FINAL
EXPANDED ENGINEERING EVALUATION/
COST ANALYSIS
FOR THE
PARK MINE SITE

Prepared for:

Mr. Vic Andersen and Mr. Joel Chavez
Montana Department of Environmental Quality
Abandoned Mine Reclamation Bureau
2209 Phoenix Avenue
Helena, MT 59620

Prepared by:

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, MT 59702

RECEIVED
JAN 22 1997
Department of
Environmental Quality
Remediation Division

JANUARY 1997

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd.)

TABLE OF CONTENTS (cont'd.)

Page

TABLE OF CONTENTS (cont'd.)

TABLE OF CONTENTS (cont'd.)

TABLE OF CONTENTS (cont'd.)

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (cont'd.)

1.0 INTRODUCTION

1.1 PURPOSE AND OBJECTIVES

This Expanded Engineering Evaluation/Cost Analysis (EEE/CA) was prepared for the Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau (DEQ/AMRB) by Pioneer Technical Services, Inc. (Pioneer), under the Engineering Services Agreement DSL 94-006, Task Order No. 51.

The primary purpose of this report is to present the detailed analysis of reclamation alternatives in accordance with the National Contingency Plan (NCP). In addition, the site background, waste characteristics, applicable or relevant and appropriate requirements (ARARs), risk assessment, and the development and screening of alternatives are presented herein. The purpose for providing this supplemental information to the detailed analysis of alternatives is to give the reviewers and risk managers a comprehensive, "stand-alone" decision making tool.

The Park/Marietta Mine and Millsite is a lode deposit mine located in the Indian Creek (also known as Park) Mining District approximately 12 miles west of Townsend, Montana, in the Elkhorn Mountains. Several mines were developed in the Park/Marietta area including the Gold Dust, Little Annie, Bullion King, Park/New Era, and Venezuela. Elevations at the site range from approximately 7,000 to 7,400 feet. The Park site is located in the Northeast ¼ of Section 15, Township 7 North, Range 1 West in Broadwater County, Montana (Figure 1-1). Portions of the Bullion King site, located just north of the Park site, are also included as part of this evaluation. The Park/Marietta area has been mined actively at various periods of time since the late 1870's, with the most intensive mining occurring from 1880 to 1908. The Marietta group was mined intermittently from 1933 to 1949 when production resumed through at least 1966. In 1905 a 50-ton cyanide plant was constructed to treat ores from the Park/New Era property, and in 1959 a 200-ton flotation mill was constructed at the Marietta property. The Park Mine and Millsite is located at the headwaters of Indian Creek, a tributary to the Missouri River. Indian Creek flows east out of the Elkhorn Mountains to the Canyon Ferry Reservoir.

Additional information regarding this site is available in the 1993 and 1994 DEQ/AMRB Abandoned Mine Hazardous Materials Inventory Forms for the sites (DEQ/AMRB-Pioneer, 1993 and 1994), the Park Mine Reclamation Investigation Work Plan (DEQ/AMRB-Pioneer 1996a), the Park Mine Reclamation Investigation Field Sampling Plan (DEQ/AMRB-Pioneer 1996b), and the Park Mine Final Reclamation Investigation Report (DEQ/AMRB-Pioneer 1996c).

1.2 REPORT ORGANIZATION

This report is organized into 11 sections. The contents of the remaining sections are briefly described in the following paragraphs.

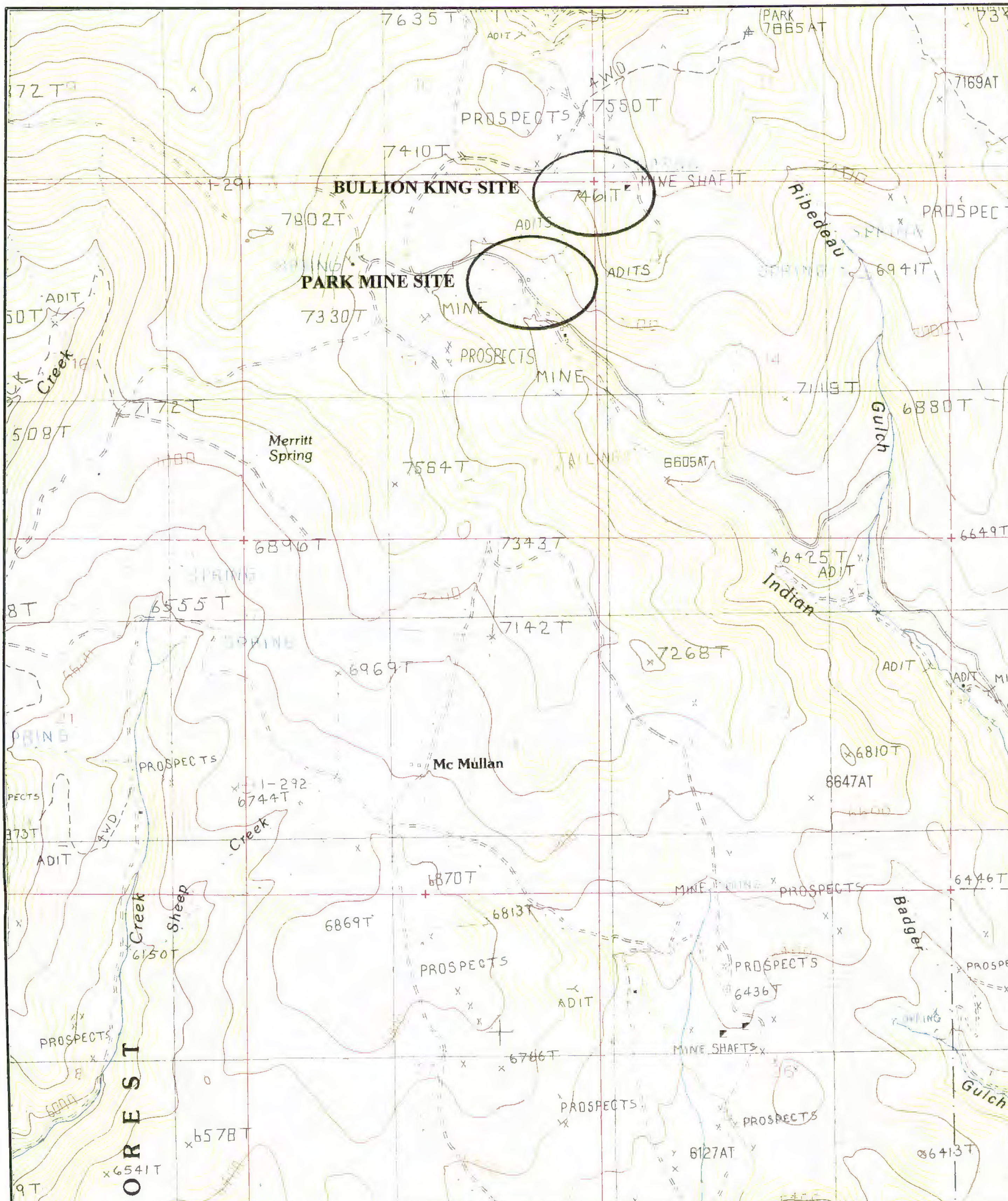


FIGURE 1-1
SITE LOCATION MAP
(Giant Hill, MT)

PIONEER TECHNICAL SERVICES, INC.

SCALE: 1"=2000'
DATE: 4/96

PRK101

SECTION 2.0 BACKGROUND - presents a background description of the Park Mine and Millsite. Significant site features; a detailed history of past mining and milling activities; geologic, hydrologic, and climatic characteristics of the sites; the biological setting, such as the wildlife and fisheries resources and the vegetation indigenous to the area; and threatened and endangered species concerns, as well as the cultural setting issues, such as present and future land uses, are described in this section.

SECTION 3.0 WASTE CHARACTERISTICS AND SUMMARY OF EXISTING SITE DATA - describes the characteristics of the wastes present at the site, including types, volumes, and contaminant concentrations, as well as an evaluation of existing data derived from previous reclamation and response actions and investigations.

SECTION 4.0 SUMMARY OF THE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS - presents the Montana State and Federal government requirements which are considered applicable or relevant and appropriate (ARAR) for the reclamation effort. Requirements discussed in this section are chemical-, location-, and action-specific in nature.

SECTION 5.0 SUMMARY OF THE RISK ASSESSMENT - presents a summary of the risk assessment performed for the site.

SECTION 6.0 RECLAMATION OBJECTIVES AND GOALS - presents the reclamation objectives and applicable clean-up standards.

SECTION 7.0 DEVELOPMENT AND SCREENING OF RECLAMATION ALTERNATIVES - identifies and screens potentially applicable reclamation alternatives. Reclamation alternatives are evaluated based on effectiveness, implementability, and cost.

SECTION 8.0 DETAILED ANALYSIS OF ALTERNATIVES - presents the detailed analysis of alternatives against the seven NCP criteria.

SECTION 9.0 COMPARATIVE ANALYSIS OF ALTERNATIVES - presents a comparative analysis of consistent with the NCP.

SECTION 10.0 PREFERRED ALTERNATIVE - presents the preferred alternative and summarizes the reasoning behind the choice of this alternative.

SECTION 11.0 REFERENCES - lists the references cited in the text.

2.0 SITE BACKGROUND

The Park Mine and Millsite is located in Broadwater County, Montana, 12 miles west of Townsend, Montana in the Northeast ¼ of Section 15, Township 7 North, Range 1 West (Figure 1-1). The project site lies on patented mining claims within the Helena National Forest in the Elkhorn Mountains. The topography in the area is mountainous with the elevations at the site ranging from approximately 7,000 to 7,400 feet.

The site can be accessed by traveling north on Highway 287 from Townsend, Montana, to the Indian Creek Road and following this road approximately 12 miles west to the mine site. The roads are maintained by the U.S. Department of Agriculture/Forest Service (USFS) or Jefferson County road crews. Land surrounding the mine site is primarily timbered forest land used for logging, livestock grazing, wildlife habitat and recreation. Some logging has been conducted in the area near the site recently.

2.1 SITE HISTORY

2.1.1 Mining History

Interest in mining in the Indian Creek area began with the discovery of gold placers in Indian Creek and other nearby areas in 1866 and 1867. The lode deposits in the Indian Creek (also known as Park) Mining District were discovered in the late 1870's. The Park/Marietta Mine area was intensively developed from 1880 to 1908 and included several mines, including: the Gold Dust, Little Annie, Bullion King, Park/New Era, and Venezuela. The Marietta group was intermittently mined from 1933 to 1949 when production resumed at least through 1966. In 1905 a 50-ton cyanide plant was built to treat ores from the Park and New Era properties, and in 1959 a 200-ton floatation mill was constructed at the Marietta property. Total production of the Indian Creek Mining District was valued in excess of $2,500,000.

2.1.2 Reclamation History

Minor reclamation activities have been conducted at the site. Groundwater discharge from one collapsed adit (GW-1) has been diverted to a small pond above waste rock dump #2.

2.2 CURRENT SITE SETTING

2.2.1 Location and Topography

The Park/Marietta Mine and Millsite are located in the Indian Creek Mining District of Broadwater County. The legal description of the site is Township 7 North, Range 1 West, Northeast ¼ of Section 15; latitude and longitude are North 46° 21' 53" and West 111° 42' 21", respectively. All of the mine workings are located on the north side of the Main Fork of the Indian Creek drainage. The site is located on Helena National Forest property and ranges in elevation from approximately 7,000 to over 7,400 feet above mean sea level. The terrain surrounding the site is generally rugged, consisting of relatively steep (20 to 30 degrees) partly timbered slopes.

2.2.2 Climate

Like most of western Montana, the Indian Creek drainage is subject to a cool and dry continental-dominated climate. The region's temperature is generally low and is marked by wide seasonal and daily variations. During winter, the temperature frequently falls below zero degrees Fahrenheit (°F), with extended periods of temperatures lower than 30°F. During summer, several days get fairly hot, but due to the generally arid climate and lightness of the mountain air, the temperature usually remains relatively low (seldom exceeding 80°F) and drops suddenly at nightfall. Precipitation is not abundant in the region (averaging approximately 25 inches annually), and approximately half of the annual precipitation falls as snow during winter (from 200 to 300 inches total average annual snowfall). Stormy weather usually brings the first snow during September; however, these "equinoctial storms" are generally succeeded by several weeks of fair weather. By October or November, the area is usually blanketed with snow. Heavy snows are frequent in the winter, as are periods of melting and freezing which occur as a result of warm chinook winds that occasionally blow from the west. The snowpack generally remains in the area for seven months or longer, with spring thaw occurring in May or June.

The area is subject to a distinct spring/summer rainy season with May or June usually being the wettest month of the year. On average, May and June each receive 3.2 and 3.3 inches of precipitation, respectively. The frost free-period (32°F or more) averages approximately 90 to 100 days annually, from mid-June to late mid-September (MAPS, 1995).

2.2.3 Geology, Hydrogeology, and Hydrology

2.2.3.1 Regional Geologic Setting

The Park/Marietta group of mines are located within the Northern part of the Indian Creek Mining District (also known as the Park), 9 miles west of Townsend, Montana. The district is on the eastern slope of the Elkhorn Mountains in Broadwater County, Montana. This area of the Elkhorn Mountains is composed of predominantly Upper Cretaceous volcanic rocks, mostly andesite flows, tuffs, and breccias. Several scattered Tertiary intrusive stocks invade the volcanics and are correlative in time and composition with the Boulder batholith. Mesozoic sedimentary rocks occur near the base of the mountains, several miles to the north and east of the district (Reed, 1951).

2.2.3.2 Local Geologic Setting

The Park/Marietta group of mines produced ore from several moderately dipping, north- and northeast trending lenticular veins in the Elkhorn Mountains Volcanics and associated intrusives (basic dikes). Most of the ore has come from the Marietta and Blue veins, which contain pyrite, arsenopyrite, galena, sphalerite and sparse chalcopyrite in a gangue of quartz, siderite, ankerite, and manganiferous carbonate (rhodochrosite). The Blue vein has been stoped for a length of 200 feet over a vertical distance of 150 feet, while the Marietta vein zone has been mined for 700 feet through a vertical distance of 250 feet. High grade silver-lead ore was reportedly mined from a near vertical pipe at the Bullion King mine, 1,000 feet northeast of the Marietta.

2.2.3.3 Hydrogeologic Setting

No published hydrogeologic information specific to this area was located. The conclusions regarding hydrogeologic conditions are, therefore, based on accepted hydrologic and geologic principals and local observations. The Park/Marietta Mine is located within the Main Fork of the Indian Creek basin. The site is approximately one mile south of a divide separating it from the Whitehorse Creek basin to the northeast and the Beaver Creek basin to the north. The Indian Creek basin drains south and east into the Missouri River near Townsend.

The hydrogeologic system contains two components: the andesite bedrock and the Quaternary to Recent alluvium valley fill. The andesite bedrock is fractured by post-emplacement faults and joints. This intense fracturing has likely resulted in a fairly permeable and transmissive bedrock aquifer system. The alluvial deposits are small and discontinuous and likely transmit both surface water from local streams and discharging bedrock groundwater.

Groundwater is present in the area at a shallow depth, evidenced by three discharging adits and numerous springs on the flanks of Indian Creek. Groundwater flow likely follows local stream gradients and topography, with groundwater discharging into gaining alluvial streams. This type of discharge is typical of high-mountain drainage systems. Local bedrock fault systems probably exert some control on the direction and rate of groundwater flow, as do the extensive underground workings associated with the mines in the area.

2.2.3.4 Surface Water Hydrology

Surface hydrology in the vicinity of the site is part of the Main Fork of Indian Creek. The site is located adjacent to, and in the headwaters of, Indian Creek, which flows approximately five miles downstream (southeast) from the site before merging with the West Fork of Indian Creek. From there, Indian Creek flows approximately seven miles east to the Missouri River.

The drainage basin of Indian Creek above the site is moderately steep, partially forested ground. The area of this drainage basin covers approximately 720 acres (1.12 square miles). Although this reach of Indian Creek is not gauged, the U.S. Geological Survey (USGS) Revised Techniques for Estimating Magnitude and Frequency of Floods in Montana (USGS Open-File Report 81-917) has been used to estimate the peak flood events in Indian Creek as follows:

Q_2 = 3.7 cubic feet per second (cfs);
Q_{10} = 11.4 cfs;
Q_{20} = 16.9 cfs;
Q_{50} = 21.6 cfs; and
Q_{100} = 27.2 cfs.

The designation "Q_2" above represents the magnitude of the estimated peak flow rate observed in Indian Creek for a flooding event with a two-year frequency return period.

2.2.4 Vegetation and Wildlife

Grassland, riparian and timbered communities occur in the area surrounding the Park site. Much of the area is fairly continuously timbered (Lodgepole pine, Subalpine fir, Engelmann spruce, and Douglas fir), although the majority of the timber in the direct vicinity of the site was burned during a 1988 forest fire in the area. The wooded area adjacent to this site supports a Douglas Fir/Pinegrass association (Pfister et al, 1977). The natural vegetation of the grasslands is Idaho Fescue/Bluebunch Wheatgrass (Mueggler and Stewart, 1980). No sensitive, threatened, or endangered plant species were found at the site. A list of plant species found in the vicinity is presented in Appendix B.

Riparian areas occur in the study area along small tributaries forming the headwaters of Indian Creek. The riparian communities are classified as Drummonds Willow/Tufted Harigrass Habitat types (Hansen et al. 1995). Most of the riparian areas on the site are affected by the mine waste and are non-functioning.. Areas above the site are functioning, but the areas area at risk because of browsing and grazing pressure.

Two species of noxious weeds occur at the site: Dalmatian Toadflax and Canada Thistle. Presently, these plants occur in small patches along roads and on waste rock. Care should be taken during reclamation to prevent the populations from spreading. Control with herbicides is appropriate because the plants occur away from surface water.

The area surrounding the site is important habitat for a variety of big game animals, fur bearers, and birds, including: elk, mule deer, moose, black bear, mountain lion, bobcat, and mountain grouse. Bighorn sheep have been transplanted in the Sheps Gulch area approximately three miles south of the site. However, no threatened or endangered species are known to frequent the area.

2.2.5 Historic or Archaeologically Significant Features

Cultural resources requirements were completed in accordance with Section 106 of the National Historic Preservation Act. All documentation is a part of the administrative record and is available at the Montana Department of Environmental Quality, Abandoned Mines Reclamation Bureau.

2.2.6 Land Use and Population

The current land use of the area surrounding the Park/Marietta Mine is primarily recreational. The Elkhorn Mountain range receives heavy big game and bird hunting usage. The area also receives use by recreational hikers, mountain bike riders and hunters.

3.0 WASTE CHARACTERISTICS AND SUMMARY OF EXISTING SITE DATA

The Park/Marietta site has been undergoing various stages of investigation by the DEQ/AMRB since 1993. Findings of the past site investigation activities are summarized below. A more detailed Reclamation Investigation was completed in 1996, and results of the 1996 investigation are presented in detail following this section.

At the Park/Marietta site, four uncontained waste rock dumps, and two small tailings deposits are situated within approximately 50 feet of Indian Creek (WR-1, -2, -7, -8, and TP-1 and -2). These waste piles appear to be causing the vast majority of the sedimentation and water quality problems in Indian Creek from the site. The upper workings of the mine area (consisting of five additional waste rock dumps of varying size) are located on fairly steep terrain, out of the immediate floodplain. Due to the distance involved, the upper waste dumps do not appear as significant sources of sedimentation or metals loading to Indian Creek, although some dumps are located in an intermittent drainage, providing a direct run-off pathway during wet periods.

According to the 1993 DEQ/AMRB Hazardous Materials Inventory, the volume of tailings located at the site was estimated to be approximately 60 cubic yards (cy). The total volume of waste rock located on-site was estimated to be approximately 65,000 cy. Nine separate waste rock dumps were inventoried at the site during the 1993 investigation, and two additional dumps were inventoried during the 1994 inventory of the Bullion King site (DEQ/AMRB-Pioneer, 1993 and 1994).

Sampling conducted at the site in 1993 indicated that arsenic and lead levels were elevated in the tailings at least three times the concentrations detected in background soil samples. The 1993 sampling also indicated that arsenic, cadmium, copper, mercury, lead, antimony, and zinc levels were elevated in the waste rock dumps at least three times the concentrations detected in background soil samples.

Three discharging adits are located at the site with flows ranging from less than 1 to greater than 35 (gpm), two of which eventually flow into Indian Creek. Two of the discharges were sampled during the 1993 inventory, and both discharges exhibited low pH values (<4.5). The maximum contaminant level (MCL) for arsenic and cadmium, the acute aquatic life criteria for arsenic, cadmium, copper, and zinc, and the chronic aquatic life criteria for arsenic, cadmium, copper, lead, and zinc were exceeded in both of the discharge samples submitted for laboratory analyses. The third discharging adit was sampled in 1994 as part of the Bullion King site, which is directly north of the Park site; this discharge does not reach surface water. No MCLs were exceeded in the discharge; however, the acute and chronic aquatic life criteria for cadmium, copper, and zinc, and the chronic aquatic life criteria for mercury and lead were exceeded.

Sediment samples collected upstream and downstream from the site in Indian Creek indicated that numerous heavy metal contaminants are entering the surface water system as suspended sediment from the physical transport of fine-grained mineralized waste rock/tailings (via erosion and run-off). The concentrations of arsenic, cadmium, copper, manganese, lead, and zinc were significantly elevated (>3 times) in the downstream sediments when compared to the upstream sediments.

Surface water samples collected upstream and downstream from the site documented observed releases of arsenic, cadmium, manganese, lead, and zinc into Indian Creek. Additionally, the MCLs for arsenic and cadmium were exceeded in the downstream sample, as were the acute and chronic aquatic life criteria for cadmium, copper, and zinc. Additionally, the chronic aquatic life criteria for lead and mercury were exceeded in the downstream sample. These exceedences were all directly attributable to the site.

Sampling of the adit discharges (GW-1, GW-2, and GW-BK) and an additional, previously unsampled discharge (GW-4) at waste rock dump #4 was performed in 1995 and each were analyzed for total and dissolved metals as well as iron speciation (Fe^{2+}/Fe^{3+}). The 1995 sample from GW-2 was also analyzed for arsenic speciation (As^{3+}/As^{5+}).

These samples showed that the lower discharges (GW-1 and GW-2) exceed the following water quality standards: MCLs for arsenic, cadmium, lead, and zinc; acute and chronic aquatic life criteria for cadmium, copper, and zinc; and chronic aquatic life criteria for arsenic, lead, and iron (no acute iron standard). The upper discharge (GW-4) exceeds the following standards: MCLs for arsenic, cadmium, and lead; acute and chronic aquatic life criteria for cadmium, copper, and zinc; and chronic aquatic life criteria for lead. The Bullion King discharge (GW-BK) exceeds the following standards: MCLs for cadmium and lead; acute and chronic aquatic life criteria for cadmium, copper, and zinc;. and chronic aquatic life criteria for lead and iron.

Comparing the total metals concentrations to the dissolved metals fraction at the lower discharges showed the following distribution: 2-3% of the As, 100% of the Cd, 86-99% of the Cu, 14-18% of the Fe, 10-100% of the Pb, and 100% of the Zn are in the dissolved phase. Additionally, 17% (GW-2) to 75% (GW-1) of the total Fe is in the 2+ oxidation state (reduced), while 58% of the total As in GW-2 is in the 3+ oxidation state (reduced). These data indicated that the GW-1 discharge is fairly well oxidized while the GW-2 discharge is only partially oxidized; however, all contaminants except As and Fe are not precipitating, and are remaining mostly in the dissolved phase.

3.1 MINE WASTE SOURCES

The following sections discuss each individual mine waste source present at the Park site. Figure 3-1 shows the location of each source, illustrates the major site features (topography, roads, waste sources, surface water, drainage patterns, etc.), and indicates the location of each sample collected at the site during the RI field activities.

3.1.1 Waste Rock

Ten waste rock piles were identified at the site, nine of which were sampled. Samples were collected from test pits dug with an excavator. Table 3-1 indicates the total depth of the test pit and gives a brief description of the physical characteristics observed in each test pit. The following paragraphs describe access and anticipated reclamation alternatives for each waste rock pile. Each sample location included at least one composite sample for laboratory and acid-base accounting (ABA), and agronomic analyses. This information will be used to establish the requirements and suitability of establishing vegetation directly on the waste rock materials, should that become a preferred reclamation alternative.

All of the waste rock piles contain metals at elevated (>3 times background) concentrations; waste rock piles WR3, WR8, and WR10 failed TCLP analyses for lead and some have considerable acid-producing potential. Table 3-2 includes a summary of these features, including estimated volumes, estimated surface areas, metals at concentrations greater than three times background, TCLP metals above regulatory limits, pH of the composite samples, organic matter content, and amount of lime required to establish vegetation.

The ABA and SMP buffering capacity results indicate that most of the waste rock materials are considered potential acid producers and lime requirements would range from 3 to 216 tons of lime per acre to successfully establish vegetation (assuming a 12-inch depth of incorporation). The pH of the waste rock dumps range from 2.5 to 7.4; many state regulatory programs consider pH levels less than 5.5 as unsuitable for plant growth. Organic amendment of the dump materials will likely be necessary due to the very low organic matter content (0.7% to 1.1%). In addition to providing temporary stabilization of the disturbed erodible surfaces, application of wheat or barley straw mulch would assist in providing the necessary organic material to help promote successful revegetation.

Using the agronomic data obtained, fertilizer recommendations are detailed for in-place revegetation of each waste rock dump. The breakdown of the revegetation requirements, as presented in each section, should be considered preliminary at this time (for planning purposes only). The waste rock dumps will be re-sampled, and the results will be re-evaluated after construction activities have been implemented and each dump has been removed or recontoured, amended, and prepared for revegetation.

3.1.1.1 <u>Waste Rock Dump #1</u>

Waste rock dump #1 (WR1) is located on the west side of Indian Creek and has a small vegetated buffer zone between it and the creek. Vehicle access to WR1 is via a side road off of the Indian Creek Road.

One test pit was dug in WR1. Material in the hole was unconsolidated and rocky, causing significant caving of the pit walls during excavation.

TABLE 3-1: PARK MINE AND TAILINGS (04-012) SOURCE SAMPLING SUMMARY

SOURCE	SAMPLE NO.	SAMPLE DEPTH (feet)	DESCRIPTION	pH	RADIOACTIVITY (mR/hr)	TAL	ABA	TCLP	CYANIDE	AGRONOMIC	PHYSICAL
BACKGROUND SOIL	04-012-BG1	0.0 - 0.3	Background sample collected in intrusive approximately 200' above WR3 adjacent to cliff.			Table A-1					
	04-012-BG2	0.0 - 0.3	Background sample collected approximately 250' above and south of WR5.			Table A-1					
	04-012 BG3	0.0 - 0.3	Background sample collected in meadow approximatey 50' east of GW 5.			Table A-1					
	04-012-BG4	0.0 - 0.3	Background sample collected approximately 50' above road above Bullion King mine (WR-9).			Table A-1					
	04-012-BG5	0.0 - 0.3	Background sample collected on south edge of clearcut above northwest part of site			Table A-1					
WR-1	04-012-WR1-C1	0.0 - 0.5	Southern end of WR1, lower level in face; gold brown and red brown medium-grained clayey sand with cobbles.	6.8	0.045	Table A-1					
	04-012-WR1-C2	22.0 - 23.0	Southern end of WR1, lower level in face; underlying soil, brown black silt with lots of cobbles.	6	0.050	Table A-1					
	04-012-WR1-C3	0.0 - 22.0	Southern end of WR1, lower level in face; gold brown and red brown medium-grained clayey sand with cobbles.	6.6	0.035	Table A-1					
	04-012-WR1-C4	0.0 - 22.0	Southern end of WR1, lower level in face; gold brown and red brown medium-grained clayey sand with cobbles.	6.6	0.035			Table A-2		Table A-4	Table A-5
	04-012-WR1-1	0.0 - 22.0	Southern end of WR1, lower level in face; gold brown and red brown medium-grained clayey sand with cobbles.	6.6	0.035		Table A-3				
WR-2	04-012-WR2-C1	0.0 - 0.5	Surface sample, composite of WR2-1 and WR2-2.			Table A-1					
	04-012-WR2-C2	16.5 - 19.0	Underlying soil, composite of WR2-1 and WR2-2.			Table A-1					
	04-012-WR2-C3	0.0 - 18.5	Composite of WR2-1 and WR2-2.			Table A-1					
	04 012-WR2-C4	0.0 - 18.5	Composite of WR2-1 and WR2-2.					Table A-2		Table A-4	Table A-5
	04-012-WR2-1	0.0 - 18.5	In base of WR2 approximately 12 feet from creek; red brown clayey silt to clayey sand with lots of cobbles.				Table A-3				
	04-012-WR2-2	0.0 - 16.5	Flat area by cement foundation adjacent,medium brown silt with many cobbles.				Table A-3				
	04-012-WR2-1A	0.0 - 0.5	In base of WR2 approximately 12 feet from creek; red brown clayey silt with many cobbles.	5.8	0.035						
	04-012-WR2-1B	0.5 - 18.5	In base of WR2 approximately 12 feet from creek; red brown clayey silt to clayey sand with lots of cobbles.	6	0.050						
	04-012-WR2-1C	18.5 - 19.0	In base of WR2 approximately 12 feet from creek; underlying soil, 8 inches of dark brown clayey loam with burnt wood.	5.2	0.040						
	04-012-WR2-2A	0.0 - 0.5	Flat area by cement foundation adjacent; medium red brown silt with many pebbles.	6.7	0.040						
	04-012-WR2-2B	0.5 - 16.5	Flat area by cement foundation adjacent; mainly medium brown silt with many cobbles.	5.9	0.050						
	04-012-WR2-2C	16.5 - 17.0	Flat area by cement foundation adjacent; underlying soil, black clayey silt with some organics and rocks, very wet.	4	0.030						
WR-3	04-012-WR3-C1	0.0 - 0.5	On top of main lobe, surface sample.	7	0.055	Table A-1					
	04-012-WR3-C2	19.5 - 20.0	On top of main lobe, underlying soil.	5.7	0.060	Table A-1					
	04-012-WR3-C3	0.0-19.5	On top of main lobe, composite of red brown silty sand and yellow silty clay both with rocks, timbers present in hole.	6	0.050	Table A-1					
	04-012-WR3-C4	0.0-19.5	On top of main lobe, composite of red brown silty sand and yellow silty clay both with rocks, timbers present in hole.	6	0.050			Table A-2		Table A-4	Table A-5
	04-012-WR3-C5	0.0-19.5	On top of main lobe, red brown silty sand with rocks, timbers present in hole.	6.6	0.045	Table A-1					
	04-012-WR3-C6	0.0-19.5	On top of main lobe, yellow silty clay with rocks, smells of sulfides, timbers present in hole.	5.8	0.040	Table A-1					
	04-012-WR3-1	0.0-19.5	On top of main lobe, composite of red brown silty sand and yellow silty clay both with rocks, timbers present in hole.				Table A-3				
WR-4	04-012-WR4-C1	0.0 - 0.5	Surface sample, composite of samples 4-1A and 4-2A.	5.2	0.05	Table A-1					
	04-012-WR4-C2	12.5-13,2.5-3.5	Underlying soil, composite of samples 4-1C and 4-2U1.	<3.5	0.035	Table A-1					
	04-012-WR4-C3		Composite of waste rock samples from 4-1 and 4-2.	5	0.045	Table A-1					
	04-012-WR4-C4		Composite of waste rock samples from 4-1 and 4-2.	5	0.045			Table A-2		Table A-4	Table A-5
	04-012-WR4-C5	4.5 - 5.5	Underlying soil from 1.0 to 2.0 feet below waste rock in 4-2.	<3.5	0.055	Table A-1					
	04-012-WR4-1	0.0 - 12.5	East of wooden structures, on top of WR4				Table A-3				
	04-012-WR4-2	0.0 - 3.5	Composite of 3 shallow holes dug in base of WR4, 4-2A, 4-2B and 4-2C.				Table A-3				
	04-012-WR4-1A	0.0 - 0.5	East of wooden structures, on top of WR4; very rocky brown fine-grained sand.	5.6	0.035						
	04-012-WR4-1B	0.0 - 12.5	East of wooden structures, on top of WR4; reddish brown sand with some clay, mostly cobbles.	4	NM						
	04-012-WR4-1C	12.5 - 13.0	East of wooden structures, on top of WR4; underlying soil, tan silt with rocks.	4.8	0.045						
	04-012-WR4-2A	0.0 - 2.0	Base of WR4, 60' west of loadout; hole is mostly large rocks with a little brown silt.								
	04-012-WR4-2B	0.0 - 2.5	Base of WR4, 25' downslope of 4-2A; yellow silty clay is matrix between rocks.								
	04-012-WR4-2B-U1	2.5-3.5	Base of WR4, 25' downslope of 4-2A; underlying soil, dark brown black clayey silty.	<3.5	0.045						
	04-012-WR4-2B-U2	3.5-4.5	Base of WR4, 25' downslope of 4-2A; underlying soil 1 foot below WR, orange stained rocks.	<3.5	0.055						
	04-012-WR4-2C	0.0 - 3.3	Base of WR4, 25' downslope of 4-2B; light orange clayey sand with cobbles.	<3.5	0.045						
WR-5	04-012-WR5-C1	0.0 - 0.5	Bottom, south portion of pile; surface sample, dark red brown silt.	6.6	0.045	Table A-1					
	04-012-WR5-C2	23.0-24.0	Bottom, south portion of pile; underlying soil.	6.8	0.05	Table A-1					
	04-012-WR5-C3	0.0 - 23.0	Bottom, south portion of pile;dark brown silt as matrix between cobbles.	6.6	0.05	Table A-1					
	04-012-WR5-C4	0.0 - 23.0	Bottom, south portion of pile; dark brown silt as matrix between cobbles.	6.6	0.05			Table A-2		Table A-4	Table A-5
	04-012-WR5-1	0.0 - 23.0	Bottom, south portion of pile; dark brown silt as matrix between cobbles.	6.6	0.05		Table A-3				

TABLE 3-1 (Cont'd.): PARK MINE AND TAILINGS (04-012) SOURCE SAMPLING SUMMARY

SOURCE	SAMPLE NO.	SAMPLE DEPTH (feet)	DESCRIPTION	pH	RADIOACTIVITY (mR/hr)	TAL	ABA	TCLP	CYANIDE	AGRONOMIC	PHYSICAL
WR-6	04-012-WR6-C1	0.0 - 0.5	Composite of samples 6-1A and 6-1B; surface sample,re brown clayey sand with pebbles.			Table A-1					
	04-012-WR6-C2	6.0-6.5	Soil underlying 6-2.	<3.5	0.04	Table A-1					
	04-012-WR6-C3	0.0 - 21.0	Composite of samples 6-1B and 6-2B; red brown clayey sand with lots of cobbles.			Table A-1					
	04-012-WR6-C4	0.0 - 21.0	Composite of samples 6-1B and 6-2B; red brown clayey sand with lots of cobbles.					Table A-2		Table A-4	Table A-5
	04-012-WR6-1	0.0 - 12.5	Upper level of WR6, main lobe; red brown clayey coarse-grained sand with lots of cobbles	4.8	0.05		Table A-3				
	04-012-WR6-2	0.0 - 21.0	Base of WR6, in face; red brown clayey silt with layers of mainly rock.	<3.5	0.045		Table A-3				
	04-012-WR6-1A	0.0 - 0.5	Upper level of WR6, main lobe; red brown clayey coarse-grained sand with lots of pebbles.	6.4	0.05						
	04-012-WR6-1B	0.0 - 12.5	Upper level of WR6, main lobe; red brown clayey coarse-grained sand with lots of cobbles	4.8	0.05						
	04-012-WR6-2A	0.0 - 0.5	Base of WR6, in face; red brown clayey silt with rocks.	4.3	0.045						
	04-012-WR6-2B	0.0 - 21.0	Base of WR6, In face; red brown clayey silt with layers of mainly rock.	<3.5	0.045						
WR-8	04-012-WR8-C1	0.0 - 0.5	Top of WR8, east side; surface sample,light red brown silt with pebbles.	5.2	0.06	Table A-1					
	04-012-WR8-C2	19.0 - 19.5	Top of WR8, east side; underlying soil, medium dark brown silty clay.	<3.5	0.040	Table A-1					
	04-012-WR8-C3	0.0 - 19.0	Top of WR8, east side; orange brown silt to silty sand with cobbles andyellow clayey sand as matrix to large rocks.	5.3	0.040	Table A-1					
	04-012-WR8-C4	0.0 - 19.0	Top of WR8, east side; orange brown silt to silty sand with cobbles andyellow clayey sand as matrix to large rocks.	5.3	0.040			Table A-2		Table A-4	Table A-5
	04-012-WR8-1	0.0 - 19.0	Top of WR8, east side; orange brown silt to silty sand with cobbles andyellow clayey sand as matrix to large rocks.	5.3	0.040		Table A-3				
WR-9	04-012-WR9-C1	0.0 - 0.5	Bullion King mine; Surface sample, composite of samples 9-1A and 9-2A.			Table A-1					
	04-012-WR9-C2	13.5;4.5-5.5	Bullion King mine; Underlying soil, composite of samples 9-1C and 9-2C.			Table A-1					
	04-012-WR9-C3	0.0 - 12.5	Bullion King mine; composite of samples 9-1B and 9-2B.			Table A-1					
	04-012-WR9-C4	0.0 - 12.5	Bullion King mine; composite of samples 9-1B and 9-2B.					Table A-2		Table A-4	Table A-5
	04-012-WR9-1	0.0 - 12.5	Bullion King mine, on top at end of east lobe; orange brown silt and clayey silt to brick red silt with lots of rocks.	<3.5	0.040		Table A-3				
	04-012-WR9-2	0.0 - 4.5	Bullion King mine, west side on top; orange brown silt, dark brown and red brown clayey silt all with lots of rocks.	4.4	0.045		Table A-3				
	04-012-WR9-1A	0.0 - 0.5	Bullion King mine, on top at end of east lobe; orange brown silt.	4.0	0.030						
	04-012-WR9-1B	0.0 - 12.5	Bullion King mine, on top at end of east lobe; orange brown silt and clayey silt to brick red silt with lots of rocks.	<3.5	0.040						
	04-012-WR9-1C	13.5	Bullion King mine, on top at end of east lobe; underlying soil.	<3.5	0.050						
	04-012-WR9-2A	0.0 - 0.5	Bullion King mine, west side on top; red brown clayey silt with lots of pebbles.	NM	NM						
	04-012-WR9-2B	0.0 - 4.5	Bullion King mine, west side on top; orange brown silt, dark brown and red brown clayey silt all with lots of rocks.	4.4	0.045						
	04-012-WR9-2C	4.5 - 5.5	Bullion King mine, west side on top; underlying soil, dark brown clayey fine-grained sand with very few rocks.	4.2	0.035						
WR-10	04-012-WR10-C1	0.0 - 0.5	In center of WR10, on top; yellow clayey silt with lots of rocks.	6.3	0.045	Table A-1					
	04-012-WR10-C3	0.0 - 11.5	In center of WR10, on top; some yellow clayey silt with lots of rocks, mainly red brown rocks with some silt.	4	0.040	Table A-1					
	04-012-WR10-C4	0.0 - 11.5	In center of WR10, on top; some yellow clayey silt with lots of rocks, mainly red brown rocks with some silt.	4	0.040			Table A-2		Table A-4	Table A-5
	04-012-WR10-1	0.0 - 11.5	In center of WR10, on top; some yellow clayey silt with lots of rocks, mainly red brown rocks with some silt.	4	0.040		Table A-3				
TP-2	04-012-TP2-C1	0.0 - 0.5	Surface sample, composite from TP1,TP2-1, TP2-2, and TP2-3.	<3.5	0.045	Table A-1			Table A-1		
	04-012-TP2-C2	0.5, 2.0 - 2.5	Underlying soil, composite from TP1, TP2-1, TP2-2 and TP2-3.	5.6	0.450	Table A-1			Table A-1		
	04-012-TP2-C3	0.0 - 2.0	Composite sample from TP1, TP2-1, TP2-2 and TP2-3, 1/3 from TP1, 2/3 from TP2.	<3.5	0.050	Table A-1			Table A-1		
	04-012-TP2-C4	0.0 - 2.0	Composite sample from TP1, TP2-1, TP2-2 and TP2-3, 1/3 from TP1, 2/3 from TP2.	<3.5	0.050		Table A-3	Table A-2		Table A-4	Table A-5
	04-012-TP1	0.0 0.7	Just below mill remains adjacent to WR8; composite of 5 shallow holes, maximum depth 8 inches.	7	0.050						
	04-012-TP2-1	0.0 - 0.9	Pile across creek from group of buildings, northwest end; fine- grained gray sand underlain by tan to whites sand.								
	04-012-TP2-2	0.0 - 0.5	Pile across creek from group of buildings, center of pile; gray sand underlain by yellow tan fine-grained sand.								
	04-012-TP2-3	0.0 - 2.0	Pile across creek from group of buildings, southeast end; yellow tan clayey silt.	<3.5	0.040						
TP-3	04-012-TP3-C1	0.0 - 0.5	Surface sample, composite from TP3-1, TP3-2 and TP3-3.	<3.5	0.040	Table A-1			Table A-1		
	04-012-TP3-C3	0.0-2.6	Composite from entire depth, TP3-1, TP3-2, TP3-3A and TP3-3B.	<3.5	0.045	Table A-1			Table A-1		
	04-012-TP3-C4	0.0 - 2.6	Composite from entire depth, TP3-1, TP3-2, TP3-3A and TP3-3B.	<3.5	0.045			Table A-2		Table A-4	Table A-5
	04-012-TP3	0.0 - -2.6	Composite from entire depth, TP3-1, TP3-2, TP3-3A and TP3-3B.	<3.5	0.045		Table A-3				
	04-012-TP3-1	0.0 - 0.75	Pile on east side of creek, 9 inches deep, white hard packed silt.	6.4	0.045						
	04-012-TP3-2	0.0 - 1.0	Pile just west of creek, 1 foot deep, white silt.	<3.5	NM						
	04-012-TP3-3A	0.0 - 1.25	West side of deposit, 0 - 1' gray sand; 1.0-1.25' brown sand.	<3.5	0.030						
	04-012-TP3-3B	1.25 - 2.6	West side of deposit; gray clay, very wet and plastic, hard crust at bottom of hole.	<3.5	0.040						

TABLE 3-1 (Cont'd.): PARK MINE AND TAILINGS (04-012) SOURCE SAMPLING SUMMARY

SOURCE	SAMPLE NO.	SAMPLE DEPTH (feet)	DESCRIPTION	pH	RADIOACTIVITY (mR/hr)	TAL	ABA	TCLP	CYANIDE	AGRONOMIC	PHYSICAL
TP-4	04-012-TP4-C1	0.0 - 0.5	Surface sample, composite from TP4-1 and TP4-2.	6	0.050	Table A-1			Table A-1		
	04-012-TP4-C3		Composite from entire depth, TP4-1 and TP4-2.			Table A-1			Table A-1		
	04-012-TP4-C4		Composite from entire depth, TP4-1 and TP4-2.					Table A-2		Table A-4	Table A-5
	04-012-TP4-C5	0.0 - 3.5	Composite sample of brown/tan/ orange sand and silt form TP4-1 and TP4-2.	5.4	0.050	Table A-1			Table A-1		
	04-012-TP4-C6	3.5 - 7.0	Composite sample of gray clay, very wet and plastic.	5.4	0.045	Table A-1			Table A-1 *		
	04-012-TP4-1	0.0 - 7.0	15' north of berm on west side; 0-1 5' tan sand; 1.5 2 5' orange sand; 2.5-3.5' brown gray clay;3.5-7.0' gray clay.				Table A-3				
	04-012-TP4-2	0.0 - 5.0'	15' north of berm on east side,0-2.0' tan to gold silt and sand; 2-2 5 brown sand; 3-3.5 tan gray clay;3-5' gray clay.				Table A-3				
TP-5	04-012-TP5	0.0 - 0.75	Deposit across from mouth of Ribedeau Creek; red brown fine-grained sand.	4.6	0.050	Table A-1			Table A-1		
REPOSITORY AREA	04-012-R1-C4	0.0 - 6.5	Approximately 50' west of WR4; 01.5' black silt with organics, 1.5-6 5' red brown clayey silt with clayey silt.								Table A-5
	04-012-R1	0.0 - 6.5	Approximately 50' west of WR4; 01 5' black silt with organics, 1 5 6.5' red brown clayey silt with clayey silt.							Table A-4	
BORROW AREA	04-012-B1-C4	0.0 - 6.5	North end of meadow, west of Park site; 0-1.5 black silty sand; 1.5-6 5 brown silty and clayey sand with large rocks.								Table A-5
	04-012-B1	0.0 - 6.5	North end of meadow, west of Park site; 0-1.5 black silty sand; 1.5-6 5 brown silty and clayey sand with large rocks.							Table A-4	
	04-012-B3-C4	0.0 - 12.0	0-.8' topsoil; 8 1.5' topsoil and sand, 1.5-7' gray to brown clayey sand; 7-12' brown clayey sand.								Table A-5
	04-012-B3	0.0 - 12.0	0-.8' topsoil, .8-1.5' topsoil and sand; 1.5-7' gray to brown clayey sand; 7-12' brown clayey sand.							Table A-4	
	04-012-B4-C4	0.0 - 13.0	Field behind (SW) of pond above Park; 0-1' topsoil; 1-2' topsoil and sand; 2-5' gray sand; 5-13' brown clayey sand.								Table A-5
	04-012-B4	0.0 - 13.0	Field behind (SW) of pond above Park; 0-1' topsoil; 1-2' topsoil and sand; 2-5' gray sand; 5-13' brown clayey sand.							Table A-4	

XRF = X-Ray Fluorescence Spectometry (Total Metals)
TAL = Target Analyte List (Total Metals)
ABA = Acid Base Accounting, Sulfur Fractions, and SMP Buffering Capacity
TCLP = Toxicity Characteristic Leaching Procedure - Metals
VOCs = Volatile Organic Compounds
BNA = Base-Neutral Acid Extractable (Semi-Volatile Organics)
Agronomic = Agronomic properties of the sample including: Organic Matter Content, Nutrient Content, Cation Exchange Capacity, Boron, pH, and Field Water Capacity
Physical = Physical properties of the sample including: Wilting Point, Particle Size Dist., Moisture, Standard Proctor, In-Place Density, Specific Gravity, Porosity, and Atterberg Limits

TABLE 3-2
WASTE ROCK DATA SUMMARY

Waste Rock Pile	Est. Volume (cy)	Est. Surface Area (Ac.)	Elevated Metals (>3X Background)	TCLP Metals Above Regulatory Limit	pH	Organic Matter Content (%)	Lime Req'ment* (tons/ac)
WR1	3,215	0.7	As, Cd, Cu, Fe Pb, Mn, Ag Zn	None	4.6	0.7	23
WR2	11,120	1.72	As, Cd, Cu, Pb, Hg, Ag, Zn	None	4.4	0.9	105
WR3	2,117	0.4	As, Cd, Cu, Pb, Hg, Ag, Zn	Pb	3.7	0.4	30
WR4	7,020	0.62	As, Cd, Cu, Pb, Hg, Ag, Zn	None	3.2	1.0	136
WR5	1,631	0.2	Pb, Hg	None	7.4	0.4	3
WR6	8,545	0.72	As, Cd, Cu, Fe, Pb, Hg, Ag, Zn	None	3.0	0.7	135
WR7	300	0.09	Not Sampled				
WR8	3,342	0.47	As, Cd, Cu, Pb, Ag, Zn	Pb	4.0	0.7	150
WR9	4,892	0.62	As, Cd, Cu, Fe, Pb, Hg, Ag, Zn	None	2.9	1.1	216
WR10	1,353	0.23	As, Cd, Cu, Fe Pb, Hg, Ag, Zn	Pb	2.5	1.0	119

* Assumes 12-inch depth of lime incorporation.

