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USING SEMI-NATURAL SYSTEMS AND A WATERSHED APPROACH FOR MINE-RELATED WATER CLEAN-UP IN RICO, COLORADO

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ABSTRACT

Rico is a small town in an old zinc mining district in a mountain valley of southeastern Colorado. Mine waste rock and mill "tailings" remained after over 100 years of mining in the area, leaving associated surface water and groundwater impacts. Atlantic Richfield Company is proposing an innovative approach, which uses lime precipitation and wetland ponds (semi-natural system, also called treatment lagoon in a wetland setting) to treat adit water in the Rico area. Besides using a non-conventional treatment approach, a non-conventional (non-Superfund) regulatory/administrative approach is being proposed. This paper will focus on the water treatment issues and solutions, as well as describing the innovative "watershed" regulatory process.

INTRODUCTION

Similar to other historic mining districts throughout the United States, the Rico area is faced with addressing some issues related to mine-related surface water discharges to the local stream, the Dolores River. Technical solutions for managing mine discharges ranging from natural wetlands, use of various lime precipitation systems, to highly mechanized treatments such as reverse osmosis have been tried nationally. Also, several administrative regulatory approaches have been employed, including state-led voluntary clean-ups, tax-funded clean-ups of abandoned, orphan sites, as well as clean-ups under the federal "Superfund" program. This paper describes a semi-natural water treatment system and an administrative approach for the Rico area, which is well-suited for the environmental situation there, as well as the local stake holders interests to improve the water quality of the local river and leave some old mine sites more available for redevelopment and economic growth.

In trying to meet the water quality challenges at Rico, the project objectives include the following:

Meet Regulatory Requirements: The proposed plan should comply with applicable regulatory requirements, including applicable portions of the State of Colorado ground and surface water quality and solid waste disposal regulations.

Maximize Developable Space: The proposed plan should maximize immediate and future developable space to the extent possible.

Operational Simplicity / Compatibility: The proposed plan should not rely on complicated operations that require a labor force unavailable in Rico or the vicinity. Operational simplicity for both the water treatment and solids managements is critical for water treatment efforts to be reliable over the long term.

Provide for a minimum 50-Year Lifespan: The proposed plan should accommodate future solids production for a 50-year period. It is reasonable to assume that within this period the volume of solids generated may be substantially reduced, eliminated or an alternate, improved water treatment technology will be discovered.

Cost Effective: To the extent other goals and objectives are met, the proposed plan should be cost effective.

Community Acceptance: The proposed plan needs to be acceptable to the local community in terms of operational requirements and future site development.

St Louis Ponds Site Development Objectives

The Town of Rico is interested in using available space within the site for various immediate and future needs. Growth options within the Town of Rico are relatively limited due to the limited minimal availability of flat developable land, especially for light industrial use. Providing adequate development space at the site is thus critical to the future growth of Rico. The proposed plan has been designed to maximize development space at the site by limiting the use of land that is immediately required for treatment onr solids disposal and eventually providing additional flat developable space that is not currently usable due to its present need in the pretreatment process.

BACKGROUND

Physical Setting

The Town of Rico is located in a mountain valley at 2683 meters (8,800 feet) elevation, on the Dolores River approximately 35 kilometers (22 miles) southwest of Telluride. The Dolores River meanders through a floodplain in the vicinity of Rico that is typically less than about 305 to 366 meters (1000-1200 feet) wide. The valley is flanked by large alluvial/colluvial fans and talus/slopewash deposits on steep slopes. Silver Creek is the primary tributary in the vicinity, entering the

Dolores River from the northeast through the Town of Rico. The town of Rico is sited on the Silver Creek Fan above the Dolores River, as this was some of the relatively little developable land above the floodplain in the river corridor.

