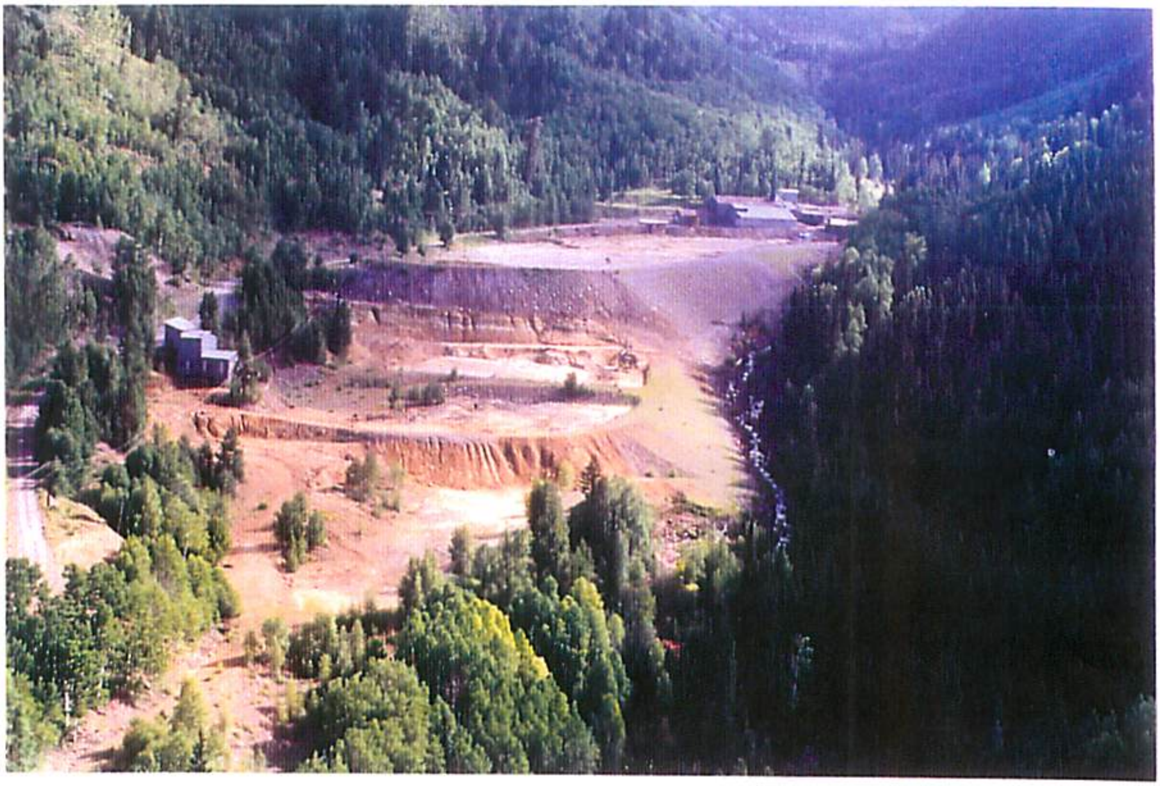
VOLUNTARY CLEANUP AND REDEVELOPMENT ACT APPLICATION FOR ARGENTINE TAILINGS SITE RICO, COLORADO



Submitted to:
COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

Submitted by:
Atlantic Richfield Company
Rico Development Corporation
Rico Properties, L.L.C.
Val Truelsen and Deanna Truelsen

February 1996

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VOLUNTARY CLEANUP AND REDEVELOPMENT ACT APPLICATION

July 11, 1994 Draft

This application form is prepared by the Colorado Department of Public Health and Environment, to assist potential applicants in meeting the requirements outlined in the Voluntary Cleanup and Redevelopment Act (HB94-1299). Adherence to this application will insure that adequate information is submitted to allow the Department to evaluate the application and make a determination on the Voluntary Cleanup Plan or No Action Petition. All applications must include a filing fee of $2000. Department review time will be billed against this fee, with any remaining funds to be returned to the applicant.

GENERAL INFORMATION

The applicant should begin by providing the following general information:

Page		
1-2	1)	Name and address of owner
1-2	2)	Contact person and phone number
1-1	3)	Location of property
1-3	4)	The type and source of contamination
1-3	5)	If contamination will remain on property following implementation of your proposal, provide Global positioning system coordinates
1-3	6)	State whether request is for approval of Voluntary Cleanup Plan (VCUP) or a petition of No Further Action Determination (NAD)
1-3	7)	Current Land Use
1-4	8)	Proposed Land Use

PROGRAM INCLUSION

This section is designed to determine whether the applicant meets the criteria for eligibility under the Act. Please answer yes (Y), no (N), or not sure (NS) to the questions below. If the answer to any of the questions is not sure (NS) please fill out the appropriate checklist questionnaire in Appendix 1 (these have not yet been developed at the time of the last draft). An answer "no" to question 1 or "yes" to questions 2-6 will result in a determination that the application is not eligible for the Voluntary Cleanup Program. The submission of misleading information will render any approval given by the Department void.

Page		
1-4 Yes	1)	Is the applicant the owner of the property for the submitted VCUP or NAD? IF yes, verify ownership.
1-4 No	2)	Is the property submitted for the VCUP or NAD listed or proposed for listing on the National Priorities List of Superfund sites established under the federal act (CERCLA)
1-4 No	3)	Is the property submitted for which the VCUP or NAD the subject of corrective action under orders or agreements issued pursuant to the provisions of Part 3 of Article 15 of this Title or the federal "Resources Conservation and Recovery Action of 1976", as amended? If yes, please list order number.

1-4 No 4) Is the property submitted for the VCUP or NAD subject to an order issued by or an agreement (including permits) with the Water Quality Control Division pursuant to Part 6 of Article 8 of this Title? If yes, please list order or permit number.

1-5 No 5) Is the property submitted for the VCUP or NAD a facility which has or should have a permit or interim status pursuant to Part 3 of Article 15 of this Title (RCRA Subtitle C) for treatment, storage, or disposal of hazardous waste? IF yes, please list permit number.

NOTE: Properties that do not have a permit or interim status but at which hazardous waste, as defined in the Colorado Hazardous Waste Act and implementing regulations, was treated, stored, or disposed of at any time after 1980 is considered by the Department to have required a permit or interim status. Disposal is defined as any discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment.

1-5 No 6) Is the property submitted for the VCUP or NAD subject to the provisions of Part 5 of Article 20 of Title 8 (Underground Storage Tank - State Oil Inspector), C.R.S. or of Article 18 of this Title (RCRA subtitle I).

VOLUNTARY CLEANUP APPLICATION

Any plan for voluntary cleanup (VCUP) or request for no action determination (NAD) must include the following information to be considered complete. Applicants need to supply enough information in sufficient detail for the Department to make a determination. If certain information is not applicable to the site, the applicant may provide evidence and explanations as to why specifically requested information is not applicable. It is most important that the applicant describe the rationale used in performing the site investigation (including selection of sampling locations and parameters), performing risk assessments, selecting cleanup levels, and any other decision making process included in the application.

The applicant should include a cross reference listing the page number(s) of the application which correspond to the following listed information requirements on the blank line to the left of the information description on this form (or by other equivalent means).

ENVIRONMENTAL ASSESSMENT

Page

2-1 1) Environmental assessments must be submitted by qualified professionals, who are defined as persons having education, training, and experience in preparing environmental studies and assessments. The applicant should submit documentation, in the form of a statement of qualifications or resume, that the environmental assessment has been prepared by a qualified environmental professional.

1-2 2) The applicant should provide the address (if applicable) and legal description of the site, and a map of appropriate scale identifying the location and size of the property.

2-2 3) The applicant should describe the operational history of the property in detail, including the most current use for the property. This description should include, but not be limited to:

2-2 (i) a description of all business/activities that occupy or occupied the site as far back as records/knowledge allows;

2-2 (ii) a brief description of all operations which may have resulted in the release of hazardous substances or petroleum products at the site both past and present, including the dates activities occurred at the property, and dates during which contaminants were released into the environment;

2-4 (iii) a list of all:

(a) site specific notifications made as a result of any management activities of hazardous substances conducted at the site, including any and all EPA ID numbers obtained for management of hazardous substances at the site from either the State or the U.S. Environmental Protection Agency (EPA):

2-4 (b) notification to county emergency response personnel for the storage of reportable quantities of hazardous substances required under Emergency Planning and Community Right to Know statutes; and

2-4 (c) notifications made to State and/or Federal agencies as a reporting spills and/or accidental releases, including notifications to the State Oil Inspection Section required under 8-20-506 and 507 and 25-18-104 C.R.S. 1989 as amended, and 6 C.C.R.1007-5 Subpart 28.50. Part 3 of the OIS regulations etc.;

2-5 (iv) a list of all known hazardous substances used at the site, with volume estimates;

2-5 (v) a list of all wastes generated by current activities conducted at the site, and manifests for shipment of hazardous wastes off-site;

2-6 (vi) a list of all permits obtained from State or Federal agencies required as a result of the activities conducted at the site; and

2-4 (vii) a brief description of the current land uses, zoning and zoning restrictions of all areas contiguous to the site.

2-6 4) The applicant shall describe the physical characteristics of the site, including a map to scale (or separate maps, whichever represent the following types of information most clearly), and an accompanying narrative showing and describing the following (where applicable):

2-6 (i) topography;
2-7 (ii) all surface water bodies and wastewater discharge points;
2-8 & 2-12 (iii) ground water monitoring & supply wells;
2-15 (iv) facility process units and loading docks;
2-15 (v) chemical and/or fuel transfer, and pumping stations;
2-15 (vi) railroad tracks and rail car loading areas;
2-15 (vii) spill collection sumps and/or drainage collection areas;
2-15 (viii) wastewater treatment units;
2-14 (ix) surface and storm water run-off retention ponds and discharge points;
2-15 (x) building drainage or wastewater discharge points;
2-15 (xi) all above or below ground storage tanks;
2-15 (xii) underground or above ground piping;
2-15 (xiii) air emission control scrubber or refrigeration units;
2-15 (xiv) water cooling systems or refrigeration units;
2-15 (xv) sewer lines;
2-15 (xvi) french drain systems;

2-15 (xvii) water recovery sumps and building foundations;
2-12 (xviii) surface impoundments;
2-12 (xix) waste storage and/or disposal areas/pits, landfills etc.;
2-15 (xx) chemical or product storage areas;
2-15 (xxi) leach fields; and
2-15 (xxii) dry wells or waste disposal sumps.

2-8 5) If groundwater contamination exists, or if the release has the potential to impact groundwater, the applicant should provide the following information for areas within one-half mile radius of the site:

2-8 Fig 2-3 (i) the State Engineer's Office listing of all wells within the one-half mile radius of the site, together with a map to scale showing the locations of these wells;

2-8 (ii) documentation of due diligence in verifying the presence or absence of unregistered wells supplying ground water for domestic use in older residential neighborhoods, or in rural areas;

Not Applicable (iii) a statement about each well within the half-mile radius of the site, stating whether the well is used as a water-supply well, or a ground water monitoring well;

Not Applicable (iv) lithologic logs for all on-site wells;

Not Applicable (v) well construction diagrams for all on-site wells, showing screened interval, casing type and construction details (obtainable from the State Engineer's Office), including: gravel pack interval, bentonite seal thickness and cemented interval;

2-8 (vi) a description of the current and proposed uses of on-site groundwater in sufficient detail to evaluate human health and environmental risk pathways. In addition, the applicant will provide a discussion of any State and/or local laws that would restrict the use of on-site ground water.

2-15 6) The applicant should provide information concerning the nature and extent of any contamination and releases of hazardous substances or petroleum products which have occurred at the site, including by not limited to:

2-15 (i) identification of the nature and extent, both on-site and off-site, of contamination that has been released into soil, ground water and surface water at the property, and/or releases of substances from each of the areas identified in Section 25-16-308(b) above;

2-15 (ii) a determination of whether or not, those substances identified in paragraph (i) above, contain hazardous substances either through process knowledge, Material Safety Data Sheet information provided by a manufacturer, or through chemical analysis;

2-12&2-16 (iii) a statement defining the chemical nature, mobility and toxicity of the substances identified in paragraph (i) above, estimated volumes and concentrations of substances discharged at each area, discharge point, drain, or leakage point;

Not Available (iv) a map to scale showing the depth to ground water across the site;

Not Available (v) a map to scale showing the direction and rate of ground water movement across the site using a minimum of three (3) measuring points;

None (vi) a discussion of all hydraulic tests performed at the site to characterize the hydrogeologic properties of any aquifers on-site and in the area;

2-16 (vii) all reports and/or correspondence which detail site soil, ground water and/or surface water conditions at the site, including original analytical laboratory reports for all samples and analyses;

Separate Reports Provided (viii) a discussion of how all environmental samples were collected, including rationale involved in sampling locations, parameters, and methodology, a description of sampling locations, sampling methodology and analytical methodology, and information on well construction details and lithologic logs. All sample analyses performed and presented as part of the environmental assessment should be appropriate and sufficient to fully characterize all constituents of all contamination which may have impacted soil, air, surface water and/or ground water on the property. The applicant should use EPA approved analytical methods when characterizing the soil, air, surface water and/or ground water.

APPLICABLE STANDARDS/RISK DETERMINATION

3-1 1) The applicant should provide a description of applicable promulgated state standards establishing acceptable concentrations of constituents (present at the site) in soils, surface water, or ground water.

3-1 2) The applicant should provide a description of the human and environmental exposure to contamination at the site based on the property's current use and any future use proposed by the property owner. This description shall include, but not be limited to the following:

2-16 (i) a table or list, for site contaminants indicating:

Not Applicable (a) whether they are known to be carcinogenic (together with any relevant toxicity information for each carcinogenic contaminant available, including the slope factor for the contaminant) or whether they are non-carcinogenic (together with any relevant toxicity information on each contaminant, including reference doses if available);

2-15&2-16 (b) which media (i.e., soil, sir surface water and ground water) are contaminated, and the estimated vertical and areal extent of contamination in each medium;

2-16 (c) the maximum concentrations of each contaminant detected on-site in the area on-site where the contaminant was discharge to the environment, and/or where the worst effects of the discharge are believed to exist;

3-1&3-3 (d) whether the contaminant has promulgated state standard, the promulgated standard and the medium (i.e., ground water, surface water, air or soil) the standard applies to;

3-4 & 3-5 (ii) a description and list of potential human and/or environmental exposure pathways pertinent to the Present Use of the property;

3-4 & 3-5 (iii) a description and list of potential human and/or environmental exposure pathways pertinent to the Future Use of the property;

2-15 Fig.2-1 (iv) a list, and map defining all source areas, areas of contamination or contaminant discharge areas;

2-15&2-16 (v) a discussion of contaminant mobilities, including estimates of contaminants to be transported by wind, volatilization, or dissolution in water. For those contaminants that are determined to be mobile and have the potential to migrate and contaminate the underlying ground water resources, the applicant should also evaluate the leachability/mobility of the contaminants. This evaluation should consider, but not be limited to, the following: leachability/mobility of the contamination; health-based ground water standards for the contamination; geological characteristics of the vadose zone that should enhance or restrict contaminant migration to ground water, including but not limited to grain size, fractures and carbon content and depth to ground water. This evaluation and any supporting documentation should be included in the plan submitted to the Department.

3-5 3) The applicant should then provide, using the information contained in the application, a risk assessment in accordance with standard EPA policy, or calculation of appropriate cleanup levels, using CDHPE hazardous Materials and Waste Management Division's **"Interim Final Policy and Guidance On Risk Assessment For Corrective Action At RCRA Facilities"** (November 16, 1993). The Department will evaluate this analysis based on an acceptable excess cancer risk of 1×10^{-6} or hazard index < 1.

VOLUNTARY CLEANUP PROPOSAL

The voluntary cleanup plan must address known or potential releases of contaminants considering the human health and environmental risks of those contaminants in both the present and future land use scenarios. The plan must demonstrate that either all applicable state standards will be met, or for contaminants where no standard exists, that the risk level has been reduced to an acceptable level (excess cancer risk of 10^{-6}, or hazard index < 1).

The remediation alternative selected should be described in sufficient detail to allow the Department to evaluate whether or not the applicant will be capable of remediating all contamination identified at the subject property within the specified 24 month time limit set down in 25-16-306(4)(a). This plan should, at a minimum, include the following information:

4-6 1) A detailed description of the remediation alternative, or alternatives selected, which will be used to remove, or stabilize contamination released into the environment, or threatened to be released into the environment.

follows

4-8 2) A map identifying areas to be remediated, the area where the remediation system will be located, if it differs from the contaminated areas, locations of confirmation samples, the locations of monitoring wells, areas where contaminated media will temporarily be stored/staged, and areas where contamination will not be remediated.

follows

4-8 3) Remediation system design diagrams showing how the system will be constructed in the field.

4-14 4) A remediation system operation and maintenance plan that describes, at a minimum, how the system will be operated to ensure that it functions as designed without interruptions and a sampling program that will be used to monitor its effectiveness in achieving the desired goal.

4-17 5) The plan should describe how the waste, or contaminated media will be managed prior to treatment, and/or disposal.

4-17 6) The plan should discuss whether or not a hazardous waste will be generated by its implementation (e.g., through the excavation of contamination, which may have been discharged prior to 1980, but which would become a hazardous waste upon being dug up or managed), and the volume of this material. The plan should also describe how such hazardous waste will managed in accordance with current state and federal hazardous waste regulations.

4-17 7) If applicable, the plan should describe the sampling program that will be used to verify that treatment of the contaminated media has resulted in a non-hazardous waste.

4-16 8) The plan should described the sampling program that will be used to verify that no contamination above the health-based cleanup standard has been allowed to remain in the environment, or at a location that could potentially threaten human health and the environment.

4-15 9) The plan should describe all sampling collection methods to be utilized along with the field and/or laboratory methods that will be used to analyze the samples.

4-19 10) The plan should include a schedule of implementation.

4-19 11) The plan should identify all permits (Federal, state and/or local including, if necessary, EPA Form 8700-12-Notification of Hazardous Waste Activity, required on the generation of hazardous waste) that will be needed before the plan can be implemented.

4-18 12) The plan should discuss the potential risks associated with the proposed cleanup alternatives, and the economic and technical feasibility of these alternatives.

4-22 13) The plan should describe the post-VCUP monitoring plan to be implemented in order to verify attainment of appropriate standards or risk levels as identified as cleanup targets.

____ 14) If not included in the risk assessment portion of the application, the plan should describe:

2-16 (a) a final list of all site contaminants, along with the remaining concentrations;

2-16 (b) a final list defining which media (i.e., soil, surface water and ground water) are contaminated, and the estimated vertical and areal extent of contamination to each medium;

2-16 Figure 2-1 (c) a final list, and map defining all source areas, areas of contamination or contaminant discharge areas; and

4-19 (d) a description of the mechanisms for insuring that use of the land is consistent with the plan.

Voluntary Cleanup and Redevelopment Act Application
for
Argentine Tailings Site
Rico, Colorado

1.0 GENERAL INFORMATION

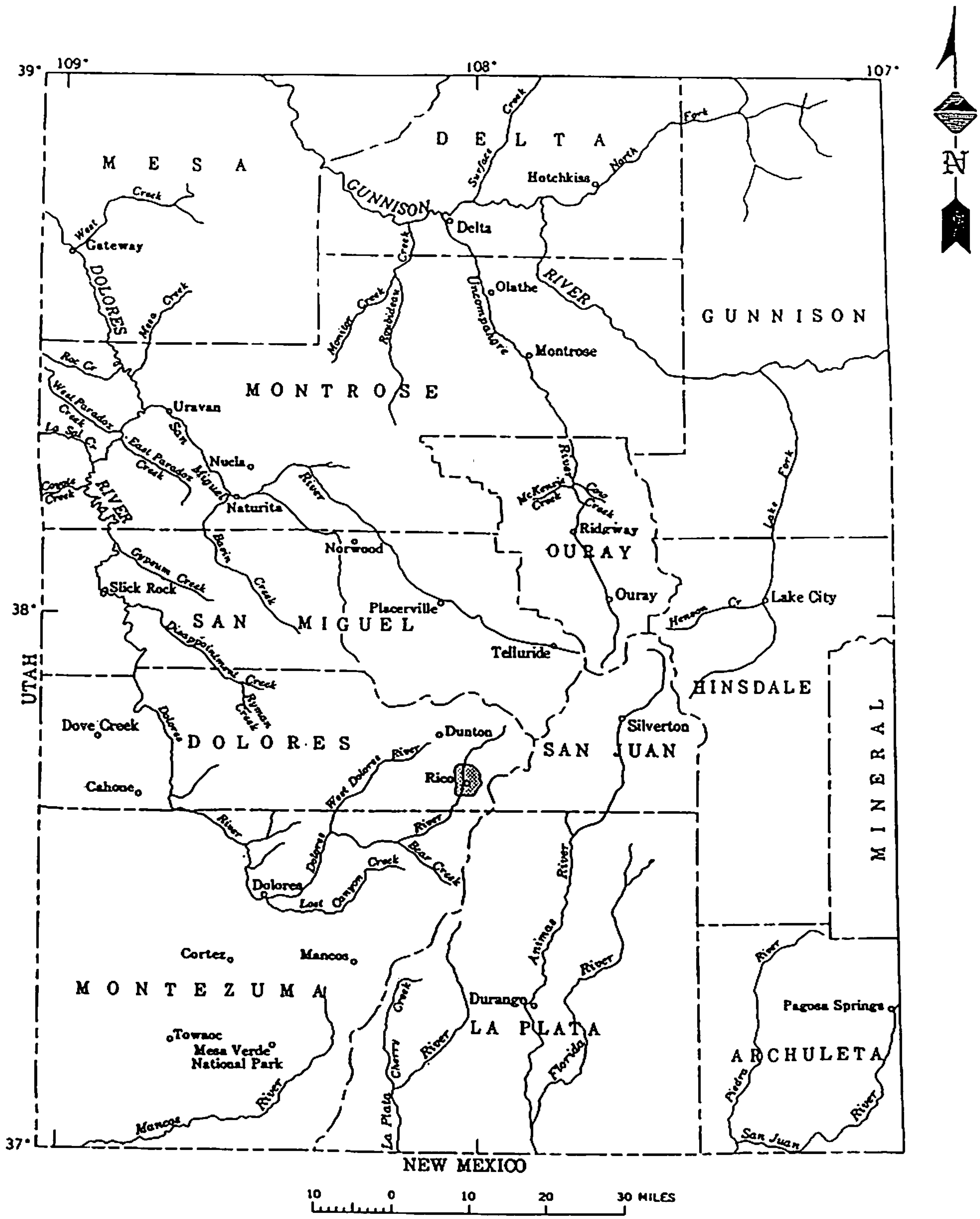
1.1 Applicants

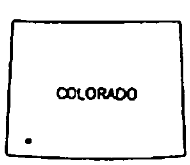
The property owners identified herein in conjunction with the Atlantic Richfield Company (collectively referred to as "Applicants") are submitting this application to the Colorado Department of Public Health and Environment (Department) in accordance with the requirements outlined in the Voluntary Cleanup and Redevelopment Act (HB94-1299) and the July 11, 1994 Draft Application Form.

The Applicants fully support the voluntary cleanup program as an effective mechanism to provide for the protection of human health and the environment and to foster both the redevelopment and reuse of mined land occupied by the inactive Argentine mill tailings facility ("Site") at Rico, Colorado (Figure 1-1). The Applicants are as follows:

1. Atlantic Richfield Company (ARCO), prior owner of certain property
2. Rico Development Corporation, current property owner
3. Rico Properties L.L.C., current property owner
4. Val Truelsen and Deanna E. Truelsen, current property owners

A portion of the lands upon which the proposed cleanup actions will occur are federal lands managed by the U.S. Forest Service ("Forest Service"). Due to jurisdictional/legal restraints, the Forest Service is not authorized to formally submit this application to the Department, and thus is not listed as an "Applicant" here. However, the Applicants have discussed this project with Forest Service representatives, who are fully supportive of the remedial objectives and purposes of the project. The Applicants will work with the Department and the Forest Service to develop a legal framework for implementation of those aspects of the project which will take place on federal lands. This process will proceed under a time frame which will allow all project components to proceed on a parallel track under the project schedule contained on page 4-27 through 4-28.





RICO DISTRICT
LOCATION MAP

FIGURE 1-1

1.2 General Site Information

This section provides general site information, as specified in the application form.

1. Location and Size of Site

a. General Site Location and Size.

The Site is located on the north side of the Silver Creek approximately 0.6 mile northeast of the Rico townsite (Figure 1-2). The Site tailings ponds occupy an area of approximately 15 acres.

b. Land Description.

The Site is located in portions of the SE1/4 of the NE1/4 of the SE1/4 and NE1/4 of the SE1/4 of the SE1/4 of Section 25, T40N, R11W; and the NW1/4 of the SW1/4 of Section 30, T40N, R10W, NMPM, Dolores County (Figures 1-2 and 1-3).