Three composite samples were collected from WR1 for laboratory and ABA analyses (Appendix A). No deviations from the sampling plan occurred at WR1.

The volume of WR1 has been estimated at 3,215 cy. Metals data for WR1 is listed in Table A-1 (Appendix A). Concentrations of the following metals are significantly elevated above background (>3X) in the dump: arsenic, cadmium, copper, iron, lead, manganese, silver, and zinc. According to the TCLP data obtained for WR1 (Table A-2, Appendix A), the concentrations of all metals measured in laboratory-generated leachate are below the regulatory limits for hazardous waste classification. Consequently, WR1 is not classifiable as a Resource Conservation and Recovery Act (RCRA) characteristic hazardous waste.

One composite sample of WR1 was collected for ABA and agronomic analyses (Tables A-3 and A-4, Appendix A) to investigate the possibility of establishing vegetation directly on the surface of the waste rock. ABA and agronomic data obtained for WR1 indicate that WR1 is a potential acid producer, and approximately 23 tons of lime per acre would be required to successfully establish vegetation on this material (assuming 12-inch depth of incorporation).

Fertilizer recommendation analyses provided the following results for WR1: 80 pounds nitrogen required per acre; and 45 pounds potassium required per acre. Assuming a recontoured surface area of approximately 0.91 acre, a 230 pound mixture of fertilizer consisting of 162 pounds urea (45% N) and 68 pounds potassium oxide (60% K) would provide optimum nutrient concentrations for establishing vegetation directly on the surface of WR1.

3.1.1.2 Waste Rock Dump #2

Waste rock dump #2 (WR2) is located just off of the Indian Creek Road. Indian Creek flows along the west edge of the dump. Two seeps are located near WR2. The upper seep is a discharge (GW-1) that flows out of a collapsed adit above the waste rock dump. This water flows towards WR2 and forms a small pond at the upper side of the waste rock pile. At higher flows, the discharge overflows the pond and continues across the access road to the concrete foundation on the east side of WR2 before seeping back into the ground. During lower flow periods, the discharge seeps/evaporates in the pond. The lower seep (GW-2) is present at the base of WR2. Water from this seep flows across eroded waste rock material to a confluence with Indian Creek.

The surface of WR2 is void of vegetation, and the dump is very loosely compacted and relatively unstable on the downslope side. A concrete foundation is present on the top of the dump.

Two test pits were dug in WR2. Table 3-1 indicates the total depth of the test pits and gives a brief description of the physical characteristics observed in the test pits. Metal and wood debris was present in WR2-2. Material in WR2-2 was unconsolidated and rocky, causing extensive caving of the pit walls during excavation. Test pit WR2-1 was approximately 12 feet from Indian Creek; it appeared that the original ground surface underlying WR2 was approximately 2 to 3 feet below the present creek bed.

A third test pit was dug near the base of WR2 to investigate the source of the lower seep (GW-2). Four seeps were encountered in this pit, including one large seep on the northwesterly side and three smaller seeps on the northeast or mill side. Water from the northeast side had a sheen on it with a hydrocarbon odor. Samples were collected from the seeps during the regular adit sampling event four weeks after the reclamation investigation. The seep from the northeast with the apparent hydrocarbon presence was sampled and analyzed for gasoline range organics (GRO) and diesel range organics (DRO). Analytical results (Appendix C) indicated the presence of an unidentified organic compound (in the gasoline range). Further sampling would be required to identify it. Groundwater was encountered in WR2-2, 16.5 feet below ground surface (bgs); no samples of this water were collected.

Three discrete samples were collected in each test pit for compositing. One composite sample was collected from each test pit in WR2 for ABA analyses. Three composite samples were submitted from WR2 for laboratory analyses; a brief description of each discrete and composite sample is provided on Table 3-1. Analytical results are provided in Appendix A.

WR2 was sampled as planned with no deviations from the sampling plan. The material encountered was relatively homogeneous throughout the entire depth of each test pit and lacked distinct stratigraphy; the material consisted mostly of rocks up to two feet in diameter in a matrix of red-brown, clayey silt.

The volume of WR2 has been estimated at 11,120 cy. Metals data for WR2 are listed in Table A-1 (Appendix A). Concentrations of the following metals are significantly elevated above background (>3X) in the dump: arsenic, cadmium, copper, lead, mercury, silver, and zinc.

According to the TCLP data obtained for WR2 (Table A-2, Appendix A), the concentrations of all metals measured in laboratory-generated leachate are well below the regulatory limits for hazardous waste classification. Consequently, WR2 is not classifiable as a RCRA characteristic hazardous waste.

One composite sample of WR2 was collected for ABA and agronomic analyses (Tables A-3 and A-4, Appendix A) to investigate the possibility of establishing vegetation directly on the surface of the waste rock. ABA and agronomic data obtained for WR2 indicate that WR2 is a potential acid producer, and approximately 105 tons of lime per acre would be required to successfully establish vegetation on this material (assuming 12-inch depth of incorporation).

Fertilizer recommendation analyses provided the following results for WR2: 80 pounds nitrogen required per acre; 21 pounds phosphate required per acre; and 50 pounds potassium required per acre. Assuming a recontoured surface area of approximately 2.24 acres for WR2, a 695 pound mixture of fertilizer consisting of 400 pounds urea (45% N), 105 pounds treble superphosphate (45% P), and 190 pounds potassium oxide (60% K) would provide optimum nutrient concentrations for establishing vegetation directly on the surface of WR2.

3.1.1.3 Waste Rock Dump #3

Waste rock dump #3 (WR3) is a relatively small dump and is located in the trees, well away from any water sources. The dump is unvegetated and relatively steep. WR3 is accessible by vehicles from a small road off of the main Indian Creek Road.

One test pit was dug in WR3. Table 3-1 indicates the total depth of the test pit and gives a brief description of the physical characteristics observed in the test pit. Material in the hole was unconsolidated and rocky, resulting in extensive caving of the pit walls during excavation. WR3 had two distinct waste materials present within the test pit: half of the pit contained red-brown clayey silt with many cobbles up to one foot in diameter; the other half was a yellow clay, with a sulfide smell and many cobbles. Both materials were sampled and submitted to the laboratory for analysis.

Five composite samples were collected from WR3; a brief description of each composite sample is provided on Table 3-1. WR3 was sampled as planned with no deviations from the sampling plan.

The volume of WR3 has been estimated at 2,117 cy. Table A-1 (Appendix A) presents the metals data obtained for WR3. Concentrations of the following metals are significantly elevated above background (>3X) in the dump: arsenic, cadmium, copper, lead, mercury, silver, and zinc.

According to the TCLP data obtained for WR3 (Table A-2, Appendix A), the concentrations of all metals measured in laboratory-generated leachate are well below the regulatory limits for hazardous waste classification except lead. Because of the lead analysis, the waste rock material from WR3 is classifiable as a characteristic hazardous waste under RCRA.

ABA and agronomic data (Tables A-3 and A-4, Appendix A) were obtained for WR3 for the reclamation scenario involving stabilizing and revegetating WR3 in place. The ABA and agronomic data obtained for WR3 indicate that it is a potential acid producer, and approximately 136 tons of lime per acre would be required to successfully establish vegetation on this material (assuming 12-inch depth of incorporation).

Fertilizer recommendation analyses provided the following results for WR3: 80 pounds nitrogen required per acre; and 63 pounds potassium required per acre. Assuming a recontoured surface area of approximately 0.52 acre for WR3, a 150 pound mixture of fertilizer consisting of 95 pounds urea (45% N) and 55 pounds potassium oxide (60% K) would provide optimum nutrient concentrations for establishing vegetation directly on the surface of WR3.

3.1.1.4 Waste Rock Dump #4

Waste rock dump #4 (WR4) is located just above Indian Creek Road. A discharging adit is associated with the dump (GW-4). Water from the adit appears to flow onto the top of WR4 and then infiltrates the dump. No seeps were present at the base of the dump at the time of the investigation. An intermittent drainage, along the east side of WR4, appears to carry storm run-off and snowmelt. The surface of WR4 is devoid of vegetation. The dump is loosely compacted, steep, and relatively unstable on the downslope side. A wooden loadout is present at the base of WR4, on the east side of the dump.

Four test pits were dug in WR4, one on top of the dump and three into the base. Table 3-1 indicates the total depth of the test pits and gives a brief description of the physical characteristics observed in each test pit. Material in WR4-1 contained abundant pyrite.

Samples were collected in each test pit for compositing. One composite sample from the upper test pit and one composite sample from the three lower test pits in WR4 were collected for ABA analyses (Tables A-3 and A-4, Appendix A). Three composite samples were submitted from WR4 for laboratory analyses (Table A-1, Appendix A); a brief description of each discrete and composite sample is provided on Table 3-1.

WR4 was sampled as planned except that three holes were dug in the base of WR4 to confirm the depth of waste material. The material encountered was relatively homogeneous throughout the entire depth of each test pit and lacked distinct stratigraphy; the material consisted mostly of rocks up to two feet in diameter in a matrix of red-brown, clayey silt or sand.

The volume of WR4 has been estimated at 7,020 cy. Metals data for WR4 are presented in Table A-1 (Appendix A). Concentrations of the following metals are significantly elevated above background (>3X) in the dump: arsenic, cadmium, copper, lead, mercury, silver, and zinc.

According to the TCLP data (Table A-2, Appendix A) obtained for WR4, the concentrations of all metals measured in laboratory-generated leachate are well below the regulatory limits for hazardous waste classification. Consequently, WR4 is not classifiable as a RCRA characteristic hazardous waste.

ABA and agronomic data were obtained for WR4 for the reclamation scenario involving stabilizing and revegetating WR4 in place. The ABA and agronomic data obtained for WR4 (Tables A-3 and A-4, Appendix A) indicate that it is a potential acid producer, and approximately 134 tons of lime per acre would be required to successfully establish vegetation on this material (assuming 12-inch depth of incorporation).

Fertilizer recommendation analyses provided the following results for WR4: 80 pounds nitrogen required per acre; 10 pounds of phosphate required per acre; and 67 pounds potassium required per acre. Assuming a recontoured surface area of approximately 0.81 acre for WR4, a 253 pound mixture of fertilizer consisting of 144 pounds urea (45% N), 18 pounds of treble super phosphate (45% P), and 91 pounds potassium oxide (60% K) would provide optimum nutrient concentrations for establishing vegetation directly on the surface of WR4.

3.1.1.5 <u>Waste Rock Dump #5</u>

Waste rock dump #5 (WR5) is located east of and above Indian Creek Road. The dump is fairly small and supports minimal vegetation. WR5 is located well away from any water sources. The dump is inaccessible to vehicles at this time.

One test pit was dug in WR5. Table 3-1 indicates the total depth of the test pit and gives a brief description of the physical characteristics observed in the test pit. Material in the hole was unconsolidated and rocky, causing continual caving of the pit walls during excavation.

Three samples were collected from WR5 for laboratory and ABA analyses. No deviations from the sampling plan occurred at WR5.

The volume of WR5 has been estimated at 1,631 cy. Table A-1 (Appendix A) presents the metals data obtained for WR5. Concentrations of lead and mercury are significantly elevated above background (>3X) in the dump.

According to the TCLP data obtained for WR5, the concentrations of all metals measured in laboratory-generated leachate are below the regulatory limits for hazardous waste classification. Consequently, WR5 is not classifiable as a RCRA characteristic hazardous waste.

ABA and agronomic data were obtained for WR5 for the reclamation scenario involving stabilizing and revegetating WR5 in place. The ABA and SMP buffering capacity results (Table A-3, Appendix A) indicate that WR5 is considered a potential acid producer, and approximately 2.6 tons of lime per acre would be required to successfully establish vegetation on this material (assuming 12-inch depth of incorporation).

Fertilizer recommendation analyses provided the following results for WR5: 80 pounds nitrogen required per acre; 36 pounds phosphate required per acre; and 47 pounds potassium required per acre. Assuming a recontoured surface area of approximately 0.26 acre for WR5, a 88 pound mixture of fertilizer consisting of 46 pounds urea (45% N), 22 pounds treble superphosphate (45% P), and 20 pounds potassium oxide (60% K) would provide optimum nutrient concentrations for establishing vegetation directly on the surface of WR5.

3.1.1.6 <u>Waste Rock Dump #6</u>

Waste rock dump #6 (WR6) is located off of a side road of Indian Creek Road. WR6 is located well above any water sources although a dry drainage appears at the base of WR6, and appears to carry storm run-off and snowmelt. The surface of WR6 is void of vegetation. The dump is loosely compacted, steep, and relatively unstable on the downslope side. Several dilapidated wooden structures are associated with the dump.

Two test pits were dug in WR6, one on the top of the dump and one at the base. The total depth of the test pits and a brief description of the physical characteristics observed in each test pit are listed in Table 3-1. A small seep was encountered in WR6-2, approximately 2.5 feet bgs or 4 feet above the natural soil interface; the seep was barely flowing. The material encountered in WR6 was relatively homogeneous throughout the entire depth of each test pit and lacked distinct stratigraphy, consisting mostly of rocks up to two feet in diameter in a matrix of red-brown, clayey silt or sand.

Discrete samples were collected in each test pit for compositing. One composite sample from the upper test pit and one composite sample from the lower test pit were collected for ABA analyses. Three composite samples were submitted from WR6 for laboratory analyses. A brief description of each discrete and composite sample is provided on Table 3-1.

Natural soil was not encountered in WR6-1 because the material was too unconsolidated to maintain an open hole. This was the only deviation from the sampling plan regarding WR6.

The volume of WR6 has been estimated at 8,545 cy. Table A-1 (Appendix A) presents the metals data obtained for WR6. Concentrations of the following metals are significantly elevated above background (>3X) in the dump: arsenic, cadmium, copper, iron, lead, mercury, silver, and zinc.

According to the TCLP data (Table A-2, Appendix A) obtained for WR6, the concentrations of all metals measured in laboratory-generated leachate are well below the regulatory limits for hazardous waste classification. Consequently, WR6 is not classifiable as a RCRA characteristic hazardous waste.

ABA and agronomic data (Tables A-3 and A-4, Appendix A) were obtained for WR6 for the reclamation scenario involving stabilizing and revegetating WR6 in place. The ABA and agronomic data obtained for WR6 indicate that it is a potential acid producer, and approximately 135 tons of lime per acre would be required to successfully establish vegetation on this material (assuming 12-inch depth of incorporation).

Fertilizer recommendation analyses provided the following results for WR6: 80 pounds nitrogen required per acre; 21 pounds phosphate required per acre; and 65 pounds potassium required per acre. Assuming a recontoured surface area of approximately 0.94 acre for WR6, a 314 pound mixture of fertilizer consisting of 167 pounds urea (45% N), 45 pounds treble superphosphate (45% P), and 102 pounds potassium oxide (60% K) would provide optimum nutrient concentrations for establishing vegetation directly on the surface of WR6.

3.1.1.7 Waste Rock Dump #7

Waste rock dump #7 (WR7) was not sampled, a deviation from the sampling plan.

3.1.1.8 Waste Rock Dump #8

Waste rock dump #8 (WR8) is located adjacent to the west side of Indian Creek. A road overgrown with vegetation from WR1 is the only access to WR8; access by vehicle is difficult. The surface of WR8 has some sparse vegetation. The dump is steep and relatively unstable on the downslope or creek side. Several dilapidated wooden structures are associated with the dump, including a loadout and an old mill building which is near the base of the dump on the east side.

One test pit was dug in WR8. The total depth of the test pit and a brief description of the physical characteristics observed are provided in Table 3-1. Material removed from the test pit contained pyrite and was less susceptible to caving than any of the other test pits.

Three samples were collected from WR8 for laboratory and ABA analyses. No deviations from the sampling plan occurred at WR8.

The volume of WR8 has been estimated at 7,000 cy. Table A-1 (Appendix A) presents the metals data obtained for WR8. Concentrations of the following metals are significantly elevated above background (>3X) in the dump: arsenic, cadmium, copper, lead, silver, and zinc.

According to the TCLP data (Table A-2, Appendix A) obtained for WR8, the concentrations of all metals measured in laboratory-generated leachate are well below the regulatory limits for hazardous waste classification except lead. Because of the lead analyses waste rock material from WR8 is classifiable as a characteristic hazardous waste under RCRA and must be treated as such when taken off-site.

One composite sample of WR8 was collected for ABA and agronomic analyses (Tables A-3 and A-4) to investigate the possibility of establishing vegetation directly on the surface of the waste rock. The ABA and SMP buffering capacity results indicate that WR8 is considered a potential acid producer and approximately 150 tons of lime per acre would be required to successfully establish vegetation on this material (assuming 12-inch depth of incorporation).

Fertilizer recommendation analyses provided the following results for WR8: 80 pounds nitrogen required per acre; 21 pounds phosphate required per acre; and 62 pounds potassium required per acre. Assuming a recontoured surface area of approximately 0.62 acre for WR8, a 205 pound mixture of fertilizer consisting of 111 pounds urea (45% N), 30 pounds treble superphosphate (45% P), and 64 pounds potassium oxide (60% K) would provide optimum nutrient concentrations for establishing vegetation directly on the surface of WR8.

3.1.1.9 Waste Rock Dump #9

Waste rock dump #9 (WR9), associated with the Bullion King Mine, is located northeast of the main Park site. It is accessible from Indian Creek Road near the divide of Indian Creek and Whitehorse Creek. A discharging adit (GW-BK) is associated with the dump and water from the adit flows onto the top of WR9 and then infiltrates the dump. During higher flows, the water from this discharge flows over the waste rock and seeps into a small exploratory pit below WR9. The surface of WR9 supports some vegetation, particularly in the area of the adit discharge and along the edges where waste material is shallower.

Two test pits were dug in WR9. The total depth of the test pits and a brief description of the physical characteristics observed in each test pit are provided in Table 3-1. The material encountered was relatively homogeneous throughout the entire depth of each test pit and lacked distinct stratigraphy.

Discrete samples were collected in each test pit for compositing. One composite sample from each test pit was submitted for ABA analyses. Three composite samples were submitted from

WR9 for laboratory analyses; a brief description of each discrete and composite sample is provided in Table 3-1. No deviations from the sampling plan occurred at WR9.

The volume of WR9 has been estimated at 4,892 cy. Table A-1 (Appendix A) presents the metals data obtained for WR9. Concentrations of the following metals are significantly elevated above background (>3X) in the dump: arsenic, cadmium, copper, iron, lead, mercury, silver, and zinc.

According to the TCLP data obtained for WR9, the concentrations of all metals measured in laboratory-generated leachate are well below the regulatory limits for hazardous waste classification. Consequently, WR9 is not classifiable as a RCRA characteristic hazardous waste.

ABA and agronomic data were obtained for WR9 for the reclamation scenario involving stabilizing and revegetating WR9 in place. The ABA and agronomic data obtained for WR9 indicate that it is a significant, potential acid producer, and approximately 216 tons of lime per acre would be required to successfully establish vegetation on this material (assuming 12-inch depth of incorporation).

Fertilizer recommendation analyses provided the following results for WR9: 80 pounds nitrogen required per acre; 15 pounds phosphate required per acre; and 66 pounds potassium required per acre. Assuming a recontoured surface area of approximately 0.81 acre for WR9, a 262 pound mixture of fertilizer consisting of 145 pounds urea (45% N), 27 pounds treble superphosphate (45% P), and 90 pounds potassium oxide (60% K) would provide optimum nutrient concentrations for establishing vegetation directly on the surface of WR9.

3.1.1.10 <u>Waste Rock Dump #10</u>

Waste rock dump #10 (WR10) is situated in the drainage approximately 250 feet north of WR6. This dump is located well away from any water sources, although the adit discharge at WR9 and a spring which flows part of the year are located in the same drainage, north of WR10. The dump is unvegetated and relatively steep. WR10 is accessible by vehicle on a narrow road from WR6.

One test pit was dug in WR10. Table 3-1 indicates the total depth of the test pit and gives a brief description of the physical characteristics observed in the test pit. The unconsolidated, rocky material encountered in the hole made digging difficult due to constant caving and sloughing of the side walls; natural soil was not encountered because of this.

Three samples were collected from WR10; a brief description of each sample is provided on Table 3-1.

WR10 was not identified as a source in the sampling plan, but because of the size of the dump it was determined that a test pit should be dug. Samples were collected on WR10 in accordance with the sampling plan for the other waste rock dumps.

The volume of WR10 has been estimated at 1,353 cy. Table A-1 (Appendix A) presents the metals data obtained for WR10. Concentrations of the following metals are significantly elevated above background (>3X) in the dump: arsenic, cadmium, copper, iron, lead, mercury, silver, and zinc.

According to the TCLP data (Table A-2, Appendix A) obtained for WR10, the concentrations of all metals measured in laboratory-generated leachate are well below the regulatory limits for hazardous waste classification except lead. Because of the lead analyses waste rock material in WR10 is classifiable as a characteristic hazardous waste under RCRA.

ABA and agronomic data (Tables A-3 and A-4, Appendix A) were obtained for WR10 for the reclamation scenario involving stabilizing and revegetating WR10 in place. The ABA and agronomic data for WR10 indicate that it is a potential acid producer, and approximately 119 tons of lime per acre would be required to successfully establish vegetation on this material (assuming 12-inch depth of incorporation).

Fertilizer recommendation analyses provided the following results for WR10: 80 pounds nitrogen required per acre; 4 pounds phosphate required per acre; and 70 pounds potassium required per acre. Assuming a recontoured surface area of approximately 0.3 acre for WR10, a 93 pound mixture of fertilizer consisting of 55 pounds urea (45% N), 3 pounds treble superphosphate (45% P), and 35 pounds potassium oxide (60% K) would provide optimum nutrient concentrations for establishing vegetation directly on the surface of WR10.

3.1.1.11 Natural Soils Underlying Waste Rock Dumps

Samples of the natural soil underlying waste rock were collected from all dumps except WR10. The soils were collected from the test pits to determine if metals have migrated out of the waste rock and into underlying materials, and to determine if some of the underlying soils are contaminated enough to also warrant removal if waste rock is moved. Although the possibility of sample contamination by overlying materials from mixing is always a concern, this was minimized by the sampling methodology (scraping to a fresh surface in the backhoe bucket prior to collecting sample material). The soils underlying the waste rock have elevated concentrations of several metals found in the waste rock dumps which are fairly mobile in their pH regimes, including: arsenic, cadmium, copper, iron, lead, silver, and zinc. The elements found in the underlying soil are in most cases at lower concentrations than those found in the waste rock, indicating that downward leaching of metals is occurring. Concentrations of metals are elevated enough to warrant removal of the underlying material for all waste rock dumps except WR1 and WR5.

Samples were collected from WR4 at 0 to 1 foot below the waste rock and also 1 to 2 feet below the waste rock and submitted for laboratory analyses. The metal concentrations present at 1 to 2 feet below WR4 were significantly elevated, particularly arsenic and lead.

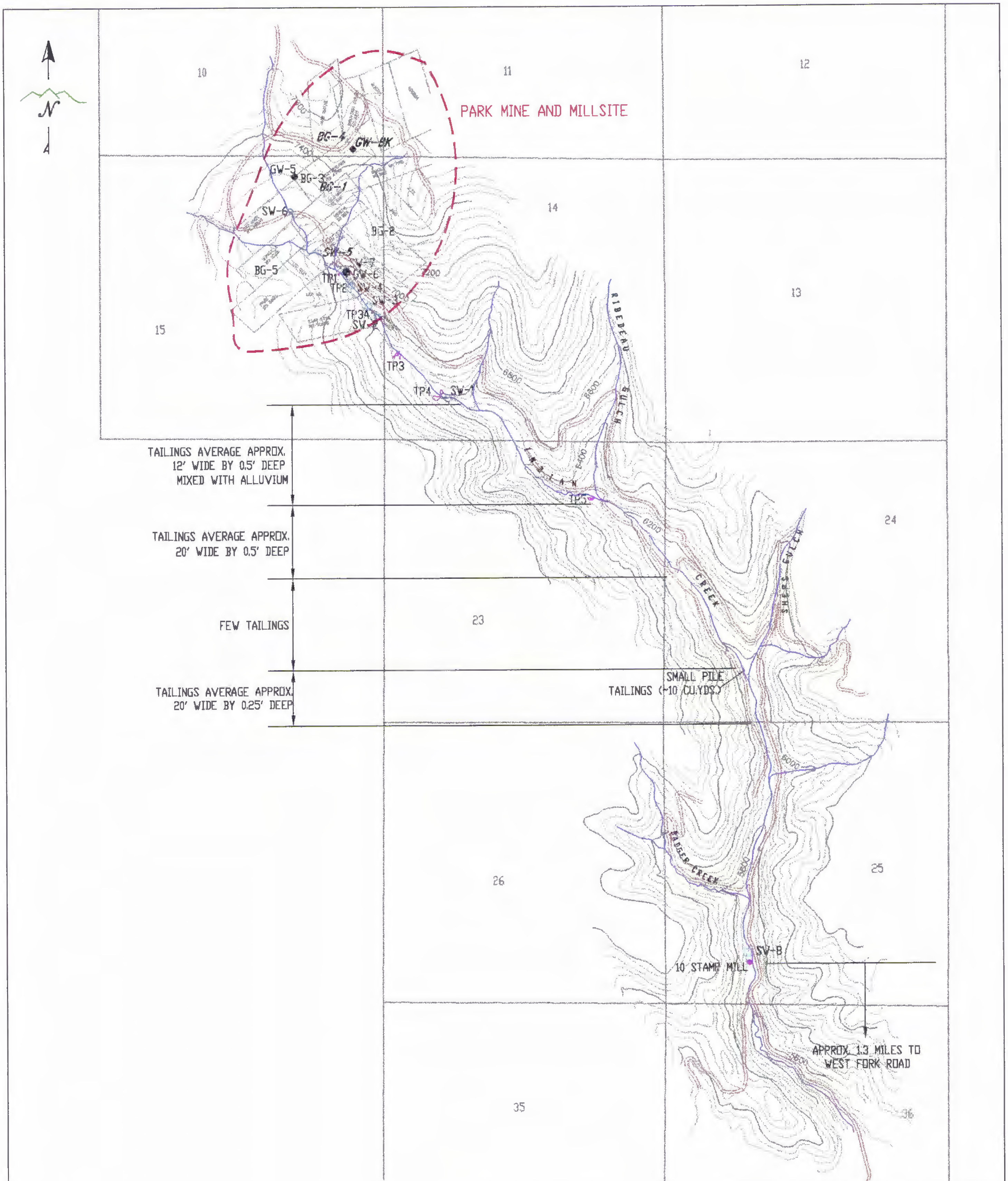
3.1.2 Tailings

Several tailings piles associated with the Park Mine and Millsite are located within Indian Creek downstream from the site. Much of the reach of Indian Creek from WR8 to the confluence with the West Fork of Indian Creek has visible deposits of tailings. The sampling plan specified sampling and analysis of Tailings Ponds 1 and 2 (TP1 and TP2), located at the main Park site, both of which were identified in the 1993 inventory of the site. Investigation of the tailings deposits downstream of these piles was included because of the potential impact of these materials on the water quality of Indian Creek. The investigation extended from the Park site at the head of the Indian Creek drainage to the existing 10-stamp mill located approximately two miles downstream of TP2. This entire reach was walked and deposits of tailings were located and mapped. Besides TP1 and TP2, three other significant deposits of tailings were located and sampled (TP3, TP4 and TP5). In most areas between these deposits there is a thin, vegetated layer of tailings on either side of the creek. The estimated depth and areal extent of these thin deposits was also noted. Figure 3-2 shows the location of the downstream tailings deposits in relation to the site and to surface water sample sites.

The tailings from TP1, TP2, TP3, and TP4 were sampled and analyzed for the same parameters as the waste rock dumps, with the addition of cyanide analysis for a sample from TP5. A summary of the information obtained from the field investigation and laboratory analysis is provided in Table 3-3. The subsections that follow describe each of the five significant tailings deposits in more detail.

As with the waste rock dumps at this site, most of the tailings analyzed exhibited pH values less than 5.5, which is considered by some state regulatory programs to be unsuitable for plant growth. Organic amendment of most of the tailings material would be necessary due to the low organic matter content. In addition to providing temporary stabilization of the disturbed erodible surfaces, application of wheat or barley straw mulch would assist in providing necessary organic material to help promote successful revegetation.

Although all of the proposed reclamation alternatives involve removal of tailings from the stream vicinity, revegetation recommendations are provided for each of the tailings deposits sampled; this includes lime requirements and fertilizer recommendations. These are provided for comparative purposes with the other waste sources investigated at the site. Texture would likely be a limiting factor when attempting to establish vegetation directly on the surface of the tailings. The tailings consist of fine silts, clays and sands which have unsuitable combinations of water holding capacity, bulk density, porosity, and infiltration properties for promoting plant growth. By integrating coarse limestone into the upper 24-inches of the tailings, and also blending topsoil, the tailings could possibly be modified to reliably establish vegetation. The breakdown of the revegetation requirements, as presented below, should be considered preliminary at this time (for planning purposes only). TP2 will be re-sampled, and the results will be re-evaluated after construction activities have been implemented and the tailings have been removed, recontoured, amended, and prepared for revegetation.



PIONEER TECHNICAL SERVICES, INC.

FIGURE 3–2
PARK MINE & MILL SITE
DOWNSTREAM TAILINGS
LOCATION MAP

SCALE: 1"=2500'
DATE: 10–7–96

344101

TABLE 3-3
TAILINGS DATA SUMMARY

Tailings Pile	Est. Volume (cy)	Est. Surface Area (Ac.)	Elevated Metals (>3X Background)	TCLP Metals Above Regulatory Limit	pH	Organic Matter Content (%)	Lime Req'ment* (tons/ac)
TP1	15	0.017	Composited with TP2				
TP2	105	0.028	As, Pb, Ag	None	2.5	0.7	197
TP3	245	0.115	As, Cd, Cu, Pb, Ag, Zn	As, Pb	4.4	6.1	675
TP4	2,490	0.243	As, Cu, Pb, Hg, Ag	None	6.0	2.3	231
TP5	102	0.084	As, Cu, Fe, Pb, Hg, Ag	Not Analyzed			
Thin Deposits	700	1.75	Not Sampled				

* Assumes 12 inch depth of lime incorporation.

3.1.2.1 Tailings Pond #1

Tailings pond #1 (TP1) is a small deposit of uncontained tailings at the base of an old wooden mill building located near WR8. Tailings were very shallow (maximum depth was eight inches). Topsoil and plants were present on the majority of the deposit. It appears that the tailings could have been washout or leakage from the mill building.

A sample of the tailings was taken and composited with the samples from TP2 because of the small amount of material. The volume of TP1 has been estimated at 15 cy.

3.1.2.2 Tailings Pond #2

Tailings pond #2 (TP2) is located on the southwest side of, and immediately adjacent to Indian Creek. No road presently accesses TP2. The closest road is on the northeast side of the creek, and it is approximately 50 feet above Indian Creek. A small berm of alluvium with some intermixed tailings separates TP2 from the creek. An old breached dam is located at the downstream end of TP2. It appears that the majority of TP2 is gone; remaining tailings are on the edge of the floodplain. A white precipitate was present on top of several portions of TP2.

Three test pits were excavated through TP2 using a shovel to reach underlying natural soil. The maximum depth of TP2 was 2 feet. Three composite samples were collected from TP2 and composited with TP1 for laboratory and ABA analyses (2/3 of the sample was TP2, 1/3 was TP1). A brief description of each discrete and composite sample is provided on Table 3-1. According to the sampling plan, TP2 was not planned to be sampled, but because TP2 was closer to the creek and contained more tailings than TP1 it was sampled and composited with TP1.

The volume of TP2 has been estimated at 105 cy. Table A-1 (Appendix A) presents the metals and cyanide data obtained for TP2. Concentrations of the following metals are significantly elevated above background (>3X) in the tailings: arsenic, lead, and silver.

According to the TCLP data (Table A-2, Appendix A) obtained for TP2, the concentrations of all metals measured in laboratory-generated leachate are well below the regulatory limits for hazardous waste classification. Consequently, TP2 is not classifiable as a RCRA characteristic hazardous waste.

One composite sample of TP2 was collected for ABA and agronomic analyses (Tables A-3 and A-4, Appendix A) to investigate the possibility of establishing vegetation directly on the surface of the tailings. ABA data obtained for TP2 indicate that TP2 is a potential acid producer, and approximately 197 tons of lime per acre would be required to successfully establish vegetation on this material (assuming 24-inch depth of incorporation).

Fertilizer recommendation analyses provided the following results for TP2: 80 pounds nitrogen required per acre; and 70 pounds potassium required per acre. Assuming a recontoured surface area of approximately 0.035 acre for TP2, a 12 pound mixture of fertilizer consisting of 7 pounds urea (45% N) and 4 pounds potassium oxide (60% K) would provide optimum nutrient concentrations for establishing vegetation directly on the surface of TP2.

Samples of the natural soil underlying TP1 and TP2 were collected from each test pit to determine if metals have migrated out of the tailings and into underlying materials, and to determine if some of the underlying soils are contaminated enough to also warrant removal. Although the possibility of sample contamination by overlying materials from mixing is always a concern, this was minimized by the sampling methodology (scraping to a fresh vertical surface prior to collecting sample material). The soils underlying the tailings have elevated concentrations of lead. Lead concentrations in the soils are at much lower levels than those found in the tailings indicating that downward leaching of lead is occurring. Concentrations of lead (1,190 ppm) in the underlying soils appear to be elevated enough that removal may be warranted.

3.1.2.3 Tailings Pond #3

Tailings pond #3 (TP3) is an uncontained tailings impoundment bisected by Indian Creek. It is located approximately 1,500 feet downstream of TP2. A dam of alluvium is located on the downstream side of TP3, but it is has been breached and is badly eroded. Much of the tailings appear to have been washed downstream. Only piles of tailings remain in the floodplain immediately adjacent to the creek behind the dam. On the southwest side of the creek and close to the edge of the floodplain, a portion of the original pond appears to be still in place; maximum depth in this area was 31 inches.

No road presently accesses TP3. However, an old road from the Park Mine ends approximately 200 feet upstream of the pond.

Several test pits were excavated in TP3 using a shovel; maximum depth encountered was 31 inches. Two composite samples were collected from TP3 and submitted for laboratory and ABA analyses. A brief description of each discrete and composite sample is provided on Table 3-1.

The volume of TP3 has been estimated at 245 cy. Table A-1 (Appendix A) presents the metals and cyanide data obtained for TP3. Concentrations of the following metals are significantly elevated above background (>3X) in the tailings: arsenic, cadmium, copper, iron, lead, silver, and zinc.

According to the TCLP data (Table A-2, Appendix A) obtained for TP3, the concentrations of all metals measured in laboratory-generated leachate are well below the regulatory limits for hazardous waste classification except arsenic and lead. Because of the lead and arsenic analyses, tailings from TP3 are classifiable as a characteristic hazardous waste under RCRA.

One composite sample of TP3 was collected for ABA and agronomic analyses (Tables A-3 and A-4, Appendix A) to investigate the possibility of establishing vegetation directly on the surface of the tailings. ABA data obtained for TP3 indicate that TP3 is a potential acid producer, and approximately 675 tons of lime per acre would be required to successfully establish vegetation on this material (assuming 24-inch depth of incorporation).

Fertilizer recommendation analyses provided the following results for TP3: 80 pounds nitrogen required per acre; and 63 pounds potassium required per acre. Assuming a recontoured surface area of approximately 0.12 acre for TP3, a 4 pound mixture of fertilizer consisting of 2 pounds urea (45% N) and 2 pounds potassium oxide (60% K) would provide optimum nutrient concentrations for establishing vegetation directly on the surface of TP3.

No samples of the natural soil underlying TP3 were obtained. A hard crust of red-brown silt with pebbles was encountered at the base of each hole that prohibited further digging.

3.1.2.4 <u>Tailings Pond #4</u>

Tailings pond #4 (TP4) is a relatively large, uncontained tailings impoundment bisected by Indian Creek. It is located approximately 1,000 feet downstream of TP3. A dam of alluvium is located on the downstream side of TP3, but it is has been breached and is badly eroded. A large area of eroded tailings is also present below the dam. There is an old, elevated, wooden flume system coming into the pond from the upstream side. Sections of the pond remain on both the east and west sides of the creek with the majority of the tailings being on the west side. No road presently accesses TP4; the closest road is near TP3. Tailings in TP4 were largely unvegetated and dead trees were present in the west part of the pond.

Two test pits were excavated in TP4 using hand augers; maximum depth encountered in TP4 before auger refusal was seven feet on the west side. Both auger holes had distinct stratigraphic zones consisting of an upper layer of brown silt/sand and a lower layer of gray clay. Samples were collected of each material for analyses. Four composite samples were collected from TP4 and submitted for laboratory and ABA analyses. A brief description of each discrete and composite sample is provided on Table 3-1.

The volume of TP4 has been estimated at 2,490 cy. Table A-1 (Appendix A) presents the metals and cyanide data obtained for TP4. Concentrations of the following metals are significantly elevated above background (>3X) in the tailings: arsenic, copper, lead, mercury and silver.

According to the TCLP data (Table A-2, Appendix A) obtained for TP4, the concentrations of all metals measured in laboratory-generated leachate are well below the regulatory limits for hazardous waste classification except lead. Because of the lead analyses, tailings in TP4 are classifiable as a characteristic hazardous waste under RCRA.

Two composite samples of TP4 were collected for ABA analyses and one composite sample for agronomic analyses (Tables A-3 and A-4, Appendix A) to investigate the possibility of establishing vegetation directly on the surface of the tailings. ABA data obtained for TP4 indicate that TP4 is a potential acid producer, and approximately 231 tons of lime per acre would be required to successfully establish vegetation on this material (assuming 24-inch depth of incorporation).

Fertilizer recommendation analyses provided the following results for TP4: 80 pounds nitrogen required per acre; 33 pounds phosphate required per acre; and 53 pounds potassium required per acre. Assuming a recontoured surface area of approximately 0.24 acre for TP4, a 83 pound mixture of fertilizer consisting of 43 pounds urea (45% N), 18 pounds treble superphosphate (45% P), and 22 pounds potassium oxide (60% K) would provide optimum nutrient concentrations for establishing vegetation directly on the surface of TP4.

No samples of the natural soil underlying TP4 were obtained. Auger refusal occurred at the bottom of each hole before natural soils were encountered.

3.1.2.5 <u>Streamside Tailings</u>

Indian Creek below TP2 was investigated to determine the location of tailings that may have washed down the creek and been deposited. Tailings were identified on the streambank approximately 300 feet below TP2, adjacent to the lowest discharging adit (SW-3). These tailings were mostly unvegetated. The volume of tailings in this area has been estimated at 33 cy. These tailings are located along the edge of a pond formed by a road crossing the stream.

Approximately 1,200 feet below TP2, on the southeast side of Indian Creek, an old stone mill foundation is present on the edge of the floodplain. Although no tailings were seen along Indian Creek, three small areas of tailings were found just below the mill foundation. The tailings had approximately two inches of topsoil and were well vegetated. The volume of this deposit has been estimated at 30 cy.

Between TP3 and TP4 only a skiff of tailings could be seen in places. Much of the area between the two ponds had been dredged in the past and the tailings may have been mixed with the dredge tailings.

A thin veneer of tailings is present for up to six feet on either side of Indian Creek from TP4 to the mouth of Ribedeau Gulch. A larger deposit of tailings is present at this location because of the depositional environment provided. A grab sample (TP5) was taken in this location and submitted for laboratory analyses. A brief description of the sample is provided in Table 3-1.

The volume of tailings in the TP5 area has been estimated at 102 cy. Table A-1 (Appendix A) presents the metals and cyanide data obtained for TP5. Concentrations of the following metals are significantly elevated above background (>3X) in the tailings: arsenic, copper, iron, lead, mercury and silver.

Below Ribedeau Gulch, tailings average 0.5 feet deep and are present for approximately 10 feet on each side of the creek for another 2,200 feet. Below that, the tailings appear as isolated skiffs along the stream bank for about 2,500 feet. Approximately 10 cy of unvegetated tailings are present near the confluence of Indian Creek with Sheps Gulch. Three to 4 inches of tailings are present for the next 1,000 feet for an average of 10 feet on each side of Indian Creek; these tailings are about 90% vegetated with a few bare spots. From that point on, only isolated skiffs of tailings occur, mostly mixed with alluvium. A 10-stamp mill is located adjacent to Indian Creek approximately 1.3 miles up from the confluence of Indian Creek with West Fork Indian Creek; the investigation of tailings from the Park site ended just upstream of this mill.