The Rico area is underlain by predominantly Permian- and Pennsylvanian-age marine sedimentary rocks (sandstones, siltstones and some shales). Limestone interbeds are locally present in many of the sedimentary rock units, and many of the sediments are calcareous. Younger (Tertiary-age) intrusive volcanic rocks also occur locally within the older rocks. (Pratt, 1969)

Mining History

The Rico area was the site of more than one hundred years of intermittent mining and ore processing between 1869 and 1975. The earliest mining was for silver (and some associated gold) until the end of the 19th century. Production in the 20th century involved primarily base metal ores (lead, zinc, and some copper). Pyrite ores were roasted in the late 1950s to mid 1960s to provide sulfuric acid for use in uranium mills, and a brief period of gold/silver heap leaching occurred in the early to mid 1970s. (McKnight, 1974)

PROBLEM IDENTIFICATION

Mining-Related Discharges

As a result of the historic mining activity, there are a number of seeps and mine adits, which drain water containing elevated concentrations of metals to the Dolores River running through the watershed near Rico. Surface water discharges to the Dolores River within the historic Rico mining district include in upstream to downstream order and are also shown in Figure 1:

St. Louis Tunnel: The largest of all discharges in the area is the St. Louis Tunnel, which is a large adit associated with a mine complex just a mile north of Rico. The St. Louis Tunnel was driven in the early 1930s to dewater mine workings more efficiently. The tunnel portal is located at the eastern edge of the Dolores River floodplain approximately 1.2 km (¾-mile) upstream of Rico. Discharges from the tunnel are routed through a series of constructed "settling" ponds prior to discharge to the Dolores River. These ponds were constructed in the mid 1950s to provide some treatment of the discharge water through simple physical settling. The pond system has evolved into semi-natural wetlands which still function to settle and passively treat discharged water. A lime addition system was added in 1984 and operated at least intermittently until sometime in the early to mid 1990s. The annual average flow rate of historic and ongoing discharges is about 1100 gallons per minute (gpm) or .069 cubic meters per second (cmps), with a seasonal range of flows that are highest in the spring just after peak runoff (potentially up to about 2000 gpm or .126 cmps) and lowest in the fall to winter seasons when rainfall and snowmelt are absent or at a minimum (as low as about 650 gpm or .041 cmps). (ESA, 1995, Paser, 1996) Tunnel discharges are elevated in various metals concentrations due to acid rock drainage (ARD) reactions in the open subsurface workings. Compared to many mine discharges, the ARD is only mildly acidic due to ore-bearing rock being an oxide formation as opposed to the more acidic sulfide ore minerals. Measurements of the pH of the tunnel discharge have been near neutral to slightly acidic (ranging from 6.3-7.4). Elevated metals include iron, zinc, cadmium, copper, lead and zinc. See Table 1 for characterization of the St. Louis Tunnel and other discharges discussed below. (ESA, 1999, ESA, 2000, SHE, 2002, SHE, 2002)

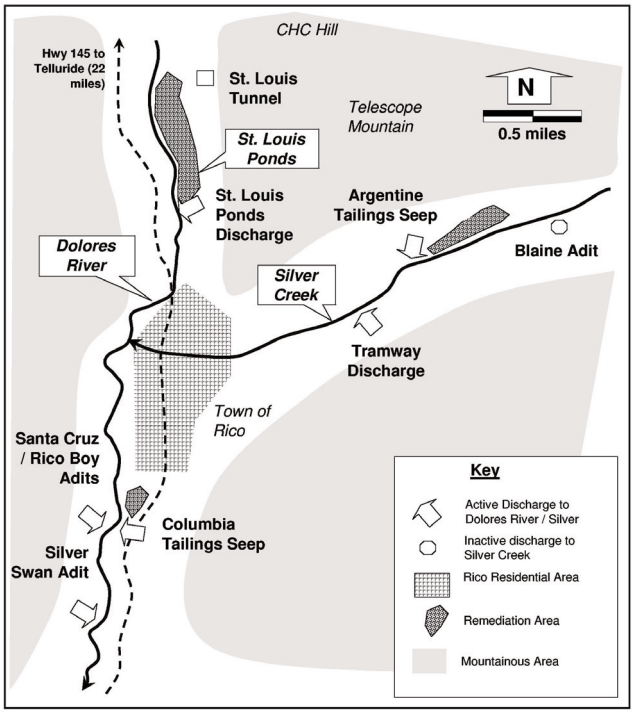

Figure 1. Rico Area Watershed and Mine Discharges to the Dolores River.