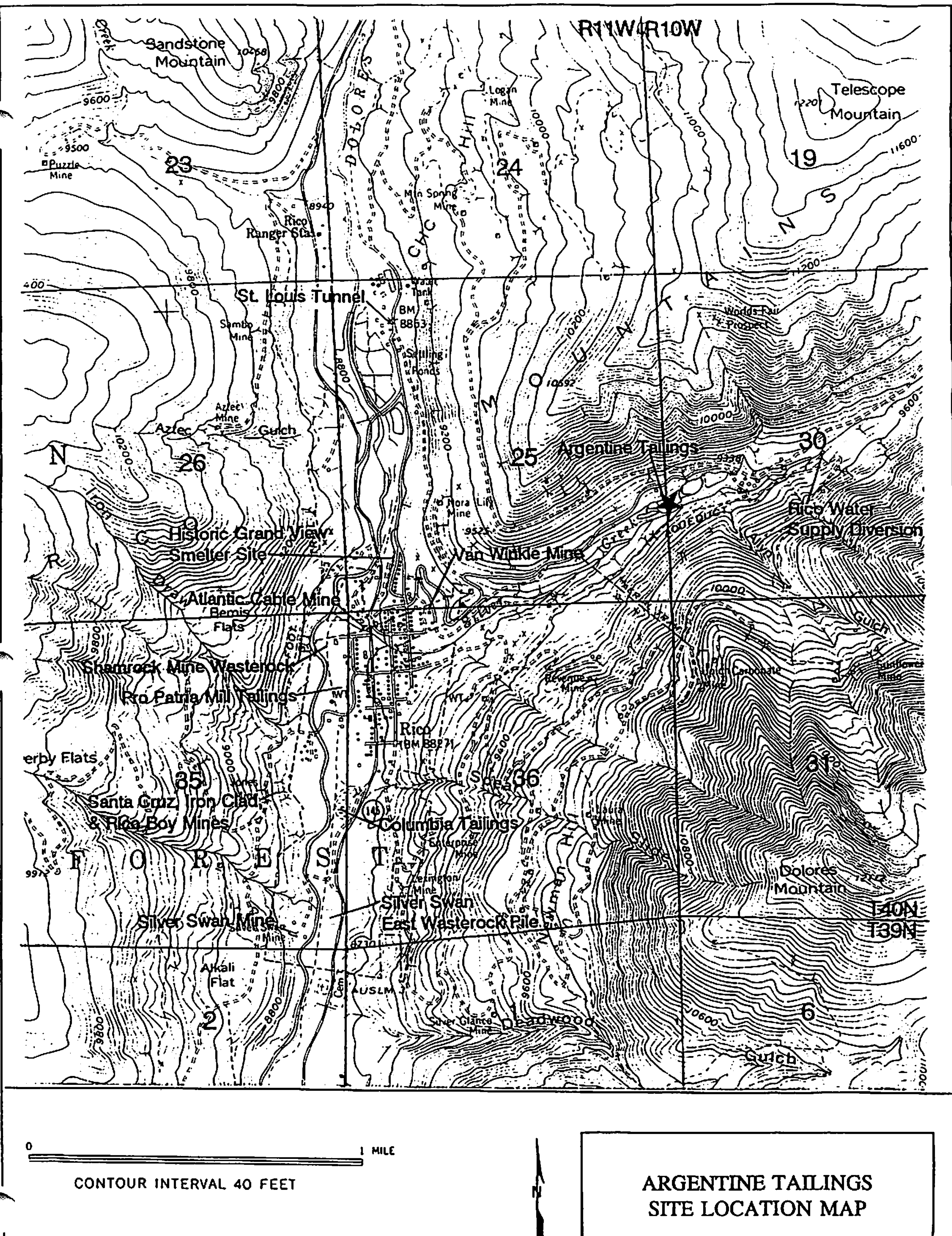
The Site comprises San Juan National land and various portions of the following patented claims (Figure 1-3):

Claim Name	Patent No.	Mineral Survey No.
Moyer	33693	13379
EBY	24278	7066
Royal Tiger	9859	1190
Missouri	25321	7898
Last Chance	27745	8622
Catskill	21923	7062
Elliot Millsite	9764	1536B

2. Property Owner and Contact Person

a. Moyer claim
Book 120, Page 187, Dolores County Clerk

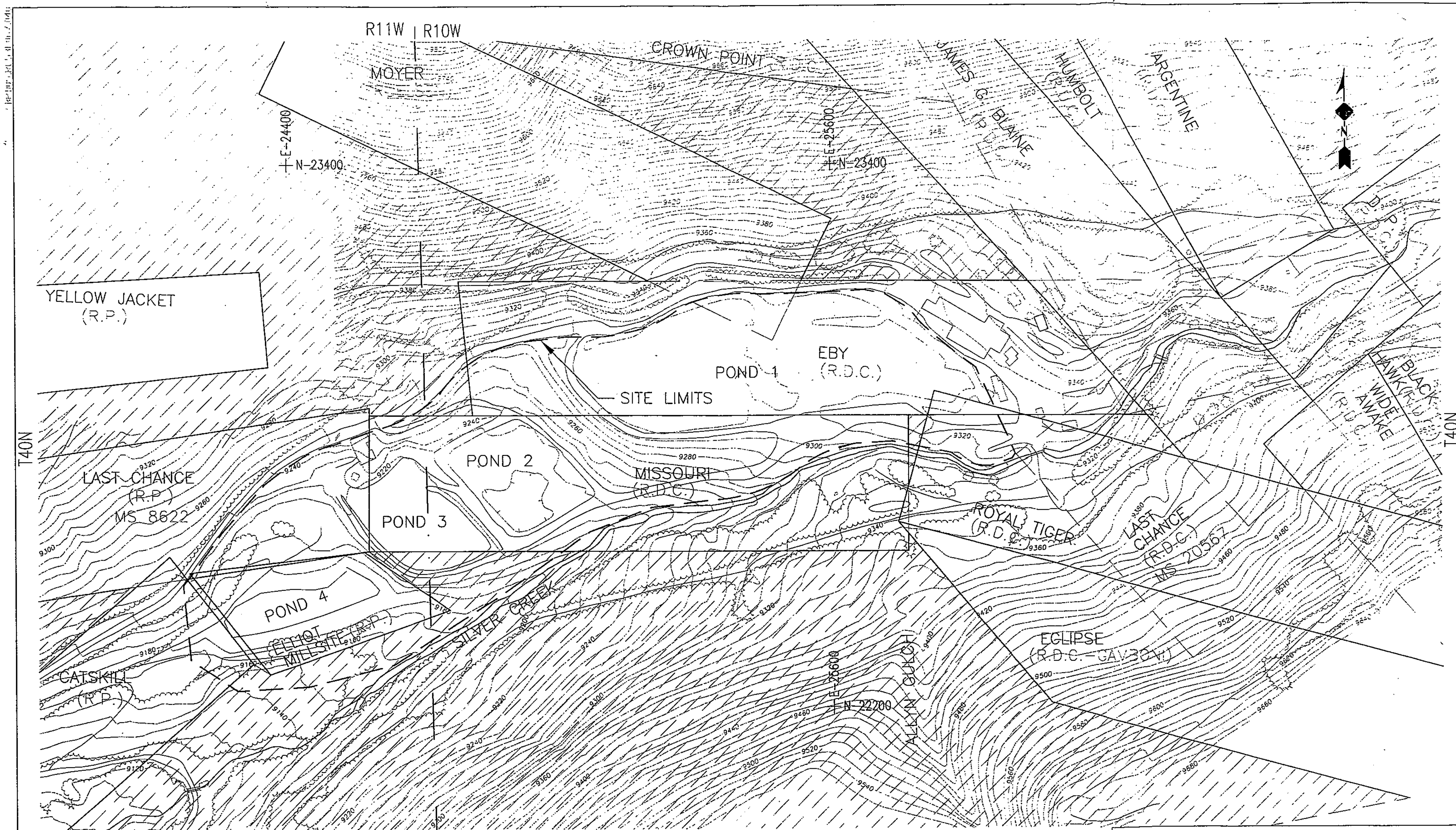
Val Truelsen and Deanna E. Truelsen
P.O. Box 458
Dolores, CO 81323
Contact: Val Truelsen (970) 882-7383



ARGENTINE TAILINGS
SITE LOCATION MAP

FIGURE 1-2

Section lines added.
Base Map: USGS Rico Quadrangle, Colorado, 7.5 Minute Series.



LEGEND

SAN JUAN NATIONAL FOREST

R.D.C. RICO DEVELOPMENT CORPORATION

R.P. RICO PROPERTIES, L.L.C.

SCALE IN FEET

0 200 400

CONTOUR INTERVAL 10 FEET

ARGENTINE TAILINGS SITE
LAND OWNERSHIP MAP

FIGURE 1-3

b. EBY, Royal Tiger and Missouri claims
Book 238, Page 309, Dolores County Clerk

Rico Development Corporation
P.O. Box 130
Rico, CO 81332
Contact: Wayne E. Webster, President (970) 967-2932 or (903) 677-1679

c. Last Chance, Catskill and Elliot Millsite claims
Book 266, Page 453, 455 and 456, Dolores County Clerk

Rico Properties, L.L.C.
P.O. Box 220
17 Glasgow Avenue
Rico, Colorado 81332
Contact: Stan Foster, Manager (970) 967-5441

d. Contact point for lands within San Juan National Forest:

Supervisor's Office
701 Camino del Rio
Durango, Colorado 81301

3. Type and Source of Contamination

Heavy metals (i.e., copper, iron, lead, and zinc) contained in historic mill tailings derived from sulfide ore and surface seep.

4. Site Coordinates

N22800, E24900 (center of Site) based on Town of Rico survey coordinate system where N20000, E20000 is the point of intersection of Glasgow Avenue (highway 145) and Mantz Street. Global positioning system coordinates are not available.

5. Statement of Request for Approval

Applicants request approval of the Voluntary Cleanup Plan (VCUP).

6. Current Land Use

Undeveloped inactive mill tailings disposal site.

7. Proposed Land Use

Continued historic inactive mill tailings site with open space and light industrial components (e.g., garages, parking areas, warehouses).

1.3 Program Inclusion Questionnaire

This section answers the questions listed in the application form as required to determine that the applicants meet the criteria for eligibility under the Act. An answer "yes" to question 1 and "no" to questions 2-6 indicate a determination that the application is eligible for the Voluntary Cleanup Program.

1. *"Is the applicant the owner of the property for the submitted VCUP or NAD? IF yes, verify ownership."*

   Yes. All applicants except ARCO are current owners of certain properties for the submitted VCUP. Ownership is verified according to Book and Page number of applicable conveyance instruments on record with Dolores County Clerk (See Section 1.2).

2. *"Is the property submitted for the VCUP or NAD listed or proposed for listing on the National Priorities List of Superfund sites established under the federal act (CERCLA)?"*

   No.

3. *"Is the property submitted for which the VCUP or NAD the subject of corrective action under orders or agreements issued pursuant to the provisions of Part 3 of Article 15 of this Title or the federal "Resources Conservation and Recovery Action of 1976", as amended? If yes, please list order number."*

   No.

4. *"Is the property submitted for the VCUP or NAD subject to an order issued by or an agreement (including permits) with the Water Quality Control Division pursuant to Part 6 of Article 8 of this Title? If yes, please list order or permit number."*

   No.

5. *"Is the property submitted for the VCUP or NAD a facility which has or should have a permit or interim status pursuant to Part 3 of Article 15 of this Title (RCRA Subtitle C) for treatment, storage, or disposal of hazardous waste? Yes, please list permit number."*

No.

6. *"Is the property submitted for the VCUP or NAD subject to the provisions of Part 5 of Article 20 of Title 8 (Underground Storage Tank - State Oil Inspector), C.R.S. or of Article 18 of this Title (RCRA Subtitle I)?"*

No.

2.0 ENVIRONMENTAL ASSESSMENT

2.1 Introduction

Pursuant to the specific information requirements outlined in the Voluntary Cleanup and Redevelopment Act, the environmental assessment section, appended documents and a variety of data reports provide the following categories of information:

- Qualifications of professionals who prepared the environmental assessment, applicable standards/risk determination and voluntary cleanup plan sections of this application;

- Location/size, operational history and current use of the Site;

- Physical and ecological characteristics of the Site, including descriptions of site investigations and results and previously implemented remedial measures;

- Nature and extent of on-site and off-site contamination; and

- Brief explanation as to why certain specifically requested information is not applicable.

2.2 Qualification of Environmental Professionals

"Environmental assessments must be submitted by qualified professionals, who are defined as persons having education, training, and experience in preparing environmental studies and assessments. The applicant should submit documentation, in the form of a statement of qualifications or resume, that the environmental assessment has been prepared by a qualified environmental professional."

The environmental assessment, applicable standards/risk determination and voluntary cleanup plan have been prepared by a qualified team of environmental, risk assessment, and engineering professionals selected by Atlantic Richfield Company (ARCO). A corporate profile of the lead environmental engineering contractor, ESA Consultants Inc. (ESA), and the qualifications of the key personnel from ESA and other consulting firms who prepared the environmental assessment, risk determination and/or voluntary cleanup plan are included in Appendix A.

2.3 Location and Size of the Site

"The applicant should provide the address(if applicable) and legal description of the Site, and a map of appropriate scale identifying the location and size of the property."

The required information is provided under Section 1.2. General Site Information (page 1-1). The location and size of the Site are identified on Figures 1-2, 1-3, and 2-1. Figures 2-2a and 2-2b are photographs of the Site.

2.4 Operational History

"The applicant should describe the operational history of the property in detail, including the most current use of the property. This description should include, but not be limited to:

- *a description of all businesses/activities that occupy or occupied the Site as far back as records/knowledge allows; and*

- *a brief description of all operations which may have resulted in the release of hazardous substances or petroleum products at the Site, both past and present, including the dates activities occurred at the property, and dates during which the contaminants were released into the environment."*

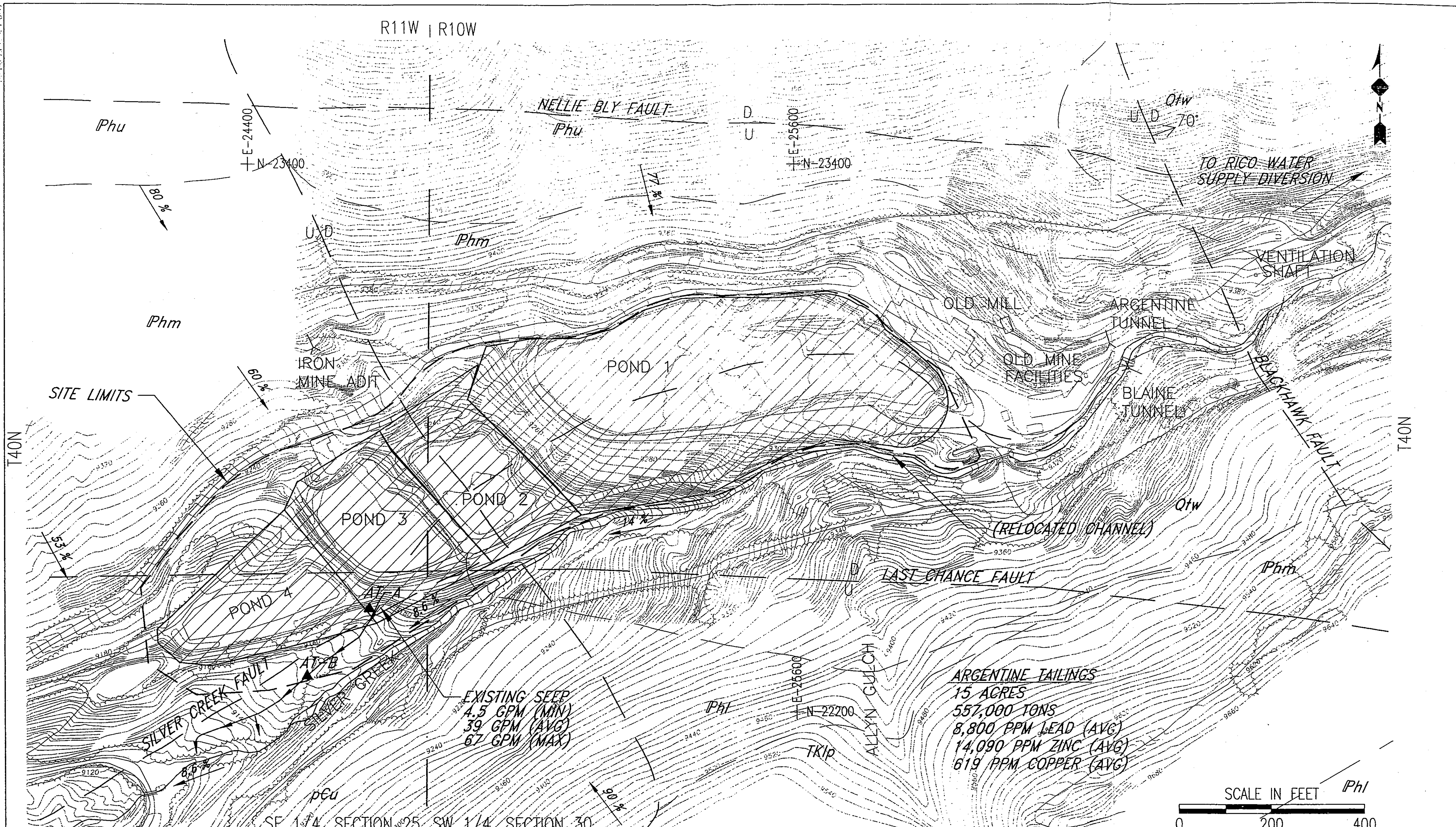
2.4.1 Introduction

Prior to 1938, the Site was undeveloped forest and stream bottomland. An unimproved road on the north side of the valley was used as access to local mines on the south side of the creek. Since 1938, the Site area has been occupied by flotation mill, mine and tailings disposal facilities.

2.4.2 Period of Active Operation (1938-1971)

Rico Argentine Mining Company began construction of a 135-ton flotation mill in late 1938 along Silver Creek near the Argentine and Blaine tunnels (Figure 2-1; McKnight, 1974). The company diverted the course of the creek to the south of the valley for several hundred feet to allow space for tailings disposal (the Argentine tailings ponds) and also moved the Town of Rico water supply intake upstream. The mill began operations in September of 1939 and production rose from 220 tons of ore in 1938 to 38,735 tons in 1940 (CMA, 1940 and BOM, 1940-1941).

Production in the district remained consistent at about 35,000 tons of ore annually from 1941 through 1948. Rico Argentine accounted for almost all of the production and treated all but a small percentage at its mill (BOM, 1943-1949). The company halted all operations in 1949. Fifteen months later, Rico Argentine resumed operations and the company produced about 40,000 tons of lead-zinc ore annually for the next 5 years (CMA, 1951 and BOM, 1952-1956).



ARGENTINE TAILINGS SITE
SITE FEATURES MAP

FIGURE 2-1

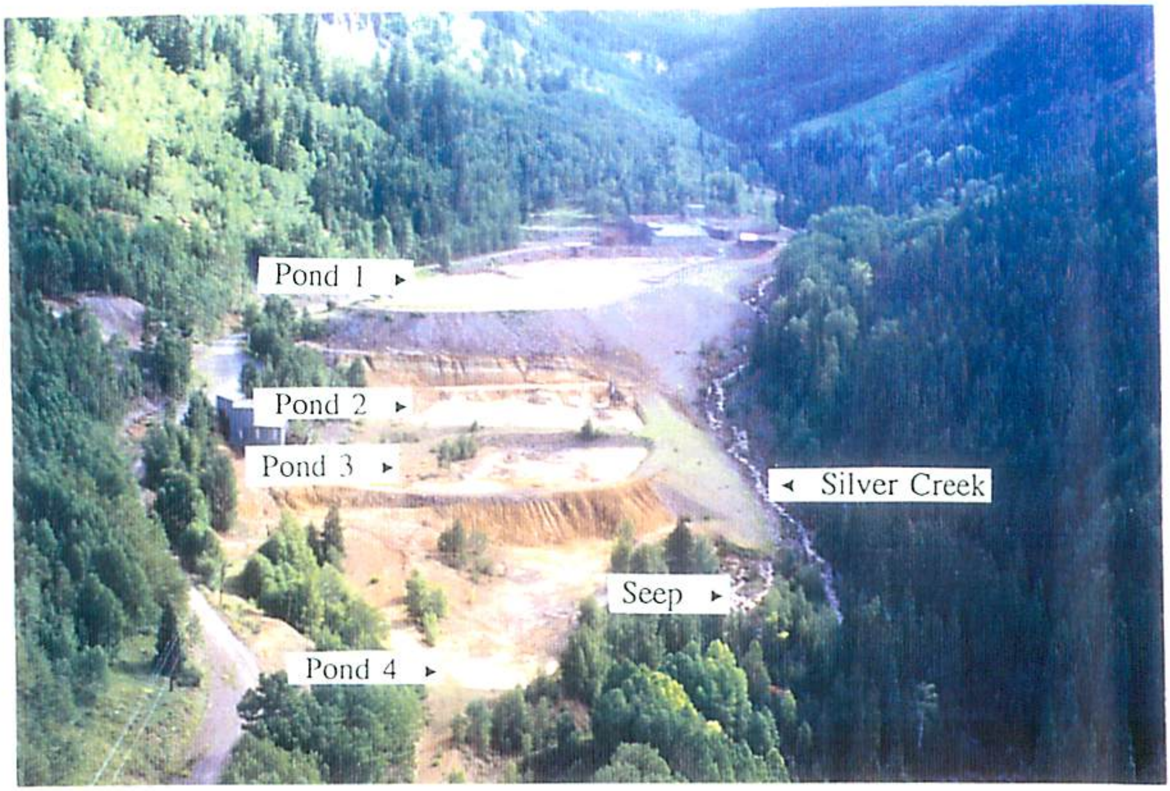


Figure 2-2a. Argentine Tailings (east) September, 1995

Figure 2-2b. Argentine Tailings (west) September, 1995

The company built a tailings upgrade plant near the Argentine mill in 1956 to supply the acid plant built in 1955 in the Dolores River valley near the St. Louis tunnel (Figure 1-2; CBM, 1957 and BOM, 1958). Approximately 80,000 tons of low-grade pyritic tailings were processed to produce sulfuric acid (McKnight, 1974). In 1956, the plant produced about 200 tons of pure sulfuric acid daily.

Rico Argentine resumed operations at its lead-zinc mill in early 1959. Production increased from 16,000 tons of ore after 1961 to over 33,000 tons in 1967. Production fluctuated over the next few years and eventually dropped to 967 tons of ore in 1971 at which time Rico Argentine ceased operation of its mine and mill (CBM, 1971). Giving credit for the 80,000 tons of tailings removed from the Argentine ponds and processed by the acid plant, an estimated 557,000 tons of pyritic base metal tailings from Rico Argentine activities remain stored at the Argentine facility.

2.4.3 Period of Inactive Operations (1972-Present)

Rico Argentine apparently did not renew operations of the Argentine lead-zinc mill after 1971. Crystal Oil Company acquired Rico Argentine through a stock transaction consummated on July 5, 1974, and the two companies merged in 1975. The Anaconda Copper Company acquired Rico Argentine properties from a subsidiary of Crystal Oil Company in 1980, but never operated any mines, the acid plant or the Argentine mill. Anaconda conducted geotechnical and hydrologic investigations of the tailings ponds in 1979 and 1981. During the summer and fall of 1982, Anaconda Minerals Company constructed flood protection and slope stabilization work at the tailings ponds (D&M, 1982). This work included the following:

- stability berm construction, riprap bank protection and reclamation along approximately 1,100 feet of the north bank of Silver Creek adjacent to the ponds;
- construction of a reinforced concrete floodwall, culvert headwall, and grouted riprap protection near the old mill upstream of the tailings ponds; and
- reconstruction of the ore cart railroad bridge across Silver Creek to the Blaine tunnel.

In 1986, a hazardous substances elimination program was implemented by Anaconda to remove milling reagents, chemicals, PCB transformers, batteries, and petroleum products stored in the mill area in accordance with applicable State or EPA regulations for the disposal or recycling of hazardous substances. The chemical inventory, disposal plan, disposal records, and manifest records are maintained by the Atlantic Richfield Company in Denver.

Rico Development Corporation (RDC) acquired all Anaconda properties in 1988. RDC has not operated any mines or the mill since then. Mill and mine facilities located immediately east of the Argentine tailings may be demolished in 1996.

Information regarding the extent to which any tailings may have been released to Silver Creek during and after production operations has not been documented. However, the reclamation and slope protection work conducted by Anaconda, as described above, would have reduced the potential for such releases from prior activities. Information regarding seepage from an area immediately below tailings pond No. 3 was first documented by the Anaconda Copper Company in 1979 prior to performing reclamation work.

2.4.4 Current Land Use

Applicant shall describe the *"current land uses, zoning, and zoning restrictions of all areas contiguous to the Site"*.

The Site remains as an undeveloped inactive tailings disposal site encompassing both patented claims and San Juan National Forest land. Contiguous area land use includes unimproved access roads, inactive Rico Argentine mill site, inactive mines, and San Juan National Forest land. The area lies outside the Town of Rico and is not subject to zoning.

2.4.5 Other Requested Operations Information

- A list of all *"site specific notifications made as a result of any management activities of hazardous substances conducted at the Site"*.

  Anaconda Minerals Company is listed as a registered transporter on the RCRA Hazardous Waste Notifiers List. This listing arises from activities described above where stored chemicals and petroleum products from historic operations were removed from the mill and Blaine mine facilities in 1986. No other such notifications have been made. There are no hazardous substance management activities conducted at the Site.

- A list of *"notifications to county emergency response personnel for the storage of reportable quantities of hazardous substances"*.

  No such notifications have been made by the Applicants. No reportable quantities of hazardous substances are stored at the Site.

- A list of *"notifications made to State and/or Federal agencies reporting spills and/or accidental releases"*.

No such notifications have been made by the Applicants.

- A list of all *"known hazardous substances used at the Site, with volume estimates"*.

The following reagents, chemicals, and petroleum products were inventoried and removed from inactive mill and mine facilities associated with the Site in 1986 by Anaconda Minerals Company. There are no known records of the volume of these substances used during the historic period of mill and mine operations.

Aero 3477, aqueous promoter
Aerofloat 31, 242 and 404 (corrosive)
Aerosol OT
Antifreeze
Aquella #2
Batteries
Derusto minute solve #5
Diesel fuel conditioner and starting fluid
D 200 flotation agent
Dowfroth
Dow Z6 potassium amylxanthate
Glazing compound
Hydroxyacetic, muriatic, nitric, and sulfuric acid
Iodine arnica n.f.
Laticret (U.S. Rubber)
Motor oil
Paint
PCB and non-PCB transformers
Perchloroethylene
Quick set, 60% keton peroxide
Reagent B 140 (powder)
Sodium cyanide
Sodium isopropyl xanthate
Surflo A117 Flocculent
Tar
Titan oil
White lead paste
Zinc monohydrate and zinc sulfate monohydrate

- A list of all *"wastes generated by current activities conducted at the Site, and manifests for shipment of hazardous wastes off-site"*.

There are no current activities generating any types of wastes at the Site.

- A list of all *"permits obtained from State or Federal agencies required as a result of the activities conducted at the Site".*

  Due to historical inactivity at the Site, no State or Federal permits have been required.

2.5 Physical and Ecological Characteristics of the Site

"The applicant shall describe the physical characteristics of the Site...":

2.5.1 Climate

The climate at Rico is characterized as semi-arid with long, cold snowy winters and short, moderately warm and wet summers. Monthly and annual climatic data has been compiled by the Colorado Climate Center at Colorado State University for Rico station 57017 for the period 1893 through 1993. The annual mean temperature is 38.7°F. The warmest months are June, July and August with monthly mean temperatures of about 52, 57 and 56°F respectively. The highest monthly mean maximum and minimum temperatures occur during these same months. The coldest months are December, January and February with respective monthly mean minimum temperatures of 6.9, 5, and 7.2°F. The growing season is relatively short because the annual frost-free period for soils ranges between 40 and 75 days (NRCS, 1995).

Mean annual precipitation is about 27 inches. Most of it occurs as snowfall in the fall, winter and spring, which averages 173 inches per year. Average total monthly precipitation ranges between about 1.4 and 3 inches. Eight months average between 2 and 3 inches of precipitation and four months average between 1.4 and 2 inches. The driest month is June . The wettest months are July and August with rainfall averaging about 3 inches each month. The driest fall month is November averaging about 1.9 inches.

Due to the absence of development in the Silver Creek valley east of the townsite, the access road to the Site is not plowed free of snow cover during the winter and early spring. Snow cover and limited access prevent human contact with tailings materials during the winter and early spring.

2.5.2 Topography

The topographic characteristics of the Rico Mountains area are high relief, very steep to steep mountain sideslopes, and steep to moderate sloping tributary stream valleys, all of which abruptly descend upon the gently to moderately sloping and relatively narrow Dolores River valley and its major tributaries (Figure 1-2). Many of the steep draws and gulches formed on the hillsides on both sides of the Dolores River and its Silver Creek tributary are snow avalanche chutes. Elevations in the Rico area generally range from over 12,000 feet at the crest of surrounding mountain peaks, such as Telescope Mountain (12,201) and Dolores Mountain (12,112) to 8,800 in the center of town and 8,700± feet in the Dolores River valley at Rico.

The Argentine tailings ponds are located along the north side of the moderately steep Silver Creek valley approximately 1.25 miles above its confluence with the Dolores River (elevation 8,734 ft). Site elevations range from 9,200 to 9,325 feet (Figure 2-1). The narrow valley is flanked by the very steep hillsides of Telescope Mountain on the north and Dolores Mountain on the south, both of which are subject to snow avalanches. Allyn Gulch on the north flank of Dolores Mountain is the largest avalanche chute of interest in the Site area (Figure 2-1).

The tailings facility is situated on the historic valley floor. Since the valley is moderately steep in this area (8 to 14 percent slope), the tailings facility comprises a series of four ponds stepped down-valley against the steep, lower hillside slope forming the north side of the valley.

2.5.3 Surface Water Bodies

Silver Creek is the only perennial surface water body at the Site. The drainage area for Silver Creek above the downstream extent of the Site is approximately 5.4 square miles. The drainage area above the confluence with the Dolores River at Rico is approximately 7 square miles.

During historic Argentine mill operations, the Silver Creek channel was relocated to the south side of the valley by Rico Argentine Mining Company to make room for expansion of the tailings ponds. The greatest displacement, about 250 feet, is alongside tailings pond No. 1 (Figure 2-1).

The gradient of the relatively narrow cobble and boulder-lined channel ranges from about 14 percent along Pond 1 to 8.6 percent along and below Ponds 3 and 4 (Figure 2-1). Historic instantaneous measurements of Silver Creek flow below the tailings ponds range from 0.06 cfs (26 gpm) to 23 cfs for the period 1980-1995. Most annual high flows occur during snowmelt runoff in the spring and early summer months (April-July). Infrequent floods result from high-intensity rainfall during the summer months. The 100-year flood peak flow is estimated at about 525 cfs (D&M, 1981a). HEC-1 and HEC-2 program models were used by Dames & Moore (D&M) for flood frequency analysis and floodplain determination at the Site. Flood area maps for Silver Creek through the Site are included in Appendix B1.

As described above, Anaconda Minerals Company implemented tailings pond berm stabilization and flood protection measures along 1,100 feet of Silver Creek in 1982. This effort continues to provide effective flood protection to eliminate human safety concerns and control potential environmental risks.

2.5.4 Surface Water and Ground-Water Supplies

There is no use of surface water or groundwater as sources of water supplies at the Site or areas contiguous to the Site. The Town of Rico water supply is obtained from Silver Creek. The point of diversion is approximately 0.3 mile above the Site (Figure 2-3). Although the west Rico area is also served by this source of supply, at least three residences obtain water from Iron Gulch.