3.1.3 Adit Discharges

Between 1994 and 1996, four discharging adits at the Park site were sampled several times as part of the DEQ/AMRB adit sampling project. Each adit discharge sample was analyzed for total metals, dissolved metals, and wet chemistry parameters. Data are included in Appendix A. Table 3-4 lists sample dates and locations, and parameters measured. Locations are shown on Figure 3-1. The adit discharge samples were also analyzed for iron speciation to determine the ratio of fully oxidized iron in solution (Fe^{3+}) to the reduced oxidative state (Fe^{2+}). These data are also included in Appendix A.

TABLE 3-4: PARK MINE AND MILL SITE ADIT DISCHARGE SOURCE SAMPLING SUMMARY

SAMPLE NO.	DESCRIPTION	DATE SAMPLED	pH	S.C. (uS/cm)	E.H. (mV)	TEMP. (C)	ALKALINITY (mg CaCO3/L)	D.O. (mg/l)	FLOW (GPM)	TM	DM	WET CHEM.	FE SPECIATION	AS SPECIATION
04-012-GW-1	Discharging adit associated with WR2	09/28/95	6.16	361	179.8	6.1	7	NM	15	Table A-8	Table A-9	Table A-11		
		01/24/96	5.54	572	220.4	3.7	6	7.33	1.5	Table A-8	Table A-9	Table A-11	Table A-10	Table A-10
		06/06/96	3.74	265	357.2	6.4	0	7.83	120	Table A-8	Table A-9	Table A-11	Table A-10	Table A-10
		08/??/96								Table A-8	Table A-9	Table A-11	Table A-10	Table A-10
04-012-GW-2	Seep at base of WR2	09/28/95	4.83	980	206.0	7.4	0	NM	5	Table A-8	Table A-9	Table A-11		
		01/24/96	6.71	150	171.9	5	31	8.16	5.6	Table A-8	Table A-9	Table A-11	Table A-10	Table A-10
		06/06/96	4.31	449	375.1	8.1	0	7.51	45	Table A-8	Table A-9	Table A-11	Table A-10	Table A-10
		08/??/96								Table A-8	Table A-9	Table A-11	Table A-10	Table A-10
04-012-GW-4	Discharging adit associated with WR4	10/16/95	7.15	45	NM	10	25	NM	<1	Table A-8	Table A-9	Table A-11		
		06/06/96	5.73	115	249.7	7	18	8.12	87	Table A-8	Table A-9	Table A-11	Table A-10	Table A-10
		08/??/96							<1	Table A-8	Table A-9	Table A-11		
04-012-GW-BK	Discharging adit associated with WR9, the Bullion King Mine	10/16/95	5.96	37.8	NM	6.1	6	NM	<1	Table A-8	Table A-9	Table A-11		
		06/06/96	6.42	101	206.2	7	12	8.12	52	Table A-8	Table A-9	Table A-11	Table A-10	Table A-10
		08/??/96								Table A-8	Table A-9	Table A-11		
04-012-SW-3	Discharging adit located approximately 300 feet below TP2	07/29/96	8.02	410	NM	9	54	NM	200	Table A-6	Table A-6	Table A-7		
04-012-GW-3	Quality Control Sample, Blank	07/31/96	NM	NM	NM	NM	NM	NM	NA	Table A-6	Table A-6	Table A-7		
04-012-GW-5	Upgradient spring sample, taken near BG-3 and B-1	07/31/96	6.34	91	NM	11.6	51	NM	5	Table A-6	Table A-6	Table A-7		
04-012-GW-6	Seep downgradient of most of the waste rock, on northeast side of creek, upstream of the cabins	07/29/96	7.31	218	NM	9.3	31	NM	10	Table A-6	Table A-6	Table A-7		

S.C. = Specific Conductance
D.O. = Dissolved Oxygen
TM = Total Metals
DM = Dissolved Metals
Wet Chem = Hardness, Total Dissolved Solids, Sulfates, and Cloride analyses.
NM = Not Measured
NA = Not Appropriate

Review of the data shows that the adit discharges exceed many water quality standards. Discharges GW-1 (above WR2), GW-2 (discharge at base of WR2), and GW-4 (above WR4) exceed the following:

- Arsenic - Federal drinking water maximum contaminant level (MCL) and Montana Human Health Standard (HHS);
- Cadmium - Federal MCL; and
- Iron, Manganese, Zinc, Lead - Montana HHS.

The discharge at GW-BK, the upper adit associated with the Bullion King Mine, exceeds the following water quality criteria:

- Arsenic - Montana HHS;
- Cadmium - Federal MCL; and
- Iron, Manganese, Zinc, Lead - Montana HHS.

The iron speciation data for the adit discharge samples show that most of the iron present in solution is in the reduced state (Fe^{2+}). These data indicate that the iron is in the process of oxidizing to Fe^{3+} as the water exits the adit; chemical kinetics will dictate the rate at which the iron will oxidize.

Comparison of total to dissolved metals in the adit discharges, averaged over time and for the four adits, indicates that 6% of the As, 98% of the Cd, 57% of the Cu, 18% of the Fe, 67% of the Mn, 82% of the Zn, and 23% of the Pb is present in the dissolved phase. These data are consistent with the observed pH, Eh, and dissolved oxygen.

3.2 SURFACE WATER

A total of six paired surface water and sediment samples were collected from Indian Creek around the Park site during the reclamation investigation. Sample locations and parameters measured are listed in Table 3-5. One additional surface water/sediment pair was planned, but there was no flow at one of the planned locations (SW-7, see Figure 3-2). Therefore, no water samples were collected from this point, but a sediment sample was collected. An additional sample was collected from an adit discharge into Indian Creek, but not associated with the Park site (SW-3).

Each surface water sample was analyzed for total metals, dissolved metals, and wet chemistry parameters. Analytical results are included in Appendix A. Each sediment sample was submitted to the laboratory for TAL metals analysis.

One of the sample locations (SW/SE6) is upgradient of mine waste sources. Water quality at the background sample location was generally good and had significantly lower concentrations than samples collected downstream. Surface water samples collected downstream of the mine waste

TABLE 3-5: PARK MINE AND MILL SITE - SURFACE WATER AND SEDIMENT SAMPLING SUMMARY

SAMPLE NO.	DESCRIPTION	pH	S.C. (uS/cm)	TEMP. (C)	ALKALINITY (mg CaCO3/L)	FLOW (ft3/sec)	TM	DM	WET CHEM.	TAL
04-012-SW-1	Sample collected approximately 50 feet downstream of breached dam of TP4.	8.4	301	16.9	42	0.92	Table A-6	Table A-6	Table A-7	
04-012-SE-1	Sample collected approximately 50 feet downstream of breached dam of TP4.									Table A-1
04-012-SW-2	Sample collected approximately 35 feet downstream of waste rock associated with the lowest discharging adit.	7.61	324	14	37	0.89	Table A-6	Table A-6	Table A-7	
04-012-SE-2	Sample collected approximately 35 feet downstream of waste rock associated with the lowest discharging adit.									Table A-1
04-012-SW-3	Adit discharge from lowest adit, sample collected just as discharge emerges from adit mouth.	8.02	410	9	54	0.45	Table A-6	Table A-6	Table A-7	
04-012-SE-3	Adit discharge from lowest adit, sample collected just as discharge emerges from adit mouth.									Table A-1
04-012-SW-4	Sample collected approximately 10 feet below breached dam of TP2.	7.87	187	21.2	60	0.22	Table A-6	Table A-6	Table A-7	
04-012-SE-4	Sample collected approximately 10 feet below breached dam of TP2.									Table A-1
04-012-SW-5	Sample collected below road at base of WR2.	7.79	207	15.5	34	0.26	Table A-6	Table A-6	Table A-7	
04-012-SE-5	Sample collected below road at base of WR2.									Table A-1
04-012-SW-6	Upstream sample; above reservoir, just above road, 5 feet downstream of confluence.	7.07	74.4	22.6	45	0.04	Table A-6	Table A-6	Table A-7	
04-012-SE-6										Table A-1
04--12-SE-7	Sample collected just below confluence of dry drainages from WR4 and WR6.					0				Table A-1
04-012-SW-8	Sample collected approximately 25' upstream of 10 stamp mill, approximately 3.5 miles downstream of the Park site.	7.19	269	12.6	61	1.6	Table A-6	Table A-6	Table A-7	
04-012-SE-8	Sample collected approximately 25' upstream of 10 stamp mill, approximately 3 5 miles downstream of the Park site.									Table A-1

S.C. = Specific Conductance
TM = Total Metals
DM = Dissolved Metals
Wet Chem = Hardness, Total Dissolved Solids, Sulfates, and Cloride analyses.
TAL = Target Analyte List (Total Metals)

sources (including waste rock dumps, adit discharges, and tailings) were generally of poor quality. Exceedences of water quality standards in Indian Creek are summarized in Table 3-6.

TABLE 3-6
SURFACE WATER QUALITY STANDARD EXCEEDENCES

SAMPLE LOCATION	WATER QUALITY STANDARD EXCEEDENCES						
	Cd	Cu	Pb	Fe	Mn	As	Zn
04-012-SW-6 upstream	None	None	None	HHS	None	None	None
04-012-SW-5 below WR2	CAL, AAL, HHS, MCL	CAL, AAL	CAL	HHS	HHS	HHS	CAL, AAL
04-012-SW-4 below TP2	CAL, AAL, HHS, MCL	CAL, AAL	CAL, HHS	HHS	HHS	HHS, MCL	CAL, AAL
04-012-SW-2 below adit discharge	CAL, AAL, HHS, MCL	None	CAL	None	HHS	HHS, MCL	CAL, AAL
04-012-SW-1 below TP4	CAL	None	None	None	None	HHS, MCL	CAL, AAL
04-012-SW-8 3.5 mi below Park Mine	None	None	None	None	None	HHS	None

CAL - Chronic aquatic life standard (DEQ/WQB, 1995).
AAL - Acute aquatic life standard (DEQ/WQB, 1995).
HHS - Montana Human Health Standard (DEQ/WQB, 1995).
MCL - Safe Drinking Water Act Maximum Contaminant Level.

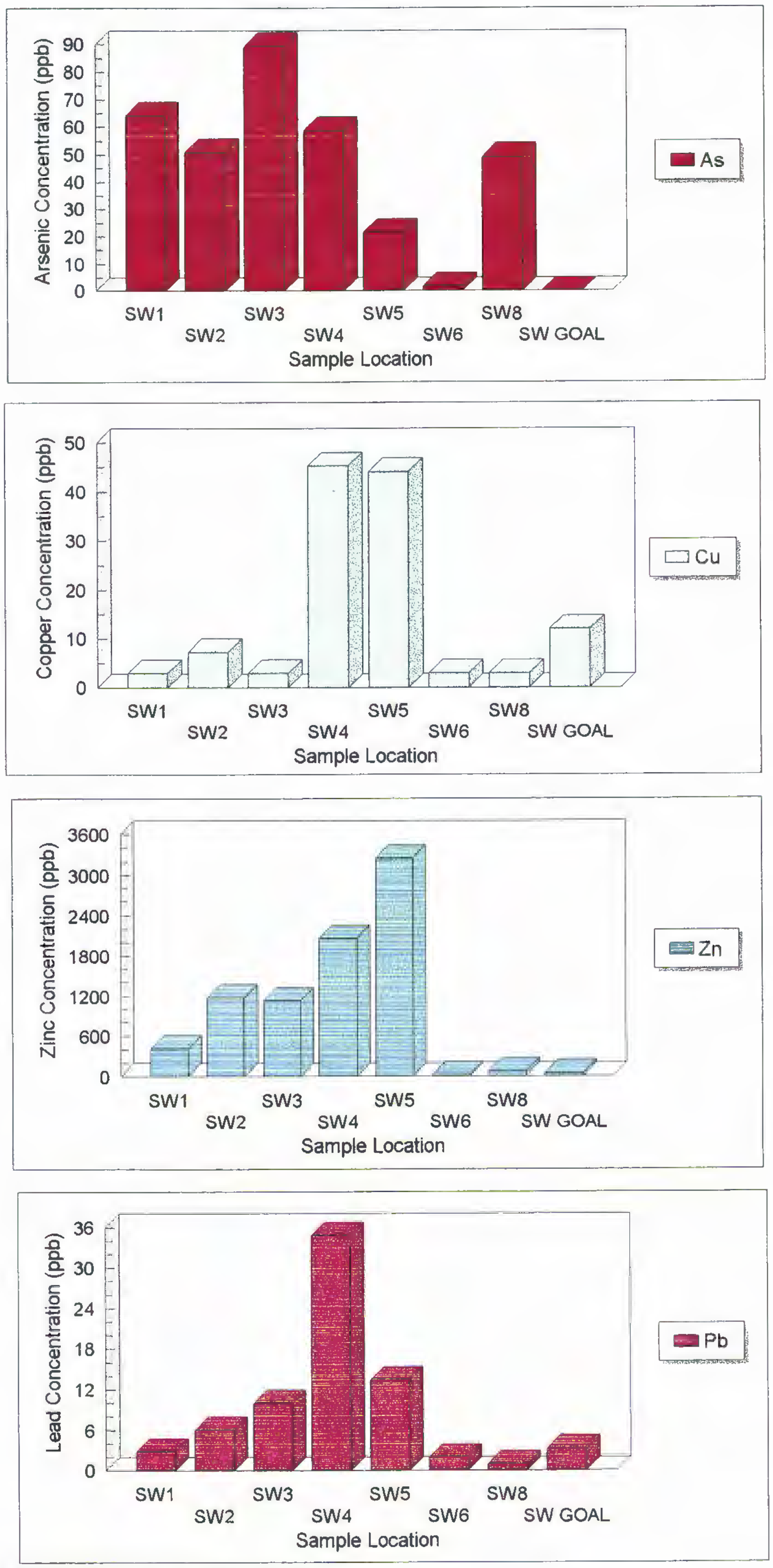
As shown in Table 3-6 arsenic and zinc concentrations in surface water are elevated below the site, persisting as far downstream as SW-1. Cadmium and lead concentrations are elevated as far downstream as SW-2 and iron and copper concentrations are elevated to just below the Park site (SW-4).

Concentrations of four metals (arsenic, copper, lead and zinc) were compared at each surface water sampling location. Concentrations of these metals at each location are plotted in bar chart form in Figure 3-3.

A loading analysis was performed to identify the relative contributions to surface water from the several contaminant sources present at the site. Surface water contaminant loadings are a

FIGURE 3-3

PARK MINE AND MILL SITE RECLAMATION INVESTIGATION
VARIATION OF METALS CONCENTRATIONS ALONG INDIAN CREEK



* All concentrations are total metals values

function of discharge (Q) and contaminant concentrations measured in water samples. Significant increases of contaminant loads between two sample stations are indicative of contributions originating at a source between the two stations. The loading analysis results are presented in Table 3-7 and allows a comparison between groups of sources for each contaminant.

TABLE 3-7
SIGNIFICANT LOADING TO INDIAN CREEK SURFACE WATER AND SEDIMENT CONCENTRATIONS

Surface Water Reach	Sources within Reach	Significant Total Metals Loading to Surface Water	Significant Metals in Stream Sediment
SW-6 to SW-5	WR2, WR3, GW1, GW2	<u>Cd</u>, <u>Zn</u>, As, Cu, Pb, Mn	As, Cd, Pb, Zn
SW-5 to SW-4	WR1, WR2, WR4, WR5, WR6, WR8, WR9, WR10, TP2, GW4, GW-BK	<u>Cu</u>, As, Cd, Pb, Zn, Mn	<u>As</u>, Cd, Cu, <u>Pb</u>, Zn
SW-4 to SW-2	Adit at SW-3	As, Cd, Zn	<u>As</u>, Cd, <u>Cu</u>, <u>Pb</u>, <u>Zn</u>
SW-2 to SW-1	TP-4	<u>As</u>, Hg, Zn	<u>As</u>, <u>Cd</u>, Cu, Pb, <u>Zn</u>
SW-1 to SW-8	None	As	As, Cd, Pb, Zn

Elevated metal concentrations in streambed sediments appear source-related; elements found in the sources at elevated concentrations are also high in sediments in Indian Creek downstream from the sources. The elevated concentrations in sediment persists at least 3.5 miles downstream from the Park Mine and may continue farther, beyond these sample stations; additional uninvestigated sources may also be responsible for the elevated sediment concentrations.

3.3 <u>GROUNDWATER</u>

Two groundwater samples were collected at the Park site. These were collected from an upgradient spring (GW-5) and a downgradient spring (GW-6). The downgradient spring is not immediately downgradient from many of the sources (e.g., tailings), but is influenced by some of the sources at the site. The sample locations are illustrated on Figures 3-1 and 3-2. Table 3-4 briefly describes each sample site and presents the field parameters measured. The groundwater analytical results are presented in Appendix A. The groundwater samples were analyzed for total and dissolved metals, TDS, sulfate, and hardness. Field parameters for all groundwater samples included pH, alkalinity, temperature, and specific conductance.

The downgradient spring generally had higher concentrations of metals compared to the upgradient spring. No drinking water standards were exceeded in either sample, for both total and dissolved phases. The slightly elevated metals concentrations in the downgradient spring may be due to wastes at the Park Mine. The elements that were elevated in the spring (arsenic, cadmium, iron, and lead) are also elevated in sources at the site.

3.4 BORROW SOURCES

Since several of the reclamation scenarios involve the use of cover soil for covering and revegetation of waste sources at the site, part of the field investigation included excavation of test pits on-site to evaluate the suitability of these soils for cover. Four test pits were excavated in the open field north of the site (B-1, B-2, B-3, B-4). Locations are shown on Figure 3-1. A description of the soils encountered is included in Table 3-1. Each pit was excavated to 12 to 13 feet bgs. In general, the soil profile in this region consists of 9 to 18 inches of topsoil, underlain by 12 inches of a topsoil/sand mixture, underlain by 3 to 5 feet of grey sand, underlain by 5 to 8 feet of a brown clayey sand. Rocks up to 18 inches in size are present throughout the profile starting at the base of the topsoil layer.

Composite samples from each of the test pits were analyzed for metals, physical properties and agronomic properties (Tables A-1, A-5 and A-4, Appendix A).

3.5 REPOSITORY SITE

One of the reclamation scenarios for this site involves on-site disposal of some or all of the waste sources in a constructed repository. One test pit (R-1) was excavated south of WR4 to determine the suitability of this location for a repository. The test pit was excavated to a depth of 6.5 feet at which bedrock was encountered. Due to the rocky soils, in-place permeability samples could not be collected. The soils consisted of 18 inches of topsoil underlain by 5 feet of red-brown silt with clayey silt, underlain by bedrock. Samples were analyzed for agronomic and physical properties (Tables A-4 and A-5, Appendix A).

3.6 BACKGROUND SAMPLES

One background sample was collected from the Park site during the 1993 inventory. Five discrete background soil samples were collected from the area surrounding the Park site (sample numbers 04-012-BG1 through BG5) during the 1996 investigation. Background soil sample 04-012-BG4 was collected on the hillside north of the Bullion King Mine (WR9), all the other samples were collected in the vicinity of the Park Mine site. The location of each background sample is described briefly in Table 3-1.

The background samples were collected from the various geologic units at the site, with some of the samples reflecting the mineralization that has occurred (i.e., along the mineralized structure, but outside of the influence of the mining/milling activity). The background samples were collected as near-surface grab samples (6-inch depth or less), below the shallow topsoil/organic material horizon, and were analyzed for total metals to establish background conditions for comparison purposes. Sample results for key CoCs at the site are summarized in Table 3-8. Approximate locations are shown in Figure 3-1. Table A-1 (Appendix A) contains the analytical results.

TABLE 3-8
SUMMARY OF BACKGROUND SOIL SAMPLES

SAMPLE ID	ANALYTE CONCENTRATION (mg/kg)								
	As	Ag	Cd	Cu	Fe	Hg	Mn	Pb	Zn
Background ('93)	44J	---	1U	28.9J	37600	0.088J	1220	31	112J
04-012-BG1	154J	1.3UJ	4.2J	14.2	19500	0.050J	1910J	546J	487
04-012-BG2	96.7J	1.5J	1.1J	25.0	22300	0.074J	6260J	34.4J	276
04-012-BG2	34.4J	1.3UJ	1.4J	15.7	19500	0.056J	669J	27.7J	131
04-012-BG4	22.9J	1.3UJ	0.88UJ	20.6	23300	0.063J	780J	25.7J	70.2
04-012-BG5	79.6J	1.7J	2.4J	16.2	22800	0.072J	2930J	71.9J	250

U - Analyte not detected
J - Estimated concentration

4.0 SUMMARY OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Section 121(d)(2) of the CERCLA, 42 United States Code (USC) § 9621(d)(2), requires that clean-up actions conducted under CERCLA achieve a level or standard of control which at least attains "any standard, requirement, criteria, or limitation under any Federal environmental law or any [more stringent] promulgated standard, requirement, criteria or limitation under a State environmental or facility siting law... [which] is legally applicable to the hazardous substance concerned or is relevant and appropriate under the circumstances of the release of such hazardous substance or pollutant, or contaminant..." The standards, requirements, criteria, or limitations identified pursuant to this section are commonly referred to as "applicable or relevant and appropriate requirements (ARARs)."

Two general types of clean-up actions are recognized under CERCLA: removal actions and remedial actions. A removal action is an action to abate, prevent, minimize, stabilize, mitigate, or eliminate a release or threat of release. This action is often temporarily taken to alleviate the most acute threats or to prevent further spread of contamination until more comprehensive action can be taken. A remedial action is a thorough investigation, evaluation of alternatives, and determination and implementation of a comprehensive and fully protective remedy for the site.

ARARs may be either "applicable" or "relevant and appropriate" to remedial activities at a site, but not both. Applicable requirements are those standards, requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. A remedial action must satisfy all the jurisdictional prerequisites of a requirement for it to be applicable to the specific remedial action at a CERCLA site.

Relevant and appropriate requirements are those standards, requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to hazardous substances, pollutants, contaminants, remedial actions, locations, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Factors which may be considered in making this determination, when the factors are pertinent, are presented in 40 Code of Federal Regulations (CFR) § 300.400(g)(2). They include, among other considerations, examination of the purpose of the requirement and of the CERCLA action, the medium and substances regulated by the requirement and at the CERCLA site, the actions or activities regulated by the requirement and the remedial action contemplated at the site, and the potential use of resources affected by the requirement and the use or potential use of the affected resource at the CERCLA site.

ARARs are divided into contaminant-specific, location-specific, and action-specific requirements. Contaminant-specific requirements govern the release of materials possessing certain chemical or physical characteristics or containing specific chemical compounds into the environment. Contaminant-specific ARARs generally set human or environmental risk-based criteria and protocol which, when applied to site-specific conditions, result in the establishment of numerical action values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.

Location-specific ARARs relate to the geographic or physical position of the site, rather than to the nature of site contaminants. These ARARs place restrictions on the concentration of hazardous substances or the conduct of clean-up activities due to their location in the environment.

Action-specific ARARs are usually technology- or activity-based requirements or are limitations on actions taken with respect to hazardous substances. A particular remedial activity will trigger an action-specific ARAR. Unlike chemical- and location-specific ARARs, action-specific ARARs do not, in themselves, determine the remedial alternative. Rather, action-specific ARARs indicate how the selected remedy must be achieved.

Non-promulgated advisories or guidance documents issued by federal or state governments do not have the status of potential ARARs. However, these advisories and guidance documents are "To Be Considered (TBC)" when determining protective clean-up levels. The TBC category consists of advisories, criteria, or guidance that were developed by the EPA, other federal agencies, or states that may be useful in developing CERCLA remedies. These categories may be considered as appropriate in selecting and developing clean-up actions.

As provided by Section 121 of CERCLA, 42 USC § 9621, only those state standards that are more stringent than any federal standard and that have been identified by the State in a timely manner are appropriately included as ARARs. Some state standards that are potentially duplicative of federal standards are identified here to ensure their timely identification and consideration in the event that they are not identified or retained in the federal ARARs. Duplicative or less stringent standards will be deleted as appropriate when the final determination of ARARs is presented.

CERCLA defines only federal environmental laws and state environmental or facility siting laws as ARARs. Remedial design, implementation, and operation and maintenance must, nevertheless, comply with all other applicable laws, both state and federal. Many such laws, while not strictly environmental or facility siting laws, have environmental impacts. Moreover, applicable laws that are not ARARs because they are not environmental or facility siting laws are not subject to the ARAR waiver provisions, and the administrative, as well as the substantive, provisions of such laws must be observed. A separate list attached to the state ARARs' list is a non-comprehensive identification of other state law requirements, which must be observed during remedial design, remedy implementation, operation, or maintenance.

Appendix C provides detailed descriptions of potential federal and state ARARs. The description of the federal and state ARARs that follows includes summaries of legal requirements that in many cases attempt to set out the requirement in a simple fashion useful in evaluating compliance with the requirement. In the event of any inconsistency between the law itself and the summaries in this section, the ARAR is ultimately the requirement as set out in the law, rather than any paraphrase provided here. Table 4-1 presents the potential federal ARARs for the site. Potential state ARARs are presented in Table 4-2.

TABLE 4-1

SUMMARY OF FEDERAL PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

STANDARD, REQUIREMENT CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/RELEVANT AND APPROPRIATE?
CONTAMINANT-SPECIFIC			
Safe Drinking Water Act	40 USC § 300		Relevant and Appropriate
National Primary Drinking Water Regulations	40 CFR Part 141	Establishes health-based standards for public water systems (maximum contaminant levels).	Relevant and Appropriate
National Secondary Drinking Water Regulations	40 CFR Part 143	Establishes aesthetic standards for public water systems (secondary maximum contaminant levels).	Relevant and Appropriate
Water Pollution Prevention and Control Act	33 USC § 1251-1387		Relevant and Appropriate
Water Quality Regulations	40 CFR Part 131 Quality Criteria for Water 1976, 1980, 1986	Sets criteria for water quality based on toxicity to aquatic organisms and human health.	Relevant and Appropriate
National Pollutant Discharge Elimination System (NPDES)	40 CFR Part 122	General permits for discharge from construction.	Relevant and Appropriate
Clean Air Act	42 USC § 7409		
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Air quality levels that protect public health.	Applicable
Resource Conservation and Recovery Act			
Lists of Hazardous Wastes	40 CFR Part 261, Subpart D	Defines those solid wastes which are subject to regulation as hazardous wastes under 40 CFR Parts 262-265 and Parts 124, 270, and 271.	Applicable
ACTION-SPECIFIC			
Clean Water Act	33 USC § 1342		Relevant and Appropriate
NPDES	40 CFR Part 122	Requires permits for the discharge of pollutants from any point source into waters of the United States.	Relevant and Appropriate

TABLE 4-1 (Cont'd)

SUMMARY OF FEDERAL PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Surface Mining Control and Reclamation Act	30 USC §§ 1201-1328	Protects the environment from effects of surface mining activities.	Relevant and Appropriate
	30 CFR Part 784	Governs underground mining permit applications and minimum requirements for reclamation and operations plans.	Relevant and Appropriate
	30 CFR Part 816	Outlines permanent program performance standards for surface mining activities	Relevant and Appropriate
Hazardous Materials Transportation Regulations	49 USC §§ 1801-1813		Relevant and Appropriate
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	Regulates transportation of hazardous waste.	Relevant and Appropriate
Resource Conservation and Recovery Act			
Land Disposal	40 CFR Part 268	Establishes a timetable for restriction of burial of wastes and other hazardous materials.	
Criteria for Classification of Solid Waste Disposal Facilities and Practices	40 CFR Part 257	Establishes criteria for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment and thereby constitute prohibited open dumps.	Applicable
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	Establishes standards which apply to persons transporting hazardous waste within the U.S. if the transportation requires a manifest under 40 CFR Part 262.	Applicable
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR Part 264	Establishes minimum national standards which define the acceptable management of hazardous waste for owners and operators of facilities which treat, store, or dispose of hazardous waste.	Applicable

TABLE 4-1 (Cont'd)

SUMMARY OF FEDERAL PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

LOCATION-SPECIFIC			
National Historic Preservation Act	16 USC § 470; 36 CFR Part 800; 40 CFR 6.310(b)	Requires Federal Agencies to take into account the effect of any Federally-assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places and to minimize harm to any National Historic Landmark adversely or directly effected by an under taking.	Applicable
Archeological and Historic Preservation Act	16 USC § 469; 40 CFR § 6.301(c)	Establishes procedures to provide for preservation of historical and archeological data which might be destroyed through alteration of terrain as a result of a Federal construction project or a Federally licensed activity or program.	Applicable
Protection of Wetlands Order	40 CFR Part 6, Appendix A, Executive Order No. 11,990	Avoid adverse impacts associated with the destruction or loss of wetlands and avoid support of new construction in wetlands if a practicable alternative exists.	Applicable
Historic Sites, Buildings and Antiquities Act Appendix A, Executive Order No. 11, 990	16 USC §§ 461-467; 40 CFR § 6.301(a)	Requires Federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks.	Applicable
Fish and Wildlife Coordination Act	16 USC § 2901-2912; 40 CFR 6.302(g)	Requires consultation when Federal department or agency proposes or authorizes any modification of any stream or other water body and adequate provision for protection of fish and wildlife resources.	Applicable

TABLE 4-1 (Cont'd)

SUMMARY OF FEDERAL PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Floodplain Management Order	40 CFR Part 6	Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid the adverse impacts associated with direct and indirect development of a floodplain.	Applicable
Endangered Species Act of 1973	16 USC §§ 1531-1543; 40 CFR 6.302(h); 50 CFR Part 402	Activities may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify a critical habitat.	Applicable
Bald Eagle Protection Act	16 USC §§ 668	Requires consultation with the USFWS during reclamation design and reclamation construction to ensure that any cleanup of the site does not unnecessarily adversely affect the Bald Eagle or Golden Eagle.	Applicable
Migratory Bird Treaty Act	16 USC § 703	Establishes a federal responsibility for the protection of the international migratory bird resource and requires consultation with the USFWS during reclamation design and reclamation construction to ensure the cleanup of the site does not unnecessarily impact migratory birds. Specific mitigative measures may be identified for compliance with this requirement.	Applicable

TABLE 4-2

SUMMARY OF STATE PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

STANDARD, REQUIREMENT CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	APPLICABLE/RELEVANT AND APPROPRIATE?
CONTAMINANT-SPECIFIC			
Montana Water Quality Act	75-5-101 et seq., MCA	Laws to prevent, abate, and control the pollution of state waters.	Applicable
Regulations Establishing Ambient Surface Water Quality Standards	ARM 16.20.604-624	Provides the water use classification for various streams and imposes specific water quality standards per classification.	Applicable
Regulations Establishing Ambient Surface Water Quality Nondegradation Standards	ARM 16.20.708-714	Applies nondegradation requirements to any activity which could cause a new or increased source of pollution to state waters and outlines review procedures.	Applicable
Regulations Establishing Waste Treatment Standards	ARM 16.20.631-633	Imposes waste treatment requirements to restore and maintain the quality of surface water to applicable water use categories. Treatment standards are based on the State's policy of nondegradation, and present and anticipated beneficial uses of the receiving waters.	Applicable
	ARM 16.20.925	Technology-based treatment for MPDES permits.	Applicable
Public Water Supplies Act	75-6-101, MCA	Establishes applicable public policy of Montana to "protect, maintain, and improve the quality and potability of water for public water supplies and domestic uses."	
Public Water Supplies Regulations	ARM 16.20.204	Establishes the maximum contaminant levels ("MCL's") for inorganic chemicals in community water systems.	Relevant and Appropriate
	ARM 16.20.205	Establishes the maximum turbidity contaminant levels for public water supply systems which use surface water in whole or in part.	Relevant and Appropriate
	ARM 16.20.922	Adopts and incorporates language for toxic pollutant effluent standards found in 40 CFR Part 129.	Relevant and Appropriate
	ARM 16.20.923	Adopts and incorporates language for effluent limitations and standards of performance found in 40 CFR Subpart N (except 40 CFR Part 403).	Relevant and Appropriate

TABLE 4-2 (Cont'd)

SUMMARY OF STATE PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Montana Water Use Act			
Montana Groundwater Pollution Control System Regulations	ARM 16.20.1011	Requires that any groundwater whose existing quality is higher than the standard for its classification must be maintained at that high quality unless degradation is allowed under the principles established in 75-3-303, MCA, and the nondegradation rules at ARM 16.20.706 et.seq.	Applicable
	ARM 16.20.1002	Classifies groundwater into Classes I through IV based on the present and future most beneficial uses of the groundwater, and states that groundwater is to be classified to actual quality or actual use, which ever places the groundwater in a higher class.	Applicable
	ARM 16.20.1003	Establishes the groundwater quality standards for groundwater classification, and should be consulted.	Applicable
Clean Air Act of Montana	75-2-102, MCA	It's Montana's policy to achieve and maintain such levels of air quality as will protect human health and safety and, to the greatest degree practicable, prevent injury to plant and animal life and property, foster the comfort and convenience of the people, promote the economic and social development of this state, and facilitate the enjoyment of the natural attractions of the State.	
Air Quality Regulations	ARM 16.8.815	No person shall cause or contribute to concentrations of lead in the ambient air which exceed the following 90-day average: 1.5 micrograms per cubic meter of air.	Applicable
	ARM 16.8.818	No person shall cause or contribute to concentrations of particulate matter in the ambient air such that the mass of settled particulate matter exceeds the following 30-day average: 10 grams per square meter.	Applicable
	ARM 16.8.821	No person may cause or contribute to concentrations of PM-10 (particulate matter that is 10 microns in diameter or smaller) in the ambient air which exceed the following standard: 1) 24-hour average: 150 micrograms per cubic meter of air, with no more than one expected exceedance per calendar year; 2) Annual average: 50 micrograms per cubic meter of air, not to be exceeded.	Applicable

TABLE 4-2 (Cont'd)

SUMMARY OF STATE PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

	ARM 16.8.1401	States "no person shall cause or authorize the production, handling, transportation or storage of any material unless reasonable precautions to control emissions of airborne particulate matter are taken."	Applicable
	ARM 16.8.1404	States no person shall cause opacity of 20% over 6 minutes.	Applicable
	ARM 16.8.1424	Sets forth emission standards for hazardous air pollutants.	Applicable
	ARM 26.4.761	Requires a fugitive dust control program be implemented in reclamation operations, and lists specific components of such a program.	Relevant and Appropriate
	ARM 16.8.1302	Lists certain wastes that may not be disposed of by open burning, including oil or petroleum products, RCRA hazardous wastes, chemicals, and treated lumber and timbers.	Relevant and Appropriate
<u>Occupational Health Act of Montana</u>	50-70-101, et seq., MCA	The purpose of this act is to achieve and maintain such conditions of the work place as will protect human health and safety.	Applicable
Occupational Air Contaminants Regulations	ARM 16.42.102	Establishes maximum threshold limit values for air contaminants under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects.	Applicable
Occupational Noise Regulations	ARM 16.42.101	Addresses occupational noise levels and provides that no worker shall be exposed to noise levels in excess of specified levels.	Applicable
		LOCATION-SPECIFIC	
<u>Floodplain and Floodway Management Act</u>	76-5-401, MCA	Lists the uses permissible in a floodway which do not require structures other than portable structures, fill, or permanent storage of materials or equipment.	Applicable
	76-5-402, MCA	Lists the permissible uses within the floodplains but outside of floodway.	Applicable

TABLE 4-2 (Cont'd)

SUMMARY OF STATE PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

	76-5-403, MCA	Lists certain uses which are prohibited in a designated floodway, including: any change that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway, or the concentration or permanent storage of an object subject to floatation or movement during flood level periods.	Applicable
Floodplain Management Regulations	ARM 36.15.216	The factors to consider in determining whether a permit should be issued to establish or alter an artificial obstruction or nonconforming use in the floodplain or floodway are set forth in this section.	Applicable
	ARM 36.15.601	Open space uses allowed in the floodway without a permit.	Applicable
	ARM 36.15.602	Permitted uses allowed in the floodway requiring a permit.	Applicable
	ARM 36.15.603	Proposed diversions or changes in place of diversions must be evaluated by the DNRC to determine whether they may significantly affect flood flows and, therefore, require a permit.	Applicable
	ARM 36.15.604	Prohibits new artificial obstructions or nonconforming uses that will increase the upstream elevation of the base flood 0.5 of a foot or significantly increase flood velocities.	Applicable
	ARM 36.15.605	Identifies artificial obstructions and nonconforming uses that are prohibited within the designated floodway except as allowed by permit and includes "a structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway...". Solid waste disposal and storage of highly toxic, flammable, or explosive materials are also prohibited.	Applicable
	ARM 36.15.606	Identifies flood control works that are allowed with designated floodways pursuant to permit and certain conditions including: flood control levies and flood walls, riprap, channelization projects, and dams.	Applicable
	ARM 36.15.701	Describes allowed uses in the flood fringe.	Applicable

TABLE 4-2 (Cont'd)

SUMMARY OF STATE PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

	ARM 36.15.703	Prohibited uses within the flood fringe including solid and hazardous waste disposal and storage of toxic, flammable, or explosive materials.	Applicable
	ARM 36.15.801	Allowed uses where the floodway is not designated or where no flood elevations are available.	Applicable
Natural Streambed and Land Preservation Standards	87-5-501, 502, and 504, MCA	Fish and wildlife resources are to be protected and no construction project or hydraulic project shall adversely affect game or fish habitat.	Applicable
	ARM 36.2.404	Proposed projects are to be evaluated by the appropriate conservation district based on criteria, including: 1) whether the project will pass anticipated sediment loads without creating harmful flooding or erosion problems upstream or downstream; 2) whether the project will minimize the amount of stream channel alteration; 3) whether the project will be as permanent a solution as possible and whether the method used will create a reasonably permanent and stable situation; 4) whether the project will minimize effects of fish and aquatic habitat; 5) whether the project will minimize turbidity or other water pollution problems; and, 6) whether the project will minimize adverse effects on the natural beauty of the area.	Applicable
Antiquities Act	22-3-424, MCA	Heritage and paleotological sites are given appropriate consideration.	Relevant and Appropriate
	22-3-433, MCA	Evaluation of environmental impacts include consultation with State Historic Preservation Officer.	Relevant and Appropriate
	22-3-435, MCA	A heritage or paleotological site is to be reported to the State Historic Preservation Officer.	Relevant and Appropriate
Cultural Resource Regulations	ARM 12.8.503-508	Procedures to ensure adequate consideration of cultural values.	Relevant and Appropriate

TABLE 4-2 (Cont'd)

SUMMARY OF STATE PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ACTION-SPECIFIC			
Clean Air Act of Montana	75-2-102, MCA	It's Montana State policy to "achieve and maintain such levels of air quality as well as protect human health and safety and, to the greatest degree practicable, prevent injury to plant and animal life and property, foster the comfort and convenience of the people, promote the economic and social development of this state, and facilitate the enjoyment of the natural attractions of this state."	
Air Quality Requirements	ARM 16.8.815	No person shall cause or contribute to concentrations of lead in the ambient air which exceed the following 90-day average: 1.5 micrograms per cubic meter of air.	Applicable
	ARM 16.8.1302	Lists certain wastes that may not be disposed of by open burning.	Applicable
	ARM 16.8.1401 and 1404	No person shall cause or authorize the production, handling, transportation, or storage of any material unless reasonable precautions to control emissions of airborne particulate matter are taken.	Applicable
Montana Water Quality Act	75-5-605, MCA	Pursuant to this section, it is unlawful among other things to cause pollution of any state waters, to place any wastes in a location where they are likely to cause pollution of any state waters, to violate any permit provision, to violate any provision of the Montana Water Quality Act, to construct, modify, or operate a system for disposing of waste (including sediment, solid waste and other substances that may pollute state waters) which discharge into any state waters without a permit or discharge waste into any state waters.	Applicable
Montana Surface Water Quality Regulations	ARM 16.20.631	Industrial waste must receive treatment equivalent to the best practicable available control technology.	Applicable
	ARM 16.20.604-624	Provides for classification of state waters.	Applicable
	ARM 16.20.925	Technology-based treatment for MPDE permits.	Applicable

TABLE 4-2 (Cont'd)

SUMMARY OF STATE PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

	ARM 16.20.633	Requires that the State's surface waters be free from, among other things, substances that will create concentrations or combinations of materials that are harmful to human, animal, plant or aquatic life. Moreover, no waste may be discharged and no activities may be conducted that can reasonably be expected to violate any of the standards.	Applicable
Nondegradation of Water Quality	ARM 16.20.708-714	Applies nondegradation requirements to any activity which could cause a new or increased source of pollution to state waters and outlines review procedures.	Applicable
Montana Groundwater Act			
Montana Groundwater Pollution Control System Regulations	ARM 16.20.1011	Requires that any groundwater whose existing quality is higher than the standard for its classification must be maintained at that high quality in accordance with 75-5-303, MCA, and ARM 16.2.701 et.seq.	Applicable
	ARM 16.20.1002	Classifies groundwater into Classes I through IV based on the present and future most beneficial uses of the groundwater, and states that groundwater is to be classified to actual quality or actual use, which ever places the groundwater in a higher class.	Applicable
	ARM 16.20.1003	Establishes the groundwater quality standards for groundwater classification, and should be consulted.	Applicable
Montana Solid Waste Management Act	75-10-201 et seq, MCA	The Montana Legislature has found that the "health and welfare of Montana citizens are being endangered by improperly operated solid waste management systems and by the improper and unregulated disposal of wastes." Therefore, Montana has declared that it is the State's public policy to "control solid waste management systems to protect the public health and safety and to conserve natural resources whenever possible."	Applicable

TABLE 4-2 (Cont'd)

SUMMARY OF STATE PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Solid Waste Management Regulations	ARM 16.14.505 and 508-509	The standards for solid waste disposal are set forth in this provision and include: preclusion against location of solid waste disposal sites in a 100-year floodplain, a requirement that sites be located only in areas that will prevent the pollution of ground and surface waters and public and private water supplies, a requirement for drainage structures to be installed where necessary to prevent surface runoff from entering disposal areas and a requirement that sites be located to allow for reclamation. The standards also provide the process for applying for a solid waste management system license and operation and maintenance plan requirements.	Applicable
	ARM 16.14.520-521	General operational and maintenance requirements for solid waste management facilities.	Applicable
	ARM 16.14.523	Solid waste must be transported in such a manner as to prevent its discharge, dumping, spilling or leaking from the transport vehicle.	Applicable
Montana Hazardous Waste and Underground Storage Tank Act	75-10-402, MCA	It is the policy of the State to "protect the public health and safety, the health of living organisms, and the environment from the effects of the improper, inadequate, or unsound management of hazardous wastes..."	Applicable
Montana Hazardous Waste Regulations	ARM 17.54.701-705	By reference to federal regulatory requirements, these sections establish the standards for all permitted hazardous waste management facilities. 1) 40 CFR 264.11 (incorporated by reference in ARM 17.54.702) establishes that hazardous waste management facilities must be closed in such a manner as to minimize the need for further maintenance and to control, minimize or eliminate, to the extent necessary to protect public health and the environment, post-closure escape of hazardous wastes, hazardous constituents, leachate, contaminated runoff or hazardous waste decomposition products to the ground or surface waters or to the atmosphere.	Relevant and Applicable

TABLE 4-2 (Cont'd)