Blaine Adit: Historic flows from the Blaine Adit discharged directly to Silver Creek (tributary of the Dolores River) until 1983 when they were redirected to underground workings connected with the St. Louis Tunnel drainage system. Sometime after 1983 a small flow (<5 gpm or .0003cmps) escaped the redirected flow route and discharged to Silver Creek. This unintended discharge was stopped in 2001 by repairing the diversion within the Blaine Adit so that the flows from it are all routed to the St. Louis Tunnel system.

Argentine Tailings Seep: An area of seepage at the toe of the upstream-most, now-reclaimed Argentine Tailings Pond drains to Silver Creek. Flows are estimated at about 15-30 gpm or .00009 - .00013 cmps. Elevated metals concentrations at this seep include iron, and zinc.

Tramway Discharge: Very minor discharge (<2-3 gpm or .0002 cmps) drains to Silver Creek from an unnamed adit in the vicinity of a historic mining tramway below the Argentine Tailings Ponds. Cadmium, iron, and zinc are the metals with the most elevated concentrations.

Columbia Tailings Seep: This is a small seepage discharge (<10-20 gpm or .0006 cmps) from a now-reclaimed tailings deposit in the eastern portion of the floodplain of the Dolores River, just downstream of Rico. Elevated metals concentrations at this seep include iron, and zinc.

Santa Cruz/Rico Boy Adits: These are two old mines and their associated now-reclaimed waste rock deposits on the lower western slope of the Dolores River valley, just downstream of the Columbia Tailings seep. Combined adit flows vary seasonal in the range of about 10-40 gpm or .0006 - .0025 cmps. During low flow periods (most times of the year), surface flow from these adits do not flow directly into the river, but infiltrate into the nearby natural wetlands adjacent to the river. Flows from both adits merge in a natural wetlands in the floodplain that intermittently overflows to the Dolores River during periods of higher precipitation and river flow. Though not as concentrated as other discharges, elevated metals concentrations

in the combined adit flows is primarily zinc and, to a much lesser degree, iron.

Silver Swan Adit: This an old mine and reclaimed waste rock deposit just downstream of the Santa Cruz/Rico Boy Adits, again on the lowermost west slope adjacent to the Dolores River. Discharges from this adit (ranging from about 10-45 gpm or .0006 - .003 cmps) also flow into a small wetlands that, in turn, intermittently discharges to the Dolores River during seasonal higher flow conditions only. As with the Santa Cruz/Rico Boy, discharges under low flow conditions do not reach the Dolores River. Iron, manganese, and zinc are the metals with elevated concentrations in the Silver Swan Adit flows.

These seven adits/seeps are the only discharges within the Rico area's watershed which have been identified to discharge any measurable flow to the Dolores River. The Blaine Adit, Argentine Tailings Seep, and Tramway Discharge, are on Silver Creek within a mile of the mouth of Silver Creek to the Dolores River. Silver Creek enters the Dolores about ½ mile downstream from where the St. Louis Tunnel discharge enters the Dolores River. Table 1 shows their flows and metals concentrations. As the data indicates, the St. Louis Tunnel contributes the greatest metals loading (loading = flow x concentration) to the river's watershed, therefore is the primary focus of addressing any water quality issues with the River itself.

Receiving Stream

The Dolores River, in the vicinity of Rico, is classified for Cold Water Aquatic Life Class 1, Class 1a, Recreation, and Agriculture by the Colorado Water Quality Control Commission (WQCC). Applicable stream standards have been established for the Dolores River in the vicinity of Rico (stream segment COSJDO03) by WQCC Regulation 34. Metals for which in-stream water quality standards have been set in this stream segment include arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc. Table 2 shows the Water Quality Standards for the Dolores River. The significance of the mining-related tunnel, adit and seep discharges noted above to the Dolores River is currently being evaluated under a Water Quality Assessment (WQA) process discussed below in this paper. To the degree that mining discharges in the Rico district impact the Dolores River, it is clear that the St. Louis Tunnel discharge is the major contributor. Also, the overall goal in addressing the water qual-

Table I Average Flows and Metals Concentrations
Mine Discharges to Dolores River and Silver Creek (1999-2002)

