the surface water in the pond by siphoning and/or pumping; convey the water removed to the next pond downgradient. (Pond 18 water was pumped down in Fall 2010.)

3. Allow the exposed solids to dewater in place for as long as possible, with the objective of drying sufficiently to remove with earthmoving equipment. (It is expected that Pond 18 solids will be sufficiently dried for removal with earthmoving equipment in the summer of 2011.)

4. Excavate and haul the dewatered solids to the drying facility using conventional earthmoving equipment (e.g., tracked excavators and/or loaders, dump trucks).

5. If groundwater levels are too high to allow adequate drying/consolidation of all the solids in the pond scheduled to be removed, remove the additional solids utilizing appropriate dredging equipment and methods, and convey the dredged material to the drying facility.

6. Interim management of the dried Pond 18 solids may be needed in 2012 to accommodate drying solids from lower ponds if the permanent site repository is not ready to receive the dried solids.

Specific details on the configuration, construction, and use of the interim drying area will be developed in the Solids Removal Plan.

5.2.1.6 Solids Removal Plan Elements

The Solids Removal Plan will be developed based on the available information and the findings of field and technical assessments. The plan will address the following issues, elements, and criteria:

- Results of site investigations;

- Solids volume estimates:

    - Estimated average depth and volume of solids removal (measured as in situ saturated volume in the pond),

    - Minimum and maximum thickness of settled solids to remain in the pond as a low permeability layer in each pond, and

    - Range (minimum and maximum) of anticipated initial removal volume to be accomplished in 2011, and total initial removal volume to be accomplished;

- Priority sequence of solids removal (initially assumed as beginning at Pond 18 in 2011 and progressing to downgradient ponds in 2012-2013);

- Solids management and drying procedures:

- Interim drying area design and backup documentation;
- Estimated volume and characteristics of dewatered (i.e., "dried") material to be removed from the interim on-site drying facility and placed in a permanent on-site repository in 2012-2013;
- Process and schedule for drying bed construction and removal of solids in 2011 and subsequent years; and
- Process and schedule for design and construction of the permanent drying facility.

The Solids Removal Plan will be submitted for review and approval by EPA.

5.2.2 Subtask B2 – Drying Bed Construction, Solids Removal, and Solids Management

Removal activities will commence following approval of the Solids Removal Plan. Removal will proceed according to the Solids Removal Plan. Work will include the following primary construction activities: 1) construction of the interim drying facility; 2) solids removal and transport to the interim drying facility; and 3) management of solids and water in the interim drying facility.

The activities of the selected construction contractor will be overseen by Atlantic Richfield on a full-time, on-site basis. Depending on actual conditions encountered during the course of the work, appropriate adjustments in the sequence and/or the means and methods of removal may be identified. Any such adjustments will be presented to the Agencies for timely review and approval, and upon approval, implemented by the construction contractor.

In addition to observing the quality of the work, Atlantic Richfield oversight will also track and record the depth and volume of solids removed from each pond and the location and time of placement in the interim on-site drying (or combined decant and drying) bed facility. Periodic surveys will be made of the solids deposited in the drying bed to document the amount and rate of ongoing consolidation.

An ongoing assessment will be made of the need to control dust from the interim drying bed facility. The surface of the solids in the drying bed will be treated either with a light water spray or a suitable dust suppressant as necessary.

Design and construction of a permanent drying facility will be performed to facilitate long-term solids management. Siting and design criteria will be similar to those described above for the interim drying facility. Siting will be dependent on other site modifications related to solids disposal, water treatment, and long-term site controls.

5.2.3 Subtask B3 – Pond Stability Analysis and Upgrades

Pond stability will be analyzed by performing a geotechnical evaluation with appropriate subsurface investigation of the pond dike structures and containment effectiveness for those settling ponds needed for future operations. In addition, a hydrological evaluation of the Dolores River channel as it relates to the pond containment structures and the floodplain area around the settling ponds will be conducted and appropriate protection measures will be identified, designed, and constructed. While some portion of this work may be performed as part of construction of the water treatment system described in Section 5.6.3.3, initial assessment of the dike system and some upgrades to the structures may be needed to meet the objectives of the Removal Action. The following tasks will be performed.