SUMMARY OF STATE PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

		2) 40 CFR 264.228(a) (incorporated by reference by ARM 17.54.702) requires that at closure, free liquids must be removed or solidified, the wastes stabilized and the waste management unit covered. 3) 40 CFR 264.228 and 310 (incorporated by reference by ARM 17.54.702) requires that surface impoundments and landfill caps must: (a) provide long-term minimization of migration of liquids through the unit; (b) function with minimum maintenance; (c) promote drainage and minimize erosion or abrasion of the final cover; (d) accommodate settling and subsidence; and (e) have a permeability less than or equal to the permeability of the natural subsoils present. 4) 40 CFR 264.119 (incorporated by reference in ARM 17.54.702) requires that, no later than 60 days after certification of closure of each hazardous waste disposal unit, the owner or operator submit a record of the type, location, and quantity of hazardous waste disposed of in each unit. The regulation also gives time limits for recording a deed restriction, in accordance with state law, that will, in perpetuity, notify potential purchasers that the property has been used for waste disposal and that its use is restricted.	
	ARM 17.54.111-119	Establishes permit conditions, duration of permits, schedules of compliance, and requirements for recording and reporting.	
	ARM 17.54.130-131	Establishes contents of a permit application.	
Montana Strip and Underground Mine Reclamation Act	82-4-231, MCA	Operators shall reclaim and revegetate the land affected by his operation as rapidly, completely, and effectively as the most modern technology and the state of the art will allow. The operator must prepare and carry out a method of operation plan to grade, backfill, topsoil, reduce highwalls, stabilize subsidence, control water, and reclaim the land. In so doing, all measures must be taken to eliminate damage from soil erosion, subsidence, land slides, water pollution, and hazards dangerous to life and property. This section contains specific reclamation objectives and should be consulted.	Relevant and Appropriate

TABLE 4-2 (Cont'd)

SUMMARY OF STATE PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

	82-4-233, MCA	Requires that after the operation has been backfilled, graded, topsoiled and approved, the operator "shall prepare the soil and plant such legumes, grasses, shrubs, and trees as are necessary to establish on the regraded areas an all other lands affected a diverse, effective and permanent vegetative cover of the same seasonal variety native to the area of land to be affected and capable of self-regeneration and plant succession at least equal in extent of cover to the natural vegetation of the area..." The vegetative cover must be capable of feeding and withstanding grazing pressure from wildlife and livestock regenerating under natural conditions prevailing at the site and preventing soil erosion.	Relevant and Appropriate
Backfilling and Grading Requirements	ARM 26.4.501	These sections give general backfilling and grading requirements.	Relevant and Appropriate
	ARM 26.4.501A	Final grading requirements.	Relevant and Appropriate
	ARM 26.4.504	Provides that permanent impoundments may be retained under certain circumstances.	Relevant and Appropriate
	ARM 26.4.514	Give contouring requirements.	Relevant and Appropriate
	ARM 26.4.519	The operator may be required to monitor settling of regraded areas.	Relevant and Appropriate
	ARM 26.4.520	Spoil materials may be disposed of on-site in accordance with the requirements of this section. This section contains specific requirements for siting, surface runoff, construction of underdrains and revegetation and should be consulted.	Relevant and Appropriate

TABLE 4-2 (Cont'd)

SUMMARY OF STATE PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Hydrology Requirements	ARM 26.4.631	In accordance with this section, reclamation operations must be planned and conducted to minimize disturbance to the prevailing hydrologic balance and to prevent material damage to the prevailing hydrologic balance. Thus, changes in water quality and quantity must be minimized and reclamation practices that will prevent or minimize water pollution should be emphasized. Proper pollution control and minimization practices include but are not limited to stabilizing disturbed areas, diverting runoff, regulating channel velocity of water, achieving quickly germinating and growing stands of temporary vegetation, regulating channel velocity of water, lining drainage channels with proper vegetation, and mulching, selectively placing waste materials in backfill areas..	Relevant and Appropriate
	ARM 26.4.633	Specifies that "all surface drainage from the disturbed area, including disturbed areas that have been graded, seeded, or planted, must be treated by the best technology currently available..." Sediment control must be maintained until the disturbed area has been restored and revegetation requirements have been met.	Relevant and Appropriate
	ARM 26.4.634	Drainage design shall emphasize channel and floodplain premining configuration that blends with the undisturbed drainage system above and below, and will meander naturally, remain in dynamic equilibrium with the system, improve unstable premining condition, provide for floods, provide for long term stability of landscape, and establish a premining diversity of aquatic habitats and riparian vegetation.	Relevant and Appropriate
	ARM 26.4.635-637	Set forth requirements for temporary and permanent diversions.	Relevant and Appropriate
	ARM 26.4.638	Sediment control measures shall be designed using the best technology currently available to prevent additional sediment to streamflows, meet the more stringent of federal or state effluent limitations, and minimize erosion.	Relevant and Appropriate

TABLE 4-2 (Cont'd)

SUMMARY OF STATE PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

	ARM 26.4.640	Provides that discharge from sedimentation ponds, permanent and temporary impoundments, and diversions shall be controlled by energy dissipaters, riprap channels, and other devices, where necessary, to reduce erosion, prevent deepening or enlargement of stream channels, and to minimize disturbance of the hydrologic balance.	Relevant and Appropriate
	ARM 26.4.641	Sets forth methods for prevention of drainage from acid-and toxic-forming spoils into ground and surface waters.	Relevant and Appropriate
	ARM 26.4.642	Prohibits permanent impoundments with certain exceptions, and set standards for temporary and permanent impoundments.	Relevant and Appropriate
	ARM 26.4.643-646	Provide for groundwater protection, groundwater recharge protection, and surface and groundwater monitoring.	Relevant and Appropriate
	ARM 26.4.649	Prohibits the discharge, diversion, or infiltration of surface and groundwater into existing underground mine workings.	Relevant and Appropriate
	ARM 26.4.650	All permanent sedimentation ponds, diversions, impoundments, and treatment facilities must be renovated postmining, to meet criteria specified in the design plan. All such temporary structures shall be regraded to the approximate original contour.	Relevant and Appropriate
	ARM 26.4.701-702	Requirements on stockpiling soil.	Relevant and Appropriate
Top Soiling, Revegetation, and Protection of Wildlife and Air Resource Regulations	ARM 26.4.703	Materials other than, or along with, soil for final surfacing of disturbances may be allowed if the resulting medium is at least as capable as soil of supporting the approved vegetation and post-remedial activity land use. Moreover, the medium must be the best available within the area to support vegetation.	Relevant and Appropriate
	ARM 26.4.711	In accordance with this section, "[a] diverse, effective, and permanent vegetative cover of the same seasonal variety and utility as the vegetation native to the area of land to be affected must be established. This vegetative cover must alsobe capable of meeting the criteria set forth in 82-4-233, MCA and must be established on all areas of land affected except on road surfaces and below the low-water line of permanent impoundments that are approved as a part of the postmining land use."	Relevant and Appropriate

TABLE 4-2 (Cont'd)

SUMMARY OF STATE PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

	ARM 26.4.713	Specifies that seeding and planting of disturbed areas must be conducted during the "first appropriate period for favorable planting after final seedbed preparation but may not be more that 90 days after soil has been replaced..."	Relevant and Appropriate
	ARM 26.4.714	Pursuant to this section, as soon as practicable, a mulch or cover crop of small grains, grasses or legumes or both must be used on all regraded and resoiled areas to control erosion, promote germination of seeds and increase the moisture retention of the soil until adequate permanent cover is established.	Relevant and Appropriate
	ARM 26.4.716	Establishes the required method of revegetation and provides that introduced species may be substituted for native species as part of an approved plan.	Relevant and Appropriate
	ARM 26.4.717	Whenever tree species are necessary, trees adapted for local site conditions and climate shall be used.	Relevant and Appropriate
	ARM 26.4.718	Soil amendments must be used as necessary to aid in the establishment of permanent vegetative cover. Irrigation, management, fencing, or other measures may also be used after review and approval by the department.	Relevant and Appropriate
	ARM 26.4.719	Livestock grazing on reclaimed land is prohibited until revegetation is established to sustain managed grazing.	Relevant and Appropriate
	ARM 26.4.721	In accordance with this section, rills and gullies may need to be filled, graded or otherwise stabilized and the area reseeded.	Relevant and Appropriate
	ARM 26.4.723	Monitoring of vegetation, soils, and wildlife.	Relevant and Appropriate
	ARM 26.4.724	Success of revegetation shall be measured on the basis of unmined reference areas approved by the agencies. Reference areas shall be established for each native community if found within the area.	Relevant and Appropriate
	ARM 26.4.725	Sets periods of responsibility and evaluation.	Relevant and Appropriate
	ARM 26.4.726	Sets means of measuring productivity.	Relevant and Appropriate
	ARM 26.4.728	Sets requirements for composition of vegetation.	Relevant and Appropriate

TABLE 4-2 (Cont'd)

SUMMARY OF STATE PRELIMINARY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

	ARM 26.4.730-731	The revegetated area must furnish palatable forage in comparable quantity and quality during the same grazing period as the reference areas. When toxicity to plants or animals is suspected due to the effects of disturbances, the department may require comparative chemical analysis of the plants or animals.	Relevant and Appropriate
	ARM 26.4.733	Sets requirements and measurement standards for trees, shrubs, and half-shrubs.	Relevant and Appropriate
	ARM 26.4.751	Pursuant to this section, required site activities must be conducted so as to avoid or minimize impacts to important fish and wildlife species, including critical habitat and any threatened or endangered species identified at the site.	Relevant and Appropriate

5.0 SUMMARY OF THE RISK ASSESSMENT

5.1 BASELINE HUMAN HEALTH RISK ASSESSMENT

The baseline human health risk assessment performed for the Park Mine and Millsite follows the Federal Remedial Investigation/Feasibility Study (RI/FS) process for CERCLA (Superfund) sites (USEPA, 1988a). The baseline human health risk assessment examines the effects of taking no further action at the site. This abbreviated assessment involves two steps: hazard identification and risk characterization. These tasks are accomplished by evaluating available data and selecting contaminants of concern (CoCs), comparing those concentrations to previously derived cleanup goals, and characterizing overall risk by integrating the results of the comparison.

General problems at the Park Mine and Millsite that could impact human health include high concentrations of metals and arsenic in waste materials on-site (mill tailings), and elevated concentrations of metals and arsenic in groundwater, surface water, and stream sediments downgradient from the site. The easily accessible waste materials may result in significant health-related consequences to the human population.

5.1.1 Hazard Identification

The initial task of the risk assessment is to select the CoCs at the site to identify those that pose significant potential human health risks. Standard EPA criteria for this selection include: 1) those contaminants that are associated with and are present at the site; 2) contaminants in waste sources with concentrations significantly above background levels; 3) contaminants with at least 20% of the measured concentrations above the detection limit; and 4) contaminants with acceptable quality assurance/quality control (QA/QC) results applied to the data.

At the Park Mine and Millsite, mill tailings, underlying soils, groundwater, surface water, and stream sediments were analyzed for the Target Analyte List of 25 metals; some of the samples were also analyzed for cyanide (the results are presented in Appendix A of this report). Only 8 of the 25 metals analyzed are present at the site at concentrations significantly above background levels, with 20% of the samples detected above the corresponding detection limit; these include: As, Ag, Cd, Cu, Fe, Hg, Pb, and Zn. These eight metals are selected for detailed evaluation because they are present in significant concentrations in wastes, soils, groundwater, stream sediments, and surface water at the site. These contaminants are characteristic of hardrock mining wastes and represent contamination reliably associated with site activities.

5.1.2 Exposure Scenarios

The following section describes the exposure scenarios assumed for the Park Mine and Millsite. The previously derived risk-based cleanup goals were derived using two exposure scenarios, a recreational use scenario and a residential use exposure scenario.

The residential use risk-based concentrations involve residential occupation of the contaminated land with the maximum level of exposure occurring for a child 0-6 years old. The resultant risk-based concentrations were derived for this worst-case residential exposure scenario by USEPA Region III (Smith, 1995) and published semi-annually. The soil ingestion and dust inhalation exposure routes assumed a surface concentration equal to the highest sample collected on one of the sources at the site in 1996. This waste represents material likely to be contacted directly prior to ingestion and likely to be suspended as dust. The drinking water ingestion route utilized groundwater concentrations sampled at a downgradient spring (GW-6).

The recreational use risk-based concentrations involve several recreational exposure scenarios occurring on the contaminated land with the maximum level of exposure occurring for either a ATV/motorcycle rider (mill tailings only), a rockhounder/gold panner (waste rock and surface water only), or a fisherman (fish consumption only). The resultant risk-based concentrations were derived for all the recreational user exposure scenarios by the DEQ/AMRB (TetraTech, 1996). For this site, a moderate level of recreational use was assigned, based on observations at the site and accessibility. The soil ingestion and dust inhalation exposure routes assumed a surface concentration equal to the highest surface sample collected at the site in 1996. This waste represents material likely to be contacted directly prior to ingestion and most likely to be suspended as dust. The water ingestion routes used surface water concentrations downstream from the site for drinking water. The fish ingestion route was not analyzed since several acute aquatic life standards are exceeded.

5.1.3 Toxicity Assessment

The toxicity assessment examines the potential for the CoCs to cause adverse effects in exposed individuals and provides an estimate of the dose-response relationship between the extent of exposure to a particular contaminant and adverse effects. Adverse effects include both noncarcinogenic and carcinogenic health effects in humans. Sources of toxicity data include EPA's IRIS, Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profiles, Health Effects Assessment Summary Tables (HEAST), and EPA criteria documents. Individual toxicity profiles for each CoC are not presented. Tables 5-1 (residential) and 5-2 (recreational) present the existing risk-based concentrations that were used to characterize risks from exposure to the CoCs for each exposure scenario.

5.1.4 Risk Characterization

5.1.4.1 Residential Land Use Scenario

The residential exposure assumptions utilized to estimate contaminant intakes were compared to the risk-based concentrations (Table 5-1). These data were used to calculate resultant human health noncarcinogenic Hazard Quotients (HQ) and carcinogenic risk values for each CoC. The results of the calculations for the residential land use scenario at the Park Mine and Millsite are summarized in Table 5-3.

TABLE 5-1
RISK-BASED CONCENTRATIONS FOR CONTAMINANTS OF CONCERN FOR THE RESIDENTIAL SCENARIO (SMITH, 1995)

Contaminant of Concern	Residential Soil Ingestion mg/Kg	Residential Dust Inhalation (soil conc.) mg/Kg	Residential Water Ingestion μg/L
Arsenic	23 0.43 (Carc.)	740,000 380 (Carc.)	11 0.045 (Carc.)
Silver	390	NA	NA
Cadmium	39	140,000 920 (Carc.)	18
Copper	3,100	NA	1,500
Iron	23,000	NA	NA
Mercury	23	7	11
Lead	400*	NA	15*
Zinc	23,000	NA	NA

NA = Not Applicable, concentration is more than unity.
* Used USEPA recommendations, not RBC table, from Smith, 1995.

TABLE 5-2
RISK-BASED CONCENTRATIONS FOR CONTAMINANTS OF CONCERN FOR THE RECREATIONAL SCENARIO (TETRATECH, 1996)

Contaminant of Concern	Recreational Soil Ing./Inh. Tailings mg/Kg	Recreational Soil Ing./Inh. Waste Rock mg/Kg	Recreational Water Ingestion μg/L
Arsenic	1,138 4.3 (Carc.)	1,172 2.8 (Carc.)	306 1.3 (Carc.)
Silver	NA	NA	NA
Cadmium	6,300 78 (Carc.)	3,500	512
Copper	193,200	108,400	37,800
Iron	NA	NA	NA
Mercury	1,476	880	306
Lead	7,840	4,400	440
Zinc	NA	880,000	306,000

NA = Not Applicable, concentration is more than unity.

TABLE 5-3
SUMMARY OF NONCARCINOGENIC HAZARD QUOTIENTS (HQ) AND CARCINOGENIC RISK VALUES FOR THE RESIDENTIAL LAND USE SCENARIO - PARK MINE AND MILLSITE

Noncarcinogenic HQ Summary	Soil Ingestion	Water Ingestion	Dust Inhalation	Total
Arsenic	1,300.00	1.1818	0.0404	1,301.22
Cadmium	1.2462	0.0133	0.0003	1.2598
Copper	0.1377	0.0010	0.0004	0.1392
Lead	51.2500	0.1533	0.0205	51.4238
Iron	5.0870	0.0024	0.1170	5.2063
Mercury	0.0300	0.0025	0.0984	0.1309
Silver	0.1456	0.0016	0.0001	0.1473
Zinc	0.2435	0.0007	0.0056	0.2498
Total HQ - Noncarcinogenic	1,358.14	1.3567	0.2828	**1,359.78**
Carcinogenic Risk Summary				
Arsenic	6.95E-02	2.89E-04	7.87E-05	6.99E-02
Cadmium	NC	NC	5.28E-08	5.28E-08
Total Risk - Carcinogenic	6.95E-02	2.89E-04	7.87E-05	6.99E-02

NC = Not Calculated because no RBC is provided.

Inspection of the HQs on Table 5-3 yields the following observations. First, HQ values exceed one for the residential land use scenario for four CoCs via two evaluated exposure routes; HQ values greater than one indicate the potential for harmful effects by a CoC via the specified pathway(s). Secondly, the arsenic HQ value of 1,300 and the lead HQ value of 151.74 via the soil ingestion route comprise the majority of the total noncarcinogenic HQ, and these values are much greater than one. HQs greater than 1 are also present for cadmium and iron via soil ingestion, and arsenic via water ingestion. The soil ingestion pathway total HQ of 1,358.14 indicates that this exposure pathway presents the greatest likelihood of adverse human health effects for this scenario and these effects are likely since the HQ is much greater than one.

The lower part of Table 5-3, carcinogenic risk, reveals that this RME to CoCs (only arsenic and cadmium have RBCs) at the site results in a total carcinogenic risk of 6.99E-02, which exceeds one per million (1.00E-06) exposed individuals by more than four orders of magnitude. The EPA utilizes this 1.00E-06 value as a point of departure in assessing the need for contaminant cleanup at a particular site. The carcinogenic risk estimates for arsenic of 6.95E-02 via soil ingestion and 2.89E-04 via water ingestion are, therefore, of concern. The primary pathway and CoC is arsenic via soil ingestion, with water ingestion of arsenic a secondary pathway; reclamation alternatives should focus on addressing these exposure pathways.

5.1.4.2 Recreational Land Use Scenario

The recreational exposure assumptions utilized to estimate contaminant intakes were compared to the risk-based concentrations (Table 5-2). These data were used to calculate resultant human health noncarcinogenic HQ and carcinogenic risk values for each CoC. The results of the calculations for the recreational land use scenario at the Park Mine and Millsite are summarized in Table 5-4.

Inspection of the HQs on Table 5-4 yields the following observations. First, HQ values exceed one for the recreational land use scenario for two CoCs via one evaluated exposure route; HQ values greater than one indicate the potential for harmful effects by a CoC via the specified pathway(s). Secondly, the arsenic HQ value of 26.27 and the lead HQ value of 4.66 via the soil/dust route comprise the majority of the total noncarcinogenic HQ and this value is greater than one. The soil/dust pathway total HQ of 31.07 indicates that this exposure pathway presents the greatest likelihood of adverse human health effects for this scenario and these effects are likely since the HQ is greater than one.

The lower part of Table 5-4, carcinogenic risk, reveals that this RME to CoCs (only arsenic and cadmium have CPFs) at the site results in a total carcinogenic risk of 7.17E-03, which exceeds one per million (1.00E-06) exposed individuals by more than three orders of magnitude. The EPA utilizes this 1.00E-06 value as a point of departure in assessing the need for contaminant cleanup at a particular site. The carcinogenic risk estimates for arsenic of 6.89E-03 via soil ingestion/dust inhalation and 2.82E-04 via water ingestion are, therefore, of concern. The primary pathway and CoC is arsenic via soil ingestion/dust inhalation, with water ingestion of arsenic a significant secondary pathway; reclamation alternatives should focus on addressing these exposure pathways.

TABLE 5-4
SUMMARY OF NONCARCINOGENIC HAZARD QUOTIENTS (HQ) AND CARCINOGENIC RISK VALUES FOR THE RECREATIONAL LAND USE SCENARIO - PARK MINE AND MILLSITE

Noncarcinogenic HQ Summary	Soil Ingestion/ Dust Inhalation	Water Ingestion	Total
Arsenic	26.2742	0.2915	26.5657
Cadmium	0.0092	0.0523	0.0616
Copper	0.0039	0.0012	0.0051
Lead	4.6591	0.0791	4.7382
Iron	0.1170	0.0008	0.1178
Mercury	0.0008	0.0002	0.0010
Silver	0.0001	0.0000	0.0001
Zinc	0.0036	0.0106	0.0142
Total HQ - Noncarcinogenic	31.0678	0.4357	31.5035
Carcinogenic Risk Summary			
Arsenic	6.89E-03	2.82E-04	7.17E-03
Cadmium	6.25E-07	NC	6.25E-07
Total Risk - Carcinogenic	6.89E-03	2.82E-04	7.17E-03

NC = Not Calculated because no RBC is provided.

5.2 ECOLOGICAL RISK ASSESSMENT

5.2.1 Introduction

The ecological risk assessment was performed for the Park Mine and Millsite following Federal RI/FS guidance for CERCLA (Superfund) sites (EPA, 1988a). The key guidance documents used were EPA's Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual (EPA, 1989b), and Ecological Assessment of Hazardous Waste Sites (EPA, 1989c). The waste materials present at the site pose a potential risk not only to humans, but also to other species that come into contact with them. Due to the sparse and indirect nature of the ecologic data available for the site, this evaluation is intended as a screening-level ecological risk assessment, and the results are of a qualitative nature.

The ecological risk assessment estimates the effects of taking no action at the site and involves four steps: 1) identification of contaminants, ecologic receptors, and ecologic effects of concern; 2) exposure assessment; 3) ecologic effects assessment; and 4) risk characterization. These four tasks are accomplished by evaluating available data and selecting contaminants, species and exposure routes of concern, estimating exposure point concentrations and intakes, assessing ecologic toxicity of the CoCs, and characterizing overall risk by integrating the results of the toxicity and exposure assessments.

Problems at the Park Mine and Millsite that could impact ecologic receptors include extremely high concentrations of metals and arsenic in waste materials on-site (mill tailings), and elevated concentrations of metals and arsenic in surface water, groundwater, and stream sediments downgradient from the site. The easily accessible waste materials may result in significant ecological effects; the objective of this ecological risk assessment are to estimate current and future effects of implementing the no-action alternative at the Park Mine and Millsite.

5.2.2 Contaminants, Receptors, and Effects of Concern

As in the human health risk assessment, contaminants that are significantly above background concentrations and are associated with the site are retained as CoCs. Only 8 of the 25 metals analyzed are present at the site at concentrations significantly above background levels, with 20% of the samples detected above the corresponding detection limit: As, Ag, Cd, Cu, Fe, Hg, Pb, and Zn. These eight metals are selected for evaluation because they are present in significant concentrations in wastes, soils, stream sediments, surface water and groundwater. These contaminants are characteristic of hardrock mining wastes and represent contamination reliably associated with site activities. However, several of these contaminants have no ecologic toxicity data to evaluate potential effects.

Three groups of ecologic receptors have been identified as potentially affected by site contamination. The first group of receptors are those associated with Indian Creek downgradient from the Park Mine and Millsite, and include fisheries, aquatic life, and wetlands. These surface water receptors are evaluated using USEPA aquatic life criteria, which apply to aquatic organisms only; there are no criteria with which to evaluate wetlands.

The second group of receptors are terrestrial wildlife that may use this area as part of their summer range, including deer and elk. The possibility exists for use by wildlife, both for water and possibly for consuming evaporative salts that can form on the wastes. This poses a potential for contaminant accumulation and subsequent health effects in the wildlife populations that visit the site. The only terrestrial wildlife receptor evaluated are deer which probably represent the highest level of exposure to site contaminants; the effects to deer can be assumed to apply to other wildlife receptors.

The third group of receptors are native terrestrial plant communities, which are notably absent on wastes at the Park Mine and Millsite. They are of concern because native vegetation has not become established on the wastes.

5.2.3 Exposure Assessment

The three exposure scenarios can be semi-quantitatively assessed; however, only the deer ingestion of salts and water scenario involves the calculation of a dose. Both the surface water-aquatic life and plant-phytotoxicity scenarios can be compared directly to toxicity standards that apply to the respective environmental media.

5.2.3.1 Surface Water/Sediment - Aquatic Life Scenario

Ecologic exposures via this pathway are threefold: direct exposure of aquatic organisms to surface water concentrations that exceed toxicity thresholds; ingestion of aquatic species (e.g., insects) that have bioaccumulated contaminants to the extent that they are toxic to the predator (e.g., fish); and exposure of aquatic organisms (e.g., fish embryos) to sediment pore water environments that are toxic due to elevated contaminant concentrations in the sediments. Data used for this assessment were collected in Indian Creek during the 1996 RI (sediment and surface water). Selected water quality and sediment concentration data are presented in Table 5-5.

TABLE 5-5
WATER QUALITY (μg/L) AND SEDIMENT (mg/Kg) DATA

Surface Water Data	**As**	**Cd**	**Cu**	**Pb**	**Ag**	**Zn**
Indian Ck. max. downstream	64.1	26.8	45.2	34.8	<0.56	3,240
Stream Sediment Data	**As**	**Cd**	**Cu**	**Pb**	**Ag**	**Zn**
Indian Ck. max. downstream	1,080	24.1	67.9	2,450	3.52	2,570

5.2.3.2 Deer Ingestion Scenario

The only wildlife salt uptake data available were found in "Elk of North America" as ranging from 1 to 11 pounds in one month for a herd of 50 to 75 elk (USDA, 1995). Using a median exposure (non-conservative) approach, the average salt usage (6 lbs/mo) was divided by the average herd size (63) for an average individual salt uptake of 0.0032 lbs/day, or 0.00144 Kg/day. This intake is modified by the uptake of an additional 50% (0.00072 Kg/day) of non-salt wastes associated with the evaporative salt deposits at the site and then divided in half to account for the lower body weight of deer with respect to elk, for a total uptake of 0.0011 Kg/day. The salts are assumed to have the same concentrations as the surface wastes, since they are solubilized and reprecipitated from minerals near the surface. The average deer is assumed to weigh 150 lbs (68 Kg) and consume 10 liters of water per day. Table 5-6 summarizes the data used to estimate the total Deer intake dose.

TABLE 5-6: DEER INTAKE DOSE ESTIMATES

	As	Cd	Cu	Pb	Zn
Wastes & Salt in mg/Kg	29,900	48.6	427	20,500	5,600
Solids dose (mg/Kg-day)	0.4754	0.0008	0.0068	0.3260	0.0890
Drinking Water in μg/L	482	410	657	365	43,800
Drinking Water dose (mg/Kg-day)	0.0709	0.0603	0.0966	0.0537	6.4430
Total Intake Dose (mg/Kg-day)	0.5463	0.0611	0.1034	0.3796	6.5320

5.2.3.3 Plant - Phytotoxicity Scenario

This scenario involves the limited ability of various plant species to grow in soils or wastes with high concentrations of site-related contaminants. Table 5-7 summarizes concentrations measured in waste materials on-site during the 1996 RI.

TABLE 5-7
CONTAMINANT CONCENTRATIONS (mg/Kg) IN SOURCES ON-SITE

Source Material	As	Cd	Cu	Pb	Zn
Surface Wastes	29,900	48.6	427	20,500	5,600

5.2.4 Ecological Effects Assessment

The known effects of the site CoCs are available from several literature sources and are not repeated here. No site-specific toxicity tests were performed to support the ecologic risk assessment, either in-situ or at a laboratory. Only existing and proposed toxicity-based criteria and standards were used for this ecological effects assessment.

5.2.4.1 Surface Water/Sediment - Aquatic Life Scenario

Freshwater acute (1-hour average) water quality criteria have been promulgated by EPA for many of the CoCs. Several of these criteria are calculated as a function of water hardness and a few are numerical standards. The numerical water quality standards are presented in Table 5-8 and apply to all surface waters at and downstream from the Park Mine and Millsite. Those criteria that are a function of hardness have been calculated for the maximum stations and are presented in Table 5-9; however, since hardness changes downstream from the site, the calculated water quality criteria also change.

TABLE 5-8: NUMERICAL WATER QUALITY CRITERIA

Acute Criteria in μg/L	As	Hg
All stations	360	2.4

TABLE 5-9: HARDNESS-DEPENDENT WATER QUALITY CRITERIA

Acute Criteria	Ag	Cd	Cu	Pb	Zn
Indian Ck. downstream	0.4	0.8	4.8	14	36

Presently, EPA has not finalized sediment quality criteria. Proposed sediment criteria for metals currently consist of the Effect Range - Low (ER-L) and Effect Range - Median (ER-M) values generated from the pool of national freshwater and marine sediment toxicity information (Long and Morgan, 1991). The ER-M values are probably most appropriate to use for comparison to Indian Creek sediment data, and are presented on Table 5-10.

TABLE 5-10: SEDIMENT QUALITY CRITERIA (PROPOSED)

Criteria in mg/Kg	As	Cd	Cu	Pb	Zn
Effect Range - Median (ER-M)	85	9	390	110	270

5.2.4.2 Deer Ingestion Scenario

Adverse effects data for test animals were obtained from the Agency for Toxic Substances and Disease Registry toxicological profiles (ATSDR 1991a, 1991b, 1991c), and from other literature sources (NAS, 1980; Maita et al, 1981). The data consist of dose (intake) levels that either cause no adverse effects (NOAELs) and/or the lowest dose observed to cause an adverse effect (LOAELs) in laboratory animals. The use of effects data for alternative species introduces an uncertainty factor to the assessment; however, effects data are not available for the species of concern (deer), so the effects data for laboratory animals (primarily rats) are adjusted only for increased body weight. These data are listed in Table 5-11.

TABLE 5-11
TOXICOLOGICAL EFFECTS LEVELS FOUND IN THE LITERATURE

Dose (mg/Kg-day)	**As**	**Cd**	**Cu**	**Pb**	**Zn**
LOAEL - Rat	6.4	0.014	90	0.005	571
Reference:	ATSDR, 1991a, p30	ATSDR, 1991b, p33	NAS, 1980	ATSDR, 1991c, p72	Maita et al, 1981

LOAEL = Lowest observed adverse effect level.

5.2.4.3 Plant - Phytotoxicity Scenario

Information is available on the phytotoxicity for some of the CoCs (Kabata-Pendias and Pendias, 1989) and these are listed in Table 5-12. The availability of contaminants to plants and the potential for plant toxicity depends on many factors including soil pH, soil texture, nutrients, and plant species.

TABLE 5-12: SUMMARY OF PHYTOTOXIC SOIL CONCENTRATIONS

	As	**Cd**	**Cu**	**Pb**	**Zn**
Concentration Range (mg/Kg, dry wt.)	15-50	3-8	60-125	100-400	70-400

5.2.5 Risk Characterization

This section combines the ecologic exposure estimates and concentrations presented in Section 5.2.3 and the ecologic effects data presented in Section 5.2.4 to provide a screening level estimate of potential adverse ecologic impacts for the three scenarios evaluated. This was accomplished by generating ecologic impact quotients (EQs), analogous to the health HQs calculated for human exposures to noncarcinogens. CoC-specific EQs were generated by dividing the particular intake estimate or concentration by available ecological effect values or concentrations. As with HQs, if EQs are less than one, adverse ecological impacts are not expected at the Park Mine and Millsite.

5.2.5.1 Surface Water/Sediment - Aquatic Life Scenario

For this scenario, surface water concentration data are compared to acute aquatic life criteria. Limitations of this comparison include that the EPA water quality criteria are not species-specific toxicity levels. They represent toxicity to the most sensitive species, which may or may not be present at the Park Mine and Millsite, and toxicity to the most sensitive species may not in itself be a limiting factor for the maintenance of a healthy, viable fishery and/or other aquatic organisms. The results of the EQ calculations for this scenario are presented in Table 5-13.

TABLE 5-13
ECOLOGIC IMPACT QUOTIENTS (EQs) FOR THE SURFACE WATER - AQUATIC LIFE SCENARIO

Criteria / Location	Ag	As	Cd	Cu	Hg	Pb	Zn
Acute - Downstream Maximum	0.75	0.18	32.6	9.41	0.03	2.49	89.6

Examination of Table 5-13 indicates the potential for serious aquatic life impacts due to Cd, Cu, Pb, and Zn in surface water in Indian Creek (acute EQs greater than 1).

Similarly, stream sediment concentration data are compared to proposed sediment quality criteria (Median Effect Range). Limitations of this comparison include that these sediment quality criteria are preliminary and are also not species-specific. They represent sediment toxicity to the most sensitive species, which may or may not be present at the Park Mine and Millsite, and toxicity to the most sensitive species may not in itself be a limiting factor for the maintenance of a healthy, viable fishery and/or other aquatic organisms. The results of these EQ calculations are presented in Table 5-14.

TABLE 5-14
ECOLOGIC IMPACT QUOTIENTS (EQs) FOR THE SEDIMENT - AQUATIC LIFE SCENARIO

	As	Cd	Cu	Pb	Zn
Indian Ck. max. downstream	12.7	2.68	0.17	22.3	9.52

Table 5-14 indicates the potential for aquatic life impacts (EQs greater than 1) due to apparent sediment toxicity for As, Cd, Pb, and Zn in Indian Creek below the Park Mine and Millsite. The elevated and persistent EQs for arsenic, lead, and zinc suggests that these contaminants have the potential to adversely affect sediment benthos, fish embryos, and/or macroinvertebrate communities. However, the sediment criteria used to calculate these EQs may not apply to species found in this system.

5.2.5.2 Deer Ingestion Scenario

Estimated deer ingestion doses were compared to the higher of the literature derived toxicological effect level (the LOAEL) and CoC-specific EQs were generated by dividing the intake estimates by the toxicological effect value. Again, the comparison is limited because of the use of effects data for alternate species, adjusted only for increased body weight; the species used for the toxicology studies may be more or less susceptible to the contaminant being studied than deer. The results of the EQ calculations for this scenario are presented in Table 5-15.

TABLE 5-15
ECOLOGIC IMPACT QUOTIENTS (EQs) FOR THE DEER INGESTION SCENARIO

Effect Level	As	Cd	Cu	Pb	Zn
LOAEL	0.085	4.363	0.001	75.93	0.011

LOAEL = Lowest observed adverse effect level.

Table 5-15 indicates a potential for adverse ecologic impacts to deer (EQ greater than 1) due to uptake of Pb and Cd from the waste salts and surface water. The assumptions used to derive the uptake dose and the comparison to rat toxicity, may overestimate actual average contaminant intake, but by less than an order of magnitude. This potential for an adverse effect can be extended to any wildlife that also use the area for salt or water.

5.2.5.3 Plant - Phytotoxicity Scenario

Source area surface concentrations collected at the Park Mine and Millsite are compared to high values of the range of plant phytotoxicity derived from the literature. Limitations of this comparison include that the phytotoxicity ranges are not species-specific; they represent toxicity to species which may or may not be present at the Park Mine and Millsite. Additionally, other physical characteristics of the waste materials may create microenvironments which limit growth and survival of terrestrial plants directly or in combination with substrate toxicity. Waste materials are likely to have poor water holding capacity, low organic content, limited nutrients, and may harden enough to resist root penetration. The results of the EQ calculations for this scenario are presented in Table 5-16.

TABLE 5-16
ECOLOGIC IMPACT QUOTIENTS (EQs) FOR THE PLANT - PHYTOTOXICITY SCENARIO

Source Area	As	Cd	Cu	Pb	Zn
Park Mine and Millsite	598	6.1	3.4	51.3	14.0

Table 5-16 indicates the potential for adverse ecologic impacts to plant communities at the Park Mine and Millsite. The calculated EQs greater than one include: As, Cd, Cu, Pb, and Zn at the Park Mine and Millsite waste sources. The non-conservative assumption of using the high end of the phytotoxicity range to derive the EQs, probably underestimates the potential phytotoxic effect to the plant community. However, several other factors in addition to phytotoxicity combine to adversely affect plant establishment and success on the waste materials.

5.2.5.4 Risk Characterization Summary

The calculated EQs can be used to determine whether ecologic receptors are exposed to potentially harmful doses of site-related contaminants via the three ecologic scenarios evaluated. The EQs for each of the three scenarios are presented in Table 5-17 to estimate a combined ecologic EQ for each scenario and each contaminant. The EQ values in the table are the maximum value for the respective scenario or CoC. The results of combining the ecologic scenarios is also summarized in Table 5-17.

The aquatic life scenario results in EQs of as high as 89.6 (surface water - Zn), and 22.3 (sediments - Pb) in Indian Creek. The deer scenario results in a maximum EQ of 75.9 (LOAEL - Pb). The plant toxicity EQs are as high as 598 (As). These EQs show that even at the lower bound of these calculated risk estimates, the ecologic risk characterization demonstrates that contaminants at the site constitute a probable adverse ecologic effect via all three exposure scenarios and justify appropriate cleanup. Arsenic is the primary CoC, and the plant community is the primary receptor; zinc and cadmium in surface water and lead and arsenic in sediment are secondary contaminants and receptors of concern.

TABLE 5-17
SUMMARY OF COMBINED ECOLOGIC IMPACT QUOTIENTS (EQ) VALUES FOR THE PARK MINE AND MILLSITE

Ecologic EQ Summary	**Surface Water**	**Sediment**	**Deer Ingestion**	**Plant Toxicity**	**Total**
Arsenic	0.18	12.7	0.085	598	611
Silver	0.75	NC	NC	NC	0.75
Cadmium	32.6	2.68	4.36	6.1	45.8
Copper	9.41	0.17	0.001	3.4	13.0
Mercury	0.03	NC	NC	NC	0.03
Lead	2.49	22.3	75.9	51.3	152
Zinc	89.6	9.52	0.011	14.0	113
Total EQ	135.1	47.35	80.39	672.7	**935.6**

NC = Not Calculated because no applicable standard exists.

6.0 RECLAMATION OBJECTIVES AND GOALS

The primary objective of the Park Mine Reclamation Project is to protect human health and the environment in accordance with the guidelines set forth by the NCP. Specifically, the remedy selected must limit human and environmental exposure to the CoCs and reduce the mobility of those contaminants to reduce impacts to the local surface water and groundwater resources.

6.1 ARAR-BASED RECLAMATION GOALS

6.1.1 Groundwater

The groundwater in the vicinity of the Park Mine site may currently be used intermittently for a drinking water source, and it may be a potential future drinking water source. Also, the groundwater at the site most likely discharges to surface water, as discussed in Section 2.3. Based on the risk assessment and exceedences of standards, the groundwater CoCs at the site have been identified as arsenic, cadmium, iron, lead, manganese and zinc.

ARAR-based reclamation goals for groundwater are most often the MCLs, non-zero maximum contaminant level goals (MCLGs), or state drinking water standards, whichever are more stringent. Potential ARAR-based reclamation goals for the CoCs in the groundwater medium are presented in Table 6-1. Although direct groundwater treatment/remediation is not within the scope of actions under consideration at the site as part of this removal action EEE/CA, removing or reclaiming source material is expected to affect groundwater metal concentrations.

TABLE 6-1
ARAR-BASED RECLAMATION GOALS FOR GROUNDWATER (μg/L)

CHEMICAL	TYPE	CONCENTRATION
Arsenic	HHS	18
Cadmium	MCL, HHS	5
Iron	HHS	300
Lead	HHS	15
Manganese	HHS	50
Zinc	HHS	5,000

Sources: HHS - Human Health Standards for Surface Water (DEQ/WQB, 1995).
MCL - Maximum Contaminant Level Drinking Water Regulations and Health Advisories (EPA, 1993).

6.1.2 Surface Water

Acute Aquatic Life Standards and Human Health Standards are common ARARs for the surface water medium. The more stringent of the two standards is identified as the ARAR-based reclamation goal; acute rather than chronic aquatic life standards are appropriate since long-term monitoring data are not available. The surface water is being evaluated for future aquatic life use rather than for a current or potential source of drinking water. The potential CoCs at the site are: arsenic, cadmium, copper, iron, lead, manganese, and zinc. Table 6-2 presents the ARAR-based reclamation goals for surface water.

TABLE 6-2
ARAR-BASED RECLAMATION GOALS FOR
SURFACE WATER (μg/L)

CHEMICAL	TYPE	CONCENTRATION
Arsenic	HHS	18
Cadmium	AALS	3.9 @ 100 mg//l hardness
Copper	AALS	18 @ 100 mg/l hardness
Iron	HHS	300
Lead	HHS	15
Manganese	HHS	50
Zinc	AALS	120 @ 100 mg/l hardness

Source: HHS - Human Health Standards for Surface Water (MDEQ/WQB, 1995).
AALS - Freshwater Acute Aquatic Life Standards (MDEQ/WQB, 1995).

6.1.3 Soil

Chemical-specific ARARs are not available at this time for the soil medium.

6.2 <u>RISK-BASED CLEANUP GOALS</u>

Previously calculated risk-based cleanup goals for both the carcinogenic and non-carcinogenic estimates of human health risk are applied for two land-use scenarios at the Park Mine site, recreational and residential. These concentrations were derived using exposure assumptions contained in other documents (residential-Smith, 1995; recreational-TetraTech, 1996) and are the same as those presented in Section 5.1. Both sets of cleanup goals attempt to reduce the risk of excess incidence of cancer to 1.0E-06 (EPA, 1990) and the non-carcinogenic health hazard quotient (HQ) to ≤ 1 (EPA, 1989a). Both sets of cleanup goals are presented for solid media (Table 6-3) and for water media (Table 6-4).

TABLE 6-3
PROPOSED CLEANUP GOALS FOR SOLID MEDIA AT THE PARK MINE SITE

Contaminant of Concern	**Recreational Soil Ing./Inh. Waste Rock** mg/Kg	**Recreational Soil Ing./Inh. Tailings** mg/Kg	**Residential Soil Ingestion** mg/Kg	**Residential Dust Inhalation (soil conc.)** mg/Kg
Arsenic	323 1.4 (Carc.)	569 2.2 (Carc.)	23 0.43 (Carc.)	740,000 380 (Carc.)
Cadmium	1,750	3,150 39 (Carc.)	39	140,000 920 (Carc.)
Iron	NA	NA	23,000	NA
Lead	2,200	3,920	400*	NA

NA = Not Applicable, concentration is more than unity.
Carc. = Carcinogenic-based cleanup goals; all other goals are non-carcinogenic based.
* Used USEPA recommendations, not RBC table, from Smith, 1995.

TABLE 6-4
PROPOSED CLEANUP GOALS FOR WATER MEDIA AT THE PARK MINE SITE

Contaminant of Concern	**Recreational Water Ingestion** (surface water) μg/L	**Residential Water Ingestion** (groundwater) μg/L
Arsenic	153 0.66 (Carc.)	11 0.045 (Carc.)
Lead	220	15*

NA = Not Applicable, concentration is more than unity.
Carc. = Carcinogenic-based cleanup goals; all other goals are non-carcinogenic based.
* Used USEPA recommendations, not RBC table, from Smith, 1995.

Risk reduction required to attain non-carcinogenic human health and ecologic reclamation goals for each CoC (by each pathway) is shown on Table 6-5.

TABLE 6-5
RISK REDUCTION NECESSARY TO ATTAIN NON-CARCINOGENIC HUMAN HEALTH AND ECOLOGIC CLEANUP GOALS

PATHWAY	RISK REDUCTION REQUIRED (%)				
	As	**Cd**	**Cu**	**Pb**	**Zn**
Human Health Exposure Pathways:					
Soil Ingestion (Res.)	100	20	--	98	--
Water Ingestion (Res.)	4	--	--	93	--
Soil Ing./Inh. (Recr.)	96	--	--	79	--
Water Ingestion (Recr.)	--	--	--	--	--
Ecologic Exposure Pathways:					
Surface Water	--	97	89	60	99
Sediments	92	63	--	96	89
Deer Salt Ingestion	--	--	--	98	--
Plant Phytotoxicity	100	84	71	98	93

-- = Risk reduction not required for the contaminant for that pathway.

7.0 DEVELOPMENT AND SCREENING OF RECLAMATION ALTERNATIVES

The contaminated waste sources located at the Park Mine and Millsite can be categorized based upon their physical and chemical characteristics. To facilitate the evaluation of potentially applicable reclamation technologies, these media can be divided into five general categories based on physical and chemical characteristics. The five categories include:

- wet tailings;
- dry tailings;
- waste rock dumps;
- mine drainage (adit/seep discharge); and
- demolition debris.