There are no known ground-water supply wells within the one-half mile radius of the Site. Colorado Division of Water Resources records were searched for all registered wells in the east end of Dolores County. Most of the wells of record are located several miles west of Rico in the Dunton area in the West Dolores River Basin (Figure 1-1).

There are three registered supply wells in the Rico area. These are located above the Rico townsite on the west side of the Dolores River valley (Figure 2-3). Two of the wells supply water for domestic use and are located about 1.4 miles northwest of the Site. The third well is no longer used by the Colorado Department of Transportation and has been abandoned and plugged. There are no known unregistered water wells within the townsite or along Silver Creek.

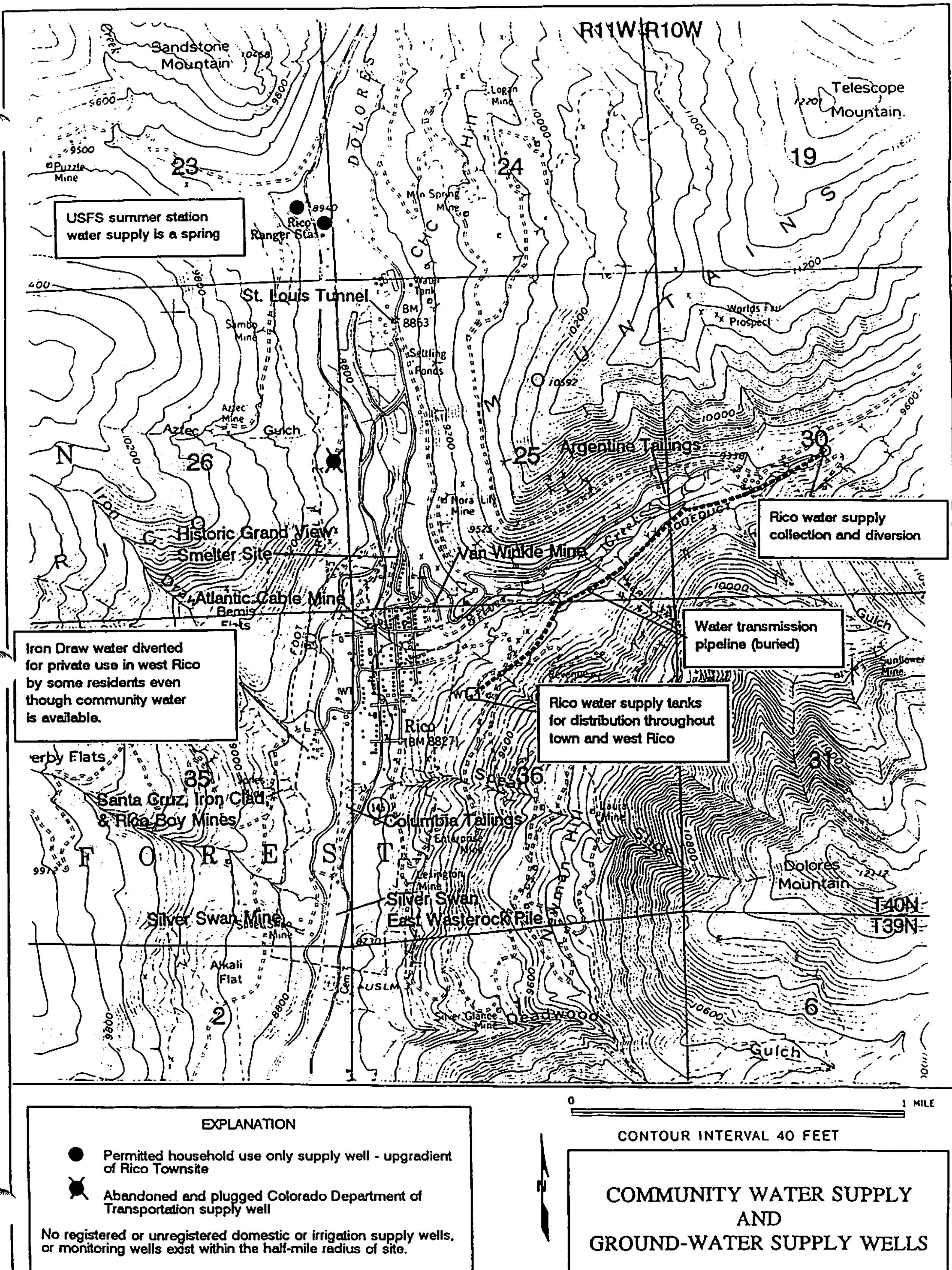
2.5.5 Vegetation Communities/Wildlife Habitats/Sensitive Species

An ecological investigation of the Rico area was conducted by Cedar Creek Associates in June 1995 to characterize major vegetation communities/wildlife habitats, identify general impacts from mining-related and other land use disturbances, and assess the potential occurrence of sensitive species. The area of investigation included the Dolores River valley between Horse Creek and the Rico Cemetery and the Silver Creek valley between the Rico water supply diversion and the Dolores River. The results of the investigation are provided in a report prepared by Cedar Creek (1995a), which has been submitted with this application under separate cover. Ecological characterization information included in the report for the Site and contiguous areas is summarized below. Figure 2-4 is a vegetation communities/wildlife habitats/land use map of the Silver Creek valley.

2.5.5.1 Vegetation Communities/Wildlife Habitat

The immediate area of disturbance associated with the Site is largely barren and devoid of vegetation, but includes small areas of disturbance exhibiting natural revegetation. The predominate vegetation communities contiguous to the Site are:

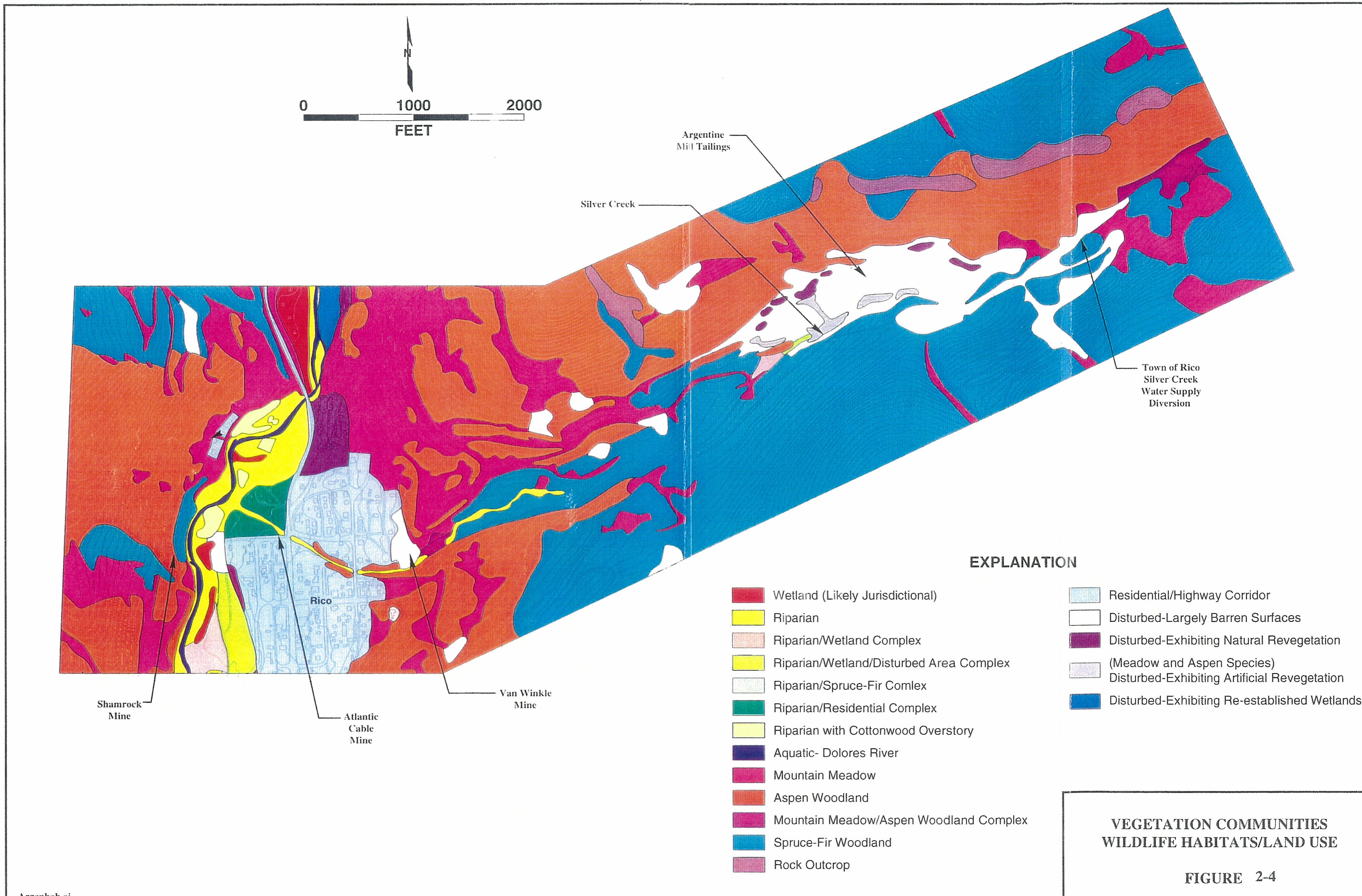
- Aspen woodland below Spruce-Fir woodland on the lower south slope of Telescope Mountain on the north side of Silver Creek;



COMMUNITY WATER SUPPLY AND GROUND-WATER SUPPLY WELLS

FIGURE 2-3

Section lines added.
Base Map: USGS Rico Quadrangle, Colorado, 7.5 Minute Series.



VEGETATION COMMUNITIES
WILDLIFE HABITATS/LAND USE

FIGURE 2-4

- Spruce-fir woodland on the lower north slope of Dolores Mountain on the south side of Silver Creek.

The aspen community is the most extensive vegetation type in the project area. It is located up to about 9,500 feet elevation and principally on westerly and southerly facing slopes. The structural diversity and condition of aspen community condition is good to very good and stable. Overall, the apparent biodiversity of this community is good with use as a wildlife habitat considered very good, especially for big game species..

The spruce-fir community is the second most extensive vegetation type in the project area. It is located primarily 8,500 feet elevation. The structural diversity and condition of the spruce-fir woodland is excellent and stable. Overall, the apparent biodiversity of this community appears to be very good with use by wildlife, especially big game species, at expected levels.

There are no wetland communities along the relatively steep and narrow portions of the Silver Creek valley bottom in the Site area. The only other vegetation community within the Site area is a small patch of invading riparian vegetation/habitat along Silver Creek below the lower tailings pond, which includes some wetlands species. Little opportunity for wetland and riparian communities exist in the area because Silver Creek is a high-gradient cobble-lined channel with little alluvial material to support development of these communities.

2.5.5.2 Aquatic Habitat

Silver Creek above the Town of Rico water supply diversion point has been stocked with cutthroat trout by the Colorado Division of Wildlife (URS, 1994). The aquatic habitat in Silver Creek above the diversion point is rated as fair to good quality (Cedar Creek, 1995a).

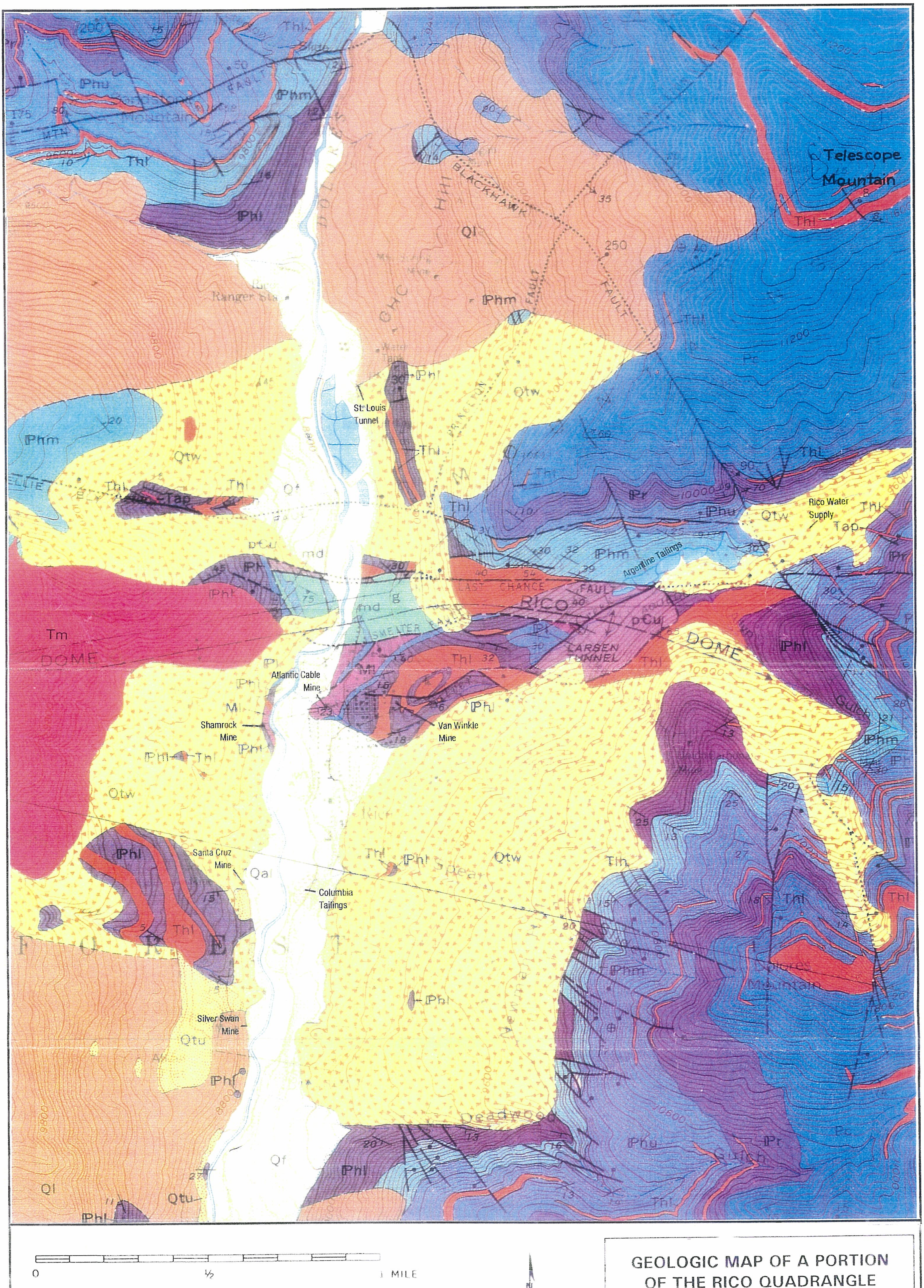
Silver Creek below the water supply diversion point to the confluence of with the Dolores River has little aquatic life because of mineralized water (URS, 1994) and the natural physical characteristics of steep terrain. This reach of Silver Creek offers reduced fish habitat potential because of the high-gradient slope, dominant cobble-boulder substrate, and very low flow (i.e., 0.06 cfs) conditions in the winter.

2.5.5.3 Threatened/Endangered Species and Critical Habitats

There are no known or suspected occurrences of listed threatened or endangered species or critical habitats in the Site area (Cedar Creek, 1995a).

2.5.6 Geology

A geologic map and detailed descriptions of the geology and ore deposits of the Rico district are presented in U.S. Geological Survey Professional Paper 723 (McKnight, 1974). A



GEOLOGIC MAP OF A PORTION OF THE RICO QUADRANGLE

FIGURE 2-5

Source: Pratt, Walden P., Edwin T. McKnight and René A. DeHon. 1969. Geologic Map of the Rico Quadrangle, Dolores and Montezuma Counties, Colorado. USGS Geologic Quadrangle Map GQ-797

GEOLOGIC MAP EXPLANATION

Geologic Age	Map Symbol	Map Unit Description
Holocene	Qal	Alluvium. Coarse stream deposits (sand, gravel and boulders) confined to the Dolores River valley flood plain. The flood plain is narrowed by encroachment of torrential fan debris at the mouths of large tributary streams.
	Qf	Torrential fans. Cone-shaped deposits of coarse alluvium formed at the mouths of such tributary streams as Horse Creek, Aztec Gulch, Silver Creek, and Deadwood Gulch.
	Qtw	Talus and slope wash. Shown principally where bedrock relations are significantly obscured. Mantle of extensive soil and coarse rock debris that has accumulated on the lower slopes of mountains at Rico. The debris has washed or fallen down from higher slopes.
	Ql	Landslide deposits. Individual blocks of rock and/or talus and slope wash deposits that have broken loose and moved en masse down mountain slopes. The extensive landslide material underlying CHC Hill is several hundred feet thick and had to be traversed by most of the mines on this hill. No such landslide deposits exist in the Rico townsite area.
	Qtu	Calcareous tufa. Patches of calcium carbonate deposited from solution of water from an unidentified spring, which cap the slopes of the landslide and wash debris in the Alkali Flat area above the Silver Swan mine on the west side of the Dolores River south of Sulphur Creek.
Lower Tertiary	Tm	Augite monzonite. Medium-gray instrusive stock west of Rico composed of andesine crystals and interstitial potassic feldspar, hornblende, or augite and biotite, minor quartz, and accessory apatite, sphene, and magnetite.
	Tlh	Hornblende lamprophyre. Dark-gray fine-grained rock composed of crystals of hornblende, quartz, agate and olivine in a groundmass of plagioclase, hornblende, agate, and minor amounts of biotite, magnetite, and alternation products. Forms dike in middle member of Hermosa Formation (PPhm) east of Laura mine on Newman Hill.
	Tap	Alaskite porphyry, conspicuous rounded crystals of quartz and, locally, potassic feldspar, in pale-gray fine-grained groundmass of potassic feldspar and subordinate quartz. Forms small dikes, 10-15 feet wide, in lower member of Hermosa Formation (PPhl) in Aztec Gulch and in upper member of Hermosa Formation (PPhu) south of Silver Creek.
	Thl	Hornblende latite porphyry. Abundant white plagioclase crystals in altered groundmass which ranges from light to dark gray, greenish gray, or brownish gray, depending on abundance of chlorite and iron oxides as alteration products. Forms sills and small laccoliths a few feet to several hundred feet thick and dikes a few feet to several tens of feet wide, throughout the Rico Mountains.
Lower Permian	Pc	**Cutler Formation**: Interbedded siltstone and arkose. Siltstone is shaly, poorly sorted, and locally micaceous and (or) arkosic; generally reddish brown; includes minor fine-grained sandstone beds and nodular limestones. Arkose is generally coarse grained, locally conglomeratic, grading into arkosic conglomerate, and commonly crossbedded; generally purplish brown or banded purplish brown and grayish pink; conglomeratic beds pinkish gray or greenish gray. Commonly bleached to gray near large intrusions or major faults. Generally crops out as rounded ledges (arkose) alternating with undercuts or slopes (siltstone). About 2,100 feet thick where measured in northeast part of quadrangle.

80

Contact, showing dip

Long dashed where approximately located; short dashed where indefinite or inferred; dotted where concealed

70 90 ?

Fault, showing dip

Long dashed where approximately located; short dashed where inferred; dotted where concealed; queried where existence is uncertain. Bar and ball on downthrown side. Vertical displacement, in feet, shown where measured or calculated. Faults in landslide area of CHC Hill projected from underground workings

Concealed inferred fault

Approximate crestline of elongated dome

?

Doubtful syncline

15			75
Strike and dip of beds	Strike of vertical beds	Horizontal beds	Strike and dip of foliation

Geologic Age	Map Symbol	Map Unit Description
Middle Pennsylvanian	Ppr	**Rico Formation**: Predominantly sandstone and arkose, in part conglomeratic, and subordinate shale and shaly limestone; sandy beds greenish gray, pinkish gray, purplish gray, or reddish brown; shaly beds commonly reddish gray or maroon, some greenish gray; limestones mostly gray or green, thin, and gnarly. Overall outcrop massive because of prevalence of thick sandstones and arkoses, in contrast to Cutler Formation. Marine fossils present in some limestones and limy sandstones. Top is thick massive sandstone. Base is a 10- to 25-foot-thick unit of dark-greenish-gray limy or sandy shale that overlies uppermost bed of Hermosa Formation. About 260-325 feet thick.
		Hermosa Formation
	PPhu	Upper member: Arkose, sandstone, some shale, some conglomerate (in upper half only), and minor thin beds of limestone, some of which are fossiliferous; uppermost bed is a 1-foot-thick bed of brownish-gray shaly or sandy limestone; brownish red or purplish gray, especially in upper part, and greenish gray, especially in lower part. About 720-830 feet thick.
	PPhm	Middle member: approximately one-half arkosic sandstone, one-third limestone, one-sixth shale. Distinctive feature of member is limestone; it is medium to dark gray, massively bedded, fine grained, fossiliferous, and mostly in units 10-40 feet thick, which are separated by greenish-gray, dark-gray, or locally brownish-red sandstones and shales. About 600-650 feet thick in Sandstone Mountain and Silver Creek, thinning to about 280 feet in Newman Hill, where massive limestones constitute about two-thirds of member.
	PPhl	Lower member: greenish-gray buff-weathering micaceous sandstone, siltstone, and arkose, locally conglomeratic, black and gray shale, and minor dark-gray limestone or dolomite; sandstone and arkose massively bedded or crossbedded, siltstone and shale thin bedded and slabby. Incompletely exposed; at least 880 feet thick.
	PPl	**Quartzite of Larsen tunnel area**: Coarse-grained quartzite containing quartz grains as much as 1-inch across in finer grained quartzose matrix; gray to brown, locally reddish gray; upper part interbedded with light-gray siltstone or shale, lower part massively bedded. Crops out near Larsen tunnel (one-half mile east of Rico along Silver Creek); narrow band through Rico is projected from underground workings and drill holes. About 80 feet thick, decreasing to 0 locally on west bank of Dolores River at Rico; basal contact not exposed.
Lower Mississippian	Ml	**Leadville Limestone**: White to gray crystallinelimestone and dolomite containing contact-metamorphic silicates and, locally, minor light-gray chert. Maximum exposed thickness 20 feet. Underlain in subsurface by Quray Limestone of Late Devonian age; total aggregate thickness of both formations 120 to 170 feet.
Precambrian	p€u	**Uncompahgre Quartzite**: Pale-gray well-indurated quartzite, commonly stained red, containing quartz grains and pebbles; bedding generally obscure; pyritized chlorite schist layers and a light-gray dolomite bed present locally. Thickness unknown, but possibly greater than 1,000 feet.
	md	**Metadiorite**: Dark-gray coarse- to fine-grained unfoliated rock containing hornblende crystals and minor plagioclase crystals, in a fine-grained matrix of feldspars, quartz, hornblende, biotite, and chlorite; occurs as lenses and pods in greenstone (g).
	g	**Greenstone**: Dark-greenish-gray fine-grained rock, generally unfoliated or poorly foliated but locally phyllitic, consisting of quartz with either actinolite, or muscovite and biotite, and with chlorite and epidote.

Source: Modified from Pratt, Walden P., Edwin T. McKnight and René A. DeHon. 1969. Geologic map of the Rico Quadrangle, Dolores and Montezuma Counties, Colorado. USGS Geologic Quadrangle Map GQ-797; *and* McKnight, Edwin T. 1974. Geology and ore deposits of the Rico District, Colorado. USGS Professional Paper 723.

geologic map of the Rico quadrangle has been published by the U.S. Geological Survey (Pratt, McKnight and DeHon, 1969). Figure 2-5 is a portion of the geologic quadrangle map with an explanation of the map units and symbols. The surficial geology of the Argentine tailings facility and contiguous areas, based on the geologic quadrangle map and field observations is depicted in Figure 2-1.

The dominant structure in the district is the faulted Rico dome (Figure 2-5). The major faults in the district are east-west trending normal faults. Many of the faults in the district in the district have been extensively mineralized, especially the Blackhawk fault. The Blackhawk fault cuts northwest to southeast diagonally across the other faults and the Silver Creek valley east of the Argentine tailings site where the mineralized fault zone has been extensively mined.

Bedrock in the Rico district comprises a wide variety of consolidated sedimentary strata ranging in age from Precambrian to Permian and Tertiary age igneous rocks that intrude sedimentary strata. In general, the older rocks are exposed in the Dolores River and Silver Creek valleys. Surficial deposits include alluvium (stream deposits), talus (rock debris) and slope wash (soil and rock debris), landslide deposits, and calcareous tufa (calcium carbonate deposits) (McKnight, 1974).

The Hermosa Formation is the most widely distributed formation in the mining district and comprises arkoses, sandtones, shales, conglomerates, and interbedded limestones. The Hermosa has been of great economic interest because most of the ore deposits in the district occur in it, particularly in the limestones (McKnight, 1974). In addition, it is of considerable environmental importance because the abundance of limestone, limy shale and limy sandstone units neutralize the acid-generating potential of sulfide ores, particularly pyrite. This natural neutralization of mineral acidity throughout the Rico district results in reduced potential concentrations of iron, cadmium, copper, lead, zinc, and other metals present in drainage waters by causing precipitation of metal ions.

The predominant ore deposits of the district consist of 1) massive sulfide replacement deposits in limestones of the Hermosa Formation, predominantly; 2) contact-metamorphic deposits of sulfides, specularite (micaceous iron oxide), and magnetite in limestones, chiefly of the Ouray and Leadville Limestones but also of the Hermosa Formation; and 3) veins on fractures and small faults in lower Hermosa sandstones and arkoses (McKnight, 1974).

Massive sulfide and contact-metamorphic deposits were the most productive of base metals with byproduct silver in the district. The most abundant sulfide mineral is pyrite (iron sulfide). Sphalerite (zinc sulfide) is second and galena (lead sulfide) is third in abundance. Least common of the base metals is chalcopyrite (copper-iron sulfide).

Bedrock units underlying the Site include the middle member of the Hermosa Formation (PPhm) and the Uncompahgre Quartzite (pCu), (Figures 2-1 and 2-5). These rocks have been brought into juxtaposition by vertical displacement on the concealed Last Chance Fault. The middle Hermosa is composed of interbedded limestone (30 percent), arkosic sandstone (45 percent) and shale (25 percent). The quartzite is pale gray and underlies the west end of the Site. Both of these bedrock units are generally hard, requiring blasting or large rippers in excavations, except where fractured and weathered.

A wedge of coarse to very coarse alluvial/colluvial valley fill (mapped as talus and slope wash by McKnight, 1994) underlies the tailings. The extent of the valley fill is interrupted immediately above and below the Site where the valley bottom is formed on exposed bedrock.

The primary potential hazards are avalanches (e.g., Allyn Gulch, Figure 2-1) and flooding along Silver Creek. There are no known landslides in the Site area. There are no mapped potentially active faults within a 30-mile radius of Rico (Kirkham and Rogers, 1981). The Rico area is located within the Colorado Plateau seismotectonic province, which is characterized by relatively low historic seismicity. A detailed description of the potential earthquake hazard evaluation associated with the engineering design of tailings pond remediation is presented in Appendix B4.

2.5.7 Aquifers

Ground water occurs in two flow systems in the Site area: shallow unconfined ground water in surficial alluvial/colluvial deposits underlying the tailings piles; and unconfined to semi-confined ground water in bedrock units.

The Silver Creek alluvial/colluvial aquifer system at the Site is a localized in extent because it is interrupted both above and below the Site where bedrock outcrops in the valley bottom. Therefore, the ground-water flow system associated with the tailings piles is limited in extent with ground-water flowing from the valley deposits into Silver Creek below Pond 3. In addition to recharge by direct infiltration of rainfall and snowmelt, the flow system may be sustained to some degree by recharge from Silver Creek water above the Site where the stream is in hydrologic contact with valley fill deposits. The quality of the seepage from below Pond 3, as described in Section 2.6.2, is indicative of the potential effect the tailings piles have on shallow ground-water quality.

Ground-water storage and flow in the bedrock system is primarily along fractures and solution channels in limestone units where such exist. The bedrock flow system has been impacted to a large extent by underground mining in the Rico district. The long crosscut from the St. Louis tunnel north of town (Figure 1-2) to the Argentine and Blaine mines on Silver Creek (Figure 2-1) has lowered the water level in the Silver Creek mine workings by about 450 feet and drains a large block of mineralized ground (McKnight, 1974).