- St. Louis Tunnel pond system stability will be analyzed by performing a geotechnical evaluation with appropriate subsurface investigation of the pond dike structures by employing standard engineering stability analyses;

- A hydrological evaluation of the Dolores River channel will be performed as it relates to the pond dike system and the stability and effectiveness of containment structures when exposed to high flow conditions (i.e., the minimum of a 100-year event) using standard channel hydraulics modeling to determine flow and velocity and appropriately size riprap or other erosion protection; and

- Appropriate protection measures will be identified, designed, and constructed.

This work will be conducted with consideration of the requirements of Subtask F3. However, upgrades to the armoring of the dike embankment exposed to the Dolores River prior to or during solids removal phases may be necessary pending completion of the above analyses.

5.3 TASK C – DESIGN AND CONSTRUCTION OF A SOLIDS REPOSITORY

Permanent disposal of settled treatment solids is a key objective of the removal action. On-site disposal of current pond solids and solids generated by future water treatment provides significant advantages compared to off-site disposal, including:

- Consolidation of treatment solids with other existing, related mine wastes at the RTOU. (The existing solids will be identified and characterized and reported to EPA prior to placement.)

- Avoidance of potential public inconvenience, safety issues, and environmental impacts that would or may arise with large-scale, long-term hauling of solids to an off-site facility (especially in the event of accidents or spills).

- Long-term management of disposed solids at a controlled location.

- Minimization of handling and conveyance time (and associated equipment emissions).

- Minimization of cost of permanent disposal of solids.

It is anticipated that the storage facility that is constructed during this action will provide long-term operating capacity for managing water treatment related solids from the Site. Furthermore, it is anticipated that long-term oversight and regulation of this facility will be performed under state and local solid waste permitting and regulatory authority. As such, in addition to meeting applicable substantive technical requirements, the design and construction of this repository will be implemented consistent with administrative requirements under state and county solid waste regulations to the degree possible. However, it is not required that a Certificate of Designation (CD) be obtained under the terms of this Work Plan, and CERCLA response actions will continue at the Site related to existing waste management and not be delayed due to administrative permitting procedures.

Task C includes compilation, review, and evaluation of existing data; alternatives evaluation; and design and construction of the solids repository. Siting of potential supplemental solids repositories will also be performed. Though several repository alternatives will be considered, the preferred alternative will be the dry-stacked repository. The dry-stacked repository design allows for more efficient use of available land and provides a more stable long-term repository than a wet-conventional design.

5.3.1 Subtask C1 – Develop a Repository Design and Operating Plan

5.3.1.1 Compile, Review and Evaluate Existing Data

Available data from previous site investigations and laboratory testing of foundation conditions and potential borrow locations at the RTOU will be compiled, reviewed for relevance to the planned on-site repository, and evaluated to support design of this facility.

5.3.1.2 Repository Siting

Alternative locations for the treatment solids repository will be identified and characterized. Potential site locations identified to date are shown on Figure 5-2. Site characterization will address existing facilities, the presence of historical mining wastes, geology (including groundwater, geologic hazards, subgrade conditions, etc.), hydrology (direct precipitation and storm runoff), and known or potential, current or future, compatible or conflicting land uses. Site selection will be based on anticipated solids properties (especially dry density), operational efficiencies and cost considerations, and if necessary, land use and/or ownership status at the time a final decision must be made. Repository siting will, to the extent practicable, comply with federal, state, andlocal applicable or relevant and appropriate requirements (ARARs).

5.3.1.3 Supplemental Field Investigations and Laboratory Testing

Field investigations will be conducted to confirm previous data and gather additional data as to key physical properties of the repository foundation and potential on-site borrow materials for construction. The field investigations will include test pits/trenches and exploratory borings (or cone penetrometer soundings) within and/or in close proximity to the proposed repository footprint, and test pits/trenches in up to two potential on-site borrow locations. Borings and test pits will be logged and photographed. The final decision as to the number and location of borings, soundings, and test pits will be based on the results of the existing data review and the repository site alternatives evaluation.

Samples from the potential repository and borrow locations will be collected and submitted to a geotechnical laboratory for gradation, Atterberg limits, and moisture/density relationship testing. Shear strength (e.g., consolidated-undrained triaxial testing with pore pressure measurement) and consolidation testing will be performed as needed. Triaxial shear strength and associated consolidation testing will be performed on precipitation solids samples generated by lime addition to St. Louis Tunnel discharge.

If a water treatment system other than or supplemental to lime precipitation is selected for use at the site, then appropriate analysis will be performed on the type of solids generated to assist in repository design and materials handling procedures.