Treatment of these various media is dependant on the concentration of metal contaminants in the media, as well as the physical characteristics of the media. The potential applicability of a technology is dependant on the interrelationship of reclamation technologies and the volume of material requiring treatment. A brief definition of each contaminated medium category follows.

Wet Tailings - Saturated tailings material located below the water surface or otherwise saturated with water. Tailings are uniform, finely ground rock particles from which most of the commercial ore has been extracted in the benefication and extraction process. The potential for tailings to impact water quality depends on the chemistry of the material and the specific conditions at the tailings' disposal site. Migration of metals from wet tailings may be limited due to the reducing conditions provided by the anaerobic environment in conjunction with the limited solubility of sulfide minerals. Wet tailings are present in Indian Creek at the Park site.

Dry Tailings - Dry or alternately wet and dry tailings tend to contain oxidized forms of metals. These oxidized metals are easily mobilized during precipitation (infiltration) or high run-off events. Dry tailings are located at five locations along Indian Creek at the Park site and four of these dumps are located directly in the active stream channel or floodplain of Indian Creek. Additional tailings materials are present as overbank deposits and are mixed with alluvium on the floodplain of Indian Creek below the site. Locations of the tailings materials are shown on Figure 3-2.

Waste Rock Dumps - Consist of overburden and gangue materials that generally do not contain sufficient economic quantities of target metals for recovery. The dumps contain non-mineralized and low-grade mineralized rock removed from areas adjacent to the ore and placed in piles close to the mine. The nature and extent of the mineralization, climatic conditions, and buffering capacity of the foundation soil determine the potential of the material to impact water quality. Locations of the waste rock dumps at the site are shown on Figure 3-1.

In general, waste rock dumps contain oxidizing sulfide minerals and are subject to percolation of precipitation and run-off. The sulfide minerals within the dump may react with percolating water in the presence of oxygen to form sulfuric acid; however, the abundance of potassium feldspar and the general lack of sulfides at the Park site may preclude the formation of significant quantities of sulfuric acid. Migration of sulfuric acid through the dumps results in the further mobilization of solubilized metal oxides. A total of ten waste rock dumps of various sizes are located at the Park site, four of these dumps are located directly in the active stream channel or floodplain of Indian Creek.

Mine Drainage (Adit/Seepage Water Discharge) - Water draining from underground mine workings often exhibits elevated concentrations of heavy metals and low (acidic) pH conditions due to chemical reactions that occur when the water comes in direct contact with soluble mineralized rock and oxygen. The discharging adits contain significantly elevated concentrations of several metals; furthermore, the pH values of the discharges have been measured from 2.9 to 7.2. The discharge flow rates vary significantly with seasonal and climatic variations. Locations of the adit discharges and seeps are shown on Figure 3-1.

Demolition Debris and Solid Waste - Some buildings and debris are present at the site. The debris may (or may not) include elevated metals concentrations on their external surfaces and may require sorting to isolate the contaminated material for special handling or decontaminating. To eliminate safety concerns, some of the buildings may be razed during the reclamation activities if deemed historically insignificant in the historic and cultural resources study.

7.1 IDENTIFICATION AND SCREENING OF RECLAMATION TECHNOLOGIES AND PROCESS OPTIONS

The purpose of identifying and screening technology types and process options is to eliminate those technologies that are obviously unfeasible, while retaining potentially effective options. General response actions are progressively refined into technology types and process options. The process options are screened, and those retained are used to develop reclamation alternatives. General response actions, technology types, and process options are briefly discussed in this section.

General response actions and process options are evaluated for contaminated solid media and mine water discharge only. No evaluation has been conducted for surface water, groundwater, or off-site stream sediments. This decision was based primarily on the presumption that remediating the contamination at the source(s) will subsequently reduce/eliminate the problems associated with these other environmental media. This decision will be reevaluated based on the results of the reclamation investigation. General response actions potentially capable of meeting the reclamation objectives are identified in Table 7-1. Response actions include no action,

TABLE 7-1
GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS FOR CONTAMINATED SOLID MEDIA AT THE PARK SITE

GENERAL RESPONSE ACTION	TECHNOLOGY TYPE	PROCESS OPTIONS
No Action	Not Applicable	Not Applicable
Institutional Controls	Access Restrictions	Fencing Land Use Control
Engineering Controls	Containment	Soil Cover Multimedia Cover Asphalt/Concrete Cover
	Surface Controls	Consolidation Grading Revegetation Erosion Protection Run-on/Run-off Control
	On-Site Disposal	RCRA Repository Solid Waste Repository
	Off-Site Disposal	RCRA Landfill Solid Waste Landfill Permitted Tailings Facility
Excavation and Treatment	Fixation/Stabilization	Pozzolan/Cement Based
	Reprocessing	Milling/Smelter
	Physical/Chemical Treatment	Soil Washing Acid Extraction Alkaline Leaching
	Thermal Treatment	Fluidized Bed Reactor Rotary Kiln Multi-Hearth Kiln Vitrification
Insitu Treatment	Physical/Chemical Treatment	Stabilization/Solidification Soil Flushing
	Thermal Treatment	Vitrification

institutional controls, engineering controls, excavation and treatment, and insitu treatment for the solid media and institutional, passive, active, source, and biological treatment for the mine water discharge. Table 7-2 contains the screening rationale that was used to eliminate or retain the various reclamation process options for potential application at the Park site.

In Section 7.2, feasible technologies are combined and several reclamation alternatives are presented. In Section 7.3 each of the alternatives developed in Section 7.2 are subjected to an initial/preliminary screening based on effectiveness, implementability, and cost. The purpose of the initial screening of alternatives is to identify those alternatives appropriate for a subsequent, detailed analysis. Detailed analyses of alternatives which pass the initial screening are presented in Section 8. The initial screening also helps identify technology-(process option) specific data needs for detailed site characterization as well as needs for possible treatability studies.

7.1.1 No Action

Under the no action option, no future reclamation or monitoring would occur at the site. The no action response is a stand-alone response that is used as a baseline against which candidate reclamation alternatives are compared.

7.1.2 Institutional Controls

Potentially applicable institutional controls consist of land use and access restrictions. Land use restrictions would limit the potential future uses for the land in the event of a sale. Limitations may be applicable in the case of no action, on-site disposal, capping in place, or other reclamation alternatives that would result in leaving contaminated material on-site that could be compromised by future activities. Institutional controls that are developed as part of an alternative are enforced by the USFS. Therefore, the USFS must be involved in the development and eventual implementation of an institutional control.

Institutional controls involve implementing access restrictions, such as fencing and land use control. These restrictions are implemented to preclude the future development of impacted areas or to protect an implemented remedy. This type of action does not, in itself, achieve a specific clean-up goal. However, institutional controls will be considered as adjacent technologies to accompany other reclamation alternatives.

7.1.3 Engineering Controls

Engineering controls are used primarily to reduce the mobility of contaminants by creating a barrier that prevents transport of waste from the contaminated source to the surrounding media. Engineering controls do not reduce the volume or toxicity of the hazardous material. Engineering controls typically applied include containment/capping, revegetation, run-on/run-off control, and/or disposal.

TABLE 7-2

REMEDIAL TECHNOLOGY SCREENING SUMMARY

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	SCREENING COMMENT
NO ACTION	None	Not Applicable	No Action	
INSTITUTIONAL CONTROLS	Access Restrictions	Fencing	Security fences installed around contaminated areas to limit access.	Potentially effective in conjunction with other technologies readily implementable.
		Land Use Control	Restrictions to control current and future land use.	Potentially effective in conjunction with other process options. Readily implementable.
ENGINEERING CONTROLS/ SOLID MEDIA	Containment	Soil Cover	Application of soil and establishment of vegetative cover to stabilize surface of contamination source.	Surface infiltration and runoff potential would be reduced, but not prevented. Readily implementable.
		Multimedia Cap	Compacted clay covered with soil/vegetation over areas of surface contamination.	Potentially effective for some waste sources in conjunction with timber removal and regrading. Readily implementable.
		Asphalt/Concrete Cover	Application of layer of asphalt or concrete over areas of surface contamination.	Limited feasibility due to remoteness of area and steep slopes. Would require extensive grading and compaction.
		Wet Closure	Applicable to wet tailings. Construct dam to flood tailings with water and provide anaerobic environment to limit oxidation/migration of contaminants.	Potentially effective if adequate coverage is provided during dry seasons. Readily implementable.
	Surface Controls	Consolidation	Combining similar waste types in a common area.	Potentially effective in conjunction with other process options. Involves removing wastes from particularly sensitive areas (e.g. floodplain). Readily implementable.
		Grading	Level out waste piles to reduce slopes for managing surface water infiltration, runoff, and erosion.	Potentially effective in conjunction with other process options. Readily implementable.
		Revegetation	Adding amendments to waste and seeding with appropriate vegetative species to establish an erosion resistant ground surface.	Potentially effective in arid climates if waste does not contain high concentrations of phytotoxic chemicals Readily implementable.
		Erosion Protection/Run-on/Run-off Control	Erosion resistant materials/fabrics placed directly on waste sources to reduce surface erosion. Surface water diversion structures constructed to direct runoff away from waste source(s).	Potentially effective at reducing contaminant mobility. Readily implementable.
	On-site Disposal	RCRA Landfill	Excavated contaminated soil deposited on-site in RCRA landfill.	Potentially effective and readily implementable.

TABLE 7-3 (Cont'd)

REMEDIAL TECHNOLOGY SCREENING SUMMARY

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	SCREENING COMMENT
		Sanitary Landfill	Excavated contaminated soil deposited on-site in sanitary landfill.	Potentially effective for non-hazardous materials or non-hazardous residues from other treatment process options. Readily implementable.
	Off-site Disposal	RCRA Landfill	Wastes permanently disposed of in RCRA-permitted facility.	Potentially effective and readily implementable.
		Solid Waste (Group II) Landfill	Non-hazardous solid wastes permanently disposed of in permitted solid waste landfill.	Potentially effective for non-hazardous materials or non-hazardous residues from other treatment process options. Readily implementable.
		Mine Waste Disposal Facility	Depositing mine wastes in an off-site impoundment that is dedicated and permitted for mine wastes.	Potentially effective if facility with adequate capacity is willing to accept waste.
EXCAVATION AND TREATMENT/SOLID MEDIA	Fixation/Stabilization	Pozzolan/Cement Based or Lime Based	Hazardous constituents are incorporated into non-leachable cement or pozzolan solidifying agents.	Extensive treatability testing required. Proper disposal of stabilized product would be required. Potentially implementable, but cost-prohibitive.
	Reprocessing	Milling/Smelter	Shipping wastes to existing milling/smelter facility for economic extraction of metals.	Potentially effective if a facility is located and willing to accept waste.
	Physical/Chemical Treatment	Soil Washing	Separate hazardous constituents from solid media via dissolution and subsequent precipitation.	Effectiveness is questionable. Potential exists to increase mobility by providing partial dissolution of contaminants. More difficulty encountered with wider range of CoCs.
		Acid Extraction	Mobilize hazardous constituents via acid leaching and recover by subsequent precipitation.	Effectiveness is questionable. Sulfides would be acid soluble only under extreme conditions of temperature and pressure.
		Alkaline Leaching	Use alkaline solution to leach contaminants from solid media in a heap, vat, or agitated vessel.	Effectiveness not well-documented for arsenic.
	Thermal Treatment	Fluidized Bed Reactor/Rotary Kiln/Multi-Hearth Kiln	Concentrate hazardous constituents into a small volume by volatilization of metals and formation of metallic oxides as particulates.	Further treatment is required to treat process by-products. Potentially implementable, but cost-prohibitive.
		Vitrification	Extremely high temperature used to melt and/or volatilize all components of the solid media. The molten material containing contaminants is cooled and, in the process, vitrified into a non-leachable form.	Further treatment is required to treat process by-products. Potentially implementable, but cost-prohibitive.

TABLE 7-3 (Cont'd)

REMEDIAL TECHNOLOGY SCREENING SUMMARY

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	SCREENING COMMENT
IN SITU TREATMENT/ SOLID MEDIA	Physical/Chemical Treatment	Stabilization	Waste constituents stabilized in place when combined with injected stabilizing agents.	Extensive treatability testing required. Potentially implementable, but cost-prohibitive.
		Solidification	Solidifying agents used in conjunction with deep soil mixing techniques to facilitate a physical or chemical change in mobility of the contaminants.	Extensive treatability testing required. Potentially implementable, but cost-prohibitive.
		Soil Flushing	Acid/base reagent or chelating agent injected into solid media to solubilize metals. Solubilized reagents are subsequently extracted using dewatering techniques.	Effectiveness not certain. Innovative process currently in its pilot stage.
	Thermal Treatment	Vitrification	Contaminated solid media subjected to extremely high temperature in-place. During cooling, material is vitrified into non-leachable form.	Difficulties may be encountered in establishing adequate control. Potentially implementable, but cost-prohibitive.

Legend

[shaded box] - Technologies/Process options that are screened out.

7.1.3.1 Containment

Containment technologies are used as source control measures to divert surface water from the contaminated media, to minimize infiltration (and subsequent formation of leachate) of surface water/precipitation into the underlying contaminated media by increasing evapotranspiration processes, and to reduce the potential health risk that may be associated with exposure (direct contact or airborne releases of particulate) to the contaminated media. The cap or cover design is a function of the degree of hazard posed by the contaminated media and may vary in complexity from a simple soil cover to a multi-layered Resource Conservation and Recovery Act (RCRA) cap. RCRA cap performance standards are included in 40 CFR 264.310 which addresses RCRA landfill closure requirements. These performance standards may not always be appropriate, particularly in instances where the toxicity of the contaminated media is relatively low, where the cap is intended to be temporary, where there is low precipitation, or where the waste is not leached by infiltrating rain water. Specific cap construction is partially driven by the desired land use following cap construction.

Capping is appropriate whenever contaminated materials are to be left in place at a site, such as when total excavation and removal or treatment would be cost prohibitive. Capping is considered to be a standard construction practice. Equipment and construction methods associated with capping are readily available, and design methods and requirements are well understood.

7.1.3.2 Surface Controls

Similar to containment, surface control measures are used primarily to reduce contaminant mobility. Surface controls may be appropriate in more remote areas where direct human contact is not a primary concern (human receptors not living or working directly on or near the site). Surface control process options include consolidation, grading, revegetation, and erosion protection. These process options are usually integrated as a single reclamation alternative.

Consolidation involves grouping similar waste types in a common area for subsequent management or treatment. Consolidation is especially applicable when multiple waste sources are present at a site and one or more of the sources require removal from particularly sensitive areas (i.e., floodplain, residential area, or heavy traffic area) or when treating one large combined waste source in a particular location rather than several smaller waste sources dispersed throughout an area.

Grading is the general term for techniques used to reshape the ground surface to reduce slopes, to manage surface water infiltration and run-off, and to aid in erosion control. The spreading and compaction steps used in grading are routine construction practices. The equipment and methods used in grading are similar for all surfaces, but will vary slightly depending upon the waste type and the surrounding terrain. Periodic maintenance and regrading may be necessary to eliminate depressions formed as a result of settlement/subsidence or erosion.

Revegetation involves adding soil amendments to the waste's surface to provide nutrients, organic material, and neutralizing agents and/or to improve the water storage capacity of the contaminated media, as necessary. This action will establish native vegetative species to provide an erosion-resistant ground surface that helps protect the ground surface from surface water and wind erosion and reduces net infiltration through the contaminated media by increasing evapotranspiration processes. In general, revegetation includes the following steps: 1) selecting appropriate plant species; 2) preparing seed bed, which may include deep application of soil amendments as necessary; 3) seeding/planting; 4) mulching and/or chemical stabilization; and 5) fertilizing and maintenance.

Erosion protection includes using erosion resistant materials, such as mulch, natural or synthetic fabric mats, riprap, and/or surface water diversion ditches, to reduce the erosion potential at the contaminated media's surface. The erosion resistant materials are placed in areas susceptible to surface water erosion (concentrated flow or overland flow) or wind erosion. Proper erosion protection design requires knowledge of drainage area characteristics, average slopes, soil texture, vegetation types and abundance, and precipitation data.

7.1.3.3 On-Site Disposal

Permanent, on-site disposal is used as a source control measure. On-site disposal involves placing the contaminated media in an engineered containment facility located within the site boundary. On-site disposal options may be applied to pre-treated or untreated contaminated materials. The design configuration of an on-site repository would depend on the toxicity and type of material requiring disposal. The design could range in complexity from a relatively simple, unlined and covered impoundment to a double-lined impoundment equipped with double leachate collection systems and RCRA-type cap. Materials failing to meet the Toxicity Characteristic Leaching Procedure (TCLP) criteria may require disposal in a repository conforming to the performance standards for a RCRA landfill closure.

7.1.3.4 Off-Site Disposal

Off-site disposal involves placing excavated contaminated material in an engineered containment facility located outside the site boundary. Off-site disposal options may be applied to pre-treated or untreated contaminated materials and would depend on TCLP results. Materials failing to meet the TCLP criteria would require disposal in a RCRA-permitted treatment, storage, and disposal (TSD) facility. Conversely, less toxic materials could possibly be disposed of in an off-site permitted sanitary landfill or mine waste permitted landfill in compliance with other applicable laws.

7.1.4 Excavation and Treatment

Excavation and treatment incorporates the removal of contaminated media and subsequent treatment via a specific treatment process that chemically, physically, or thermally results in a reduction of contaminant toxicity and/or volume. Treatment processes have the primary objective of either: 1) concentrating the metal contaminants for additional treatment or recovery of valuable constituents; or 2) reducing the toxicity of the hazardous constituents.

Excavation can be completed using conventional earth-moving equipment and accepted hazardous materials handling procedures. Precautionary measures, such as stream diversion or isolation, would be necessary for excavating materials contained in the floodplain of a stream. Containment and/or treatment of water encountered during excavation may also be necessary.

7.1.4.1 Fixation/Stabilization

Fixation/stabilization technologies are used to treat materials by physically encapsulating them in an inert matrix (stabilization) and/or chemically altering them to reduce the mobility and/or toxicity of their constituents (fixation). These technologies generally involve mixing materials with binding agents under prescribed conditions to form a stable matrix. Fixation/stabilization is an established technology for treating inorganic contaminants. The technology incorporates a reagent or combination of reagents to facilitate a chemical and/or physical reduction of the mobility of contaminants in the solid media. Lime/fly, ash-based treatment processes and pozzolan/cement-based treatment processes are potentially applicable fixation/stabilization technologies.

7.1.4.2 Reprocessing

Reprocessing involves excavating and transporting the waste materials to an existing permitted mill or smelter facility for processing and economic recovery of target metals. Applicability of this option depends on the willingness of an existing permitted facility to accept and process the material and dispose of the waste. Although reprocessing at active facilities has been conducted in the past, permit limitations, CERCLA liability, and process constraints all limit the feasibility of this process option.

7.1.4.3 Physical/Chemical Treatment

Physical treatment processes use physical characteristics to concentrate constituents into a relatively small volume for disposal or further treatment. Chemical treatment processes treat contaminants through adding a chemical reagent that removes or fixates the contaminants. The net result of chemical treatment processes is a reduction of toxicity and/or mobility of contaminants in the solid media. Chemical treatment processes often work in conjunction with physical processes to wash the contaminated media with water, acids, bases, or surfactants. Potentially applicable physical/chemical treatment process options include: soil washing, acid extraction, and alkaline leaching.

Soil washing is an innovative treatment process which consists of washing the contaminated media (with water) in a heap, vat, or agitated vessel to dissolve water soluble contaminants. Soil washing requires that contaminants be readily soluble in water and small enough so that dissolution can be achieved in a practical retention time. Dissolved metal constituents contained in the wash solution are precipitated as insoluble compounds, and the treated solids are de-watered before additional treatment or disposal. The precipitates form a sludge which would require additional treatment, such as de-watering or stabilization before disposal.

Acid extraction applies an acidic solution to the contaminated media in a heap, vat, or agitated vessel. Depending on temperature, pressure, and acid concentration, varying quantities of the metal constituents present in the contaminated media would be solubilized. A broader range of contaminants can be expected to be acid soluble at ambient conditions using acid extraction versus soil washing; however, sulfide compounds may only be acid soluble under extreme conditions of temperature and pressure. Dissolved contaminants are subsequently precipitated for additional treatment and/or disposal.

Alkaline leaching is similar to acid extraction in which a leaching solution (in this case ammonia, lime, or caustic soda) is applied to the contaminated media in a heap, vat, or agitated vessel. Alkaline leaching is potentially effective for leaching the majority of metals from the contaminated media; however, the removal of arsenic is not well documented.

7.1.4.4 Thermal Treatment

Under thermal treatment technologies, heat is applied to the contaminated media to volatilize and oxidize metals and render them amenable to additional processing and/or to vitrify the contaminated media into a glass-like, non-toxic, non-leachable matrix. Potentially applicable moderate temperature thermal processes, which volatilize metals and form metallic oxide particulates, include the fluidized bed reactor, the rotary kiln, and the multi-hearth kiln. Potentially applicable high temperature thermal treatment processes include vitrification. All components of the contaminated media are melted and/or volatilized under high temperature vitrification. Volatile contaminants and gaseous oxides of sulfur are driven off as gases in the process, and the non-volatile, molten material containing contaminants is cooled and, in the process, vitrified.

Thermal treatment technologies can be applied to wet or dry contaminated media; however, the effectiveness may vary somewhat with variable moisture content and particle size. Crushing may be necessary as a pre-treatment step, especially for large and/or variable particle sizes, such as in waste rock dumps. Moderate temperature thermal processes should only be considered as pretreatment for other treatment options. This process concentrates the contaminants into a highly mobile (and potentially more toxic) form. High temperature thermal processes immobilize most metal contaminants into a vitrified slag which have to be properly disposed. The volatile metals would be removed and/or concentrated into particulate metal oxides which would likely require disposal as hazardous waste. Thermal treatment costs are extremely high compared to other potentially applicable reclamation technologies.

7.1.5 Insitu Treatment

Insitu treatment involves treating the contaminated media in place. Insitu technologies reduce the mobility and toxicity of the contaminated media and may reduce worker exposure to the contaminated materials; however, insitu technologies allow a lesser degree of control, in general, than exsitu treatment options.

7.1.5.1 Physical/Chemical Treatment

Potentially applicable insitu physical/chemical treatment technologies include stabilization/ solidification and soil flushing.

Insitu stabilization/solidification is similar to conventional stabilization in that a solidifying agent (or combination of agents) is used to create a chemical or physical change in the mobility and/or toxicity of the contaminants. The insitu process uses deep mixing techniques to allow maximum contact of the solidifying agents with the contaminated media.

Soil flushing is an innovative process that injects an acidic or basic reagent or chelating agent into the contaminated media to solubilize metals. The solubilized metals are extracted using established dewatering techniques, and the extracted solution is then treated to recover metals or is disposed as aqueous waste. Low permeability materials may hinder proper circulation, flushing solution reaction, and ultimate recovery of the solution. Currently, soil flushing has only been demonstrated at pilot scale.

7.1.5.2 Thermal Treatment

Insitu vitrification is an innovative process used to melt contaminated solid media in place to immobilize metals into a glass-like, inert, non-leachable solid matrix. Vitrification requires significant energy to generate sufficient current to force the solid media to act as a continuous electrical conductor. This technology is seriously inhibited by high-moisture content. Gases generated by the process must be collected and treated in an off-gas treatment system. Insitu vitrification has only been demonstrated at pilot scale, and treatment costs are extremely high compared to other treatment technologies.

7.1.6 Water Treatment (Adit Discharges)

Water treatment alternatives for the Park Mine site were developed and considered in the reclamation investigation work plan, and were eliminated for reasons stated in the work plan. Because the water treatment alternatives were eliminated in the work plan, no discussion of the various water treatment technologies is provided in this report.

7.2 IDENTIFICATION OF ALTERNATIVES

In this section, the remaining remedial technology types and associated process options that passed the initial screening are assembled into reclamation alternatives. For the purposes of defining reclamation alternatives at this stage, the solid media (tailings, waste rock and disturbed soils, intermixed mine waste, and demolition debris) and physical hazards (adits, shafts, and unstable slopes) are addressed independently. Table 7-3 presents the preliminary reclamation alternatives that have been identified for the solid and aqueous media, respectively, at the Park site.

TABLE 7-3
RECLAMATION ALTERNATIVES FOR THE WASTE ROCK DUMPS AND TAILINGS AT THE PARK SITE

Alternative #1:	No Action
Alternative #2:	Institutional Controls
Alternative #3:	In-Place Containment of Wastes
Alternative #4a:	Partial Removal and In-Place Containment
Alternative #4b:	Partial Removal (Excluding Streamside Tailings) and In-Place Containment,
Alternative #5a:	Partial Removal/Disposal of Solid Media on-Site in a Constructed RCRA Subtitle C Repository and Partial In-Place Containment
Alternative #5b:	Partial Removal/Disposal of Solid Media on-Site in a Constructed Modified RCRA Repository and Partial In-Place Containment
Alternative #5c:	Partial Removal/Disposal of Solid Media on-Site in an Unlined Repository and Partial In-Place Containment
Alternative #6:	Removal/Treatment/Disposal at a Permitted Off-Site Waste Disposal Facility

It should be noted that the solid media alternative selected will have impact on the contaminated aqueous media. In other words, the two media cannot be considered independently. It is conceivable that the solid media alternative selected, coupled with the previous actions regarding the aqueous media, will make no further action necessary for the contaminated aqueous media. After implementing a reclamation action for the solid media, reclamation goals for the aqueous media may be attained. A solid media alternative must be selected and implemented to determine if the previous actions directed at the aqueous media are effective enough to meet reclamation goals. Therefore, this EEE/CA is focused specifically on the development, evaluation, and selection of solid media alternatives. Because contaminated aqueous media alternatives were eliminated in the reclamation investigation work plan, only solid media alternatives are developed and evaluated in detail, and a preferred solid media alternative will be selected and discussed.

7.3 PRELIMINARY EVALUATION AND SCREENING OF ALTERNATIVES

The alternatives identified above are described, developed, and then subjected to a preliminary evaluation and screening in this section. The evaluation and screening at this stage is based on the anticipated effectiveness, implementability, and relative costs of the alternatives. The preliminary screening has been conducted to identify those alternatives that are obviously not as cost effective or implementable as other alternatives that would provide a similar degree of risk reduction, thereby possibly reducing the number of reclamation alternatives requiring detailed evaluation.

The evaluation of effectiveness includes determining the ability of an alternative to process the contaminated media sufficiently to achieve the reclamation goals. The reclamation goals include overall protection of human health and the environment, compliance with ARARs, and short- and long-term effectiveness and/or performance related to reducing toxicity, mobility, and/or volume of contaminants. The effectiveness screening criteria included consideration of the nature and extent of the contamination, as well as site-specific conditions, such as geology, hydrology, hydrogeology, climate, current land use, and potential future land use.

The implementability of each alternative has been evaluated to consider the technical and administrative feasibility of constructing, operating, and maintaining each reclamation alternative. Technical feasibility considerations included applicability of the alternative to the waste source(s), availability of the required equipment and expertise to execute the alternative, and overall reliability of the alternative. Administrative feasibility considerations included logistical and scheduling constraints. The evaluation of implementability also considered appropriate combinations of alternatives with respect to site-specific conditions.

Cost screening consists of developing conservative, order-of-magnitude cost estimates for each remedial alternative based on similar sets of assumptions. Costs have been developed by analyzing data available from screening and implementing remedial alternatives at similar sites, particularly past abandoned mine reclamation activities conducted by DEQ/AMRB. Unit and total costs presented in the cost evaluations are present-worth values structured to account for contaminated materials handling, adverse site conditions, administrative and engineering costs, and contingency. Total costs were derived by applying estimated unit costs to assumed volumes of contaminated solid media. Cost estimates are based on the following volumes of waste materials:

- Approximately 3,000 cy of tailings material and approximately 800 cy of contaminated underlying soils covering approximately 0.5 acres.

- Approximately 49,000 cy of waste rock and approximately 20,000 cy of contaminated underlying soils covering approximately 6.2 disturbed acres.

- An additional approximately 1,740 cy of tailings covering approximately 2.5 acres are present as overbank deposits along Indian Creek below the site. These "streamside tailings" are present as thin deposits on the floodplain of Indian Creek below the site and are largely (>90%) vegetated. These tailings are also mixed with alluvium present in the creek channel and floodplain as a result of natural and/or placer mining processes.

- Of these wastes approximately 13,200 cy of wastes exceeded the TCLP standards for lead and/or arsenic. These wastes may require special handling or disposal.

Overall, approximately 9.1 acres at the site have been disturbed by mine wastes, and a total of approximately 74,500 cy of contaminated solid media are present. These estimated volumes are based on data from the 1996 Reclamation Investigation (DEQ/AMRB-Pioneer, 1996).

Several physical hazards are also present at the site: two open portals (WR-8 and SW-3), two collapsed adits (GW-1 and GW-4), one open shaft (above SW-3), and eight open cuts with unstable high walls (near WR-1, GW-1, WR-3, WR-4, WR-5, WR-6, WR-8 and WR-9). Each of these physical hazards would be addressed as follows during reclamation of the solid media present at the site:

<u>SW-3</u>: SW-3 is an open adit located near Indian Creek approximately 3,000 feet below WR-8. This adit is not located in a cut area, but does have a large volume adit discharge. The water quality of the adit discharge is poor. This adit will be closed with clean, crushed limestone to allow drainage and eliminate access.

<u>Shaft</u>: An open shaft is present approximately 250 feet upstream from SW-3 immediately adjacent to Indian Creek. This shaft will be closed by placing a permanent steel grate over the shaft opening.

<u>WR-1</u>: WR-1 has a long cut above the dump. No adits or seeps have been identified in the cut. The cut has unstable slopes which present significant physical hazards. The cut will be backfilled with waste rock available on-site. A drainage layer of crushed limestone will be placed under the waste rock to facilitate drainage under the fill materials. A filter fabric layer above the drain materials may be needed to prevent clogging of the drain. The upper surface of the fill materials will be graded to promote run-off and to allow cover soil placement and revegetation.

<u>GW-1</u>: GW-1 is a collapsed adit located at the end of a long cut above WR-2. This adit has a discharge with poor water quality (low pH, elevated metals). The cut has unstable slopes which present significant physical hazards. The cut will be backfilled with waste rock available on-site. A drainage layer of crushed

limestone will be placed under the waste rock to facilitate drainage of the adit discharge under the fill materials and to prevent additional leaching of contaminants from the waste rock fill materials. A filter fabric layer above the drain materials may be needed to prevent clogging of the drain. The upper surface of the fill materials will be graded to promote run-off and to allow cover soil placement and revegetation.

WR-3: WR-3 has a cut above the dump. No adits or seeps have been identified in the cut. The cut has unstable slopes which present significant physical hazards. The cut will be backfilled with waste rock available on-site. The upper surface of the fill materials will be graded to promote run-off and to allow cover soil placement and revegetation.

WR-4: WR-4 is a collapsed adit located at the end of a long cut above WR-4. This adit has a discharge with poor water quality (low pH, elevated metals). The cut has unstable slopes which present significant physical hazards. The cut will be backfilled with waste rock available on-site. A drainage layer of crushed limestone will be placed under the waste rock to facilitate drainage of the adit discharge under the fill materials and to prevent additional leaching of contaminants from the waste rock fill materials. A filter fabric layer above the drain materials may be needed to prevent clogging of the drain. The upper surface of the fill materials will be graded to promote run-off and to allow cover soil placement and revegetation.

WR-5: WR-5 has a cut above the dump. No adits or seeps have been identified in the cut. The cut has unstable slopes which present significant physical hazards. The cut will be backfilled with waste rock available on-site. The upper surface of the fill materials will be graded to promote run-off and to allow cover soil placement and revegetation.

WR-6: WR-6 has a long cut above the dump. Evidence of a seep has been observed in the cut. The cut has unstable slopes which present significant physical hazards. The cut will be backfilled with waste rock available on-site. A drainage layer of crushed limestone will be placed under the waste rock to facilitate drainage of the adit discharge under the fill materials and to prevent additional leaching of contaminants from the waste rock fill materials. A filter fabric layer above the drain materials may be needed to prevent clogging of the drain. The upper surface of the fill materials will be graded to promote run-off and to allow cover soil placement and revegetation.

WR-8: WR-8 has a long cut above the dump with an open adit at the end of the cut. No seeps have been observed from this adit. The cut has unstable slopes which present significant physical hazards. The adit will be closed by backfilling the cut with waste rock available on-site. A drainage layer of crushed limestone will be placed under the waste rock to facilitate drainage under the fill materials. A filter fabric layer above the drain materials may be needed to prevent clogging of the drain. The upper surface of the fill materials will be graded to promote run-off and to allow cover soil placement and revegetation.

WR-9: WR-9 has a long cut above the dump. The cut has a small-volume seep (GW-BK). The cut has unstable slopes which present significant physical hazards. The cut will be backfilled with waste rock available on-site. A drainage layer of crushed limestone will be placed under the waste rock to facilitate drainage of the adit discharge under the fill materials and to prevent additional leaching of contaminants from the waste rock fill materials. A filter fabric layer above the drain materials may be needed to prevent clogging of the drain. The upper surface of the fill materials will be graded to promote run-off and to allow cover soil placement and revegetation.

A screening summary is presented after evaluating each alternative to identify alternatives retained for detailed evaluation and to offer rationale for those alternatives that will not be considered further.

7.3.1 Solid Media Alternatives

7.3.1.1 Alternative 1 (Solid Media): No Action

The no action alternative means that no actual reclamation activities would occur at the site to control contaminant migration or to reduce toxicity or volume.

Effectiveness - Protection of human health and the environment would not be achieved under the no action alternative. Prevention of direct human contact would also not be achieved. The solid media contaminant sources present at the Park site contribute significantly to surface water contamination, which presents long-term risks to important environmental resources as well as potential human health risks. No action continues to provide a pathway to affect human health through the food-chain due to uptake of contaminants by fish, other aquatic life, and streamside vegetation. Toxicity, mobility, and volume of contaminants would not be reduced under the no action alternative.

Implementability - Technical and administrative feasibility evaluation criteria do not apply to this alternative.

Cost Screening - No capital or operating costs would be incurred under this alternative.

Screening Summary - This alternative has been retained for further evaluation as suggested by the NCP.

7.3.1.2 Alternative 2 (Solid Media): Institutional Controls

The institutional control alternative includes erecting fences to restrict access to contaminated sources and land use restrictions to prevent land development on or near the affected areas.

Effectiveness - This alternative is not protective of important environmental resources. It is not fully protective of human health if implemented as a stand alone alternative due to allowing the waste sources to continue to contribute significantly to surface water contamination. Toxicity, mobility, and volume of the contaminated media would not be reduced under this alternative.

Implementability - Institutional controls are easily implementable based on the criteria of applicability, availability, and reliability. This alternative is considered applicable for minimizing the potential for direct contact and restricting future inappropriate land development; however, due to the lack of residents and workers on or near the site, direct contact is not a primary route of exposure or cause for major concern. Fencing materials and construction contractors are readily available should direct contact with the area become a problem. Reliability of this alternative for its intended purpose (protection from direct contact) is considered good as long as enforcement of the institutional controls is maintained by the regulatory agencies and landowners. Due to the logistical simplicity of implementing institutional controls, administrative feasibility is considered very good.

Cost Screening - Costs associated with institutional controls would be relatively low as compared to other reclamation measures; however, a considerable amount of fencing materials would be required to fully enclose the contaminated sources present at the site. Capital costs associated with constructing an 8-feet high, chain-link fence would be approximately $144,000 assuming no consolidation of contaminated materials, and a fencing requirement of approximately 7,200 linear feet at approximately $20 per linear foot. Maintenance costs would likely be less than $200 per year.

Screening Summary - Institutional controls will not be considered further as a stand-alone reclamation alternative, but may be used in conjunction with other selected treatment alternatives.

7.3.1.3 Alternative 3 (Solid Media): In-Place Containment

Alternative 3 involves in-place containment of wastes present at the site by establishing vegetation on the surface of the contaminant sources. The purpose of establishing vegetation is to stabilize the surface (provide erosion protection) and to decrease net infiltration through the waste by increasing evapotranspiration.

Containment technologies may involve establishing vegetation directly on the waste source or applying a cover over the waste source upon which the vegetation is established. Covers may range from a simple, single-layered soil cover to complex multi-layered covers consisting of various composite materials. Given the available physical and chemical data/characteristics of the waste sources present at the Park site (the lime requirements for direct vegetation of the waste rock dumps vary from 2.6 to 219 tons of lime per acre based on a 12 inch depth of incorporation) it is reasonable to expect that vegetation could be successfully established on some of the waste rock dumps by incorporating proper quantities and types of amendments into the material before seeding, and that some waste rock dumps will require a soil cover. Soil covers are often subject to severe surface water erosion problems when placed on overly steep slopes (>3:1 slope). Compaction may help reduce erosion problems; however, excessive compaction is not desirable for successful seed germination.

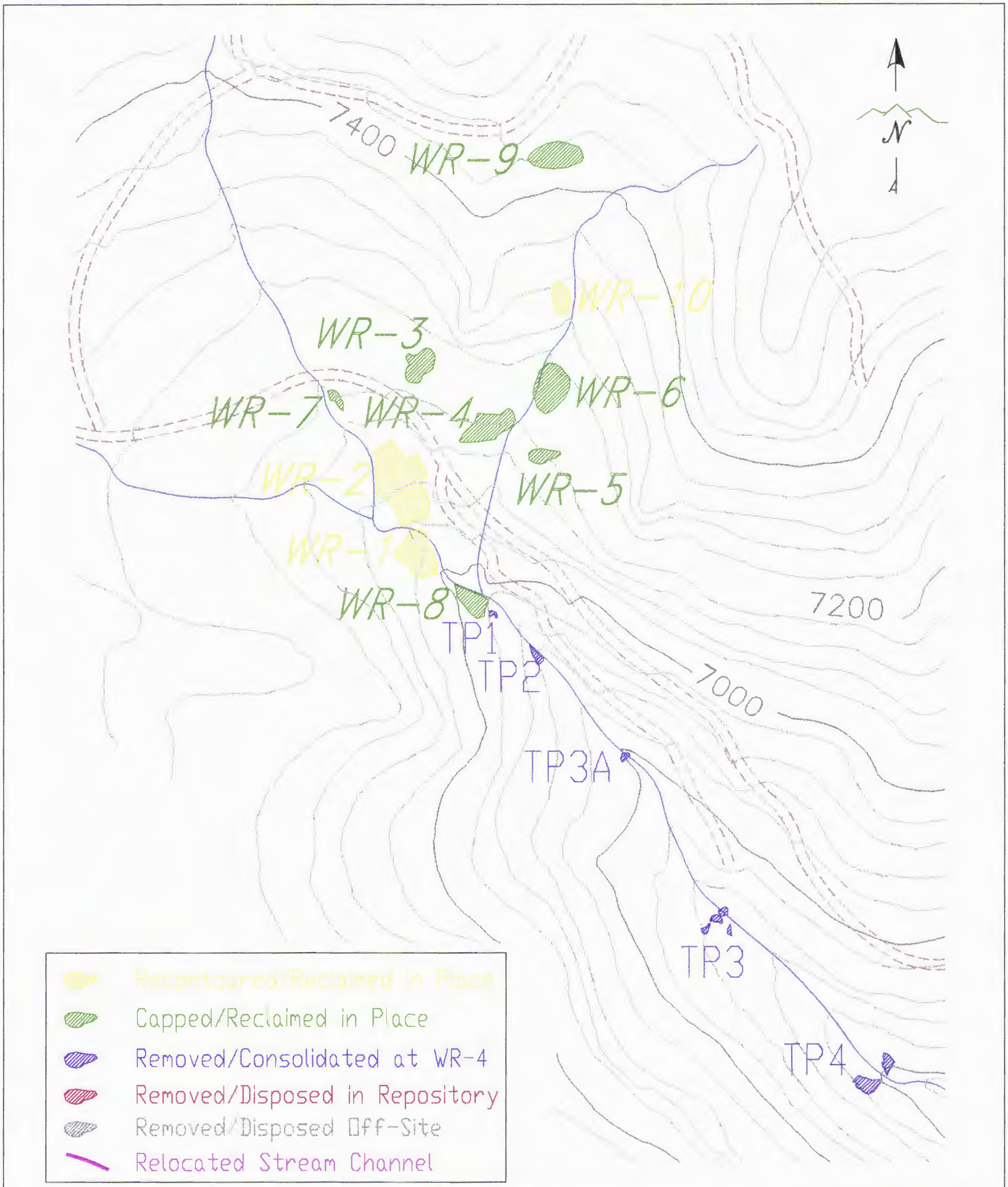
The discrete tailings piles at this site represent a relatively small volume of waste (compared to the volume of waste rock) and they are located directly in the creek channel or on the floodplain. Because the tailings are located very close to the creek, covering in place would not be protective of the surface water. Since the volume of tailings is relatively small (approximately 3,000 cy), the tailings would be removed and consolidated with the waste rock piles, away from the creek. Additional fill will be placed in areas where tailings are removed as needed, and the areas would be recontoured, and revegetated. The streamside tailings are largely vegetated (approximately 90%) and would not be addressed under this alternative.

Conceptual Design and Assumptions

Given the above considerations, the conceptual design for Alternative 3 involves recontouring the waste rock dumps in place and either placing a cover soil cap over the recontoured dumps or amending the wastes and establishing vegetation directly on the dumps. Vegetation would be established directly on the waste rock dumps with lower acid-producing potential by incorporating proper amendments into the dump material before establishing vegetation.

The discrete tailings piles (TP-1 through TP-5) would be removed from their present locations and consolidated with WR-4 prior to capping. Approximately one foot of contaminated underlying soils would also be removed from the tailings. Because the lower waste rock dumps (WR-1, WR-2, WR-7 and WR-8) are located very near Indian Creek, the portions immediately adjacent to the current creek channel would be excavated and regraded, and extensive run-on controls would be designed as an integral part of the containment strategy. Portions of other waste rock dumps located near areas with high potential for erosion from surface water run-off channels (WR-6 and WR-10) would be regraded and extensive run-on controls would be designed as an integral part of the containment strategy. Various treatment strategies to be employed at each waste source under this alternative are shown on Figure 7-1.

Based on the available data and the above considerations, the conceptual design of Alternative 3 includes:



PIONEER TECHNICAL SERVICES, INC.

FIGURE 7-1
Alternative 3
Reclamation Scenario

SCALE: 1" = approx. 650'
DATE: 12/23/96

- improving road access to the site to facilitate reasonable access by heavy equipment and construction crews;

- improving existing and constructing new surface water diversion ditches to route mine water discharge, run-off/run-on, and seeps away from contaminated solid media, and implementing construction Best Management Practices (BMPs) to protect surface water resources during road construction and reclamation;

- disposing and/or recycling the two fuel tanks, the concrete pads, and other demolition debris located at the site;

- removing the tailings piles immediately adjacent to Indian Creek (TP-1, TP-2, TP-3, TP-4, and TP-5) and recontouring waste rock dumps near the creek;

- excavating one foot of contaminated underlying soils from the tailings piles;

- backfilling areas where wastes and tailings were removed with clean fill materials;

- grading other solid media in place to reduce slopes in order to provide surfaces amenable to amendment application or cover soil placement, and revegetation;

- stream channel reconstruction/channel armoring may be needed after removing waste rock dumps immediately adjacent to Indian Creek;

- backfilling cuts to stabilize highwalls and recontouring the areas to control run-off;

- closing open adits by backfilling with clean, crushed limestone;

- closing the open shaft with a steel grate; and

- revegetating disturbed areas, areas from which wastes have been removed, other solid media to be contained in place and borrow areas.

The current access road to the site is in poor condition and needs improvement to allow unobstructed access for the required heavy equipment and machinery. The road needs to be resurfaced, widened in some sections, and turn-outs need to be constructed. Suitable road construction materials can be obtained from the Continental Lime facility located on Indian Creek Road. Roads would also be constructed in the vicinity of the waste sources at the site to allow the required heavy equipment to access, excavate and/or grade the wastes.