2.5.8 Ground-Water Monitoring and Supply Wells

"If groundwater contamination exists, or if the release has a potential to impact groundwater, the applicant should provide...listing of all wells within the one-half mile radius of the Site, together with a map showing the locations of these wells;..."

There are no known ground-water monitoring or supply wells on the Site or within a one-half mile radius of the Site. As described in Section 2.5.4, there are only two supply wells in use in the Rico area and they are located in the Dolores River valley about 1.4 miles northwest of the Site (Figure 2-3).

2.5.9 Tailings Ponds Physical Characteristics

2.5.9.1 Area and Volume

The Argentine tailings facility contains approximately 557,000 tons (342,600 c.y.) of tailings, wasterock and miscellaneous debris covering a footprint of approximately 15 acres (shown as the hatched area in Figure 2-1). Additional volume and assay data are included in Appendix B5.

2.5.9.2 Surface Conditions

Most of the surface area of the ponds are devoid of vegetation where tailings are exposed, except for areas reclaimed by Anaconda Minerals in the early 1980's, (D&M, 1981b) as described below. Miscellaneous surface debris (primarily timbers and discarded machine parts associated with pond and mining operations) are scattered within and around the ponds. Old mill and mine facility structures remain at the east (upstream) end of the ponds (Figure 2-1). A relatively shallow surface slump has occurred on the southwest corner of the Pond 1 embankment. Assessment of existing tailings pond embankment stability is provided in Section 2.5.9.4 - Slope Stability.

Anaconda contracted Dames & Moore (D&M) to design and oversee Silver Creek rechannelization/flood protection and tailings stabilization work in the summer/fall of 1981 and 1982. This work was partially in response to historic erosion of the tailings embankment toes during period of high flow in Silver Creek. The construction work documented by D&M (1982) consisted of the following elements:

- Approximately 1100 feet of stability berm, flood protection including riprap, grouted riprap and reinforced concrete flood wall and a concrete cutoff wall along Silver Creek adjacent to the Argentine tailings ponds;

- Approximately 200 lineal feet of french drain consisting of 4" perforated PVC pipe day lighted to three outlets along Pond 1 adjacent to Silver Creek; and

- Placement of rock mulch cover and revegetation of slopes alongside Ponds 1, 2 and 3 adjacent to Silver Creek.

The surfaces of the ponds are graded and bermed such that they collect and hold direct precipitation and upland runoff until the water either evaporates or soaks into the ground. No evidence of overtopping of the existing embankments by collected surface waters has been observed. Erosion of the embankments presumably from direct precipitation is evident where oxidized tailings are exposed on steep slopes. However, sedimentation is not a problem because the sediments are collected and retained in Ponds 2 and 4. Overland runoff to the pond surfaces is from the southwest flank of Telescope Mountain, which has a contributing drainage basin of approximately 150 acres.

Cedar Creek & Associates (1995b and 1995c) has conducted a study characterizing the revegetation potential of tailings and borrow materials in the area and a revegetation plan for the Site. The revegetation study report and revegetation plan are provided under separate cover with this application.

2.5.9.3 Subsurface Conditions

The valley fill underlying the tailings facility comprises mixed colluvial and alluvial materials consisting of sandy, silty gravel, cobbles and boulders. Ponds 1 through 4 are generally composed of fine sand and sandy silt tailings, and fine grained silt and clayey silt slimes (D&M, 1981b; and CDM, 1979; see Appendix B3 for additional geotechnical information).

Tailings Pond 1 contains primarily clayey silt tailings slimes. The embankments along Silver Creek were apparently constructed using a shell of valley alluvium in the lower portion and colluvium borrowed from the hillsides in the upper portion. The cross-valley portion of the embankment consists of coarser grained sandy silt tailings shell.

Ponds 2 and 3 previously formed a single pond containing clayey silt slimes under sandy silt tailings. The cross-valley portion and presumably the portion of the embankment adjacent to Silver Creek are composed of a sandy silt tailings shell. Sometime after the majority of the upper sandy silt tailings were placed in the single pond, a small, approximately 10-foot high dike was constructed across the tailings pond separating the pond into Ponds 2 and 3. The dike is composed of silty, sandy gravel earthfill.

The Pond 4 embankment is composed of a silty, sandy gravel shell presumably derived from valley alluvium. Within the pond are sandy silt tailings. No tailings slimes have been encountered within the pond.

Piezometers were installed in the borings drilled during previous geotechnical investigations (D&M, 1981b). The details of the piezometer installation and the piezometric readings are presented in the Appendix B3. Data from these investigations indicated no excess pore pressures within the slimes and phreatic levels near the top of the pre-existing natural valley alluvium (bottom of the tailings), although samples collected from the borings indicated generally saturated conditions within the tailings slimes. Only one of the piezometers still exists (B-12). This piezometer is located directly below the southwest corner of Pond 3 near the seep and indicates a water-table level at ground surface.

The source of seepage below Pond 3 is predominantly ground-water flow from the valley fill materials under the ponds. The seep emerges at a point where the historic Silver Creek channel, which is buried under the tailings piles, daylights to the existing Silver Creek channel. Seepage water quality is described in Section 2.6.2.

2.5.9.4 Slope Stability

Slope stability of the embankments was investigated and documented by (D&M, 1981b). Dames & Moore concluded that the existing tailings embankments were geotechnically stable under existing (using phreatic levels observed in installed piezometers) and worst case conditions (assumed phreatic levels much higher within the embankment) using static and pseudo-static loading conditions.

ESA Consultants Inc. re-evaluated existing pond slope stability as a part of VCUP development (Appendix B4). This evaluation assessed both the reclaimed embankments on the south side of Ponds 1, 2, and 3, and the interior embankments of Ponds 1 and 3. Static loading factors of safety for deep failure surfaces generally match the Dames & Moore static loading analysis results for all slopes examined. However, significant shallow failure surfaces through the interior embankments of Ponds 1 and 3 exhibit static loading factors of safety below the generally accepted criteria of 1.5. This suggests that the interior embankment slopes are generally too steep for long-term static stability. The shallow slump feature observed on the southwest corner of Pond 1 supports this conclusion.

ESA also used the liquefaction analysis method to assess the potential for post-earthquake failure through liquefaction of tailings slimes (clayey silt). The method is based on estimates of residual shear strength (liquefaction resistance) of the tailings slimes against the design earthquake (Appendix B4). The geotechnical data compiled by Dames & Moore (Appendix B3) were used to assess the residual shear strength of tailings slimes under saturated conditions (worst case). The results indicate that the interior embankments of Ponds 1 and 3 have unacceptable post-earthquake factors of safety (<1.0) against the design earthquake when the tailings slimes are saturated. Specific measures (i.e., slope reduction) planned to achieve a factor of safety >1.0 are described in Section 4.3.2.2 Slope Stability.

2.5.10 Other Requested Physical Characteristics Information

- Description of *"(ix) surface and storm water run-off retention ponds and discharge points."*

  The tailings ponds serve as collection basins for direct precipitation and surface and storm water runoff run-off from contiguous north hillsides slopes. Embankment berms prevent collected water in contact with tailings from direct discharge to Silver Creek. Runoff from the reclaimed south slopes of the tailings ponds flows directly into Silver Creek.

- The following facilities or systems are not applicable to this application because they do not exist at the Site:

  (iv) facility process units and loading docks;
  (v) chemical and/or fuel transfer, and pumping stations;
  (vi) railroad tracks and rail car loading areas;
  (vii) spill collection sumps and/or drainage collection areas;
  (viii) wastewater treatment units
  (x) building drainage or wastewater discharge points;
  (xi) all above or below ground storage tanks;
  (xii) underground or above ground piping;
  (xiii) air emission control scrubber or refrigeration units;
  (xiv) water cooling systems or refrigeration units;
  (xv) sewer lines;
  (xvi) french drain systems;
  (xvii) water recovery sumps and building foundations;
  (xx) chemical or product storage areas;
  (xxi) leach fields; and
  (xxii) dry wells or waste disposal sumps.

2.6 Nature and Extent of Contaminants and Releases

"The applicant should provide information concerning the nature and extent of any contamination and releases of hazardous substances or petroleum products which have occurred at the Site."

2.6.1 Tailings Assay Data

Tailings sampled by Anaconda Minerals Company in 1980 were assayed to determine the economic recoverability of lead, zinc, copper, silver, and gold. No data are available regarding total concentrations of other constituents in these tailings. Assay data for the tailings, except for gold, are listed in Table 2-1 and Appendix B6. A summary of concentration data for the metals is presented below.

Lead. The average lead concentration is 8,800 parts per million (ppm) and ranges from 390 to 28,600 ppm

Zinc. The average zinc concentration is 14,000 ppm and ranges from 860 to 32,700 ppm.

Copper. The average copper concentration is 620 ppm and ranges from 140 ppm to 1,700 ppm.

Silver and Gold. The approximate grade is 1.05 oz/ton silver and 0.005 oz/ton gold.

2.6.2 Seepage Water Quality

Historic water quality data for the periods 1980–1984 and 1989-1994 from several sources (Table 2-2) for the seepage is given in Table 2-3 (PTI and ESA, 1995). In June 1995, samples were collected at the toe of the tailings pile where the seep emerges and in the wetland about 200 feet downstream from the where the seep emerges (PTI, 1995a). In September 1995, samples were collected at the toe of the tailings pile and above the confluence of the seep with Silver Creek about 450 feet downstream from where the seep emerges (PTI, 1995b). Table 2-4 gives the results of field measurements for temperature, pH, specific conductance, Eh, iron (II), dissolved oxygen, and alkalinity for the sampling event in early June 1995 and the same measurements (minus Eh) for September 1995. In June, the seep had a pH of 6.4, an alkalinity of 144 mg/l as $CaCO_3$, dissolved oxygen of 5.7 mg/l, and dissolved iron (II) of 15 mg/l at the tailings toe. The dissolved oxygen increased to 7.9 mg/l and the dissolved iron (II) decreased to 11 mg/l within 200 feet, due to exposure to atmospheric oxygen. Similar results were found for the September sampling, except that the pH was somewhat higher and iron (II) as a percentage of total iron was somewhat lower. This result suggests that a holding/settling pond would be required to allow sufficient residence time for the iron to oxidize and precipitate out as an iron hydroxide floc.

Table 2-5 gives the concentrations of total-recoverable, dissolved, and suspended (by difference) metals in water from the same two locations for the June 1995 sampling event. Except for lead, most of the metals were initially in dissolved form as the water seeps to the surface. After 200 feet of exposure to atmospheric oxygen, only 19 percent of the iron had flocculated as suspended iron hydroxide. None of the cadmium, only 5 percent of the manganese and zinc, and about 50 percent of the copper converted to suspended metal in that distance. In contrast to the other metals, 99 percent of the lead precipitated or adsorbed onto the iron hydroxide and became suspended. Similar results were found for the September 1995 sampling event (not shown).

TABLE 2-1. ARGENTINE TAILINGS ASSAY DATA[a]

Sample No.	Location No.[b]	Lead (mg/kg)	Zinc (mg/kg)	Silver (mg/kg)	Copper (mg/kg)
80-131-42	2-E			23.4	
80-131-43	2-F	10,700	13,800	41.9	
80-131-44	3-D	5,100	9,500	25.6	
80-131-45	3-E	11,100	11,300	43.8	
80-131-46	4-D	6,600	15,100	21.3	
80-131-47	4-E	5,100	6,200	37.5	
80-131-48	5-C	9,300	17,600	55.0	
80-131-49	5-D	8,300	16,100	35.0	
80-131-50	5-E	6,100	16,200	38.1	
80-131-51	6-B	14,200	18,200	45.0	
80-131-52	6-C	8,100	9,700	25.0	
80-131-53	6-D	8,500	11,100	31.3	
80-131-54	7-C	7,100	8,200	28.4	
80-131-55	7-D	8,000	10,700	36.3	
80-131-56	116	6,400	5,700	22.5	
80-131-57	8-C	13,800	13,900	33.8	
80-131-58	8-E#1	9,300	12,100	29.4	
80-131-59	8-E#2	5,500	9,600	17.5	
80-131-60	9-B	17,200	15,300	36.3	
80-131-61	11-C	5,700	11,000	24.4	
80-131-62	11-D	6,300	10,900	36.3	
80-131-63	11-E	11,100	18,200	38.1	
80-131-64	2-E	11,700	18,000	36.3	
80-131-65	11-5C	9,500	13,600	31.9	
80-131-66	11-5D-5	11,300	23,400	35.0	
80-131-67	12-C	6,300	8,600	36.3	
80-131-68	12-D	10,000	15,000	27.5	
80-131-69	12-E	23,200	32,700	55.0	
80-131-70	12-5D-5	11,000	12,700	26.3	
80-131-71	13-D	12,400	15,400	28.8	
80-131-72	13-E	11,100	18,600	28.8	
80-131-73	14-D	7,900	20,800	21.3	
80-131-74	14-E	8,600	16,900	26.3	
80-131-75	16-E	14,200	16,100	32.5	
80-131-76	17-E	16,100	18,100	31.3	
80-131-77	18-E	28,600	23,700	45.0	
80-131-78	19-E	16,300	14,400	31.9	
80-131-79	98	8,100	11,200	26.3	
80-131-80	99	10,100	26,900	25.0	
TP-01	DH 1 @ 5'	4,900	18,000	15	730
TP-25	DH 1 @ 15'	4,600	7,000	19	308
TP-26	DH 1 @ 20'	18,500	20,000 J	45	540
TP-02	DH 1 @ 25'	5,950	11,500	14	510
TP-27	DH 1 @ 30'	5,600	19,800	88	750
TP-03	DH 1 @ 35'	7,400	15,500	5.2	1,300
TP-28	DH 1 @ 40'	1,175	15,200	51	820
TP-29	DH 2 @ 5'	18,750	15,600	13	600
TP-31	DH 3 @ 20'	5,800	11,550	29	420
TP-32	DH 3 @ 25'	7,500	8,550	23	315
TP-07	DH 3 @ 30'	7,200	13,000	15	400
TP-33	DH 3 @ 30'	6,200	8,000	19	269

TABLE 2-1. (cont.)

Sample No.	Location No.[b]	Lead (mg/kg)	Zinc (mg/kg)	Silver (mg/kg)	Copper (mg/kg)
TP-34	DH 3 3 @ 35'	3,800	20,000 J	52	740
TP-35	DH 3 @ 40'	5,400	13,750	20	285
TP-08	DH 3 @ 55'	6,550	6,600	22	770
TP-36	DH 3 @ 70'	3,200	11,000	22	465
TP-10	DH 4 @ 15'	13,500	21,500	40	660
TP-39	DH 4 @ 20'	10,100	16,200	24	590
TP-40	DH 4 @ 25'	6,750	20,000 J	24	480
TP-41	DH 4 @ 35'	5,900	18,700	23	339
TP-42	DH 4 @ 45'	13,000	15,850	32	510
TP-43	DH 4 @ 55'	5,700	9,600	21	1,085
TP-44	DH 4 @ 55-57.5'	2,400	7,200	15	655
TP-45	DH 4 @ 60'	2,850	9,050	13	540
TP-46	DH 5 @ 15'	20,000 J	20,000 J	74	1,100
TP-12	DH 5 @ 20'	10,500	17,500	20	250
TP-47	DH 5 @ 35'	8,000	9,200	26	710
TP-48	DH 5 @ 40'	8,400	8,900	23	355
TP-13	DH 5 @ 60'	6,550	19,000	28	950
TP-50	DH 6 @ 2'	390	860	11	141
TP-51	DH 6 @ 4'	780	2,100	31	258
TP-14	DH 6 @ 9'	20,500	15,000	38	190
TP-52	DH 6 @ 19'	11,750	17,700	45	605
TP-53	DH 6 @ 25'	8,200	20,000 J	35	615
TP-54	DH 6 @ 29'	4,300	20,000 J	20	480
TP-15	DH 6 @ 34'	5,350	9,500	17	360
TP-55	DH 6 @ 49'	8,100	20,000 J	55	1,060
TP-56	DH 6 @ 54'	4,200	19,800	28	620
TP-57	DH 6 @ 59'	10,500	8,500	34	845
TP-58	DH 6 @ 64'	16,000	10,600	29	470
TP-16	DH 6 @ 69'	11,500	13,000	28	1,700
TP-60	DH 7 @ 15'	4,300	9,200	17	1,100
TP-19	DH 9 @ 35'	6,000	13,000	24	770
TP-64	DH 10 @ 20'	2,500	20,000 J	46	1,675
TP-65	DH 10 @ 35'	1,720	14,000	16	364
TP-66	DH 11 @ 5'	2,600	3,750	12	373
TP-11	DH 11 @ 50'	11,000	16,000	26	450
TP-69	DH 12 @ 10'	1,475	4,200	4.8	182
Minimum		390	860	4.8	141
Maximum		28,600	32,700	88	1,700
Arithmetic mean		8,805	14,087	30	619
UCLM		10,897	16,277	33	729

[a] See Appendix B6 for tailings volume and laboratory data sheets.

[b] Corresponds to surface pit or borehole number.

J =Estimated value (greater than)

UCLM = Upper 95 percent confidence limit of the arithmetic mean (calculated assuming a lognormal distribution)

TABLE 2-2

Summary of Historical
Surface Water Quality Data Sources for Rico Area

Description	Data Available	Frequency	Hardness?	Source of Data[a]
Surface Water				
1980 and 1981 surface water data	Dissolved, Total	Monthly (OCt 80-Oct 81)	Yes	CORE for Gibbs & Hill (1981)
1982 Surface Water Data	Dissolved, Total, Total Recoverable	Three times	Yes	CORE for SRK (1983)
1983 Surface Water Data	Dissolved, Total, Total Recoverable	Monthly	Yes	CORE for SRK (1984)
1984 Surface Water Data	Dissolved, Total, Total Recoverable	Quarterly	No	CORE for SRK (1984)
1984 Surface Water Data	Dissolved, Total	Once	No	FIT Team (E&E, 1985)
1989-1993 Surface Water Data	Dissolved, Total	Sporadic (1-10 times during 4 years)	No	USBR (1995)

[a] All available historic surface water and ground-water data is provided in "Summary of Surface Water and Ground-Water Data for Rico, Colorado" (PTI, 1995).

TABLE 2-3

Argentine Tailings Seep
Water Quality Data Summary
(Sampling Stations S-02A, SW-04, Argentine Tails A, S-02, RA-SW-04, and SVS-12)

Date Sampled	Consultant	Flow (gpm)	pH (s.u.)	Hardness (as CaCO3) (mg/L)	Alkalinity (as CaCO3) (mg/L)	Ag-D (ug/L)	Ag-T (ug/L)	As-T (ug/L)	Cd-D (ug/L)	Cd-T (ug/L)	Cu-D (ug/L)	Cu-T (ug/L)	Fe-D (ug/L)	Fe-T (ug/L)	Hg-T (ug/L)	Pb-D (ug/L)	Pb-T (ug/L)	Mn-D (ug/L)	Mn-T (ug/L)	Zn-D (ug/L)	Zn-T (ug/L)
30-Oct-80	Gibbs & Hill	18	7.9	741					10 U	10 U	10 U	10 U	140	150	0.3 U	50 U	50 U	5010		2800	2800
19-Nov-80	Gibbs & Hill	18	7.5	635					10 U	10	10 U	20	50 U	2920	0.3 U	50 U	50 U	5900		3600	4300
20-Apr-81	Gibbs & Hill	4.5	7.5	681			0.8		2.3	2.3	2	13	50 U	390	0.09	1 U	1 U	180		900	1100
14-May-81	Gibbs & Hill	67	7.2	1096			0.1 U		23	37	5	13	50 U	340	0.05 U	1 U	1 U	4950		4900	4900
21-May-81	Dames & Moore			1054	165 L			10 U	20	20	10 U	10 U	100	520	0.3 U	50 U	10 U	5300	5900	4600	4600
4-Jun-81	Gibbs & Hill	67	7.0	863			0.1 U		10	11	3	4	50 U	1550	0.05 U	1 U	1 U	5400		4700	5000
24-Jun-81	Gibbs & Hill	36	7.2	867			0.1 U		5.4	5.4	1 U	1 U	50 U	820	0.05 U	1 U	1 U	5800		3100	3800
14-Jul-81	Gibbs & Hill	40	7.4	739			0.1 U		8.7	8.7	1 U	1 U	50 U	1230	0.09	1 U	1 U	6300		3700	4400
13-Aug-81	Gibbs & Hill	45	7.2	789			0.4		13	13	1 U	25	680	4800	0.05 U	9	25	7500		4600	4800
8-Sep-81	Gibbs & Hill	45	7.8	647			0.1 U		5.4	6.5	1 U	3	510	1420	0.05 U	2	2	6200		3300	3800
5-Oct-81	Gibbs & Hill	45	7.8	697			0.1 U		6	6	1 U	1 U	50 U	1600	0.05 U	1 U	6	6500		3500	3800
13-Apr-82	SRK	45	7.7	984	162 F	0.05 U	0.05 U		10	10.5	1 U	1 U	130	1980	0.01 U	1 U	1 U	7000	7400	5700	6200
16-Jun-82	SRK	44	7.9	1054	168 F	0.11	0.11		10	18	5	14	250	2840	0.01 U	1 U	6	10200	10200	6300	6700
13-Oct-82	SRK	30	7.2	993	121 F	0.05 U	0.05 U		8.5	11.1	3	3	3050	5100	0.01 U	1 U	4	10600	11700	9000	9800
14-Nov-84	EPA/FIT		6.3			5 U	5 U	3.6	5 U	7.5	5 U	15	16500	22900	0.1 U	5 U	130	11200	12500	10800	11800
1-Jun-95	PTI/ESA	40	6.4	1320	144 F	0.07		2	5	6	10 U	20	17600	20600	0.5 U	9.2	99.7	12400	12400	15100	15000
26-Sep-95	PTI/ESA	44	7.0	733		0.02 U	0.02 U		2.4	2.1 U	10 U	10 U	17500	18700		1.7	6.5	8600	8490	11400	12000
Statistical Calculations - Undetects set to zero																					
Mean		39		868	152	0.03	0.1	1.87	7.6	10.2	1.1	7.6	3321	5168	0.011	1.3	16.4	7002	9799	5765	6165
Standard Deviation		17		196	20	0.05	0.24	1.8	6.6	8.8	1.8	8.7	6666	7598	0.031	3.0	37.9	2926	2598	3702	3750

D = Dissolved
T = Total recoverable
U = Not detected; value represents detection limit

CaCO3 = Calcium Carbonate
Ag = Silver
As = Arsenic

Cd = Cadmium
Cu = Copper
Fe = Iron

Hg = Mercury
Pb = Lead
Mn = Manganese

Zn = Zinc
F = Field
L = Lab

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Table 2-4
Argentine Seep Surface Water Field Analysis

	Seep Drainge at Source		**Seep Drainage Downstream from Source**	
			200 Feet Downstream	**450 Feet Downstream**[1]
Sample Date	June 1, 1995	September 26, 1995	June 1, 1995	September 26, 1995
Discharge (gpm)	40	44	40	NM
Temperature (C)	7	8.2	8	6.6
pH	6.4	6.98	7.0	7.24
Conductivity (mS/cm)	0.95	1.33	1.89	1.32
Eh (mv)	262	NM	222	NM
Iron (II) (mg/l)	15.0	11.9	11.0	8.9
Iron (total dissolved) (mg/l)	19.0	19.7	20.0	16.1
Dissolved oxygen (mg/l)	5.7	9.2	7.9	6.4
Alkalinity (as $CaCO_3$)(mg/l)	144	NM	NM	100

NM = not measured.

[1] Immediately above confluenve with Silver Creek.

TABLE 2-5

Comparison of pH, Sulfate, and Metal Concentrations in Argentine Tailings Drainage at the Seepage Point and after traveling 200 feet Downstream through Wetlands (in μg/l, except sulfate in mg/l and pH in s.u.) for Spring 1995

	pH	Sulfate	Fe	Cd	Cu	Pb	Mn	Zn
Seepage from Toe of Tailings								
Total-Recoverable			20,600	6	20	99.7	12,400	15,000
Dissolved	6.4	1,100	17,600	5	10	9.21	12,400	15,100
Suspended			3,000	1	10	90.5	0	0
Suspended as % of Total Recoverable			15	17	50	91	0	0
Drainage 200 feet Downstream								
Total-Recoverable			19,200	5	20	39.2	13,000	14,700
Dissolved	7.0	1,100	15,500	6	10	0.43	12,300	14,000
Suspended			3,700	0	10	38.8	700	700
Suspended as % of Total Recoverable			19	0	50	99	5	5
% Decrease in Dissolved*		0	12	0	0	95	1	7

* Decrease in dissolved metal concentrations as % of dissolved metals in Argentine tailings seepage.

A comparison of data collected from 1980 through 1982 and samples collected after 1982 (Table 2-3) indicates a significant change in iron, manganese and zinc concentrations in sampling events after 1982. In June 1995, the total iron concentration of the seepage was 20.6 mg/l; the total manganese was 12.4 mg/l; and the total zinc was 15.0 mg/l. In September 1995, total iron was 18.7 mg/l; total manganese 8.49 mg/l; and total zinc was 12.0 mg/l. The apparent increase in concentrations after 1982 does not indicate a trend, but appears to represent a one time shift, as samples collected in 1984 and those collected 11 years later (June and September 1995) show reasonably consistent metals concentrations.

2.6.3 Silver Creek Water Quality

2.6.3.1 Historic Water Quality Data Sources

Historic sampling locations and sample station designations are identified on Figure 2-6. The entire historic Silver Creek water quality database is presented in the report entitled, "Summary of surface water and groundwater data for Rico, Colorado" (PTI, 1995a). Silver Creek was sampled at nine locations in September 1995 (PTI, 1995b). A summary of the historic Silver Creek surface water quality data for sampling stations on Silver Creek above the Blackhawk fault (SC-4), below the Blackhawk fault and above the Argentine tailings (SC-3), and below the Argentine tailings (SC-2) are provided on Tables 2-6, 2-7, and 2-8, respectively.

2.6.3.2 Water Quality Characteristics

The water quality of Silver Creek in the vicinity of the Site is affected by natural mineralization of rock outcrops in the Blackhawk fault area, by wasterock above the fault and the Site, and by the Argentine tailings. An evaluation of measured dissolved metals concentrations indicates that mean dissolved cadmium, iron, manganese, and zinc concentrations increase in Silver Creek in the vicinity of the Blackhawk fault and wasterock pile above the Site (Tables 2-6 through 2-8). For example, mean dissolved zinc concentrations above and below the Blackhawk fault are 28 and 893 μg/L, respectively, and 466 μg/L in Silver Creek below the Argentine tailings. The September 1995 sampling event yielded a value of 1240 μg/l for dissolved zinc in Silver Creek below the Argentine tailings. This value is high compared with previous determinations since 1982, considering that the zinc concentration in the tailings seep was not anomalously high. Future sampling events should help clarify whether this value is anomalous. Mean dissolved concentrations of iron, manganese, zinc, and cadmium, as a function of sampling station, are provided on Figures 2-7 through 2-10, respectively. A comparison of Silver Creek water quality to numeric standards is provided in Section 3.1.