Parameter	Units	DR-3	DR-1-SW	DR-27	DR-7-SW	SC-2	SVS-12	SVS-26
		St. Louis Tunnel	Columbia Tailings Seep	Rico Boy/Santa Cruz Adits	Silver Swan Adit	Blaine Adit	Argentine Tailings Seep	Tramway Discharge
Field Parameters								
Flow	gpm	512	na	23	18	1.5	24	1.4
Temperature	°C	19	14	19	13	5.3	7.8	6.0
Conductivity	µmhos/cm	1008	350	1070	1026	7805	652	410
Alkalinity	Mg/L as $CaCO_3$	86	114	639	616	<10	150	60
General Parameters								
Hardness	Mg/L as $CaCO_3$	671	266	911	1050	2087	717	395
Total Dissolved Solids	Mg/L as TDS	1017	340	1120	1250	9245	955	605
Total Suspended Solids	Mg/L as TSS	26	U	<8 B	19 B	12	12 B	11 B
Dissolved Trace Metals								
Cadmium	µg/L as Cd	14	2.6	<1.9	0.2 B	4500	2.4	14
Copper	µg/L as Cu	21	3.3	6.7	2.4 B	27,600	2.6	27
Cyanide	Mg/L as Cn	U	U	U	U	na	U	U
Iron	µg/L as Fe	2525	na	na	na	1,172,000	na	na
Lead	µg/L as Pb	8.0	0.2 B	<0.7	1.2	302	<1.0	20
Manganese	µg /L as Mn	2185	209	71	2665	132,000	6480	11,100
Nickel	µg /L as Ni	<10 B	U	U	U	na	<15	20 B
Selenium	µg /L as Se	U	U	U	U	na	U	U
Silver	µg /L as Ag	<0.1	U	U	<0.15 B	1.5	U	.07 B
Zinc	µg /L as Zn	4163	715	655	820	359,500	5590	8085
Total Recoverable Trace Metals								
Arsenic	µg/L as As	1.9 B	U	U	5.9	na	<0.7	U
Chromium	µg/L as Cr	5.2	U	<0.15 B	<0.8	na	0.1 B	U
Iron	µg/L as Fe	9528	505	15	14,200	na	5250	15,000
Total Metals								
Mercury	µg/L as Hg	na	na	<0.0003 B[1]	<0.0003 B[1]	na	U	.0006[1]

B – Analyte concentration detected at a value between MDL and PQL
na – not analyzed
U – Analyte was analyzed for but not detected at the minimum detection limit (MDL)
[1] Results for Mercury samples collected on 10/7/2002 considered suspect

ity issues of the Dolores River near Rico is to reduce the loading to the river so that the river continues to meet the state's water quality standards as measured in the stream within the Rico area watershed.

Table 2 Water Quality Standards for Metals for Dolores River Stream Segment – Dolores River After Confluence of the St. Louis Ponds Discharge (COSJDO03)

Based on the Table Value Standards Contained in the Colorado Department of Public Health and Environment Water Quality Control Commission Regulation 34

Parameter	In-Stream Water		
Cadmium, Dissolved	Acute [1]	7.6	µg/l
	Trout	NA	µg/l
	Chronic [1]	3.3	µg/l
Hexavlent Chromium, Dissolved	Acute	16	µg/l
	Chronic	11	µg/l
Copper, Dissolved	Acute [1]	22	µg/l
	Chronic [1]	14	µg/l
Lead Dissolved	Acute [1]	115	µg/l
	Chronic [1]	4.5	µg/l
Manganese, Dissolved	Acute [1]	3570	µg/l
	Chronic [1]	1972	µg/l
Nickel, Dissolved	Acute [1]	737	µg/l
	Chronic [1]	82	µg/l
Selenium, Dissolved	Acute	18.4	µg/l
	Chronic	4.6	µg/l
Silver, Dissolved	Acute [1]	5.1	µg/l
	Trout	NA	µg/l
	Chronic [1]	0.81	µg/l
Zinc, Dissolved	Acute [1]	185	µg/l
	Chronic [1]	186	µg/l

[1] Standard is hardness dependent based on Hardness as CaCO3 = 171 mg/l

ALTERNATIVES CONSIDERED

Overview – Alternatives Analysis

The various water treatment and management alternatives/ options for addressing the water quality issues on the Dolores River near Rico were reviewed in a screening process to identify those most suitable for implementation. This included consideration of the various available technologies and alternative components for water treatment relative to the project objectives and goals expressed above and in light of the following factors:

- Overall protection of human health and environment
- Compliance with State Water Quality Regulations
- Balancing Criteria
  - Effectiveness – long and short term
  - Operation and Maintenance ease
  - Implementability
  - Cost
  - Sustainability of Redevelopment

Water Treatment Alternatives

Given the St. Louis Tunnel is by far the largest metals contributor to the Dolores, the following potential alternative technologies were screened out at presentconsidered primarily for the St. Louis Tunnel discharge:

Ion Exchange: Ion exchange is a suitable technology for metals reduction that was considered but deemed impractical due to the excessive cost, complexity, operational requirements and the apparent ability to meet treatment requirements with simpler and lower maintenance technologies.

Lime Precipitation with Mechanical Clarification / Solids Recirculation: Lime precipitation, with mMechanical clarification with and internal solids recirculation followed by mechanical dewatering in lieu of the pond system or ahead of the pond system is a technology that has been used at a number of other large mine discharges throughout the country. The technology is essentially the same as any lime precipitation technology, except for how precipitated solids are handled. Solids dewatering would be by use of a belt press or vacuum filter and could be disposed onsite or through haul to a remote disposal site. However, this alternative is more costly both in terms of capital and operations and maintenance and it providesimposes additional operation and maintenance complexities and cost, that which are, at present, deemed unnecessary at present for the water quality treatment requirements at the St. Louis Ponds system. This technology was investigated in earlier treatability studies (CSMRI, 1982b) for the St. Louis Ponds and was found to be satisfactory for removal of zinc, copper, lead and cadmium but incapable of removing silver from the effluent. For the treatment requirements anticipated based on the WQA, this alternative does not appear to offer advantages over lime precipitation in a pond system because it is no more effective at meeting potential discharge standards. It is therefore not being consideredincorporated at this time.

Passive Wetlands (Sulfide Reducing Sub-Surface Wetlands): This option has been reviewed and presently eliminated as a full-scale solution. A chief drawback to the option is the limited space available onsite and the ability for the anticipated quantities of solids from the mine that must be accommodated. Additional issues relate to the unproven reliability of such a system in the Rico climate. However, passive treatment in the existing St. Louis settling ponds as an extension of the proposed lime amendment facility will be pursued as part of the selected option.

Treatment Lagoon in a Wetland Setting: This involves upgrading the existing pond and lime addition systems. The existing ponds system, with improved lime addition and solids dewatering facilities, will retain the technological simplicity necessary for success in the small community of Rico, while meeting the necessary water quality standards. Enhancements to the existing system would include a more reliable and flow calibrated lime delivery system, automated operational and monitoring instruments, and upgrading the settling pond system to allow increased retention time. Additionally, with these upgrades it should be capable of meeting water quality requirements, while enabling development of valuable space at Rico.

The option of upgrading the existing system as a treatment lagoon in a wetland setting was chosen for implementation at this time to enable the greatest opportunity for total success in a timely fashion. This option may be combined with the following options over time.

Adit Discharge Volume or Oxygen Reduction: The opportunity to reduce the volume of water discharging from the St. Louis Tunnel by finding and cutting off clean water sources from getting into the mines has been considered and will be reviewed additionally in the future. Also, the potential for reducing the availability of oxygen to enter the system has been reviewed and will be explored further with the intent of reducing metals concentrations in the tunnel discharge. Due to many uncertainties, these options will likely not meet water quality requirements if implemented alone, but may complement another

treatment option by reducing metal loading before water discharges from the adit itself.

Internal Lime Addition: The potential of adding lime to flows within the mine (such as in the Blaine aAdit) may be pursued as an alternative or supplemental technology to the primary treatment option.

Separate treatment at individual onsite locations: In general, providing a number of small-scale facilities is possible, but would provide minimal water quality benefits or load reduction at a substantial increase in operations and maintenance (O&M) requirements. Limited space, locations mostly in floodplains, and lack of site control also contribute to the lack of reliability of treating the other six smaller discharges separately. The one exception was the decision to redivert the Blaine adit flow back to the St. Louis Pond system via the internal mine workings because the pH of the Blaine water would be neutralized in route and result in minor impact at the St. Louis, whereas onsite treatment would require significant ongoing O&M including monitoring and permit compliance issues. The Blaine adit has since been re-diverted and no longer has a separate discharge.