Run-on/run-off and groundwater control would be achieved by the design and construction of several structures. Temporary surface water diversions would be constructed and BMPs would be implemented to prevent additional sedimentation in Indian Creek from occurring during construction. Groundwater discharges GW-1, GW-2, and GW-4 would be diverted using interceptor ditches to direct water away from downgradient contaminated media, construction areas, and reclaimed areas. The seep at GW-BK would be directed away from the reclaimed area and allowed to infiltrate into the ground before reaching Indian Creek. Diversion channels would be constructed to divert run-off generated upgradient from each source around the reclaimed areas and into Indian Creek.

Because the acid-producing potential of the waste rock dumps vary significantly, different dumps at the site would require different revegetation techniques (lime application rates for each waste source are summarized in Table 3-3). Based on a cost of imported cover soil of $14/LCY and a lime application cost of $250 per ton in place, waste rock dumps with lime requirements greater than approximately 120 TPA can be capped with imported cover soil cheaper than vegetation can be established directly on the dump materials. Considerable cost savings may be possible by substituting lime kiln dust or cement kiln dust for lime. Based on this determination WR-1, WR-2, and WR-10 would be recontoured, amended with lime, fertilizer and organic material and revegetated in place. All other waste rock dumps (WR-3, WR-4, WR-5, WR-6, WR-7, WR-8, and WR-9) would be recontoured, a 4-inch thick crushed limestone capillary barrier placed over the recontoured surface, capped with two feet of cover soil, and revegetated.

Tailings piles TP-1, TP-2, TP-3, TP-4 and TP-5 and approximately one foot of contaminated underlying soils would be removed from the floodplain and consolidated with WR-4 away from the creek. Areas where tailings and underlying soils are removed would be reclaimed by amending with lime to a depth of one foot, placing a 12-inch lift of clean cover soils, grading and planting.

Based on the above discussion regarding soil amendment requirements for the various wastes at the site, the cap for the waste consolidation area would be constructed with the capillary barrier/soil cap as described above. A portion of the soil cap would consist of amended underlying soil removed from the tailings piles. Although the underlying soils may have low pH and elevated metals concentrations, the lime requirement is expected to be relatively low; the low pH and elevated metals concentrations are the result of downward leaching from the waste rock above the soils, and the underlying soils would be expected to have low inherent acid-generating potential. The amended underlying soils would likely be suitable for establishing vegetation. Sampling of these soils for agronomic and acid-generating potential would be necessary prior to design. Amendment of the tailings for use as cover soil for revegetation was also considered, but was determined to be too costly because of the high lime application rate (average 265 TPA) which would be required to successfully establish vegetation in the tailings.

Under this scenario the tailings would be excavated and consolidated with WR-4 and recontoured. First, a four-inch layer of crushed limestone would be placed over the consolidation area. Next, the contaminated underlying soils from the tailings would be excavated, placed over the crushed limestone and amended with lime, fertilizer and organic matter to provide a suitable rooting medium. Finally, clean cover soils would be placed to provide a two-foot thick layer for establishing vegetation, grading would be completed, and vegetation would be established.

Portions of WR-1, WR-2, WR-7 and WR-8 which are immediately adjacent to the creek would also be removed from the creek channel/bank and consolidated within the remainder of their source waste rock dump. Clean backfill materials would be placed in areas where wastes were removed as needed.

The remaining waste rock dumps would be recontoured and reclaimed in place. WR-3, WR-5, WR-6, WR-7, WR-8, and WR-9 would be reclaimed by placing a 4-inch thick crushed limestone capillary barrier over the recontoured surface, capping with 2 feet of cover soil, and revegetating. WR-1, WR-2, and WR-10 would be reclaimed by recontouring the dumps, amending the waste rock with lime, fertilizer and compost, and revegetating.

All waste sources would be graded to a maximum 3:1 slope to minimize potential for erosion and to allow cover soil placement, incorporation of lime and amendments, and seeding to be accomplished with conventional equipment. Lime would be applied to the waste rock dumps using conventional agricultural techniques (plowing) or deep-incorporation techniques as appropriate.

Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of the disturbed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the reclaimed materials with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism.

Removal of wastes from near the creek will alter the current channel morphology and stream channel reconstruction or armoring will be needed. Areas where wastes are removed will be armored to stabilize the channel and prevent the creek from cutting into the reclaimed dumps.

Physical hazards (high walls, adits/portals, and shafts) would be mitigated as a portion of the reclamation as described in Section 7.3 previously.

The following assumptions were used to develop costs directly and to calculate associated costs for this alternative:

- The cost of road access improvements to the site is approximately $10,500 per mile for 5.5 miles.
- The total cost for materials and construction of the surface water diversion structure used to divert the creek is assumed to be $15,000.
- Approximately 500 feet of stream channel will require reconstruction at a cost of $35 per foot.

- Deep lime incorporation techniques would be required for WR-1, WR-2, WR-5 and WR-10. Lime application rates and areas listed in Table 3-3 were adjusted for two feet of incorporation and used to estimate costs.

- Two feet of cover soil would be used to cover the remaining waste piles. The recontoured surface area of the remaining waste rock dumps is approximately 4.5 acres.

- The area of the tailings to be removed which will require revegetation is approximately 0.5 acre.

- The total surface area at the site requiring revegetation is approximately 8.7 acres (which includes the excavated source areas, and reclaimed waste rock dumps).

- The total length of required run-on control and adit discharge diversion ditches is 5,150 linear feet.

- The total cost for removal and disposal of existing buildings and debris is estimated at $15,000.

Effectiveness - The primary purpose of establishing vegetation on a waste source is to limit the contaminant's mobility. Vegetation effectively stabilizes the surface against wind and surface water erosion, and minimizes the potential for migration of vadose zone contaminants from water infiltration by increasing evapotranspiration and decreasing infiltration. Vegetation would help minimize human and terrestrial biota exposure to the contaminants via direct contact and inhalation of entrained dust; however, the toxicity or volume of the wastes would not be reduced since no actual treatment of the contaminants would be conducted. The overall effectiveness of the containment/revegetation program would be enhanced by carefully selecting appropriate plant species that are metal tolerant and adapted to relatively high altitudes and relatively short growing seasons.

Since the lower waste rock dumps are located in a well-defined, surface water erosion pathway, there can be no assurance that future erosion of these sources will not occur if they are contained in place. Some of these waste sources currently have groundwater seeps which contribute significant metals loads to Indian Creek. These seeps would be expected to continue if the wastes are reclaimed in place.

Implementability - This alternative is both technically and administratively feasible. Incorporation of amendments, soil covers, and establishing vegetation are readily implementable technologies that use conventional construction techniques. Design methods and requirements have been thoroughly tested, and the necessary construction equipment and methods are readily available and widely used. Construction methods may vary depending on the complexity of the terrain and the required depth of amendment incorporation.

Cost Screening - The total present worth cost for this alternative has been estimated at $1,239,000 which represents the reclamation of all solid media contaminant sources present at the Park site (tailings and waste rock dumps). Table D-1 (Appendix D) presents the cost details associated with implementing this alternative. The total cost includes the present worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

Screening Summary - In-place containment may be a feasible and cost-effective remedy for the site, and this alternative has been retained for detailed analysis.

7.3.1.4 Alternative 4a (Solid Media): Partial Removal and In-Place Containment

Alternative 4 is very similar to Alternative 3 in that it involves in-place containment of some of the waste sources present at the site. However, Alternative 4a involves completely removing all wastes which are located near Indian Creek and moving them to another location on-site. These wastes would be consolidated or contained with WR-4. Consolidation of wastes at the Park Mine site would be advantageous because it will increase the distance from the wastes to surface water. The other waste rock dumps would be recontoured and reclaimed in place.

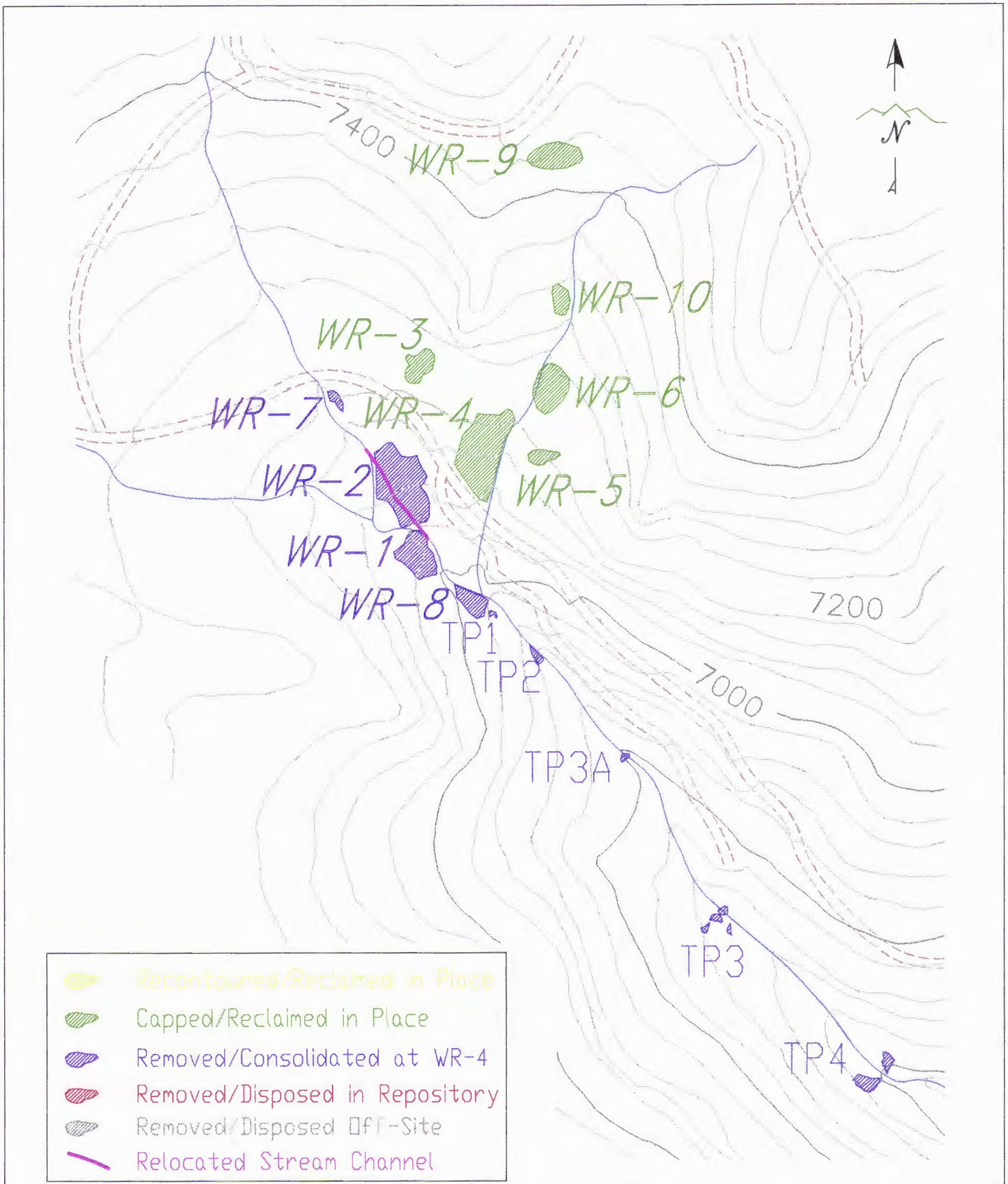
Conceptual Design and Assumptions

For the purpose of this evaluation, the conceptual design for Alternative 4a includes removing WR-1, WR-2, WR-7, WR-8, TP-1, TP-2, TP-3, TP-4, TP-5, and the streamside tailings from their current locations, consolidating these wastes near the current location of WR-4, and containing the consolidated waste materials by contouring, covering with soil, and revegetating. Other waste sources at the site (WR-3, WR-4, WR-5, WR-6, WR-9 and WR-10) would be recontoured, covered with soil and revegetated. Various treatment strategies to be employed at each waste source under this alternative are shown on Figure 7-2.

The general construction steps for implementing Alternative 4a, as conceptualized, are as follows:

- improving road access to the site to facilitate reasonable access by heavy equipment and construction crews;

- constructing temporary surface water diversion structures and implementing construction BMPs to isolate the stream and mine water discharges while excavating wastes from the floodplain and stream channel;



PIONEER TECHNICAL SERVICES, INC.

FIGURE 7-2
Alternative 4a
Reclamation Scenario

SCALE: 1" = approx. 650'
DATE: 12/23/96

- razing and disposing of any remaining dilapidated buildings/structures remaining at the site;

- totally excavating WR-1, WR-2, WR-7, WR-8, TP-1, TP-2, TP-3, TP-4, TP-5 and the streamside tailings, and transporting and consolidating the contaminated materials in the area near WR-4;

- excavating approximately one foot of contaminated underlying soils from WR-2, WR-7, WR-8, TP-1, TP-2, TP-3, TP-4, and TP-5, and transporting and consolidating the contaminated materials in the area near WR-4;

- constructing a cap over the consolidated waste area with materials from the excavation of WR-1, WR-2, the underlying soils and clean fill materials;

- stream channel reconstruction/stabilization near removed waste sources to ensure that the stream channel is stable after waste removal and reclamation have been completed;

- restoring the riparian zone in the excavated areas via backfilling with clean fill (where required) and revegetation;

- grading out the remaining waste rock dumps to reduce slopes and provide surfaces amenable to revegetation;

- backfilling cuts to stabilize highwalls and recontouring the areas to control run-off;

- closing open adits by backfilling with clean, crushed limestone;

- closing the open shaft with a steel grate;

- importing cover soil to apply to the waste rock areas and excavated areas;

- establishing vegetation on the covered waste rock and excavated areas; and

- constructing surface water diversion ditches/structures throughout the site to route run-off away from the reclaimed source areas.

The current access road to the site is in poor condition and needs improvement to allow unobstructed access for the required heavy equipment and machinery. The road needs to be resurfaced, widened in some sections and turn-outs need to be constructed. Suitable road construction materials can be obtained from the Continental Lime facility located on Indian Creek Road. Roads would also be constructed in the vicinity of the waste sources at the site to allow the required heavy equipment to access, excavate and/or grade the wastes.

Run-on/run-off and groundwater control would be achieved by the design and construction of several structures. Temporary surface water diversions would be constructed and BMPs would be implemented to prevent additional sedimentation in Indian Creek from occurring while excavating WR-1, WR-2, WR-7, WR-8, TP-1, TP-2, TP-3, TP-4, TP-5 and the streamside tailings. Groundwater discharges GW-1, GW-2, and GW-4 would be diverted using interceptor ditches to direct water away from contaminated media, construction areas, and reclaimed areas. The seep at GW-BK would be directed away from the reclaimed area and allowed to infiltrate into the ground before reaching Indian Creek. Diversion channels would be constructed to divert run-off generated upgradient from each source around the reclaimed areas and into Indian Creek.

As discussed previously in Alternative 3, the acid-producing potential of the waste rock dumps vary significantly and waste rock dumps with lime requirements greater than approximately 120 TPA can be capped with imported cover soil cheaper than vegetation can be established directly on the dump materials. Based on this analysis it was determined that WR-1, WR-2, WR-5 and WR-10 could economically be recontoured, amended with lime, fertilizer and organic material and revegetated in place. All other waste rock dumps would be recontoured, a four-inch thick crushed limestone capillary barrier placed over the recontoured surface, a two foot layer of cover soil placed, and revegetated. However, under this alternative only WR-5 and WR-10 would remain in place, and would also be reclaimed with the limestone/cover soil cap.

Under Alternative 4a, all waste sources near the creek (see list above) would be removed and consolidated near WR-4. Approximately one foot of contaminated underlying soils would also be removed from under WR-2, WR-7 (assumed, needs to be sampled prior to design), WR-8, TP-1, TP-2, TP-3, TP-4, and TP-5. The remaining contaminated underlying soils would remain in place and would be amended with lime to adjust the pH and to stabilize the metals. A one-foot thick layer of clean cover soils would be placed over the amended underlying soils, graded and revegetated. Because the streamside tailings are mixed with alluvium, the minimum depth of removal is assumed to be six inches, and six inches of clean cover soil will be required to replace the remove materials. All areas where wastes are removed would be regraded, amended and revegetated.

Based on the above discussion regarding soil amendment requirements for the various wastes at the site, the cap for the waste consolidation area would be constructed with lime amended wastes from WR-1, WR-2, lime amended underlying soils, and clean cover soils. Although the underlying soils show low pH and elevated metals concentrations, the lime requirement is expected to be relatively low; the low pH and elevated metals concentrations are the result of downward leaching from the waste rock above the soils and the underlying soils would be expected to have low inherent acid-generating potential. The amended underlying soils would likely be suitable for establishing vegetation. Sampling of these soils for agronomic and acid-generating potential would be necessary prior to design. Amendment of the tailings for use as cover soil for revegetation was also considered, but was determined to be too costly because of the high lime application rate (average 265 TPA) which would be required to successfully establish vegetation in the tailings.

Under this scenario WR-7, WR-8 and the tailings would be excavated and consolidated with WR-4 and recontoured. WR-1 and WR-2 would then be excavated and placed over the other consolidated wastes and the upper 12 inches would be amended with lime. Next, the contaminated underlying soils from WR-2, WR-7 and WR-8 would be excavated, placed in an approximately one-foot thick layer over the consolidation area, and amended with lime, fertilizer and organic matter to provide a suitable rooting medium. Finally, a one-foot thick layer of clean cover soils would be placed, grading completed, and vegetation would be established.

The remaining waste rock dumps (WR-3, WR-5, WR-6, WR-9 and WR-10) will be recontoured and reclaimed in place. Based on the discussion above, these dumps would be reclaimed by placing a four-inch thick crushed limestone capillary barrier over recontoured surface, capping with two feet of cover soil, and revegetation.

All waste sources would be graded to a maximum 3:1 slope to minimize potential for erosion and to allow cover soil placement, incorporation of lime and amendments, and seeding to be accomplished with conventional equipment. Lime would be applied to the waste rock dumps using conventional agricultural techniques (plowing) or deep-incorporation techniques as appropriate.

Removal of wastes from near the creek will alter the current channel morphology and stream channel reconstruction will be needed. Areas where contaminated underlying soils are removed will be backfilled with clean fill and recontoured to restore the floodplain. The natural stream channel may have been altered by WR-2 and may need to be restored to provide a stable channel in the vicinity of WR-1, WR-2, and WR-8. Removal of the streamside tailings may significantly alter the channel cross-section and change the bank-full capacity of the stream. Areas where streamside tailings are removed would need to be backfilled with clean materials and revegetated to stabilize the stream channel.

Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of the disturbed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the reclaimed materials with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism.

Physical hazards (high walls, adits/portals, and shafts) would be mitigated as a portion of the reclamation as described in Section 7.3 previously.

The following assumptions were used to develop costs directly and to calculate associated costs for this alternative:

- The cost of road access improvements to the site is approximately $10,500 per mile for 5.5 miles.

- The total cost for materials and construction of the surface water diversion structure used to divert the creek is assumed to be $5,000.

- Approximately 1,100 feet of stream channel will require reconstruction at a cost of $35 per foot.

- The lime requirements for the waste rock/underlying soil cap are based on the lime requirements for WR-1 of 23 TPA (based on one foot depth).

- The total volume of wastes (waste rock tailings and underlying soils) to be removed and consolidated is approximately 38,490 cy.

- The final recontoured surface area of the consolidated waste disposal area is 2.0 acres.

- Two feet of cover soil would be used to cover the remaining waste piles. The recontoured surface area of the remaining waste rock dumps is approximately 2.5 acres.

- The total volume of clean soils to be imported as cover soils and to replace removed underlying soils is approximately 20,360 LCY.

- The area of the tailings to be removed which will require revegetation is approximately 3.2 acres.

- The total surface area at the site requiring revegetation is approximately 18.5 acres (which includes the excavated source areas, the reclaimed consolidation area, and reclaimed temporary access roads).

- The total length of required run-on control and adit discharge diversion ditches is 5,150 linear feet.

- The total cost for removal and disposal of existing buildings and debris is estimated at $15,000.

Effectiveness - The toxicity or volume of the wastes would not be reduced under this alternative since no actual treatment of the contaminants would be conducted; however, the complete removal of WR-1, WR-2, WR-7, WR-8, TP-1, TP-2, TP-3, TP-4, TP-5 and the streamside tailings from the floodplain and containment of the other on-site sources would likely significantly decrease contaminant mobility at the site. The overall effectiveness of the containment/revegetation program would be enhanced by carefully selecting appropriate plant species that are metal tolerant and adapted to relatively high altitudes and relatively short growing seasons. Removal of WR-2 and relocating the creek channel may also significantly reduce the seepage volume at GW-2.

Implementability - This alternative is both technically and administratively feasible, although removal of the streamside tailings may be very difficult to achieve. Access to the streamside areas is limited and removal of the tailings would cause severe disruption of the vegetation currently growing in these areas. Excavation of these tailings would also alter the stream channel morphology and channel reconstruction may be needed to provide a stable creek channel during high flow events. Incorporation of cover soil, amendments, and establishing vegetation are readily implementable technologies which use conventional construction techniques. Design methods and requirements have been thoroughly tested, and the necessary construction equipment and methods are readily available and widely used. Construction methods may vary depending upon the complexity of the terrain and the required depth of amendment incorporation.

Cost Screening - The total present-worth cost for this alternative has been estimated at $1,628,000 which represents the reclamation of all waste rock present at the Park Mine site. Table D-2 (Appendix D) presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital/construction costs.

Screening Summary - Although partial removal and containment may be a feasible and cost-effective remedy for the site, this alternative has not been retained for detailed analysis because of the high costs and difficulties associated with removing the streamside tailings.

7.3.1.5 Alternative 4b (Solid Media): Partial Removal (Excluding Streamside Tailings) and In-Place Containment

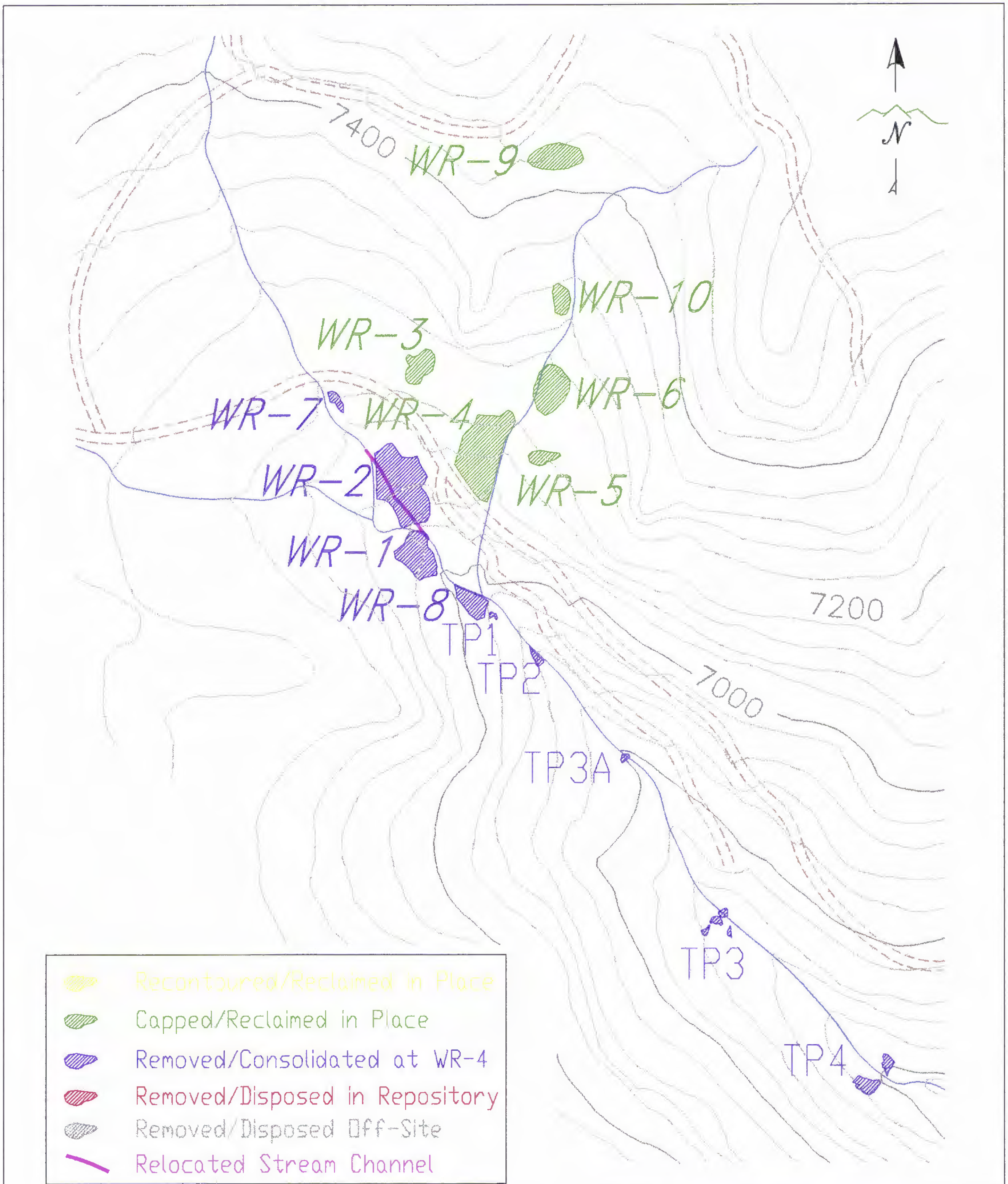
Alternative 4b is identical to Alternative 4a except that the streamside tailings would be left in place. The streamside tailings present as thin deposits on the floodplain of Indian Creek below the site are largely (>90%) vegetated. These tailings are mixed with alluvium present in the creek channel and floodplain. Because these tailings deposits are largely vegetated, segregation of the tailings from the alluvium would be difficult, and reclamation would cause severe disruption of the existing vegetation, these deposits will not be addressed under this alternative. Alternative 4b involves completely removing all other wastes which are located near Indian Creek and moving them to another location on-site. These wastes would be consolidated or contained with WR-4. Consolidation of wastes at the Park Mine site would be advantageous because it will increase the distance from the wastes to surface water. The other waste rock dumps would be recontoured and reclaimed in place.

Conceptual Design and Assumptions

For the purpose of this evaluation, the conceptual design for Alternative 4b includes removing WR-1, WR-2, WR-7, WR-8, TP-1, TP-2, TP-3, TP-4, and TP-5 from their current locations, consolidating these wastes near the current location of WR-4, and containing the consolidated waste materials by contouring, covering with soil and revegetating. Other waste sources at the site (WR-3, WR-4, WR-5, WR-6, WR-9 and WR-10) would be recontoured, covered with soil and revegetated. Various treatment strategies to be employed at each waste source under this alternative are shown on Figure 7-3.

The general construction steps for implementing Alternative 4b, as conceptualized, are as follows:

- improving road access to the site to facilitate reasonable access by heavy equipment and construction crews;
- constructing temporary surface water diversion structures and implementing construction BMPs to isolate the stream and mine water discharges while excavating wastes from the floodplain and stream channel;
- razing and disposing of any remaining dilapidated buildings/structures remaining at the site;
- totally excavating WR-1, WR-2, WR-7, WR-8, TP-1, TP-2, TP-3, TP-4, and TP-5 and transporting and consolidating the contaminated materials in the area near WR-4;
- excavating approximately one foot of contaminated underlying soils from WR-2, WR-7, WR-8, TP-1, TP-2, TP-3, TP-4, and TP-5, and transporting and consolidating the contaminated materials in the area near WR-4;
- constructing a cap over the consolidated waste area with materials from the excavation of WR-1, WR-2, the underlying soils and clean fill materials;
- stream channel reconstruction/stabilization near removed waste sources to ensure that the stream channel is stable after waste removal and reclamation have been completed;
- restoring the riparian zone in the excavated areas via revegetation;
- grading out WR-3, WR-5, WR-6, WR-9 and WR-10 to reduce slopes and provide surfaces amenable to revegetation;
- importing cover soil to apply to the waste rock areas and excavated areas;
- establishing vegetation on the covered waste rock and excavated areas;
- backfilling cuts to stabilize highwalls and recontouring the areas to control run-off;
- closing open adits by backfilling with clean, crushed limestone;



PIONEER
TECHNICAL SERVICES, INC.

FIGURE 7-3
Alternative 4b
Reclamation Scenario

SCALE: 1" = approx. 650'
DATE: 12/23/96

- closing the open shaft with a steel grate; and

- constructing surface water diversion ditches/structures throughout the site to route run-off away from the reclaimed source areas.

The current access road to the site is in poor condition and needs improvement to allow unobstructed access for the required heavy equipment and machinery. The road needs to be resurfaced, widened in some sections and turn-outs need to be constructed. Suitable road construction materials can be obtained from the Continental Lime facility located on Indian Creek Road. Roads would also be constructed in the vicinity of the waste sources at the site to allow the required heavy equipment to access, excavate and/or grade the wastes.

Run-on/run-off and groundwater control would be achieved by the design and construction of several structures. Temporary surface water diversions would be constructed and BMPs would be implemented to prevent additional sedimentation in Indian Creek from occurring while excavating WR-1, WR-2, WR-7, WR-8, TP-1, TP-2, TP-3, TP-4, and TP-5. Groundwater discharges GW-1, GW-2, and GW-4 would be diverted using interceptor ditches to direct water away from contaminated media, construction areas, and reclaimed areas. The seep at GW-BK would be directed away from the reclaimed area and allowed to infiltrate into the ground before reaching Indian Creek. Diversion channels would be constructed to divert run-off generated upgradient from each source around the reclaimed areas and into Indian Creek.

As discussed previously in Alternative 3, the acid-producing potential of the waste rock dumps vary significantly and waste rock dumps with lime requirements greater than approximately 120 TPA can be capped with imported cover soil cheaper than vegetation can be established directly on the dump materials. Based on this analysis it was determined that WR-1, WR-2, WR-5 and WR-10 could economically be recontoured, amended with lime, fertilizer and organic material and revegetated in place. All other waste rock dumps would be recontoured, a four-inch thick crushed limestone capillary barrier placed over the recontoured surface, a two foot layer of cover soil placed, and revegetated. However, under this alternative only WR-5 and WR-10 would remain in place, and would also be reclaimed with the limestone/cover soil cap.

Under Alternative 4b, all waste sources near the creek (WR-1, WR-2, WR-7, WR-8, TP-1, TP-2, TP-3, TP-4, and TP-5) would be removed and consolidated near WR-4. Approximately one foot of contaminated underlying soils would also be removed from under WR-2, WR-7 (assumed, needs to be sampled prior to design), WR-8 and the tailings. The remaining contaminated underlying soils would remain in place and would be amended with lime to adjust the pH and to stabilize the metals. A one-foot layer of clean cover soils would be placed over the amended underlying soils, graded and revegetated. All other areas where wastes are removed would be regraded, amended and revegetated. Clean cover soils would be placed as needed to complete recontouring.

Based on the above discussion regarding soil amendment requirements for the various wastes at the site, the cap for the waste consolidation area would be constructed with lime amended wastes from WR-1 and WR-2, lime amended underlying soils, and clean cover soils. Although the underlying soils show low pH and elevated metals concentrations, the lime requirement is expected to be relatively low; the low pH and elevated metals concentrations are the result of downward leaching from the waste rock above the soils and the underlying soils would be expected to have low inherent acid-generating potential. The amended underlying soils would likely be suitable for establishing vegetation. Sampling of these soils for agronomic and acid-generating potential would be necessary prior to design. Amendment of the tailings for use as cover soil for revegetation was also considered, but was determined to be too costly because of the high lime application rate (average 265 TPA) which would be required to successfully establish vegetation in the tailings.

Under this scenario WR-7, WR-8 and the tailings would be excavated and consolidated with WR-4 and recontoured. WR-1 and WR-2 would then be excavated and placed over the other consolidated wastes and the upper 12 inches would be amended with lime. Next, the contaminated underlying soils from WR-2, WR-7 and WR-8 would be excavated, placed in an approximately one-foot thick layer over the consolidation area, and amended with lime, fertilizer and organic matter to provide a suitable rooting medium. Finally, a one-foot thick layer of clean cover soils would be placed, grading completed, and vegetation would be established.

The remaining waste rock dumps (WR-3, WR-5, WR-6, WR-9 and WR-10) will be recontoured and reclaimed in place. Because of the high lime requirements these dumps would be reclaimed by placing a four-inch thick crushed limestone capillary barrier over recontoured surface, capping with two feet of cover soil, and revegetation.

All waste sources would be graded to a maximum 3:1 slope to minimize potential for erosion and to allow cover soil placement, incorporation of lime and amendments, and seeding to be accomplished with conventional equipment. Lime would be applied to the waste rock dumps using conventional agricultural techniques (plowing) or deep-incorporation techniques as appropriate.

Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of the disturbed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the reclaimed materials with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism.

Removal of wastes from near the creek will alter the current channel morphology and stream channel reconstruction will be needed. Areas where contaminated underlying soils are removed will be backfilled with clean fill and recontoured to restore the floodplain. The natural stream channel has been altered by WR-2 and may need to be restored to provide a stable channel in the vicinity WR-1, WR-2, and WR-8.

Physical hazards (high walls, adits/portals, and shafts) would be mitigated as a portion of the reclamation as described in Section 7.3 previously.

The following assumptions were used to develop costs directly and to calculate associated costs for this alternative:

- The cost of road access improvements to the site is approximately $10,500 per mile for 5.5 miles.

- The total cost for materials and construction of the surface water diversion structure used to divert the creek is assumed to be $15,000.

- Approximately 1,100 feet of stream channel will require reconstruction at a cost of $35 per foot.

- The lime requirements for the waste rock/underlying soil cap are based on the lime requirements for WR-1 of 23 TPA (based on one foot depth).

- The total volume of wastes (waste rock tailings and underlying soils) to be removed and consolidated is approximately 35,030 cy.

- The final recontoured surface area of the consolidated waste disposal area is 2.0 acres.

- Two feet of cover soil would be used to cover the remaining waste piles. The recontoured surface area of the remaining waste rock dumps is approximately 3.4 acres.

- The total volume of clean soils to be imported as cover soils and to replace removed underlying soils is approximately 18,630 LCY.

- The area of the tailings to be removed which will require revegetation is approximately 0.5 acre.

- The total surface area at the site requiring revegetation is approximately 18.5 acres (which includes the excavated source areas, reclaimed areas where wastes were contained in place, and the reclaimed temporary access roads).

- The total length of required run-on control and adit discharge diversion ditches is 5,500 linear feet.

- The total cost for removal and disposal of existing buildings and debris is estimated at $15,000.

Effectiveness - The toxicity or volume of the wastes would not be reduced under this alternative since no actual treatment of the contaminants would be conducted; however, the complete removal of WR-1, WR-2, WR-7, WR-8, TP-1, TP-2, TP-3, TP-4, and TP-5 from the floodplain and containment of the other on-site sources would likely significantly decrease contaminant mobility at the site. The overall effectiveness of the containment/revegetation program would be enhanced by carefully selecting appropriate plant species that are metal tolerant and adapted to relatively high altitudes and relatively short growing seasons.

Implementability - This alternative is both technically and administratively feasible. Incorporation of cover soil, amendments, and establishing vegetation are readily implementable technologies which use conventional construction techniques. Design methods and requirements have been thoroughly tested, and the necessary construction equipment and methods are readily available and widely used. Construction methods may vary depending upon the complexity of the terrain and the required depth of amendment incorporation.

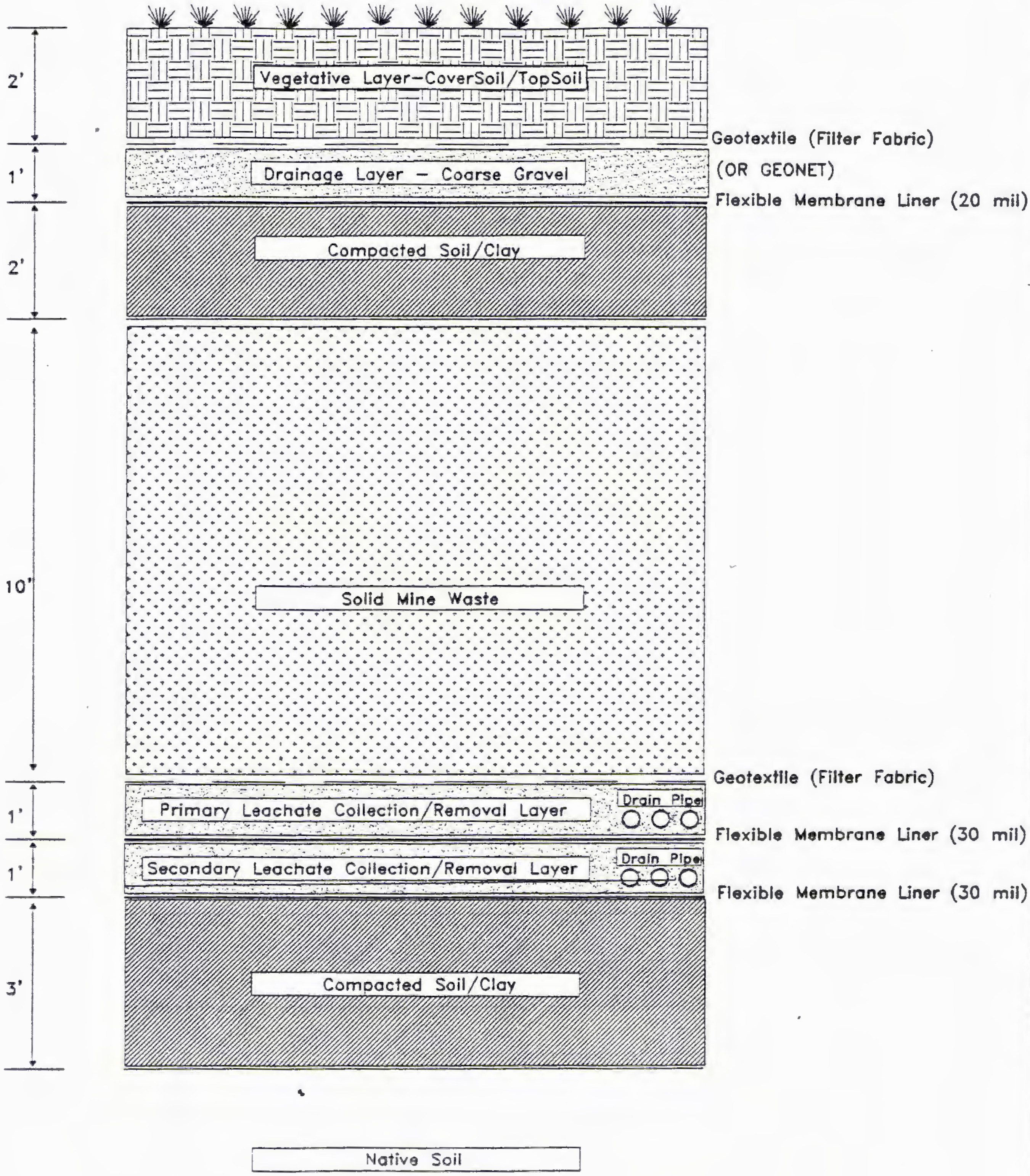
Cost Screening - The total present-worth cost for this alternative has been estimated at $1,380,000 which represents the reclamation of all waste rock present at the Park Mine site. Table D-3 (Appendix D) presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital/construction costs.

Screening Summary - This alternative has been retained for detailed analysis since partial removal and containment may be a feasible and cost-effective remedy for the site.

7.3.1.6 Alternative 5a (Solid Media): Partial Removal/Disposal of Solid Media On-Site in a Constructed RCRA Subtitle C Repository, and Partial In-Place Containment

The remedial strategy for Alternative 5a involves removing or relocating the solid media contaminant sources at the Park site which exhibit the highest environmental risks. This alternative was developed to address varied waste characteristics and conditions present at the site. Samples of WR-3, WR-8, WR-10, TP-3 and TP-4 collected during the 1996 RI exceeded RCRA TCLP standards for lead (TP-3 also exceeded the TCLP standard for arsenic). In this alternative all tailings materials and all wastes which exceeded the TCLP standards would be removed from their present location and disposed in a RCRA Subtitle C repository constructed on-site. A typical cross-section for a RCRA Subtitle C Repository is presented in Figure 7-4. The remaining waste rock dumps located close to Indian Creek (WR-1, WR-2, and WR-7) would be removed from their locations near Indian Creek, consolidated with other waste rock at the site near WR-4, and contained with the other wastes. All other waste sources at the site (WR-5, WR-6, and WR-9) would be recontoured and reclaimed in place.

Three possible locations for the on-site repository were considered: one near the present location of WR-4, one near the present location of the "reservoir", and one near the Bullion King Mine upper dumps. These locations were considered for several reasons including: they are relatively flat, they are generally clear of trees and fallen timber, they contain no visible seepage or discharges, they are not located in a major drainage, and they have been previously disturbed by



PIONEER TECHNICAL SERVICES, INC.

FIGURE 7-4
ALTERNATIVE 5a
RCRA SUBTITLE C
REPOSITORY, CROSS SECTION

SCALE: N/A
DATE: 2/96

REP4A.DWG

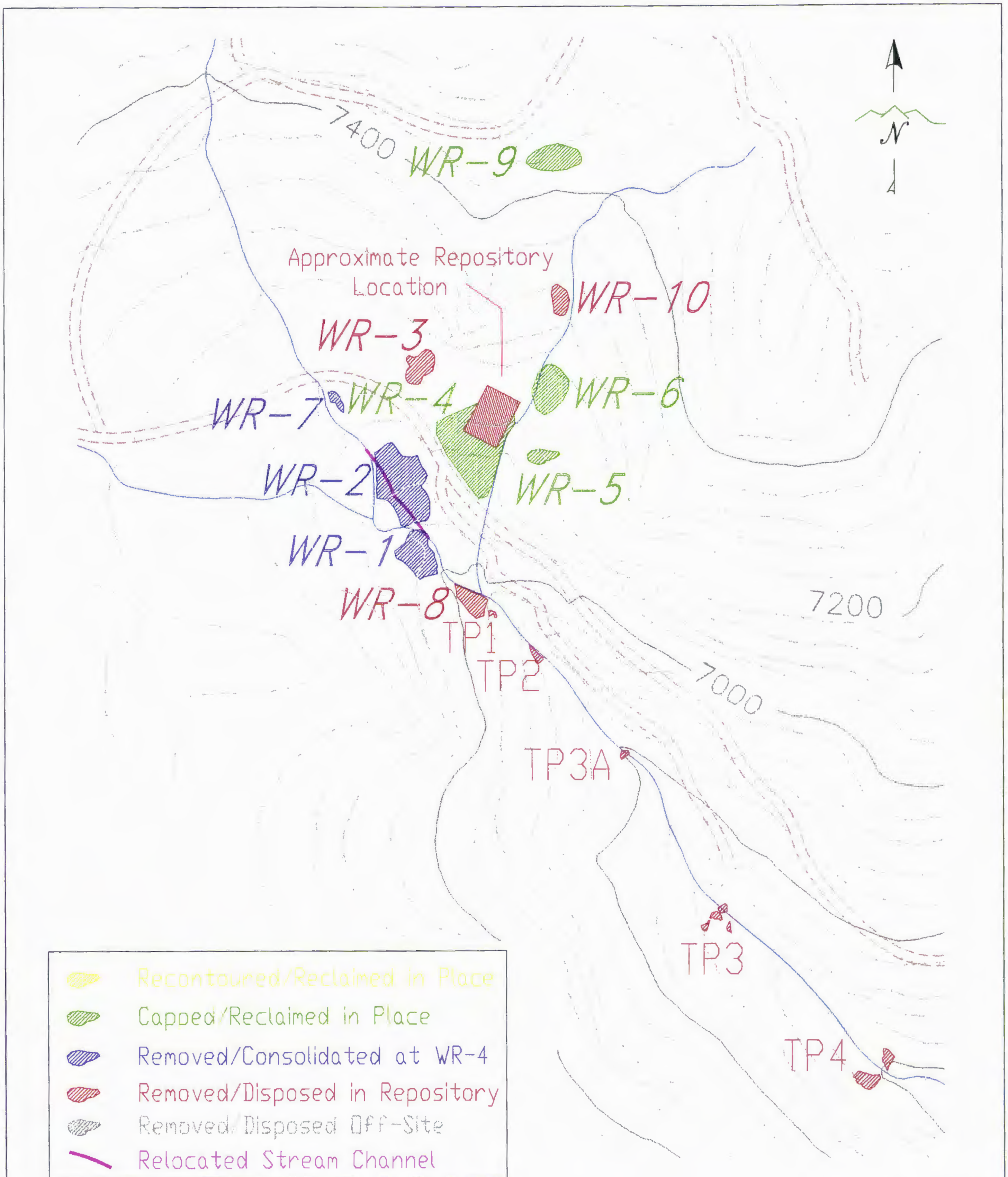
mining/human activities. However, constructing a repository with an approximately 16,500 cy capacity anywhere on-site will be difficult and will most likely require disturbing previously undisturbed land on the site. This is due primarily to the steep slopes and shallow groundwater present throughout the site.