Approximately 0.5 miles downstream from the Blackhawk fault, the Argentine tailings seep converges with Silver Creek. The analytical data indicate that the Argentine tailings seepage contributes average dissolved concentrations of cadmium, iron, manganese, and zinc of 7.6, 3320, 7000, and 5760 μg/L, respectively to Silver Creek (Table 2-3). Mean alkalinity in the Argentine

TABLE 2-6

Silver Creek Above Blackhawk Fault
Surface Water Quality Data Summary
(Combined Sampling Station SC-4*)

Date Sampled	Consultant	Flow	pH	Hardness (as CaCO3)	Alkalinity (as CaCO3)	Ag-D	Ag-T	As-T	Cd-D	Cd-T	Cu-D	Cu-T	Fe-D	Fe-T	Hg-T	Pb-D	Pb-T	Mn-D	Mn-T	Zn-D	Zn-T
		(gpm)	(s.u.)	(mg/L)	(mg/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)
13-Apr-82	SRK	1212	8.3	108	109 F	0.1 U	0.05 U		0.8	8	4	4	50 U	200	0.01 U	4	4	10 U	10 U	80	80
16-Jun-82	SRK	4354	8.8	60	66 F	0.1 U	0.05 U		1.1	1.1	7	7	50 U	130	0.09	2	6	10 U	10 U	10 U	40
13-Oct-82	SRK	790	7.4	93	88 F	0.1 U	0.05 U		0.2	0.2	1 U	1 U	50 U	50	0.01 U	8	8	10 U	10 U	40	70
12-Jun-83	SRK		8.0			0.1 U	0.1 U		1.3	1.3	3	4	50	100	0.05 U	3	3	10 U	10 U	70	80
22-Sep-83	SRK		8.0			0.1 U	0.1 U		0.4 U	0.4 U	10	28	50 U	90	0.05 U	1 U	1	10	20	10 U	110
15-Dec-83	SRK					0.1 U	0.1 U		0.4	0.4 U	3	1 U	50 U	50 U	0.05 U	2	2	10 U	10 U	10	10
12-Sep-84	SRK					0.1 U	0.1 U		0.4 U	0.6	3	4	50	70	0.05 U	1 U	1 U	100 U	10 U	40	30
14-Nov-84	EPA/FIT		6.6			5 U	5 U	10 U	5 U	5 U	5 U	6.8	12	44	0.1 U	2 U	2 U	4 U	5.7	14	17
25-Sep-95	PTI/ESA	350	7.6	98	97 L	10 U	0.02 U		3 U	0.02 U	10 U	10 U	28	20 U		0.04 U	0.4	5 U	5 U	10 U	10 U
Statistical Calculations - Undetects set to zero																					
Mean		1677		90	90	0	0	0	0.4	1.2	2.3	6.0	16	76	0.01	2.1	2.7	1	3	28	49
Standard Deviation		1819		21	18	0	0		0.5	2.6	2.9	8.7	22	64	0.03	2.7	2.8	3	7	31	38
Number of Samples		4		4	4	9	9	1	6 **	9	6 **	9	9	9	8	9	9	9	9	9	9

D = Dissolved
T = Total recoverable
U = Not detected; value represents detection limit

CaCO3 = Calcium Carbonate
Ag = Silver
As = Arsenic

Cd = Cadmium
Cu = Copper
Fe = Iron

Hg = Mercury
Pb = Lead
Mn = Manganese

Zn = Zinc
F = Field
L = Lab

* Sampling stations combined are SW-01, S-0, and SVS-1.
** Dissolved Cd and Cu results from SRK (1983) were not used to calculate the mean because of contamination during filtration.

TABLE 2-7

Silver Creek Below Blackhawk Fault/Above Argentine Tailings
Surface Water Quality Data Summary
(Combined Sampling Station SC-3)

Date Sampled	Consultant	Flow	pH	Hardness (as CaCO3)	Alkalinity (as CaCO3)	Ag-D	Ag-T	As-T	Cd-D	Cd-T	Cu-D	Cu-T	Fe-D	Fe-T	Hg-T	Pb-D	Pb-T	Mn-D	Mn-T	Zn-D	Zn-T
		(gpm)	(s.u.)	(mg/L)	(mg/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)
30-Oct-80	Gibbs & Hill	27	7.3	192					10 U	26.9	10 U	10 U	50 U	460	0.3 U	50 U	50 U	160		2000	2100
19-Nov-80	Gibbs & Hill		6.8	297					20	30	10 U	20	170	2750	0.3 U	50 U	50 U	950		4600	4600
20-Apr-81	Gibbs & Hill	673	7.7	114			1.5		6.1	6.4	1 U	14	50 U	1910	0.05 U	1 U	7	230		1100	1500
14-May-81	Gibbs & Hill	2918	7.4	74			1		0.8	0.8	4	4	50 U	50 U	0.05 U	1 U	5	30		140	230
4-Jun-81	Gibbs & Hill	####	7.4	49			0.1 U		0.2	0.2	5	5	50 U	200	0.05 U	1 U	1 U	10 U		50	60
24-Jun-81	Gibbs & Hill	3187	7.9	62			0.1 U		0.5	0.5	1 U	1 U	50 U	580	0.05 U	1 U	10	10 U		90	150
14-Jul-81	Gibbs & Hill	6374	8.0	72			1		2.2	3.2	5	15	50 U	150	0.05 U	3	3	20		170	200
13-Aug-81	Gibbs & Hill	763	7.2	106		10 U	0.1 U		7.1	8.1	1 U	1 U	110	440	0.05 U	1 U	20	50		660	700
8-Sep-81	Gibbs & Hill	1212	8.1	103			0.1 U		3.3	3.6	1	18	180	450	0.06	7	7	60		360	3200
5-Oct-81	Gibbs & Hill	1706	7.5	102			0.1 U		3.8	4.2	2	2	240	640	0.05 U	5	5	80		550	750
13-Apr-82	SRK	3142	7.0	141	75 F	0.05 U	0.05 U		16.7	17	1	1	50 U	14500	0.01 U	1 U	1 U	930	990	3300	3900
16-Jun-82	SRK	6329	8.0	60	52 F	0.05 U	0.05 U		2.8	2.8	5	6	50 U	140	0.12	1	13	10 U	10 U	30	80
13-Oct-82	SRK	642	8.0	105	91 F	0.05 U	0.05 U		3.4	3.4	1 U	13	170	290	0.01 U	11	11	40	40	530	600
21-May-83	SRK		8.0			0.1 U	0.1 U		0.4 U	1	6	7			0.05 U	1	3			10 U	10 U
14-Nov-84	EPA/FIT		6.9			5 U	5 U	10 U	5 U	5.6	5 U	5.9	49	126	0.1 U	2 U	5 U	38	37	283	329
26-Sep-95	PTI/ESA	840	7.7		93 L	0.02 U			2.2		10 U		95			3.9		20		423	
Statistical Calculations - Undetects set to zero																					
Mean		2951		114	78	0	0.27	0	4.6	7.6	1.5	7.4	68	1617	0.01	2.0	5.6	174	267	893	1227
Standard Deviation		3080		67	19	0	0.53		6.0	9.5	2.1	6.9	86	3787	0.03	3.2	5.9	317	483	1316	1520
Number of Samples		13		13	4	7	13	1	15.0 **	15.0	15.0 **	15.0	15	14	15	16.0	15.0	15	4	16	15

D = Dissolved
T = Total recoverable
U = Not detected; value represents detection limit
CaCO3 = Calcium Carbonate
Ag = Silver
As = Arsenic
Cd = Cadmium
Cu = Copper
Fe = Iron
Hg = Mercury
Pb = Lead
Mn = Manganese
Zn = Zinc
F = Field
L = Lab

*Sampling stations combined are S-01, SW-02, and SVS-5.

** Dissolved Cd and Cu results from SRK (1983) were not used to calculate the mean because of contamination during filtration.

TABLE 2-8

Silver Creek Below Argentine Tailings
Surface Water Quality Data Summary
(Combined Sampling Station SC-2*)

Date Sampled	Consultant	Flow	pH	Hardness (as CaCO3)	Alkalinity (as CaCO3)	Ag-D	Ag-T	As-T	Cd-D	Cd-T	Cu-D	Cu-T	Fe-D	Fe-T	Hg-T	Pb-D	Pb-T	Mn-D	Mn-T	Zn-D	Zn-T
		(gpm)	(s.u.)	(mg/L)	(mg/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)
12-Jun-83	SRK	5387	7.9			0.1 U	0.1 U		2	2.5	16	24	160	340	0.05	2	5	90	140	350	350
26-Jul-83	SRK	23791	7.9			0.1 U	0.1 U		8.5	1.8	4	10			0.05 U	1 U	250			150	250
22-Sep-83	SRK	898	7.7			0.1 U	0.1		1.4	1.8	9	11	50 U	370	0.05 U	1 U	1	440	490	500	690
15-Dec-83	SRK					0.1 U	0.1 U		1.1	1.3	2	1 U	50 U	60	0.05 U	1 U	1	110	110	400	430
12-Sep-84	SRK					0.1 U	0.1 U		1.1	1.8	4	6	100	770	0.05 U	1 U	1	480	530	420	710
14-Nov-84	EPA/FIT		7.3			5 U	5 U	10 U	5 U	5 U	5 U	6.2	10 U	353	0.1 U	2 U	5 U	454	474	561	65.1
14-Jul-92	USBR	2630	7.0				0.1 U	5	0.3 U	0.3 U	5 U	5 U	50 U	50 U	0.2 U		1 U	50 U	50 U	10 U	10 U
15-Sep-92	USBR	898	7.5			10 U	10 U	10 U	5 U	5 U	25 U	25 U	330	390	0.03 U	7.6	3 U	280	320	570	610
26-Sep-95	PTI/ESA	677	7.3	195	94 L	0.02 U	0.02 U		2.0	2.1 U	10 U	10 U	613	1050		0.42	3	588	597	1240	1340
Statistical Calculations - Undetects set to zero																					
Mean		5713		195	94	0	0.01	1.67	0.6	1.0	0.8	6.4	150	417	0.006	1.3	29.0	305	333	466	494
Standard Deviation		9035				0	0.03	2.89	0.9	1.0	1.8	8.0	220	346	0.018	2.7	82.9	217	224	346	407
Number of Samples		6		1	1	8	9	3	5 **	9	5 **	9	8	8	8	8	9	8	8	9	9

D = Dissolved
T = Total recoverable
U = Not detected; value represents detection limit

CaCO3 = Calcium Carbonate
Ag = Silver
As = Arsenic

Cd = Cadmium
Cu = Copper
Fe = Iron

Hg = Mercury
Pb = Lead
Mn = Manganese

Zn = Zinc
F = Field
L = Lab

*Sampling stations combined are DR43T, S-02B, SW-03, S-2B, S2B, and SVS-8.

** Dissolved Cd and Cu results from SRK (1983) were not used to calculate the mean because of contamination during filtration.

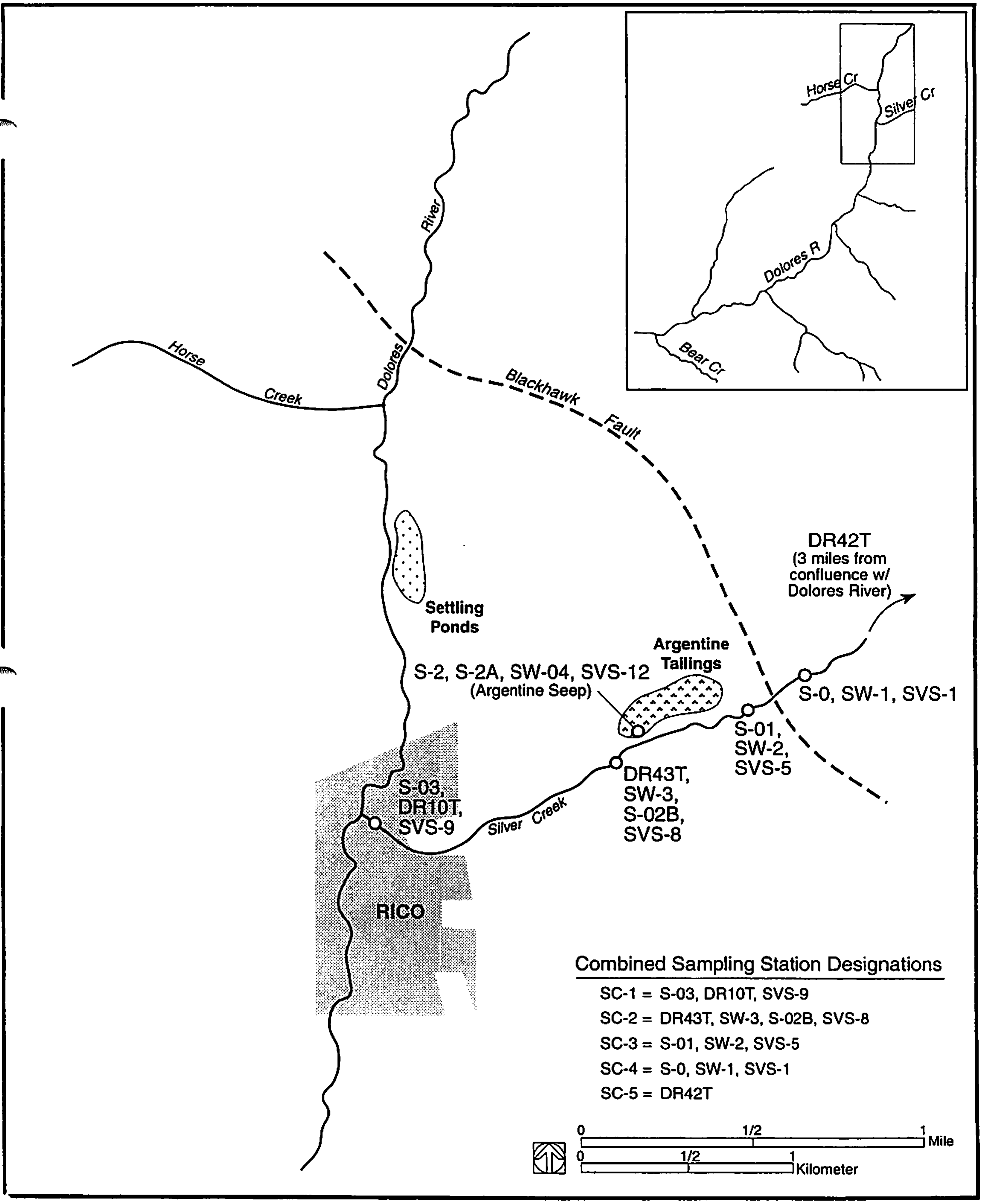

Figure 2-6. Sampling station locations on Silver Creek.

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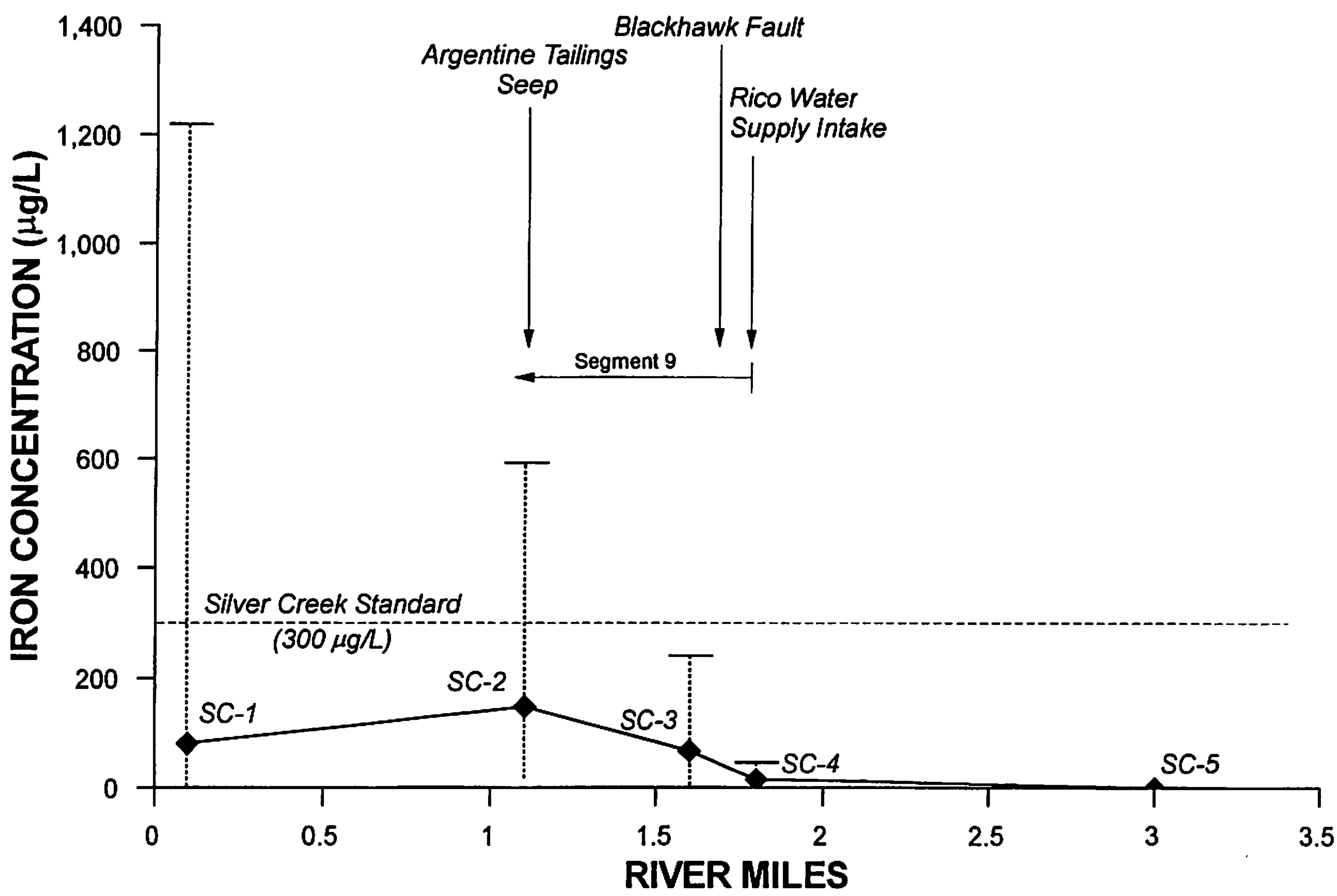

Figure 2-7. Iron concentrations (mean [◆], maximum, and minimum) in Silver Creek (1980-1995).
[River miles are measured upstream from confluence with the Dolores River (mile 0)].

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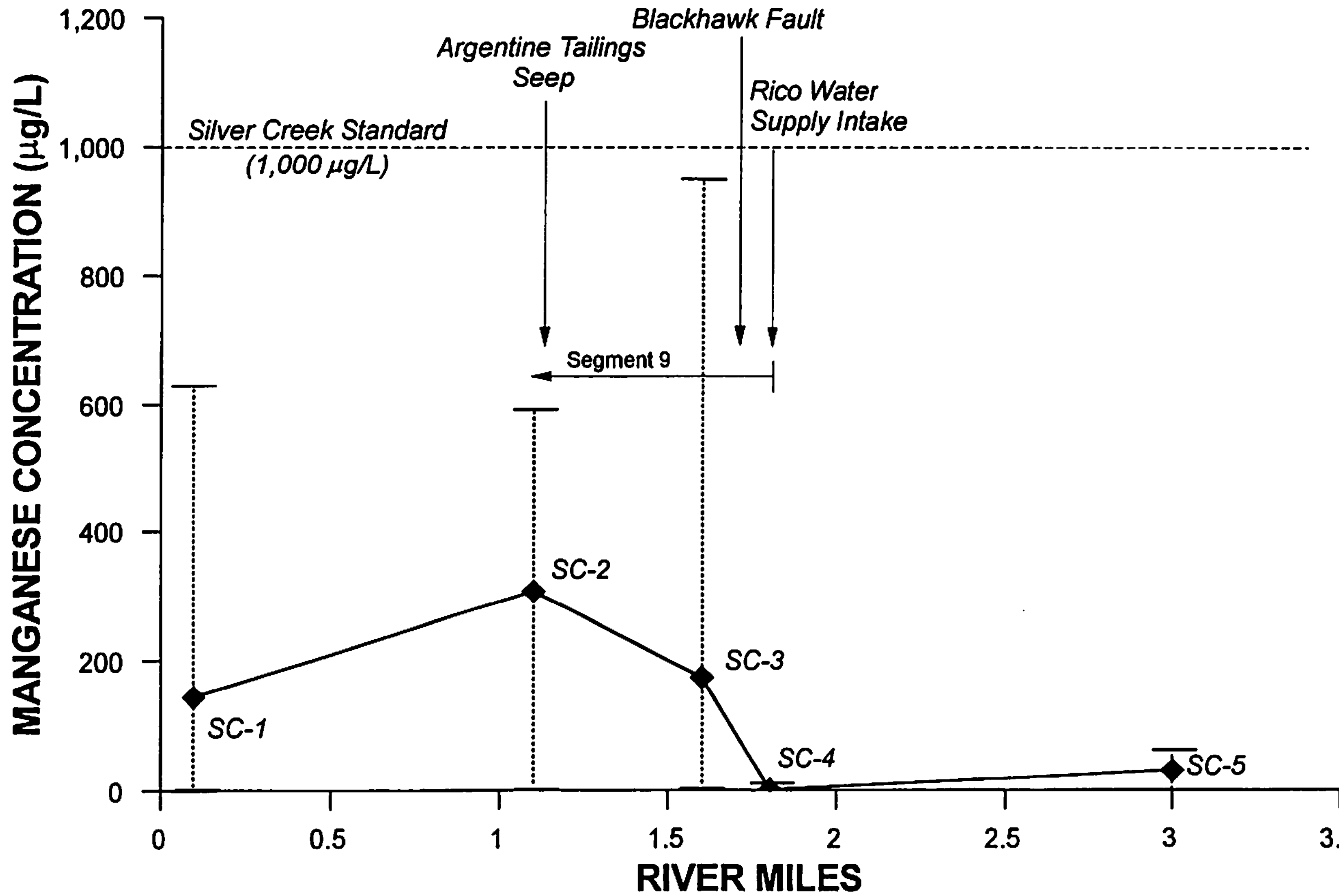

Figure 2-8. Manganese concentrations (mean [◆], maximum, and minimum) in Silver Creek (1980-1995).
[River miles are measured upstream from confluence with the Dolores River (mile 0)].

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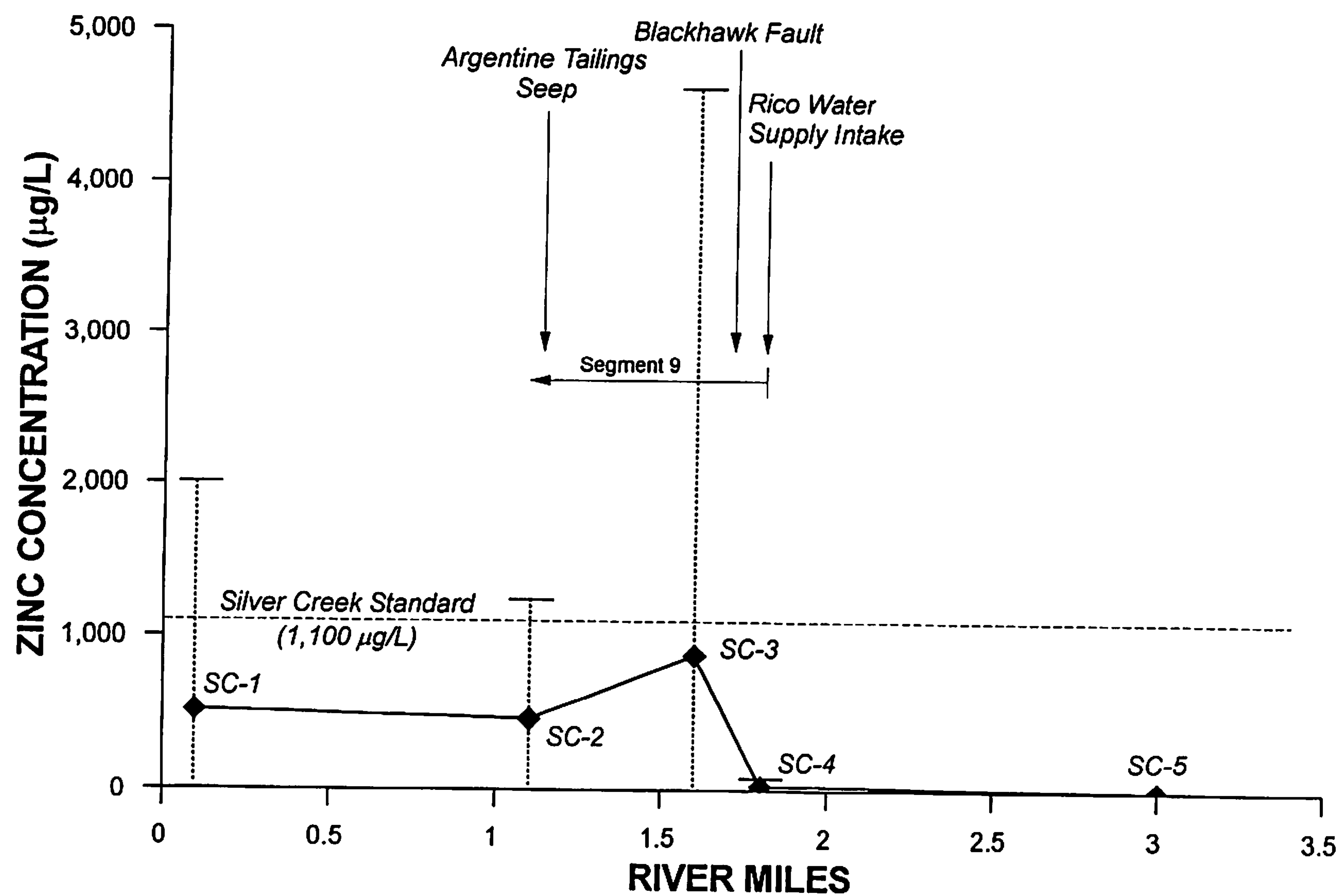

Figure 2-9. Zinc concentrations (mean [◆], maximum, and minimum) in Silver Creek (1980-1995). [River miles are measured upstream from confluence with the Dolores River (mile 0)].

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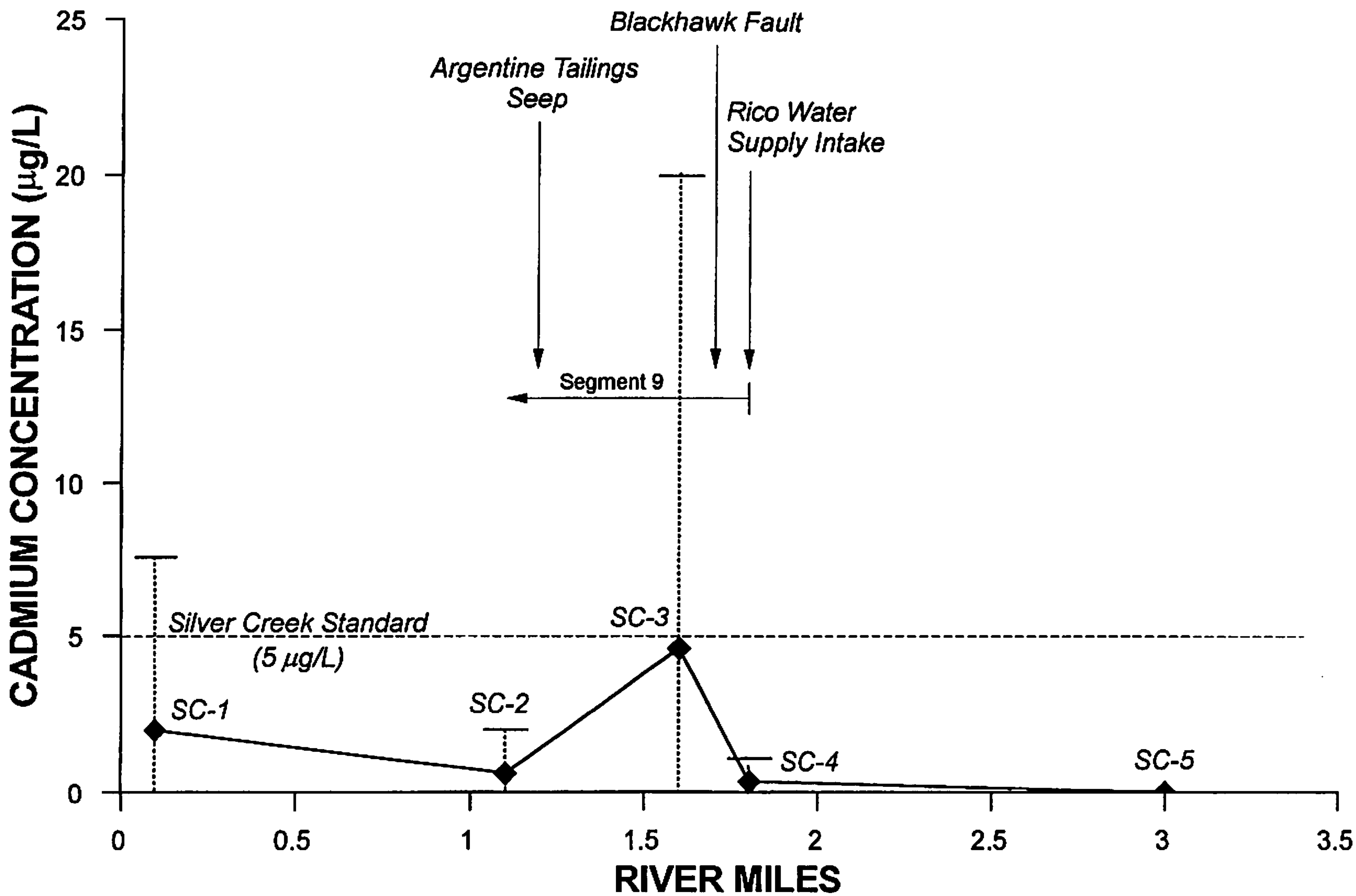

Figure 2-10. Cadmium concentrations (mean [◆], maximum, and minimum) in Silver Creek (1980-1995). [River miles are measured upstream from confluence with the Dolores River (mile 0)].