The water treatment alternative chosen was the treatment lagoon in a wetland setting based on the information summarized above. The proposed St. Louis Ponds Water Treatment Plan discussed below provides further detail on the preferred water treatment option.

Administrative Alternatives

Several administrative alternatives are available to ensure the water quality issues are addressed to the satisfaction of the local community and applicable environmental regulations. The following options were considered:

Voluntary, Unadministered Approach: In some cases in other areas, an owner or other interested party voluntarily addresses an environmental issue without direct or close agency oversight. This situation does not apply in Rico, as current landowners have not been willing or able to address the water quality issues voluntarily and state and federal agencies have already shown concern over potential water quality issues.

EPA – led "Superfund" Action: The EPA administers the Superfund programs, which under the CERCLA law is intended to clean up hazardous waste sites that pose risk to human health or the environment. Clean-ups under this program are often effective, but often take years to complete and come at extreme costs. Also, redevelopment of affected sites is not easily facilitated under this program.

Local/State-led Cooperative Approach: Taking elements of the two above approaches, with local stakeholders, landowners, and one past owner (Atlantic Richfield) are proposing to work together to ensure water quality goals and regulations are met, as well as assuring redevelopment goals are achieved. The State would be the lead agency on this approach. This approach is further described below.

PROPOSED SOLUTION

Water Quality Assessment

The Water Quality Control Division (WQCD) of the Colorado Department of Public Health and Environment (CDPHE) is currently performing a WQA as the basis for the eventual issuance of a Colorado Discharge Permit System (CDPS) permit for the St. Louis Tunnel point source discharge. The scope of this WQA is appropriately limited to mining-related discharges, and is focused on low-flow conditions in the Dolores River as the receiving stream. Ambient water quality in the Dolores River is being evaluated as the basis for determining the remaining assimilative capacity of the river for pollutants of concern, and to support antidegradation reviews. (CDPHE, 2002)

The WQA will determine appropriate water quality-based effluent limits (WQBELs). Available recent data is being supplemented by ongoing flow measurement and water quality sampling and analysis in order to develop a data set amenable to statistically valid regression analysis. It is especially important to collect and utilize data both from the discharges of concern and the receiving stream during times of low river flow. As would be expected in this climatic setting, available data document (or in some cases strongly suggest) that the mining discharge flows are seasonal, with highest flows following shortly after peak runoff in the basin and low flows occurring from late summer to mid-winter. Loadings to the Dolores River follow the same pattern, with lower seasonal loadings when low river flows are present. This is a key factor in setting effluent limits for the St. Louis Tunnel that are protective, but not unreasonable.

Proposed Water Treatment Plan

The goals and objectives of the proposed water treatment plan for the St. Louis Tunnel discharge are summarized as follows:

- Regulatory compliance (surface and groundwater; treatment sludge solids disposal)
- Operational simplicity/compatibility
- 50-year facility life
- Cost effectiveness
- Community acceptance and compatibility with redevelopment goals.
- Upgradable or changeable (for sustaining goals beyond its 50-year life or making it more efficient).

A conceptual plan for treatment of the discharge has been developed to meet these goals and objectives. The plan is based on available tunnel discharge water quality data and presently estimated discharge effluent limitations. Alternative methods for treating the discharge were investigated, and the conclusion to date is that lime amendment is the best available technology to meet surface and groundwater quality requirements. Testing to date has shown that very significant reductions in zinc (the anticipated primary metal of concern in terms of loadings to the Dolores River) are achieved with lime addition to pH 9.0. For example, raw water zinc concentrations as high as 4500 ppm were reduced to 200 ppm at pH 9 under bench-scale tests. It also appears that existing natural wetlands (i.e., passive biologic) processes are at work to some degree in portions of the existing ponds. This semi-natural system design will encourage the continuance and, if possible, enhancement of passive biologic treatment aspects of the system. This combined active and passive treatment scheme will be relatively simple to operate, and much more cost-effective than other technologies considered. This type of semi-natural system has been used successfully in several other locations in Montana to treat metals impacted water. This lime precipitation and wetland pond system is also called "Treatment Lagoon in a Wetland Setting".