The vicinity of WR-4 was considered the primary potential repository site. One test pit was dug near WR-4 during the Reclamation Investigation to identify subsurface conditions and gather geotechnical data necessary to design a repository in this location. The test pit showed that the alluvium is shallow (approximately six feet) and that some mining-related fill is present in the area. Groundwater occurs at a very shallow depth in all locations, and is generally near the surface throughout the property. Sufficient data to design the repository in this area are currently available. However, the space in this location is limited and would be further limited by consolidation of other wastes in this area. Construction of a repository in this location may require particular care in engineering design and construction.

Location of a repository at the reservoir site was also considered. The area is generally flat and soil conditions appear to be amenable to constructing a repository in this location. General soil data for this area were available from soil pits dug near the reservoir in the meadows above the site. These test pits showed that groundwater is present at depths ranging from 0.5 to 6 feet bgs and the bottom of the repository would be below the natural groundwater level. Because of this difficulty, a groundwater interception trench would be required upgradient from the repository to lower the water table below the bottom of the lowest point in the repository. As a result, the bottom of the repository would be very close to the water table. No data regarding seasonal or historic fluctuations in groundwater elevation in the vicinity of the reservoir site are available. Additional geotechnical data would be required to design a repository in this area. Further, the long-term effectiveness of the groundwater interception trench is questionable and may in turn affect the long-term effectiveness of the repository design.

Location of a repository near the Upper Bullion King dumps was also considered. The area is generally flat and the area could be suitable for constructing a repository. No soil or groundwater data were available for this area. Test pits dug in the meadows above the Park Mine site showed that groundwater is present at depths ranging from 0.5 to 6 feet bgs. It is unknown if these conditions are also present near the Bullion King site. Additional geotechnical data would be required to design a repository in this area. Locating the repository at the Bullion King site would involve additional road construction and would require a long, uphill haul to transport the wastes to the repository.

Comparative cost estimates for construction of repositories in each location were developed, and showed that the area near WR-4 is the most economic location for a repository. Location of the repository near WR-4 would result in all excavated wastes from the Park Mine being located in a single disposal/consolidation area. The vicinity of WR-4 is the preferred location for constructing an on-site repository because adequate geotechnical data are available, all excavated wastes would be located in one area, and this location is the lowest cost alternative. The approximate location of the repository is shown on Figure 7-5.



PIONEER TECHNICAL SERVICES, INC.

FIGURE 7-5
Alternative 5a
Reclamation Scenario

SCALE: 1" = approx. 650'
DATE: 12/23/96

Conceptual Design and Assumptions

For the purpose of this evaluation, the conceptual design for Alternative 5a includes removing WR-3, WR-8, WR-10, TP-1, TP-2, TP-3, TP-4 and TP-5 from their current locations and disposing the wastes in RCRA Subtitle C repository near WR-4, removing WR-1, WR-2, and WR-7 from their current locations near Indian Creek and consolidating the wastes near WR-4, and recontouring and reclaiming in place all other waste sources at the site (WR-5, WR-6, WR-9). Various treatment strategies to be employed at each waste source under this alternative are shown on Figure 7-5.

Based on the available data and the above considerations, the conceptual design of Alternative 5a includes:

- improving road access to the site to facilitate reasonable access by heavy equipment and construction crews;
- constructing temporary surface water diversion structures and implementing construction BMPs to isolate the stream and mine water discharges while excavating wastes from the floodplain and stream channel;
- razing and disposing of any remaining dilapidated buildings/structures remaining at the site;
- totally excavating WR-1, WR-2, WR-7, from their present locations, transporting to the area near WR-4, and building the repository foundation from these wastes;
- totally excavating WR-3, WR-8, WR-10, TP-1, TP-2, TP-3, TP-4 and TP-5 from their present locations, and transporting and disposing of these contaminated materials in the repository;
- excavating approximately one foot of contaminated underlying soils from WR-2, WR-3, WR-7, WR-8, WR-10, TP-1, TP-2, TP-3, TP-4, and TP-5, and stockpiling the soils for use as cover soils;
- building the repository floor from materials from excavation of WR-1. WR-2 and WR-7 and finish grading 1.1 acres of the repository floor;
- installing a multi-layer bottom liner and leachate collection system that meets RCRA Subtitle C criteria;
- hauling, placing, and compacting the excavated waste rock and tailings in the repository;
- installing a multi-layer cap over the repository that meets RCRA Subtitle C criteria;

- grading out the remaining waste rock dumps (WR-5, WR-6, and WR-9) to reduce slopes and provide surfaces amenable to revegetation;

- constructing a cap over the consolidated waste area (excluding the repository) and regraded dumps with amended underlying soils and clean cover soils;

- backfilling, grading and amending disturbed areas to provide surfaces amenable to amendment application and revegetation;

- revegetating disturbed areas including the repository cap, areas from which wastes have been removed, and other solid media to be contained in place;

- stream channel reconstruction/stabilization near removed waste sources to ensure that the stream channel is stable after waste removal and reclamation have been completed;

- restoring the riparian zone in the excavated areas via revegetation;

- backfilling cuts to stabilize highwalls and recontouring the areas to control run-off;

- closing open adits by backfilling with clean, crushed limestone;

- closing the open shaft with a steel grate;

- importing cover soil to apply to reclaimed waste rock dumps, repository cap and excavated areas; and

- constructing surface water diversion ditches/structures throughout the site to route run-off away from the reclaimed source areas.

The current access road to the site is in poor condition and needs improvement to allow unobstructed access for the required heavy equipment and machinery. The road needs to be resurfaced, widened in some sections and turn-outs need to be constructed. A considerable amount of heavy equipment/machinery would be necessary to efficiently implement this alternative. To construct the repository and load out the contaminated material, as well as construct run-on/run-off control structures, equipment requirements may include bulldozers, front-end loaders, excavators, and scrapers. Haul trucks or a conveyor system would also be required to transport and deposit the contaminated material in the repository. The field procedures would involve constructing suitable access roads (and possible turnout points) between the waste sources and the repository site to allow unobstructed access for heavy equipment. Suitable road construction materials can be obtained from the Continental Lime facility located on Indian Creek Road. Roads would also be constructed in the vicinity of the waste sources at the site to allow the required heavy equipment to access, excavate and/or grade the wastes.

Run-on/run-off and groundwater control would be achieved by the design and construction of several structures. Temporary surface water diversions would be constructed and BMPs would be implemented to prevent additional sedimentation in Indian Creek from occurring while excavating WR-1, WR-2, WR-7, WR-8, TP-1, TP-2, TP-3, TP-4, and TP-5. Groundwater discharges GW-1, GW-2, and GW-4 would be diverted using interceptor ditches to direct water away from contaminated media, construction areas, and reclaimed areas. The seep at GW-BK would be directed away from the reclaimed area and allowed to infiltrate into the ground before reaching Indian Creek. Diversion channels would be constructed to divert run-off generated upgradient from each source around the reclaimed areas and into Indian Creek.

Under Alternative 5a, WR-1, WR-2, and WR-7 would be removed and consolidated near WR-4. The materials would be placed, compacted and graded to form the repository floor. The depth to groundwater in the vicinity of the waste consolidation area is approximately 6 feet. Placement of these waste materials will increase the depth to groundwater below the repository. The bottom liner and leachate collection system would then be installed. The wastes to be placed in the repository would then be excavated, hauled to, and deposited in the repository.

WR-3, WR-8, WR-10, TP-3, and TP-4 failed the TCLP test for lead (TP-3 also failed for arsenic) and would be excavated from their present locations, and transported and disposed in the repository. Because of the physical characteristics of tailings TP-1, TP-2 and TP-5 would also be disposed in the repository. A total of approximately 15,000 bank cy of tailings and waste rock are to be placed in the repository. The wastes present at the site are generally unconsolidated and some volume reduction may be achieved when the materials are compacted in the repository. However, because of the possible need for over-excavation of waste sources, it is assumed that the capacity of the repository must be at least 16,500 cy. After all designated wastes have been placed in the repository, the cap would be installed. This would include the placement of cover soils and establishing a vegetative stand on the repository cap.

The repository would comprise roughly 1.1 acres of the waste consolidation area. The repository would consist of a composite, double-lined leachate collection and removal system underlying the waste in conjunction with a composite, multi-layered, lined cap overlying the waste, as shown on Figure 7-4. Run-on/run-off control would be constructed as an integral part of the repository design.

Preliminary analyses show that the materials to be placed in the repository should have adequate strength to place them at a finish slope of 4:1, if the materials are compacted adequately (i.e., 95% of their standard Proctor density). Detailed analysis of slope stability, including conducting triaxial shear tests with the materials, will be necessary for design purposes if this alternative is implemented. If necessary, geosynthetics (geogrids) could be used to improve slope stability if the detailed analysis shows the materials may be prone to slope failure.

Approximately one foot of contaminated underlying soils would also be removed from under WR-2, WR-3, WR-7 (assumed, needs to be sampled prior to implementation), WR-8, WR-10, TP-1, TP-2, TP-3, TP-4 and TP-5. The underlying soils would be stockpiled and used as a portion of the cover soils used to cap the waste rock dumps to be reclaimed in place and for reclamation of the cut areas as described below. The remaining contaminated underlying soils would be left in place and would be amended with lime to adjust the pH and to stabilize the metals. A one-foot thick layer of clean cover soils would be placed over the amended underlying soils, graded to reduce slopes and eliminate depressions (to promote positive drainage), and revegetated. All other areas where wastes are removed would be regraded, amended as needed, and revegetated.

As discussed previously in Alternative 3, the acid-producing potential of the waste rock dumps varies significantly, and waste rock dumps with lime requirements greater than approximately 120 TPA can be capped with imported cover soil cheaper than vegetation can be established directly on the dump materials. Based on these assumptions it was determined that WR-1, WR-2, WR-5 and WR-10 could economically be recontoured, amended with lime, fertilizer and organic material and revegetated in place. All other waste rock dumps would be recontoured, a four-inch thick crushed limestone capillary barrier placed over the recontoured surface, a two foot layer of cover soil placed, and revegetated. Under this alternative WR-1, WR-2, and WR-10 would be excavated from their current locations, and, therefore, all other waste dumps which are reclaimed in place (WR-5, WR-6 and WR-9) would be reclaimed with the limestone/cover soil cap.

Based on the above discussion, the remaining waste rock dumps (WR-5, WR-6, and WR-9) will be recontoured and reclaimed in place. The dumps would be graded to a maximum 3:1 slope to minimize potential for erosion and to allow cover soil placement, incorporation of lime and amendments, and seeding to be accomplished with conventional equipment. These dumps would be reclaimed by placing a four-inch thick crushed limestone capillary barrier over recontoured surface, capping with two feet of cover soil, and revegetation. The two feet of cover soils would consist of approximately one foot of lime amended underlying soils from the stockpile and one foot of imported clean cover soils. (**Note**: it is not possible to use underlying soils on the repository cap because of the potential for damaging the cap during amendment). Although the underlying soils show low pH and elevated metals concentrations, the lime requirement is expected to be relatively low; the low pH and elevated metals concentrations are the result of downward leaching from the waste rock above the soils and the underlying soils are expected to have low inherent acid-generating potential. The amended underlying soils would likely be suitable for establishing vegetation. Sampling of these soils for agronomic properties and acid-generating potential would be necessary prior to implementation. Lime, fertilizer and amendments would be applied to the soils using conventional agricultural techniques (plowing).

Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of the disturbed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the reclaimed materials with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism.

Removal of wastes from near the creek will alter the current channel morphology and stream channel reconstruction will be needed. Areas where contaminated underlying soils are removed will be backfilled with clean fill and recontoured to restore the floodplain. The natural stream meander corridor may have been altered by WR-2 and may need to be restored to provide a stable channel in the vicinity WR-1, WR-2, and WR-8.

Physical hazards (high walls, adits/portals, and shafts) would be mitigated as a portion of the reclamation as described in Section 7.3 previously.

The following assumptions were used to develop costs directly and to calculate associated costs for this alternative:

- The cost of road access improvements to the site is approximately $10,500 per mile for 5.5 miles.

- The total cost for materials and construction of the surface water diversion structure used to divert the creek is assumed to be $15,000.

- The total cost for materials and construction of the surface water diversion structure used to divert the creek is assumed to be $5,000.

- Approximately 1,100 feet of stream channel will require reconstruction at a cost of $35 per foot.

- The total volume of wastes (waste rock, tailings and underlying soils) to be removed and consolidated is approximately 22,600 cy.

- The total volume of waste material to be excavated and disposed in the repository is approximately 16,500 cy.

- Bottom Liner--A three-foot layer of clay material meeting the specified hydraulic conductivity requirement for the bottom liner would be installed for the bottom liner. This compacted base layer would be installed in estimated 6-inch compacted lifts. The side slopes of the repository would be 3:1 maximum. A 30-mil-thick, HDPE flexible membrane liner would overlay the compacted base.

- Secondary Leachate Collection/Removal Layer--A one-foot-thick layer of washed, coarse gravel would overlay the bottom liner. PVC drain pipes would be installed in conjunction with the coarse gravel layer for leachate collection/removal. A 30-mil thick, HDPE flexible membrane liner would overlay the secondary coarse gravel layer.

- Primary Leachate Collection/Removal Layer--A one-foot-thick layer of washed, coarse gravel would overlay the secondary leachate collection/removal layer. PVC drain pipes would be installed in conjunction with the coarse gravel layer for leachate collection/removal. A geotextile filter fabric layer (to prevent potential clogging of the coarse gravel) would overlay the primary coarse gravel layer.

Note: To increase space for waste disposal (and possibly reduce construction costs), synthetic drainage layers (geonets) can be used in lieu of granular drainage layers in constructing the repository.

- Soil Cover--A compacted layer of imported clay meeting the hydraulic conductivity and thickness specifications would be installed over the wastes as part of the cap. This material would be applied and compacted in 6-inch compacted lifts. A 20-mil thick, HDPE flexible membrane liner would overlay the compacted soil layer.

- Drainage Layer--A one-foot lift of washed, coarse gravel would overlay the HDPE and compacted clay layers. A geotextile filter fabric layer (to prevent potential clogging of the coarse gravel) would overlay the coarse gravel drainage layer. A geonet could be used in place of the gravel drainage layer.

- Vegetative Cover--A two-feet-thick layer of cover soil would overlay the cap drainage layer. Cover soils would be imported from off-site at an estimated cost of $14 per cubic yard delivered to the site.

- The total surface area at the site requiring revegetation is approximately 19.2 acres (which includes the excavated source areas, reclaimed areas where wastes were contained in place, reclaimed temporary access roads, and the repository cap).

- The lime requirements for the waste rock/underlying soil cap are based on the lime requirements for WR-1 of 23 TPA (based on one foot depth).

- The final recontoured surface area of the consolidated waste disposal area is 2.0 acres.

- Two feet of cover soil would be used to cover the remaining waste piles. The recontoured surface area of the remaining waste rock dumps is approximately 2.5 acres.

- The total volume of clean soils to be imported as cover soils and to replace removed underlying soils is approximately 21,060 LCY.

- The area of the tailings to be removed which will require revegetation is approximately 0.5 acre.

- The total length of required run-on control and adit discharge diversion ditches is 5,650 linear feet.

- The total cost for removal and disposal of existing buildings and debris is estimated at $15,000.

Other quantity estimates are included with the cost estimate, discussed below.

Effectiveness - This alternative would effectively reduce solid media contaminant mobility at the site by removing the highest risk solid media contaminant sources and disposing of the waste in a secure disposal facility. Consequently, the surface water erosion problems associated with the site are expected to be corrected. Contaminant toxicity and volume would not be reduced; however, the waste would be rendered immobile in a structure and physical location protected from erosion problems. Long-term monitoring and control programs would be established to ensure continued effectiveness.

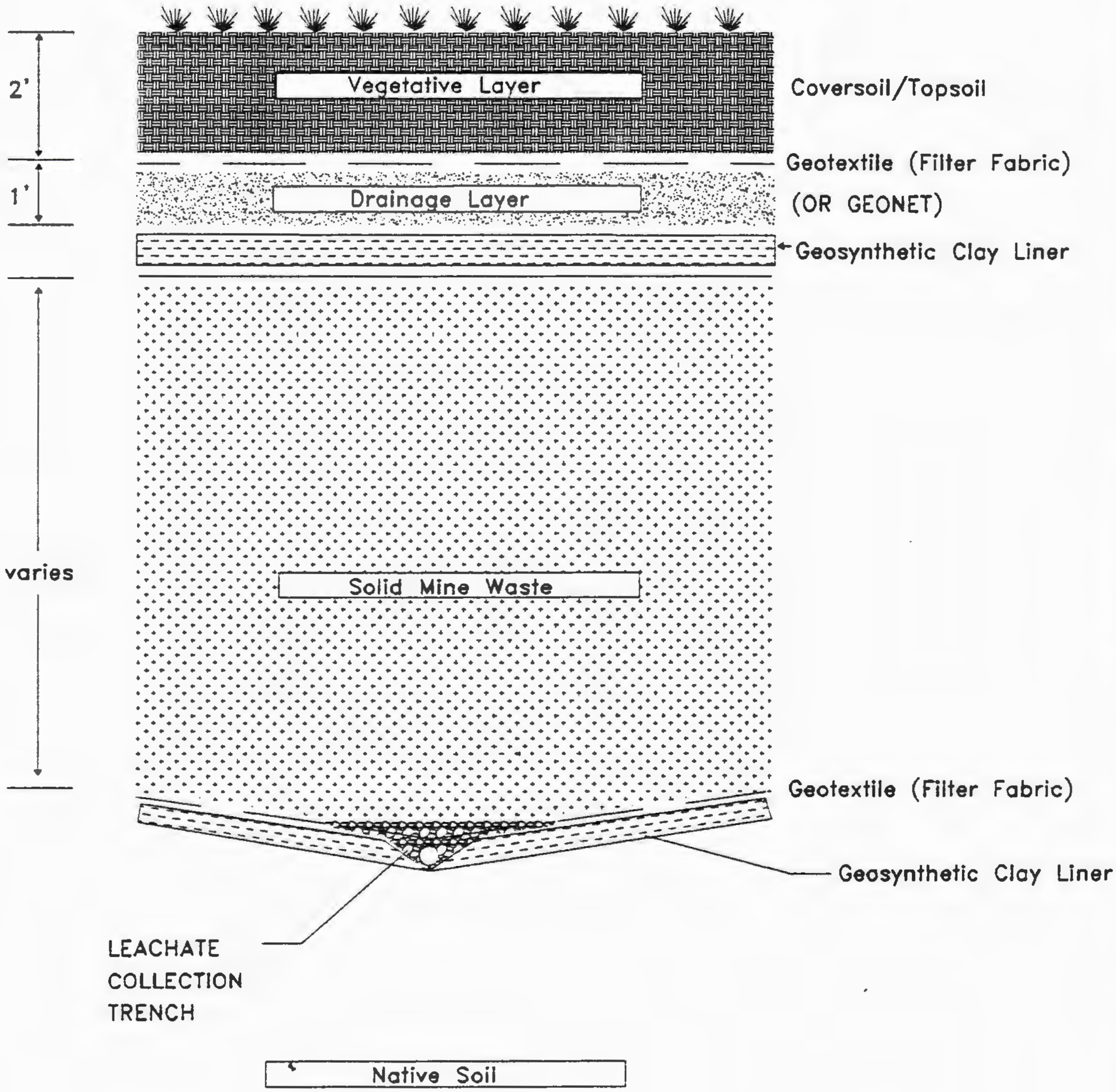
Implementability - This alternative is administratively feasible, but may be technically difficult to implement. The construction steps required are considered standard/conventional construction practices. Key project components, such as the availability of equipment, materials, and construction expertise, are all present. However, locating a nearby source of clay material which satisfies the hydraulic conductivity specifications for the repository liner and cap may be difficult. Furthermore, constructing a repository with the required capacity will be difficult (given the steep terrain and shallow depth to groundwater throughout the site) and would impact previously undisturbed land.

Cost Screening - The total present-worth cost for this alternative has been estimated at $1,818,000 which represents the remediation of all solid media contaminant sources present at the Park site (tailings, and waste rock). The cost details associated with implementing this alternative are included in Table D-4 (Appendix D). The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

Screening Summary - This alterative has not been retained for detailed analysis. Implementability may be hampered because of difficulty acquiring clays that meet hydraulic conductivity specifications. Other alternatives are expected to provide comparable effectiveness at much lower costs. Also, the wastes at the site are excluded from RCRA Subtitle C regulations by the Bevill Amendment. Therefore, a repository that fully complies with EPA's Minimum Technology Guidance for hazardous waste disposal facilities is not necessary to comply with ARARs.

7.3.1.7 Alternative 5b (Solid Media): Partial Removal/Disposal of Solid Media On-Site in a Modified RCRA Repository and Partial In-Place Containment

This alternative is the same as Alternative 5a discussed previously with the exception of the repository design. Instead of a repository that fully satisfies RCRA Subtitle C criteria, a modified repository design would be used. The modified RCRA Subtitle C repository consists of a single liner and leachate collection system and a low permeability cap. A typical cross-section of the Alternative 5b repository is shown on Figure 7-6. As with Alternative 5a, the repository would



PIONEER TECHNICAL SERVICES, INC.

FIGURE 7-6
ALTERNATIVE 5b
MODIFIED RCRA REPOSITORY
CROSS SECTION

SCALE: N/A
DATE: 1/97

REP48.DWG

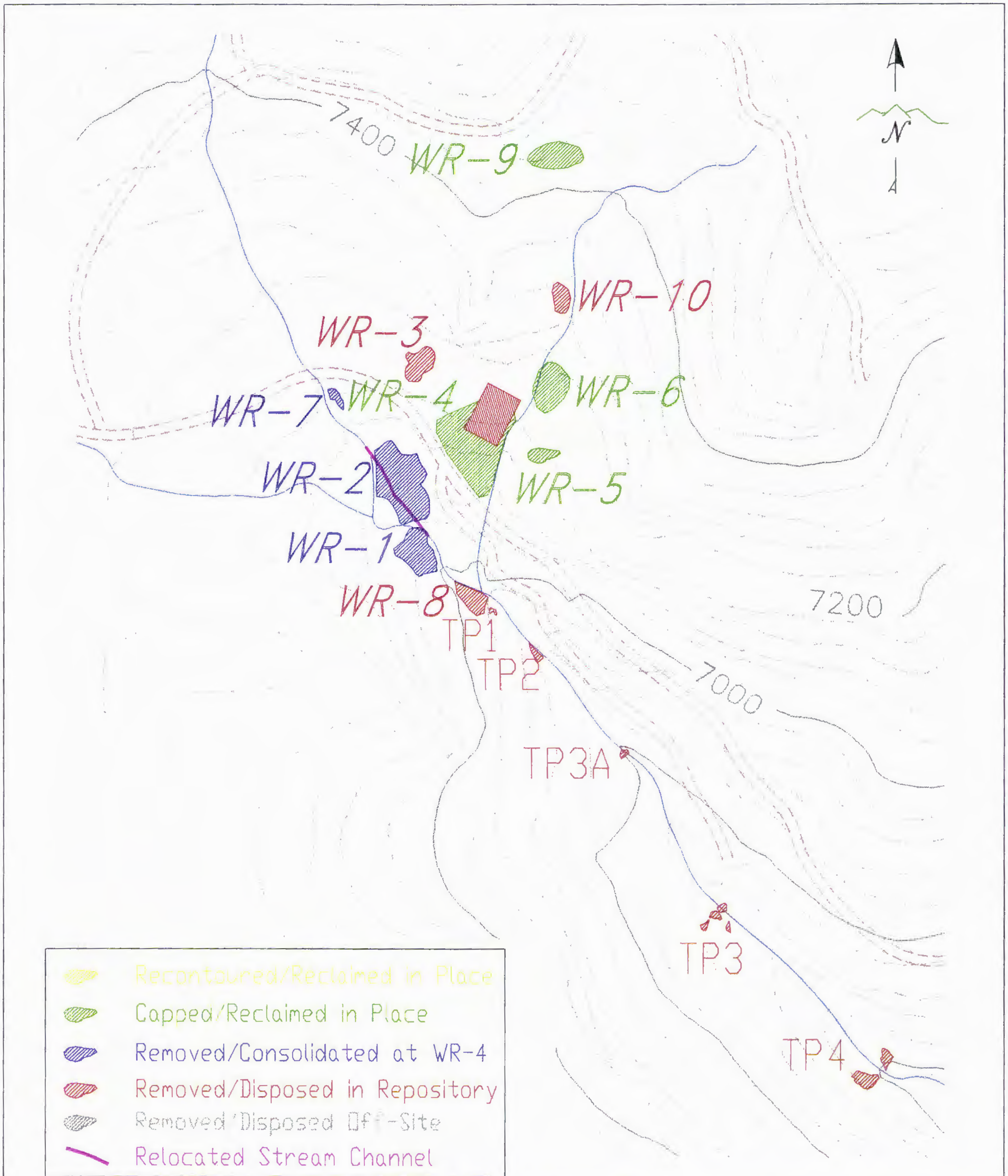
be located in the vicinity of the reservoir site, cover approximately 1.1 acre, and contain 16,500 cy of wastes. The location of the consolidated wastes would be the same as for Alternative 4a.

Conceptual Design and Assumptions

For the purpose of this evaluation, the conceptual design for Alternative 5b includes removing WR-3, WR-8, WR-10, TP-1, TP-2, TP-3, TP-4 and TP-5 from their current locations and disposing the wastes in modified RCRA Subtitle C repository near WR-4, removing WR-1, WR-2, and WR-7 from their locations near Indian Creek and consolidating the wastes near WR-4, and recontouring and reclaiming in place all other waste sources at the site (WR-5, WR-6, WR-9). Various treatment strategies to be employed at each waste source under this alterative are shown on Figure 7-7.

Based on the available data and the above considerations, the conceptual design of Alternative 5b includes:

- improving road access to the site to facilitate reasonable access by heavy equipment and construction crews;
- constructing temporary surface water diversion structures and implementing construction BMPs to isolate the stream and mine water discharges while excavating wastes from the floodplain and stream channel;
- razing and disposing of any remaining dilapidated buildings/structures remaining at the site;
- totally excavating WR-1, WR-2, WR-7, from their present locations, transporting to the area near WR-4, and building the repository foundation from these wastes;
- totally excavating WR-3, WR-8, WR-10, TP-1. TP-2, TP-3, TP-4 and TP-5 from their present locations, and transporting and disposing of these contaminated materials in the repository;
- excavating approximately one foot of contaminated underlying soils from WR-2, WR-3, WR-7, WR-8, WR-10, TP-1, TP-2, TP-3, TP-4, and TP-5, and stockpiling the soils for use as cover soils;
- building the repository floor from materials from excavation of WR-1. WR-2 and WR-7 and finish grading 1.1 acres of the repository floor;
- installing a geosynthetic clay liner (GCL) bottom liner and leachate collection system similar to that shown on Figure 7-6;



PIONEER TECHNICAL SERVICES, INC.

FIGURE 7-7
Alternative 5b
Reclamation Scenario

SCALE: 1" = approx. 650'
DATE: 12/23/96

- hauling, placing, and compacting the excavated waste rock and tailings in the repository;
- installing a GCL, geo-composite and native soil cap over the repository (as shown on Figure 7-6);
- grading out the remaining waste rock dumps (WR-5, WR-6, and WR-9) to reduce slopes and provide surfaces amenable to revegetation;
- constructing a cap over the consolidated waste area (excluding the repository) and regraded dumps with amended underlying soils and clean cover soils;
- backfilling, grading and amending disturbed areas to provide surfaces amenable to amendment application and revegetation;
- revegetating disturbed areas including the repository cap, areas from which wastes have been removed, and other solid media to be contained in place;
- stream channel reconstruction/stabilization near removed waste sources to ensure that the stream channel is stable after waste removal and reclamation have been completed;
- restoring the riparian zone in the excavated areas via revegetation;
- backfilling cuts to stabilize highwalls and recontouring the areas to control run-off;
- closing open adits by backfilling with clean, crushed limestone;
- closing the open shaft with a steel grate;
- importing cover soil to apply to reclaimed waste rock dumps, repository cap and excavated areas; and
- constructing surface water diversion ditches/structures throughout the site to route run-off away from the reclaimed source areas.

The current access road to the site is in poor condition and needs improvement to allow unobstructed access for the required heavy equipment and machinery. The road needs to be resurfaced, widened in some sections and turn-outs need to be constructed. A considerable amount of heavy equipment/machinery would be necessary to efficiently implement this alternative. To construct the repository and load out the contaminated material, as well as construct run-on/run-off control structures, equipment requirements may include bulldozers, front-end loaders, excavators, and scrapers. Haul trucks or a conveyor system would also be required to transport and deposit the contaminated material in the repository. The field procedures would involve constructing suitable access roads (and possible turnout points) between the waste sources and the repository site to allow unobstructed access for heavy equipment. Suitable road construction materials can be obtained from the Continental Lime facility located on Indian Creek Road. Roads would also be constructed in the vicinity of the waste sources at the site to allow the required heavy equipment to access, excavate and/or grade the wastes.

Run-on/run-off and groundwater control would be achieved by the design and construction of several structures. Temporary surface water diversions would be constructed and BMPs would be implemented to prevent additional sedimentation in Indian Creek from occurring while excavating WR-1, WR-2, WR-7, WR-8, TP-1, TP-2, TP-3, TP-4, and TP-5. Groundwater discharges GW-1, GW-2, and GW-4 would be diverted using interceptor ditches to direct water away from contaminated media, construction areas, and reclaimed areas. The seep at GW-BK would be directed away from the reclaimed area and allowed to infiltrate into the ground before reaching Indian Creek. Diversion channels would be constructed to divert run-off generated upgradient from each source around the reclaimed areas and into Indian Creek.

Under Alternative 5a, WR-1, WR-2, and WR-7 would be removed and consolidated near WR-4. The materials would be placed, compacted and graded to form the repository floor. The depth to groundwater in the vicinity of the waste consolidation area is approximately 6 feet. Placement of these waste materials will increase the depth to groundwater below the repository. The bottom liner and leachate collection system would then be installed. The wastes to be placed in the repository would then be excavated, hauled to, and deposited in the repository.

WR-3, WR-8, WR-10, TP-3, and TP-4 failed the TCLP test for lead (TP-3 also failed for arsenic) and would be excavated from their present locations, and transported and disposed in the repository. Because of the physical characteristics of tailings TP-1, TP-2 and TP-5 would also be disposed in the repository. A total of approximately 15,000 bank cy of tailings and waste rock are to be placed in the repository. The wastes present at the site are generally unconsolidated and some volume reduction may be achieved when the materials are compacted in the repository. However, because of the possible need for over-excavation of waste sources, it is assumed that the capacity of the repository must be at least 16,500 cy. After all designated wastes have been placed in the repository, the cap would be installed. This would include the placement of cover soils and establishing a vegetative stand on the repository cap.

The repository would comprise roughly 1.1 acres of the waste consolidation area. The repository would consist of a composite, single-layer leachate collection and removal system underlying the waste in conjunction with a single-layer composite lined cap overlying the waste, as shown on Figure 7-6. Run-on/run-off control would be constructed as an integral part of the repository design.

Preliminary analyses show that the materials to be placed in the repository should have adequate strength to place them at a finish slope of 4:1, if the materials are compacted adequately (i.e., 95% of their standard Proctor density). Detailed analysis of slope stability, including conducting triaxial shear tests with the materials, will be necessary for design purposes if this alternative is implemented. If necessary, geosynthetics (geogrids) could be used to improve slope stability if the detailed analysis shows the materials may be prone to slope failure.

Approximately one foot of contaminated underlying soils would also be removed from under WR-2, WR-3, WR-7 (assumed, needs to be sampled prior to implementation), WR-8, WR-10, TP-1, TP-2, TP-3, TP-4 and TP-5. The underlying soils would be stockpiled and used as a portion of the cover soils used to cap the waste rock dumps to be reclaimed in place and for reclamation of the cut areas as described below. The remaining contaminated underlying soils would be left in place and would be amended with lime to adjust the pH and to stabilize the metals. A one-foot thick layer of clean cover soils would be placed over the amended underlying soils, graded to reduce slopes and eliminate depressions (to promote positive drainage) and revegetated. All other areas where wastes are removed would be regraded, amended as needed and revegetated.

As discussed previously in Alternative 3, the acid-producing potential of the waste rock dumps varies significantly, and waste rock dumps with lime requirements greater than approximately 120 TPA can be capped with imported cover soil cheaper than vegetation can be established directly on the dump materials. Based on these assumptions it was determined that WR-1, WR-2, WR-5 and WR-10 could economically be recontoured, amended with lime, fertilizer and organic material and revegetated in place. All other waste rock dumps would be recontoured, a four-inch thick crushed limestone capillary barrier placed over the recontoured surface, a two foot layer of cover soil placed, and revegetated. Under this alternative WR-1, WR-2, and WR-10 would be excavated from their current locations, and, therefore, all other waste dumps which are reclaimed in place (WR-5, WR-6 and WR-9) would be reclaimed with the limestone/cover soil cap.

Based on the above discussion, the remaining waste rock dumps (WR-5, WR-6, and WR-9) will be recontoured and reclaimed in place. The dumps would be graded to a maximum 3:1 slope to minimize potential for erosion and to allow cover soil placement, incorporation of lime and amendments, and seeding to be accomplished with conventional equipment. These dumps would be reclaimed by placing a four-inch thick crushed limestone capillary barrier over recontoured surface, capping with two feet of cover soil, and revegetation. The two feet of cover soils would consist of approximately one foot of lime amended underlying soils from the stockpile and one foot of imported clean cover soils. (**Note**: it is not possible to use underlying soils on the repository cap because of the potential for damaging the cap during amendment). Although the underlying soils show low pH and elevated metals concentrations, the lime requirement is expected to be relatively low; the low pH and elevated metals concentrations are the result of downward leaching from the waste rock above the soils and the underlying soils are expected to have low inherent acid-generating potential. The amended underlying soils would likely be suitable for establishing vegetation. Sampling of these soils for agronomic properties and acid-generating potential would be necessary prior to implementation. Lime, fertilizer and amendments would be applied to the soils using conventional agricultural techniques (plowing).

Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of the disturbed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the reclaimed materials with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism.

Removal of wastes from near the creek will alter the current channel morphology and stream channel reconstruction will be needed. Areas where contaminated underlying soils are removed will be backfilled with clean fill and recontoured to restore the floodplain. The natural stream meander corridor may have been altered by WR-2 and may need to be restored to provide a stable channel in the vicinity WR-1, WR-2, and WR-8.

Physical hazards (high walls, adits/portals, and shafts) would be mitigated as a portion of the reclamation as described in Section 7.3 previously.

The following assumptions were used to develop costs directly and to calculate associated costs for this alternative:

- The cost of road access improvements to the site is approximately $10,500 per mile for 5.5 miles.
- The total cost for materials and construction of the surface water diversion structure used to divert the creek is assumed to be $15,000.
- The total cost for materials and construction of the surface water diversion structure used to divert the creek is assumed to be $5,000.
- Approximately 1,100 feet of stream channel will require reconstruction at a cost of $35 per foot.
- The total volume of wastes (waste rock, tailings and underlying soils) to be removed and consolidated is approximately 22,600 cy.
- The total volume of waste material to be excavated and disposed in the repository is approximately 16,500 cy.
- The bottom liner would consist of a finished graded smooth surface overlain by a GCL liner.
- Leachate Collection/Removal Layer--A one-foot-thick layer of washed, coarse gravel would overlay the bottom liner. PVC drain pipes would be installed in conjunction with the coarse gravel layer for leachate collection/removal. A geotextile filter fabric layer (to prevent potential clogging of the coarse gravel) would overlay the primary coarse gravel layer.

Note: To increase space for waste disposal (and possibly reduce construction costs), synthetic drainage layers (geonets) can be used in lieu of granular drainage layers in the constructing the repository.

- The repository cap would include a GCL installed over the mine wastes.

- Drainage Layer--A one-foot lift of washed, coarse gravel would overlay the cap GCL. A geotextile filter fabric layer (to prevent potential clogging of the coarse gravel) would overlay the coarse gravel drainage layer. A geonet could be used in place of the gravel drainage layer.

- Vegetative Cover--A two-feet-thick layer of cover soil would overlay the cap drainage layer. Cover soils would be imported from off-site at an estimated cost of $14 per cubic yard delivered to the site.

- The total surface area at the site requiring revegetation is approximately 19.2 acres (which includes the excavated source areas, reclaimed areas where wastes were contained in place, reclaimed temporary access roads, and the repository cap).

- The lime requirements for the waste rock/underlying soil cap are based on the lime requirements for WR-1 of 23 TPA (based on one foot depth).

- The final recontoured surface area of the consolidated waste disposal area is 2.0 acres.

- Two feet of cover soil would be used to cover the remaining waste piles. The recontoured surface area of the remaining waste rock dumps is approximately 2.5 acres.

- The total volume of clean soils to be imported as cover soils and to replace removed underlying soils is approximately 21.060 LCY.

- The area of the tailings to be removed which will require revegetation is approximately 0.5 acre.

- The total length of required run-on control and adit discharge diversion ditches is 5,650 linear feet.

- The total cost for removal and disposal of existing buildings and debris is estimated at $15,000.

<u>**Effectiveness**</u> - This alternative would effectively reduce contaminant mobility at the site by removing the highest risk solid media contaminant sources and disposing of the waste in a secure disposal facility. Consequently, the direct contact and surface water erosion problems associated with the site would be mitigated. Contaminant toxicity and

volume would not be reduced; however, the waste's mobility would be reduced in a repository; infiltration of precipitation through the waste sources and resulting migration of contaminants through the vadose zone and groundwater would be significantly reduced. Long-term monitoring and control programs would be established to ensure continued effectiveness.

This alternative is not expected to provide as high a degree of effectiveness as provided by a repository which complies with all RCRA Subtitle C regulations (Alternative 5a); however, this alternative may provide adequate protection at a significantly reduced cost. Furthermore, the wastes at the site are excluded from RCRA Subtitle C regulations by the Bevill Amendment. Therefore, a repository that fully complies with EPA's Minimum Technology Guidance for hazardous waste disposal facilities is not necessary to comply with ARARs. This design is expected to provide adequate environmental protection considering the chemical and physical characteristics of the mine waste in conjunction with the physical location of the repository site and the area's generally arid climate.

Implementability - This alternative may be technically and administratively feasible. The construction steps required are considered standard/conventional construction practices. Key project components, such as the availability of equipment, materials, and construction expertise, are all present and would help ensure the timely implementation and successful execution of the proposed plan.

However, there are factors that could possibly limit the implementability of this alternative as planned. Constructing a repository with the required capacity will be difficult (given the steep terrain and shallow depth to groundwater throughout the site) and would impact previously undisturbed land. Also, handling of the saturated tailings may be difficult. Pre-treatment of the wet material may be necessary to reduce the water content of the tailings to improve their handling characteristics.

Cost Screening - The total present-worth cost for this alternative has been estimated at $1,710,000 which represents the remediation of all solid media contaminant sources present at the Park site (tailings, intermixed waste, and waste rock). The cost details associated with implementing this alternative are included in Table D-5 (Appendix D). The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

Screening Summary - This alternative has been retained for detailed analysis due to its potential to cost effectively meet reclamation goals for solid media with a proven and relatively uncomplicated technology.

7.3.1.8 Alternative 5c (Solid Media): Partial Removal/Disposal of Solid Media On-Site in an Unlined Repository and Partial In-Place Containment

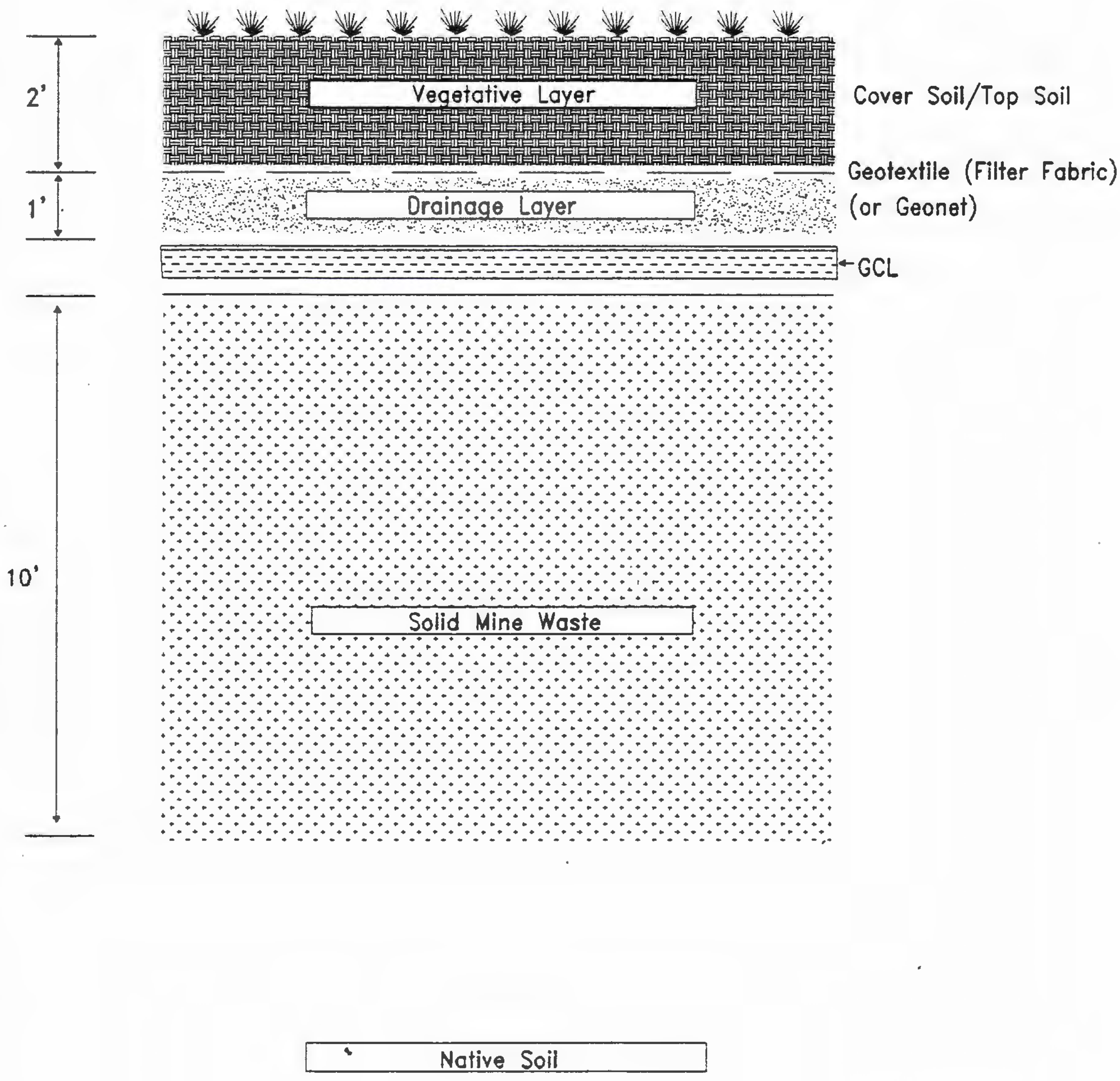
This alternative is similar to Alternative 5a and 5b discussed previously with the exception of the repository design. Instead of a repository that fully satisfies RCRA Subtitle C criteria or a modified repository design, an unlined repository with a composite cap would be used. Further, the entire waste consolidation area at WR-4 would be covered with the composite cap. Under this scenario all of the higher-risk wastes (tailings, near stream wastes, and wastes which failed the TCLP test) would be excavated and disposed in an unlined repository. A typical cross-section of the Alternative 5c repository is shown on Figure 7-8. The location of the consolidated wastes would be the same as for previous alternatives.