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tailings seep was 152 mg/L (range of 121 to 168 mg/L as $CaCO_3$), with a pH range of 6.3 to 7.9. These data indicate that the seepage water has a high buffering capacity, is of neutral pH, and is not a classic acid rock drainage. Silver Creek alkalinity ranges from 52 to 109 mg/L as $CaCO_3$. The high buffering capacity of seepage water and Silver Creek is a result of the widespread existence of carbonate minerals in the Rico mining district, as described in Section 2.5.6.

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3.0 APPLICABLE STANDARDS/RISK DETERMINATION

"The applicant should provide a description of applicable promulgated state standards establishing acceptable concentrations of constituents (present at the site) in soils, surface water, or ground water."

"The applicant should provide a description of the human and environmental exposure to contamination at the site based on the property's current use and any future use proposed by the property owner."

3.1 Applicable Standards

3.1.1 Surface Water

As described in Section 2.6.2, the seepage emanating from below tailings Pond 3 flows into Silver Creek. Therefore, the current State of Colorado water quality standards for Dolores River Basin stream segment 9 apply (CDH, 1995). Segment 9 is described as follows:

"Mainstream of Silver Creek from a point immediately below the Town of Rico's water supply diversion to the confluence with the Dolores River".

Segment 9 use classifications are defined as follows:

"Aquatic Life - Class 2" - secondary aquatic habitat.

"Recreation - Class 2" - stream segment where primary contact recreation does not exist and cannot be reasonably expected to exist.

"Agriculture" - suitable for agricultural use, although such use does not exist.

There are no promulgated use classifications or stream standards establishing acceptable concentrations of constituents in Silver Creek upstream of segment 9.

The calculated table value standards (TVSs) and fixed standards for constituents in Silver Creek (segment 9) below the Town of Rico's water supply diversion (Figure 2-3) are listed in Table 3-1. The calculated values are based on the average mean hardness value of 240 mg/l recommended by CDH (Anderson, 1995).

TABLE 3-1

Current Water Quality Standards[a]

All metals dissolved, unless otherwise noted

Analyte	Standard (μg/l)	Equation or source
Silver Creek (Segment 9): Hardness = 240 mg/l[b]		
Arsenic (total recoverable), chronic & acute	100	Agriculturally-based standard
Cadmium, acute	26.5	EXP {Ln(hardness) x 1.128 - 2.905}
Cadmium, chronic	5.0	Fixed in stream classification table
Chromium III (total recoverable), chronic[c]	100	Fixed in stream classification table
Chromium VI, acute	16	Fixed in TVS
Chromium VI, chronic	11	Fixed in TVS
Copper, acute	40.5	EXP {Ln(hardness) x 0.9422 - 1.4634}
Copper, chronic	25.0	EXP {Ln(hardness) x 0.8545 - 1.465}
Iron, dissolved	300	Agriculturally-based standard
Iron, total	1,000	Agriculturally-based standard
Lead, acute	394	EXP {Ln(hardness) x 1.6148 - 2.8736}
Lead, chronic	13.45	EXP {Ln(hardness) x 1.417 - 5.167}
Manganese, chronic[d]	1,000	Fixed in stream classification table
Mercury (total), chronic[d]	0.01	Fixed in stream classification table
Nickel, acute	1,800	EXP {Ln(hardness) x 0.76 + 3.33}
Nickel, chronic	186	EXP {Ln(hardness) x 0.76 + 1.06}
Selenium, acute	135	Fixed in TVS
Selenium, chronic	17	Fixed in TVS
Silver, acute	9.18	EXP {Ln(hardness) x 1.72 - 7.21}
Silver, chronic	1.44	EXP {Ln(hardness) x 1.72 - 9.06}
Zinc, chronic[c]	1,100	Fixed in stream classification table

[a] All equations and standards are from the "Classifications and numeric standards for San Juan River and Dolores River Basins, 3.4.0", effective May 30, 1995, Colorado Department of Health, Water Quality Control Commission.

[b] Hardness values provided by Dennis Anderson at the Colorado Department of Health, 6/5/95.

[c] Only chronic standards are listed for this stream segment, although formulas are available for acute standards.

[d] Fixed value given for chronic standard; no information given for acute standard.

Notes:

EXP = e raised to the indicated power
Ln = Natural logarithm
TVS = Table Value Standards

3.1.2 Mill Tailings

There are no promulgated state standards establishing acceptable concentrations of constituents in soils, tailings or mine waste.

3.2 Comparison of Silver Creek Water Quality to Stream Standards

3.2.1 Approach to Use of Historic Data

As described in Section 2.6.4, aggregate water quality data for Silver Creek are available for the periods 1980-1984, 1989-1993, and September 1995. Historic water quality sampling stations for Silver Creek are identified in Figure 3-1. The sampling station designation of "SC" has been assigned to aggregate historic sampling stations given different station designations by different consulting firms. River miles are measured upstream from the confluence of Silver Creek with the Dolores River (mile 0). Station SC-4 includes historic sampling locations immediately below the Town of Rico's water supply diversion, the beginning point for stream segment 9, as well as locations immediately above the diversion and thus outside of segment 9. For the purpose of analyzing Silver Creek water quality, data were evaluated separately for stations SC-4 and SC-5, called the background segment, and for segment 9 excluding SC-4 (i.e., stations SC-1, SC-2 and SC-3). Since stream standards have not been established for Silver Creek above segment 9, the data for the background segment were compared against segment 9 stream standards.

The use of historic data for comparison against acute and chronic standards is dependent on the type of sample collected. Samples composited over a thirty-day period are appropriate for comparison against chronic standards, while grab samples are appropriate for comparison against acute standards. Historic sampling events on Silver Creek were all based on grab samples. However, the CDH Water Quality Committee has indicated that the aggregate of grab samples should be used for comparison with chronic standards (Anderson, 1995).

The Colorado Water Quality Control Commission has also recommended that the 85th percentile of aggregate concentration data be used to compare such data against the standard (Anderson, 1995). If the 85th percentile value is less than the standard, the Commission acknowledges that water quality standards have not been exceeded. Therefore, this value has been used to compare the historic data with the current chronic standard for each constituent in segment 9 to evaluate Silver Creek water quality relative to the standards. Additionally, to evaluate changes in water quality within the stream segment, the mean concentration for each compound was determined at each historic sampling location.

As stated in the CDH surface water regulations, "Both acute and chronic numbers adopted as stream standards are levels not to be exceeded more than once every three years on the average." The historic database for Silver Creek comprises 13 years, thus there are four (4)

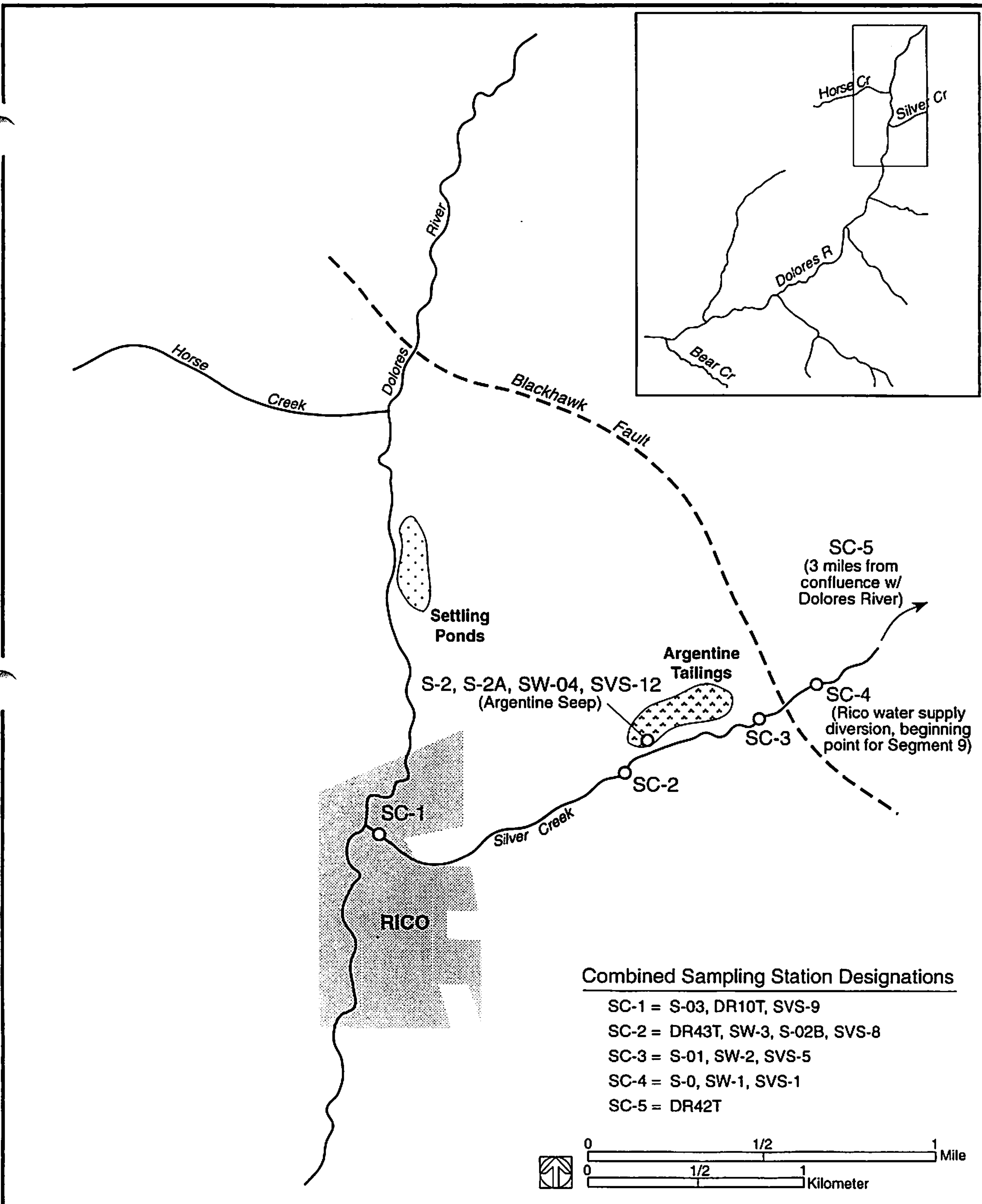

Figure 3-1. Sampling station locations on Silver Creek.

allowable acute value exceedences. The number of detected values that exceed the acute state standard was determined for segment 9.

All non-detects were set equal to zero. This approach is consistent with the data interpretation method used to develop the stream segment standards (CDH, 1995) and with the verbal guidance provided by CDH (Anderson, 1995).

Background concentrations of site metals in surface water were evaluated with respect to both observed water quality and state standards. The Colorado Water Quality Control Commission states that on many stream segments, "elevated levels of metals are present due to natural or unknown causes" (CDH, 1995). For the purpose of determining background water quality in Silver Creek, metal concentrations were calculated for those sampling stations upstream of segment 9 (Stations SC-4 and SC-5).

3.2.2 Results

Table 3-2 presents a summary of historic Silver Creek water quality data by constituent, sampling station and stream segment. Except for mercury, the historic data for the background segment (above segment 9) indicate concentrations of constituents below stream standards established for segment 9. Values for mercury may not be representative because the reported detection limits (0.01-0.3 μg/l) in most cases are above the stream standard (0.01 μg/l).

Data for Station SC-3 below the Blackhawk Fault and above the Argentine tailings indicates that a notable increase in the average concentration of most constituents occurs upstream of the Site. Average concentrations of arsenic, iron, and manganese at Station SC-2 are higher than those at SC-3, while the other constituent concentrations are lower at SC-2 than at SC-3. Average concentrations of iron, lead, manganese above the confluence with the Dolores River (SC-1) are lower than at SC-2. Average concentrations of arsenic, cadmium, copper, lead mercury, silver, and zinc increase between SC-2 and SC-1, although as described above, reported concentrations for mercury are suspect. Figures 3-2 through 3-4 depict the range and mean concentrations for iron, zinc and cadmium.

Except for mercury, the calculated 85th percentile concentrations for the background segment indicate concentrations of metals below standards. For segment 9, the 85th percentile calculation indicates concentrations of cadmium, mercury and zinc above the standards for these constituents (Figures 3-3 and 3-4). Again, there mercury value is not considered representative because of the detection limit issue relative to the standard value. The calculated iron concentration for segment 9 approaches the chronic standard (Figure 3-2). The 85th percentile concentrations for arsenic, copper, lead, manganese, and silver are below the established standard for each of these constituents.

TABLE 3-2. SILVER CREEK SURFACE WATER QUALITY 1980-95

All units µg/L

PTI Station No.	Other identifiers	River mile	Number of samples	Arithmetic Mean[a]	85th Percentile[a]	Number of Exceedances of Acute Standard
ARSENIC (total): State developed standard (chronic & acute) = 100 µg/L[b]						
SC-1	S-03/DR10T/SVS-9	0.1	12	4		
SC-2	S-02B/DR43T/SW-3/SVS-8	1.1	3	1.7		
SC-3	S-01/SW-2/SVS-5	1.6	1	0		
SC-4	S-0/SW-1/SVS-1	1.8	1	0		
SC-5	DR42T	3.0	2	1.5		
Segment 9		0.1 – 1.6	16	3.3	10	0
Background segment[c]		1.8 – 3.0	3	1.0	2.8	0
CADMIUM: State developed standard (chronic) = 5.0 µg/L[d]; State developed standard (acute) = 26.5 µg/L						
SC-1	S-03/DR10T/SVS-9	0.1	33 [e]	2.0		
SC-2	S-02B/DR43T/SW-3/SVS-8	1.1	5	0.62		
SC-3	S-01/SW-2/SVS-5	1.6	15	4.6		
SC-4	S-0/SW-1/SVS-1	1.8	6	0.35		
SC-5	DR42T	3.0	2	0		
Segment 9		0.1 – 1.6	53 [e]	2.6	6.4	0
Background segment[c]		1.8 – 3.0	8	0.26	0.72	0
COPPER: Table value standard (chronic) = 25 µg/L[d]; Table value standard (acute) = 40.5 µg/L						
SC-1	S-03/DR10T/SVS-9	0.1	33	5.6		
SC-2	S-02B/DR43T/SW-3/SVS-8	1.1	5	0.8		
SC-3	S-01/SW-2/SVS-5	1.6	15	1.5		
SC-4	S-0/SW-1/SVS-1	1.8	6	2.3		
SC-5	DR42T	3.0	2	0		
Segment 9		0.1 – 1.6	53	4.0	13	1
Background segment[c]		1.8 – 3.0	8	1.8	4.5	0
IRON: State developed standard (chronic) = 300 µg/L						
SC-1	S-03/DR10T/SVS-9	0.1	37	81		
SC-2	S-02B/DR43T/SW-3/SVS-8	1.1	8	148		
SC-3	S-01/SW-2/SVS-5	1.6	15	68		
SC-4	S-0/SW-1/SVS-1	1.8	9	16		
SC-5	DR42T	3.0	2	0		
Segment 9		0.1 – 1.6	60	87	286	NA [f]
Background segment[c]		1.8 – 3.0	11	13	34	NA [f]

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TABLE 3-2. (cont.)
All units µg/L

PTI Station	Other identifiers	River mile	Number of samples	Arithmetic Mean[a]	85th Percentile[a]	Number of Exceedances of Acute Standard
LEAD: Table value standard (chronic) = 13.5 µg/L						
Table value standard (acute) = 394 µg/L						
SC-1	S-03/DR10T/SVS-9	0.1	43	1.7		
SC-2	S-02B/DR43T/SW-3/SVS-8	1.1	8	1.2		
SC-3	S-01/SW-2/SVS-5	1.6	16	2.0		
SC-4	S-0/SW-1/SVS-1	1.8	9	2.1		
SC-5	DR42T	3.0	1	0		
Segment 9		0.1 – 1.6	67	1.7	5.3	0
Background segment[c]		1.8 – 3.0	10	1.9	4.6	0
MANGANESE: State developed standard (chronic) = 1,000 µg/L						
SC-1	S-03/DR10T/SVS-9	0.1	35	144		
SC-2	S-02B/DR43T/SW-3/SVS-8	1.1	8	306		
SC-3	S-01/SW-2/SVS-5	1.6	15	174		
SC-4	S-0/SW-1/SVS-1	1.8	9	1.1		
SC-5	DR42T	3.0	2	31		
Segment 9		0.1 – 1.6	58	174	389	NA [f]
Background segment[c]		1.8 – 3.0	11	6.45455	26	NA [f]
MERCURY (total): State developed standard (chronic) = 0.01 µg/L[g]						
SC-1	S-03/DR10T/SVS-9	0.1	30 [f]	0.055		
SC-2	S-02B/DR43T/SW-3/SVS-8	1.1	7 [f]	0.007		
SC-3	S-01/SW-2/SVS-5	1.6	15	0.012		
SC-4	S-0/SW-1/SVS-1	1.8	8	0.011		
SC-5	DR42T	3.0	1 [f]	0		
Segment 9		0.1 – 1.6	52 [f]	0.036	0.18	NA [f]
Background segment[c]		1.8 – 3.0	9 [f]	0.010	0.041	NA [f]
SILVER: Table value standard (chronic) = 1.44 µg/L						
Table value standard (acute) = 9.18 µg/L						
SC-1	S-03/DR10T/SVS-9	0.1	28	0.31		
SC-2	S-02B/DR43T/SW-3/SVS-8	1.1	8	0		
SC-3	S-01/SW-2/SVS-5	1.6	6	0		
SC-4	S-0/SW-1/SVS-1	1.8	9	0		
SC-5	DR42T	3.0	1	0		
Segment 9		0.1 – 1.6	42	0.21	1.2	0
Background segment[c]		1.8 – 3.0	10	0	0	0

TABLE 3-2. (cont.)

All units µg/L

PTI Station	Other identifiers	River mile	Number of samples	Arithmetic Mean[a]	85th Percentile[a]	Number of Exceedances of Acute Standard
ZINC: State developed standard (chronic) = 1,100 µg/L						
SC-1	S-03/DR10T/SVS-9	0.1	43	518		
SC-2	S-02B/DR43T/SW-3/SVS-8	1.1	9	466		
SC-3	S-01/SW-2/SVS-5	1.6	15	879		
SC-4	S-0/SW-1/SVS-1	1.8	9	28		
SC-5	DR42T	3.0	2	0		
Segment 9		0.1 – 1.6	67	592	1,367	NA [f]
Background segment[c]		1.8 – 3.0	11	23	54	NA [f]

[a] Non-detect results were set to zero when calculating the mean and 85th percentile.

[b] Standard is total recoverable metals, but only total metals data were available.

[c] Upgradient of mining areas and Segment 9.

[d] Excluding SRK data from 1983 because of contamination during filtration.

[e] Rejecting one data point from SRK, 3/27/84, because dissolved cadmium was 14 times higher than total recoverable cadmium.

[f] Only chronic standard was developed based on evaluation of historical data.

[g] Excluding 1989-91 and 1993 data from Bureau of Reclamation report due to problems with data quality.

NA = Not applicable

Notes:

Results from Walsh (1994) were not used because detection limits were high and no analytes of interest were detected.

All metals were reported as dissolved unless otherwise noted.

Hardness value of 240 mg/L for this segment was obtained from Colorado Department of Health Water Quality Control Commission.

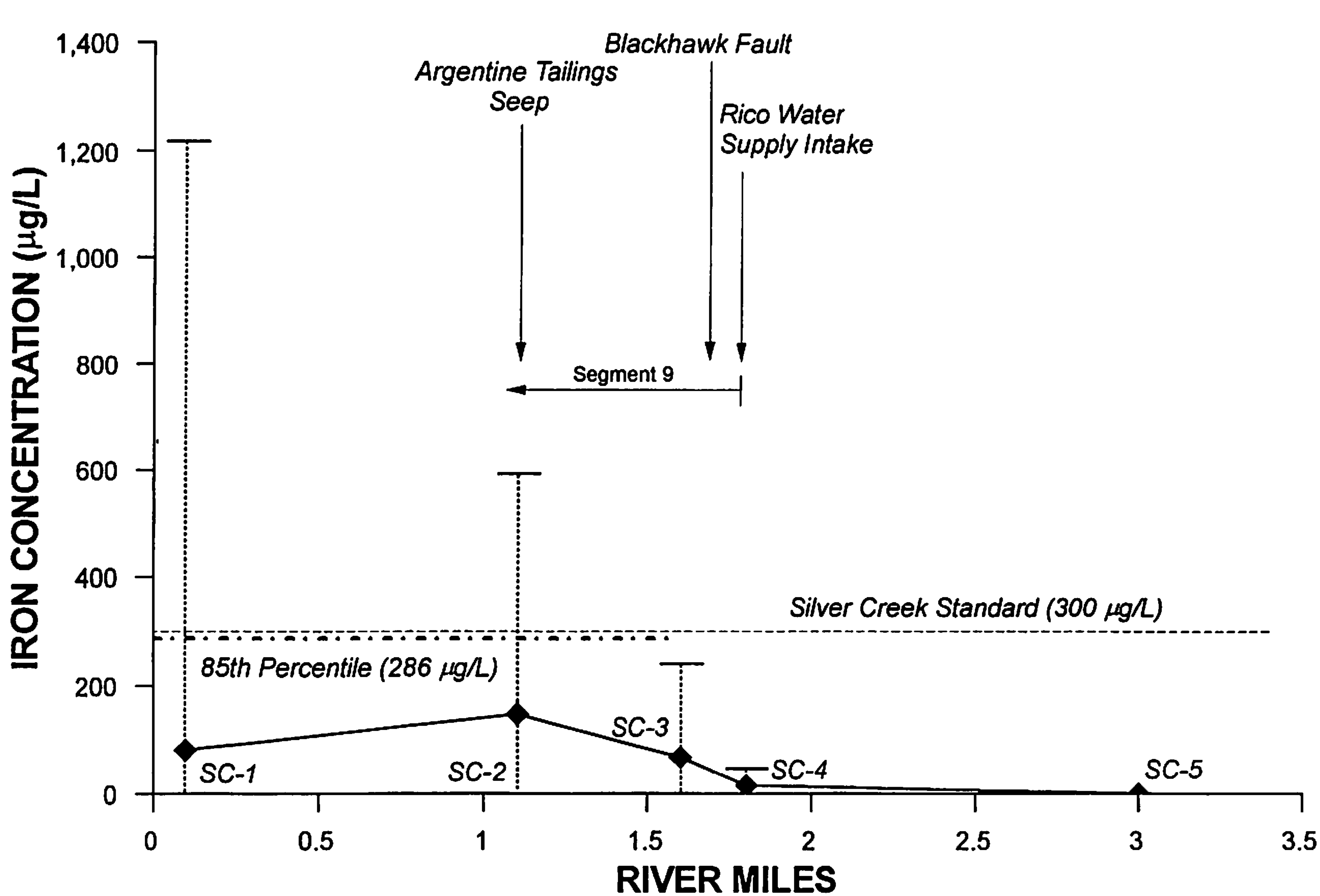

Figure 3-2. Iron concentrations (mean [◆], maximum, and minimum) in Silver Creek (1980-1995). [River miles are measured upstream from confluence with the Dolores River (mile 0)].

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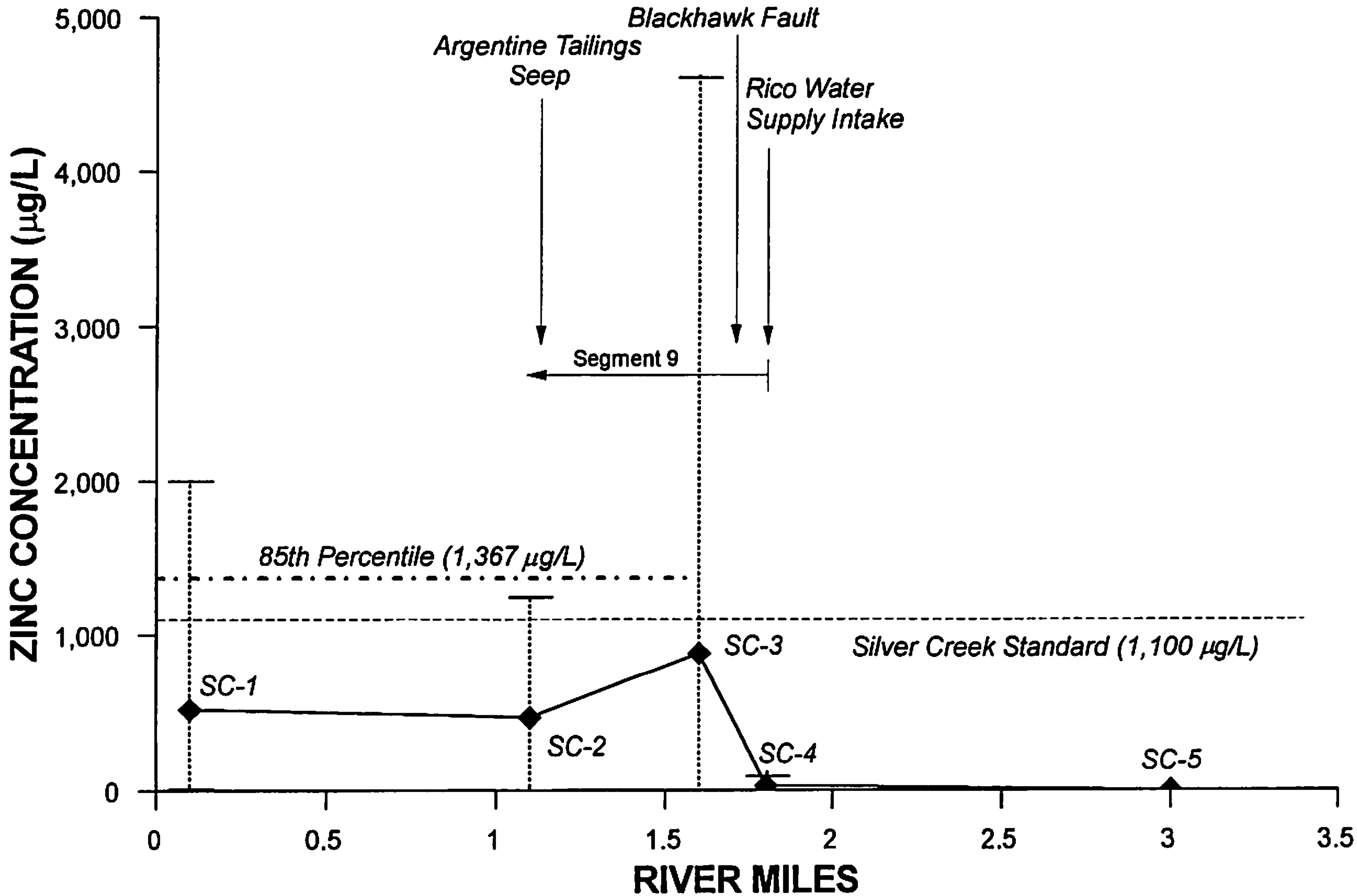

Figure 3-3. Zinc concentrations (mean [◆], maximum, and minimum) in Silver Creek (1980-1995). [River miles are measured upstream from confluence with the Dolores River (mile 0)].