5.3.1.4 Repository Design

A Repository Evaluation and Preliminary Design Report will be provided to EPA and include the data and conclusions for repository site selection, the results of field investigations and laboratory testing, and a preliminary repository design with documentation supporting design criteria. Upon EPA approval of the Repository Evaluation and Preliminary Design Report, the detailed repository design will be completed.

The design of the on-site repository will address the following issues and criteria:

- Provide capacity for 50 to 100 years of solids disposal from rehabilitation of the settling ponds, non-water treatment waste disposal, and future operation of the treatment system (i.e., 50- to 100-year repository design life);

- Provide run-on/runoff erosion protection to accommodate active operations during the pre-closure period and long-term protection during the post-closure period;

- Minimize infiltration and resultant leachate generation;

- Prevent, to the extent practicable, release of untreated leachate;

- Achieve adequate factors of safety (FS) against slope failure under appropriate loading conditions; and

- Achieve adequate factors of safety related to flood events.

As discussed further under Slope Stability below, the ultimate dry density (and associated shear strength) of the treatment solids to be placed in the repository will govern the type of repository (i.e., wet-conventional versus dry-stacked), and if dry-stacked, the stable slope inclination. At this time, it is anticipated that the design will move forward based on a dry-stacked repository concept. The dry-stacked repository design allows for more efficient use of available land and provides a more stable long-term repository than a wet-conventional design but may require additional design features to ensure the waste remains dry. Results from studies performed by Atlantic Richfield will be presented in the design report to support this approach.

Design evaluations/analyses and design features to address these issues and achieve these criteria are described in the following paragraphs.

Capacity Determination. The required capacity of the repository will be established by conservatively estimating the volume of solids to be removed from the upper ponds and the average annual production of treatment solids, and the degree of dewatering and consolidation anticipated prior to placement of the solids in the repository. Initial design will be based on the results of prior field and laboratory testing and proposed additional laboratory testing of representative treatment solids as described above under Supplemental Field Investigations and Laboratory Testing. As discussed under Solids Repository Permitting below, the required capacity of the repository will be further evaluated during the first years of full-scale operation by monitoring of the effectiveness of the proposed means and methods of dewatering and enhanced drying of removed solids.

Given the required design capacity, a final location and preliminary plan layout of the full build-out of the repository will be prepared as part of the design documentation (see below). The layout will then be refined in coordination with the infiltration/leachate control and slope stability design described below.

Run-on/Runoff and Infiltration Control. The Hydrological Evaluation of Landfill Performance (HELP) model will be utilized to evaluate the potential infiltration of direct precipitation (snowmelt and rainfall) and resultant leachate generation within the repository. Infiltration will be minimized to the extent practical by a combination of run-on control utilizing ditches/berms, appropriate sloping of the repository top and side slopes, and placement of interim cover material during operation and permanent cover material upon final filling. Interception ditches/berms will be designed to safely convey run-on from the 25-year, 24-hour storm during the pre-closure period and from the 100-year, 24-hour storm during the post-closure period of the repository, as approved by CDPHE for the existing on-site Soil Lead Repository. Interim (pre-closure) cover material will be designed primarily to control dust generation from, and erosion of, the placed treatment solids, and secondarily to minimize infiltration to the extent practical consistent with ongoing operations. The permanent (post-closure) cover will be designed to minimize long-term infiltration and support vegetation to provide erosion resistance. Consideration will be given to an internal vertical drain (as utilized successfully at the on-site Soil Lead Repository) to capture and convey incident precipitation on the active top surface of the repository to the ponds treatment system during the active life of the repository.

Leachate Control. A liner and leachate collection system will be designed to intercept precipitation that infiltrates into the repository and pore water released from the placed treatment solids. The intercepted leachate will be conveyed to the ponds treatment system. The preliminary design concept for the liner and leachate collection system is summarized as follows:

- Graded and compacted subgrade;
- Basal cushion layer of appropriately graded sand to fine gravel;
- Geo-membrane liner (e.g., high-density polyethylene [HDPE], polyvinyl chloride [PVC] or similar liner material);
- Drainage layer of graded sand and gravel overlain by a filter layer of graded sand compatible with the overlying treatment solids and underlying drainage material; and
- PVC piping to convey collected leachate by gravity to ponds treatment system.