Laboratory bench-scale treatability tests and field pilot-scale testing have been conducted to investigate effective methods for settling, relocating, dewatering, and safely storing solids resulting from lime amendment of the tunnel discharges. The proposed system will utilize the existing ponds and contiguous, already disturbed ground to the maximum degree possible, thereby minimizing new disturbances. Utilizing the existing ponds for near-term solids storage, and eventual reclamation of many of the storage repositories following gravity drainage and consolidation will result in a significant increase in developable land in the St. Louis Ponds area for appropriate light industrial and related uses. The concept of stacking solids in some of the repositories is being investigated to maximize potential developable space. Results to date in this regard are encouraging.

Monitoring Program

Flow measurement and water quality sampling has been performed by various agencies and entities historically at numerous locations along both the Dolores River and Silver Creek corridors within the Rico mining district.

As part of the proposed plan for treatment of the St. Louis Tunnel discharge, a comprehensive monitoring program for surface waters in the watershed will be developed. Also, groundwater in the St. Louis Ponds area is included. The basis of the surface water portion of this plan will be the recently developed Sampling and Analysis Plan (SAP) developed to support ongoing data collection for completion of the WQA and design of the treatment system. The SAP currently includes a total of 21 sampling locations and 20 field and laboratory measurements and analytes. The final monitoring plan will consist of a subset of these current locations/analytes appropriate to documenting compliance of the system with a St. Louis discharge permit and to verify other, smaller discharges are not impacting the Dolores River quality significantly. Groundwater monitoring at appropriate locations will also be performed to document that the system is not degrading groundwater beneath the treatment system and solids disposal repositories, or increasing loadings of metals to the Dolores River. In fact, it is anticipated that this data will show that groundwater quality in the local Dolores River alluvial aquifer will improve over time as some seepage of high pH water in the treatment system occurs through the existing unlined treatment ponds and proposed unlined solids repositories.

Administrative/Regulatory Plan

An administrative process is proposed which will allow several local stakeholders including the Town of Rico and the local developer, Rico Renaissance, to work closely with past owner, Atlantic Richfield, and the regulatory agencies to ensure both the water quality and sustainable redevelopment objectives are met. While the focus is located in the St. Louis Tunnel area, the intent is for metals- related water issues of the river in the entire Rico area or watershed be assured. In brief, this approach involves the following:

- Water Quality Assessment – To establish water quality requirements for the St. Louis Ponds system to meet applicable state water quality standards.
- Establish Non-Profit Entity – This unique element is necessary to hold the land involved (now owned by multiple parties), hold the water discharge permit, oversee the operation of the water treatment system, and manage the redevelopment of the land. The Town of Rico, Atlantic Richfield, and Rico Renaissance will be members of the non-profit entity.
- Design and construct St. Louis Ponds Water Treatment System – Once appropriate permit limits are known from The Water Quality Assessment, the Non-Profit entity is established, and land is transferred to it, the design and construction of the new treatment system can occur. Atlantic Richfield would take the lead on funding and completing this work.
- Monitoring and Potential Future Actions – After several years of operating the new treatment plant and monitoring the water quality conditions in the Dolores, it can be determined if water quality goals for the Dolores River are being met. If they are not, then further actions to address other, smaller discharges could be considered.
- Sustainable Redevelopment – Under the direction of the Non-Profit entity, redevelopment of the available land around the St. Louis Tunnel and Ponds can be done in such a manner that ensures that it contributes to the overall sustainability of the community. As shown in Figure 3, several areas would be immediately available for light industrial users and over the next decade, other areas would be made available due to filling low, wet disposal areas with solids from the water treatment system and closing those repositories as reclaimed flat areas suitable for development. The Non-Profit could oversee the leasing of land to developers or users, and/or could administer a “business incubator” which would allow new businesses to get started in the area with lower overhead costs.
- Funding - In addition to the design and construction of the treatment system, Atlantic Richfield would fund the systems O&M and the monitoring program. Where available, the non-profit can apply for “Brownsfields” grants to assist with redevelopment efforts.
- Regulatory Assurances – Though administered through a cooperative effort between local stakeholders and past owners, the state and federal regulatory agencies would still have ultimate authority to step in and deal with any un-addressed environmental or regulatory concerns.