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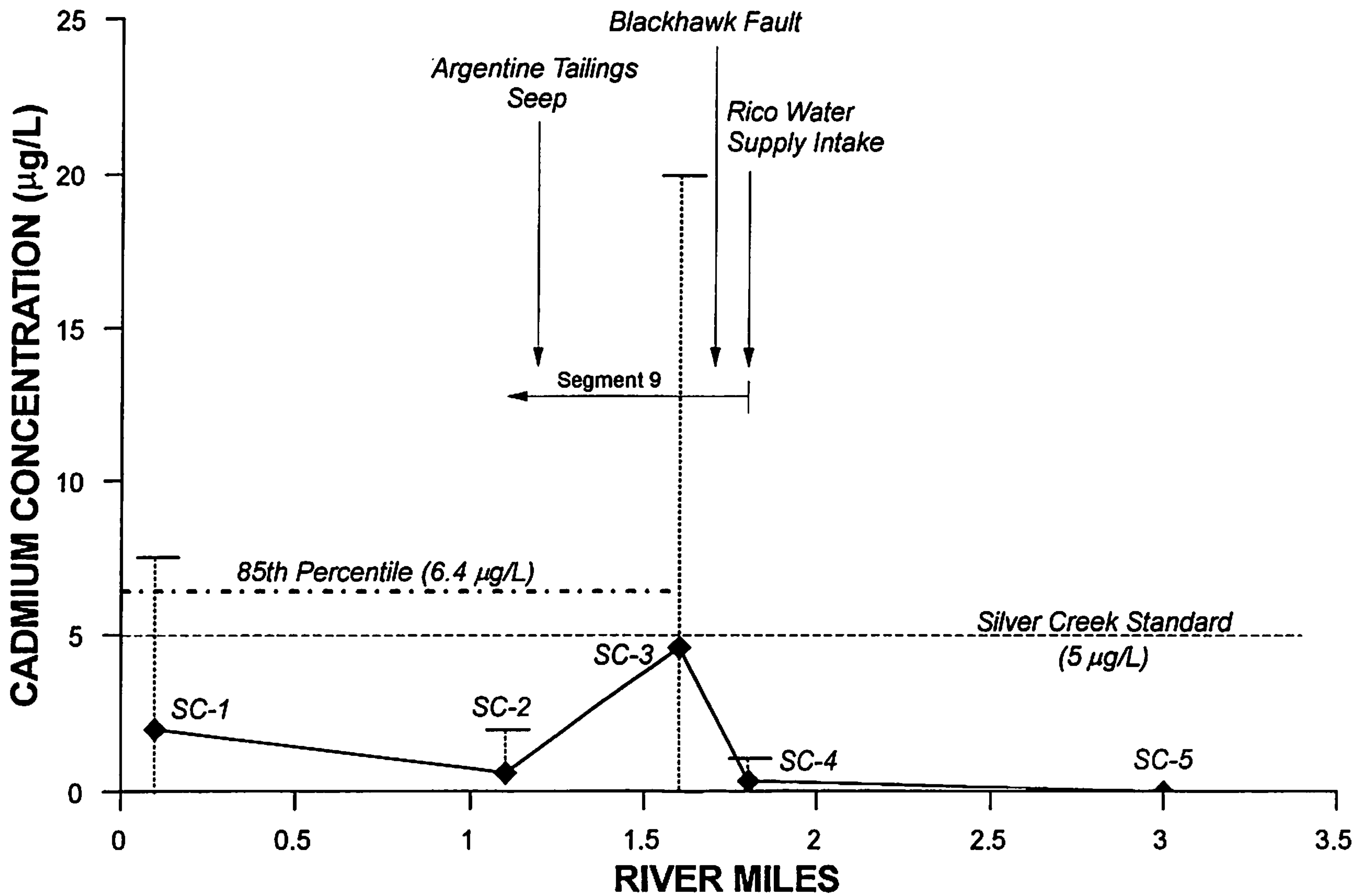

Figure 3-4. Cadmium concentrations (mean [◆], maximum, and minimum) in Silver Creek (1980-1995).
[River miles are measured upstream from confluence with the Dolores River (mile 0)].

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3.2.3 Conclusions

Comparison of Silver Creek historic water quality data with established stream standards for segment 9 and water quality upstream of segment 9 indicate notable increases in metals loading to Silver Creek in segment 9. The primary constituents contributing to the metals loading in Silver Creek are iron, manganese and in particular, zinc. As described in Section 2.6.3, the primary sources of metals loading in Silver Creek include the seep at the Site and surface water runoff from mine wastes and natural mineralized areas associated with the Blackhawk fault zone upstream of the Site.

The proposed reclamation plan is designed to reduce metals loading to Silver Creek from the Site. These measures will effectively control potential environmental risks. However, the various natural and mining-related non-point sources located upstream of the Site are expected to continue to impact Silver Creek water quality.

3.3 Risk Considerations for Tailings

Tailings material was previously assayed by Anaconda Minerals Company to determine the economic recoverability of lead, zinc, copper, gold, and silver. (See Section 2.6.1.) No data are available for other potential elements of concern (e.g., arsenic, cadmium, and manganese). However, these elements are closely associated with lead in ores from the Rico mining district. They are also found in mill tailings and wasterock. Therefore, lead levels in tailings and wasterock materials would essentially drive any health risk assessment and final remedial action for all elements of concern.

The key consideration in assessing risk associated with tailings and wasterock at the Site is the extent of human or environmental exposure. Given the proposed non-residential land use plan and lack of opportunity for direct contact, human exposure pathways are considered negligible. In addition, to ensure protectiveness of human health and to protect against environmental releases, the proposed reclamation plan for the Site include a combination of drainage/erosion control measures, rock mulch cover on exposed surfaces, slopes and embankments, and revegetation. These measures will effectively eliminate any direct human exposure and control potential environmental risks.

3.4 References

Anderson, D. 1995. Personal communication (telephone conversation on July 24, 1995, with Jeff Writer, PTI Environmental Services, Boulder, CO). Colorado Department of Health, Denver, CO.

CDH. 1995. Classification and numeric standards for San Juan and Dolores River basins. 3.4.0 (CCR 1002-8), adopted April 10, 1995, effective May 30, 1995. Colorado Department of Health.

4.0 VOLUNTARY CLEANUP PLAN

"The voluntary cleanup plan must address known or potential releases of contaminants considering the human health and environmental risks of those contaminants in both the present and future land use scenarios. The plan must demonstrate that either all applicable state standards will be met, or for contaminants where no standard exists, that the risk level has been reduced to an acceptable level (excess cancer risk of 10^{-6}, or hazard index <1).

The remediation alternative selected should be described in sufficient detail to allow the Department to evaluate whether or not the applicant will be capable of remediating all contamination identified at the subject property within the specified 24 month time limit set down in 25-16-306(4)(a)."

4.1 Introduction

The primary objectives of this Voluntary Cleanup Plan (VCUP) for the Argentine tailings site are to:

- Effectively minimize the potential for direct human health exposure to the mill tailings and wasterock at the site;
- Stabilize the tailings piles in-place from erosion and slope instability due to runon/runoff, floods and earthquakes, thereby preventing off-site dispersal of wastes;
- Implement source controls and infiltration minimization techniques to both reduce the generation of dissolved metals in seeps from the tailings piles and diminish overall seepage volume.

These objectives address the known or potential releases of contaminants at the site, as described and discussed in the environmental assessment (Section 2.0) and the applicable standards/risk determination (Section 3.0).

The design bases and remediation techniques utilized in developing the proposed plan are described in Section 4.2. The design bases include specific regulatory requirements, best management practices (BMPs), applicable precedent from other sites, and standard engineering practice. The remediation techniques encompass hydrologic controls, reclamation cover, slope stabilization, and institutional controls.

The proposed conceptual remedial design for the Argentine tailings site is described in detail in Section 4.3. The plan includes stabilization and source control of the wastes on-site.

Specific measures to be implemented involve:

- Flattening of slopes on the tailings embankments susceptible to static or earthquake instability and erosion;

- Grading to route offsite surface water (rainfall and snowmelt) around the wastes (runon control), and grading to shed incident rainfall and snowmelt from the wastes in a non-erosive manner (both of which contribute to limiting infiltration of water into the wastes);

- Compaction of the surface and slopes of the tailings piles, and placement of reclamation cover to further limit infiltration and erosion, and to prevent incidental direct human contact; and

- Providing erosion protection (using riprap, gabions or equivalent means) against flooding in Silver Creek adjacent to the site.

Other aspects of the VCUP are described in Sections 4.4 through 4.11. These are summarized briefly as follows:

- Short- and long-term risks associated with the implementation (construction) and operation of the VCUP are relatively low and fully manageable; all of the proposed remediation measures are technically feasible; and the overall project is economically feasible.

- Operations and maintenance (O&M) requirements have been minimized to the extent practicable as part of the conceptual design, and are simple and fully implementable.

- Specific mechanisms will be considered for insuring land use is consistent with the VCUP implementation process. Some of the mechanisms currently being evaluated include application of Rico planning and development regulations, dedication of private land parcels to town ownership, use easements, restrictive covenants, and conservation easements.

- Discussions regarding permit requirements or other approval mechanisms for measures under the VCUP are currently being pursued with federal and state agencies. Any permit requirements will be structured to support the remedial nature of the proposed activities and are expected to dovetail with VCUP components described herein. The remedial nature of activities to be conducted under the VCUP, which technically qualify as on-site "removal or remedial actions" under CERCLA, also raise the prospect of permit waivers under Section 121(e)(1) of CERCLA.

- The proposed plan can be implemented and completed within the required 24-month time frame, assuming timely reviews and permit approvals and barring extreme weather conditions.

4.2 Summary of Remediation Techniques

4.2.1 Design Basis

The design bases for the various elements of remediation at the Argentine tailings site included in this VCUP have been developed to meet the objectives discussed in Section 4.1 and the more specific purposes associated with the remediation techniques as summarized in the subsections below. The remediation techniques proposed and the bases for their conceptual design have been developed, in part, by appropriate application of selected Best Management Practices (BMPs) such as those presented by Colorado Mined Land Reclamation Division (1988) and Idaho Mining Advisory Committee (1992), and in general accordance with the relevant reclamation practices of the Mineral Rules and Regulations (Colorado Mined Land Reclamation Board, 1995). In addition, techniques or measures developed for and/or applied successfully at other mining sites in similar conditions in Colorado are incorporated as appropriate in the conceptual design. Design criteria or standards are based on these BMPs, rules and regulations, and/or precedents noted where possible. In all cases, and especially where specific guidance is otherwise absent, standard engineering practice is applied in all of the conceptual design. In the discussions following, the various remedial measures proposed are briefly described, their purpose(s) is identified, and key design standards are presented. More detailed and comprehensive descriptions of the specific measures and how they will be applied at the site are presented in Section 4.3.

4.2.2 Hydrologic Controls

4.2.2.1 Runon Control

Practice: Runon controls are intended to prevent upland offsite surface water from coming into contact with mine waste or mine-related drainage. The structures envisioned for remediation of the Argentine tailings site described herein are earthen dikes, ditches, drop structures/chutes, and energy dissipators (e.g., riprap plunge pools). These structures are appropriately protected from erosion under the design runon flows. This protection may be provided by the gradation of the earth materials used in the structures themselves, revegetation, riprap, or other materials (e.g., geocell mattress, gabions, grouted riprap) depending on the flow velocities and depths.

Purpose: The purpose of diversion (or runon control) structures is to intercept and re-route upland surface water flows away from waste deposits and/or contaminated discharges at the site to be remediated. The structures are sized such that the estimated offsite consequences, if their capacity is exceeded, are not significant given the dilution effects associated with the larger flow events.

Design Standards: The design standard adopted to meet the objectives of this measure is the 100-year frequency precipitation event.

4.2.2.2 Runoff Control

Practice: Runoff controls include measures to provide for controlled runoff from areas containing mine waste. Measures applicable to the Argentine tailings site include contouring and grading of tailings piles (and some waste rock), and ditches and/or dikes to convey the collected runoff flows offsite in a controlled manner. Reclamation cover measures, discussed separately below, also provide for runoff control by mitigating the potential for erosion of the wastes. Eliminating runon, as discussed above, is important in limiting the source of runoff water to direct precipitation (i.e., rainfall and/or snowmelt).

Purpose: Runoff controls are intended to shed water from areas containing tailings in a manner that does not erode and transport the wastes offsite. Proper runoff controls contributes substantially to limiting infiltration of surface water into the wastes.

Design Standards: The design standard adopted for sizing and layout of runoff controls is the same as for runon controls as described above (i.e., 100-year precipitation event). The top surfaces of tailings piles are graded to drain at 3 percent. As discussed below under Slope Stabilization, slopes as steep as 3H:1V are utilized where such remediated slopes will be stable and grading to flatter slopes requires excessive grading.

4.2.2.3 Infiltration Control

Practice: Infiltration controls are measures or practices which reduce or eliminate infiltration of surface water into and through mine wastes and ultimately to ground water. Such controls at the Argentine tailings site include consolidation of waste materials to reduce the surface area susceptible to infiltration, compaction of the upper surface of the waste pile to reduce the rate of infiltration, and most importantly, minimizing the quantity and duration of surface water contact with the waste pile by runon/runoff controls.

Purpose: The primary purposes of infiltration controls are to limit the potential for uncontaminated water coming into contact with the waste materials and becoming contaminated, and to reduce the potential for flows through the waste materials transporting contaminants away from the site by surface seepage discharge or ground-water flow.

Design Standards: The standard adopted for compaction of the surface of tailings piles (beneath the reclamation cover) is that the upper 12 inches of waste be of a compactable gradation, and that 95 percent of Standard Proctor maximum dry density (or 95 percent of maximum index density for soils with little or no fines) be achieved.

4.2.2.4 Drainage Stabilization

Practice: Drainage stabilization involves measures to prevent or minimize erosion of contaminated materials by or into a receiving stream. For the Argentine tailings site, such flood protection is provided by appropriate protection for natural ground, dikes, and the waste materials to withstand the erosive forces of the flooding. Erosion protection may be provided by riprap, gabions, grouted riprap, geosynthetic liners or systems, or other means appropriate to the flooding event and site conditions.

Purpose: The purposes of drainage stabilization and/or flood control measures is to prevent uncontrolled erosion and dispersal of wastes due to normal and flood flows in receiving streams at the site. Similar to the case for runon/runoff controls, these measures are sized such that the estimated offsite consequences of exceedance of their capacity are not significant given the dilution effects associated with larger flood events.

Design Standards: Given the substantially higher flows involved and the potentially more significant consequences of dispersal of wasterock or tailings offsite associated with flooding versus runon/runoff, the design standard adopted to meet this objective is the 500-year frequency precipitation event.

4.2.3 Reclamation Cover

Practice: Reclamation cover encompasses methods and materials applied to the surface of wastes, which can include soil, rock, amendments to soil, pavements (asphalt or concrete), geosynthetic liners, revegetation, or composite systems of two or more of these items. For the Argentine tailings site, the primary cover methods proposed include: 1) rock mulch (i.e., erosion-resistant gravelly soil) applied directly to the compacted, unamended tailings surface; or 2) 24 inches of growth media placed over 6 inches of lime amended and compacted tailings/wasterock.

Purpose: Reclamation covers are intended to provide protection of the surface of mine wastes from wind and water erosion, and interrupt incidental direct human and/or environmental contact with the underlying wastes. Erosion protection effectively minimizes or eliminates uncontrolled dispersal of waste material offsite. The physical barrier of rock mulch in the non-vegetated cover alternative to be used at the Argentine tailings site effectively prevents incidental contact or ingestion of waste materials.

Design Standards: The 100-year precipitation event has been adopted as the basis of design for which erosion protection is to be provided.

4.2.4 Slope Stabilization

Practice: Slope stabilization encompasses measures and/or structures to prevent sliding or mass wasting of natural, cut or fill slopes which may result in uncontrolled release of mine wastes. Measures to be employed at the Argentine tailings site involve grading tailings piles with sufficiently gentle slopes, implementing runon/runoff and infiltration controls to reduce or eliminate pore pressures within the slopes, and providing erosion protection in areas where scour could result in destabilizing slopes.

Purpose: Important objectives of stabilizing slopes are to prevent uncontrolled release of mine wastes into adjacent receiving streams, and to maintain the integrity of other remedial measures including runon/runoff and infiltration controls. Slope stability can also be important in terms of site safety, to the extent that failures could endanger roads or visitors to the site area, or temporarily impound runon/runoff or stream flows with potential uncontrolled release of water.

Design Standards: The standards for static stability of waste material slopes are a factor of safety against sliding of 1.5 for long-term, steady seepage conditions, and 1.3 for short-term, non-earthquake loadings including during construction. Stability during earthquakes (seismic loading) should be provided to a degree commensurate with the consequences of failure, and generally consistent with (or no less stringent than) the level of flood protection to be provided (i.e., an earthquake frequency on the order of at least 100-year to 500-year recurrence). Factor of safety under earthquake loading should be greater than 1.0.

4.3 Argentine Tailings Site Remedial Design

The VCUP should include: *"A detailed description of the remediation alternative, or alternatives selected, which will be used to remove, or stabilize contamination released into the environment, or threatened to be released into the environment;*

A map identifying areas to be remediated, the area where the remediation system will be located, if it differs from the contaminated areas, locations of confirmation samples, the locations of monitoring wells, areas where contaminated media will temporarily be stored/staged, and areas where contamination will not be remediated; and

Remediation system design diagrams showing how the system will be constructed in the field."

4.3.1 Introduction

The conceptual plan for remediation of the Argentine tailings site is described in the following subsection. The remediation measures comprising the proposed alternative are described in sufficient detail to document that the concepts are technically and economically feasible, constructable, and can be implemented within the required 24-month time limit set by statute. Design diagrams are presented which show conceptual layouts and cross-sections of major elements of the remediation. Prior to implementation of the proposed remediation, final design investigations and analyses will be performed, and construction drawings and technical specifications prepared. The specific layout, sizing, and construction materials of the selected alternative would be refined and finalized.

4.3.1.1 Geohazards

As described in Section 2.5.6 previously, the only natural hazards that require consideration at the Argentine tailings site are flooding and seismicity. Substantial grading is proposed to mitigate the potential for slope instability under static and earthquake loadings as discussed in more detail in the following subsection. Erosion due to flooding along Silver Creek has already been largely addressed by work done in the early 1980s by Anaconda Minerals Company; only relatively minor upgrading of this existing protection is envisioned.

4.3.1.2 Site Access

Access to the Argentine tailings site is available on existing public roads. These roads and the bridge over lower Silver Creek are adequate for the anticipated construction traffic and loads without any substantial upgrading. The roads would be maintained in accordance with usual and customary practice, and/or with any applicable local ordinances or U.S. Forest Service requirements.

4.3.1.3 Construction Site Controls

Controls would be implemented during construction to implement the requirements of any applicable federal, state or local permits, codes or regulations. In particular, construction drawings and specifications would identify and require implementation of appropriate Best Management Practices (BMPs) to protect Silver Creek from sedimentation during construction. These BMPs might include:

- Temporary grading and berms to prevent runoff from disturbed areas to Silver Creek;
- Detention of runoff from disturbed areas before allowing discharges into Silver Creek; and/or
- Placement of silt fencing and hay bales along the bank of Silver Creek during excavation and fill placement.

BMPs would also be employed to control dust and spillage during earthmoving operations. These would include dust suppression at grading sites and on haul roads, and proper loading of haul trucks to prevent spillage. Special care would be exercised in the transport of fuel and lubricants to the construction site, and their temporary storage onsite.

All on-site construction and related activities will be conducted in strict conformance with a Site Specific Safety and Health Plan to be developed prior to mobilization. A Site Safety Officer will be designated to ensure that the requirements of the plan are met, and that safe work practices are implemented. Preliminary personal air monitoring and experience at other similar sites suggests that health risks will be minimal during earthmoving operations using appropriate BMPs.

4.3.2 Conceptual Design

4.3.2.1 Hydrologic Controls

Runon Control. Controls to minimize runon of flows originating offsite at the Argentine tailings site are shown schematically on Figures 4-1 and 4-2, and involve the following remediation element:

- *Approximately 1300 lineal feet of road grading and drainage ditch improvements to utilize the existing drainage ditch along the access road as a collection/conveyance feature for upland flows.*

Runon due to precipitation and/or snowmelt will originate from the forested slope immediately above the ponds. The contributing drainage area for local runon is approximately 154 acres. Peak runon flow during the 100-year precipitation event will be determined during final design. All of the runon originating from drainages east of the mill area appears to flow into Silver Creek above the site. Provision is made to verify this condition during final design, and if necessary to implement local grading to insure this runon drainage pattern.

The primary runon control feature is the existing access road drainage ditch that traverses the northern boundary of the tailings impoundments. The road will be regraded to drain into the hillside drainage ditch. The existing drainage ditch will be enlarged and lined with raprap as necessary to provide adequate capacity to convey the design peak storm runoff flow (100-year precipitation event) around the site. Storm water will be directed through a road culvert, and into an erosion-resistant outfall channel to convey storm water around Pond 3 through the Pond 4 area. Erosion protection will be provided by riprap or other means of equivalent resistance. The outfall channel from the Pond 4 area will convey runon flows down the natural slope into Silver Creek. Outfall channel discharges will enter Silver Creek upstream of the existing culverted road crossing below the site. A small portion of the runon at the eastern end of the site will be intercepted by the existing mill site yard/road grading and flow to Silver Creek just above Pond 1 at the existing crossing. If necessary as determined in final design, minor grading will be performed to insure this drainage pattern.

Runoff Control. Runoff controls for the Argentine tailings site area are shown schematically on Figures 4-1 and 4-2, and include the following elements:

- *Lowering of the crests of Embankments 1 and 3 and removal of Embankment 2 to prevent impoundment of runoff water on the surfaces of the tailings piles*;

- *Grading of the compacted surfaces of Ponds 1, 2, and 3 to drain towards Silver Creek at slopes no steeper than 3 percent.*

Runoff at this site originates from direct precipitation and/or snowmelt from the surfaces of the tailings ponds, from the embankment slopes, and from the area above the impoundments but below the runon control feature (the access road). The total runoff area is approximately 11.5 acres, which will yield an estimated 21.8 cfs peak flow during the design 100-year precipitation event (see Appendix B1A for hydrologic calculations). Runoff will be induced by removing above-grade embankments that are currently impounding runoff water, and by grading the tailings pile surfaces to drain toward Silver Creek (towards the southwest). Tailings runoff surfaces will be protected from erosion during runoff by a rock mulch cover, as described under Reclamation Cover later in this section.

Infiltration Control. Infiltration controls for the Argentine tailings site are shown schematically on Figures 4-1 and 4-2, and include the following elements:

- *Eliminating ponding and enhancing runoff on reclaimed tailings surfaces*;

- *Reducing the exposed infiltration surface area by consolidating tailings from Pond 4 to Pond 1*;

- *Reducing infiltration rates in Pond 1 by compacting the finer-grained tailings materials imported from Pond 4 onto the surface of Pond 1*; *and*

- *Reducing infiltration rates in Ponds 2 and 3 by compacting the surficial in-place tailings materials.*

Infiltration through the Argentine tailings piles will be reduced by consolidating materials, eliminating ponding, enhancing runoff, and reducing vertical hydraulic conductivity at the tailings surfaces. Preliminary analyses indicate that infiltration may be reduced by up to 50 percent by eliminating ponding and enhancing runoff on the tailings surfaces. These remediation elements were described previously under Runoff Controls above.

The Pond 4 tailings materials will be excavated as shown on Figures 4-1 and 4-2. Excavated tailings materials will be hauled to Pond 1 and placed as a compacted cover over the surface of Pond 1. This consolidation of tailings materials will reduce the total surface area of tailings at the Argentine tailings site by about 13 percent (from approximately 15 to 13 acres).

The excavated Pond 4 tailings will be placed as a compacted cover layer on the surface of Pond 1 where a significant percentage of the existing surficial soils are sandy, and have relatively higher infiltration/lower runoff characteristics. Surficial tailings materials in Ponds 2 and 3 are typically finer grained than those in Pond 1, and will be compacted in-place to improve infiltration/runoff characteristics. The imported Pond 4 tailings materials placed on Pond 1, and the surficial in-place tailings materials in Ponds 2 and 3 will be compacted under controlled procedures to reduce the permeability of the tailings surfaces. Compaction will be performed after rough grade is established for runoff control. Compaction of the surficial 12 inches will be controlled according to engineering standards based on Standard Proctor or minimum index density tests, as appropriate. If necessary, as determined by final design exploration and analyses, the saturated, very fine-grained tailings materials (slimes) located in the northeast corner of Pond 1 can be selectively over excavated and replaced with Pond 4 tailings materials to grade. This will allow adequate compaction of the cover materials in that area, and the excavated slimes can be mixed with the Pond 4 tailings to further reduce the permeability of the pond surface materials.

Drainage Stabilization. The Argentine tailings ponds are located adjacent to the relocated channel of Silver Creek and thus subject to potential flooding. Protection of the Argentine tailings site against erosion due to flooding along Silver Creek has been previously addressed by work done in 1981 and 1982. Anaconda Minerals Company constructed approximately 1100 feet of stabilizing toe berms, riprap and grouted-riprap revetments, and a concrete cutoff wall to protect the streamside dikes from erosion. This work was designed and documented by Dames and Moore (1981a, 1982a,b), and provides sufficient protection of the existing facilities against floods in Silver Creek up to and including the 100-year event according to the construction inspection report. In general, the existing revetment appears to be in good condition, and only relatively minor repairs and/or improvements are envisioned. Preliminary analyses indicate that the existing revetment has sufficient freeboard for the 500-year event. Erosion protection at the somewhat higher flows of the 500-year event includes the existing riprap and revetments, and the streamside dikes and toe berms constructed of gravelly (erosion-resistant) materials. The berms and dikes provide an auxiliary, sacrificial zone behind the riprap revetment, so that even if local disruption of the riprap were to occur during the 500-year flood, no disruption of the tailings is anticipated.

4.3.2.2 Slope Stability

Static and seismic (earthquake) stability of critical embankments and slopes at the Argentine tailings site will be ensured by implementing the following remedial measures as illustrated on Figures 4-1 and 4-2:

- *Slope reduction to maximum slopes of 3H:1V of the north-south sections of Embankments 1 and 3 (constructed largely of tailings), and the waste rock slope below the mill buildings;*

- *Grading of Embankment 2 to 3 percent slopes as part of runoff control.*

Slope flattening of Embankment 1 will be accomplished by cutting the crest dike and upper embankment materials and filling the lower slope with those excavated materials. All fill materials are to be compacted to typical engineering standards based on Standard Proctor or maximum index density tests, as appropriate. The cut section on Embankment 1 at the north end of the embankment will be minimized as necessary to avoid exposing weak fine-grained tailings (slimes) that are impounded in that area. Fill makeup materials on that section of Embankment 1 would be derived from excavation of native gravelly materials in the Pond 4 area.

The existing Embankment 2 will be graded so as to blend with the overall 3 percent grade to the southwest which will promote runoff of the tailings. This will effectively remove the existing slopes and thereby eliminate any potential for slope or foundation instability in that area. Slope flattening of Embankment 3 will be by cut and fill of the existing embankment. The cut embankment is to be sloped back at 3H:1V, and the materials generated used to flatten the eastern slope of Embankment 3 to a maximum 3H:1V.

The slope below the mill buildings contains exposed waste rock materials. This slope will be flattened to a maximum 3H:1V by placing fill imported from excavations in Pond 4.

Slope reduction results in increased factors of safety against mass slope failure, as well as reduced vulnerability to surficial erosion of tailings by runoff and wind (see Reclamation Cover). Mass slope stability at critical embankment sections was analyzed for the proposed 3H:1V slopes. Geotechnical data on the tailings embankments were obtained from two previous site investigations:

- A study by Camp Dresser & McKee (1979), in conjunction with boring logs and sample test data documented by Geotek, Inc. (1979).

- A study by Dames & Moore documented in two reports (Dames & Moore, 1981a and 1981b).

Based on review of these data, cross sections were drawn at critical locations, and representative shear strength and unit weight values were assigned to the various materials comprising the embankments and their foundations. As documented in Appendix B4, preliminary analyses indicate that under normal conditions of static loading the proposed embankment slopes will be stable with adequate factors of safety.

A preliminary (conceptual) analysis also was performed to evaluate embankment stability under seismic (i.e., earthquake loading) conditions. Based on the seismic risk zonations and historic seismicity discussed in Appendix B4, the seismic design parameters adopted for conceptual remediation at this site are as follows:

- Two design basis earthquakes are selected to represent a nearby and a more distant event; the nearby event is taken as a magnitude 5.0 earthquake 15 km from the site, and the more distant event is taken as a magnitude 6.0 at 50 km. These events are conservatively assumed as approximately 0.5 magnitude greater and substantially closer to the site than the larger of the historic earthquakes in the region.