The minimum hydraulic capacity of the drainage layer and piping will be based on the results of the HELP modeling discussed previously and analysis of the long-term consolidation of the treatment solids in the repository utilizing the SIGMA/W (and if necessary the SEEP/W) software by Geo-Slope International, or equivalent software. The hydraulic design of the drainage system will utilize calculations based on Darcy's equation to size, slope, and select the appropriate gradation for the drainage layer; collection and conveyance piping will be sized and sloped based on standard pipe flow equations.

Slope Stability. As discussed previously, the type of repository (wet-conventional versus dry-stacked) will depend on the dry density (and associated shear strength) of the treatment solids at the time of final placement in the repository. A wet-conventional repository would involve constructing a conventional earthen-diked basin to contain solids that have not been adequately dewatered and consolidated. Based on prior laboratory and pilot-scale field studies, and the currently proposed primary in-pond dewatering and consolidation of treatment solids in a drying facility and subsequent solids management, it is assumed that a dry-stacked repository design will prove feasible. The following discussion is based on this assumption.

The design of a dry-stacked repository will address: 1) the anticipated shear strength of the placed treatment solids; 2) the materials and geometry of the liner system; and 3) the inclination of the exterior slopes of the repository. If necessary to achieve the design factors of safety noted previously, consideration will be given to the use of tensile reinforcement within the placed treatment solids (e.g., geogrid or granular soil layers). The stability of the repository will be evaluated utilizing the SLOPE/W software by Geo-Slope International. Loading cases to be analyzed (and the associated minimum required FS) will include: short-term loading during active operations (pre-closure period) – FSmin = 1.3; long-term loading at full build-out (post-closure period) – FSmin = 1.5; and seismic loading – FSmin = 1.1 (based on an appropriately conservative pseudo-static analysis).

Design Documentation. The design of the treatment solids repository will be documented in an Engineering Design and Operations Report (ED&OR) for submittal to EPA, Dolores County, and CDPHE.

5.3.1.5 Solids Repository Permitting

EPA recognizes that Atlantic Richfield intends to obtain a CD for the Solids Repository, and construction activities for the permanent repository will commence following issuance of the DLUA and CD by Dolores County. EPA is not requiring that a permit be obtained as consistent with CERCLA response actions. However, the schedule associated with this Work Plan is intended to accommodate the permit review and decision process for the repository to be completed before it is necessary to place pond-related solids. If the permitting process is delayed for an extended period, then it may be necessary to re-evaluate this condition.

A CD application will be made for construction of the repository subgrade, liner/leachate collection system, and placement of the existing precipitation solids removed from the upper ponds (and temporarily staged in the interim drying facility). The ED&OR will also address post-removal action of new treatment solids in the permanent drying facility and then into the solids repository following adequate dewatering and consolidation. The ED&OR accompanying the application will describe potential alternative placement methods, slope configurations, and stabilizing elements (e.g., external slope buttress; internal tensile reinforcement; etc.) that may be implemented pending the testing and evaluation of dewatered and consolidated treatment solids during the first several years of full-scale operation of the ponds treatment system and permanent drying facility. An amendment will be prepared and submitted to Dolores County and CDPHE describing the final selected repository slope configuration and stabilizing elements (if any) prior to placement of newly generated treatment solids.

5.3.2 Subtask C2 – Solids Repository Construction and Initial Solids Placement

Construction will proceed in the sequence and utilizing approved means and methods as identified in the ED&OR, construction drawings, and technical specifications. The work will include the following primary construction activities: 1) construction of the subgrade improvements, run-on controls, liner system, and initial berm/buttress constituting the primary solids repository; 2) construction of the permanent drying facility (described in Section 5.2); and 3) placement of solids from the interim drying facility into the prepared repository, including external buttressing and/or internal reinforcing elements if/as needed.

The activities of the selected construction contractor will be overseen by Atlantic Richfield on a full-time, on-site basis. Depending on actual conditions encountered during the course of the work, appropriate adjustments in the means and methods of construction and/or initial placement of solids may be identified. Any such adjustments will be presented to the Agencies for timely review and approval, and upon approval, implemented by the construction contractor.

In addition to observing the quality of the work, Atlantic Richfield oversight will also track and record the depth and volume of solids removed from the interim drying facility and the location and time of placement in the solids repository. Periodic surveys will be made of the solids deposited in the repository to document the amount and rate of ongoing consolidation.

An ongoing assessment will be made of the need to control dust from the repository. If necessary, the surface of the repository will be treated with a light water spray, a suitable dust suppressant, or if appropriate and otherwise necessary, with a reinforcing element.