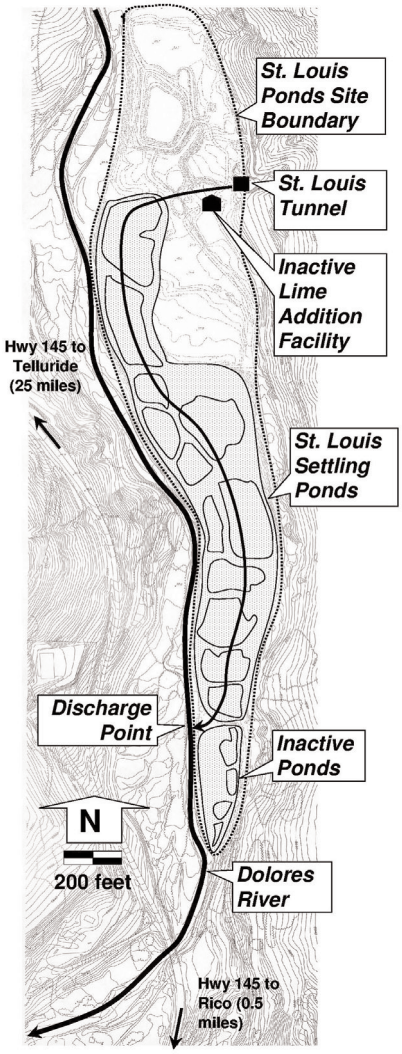

Figure 2: St. Louis Tunnel Area

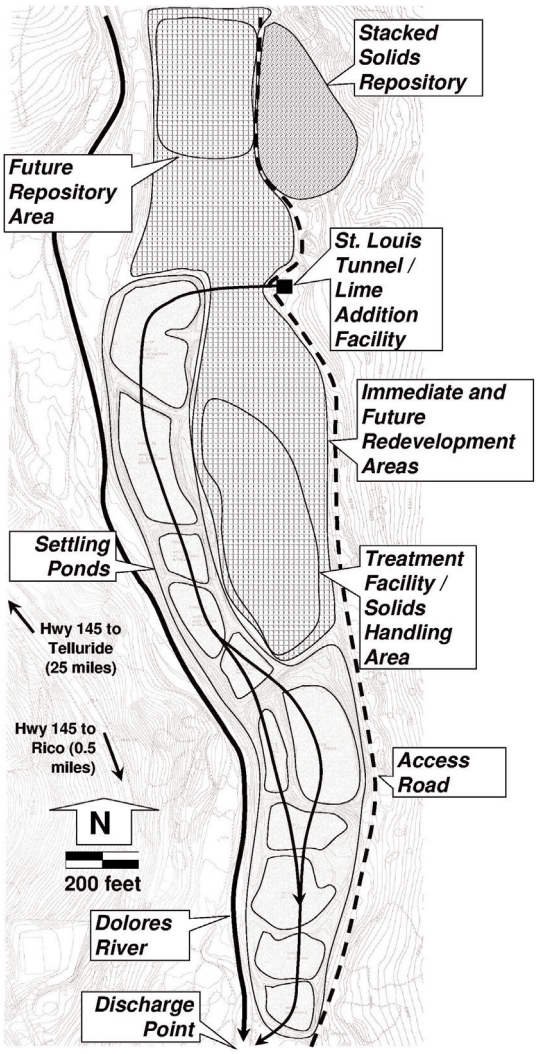

Figure 3: St. Louis Treatment System Layout, with Developable Areas.

SUMMARY

As described, this pragmatic water treatment and unique administrative approach is being pursued for tackling Rico's water quality and redevelopment concerns. The opportunity to combine achieving water treatment and redevelopment in the same area, and do so through streamlined cost and time efficient means offers clear advances over performing cleanup in a more conventional manner. This approach is not only attractive over the short-term, but because it is locally controlled, overseen by appropriate regulatory agencies, and involves redevelopment of an old mine site, it should be sustainable over the long term.

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