- The maximum horizontal ground acceleration at the site is taken as in the range of 0.03 to 0.07g, with the lower acceleration associated with the larger but assumed more distant magnitude 6.0 event.

- For any structures or facilities for which pseudo-static methods of analysis are appropriate, a seismic coefficient of 0.075 should be used.

Based on the available geotechnical data, the north-south reach of Embankment 1 separating Ponds 1 and 2 was identified as the appropriate slope for evaluation of the potential for instability under seismic loading. That embankment section is approximately 70 feet high, and is founded on up to approximately 25 to 30 feet of clayey silt tailings (i.e., slimes) over the native silty sandy gravels. The embankment itself is constructed of soft clayey or sandy silt tailings materials except for the uppermost portion where alluvial/colluvial gravels were used to top out the dam. Of the range of materials known at the site, the portions of this embankment and of the tailings in its foundation which are relatively soft or loose and also saturated are potentially most vulnerable to strength loss during an earthquake. These materials are predominantly clayey silts of low to moderate plasticity. Although judged susceptible to some strength loss under cyclic loading, the available data suggest that these materials do not meet the criteria cited in Finn, et al. (1994) characteristic of plastic fine-grained soils vulnerable to liquefaction or significant strength loss.

Ground-water levels are approximately 60 to 70 feet below the crest of Embankment 1 so that the phreatic line is low in the slope. This greatly enhances both static and seismic stability of the structure. The available data suggest, however, that the clayey silt slimes in the Embankment 1 foundation are saturated (based on piezometric levels observed in 1981-82), and thus potentially subject to pore pressure increase under seismic loading. It is also suggested by the available data that tailings for some distance above the phreatic line may be saturated under capillarity (i.e., negative or suction pressure), and also subject to pore pressure increases due to an earthquake of sufficient magnitude.

Given these estimated material properties and pore pressure conditions, preliminary seismic stability analysis was performed for Embankment 1 assuming shear strength reduction of 25 percent of the static strength in the potentially susceptible fine-grained foundation and embankment materials. This estimated strength loss is based on extensive prior experience with detailed in-situ and/or laboratory testing and dynamic analyses of similar materials. It is also commensurate with the seismic design parameters for the site described above. The preliminary seismic stability analysis indicates that a remediated embankment slope at 2H:1V would be stable for the conditions noted above with a factor of safety of 1.2. Using a remediated slope of 3H:1V would reduce driving forces and increase the factor of safety above 1.2. The preliminary assessment of regional seismicity and tectonics, seismic risk at the site, the resultant seismic design parameters, and the seismic stability analysis will be confirmed and refined during final design.

In contrast to the north-south reach, the Embankment 1 dike section along Silver Creek, and all of Embankment 3 were constructed using alluvial/colluvial gravel starter dikes, with subsequent raises comprised of gravels founded partially on previously placed gravel dike materials and partially on tailings. These dikes are thus inherently much more resistant to earthquake shaking than the Embankment 1 section that was constructed of and founded on tailings materials.

4.3.2.3 Reclamation Cover

The proposed reclamation cover at the Argentine tailings site comprises the following elements:

- *Placement of approximately 8,000 cubic yards of rock mulch on all exposed surfaces of tailings and mine waste associated with Pond 1 including appropriate seeding materials as follows: 6-inches on the surfaces of Pond 1; and 12 inches on the 3H:1V slopes of Embankments 1, and the waste rock slope below the mill buildings;*

- *Lime amendment and compaction of the upper 6 inches of the surface of Ponds 2 and 3 and the lower portion of the west side embankment 1;*

- *Placement of 24 inches of growth media including appropriate seeding materials over the lime amended surface of Ponds 2 and 3 and the lower portion of the west side of embankment 1; and*

- *Placement of materials as needed (field directed) to locally supplement previously remediated embankment slopes.*

The primary purposes of the rock mulch cover are to mitigate erosion of tailings and mine waste materials due to runoff and wind, and prevent direct human and environmental contact with the waste materials. Rock mulch for the Argentine tailings site will be derived from excavation from selected borrow sites. An acceptable range of gradations will be established as part of final design to specify this material. Lime amendment and placement of 24 inches of soil cover is provided primarily as an alternative to rock mulch cover to enhance the opportunity for open space use of portions of the site, and is considered to be equally effective as rock mulch for the reclamation cover. The final type of reclamation cover to be used on Ponds 2 and 3 will be determined during final design based on the availability of growth media material.

Available soil characterization data (Cedar Creek, 1995a) indicate the availability of proposed cover materials that are relatively clean, durable sandy gravels that will be resistant to erosion and weathering. Similar materials were placed as rock mulch on the streamside dikes above the riprap revetment during the 1981-82 drainage stabilization construction. The previously treated areas are in excellent condition after 13 years, with little evidence of erosion or disturbance, except at a few localized areas, particularly the upper end of Pond 2 along Silver Creek. Limited placement of rock mulch, possibly in combination with other erosion control measures to supplement the existing cover is anticipated in these areas where the original cover was apparently placed at an insufficient thickness. In addition, the rock mulch cover will be broadcast seeded following the recommendations provided by Cedar Creek (1995b).

4.4 Operations and Maintenance Plan and Monitoring

The VCUP should include: *"A remediation system operation and maintenance plan that describes, at a minimum, how the system will be operated to ensure that it functions as designed without interruptions and a sampling program that will be used to monitor its effectiveness in achieving the desired goal."*

4.4.1 Operations and Maintenance Plan

The proposed VCUP for the Argentine tailings site is intentionally comprised of remedial measures requiring the minimum practicable operations and maintenance (O&M) and maximum practicable service life consistent with the applicable performance objectives, regulatory requirements, and anticipated future land uses. An overview of the anticipated O&M for the major elements of the proposed remedy is presented here. The specific requirements for operation and maintenance will be refined as part of final design before implementation of the remediation.

No specific operations are required for the hydrologic control, slope stabilization or reclamation cover elements of the VCUP. The need for maintenance of these elements is also expected to be minimal, assuming that they are not subjected to loadings or disturbances for which they are not designed. An annual inspection by the property owners is recommended for the first five years after construction of the remedy to verify that the integrity of these measures has not been breached and/or to identify any conditions requiring maintenance (e.g., local disturbance of rock mulch cover or channel erosion protection). Additionally, an inspection should be made following severe precipitation events or earthquakes approaching the design basis events. The frequency and scope of inspections should be reevaluated after five years and modified as appropriate based on the performance of the remedy.

4.4.2 Monitoring Plan

A program to determine the impacts of the VCUP on water quality in the project area will include:

- Pre-VCUP water quality determination
- Post-VCUP confirmation sampling

All sampling will be performed according to specified methods in 40 CFR, Part 136; methods approved by EPA pursuant to 40 CFR, Part 136; or methods approved by the Division, in the absence of a method specified in or approved pursuant to 40 CFR, Part 136. The analytical method selected for a parameter will be the one that can measure the lowest detected limit for that parameter unless the stream standard for that parameter is within the testing range of another approved method.

4.4.2.1 Pre-VCUP Water Quality Determination

A pre-construction water quality sampling program will be conducted to further determine the baseline water quality of the seep discharge and adjacent areas of Silver Creek. Water quality will be determined from existing information and additional sampling analysis prior to construction to determine natural fluctuations in water quality of the seep and Silver Creek. Results of the water quality program will be used for the comparative assessment of post-VCUP surface water quality.

The pre-VCUP sampling program was implemented in the fall of 1995, will continue until start of construction, and includes the following sampling station locations, parameters and frequency of sampling:

1. **Sampling Locations**

   Seepage outflow below Pond 3
   Silver Creek instream above and below the Site

2. **Parameters**

Field	Laboratory
Flow rate (including Silver Creek when it can be safely waded)	Total-recoverable and dissolved:
pH	Iron
Temperature	Manganese
	Cadmium

Specific conductance	Copper
Total iron and dissolved iron (II)	Lead
Dissolved oxygen	Silver
Alkalinity	Zinc
	Total suspended solids
	Total dissolved solids
	Hardness
	Sulfate

3. **Frequency**

   Quarterly (weather and access conditions permitting)

4.4.2.2 Post-VCUP Sampling and Inspections

A post-VCUP confirmation sampling and inspection program will be conducted to determine the impacts of the project in reducing the quantity and quality of seepage water as compared with pre-VCUP water quality. Qualified personnel will conduct inspections concurrent with monitoring program sampling events. Such personnel will inspect all control measures identified in the VCUP to ensure that they are operating as designed. Results of each inspection and sampling event will be summarized in a written report, including scope of the inspection/sampling, personnel, date of inspection/sampling, major observations, any actions taken as a result of the inspection and/or sampling, and sampling results.

The water quality sampling program will be conducted for **two years** following completion of construction and include the following sampling station locations, parameters and frequency of sampling:

1. **Sampling Locations**

   Same as pre-VCUP water quality program

2. **Parameters**

   Same as pre-VCUP water quality program, except that only dissolved concentrations of the specified trace metals will be measured

3. **Frequency**

   Quarterly (weather and access conditions permitting)

4.4.2.3 Performance Assessment, Records and Reporting

An assessment of inspection and monitoring results will be performed to determine effectiveness of control measures in reducing metals loading and improving water quality. The assessment will take into account baseline water quality information, instream Silver Creek water quality immediately upstream and downstream of the site, and numeric water quality standards for Silver Creek (Dolores River Basin, Segment 9) effective May 30, 1995. Records of all assessment, inspection and monitoring information will be established and maintained by the applicants. Such information will be submitted to the Division. These reports will include conclusions, major observations, results of monitoring, site inspections reports and any follow-up activities, and assessment of the VCUP's effectiveness.

4.5 Management of Wastes Prior to Implementation of Remedial Action

"The plan should describe how the waste, or contaminated media will be managed prior to treatment, and/or disposal."

The remedial alternative for the tailings does not include treatment or removal and disposal at an offsite location. No formal management of the tailings facility is necessary, primarily due to the previous improvements made by Anaconda as previously described. Site access is monitored by a local caretaker provided by Rico Development Corporation to control unauthorized access. No trespassing signage is provided at the access road entrance. The site has been used and will be maintained as a tailings repository.

4.6 Hazardous Waste Generation

"The plan should discuss whether or not a hazardous waste will be generated by its implementation (e.g. through the excavation of contamination, which may have been discharged prior to 1980, but which would become a hazardous waste upon being dug up or managed), and the volume of this material. The plan should also describe how such hazardous waste will be managed in accordance with current state and federal hazardous waste regulations."

No hazardous waste will be generated by implementation of the VCUP.

4.7 Verification Sampling Program (Tailings)

"If applicable, the plan should describe the sampling program that will be used to verify that treatment of the contaminated media has resulted in a non-hazardous waste."

The proposed remedial alternatives for the Argentine tailings site does not include the treatment of the tailings materials. Therefore, a verification sampling program for the tailings is not applicable.

4.8 Remediation Risk Analysis

"The plan should discuss the potential risks associated with the proposed cleanup alternatives, and the economic and technical feasibility of these alternatives."

No significant short- or long-term risks have been identified for the remediation proposed in this VCUP. Short-term (implementation/construction period) risks will be typical of those for any earthmoving project, and are readily manageable so as to effectively avoid any significant environmental or health and safety consequences. As discussed in Section 4.3.1.3, construction controls will be fully implemented to protect Silver Creek, and undisturbed lands adjacent to the work areas and/or offsite from uncontrolled releases of sediment or mine waste. The technologies to be employed for the proposed remediation, and the construction control BMPs are simple, have been used successfully for decades, and are readily controlled and verified by on-site inspection and supervision of the work.

All on-site construction and related activities will be conducted in strict conformance with a Site-Specific Safety and Health Plan to be developed prior to mobilization. A Site Safety Officer will be designated to ensure that the requirements of the plan are met, and that safe work practices are implemented. Preliminary personal air monitoring and experience at other similar sites suggests that health risks will be minimal during earthmoving operations using appropriate BMPs.

Potential long-term risks to the integrity of the proposed remediation at the Argentine tailings site include natural processes or hazards such as erosion, floods and earthquakes, and man-induced disturbances such as inappropriate land use. The design of the various elements of the remediation to the standards identified in Section 4.2 and as described in Section 4.3 will effectively mitigate the potential for significant damage and/or release of contaminants from the sites under the design events adopted (e.g., 100-year/500-year flood; design basis earthquakes). The potential for man-induced disturbances is effectively addressed by land use and related institutional controls as described in Section 4.9.

The technical and economic feasibility of the proposed remediation at the Argentine tailings site derives from the nature, scope and relative simplicity of the design and implementation of the plan.

4.9 Land Use/Institutional Controls

The proposed land use for the site will be as a continued inactive tailings site with open space and light industrial use. Maintenance of this use will largely be self-implementing. ARCO and the current landowner Applicants will work together to ensure continued coordination and maintenance of the site. Some of the mechanisms currently being evaluated for the private parcels include application of Rico planning and development regulations, dedication of private land parcels to town ownership, use easements, restrictive covenants, and conservation easements.

4.10 Permit Requirements

The plan should identify all permits (Federal, state and/or local including, if necessary, EPA Form 8700-12-Notification of Hazardous Waste Activity, required on the generation of hazardous waste) that will be needed before the plan can be implemented.

Two general areas involving permitting or application of government standards have been identified:

1. NPDES/Dredge and Fill Permits. All work performed within the existing drainage will comport with appropriate U.S. Army Corps of Engineers ("Corps"), EPA and State standards under these programs, and the Applicants will continue to work closely with regulatory agencies on these matters. Although, formal government approval under the NPDES and Section 404 programs does not appear necessary based on current reclamation-based measures appropriate storm water notices will be provided. In any case, best management practices associated with construction activities along Silver Creek, including storm water controls will be employed.

2. Reclamation Standards. While no reclamation permit will be required from the Colorado Mine Land Reclamation Division ("MLRD") or other agencies, the applicants will consider and apply appropriate MLRD standards to those aspects of the project involving traditional reclamation activities.

4.11 Schedule of Implementation

The plan should include a schedule of implementation.

Implementation of remediation for the Argentine tailings site will begin immediately upon approval of the VCUP. The major required activities in their general order of implementation are:

- Final design engineering and preparation of construction documents
- Permitting
- Project procurement (bidding, negotiation, award)
- Construction

As appropriate, certain of these activities and/or specific sub-activities would be performed with overlap or concurrently. It is anticipated that engineering through permitting should be achievable within six months of the start date. Project procurement can be completed in no more than three months. These activities generally are not seasonally (weather) dependent, with the exception of final design field investigations and site surveying. Construction, on the other hand, is highly dependent on weather.

The construction season at the Argentine tailings site is reasonably assumed as from May 15 to October 15, representing the time of year which is typically above freezing during the day. Snow-free conditions are expected by at least mid-June most years; mobilization and some preparatory work could be done as the spring melt finishes. A variation of plus or minus two to three weeks on both ends of this assumed construction season is probable. The duration of construction activities is estimated at 3.5 to 4 months.

The total duration of the project is strongly influenced not only by the durations of various tasks, but also the start dates of seasonally dependent activities. If, for example, final design investigations and site surveys cannot begin before weather sets in the late fall, then design and preparation of construction documents would be delayed until the following summer. Similarly, if pre-construction activities delay the potential start of construction until too late in the summer, it may be necessary to delay work until the following spring or summer. In general, the construction would not be split between two seasons due to potential damage to uncompleted parts of the work, greater risk of off-site sediment releases, and higher costs associated with winterization, remobilization and repair of any damaged work.

Given the factors and conditions discussed above, the required 24 month time limit for implementation of the remedial measures at the Argentine tailings site can be attained, assuming the following conditions are met:

- Any necessary permits are attained in a reasonably timely manner (within no more than 6 months from initial submittal of permit applications);
- The construction seasons identified above are not significantly impacted by extremely severe weather;
- Any necessary reviews of construction drawings and technical specifications are performed in a timely manner; and
- Seasonally dependent activities are not delayed into the following year.

4.12 References

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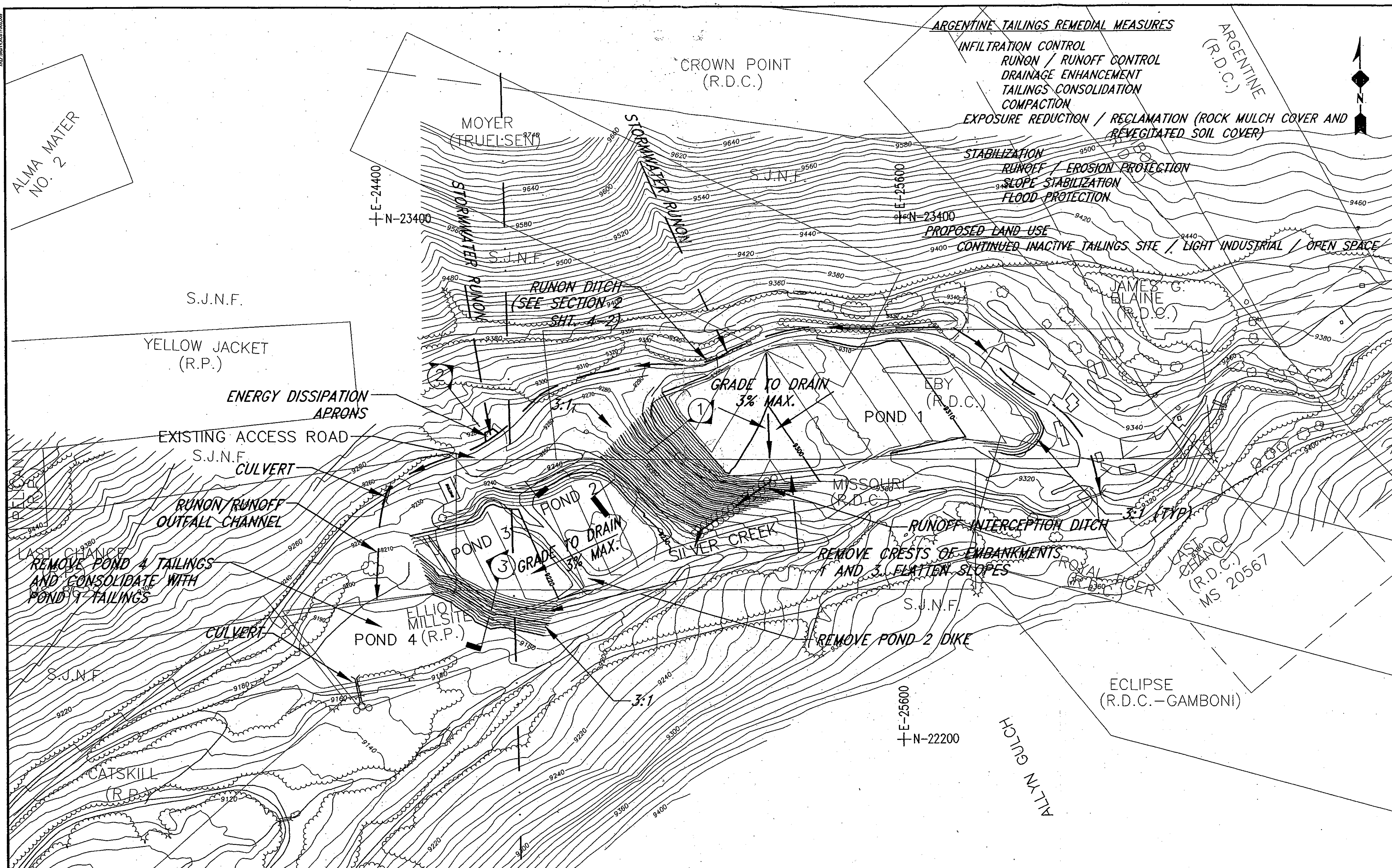
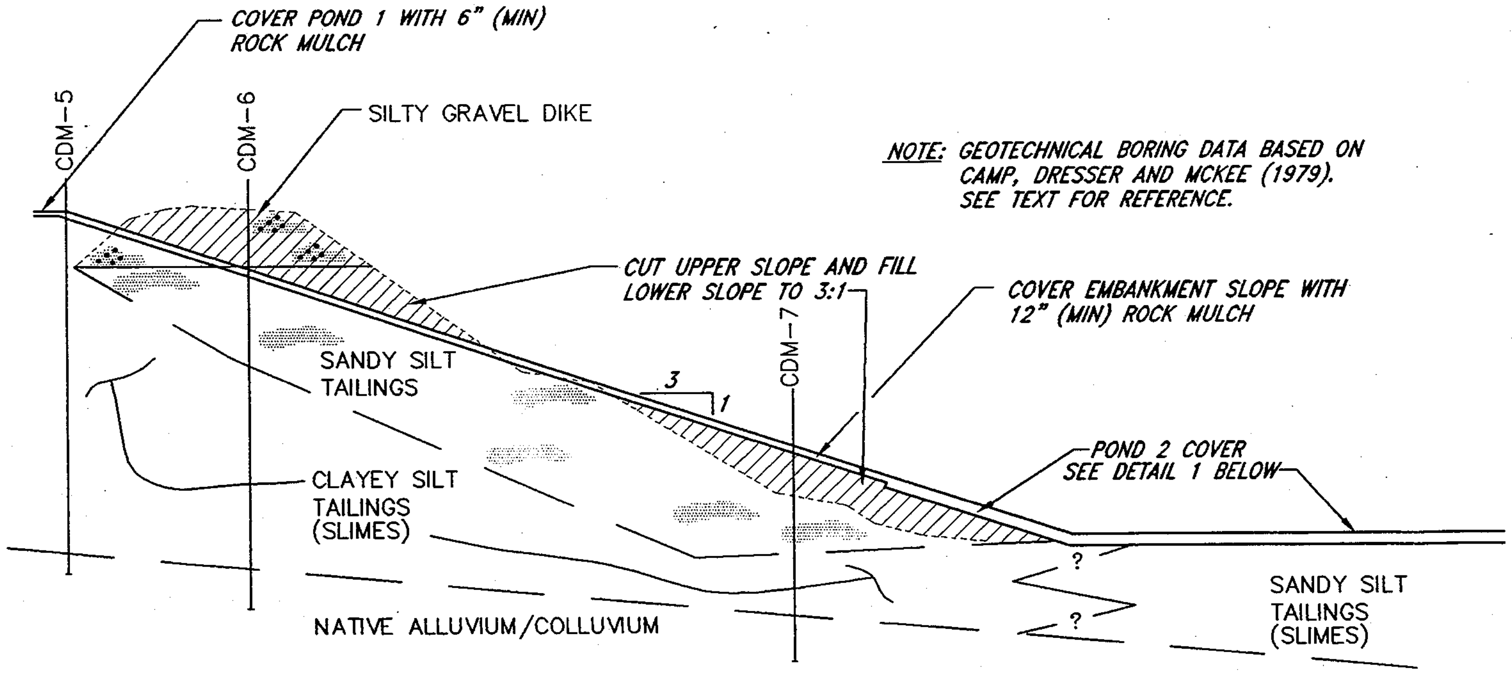


TOPOGRAPHY BASED ON OLYMPUS AERIAL PHOTOGRAPHS, OCT. 27, 1994

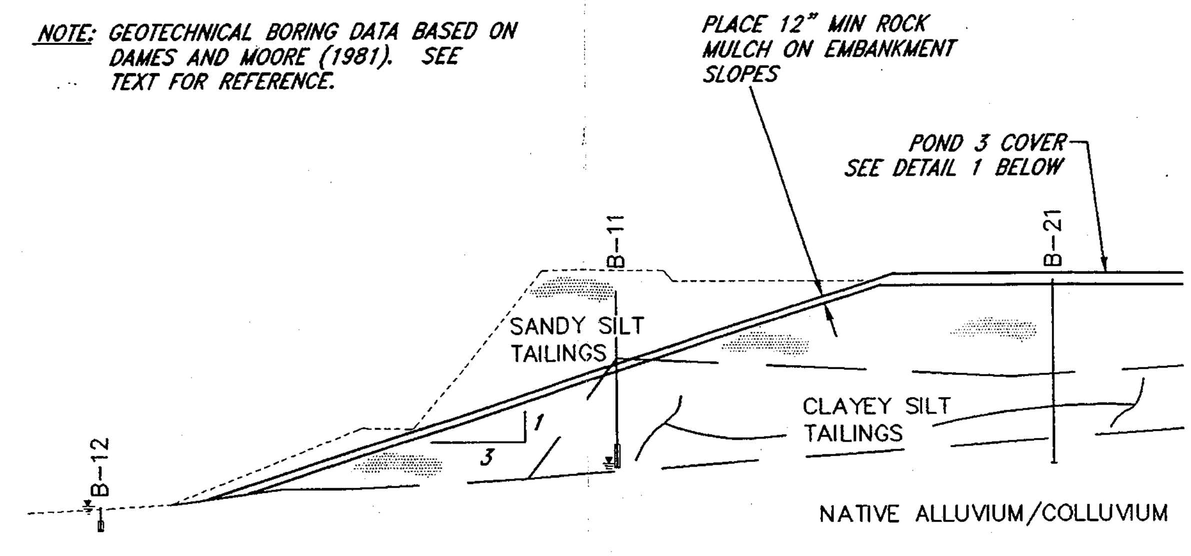
SCALE HORIZ: 1"=200' VERT: N/A
SCALE IN FEET 0 100 200

REMEDIAL MEASURES
ARGENTINE TAILINGS SITE PLAN

Figure 4-1



SECTION 1



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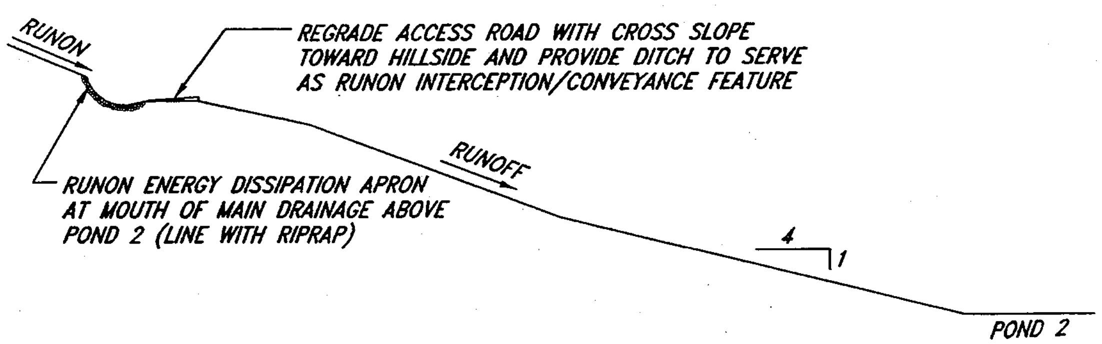

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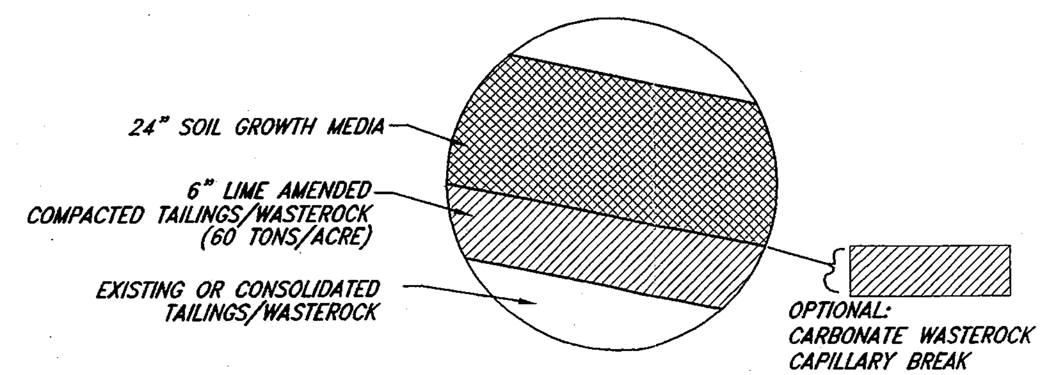

DETAIL 1

INFILTRATION CONTROL/ RECLAMATION COVER

SCALE		
HORIZ: 1"=40' VERT: 1"=40' SCALE IN FEET 0 20 40	REMEDIAL MEASURES ARGENTINE TAILINGS CROSS SECTIONS (PIPELINE ALT.)	Figure 4-2