Conceptual Design and Assumptions

For the purpose of this evaluation, the conceptual design for Alternative 5c includes removing WR-1, WR-2, WR-3, WR-7, WR-8, WR-10, TP-1, TP-2, TP-3, TP-4 and TP-5 from their current locations and disposing these wastes in an unlined repository near WR-4, and recontouring and reclaiming in place all other waste sources at the site (WR-5, WR-6, WR-9). The wastes which are generally regarded as higher-risk wastes (wastes which fail the TCLP test and tailings) would be placed higher in the consolidation area to increase the distance to groundwater. After placing the wastes and grading, the entire waste disposal area would be covered with the composite cap. Various treatment strategies to be employed at each waste source under this alternative are shown on Figure 7-9.

Based on the available data and the above considerations, the conceptual design of Alternative 5c includes:

- improving road access to the site to facilitate reasonable access by heavy equipment and construction crews;
- constructing temporary surface water diversion structures and implementing construction BMPs to isolate the stream and mine water discharges while excavating wastes from the floodplain and stream channel;
- razing and disposing of any remaining dilapidated buildings/structures remaining at the site;
- totally excavating WR-1, WR-2, and WR-7 from their present locations, and transporting and consolidating these contaminated materials in the area near WR-4;
- totally excavating WR-3, WR-8, WR-10, TP-1, TP-2, TP-3, TP-4 and TP-5 from their present locations, and transporting and disposing of these contaminated materials near the top of the consolidated waste area near WR-4;

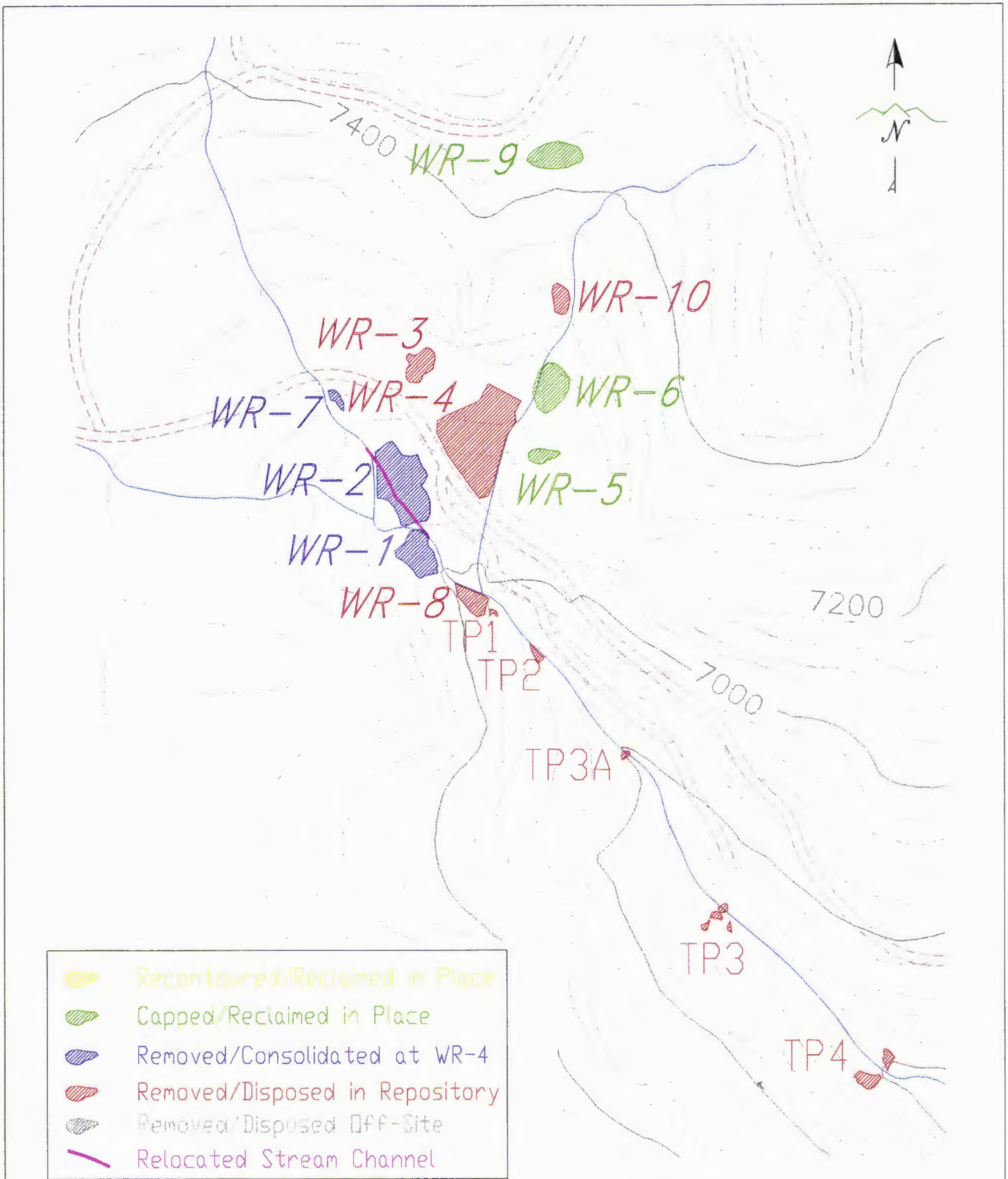


PIONEER TECHNICAL SERVICES, INC.

FIGURE 7-8
ALTERNATIVE 5c
LINED REPOSITORY CAP
CROSS SECTION

SCALE: N/A
DATE: 1/97

prk008.dwg



PIONEER TECHNICAL SERVICES, INC.

FIGURE 7-9
Alternative 5c
Reclamation Scenario

SCALE: 1" = approx. 650'
DATE: 12/23/96

- excavating approximately one foot of contaminated underlying soils from WR-2, WR-3, WR-7, WR-8, WR-10, TP-1, TP-2, TP-3, TP-4, and TP-5, stockpiling the soils and using the amended soils as a portion of the cover soils for wastes to be capped in-place;

- installing a GCL, geo-composite and cover soil cap over the waste consolidation area (as shown on Figure 7-8);

- backfilling disturbed soils and grading other solid media in place to provide surfaces amenable to amendment application and revegetation;

- revegetating disturbed areas including the composite cap, areas from which wastes have been removed, and other solid media to be contained in place;

- stream channel reconstruction/stabilization near removed waste sources to ensure that the stream channel is stable after waste removal and reclamation have been completed;

- restoring the riparian zone in the excavated areas via revegetation;

- grading out the remaining waste rock dumps (WR-5, WR-6, and WR-9) to reduce slopes and capping to provide surfaces amenable to revegetation;

- backfilling cuts to stabilize highwalls and recontouring the areas to control run-off;

- closing open adits by backfilling with clean, crushed limestone;

- closing the open shaft with a steel grate;

- importing cover soil to apply to the consolidated waste rock area and excavated areas; and

- constructing surface water diversion ditches/structures throughout the site to route run-off away from the reclaimed source areas.

The current access road to the site is in poor condition and needs improvement to allow unobstructed access for the required heavy equipment and machinery. The road needs to be resurfaced, widened in some sections and turn-outs need to be constructed. A considerable amount of heavy equipment/machinery would be necessary to efficiently implement this alternative. To excavate and load out the contaminated material, as well as construct run-on/run-off control structures, equipment requirements may include bulldozers, front-end loaders, excavators, and scrapers. Haul trucks or a conveyor system would also be required to transport and deposit the contaminated material in the consolidation area. The field procedures would involve constructing suitable access roads (and possible turnout points) between the waste sources and consolidation area to allow unobstructed access for heavy equipment. Suitable road construction materials can be obtained from the Continental Lime facility located on Indian

Creek Road. Roads would also be constructed in the vicinity of the waste sources at the site to allow the required heavy equipment to access, excavate and/or grade the wastes.

Run-on/run-off and groundwater control would be achieved by the design and construction of several structures. Temporary surface water diversions would be constructed and BMPs would be implemented to prevent additional sedimentation in Indian Creek from occurring while excavating WR-1, WR-2, WR-7, WR-8, TP-1, TP-2, TP-3, TP-4, and TP-5. Groundwater discharges GW-1, GW-2, and GW-4 would be diverted using interceptor ditches to direct water away from contaminated media, construction areas, and reclaimed areas. The seep at GW-BK would be directed away from the reclaimed area and allowed to infiltrate into the ground before reaching Indian Creek. Diversion channels would be constructed to divert run-off generated upgradient from each source around the reclaimed areas and into Indian Creek.

Under Alternative 5c all wastes which pose the highest environmental risks (tailings, near stream wastes, or wastes which failed the TCLP test) would be excavated and disposed in an unlined repository located near WR-4. First, WR-1, WR-2, and WR-7 would be excavated and consolidated near WR-4. These wastes would be graded and compacted to provide a foundation beneath the higher risk wastes also to be placed in the area near WR-4 (see below). The total volume of these wastes to be excavated (including contingency for over-excavation) is approximately 22.600 BCY.

WR-3, WR-8, WR-10, TP-3, and TP-4 failed the TCLP test for lead (TP-3 also failed for arsenic) and would then be excavated from their present locations, and transported and disposed at the consolidated waste area. These wastes would be placed higher in the consolidation area on top of the lower risk wastes (WR-1, 2 and 7) as described above to increase the distance to groundwater. Because of the physical characteristics of tailings, TP-1, TP-2 and TP-5 would also be handled and placed similarly to the wastes which failed the TCLP test. The total volume of these higher-risk wastes to be disposed (including contingency for over-excavation of wastes) is approximately 16,500 BCY.

After all required materials are placed in the consolidation area, compacted, and graded, the area will be prepared for installation of the composite cap. Finally, the composite cap would be installed over the entire waste consolidation area. This would include the placement of cover soils and establishment a vegetative stand on the composite cap.

Preliminary analyses show that the materials to be placed in the consolidation area should have adequate strength to place them at a finish slope of 4:1, if the materials are compacted adequately (i.e., 95% of their standard Proctor density). Detailed analysis of slope stability, including conducting triaxial shear tests with the materials, will be necessary for design purposes if this alternative is implemented. If necessary, geosynthetics (geogrids) could be used to improve slope stability if the detailed analysis shows the materials may be prone to slope failure. Further, the size of the consolidation area will lead to a long slope (approximately 500 feet). Because of the long slope it will be necessary to construct benches at approximately 100 foot intervals to tie in the GCL liner and to control run-off from the face.

Approximately one foot of contaminated underlying soils would also be removed from under WR-2, WR-3, WR-7 (assumed, needs to be sampled prior to implementation), WR-8, WR-10, TP-1, TP-2, TP-3, TP-4 and TP-5. The underlying soils would be stockpiled and used as a portion of the cover soils used to cap the waste rock dumps to be reclaimed in place and for reclamation of the cut areas as described below. The remaining contaminated underlying soils would be left in place and would be amended with lime to adjust the pH and to stabilize the metals. A one-foot thick layer of clean cover soils would be placed over the amended underlying soils, graded to reduce slopes and eliminate depressions (to promote positive drainage) and revegetated. All other areas where wastes are removed would be regraded, amended as needed and revegetated.

As discussed previously in Alternative 3, the acid-producing potential of the waste rock dumps varies significantly, and waste rock dumps with lime requirements greater than approximately 120 TPA can be capped with imported cover soil cheaper than vegetation can be established directly on the dump materials. Based on these assumptions it was determined that WR-1, WR-2, WR-5 and WR-10 could economically be recontoured, amended with lime, fertilizer and organic material and revegetated in place. All other waste rock dumps would be recontoured, a four-inch thick crushed limestone capillary barrier placed over the recontoured surface, a two foot layer of cover soil placed, and revegetated. Under this alternative WR-1, WR-2, and WR-10 would be excavated from their current locations, and, therefore, all other waste dumps which are reclaimed in place (WR-5, WR-6 and WR-9) would be reclaimed with the limestone/cover soil cap.

Based on the above discussion, the remaining waste rock dumps (WR-5, WR-6, and WR-9) will be recontoured and reclaimed in place. The dumps would be graded to a maximum 3:1 slope to minimize potential for erosion and to allow cover soil placement, incorporation of lime and amendments, and seeding to be accomplished with conventional equipment. These dumps would be reclaimed by placing a four-inch thick crushed limestone capillary barrier over recontoured surface, capping with two feet of cover soil, and revegetation. The two feet of cover soils would consist of approximately one foot of lime amended underlying soils from the stockpile and one foot of imported clean cover soils. (**Note**: it is not possible to use underlying soils on the composite cap because of the potential for damaging the cap during amendment). Although the underlying soils show low pH and elevated metals concentrations, the lime requirement is expected to be relatively low; the low pH and elevated metals concentrations are the result of downward leaching from the waste rock above the soils and the underlying soils are expected to have low inherent acid-generating potential. The amended underlying soils would likely be suitable for establishing vegetation. Sampling of these soils for agronomic properties and acid-generating potential would be necessary prior to implementation. Lime, fertilizer and amendments would be applied to the soils using conventional agricultural techniques (plowing).

Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of the disturbed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the reclaimed materials with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism.

Removal of wastes from near the creek will alter the current channel morphology and stream channel reconstruction will be needed. Areas where contaminated underlying soils are removed will be backfilled with clean fill and recontoured to restore the floodplain. The natural stream meander corridor may have been altered by WR-2 and may need to be restored to provide a stable channel in the vicinity WR-1, WR-2, and WR-8.

Physical hazards (high walls, adits/portals, and shafts) would be mitigated as a portion of the reclamation as described in Section 7.3 previously.

The following assumptions were used to develop costs directly and to calculate associated costs for this alternative:

- The cost of road access improvements to the site is approximately $10,500 per mile for 5.5 miles.
- The total cost for materials and construction of the surface water diversion structure used to divert the creek is assumed to be $15,000.
- The total cost for materials and construction of the surface water diversion structure used to divert the creek is assumed to be $5,000.
- Approximately 1,100 feet of stream channel will require reconstruction at a cost of $35 per foot.
- The total volume of waste material to be excavated and disposed in the waste consolidation area/repository is approximately 39,100 CY.
- The repository cap would include a GCL installed over the mine wastes.
- Drainage Layer--A one-foot lift of washed, coarse gravel would overlay the cap GCL. A geotextile filter fabric layer (to prevent potential clogging of the coarse gravel) would overlay the coarse gravel drainage layer. A geonet could be used in place of the gravel drainage layer.
- Vegetative Cover--A two-feet-thick layer of clean cover soil would overlay the cap drainage layer. If additional soils are required, they would be imported from off-site at an estimated cost of $14 per cubic yard delivered to the site. Clean topsoil would be applied to provide the uppermost layer of the vegetative cover.

- The total surface area at the site requiring revegetation is approximately 19.2 acres (which includes the excavated source areas, reclaimed areas where wastes were contained in place, reclaimed temporary access roads, and the repository cap).

- The lime requirement for the underlying soils to be used for capping is based on the lime requirements for WR-1 of 23 TPA (based on one foot depth).

- The final recontoured surface area of the consolidated waste disposal area is 2.5 acres.

- Two feet of cover soil would be used to cover the remaining waste piles. The recontoured surface area of the remaining waste rock dumps is approximately 2.5 acres.

- The total volume of clean soils to be imported as cover soils and to replace removed underlying soils is approximately 21,060 LCY.

- The area of the tailings to be removed which will require revegetation is approximately 0.5 acre.

- The total length of required run-on control and adit discharge diversion ditches is 5,650 linear feet.

Effectiveness - This alternative would effectively reduce contaminant mobility at the site by removing the highest risk solid media contaminant sources and disposing of the waste in a secure disposal facility. Consequently, the direct contact and surface water erosion problems associated with the site would be mitigated. Contaminant toxicity and volume would not be reduced. However, the waste's mobility would be reduced in an engineered disposal area because infiltration of precipitation through the waste sources and resulting migration of contaminants through the vadose zone and groundwater would be significantly reduced. Further, the distance to ground and surface water would be increased. Long-term monitoring and control programs would be established to ensure continued effectiveness.

This alternative is not expected to provide as high a degree of effectiveness as provided by a repository which complies with all RCRA Subtitle C regulations (Alternative 5a) or a Modified RCRA C repository; however, this alternative may provide adequate protection at a significantly reduced cost. Furthermore, the wastes at the site are excluded from RCRA Subtitle C regulations by the Bevill Amendment. Therefore, a repository that fully complies with EPA's Minimum Technology Guidance for hazardous waste disposal facilities is not necessary to comply with ARARs. This design is expected to provide adequate environmental protection considering the chemical and physical characteristics of the mine waste in conjunction with the physical location of the repository site and the area's generally arid climate.

Implementability - This alternative may be technically and administratively feasible. The construction steps required are considered standard/conventional construction practices. Key project components, such as the availability of equipment, materials, and construction expertise, are all present and would help ensure the timely implementation and successful execution of the proposed plan.

However, there are factors that could possibly limit the implementability of this alternative as planned. The area available for waste consolidation near WR-4 is limited. Because of this some special construction techniques and careful sequencing may be required.

Cost Screening - The total present-worth cost for this alternative has been estimated at $1,672,000 which represents the remediation of all solid media contaminant sources present at the Park site (tailings, underlying soils, and waste rock). The cost details associated with implementing this alternative are included in Table D-6 (Appendix D). The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

Screening Summary - This alternative has been retained for detailed analysis due to its potential to cost effectively meet reclamation goals for solid media with a proven and relatively uncomplicated technology.

7.3.1.9 Alternative 6 (Solid Media): Removal/Treatment/Off-Site Disposal in a Permitted Waste Disposal Facility

The remedial strategy for Alternative 6 involves removing the solid media contaminant sources at the Park Mine site which are the principal sources of concern (those sources which contribute the highest relative risks) and disposing of these wastes in a permitted waste disposal facility. Those sources that are the greatest concern are the waste sources which exhibit hazardous waste characteristics as determined by TCLP analysis; these include WR-3, WR-8, WR-10, TP-1, TP-2, TP-3, TP-4 and TP-5. The materials could be disposed at a RCRA-permitted hazardous waste facility or at a municipal solid waste landfill; both possibilities are discussed in the following paragraphs. The remaining materials would be reclaimed on-site as described previously in Alternatives 5a and 5b.

Since the materials exhibit hazardous waste characteristics, they may be shipped directly to a RCRA-permitted hazardous waste facility. The two nearest RCRA-permitted hazardous waste disposal facilities with the capacity to dispose of the wastes are both located several hundred miles from the site (one facility is located in Idaho, the other in Oregon). Approximately 15,000 cy (or about 24,000 tons) of waste rock and tailings would be removed from the site and transported to the RCRA facility. Since the materials fail TCLP for lead and arsenic (land-banned substances), treatment would be required before disposal. This treatment would most likely consist of solidification/stabilization conducted by the RCRA facility.

Alternatively, the materials could be excavated and treated on-site to remove their hazardous characteristics. The most likely form of treatment would be solidification/stabilization using Portland cement and/or pozzolonic materials. Once the materials have been treated, they could be disposed off-site at a permitted municipal solid waste (Montana Class II) landfill. Treatment and disposal in this manner would be allowable since the material are excluded from RCRA hazardous waste regulations under the Bevill Amendment. (Even though they are Bevill excluded, the materials must be treated to remove their hazardous characteristics before they would be accepted by a Class II landfill.) Once the hazardous characteristics are removed from the materials through treatment, disposal in a Class II landfill would provide adequate environmental protection, including long-term monitoring and maintenance of the facility as required by solid waste regulations in ARM 16.14.531.

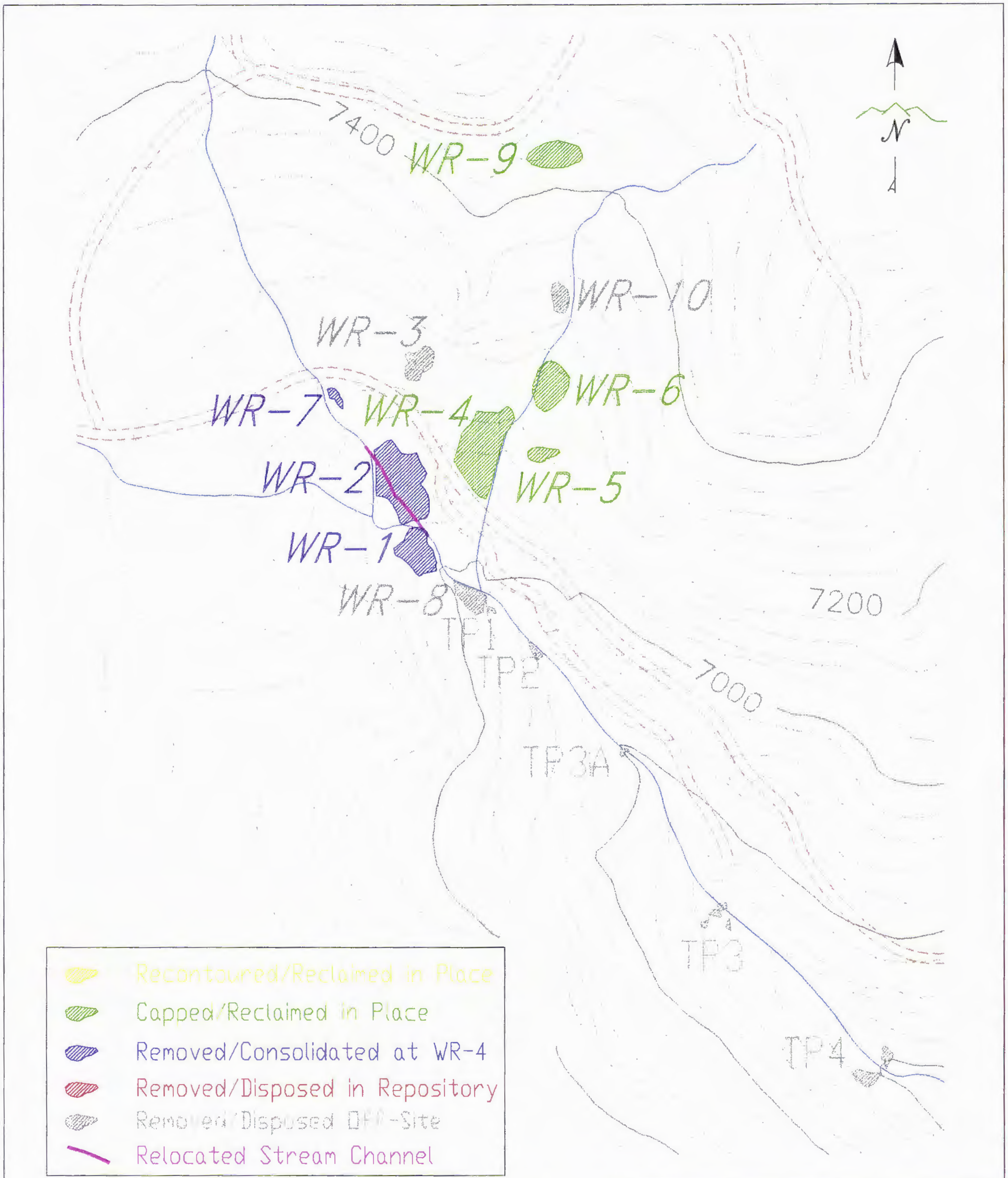
Fees for treatment and disposal (including taxes) at a RCRA hazardous waste facility are estimated at $250 per ton. Hauling costs would be approximately $60 per ton. When stabilization testing, waste profiling, and excavation are considered, the total cost per ton for off-site treatment and disposal at a hazardous waste facility would be approximately $310 per ton. On-site treatment to remove hazardous characteristics, coupled with transportation and disposal at a Class II landfill, is estimated to be approximately $100 per ton. This option would require extensive testing to determine the optimum stabilization mix to remove the hazardous characteristics.

Conceptual Design and Assumptions

For the purpose of this evaluation, the conceptual design for Alternative 6 includes removing WR-3, WR-8, WR-10, TP-1, TP-2, TP-3, TP-4 and TP-5 from their current locations, stabilizing the wastes and disposing of the waste in an area landfill, removing WR-1, WR-2, and WR-7 from their locations near Indian Creek and consolidating the wastes near WR-4, and recontouring and reclaiming in place all other waste sources at the site (WR-5, WR-6, and WR-9). Various treatment strategies to be employed at each waste source under this alternative are shown on Figure 7-10.

Based on the available data and the above considerations, the conceptual design of Alternative 6 includes:

- improving road access to the site to facilitate reasonable access by heavy equipment and construction crews;
- constructing temporary surface water diversion structures and implementing construction BMPs to isolate the stream and mine water discharges while excavating wastes from the floodplain and stream channel;
- razing and disposing of any remaining dilapidated buildings/structures remaining at the site;



PIONEER TECHNICAL SERVICES, INC.

FIGURE 7-10
Alternative 6
Reclamation Scenario

SCALE: 1" = approx. 650'
DATE: 12/23/96

- totally excavating WR-1, WR-2, WR-7, from their present locations, and transporting and consolidating these contaminated materials in the area near WR-4;

- excavating approximately one foot of contaminated underlying soils from WR-2, WR-3, WR-7, WR-8, WR-10, TP-1, TP-2, TP-3, TP-4, and TP-5, and transporting and consolidating the contaminated materials in the area near WR-4;

- constructing a cap over the consolidated waste area with materials from the excavation of WR-1, WR-2, the underlying soils and clean cover soils;

- establishing a mixing/treatment area including run-off containment;

- totally excavating WR-3, WR-8, WR-10, TP-1, TP-2, TP-3, TP-4, and TP-5 from their present locations, treating the materials on-site;

- hauling and disposing the treated tailings to the Helena Class II landfill for disposal;

- backfilling disturbed soils and grading other solid media in place to provide surfaces amenable to amendment application and revegetation;

- revegetating disturbed areas including the repository cap, areas from which wastes have been removed, and other solid media to be contained in place;

- stream channel reconstruction/stabilization near removed waste sources to ensure that the stream channel is stable after waste removal and reclamation have been completed;

- restoring the riparian zone in the excavated areas via revegetation;

- grading out the remaining waste rock dumps (WR-5, WR-6, and WR-9) to reduce slopes and provide surfaces amenable to revegetation;

- backfilling cuts to stabilize highwalls and recontouring the areas to control run-off;

- closing open adits by backfilling with clean, crushed limestone;

- closing the open shaft with a steel grate;

- importing cover soil to apply to the waste rock areas and excavated areas; and

- constructing surface water diversion ditches/structures throughout the site to route run-off away from the reclaimed source areas.

The current access road to the site is in poor condition and needs improvement to allow unobstructed access for the required heavy equipment and machinery. The road needs to be resurfaced, widened in some sections and turn-outs need to be constructed. A considerable amount of heavy equipment/machinery would be necessary to efficiently implement this alternative. Waste removal, on-site treatment and load out of the contaminated material, as well as construction of run-on/run-off control structures, may require bulldozers, front-end loaders, excavators, and scrapers, crushers, and mills, etc. Haul trucks or a conveyor system would also be required to transport the contaminated material to the treatment area. The field procedures would involve constructing suitable access roads (and possible turnout points) between the waste sources and the treatment site to allow unobstructed access for heavy equipment. Suitable road construction materials can be obtained from the Continental Lime facility located on Indian Creek Road. Roads would also be constructed in the vicinity of the waste sources at the site to allow the required heavy equipment to access, excavate and/or grade the wastes.

Run-on/run-off and groundwater control would be achieved by the design and construction of several structures. Temporary surface water diversions would be constructed and BMPs would be implemented to prevent additional sedimentation in Indian Creek from occurring while excavating WR-1, WR-2, WR-7, WR-8, TP-1, TP-2, TP-3, TP-4, and TP-5. Groundwater discharges GW-1, GW-2, and GW-4 would be diverted using interceptor ditches to direct water away from contaminated media, construction areas, and reclaimed areas. The seep at GW-BK would be directed away from the reclaimed area and allowed to infiltrate into the ground before reaching Indian Creek. Diversion channels would be constructed to divert run-off generated upgradient from each source around the reclaimed areas and into Indian Creek.

As discussed previously in Alternative 3, the acid-producing potential of the waste rock dumps vary significantly and waste rock dumps with lime requirements greater than approximately 120 TPA can be capped with imported cover soil cheaper than vegetation can be established directly on the dump materials. Based on these assumptions it was determined that WR-1, WR-2, WR-5 and WR-10 could economically be recontoured, amended with lime, fertilizer and organic material and revegetated in place. All other waste rock dumps would be recontoured, a four-inch thick crushed limestone capillary barrier placed over the recontoured surface, a two foot layer of cover soil placed, and revegetated. Under this alternative WR-1, WR-2, and WR-10 would be excavated from their current locations, and, therefore, all other waste dumps which are reclaimed in place would be reclaimed with the limestone/cover soil cap.

Under Alternative 6, WR-1, WR-2, and WR-7 would be removed and consolidated near WR-4. Approximately one foot of contaminated underlying soils would also be removed from under WR-2, WR-7 (assumed, needs to be sampled prior to design), and WR-8. The remaining contaminated underlying soils would remain in place and would be amended with lime to adjust the pH and to stabilize the metals. A one-foot thick layer of clean cover soils would be placed over the amended underlying soils, graded and revegetated. All other areas where wastes are removed would be regraded, amended and revegetated. Clean cover soils would be placed as needed to complete recontouring.

Based on the above discussion regarding soil amendment requirements for the various wastes at the site, the cap for the waste consolidation area would be constructed with lime amended wastes from WR-1 and WR-2, lime amended underlying soils, and clean cover soils. Although the underlying soils show low pH and elevated metals concentrations, the lime requirement is expected to be relatively low; the low pH and elevated metals concentrations are the result of downward leaching from the waste rock above the soils and the underlying soils would be expected to have low inherent acid-generating potential. The amended underlying soils would likely be suitable for establishing vegetation. Sampling of these soils for agronomic and acid-generating potential would be necessary prior to design.

Under this scenario WR-7 would be consolidated with WR-4 and recontoured. WR-1 and WR-2 would then be excavated and placed over the other consolidated wastes and the upper 12 inches would be amended with lime. Next, the contaminated underlying soils from WR-2, WR-7 and WR-8 would be excavated, placed in an approximately one-foot thick layer over the consolidation area, and amended with lime, fertilizer and organic matter to provide a suitable rooting medium. Finally, a one-foot thick layer of clean cover soils would be placed, grading completed and vegetation would be established.

WR-3, WR-8, WR-10, TP-3, and TP-4 failed the TCLP test for lead (TP-3 also failed for arsenic) and would be excavated from their present locations, treated, transported and disposed in an off-site landfill. Because of the physical characteristics of tailings, TP-1, TP-2 and TP-5 would also be disposed in the repository. Approximately one foot of contaminated underlying soils would also be removed from under these wastes and would be treated and used as cover soil as described above. The remaining contaminated underlying soils would remain in place and would be amended with lime to adjust the pH and to stabilize the metals. A one-foot thick layer of clean cover soils would be placed over the amended underlying soils, graded and revegetated. All other areas where wastes are removed would be regraded, amended and revegetated. Allowing for over-excavation of wastes, the total volume of wastes to be disposed off-site is approximately 16,500 BCY.

Once the wastes have been excavated, they would be moved to a central location for treatment. Given the large quantity of wastes requiring treatment, mixing of solidification/stabilization agents with the wastes in a pug mill would most likely be the most cost-effective method. However, mixing in cribs with a backhoe or excavator is also possible. Because of the coarse nature of the waste rock, additional crushing and/or grinding may be required prior to stabilization. Prior to beginning the construction work, stabilization testing would need to be completed to determine the most cost-effective stabilization recipe to immobilize the metals and remove the material's hazardous characteristics.

After the wastes have been treated, they would be hauled to a Class II landfill for disposal. The nearest Class II landfill is in Helena, Montana. However, the large volume of waste may not make it feasible to dispose of the waste at a single Class II facility. Some wastes may also be disposed at Class II facilities in Butte, Great Falls, and/or Missoula. Before disposal, the wastes must be approved as a special waste by each facility accepting the waste.

The remaining waste rock dumps (WR-5, WR-6, WR-9) will be recontoured and reclaimed in place. Because of the high lime requirements these dumps would be reclaimed by placing a four-inch thick crushed limestone capillary barrier over the recontoured surface, capping with two feet of cover soil, and revegetation.

All waste sources would be graded to a maximum 3:1 slope to minimize potential for erosion and to allow cover soil placement, incorporation of lime and amendments, and seeding to be accomplished with conventional equipment. Lime would be applied to the waste rock dumps using conventional agricultural techniques (plowing) or deep-incorporation techniques as appropriate.

Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of the disturbed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the reclaimed materials with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism.

Removal of wastes from near the creek will alter the current channel morphology and stream channel reconstruction will be needed. Areas where contaminated underlying soils are removed will be backfilled with clean fill and recontoured to restore the floodplain. The natural stream meander corridor may have been altered by WR-2 and may need to be restored to provide a stable channel in the vicinity WR-1, WR-2, and WR-8.

Physical hazards (high walls, adits/portals, and shafts) would be mitigated as a portion of the reclamation as described in Section 7.3 previously.

The following assumptions were used to develop costs directly and to calculate associated costs for this alternative:

- The volume of wastes to be excavated and treated is 15,000 BCY.
- Costs for the remaining wastes to be reclaimed on-site are identical to Alternatives 5a and 5b above.

Effectiveness - This alternative would effectively reduce contaminant toxicity through treatment that would be required prior to disposal off-site. Also, the contaminant mobility would be reduced through treatment and placing the wastes in an off-site landfill. Contaminant volume would not be reduced. Disposal at a Class II landfill or a RCRA-permitted hazardous waste facility establishes long-term monitoring and control programs to ensure continued effectiveness. However, short-term risks of exposure to the contaminated material would occur during transport to the disposal facility.

Implementability - This alternative is technically feasible, although some difficulties could be caused by the coarse waste rock materials. The construction steps required (excavation and loadout) are considered standard construction practices. Solidification/stabilization is also a standard, well-proven process to remove hazardous characteristics from solid wastes, although it may not be feasible to crush and grind the waste rock on-site. This alternative is most likely administratively feasible, however, there are some possible limitations; primarily, a Class II landfill must agree to accept the wastes. It is possible that a number of Class II landfills would be required to accommodate the large volume of wastes. Alternatively, a hazardous waste facility must be willing to accept, treat, and dispose the materials; this should not be administratively difficult.

Cost Screening - The total present-worth cost for this alternative has been estimated at $4,564,000. The cost details associated with implementing this alternative as described are included in Table D-7 (Appendix D). The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

Screening Summary - This alternative has not been retained for detailed analysis because of the high cost and potential difficulties associated with successful treatment of the course waste rock fragments.

7.3.2 Contaminated Aqueous Media Alternatives

Alternatives to address contaminated aqueous media at the site were considered in the reclamation investigation work plan and were eliminated for reasons presented in the work plan. Because these alternatives were eliminated no discussion is provided in this report.

7.4 SUMMARY OF ALTERNATIVE SCREENING

Table 7-4 summarizes the findings of the solid media alternatives preliminary evaluation and screening. Costs generated and summarized on this table are present-worth values, which include construction costs and O&M costs for a 30-year project period.

The aqueous media alternatives are not included in the table, since they have been subjected to a preliminary evaluation, but have been screened from consideration. As explained earlier in this section, the need for additional action to address the contaminated aqueous media will not be clearly defined until a solid media alternative has been selected and implemented.

TABLE 7-4

PARK MINE SITE
SOLID MEDIA ALTERNATIVES SCREENING SUMMARY

ALTERNATIVE DESCRIPTION	EFFECTIVENESS	IMPLEMENTABLE	COST ESTIMATE	RETAINED FOR DETAILED ANALYSIS
Alt. 1: No Action	NA	NA	$0	Yes
Alt. 2: Institutional Controls	Low	Yes	$144,000	No
Alt. 3: In-Place Containment of Wastes	Low - Med.	Yes	$1,239,000	Yes
Alt. 4a: Partial Removal and In-Place Containment	Med-High	Questionable	$1,628,000	No
Alt. 4b: Partial Removal (Excluding Streamside Tailings) and In-Place Containment	Med-High	Yes	$1,380,000	Yes
Alt. 5a: Partial Removal/Disposal in an On-Site RCRA C Repository with Partial In-Place Containment	High	Yes	$1,818,000	No
Alt. 5b: Partial Removal/Disposal in an On-Site Modified RCRA C Repository With Partial In-Place Containment	High	Yes	$1,710,000	Yes
Alt. 5c: Partial Removal/Disposal in an Unlined Repository With Partial In-Place Containment	High	Yes	$1,672,000	Yes
Alt. 6: Removal/Treatment/Disposal in a Permitted Off-Site Waste Disposal Facility	High	Questionable	$4,564,000	No

8.0 DETAILED ANALYSIS OF ALTERNATIVES

The purpose of the detailed analysis is to evaluate, in detail, reclamation alternatives for their effectiveness, implementability, and associated cost to control and reduce the toxicity, mobility, and/or volume of contaminated mine wastes at the Park Mine site. Only those reclamation alternatives which were retained after the preliminary evaluation and screening (as presented in Section 7) are included. For clarity, the retained alternative numbers are carried over from Section 7. Each reclamation alternative currently being considered for implementation at the Park site is classifiable as an interim or removal action and is not a complete remedial action. The reclamation alternatives evaluated in detail are applicable to the contaminated solid media only; no reclamation alternatives for aqueous media are analyzed in detail. The rationale for not directly developing reclamation alternatives for these environmental media was based primarily on the presumption that reclaiming the contaminant source(s) will subsequently reduce the problems associated with groundwater and surface water at a significantly reduced cost. However, potential alternatives for groundwater and surface water reclamation were presented and subjected to a preliminary analysis in the reclamation investigation work plan in the event that reclamation action is necessary for the aqueous media after a solid media alternative has been selected and implemented.

As required by the CERCLA and the NCP, reclamation alternatives that were retained after the initial evaluation and screening have been evaluated individually against the following criteria:

- overall protection of human health and the environment;
- compliance with ARARs;
- long-term effectiveness and permanence;
- reduction of toxicity, mobility, or volume through treatment;
- short-term effectiveness;
- implementability; and
- cost.

Supporting agency acceptance and community acceptance are additional criteria that will be addressed after DEQ and the public have reviewed the evaluations presented herein. The analysis criteria have been used to address the CERCLA requirements and considerations with EPA guidance (EPA, 1988a), as well as additional technical and policy considerations. These criteria serve as the basis for conducting the detailed analysis and subsequently selecting the preferred reclamation alternative. The criteria listed above are categorized into three groups, each with distinct functions in selecting the preferred alternative. These groups include:

- Threshold Criteria - overall protection of human health and the environment and compliance with ARARs;
- Primary Balancing Criteria - long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost; and
- Modifying Criteria - state and community acceptance.

"Overall protection of human health and the environment and compliance with applicable or relevant and appropriate requirements" are threshold criteria that must be satisfied for an alternative to be eligible for selection. Long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; and cost are the primary balancing factors used to weigh major trade-offs between alternative hazardous waste management strategies. State and community acceptance are modifying considerations that are formally considered after public comment is received on the proposed plan and the Expanded EE/CA report" (Federal Register, No. 245, 51394-50509, December 1988). Each of these criteria is briefly described in the following paragraphs.

The overall protection criteria evaluates how the alternative, as a whole, protects and maintains human health and the environment. The overall assessment of protection is based on a combination of factors assessed under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Compliance with ARARs criteria assesses how each alternative complies with applicable or relevant and appropriate standards, criteria, advisories, or other guidelines. Waivers will be identified, if necessary. The following factors will be addressed for each alternative during the detailed analysis of ARARs:

- compliance with chemical-specific ARARs;
- compliance with action-specific ARARs;
- compliance with location-specific ARARs; and
- compliance with appropriate criteria, advisories, and guidelines.

For this evaluation, compliance with chemical-specific ARARs was considered at different points for groundwater and surface water at the site. Groundwater compliance with ARARs was considered both underneath the site itself and also at the downgradient boundary of the site. Surface water compliance with ARARs was considered at two points: SW-4 immediately below TP-2, and SW-2 below TP-3.

Long-term effectiveness and permanence evaluates the alternative's effectiveness in protecting human health and the environment after response objectives have been met. The following components of the criteria will be addressed for each alternative:

- magnitude of remaining risk;
- adequacy of controls; and
- reliability of controls.

The reduction of toxicity, mobility, or volume assessment evaluates anticipated performance of the specific treatment technologies. This evaluation focusses on the following specific factors for a particular reclamation alternative:

- the treatment process, the remedies they will employ, and the materials they will treat;

- the amount of hazardous materials that will be destroyed or treated, including how principal threat(s) will be addressed;
- the degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction (or order of magnitude);
- degree to which the treatment will be irreversible; and
- the type and quantity of treatment residuals (i.e., wastewater treatment sludges, spent reagents) that will remain following treatment.

Short-term effectiveness evaluates an alternative's effectiveness in protecting human health and the environment during the construction and implementation period until the response objectives are met. Factors that will be considered under this criteria include:

- protection of the surrounding community during reclamation actions;
- protection of on-site workers during reclamation actions;
- protection from environmental impacts; and
- time until removal response objectives are achieved.

Implementability evaluates the technical and administrative feasibility of alternatives and the availability of required resources. Analysis of this criteria will include the following factors and subfactors:

Technical Feasibility

- construction and operation;
- reliability of technology;
- ease of undertaking additional remedial action; and
- monitoring considerations.

Administrative Feasibility

- RCRA disposal restrictions;
- institutional controls; and
- permitting requirements.

Availability of Services and Materials

- adequate off-site treatment, storage capacity, and disposal service;
- necessary equipment and specialists and provisions to ensure any necessary additional resources;
- timing of the availability of technologies under consideration; and
- services and materials.

The cost assessment evaluates the capital and O&M costs of each alternative. A present-worth analysis based on a 4-percent inflation rate and a maximum design life of 30 years will be used to compare alternatives. Cost screening consists of developing conservative, order-of-magnitude cost estimates based on similar sets of site-specific assumptions. Cost estimates for each alternative will consider the following factors:

Capital Costs

- construction costs;
- equipment costs;
- land and site development costs;
- disposal costs;
- engineering design;
- legal fees, license, and permit costs;
- startup and troubleshooting costs; and
- contingency allowances.

Annual Costs

- operating labor;
- maintenance materials and labor;
- auxiliary materials and energy;
- disposal residues;
- purchased services (i.e., sampling costs, laboratory fees, professional fees);
- administrative costs;
- insurance, taxes, and licensing;
- maintenance reserve and contingency funds;
- rehabilitation costs; and
- periodic site reviews.

State acceptance will evaluate the technical and administrative issues and concerns the state may have regarding each of the alternatives. State acceptance will also focus on legal issues and compliance with state!statutes and regulations. ***Community acceptance*** will incorporate public concerns into the analyses of the alternatives.

The final step of this analysis is to conduct a comparative analysis of the alternatives. The analysis will include a discussion of the alternative's relative strengths and weaknesses with respect to each of the criterion and how reasonable key uncertainties could change expectations of their relative performance.

Once completed, this evaluation will be used to select the preferred alternative(s). The selection of the preferred alternative(s) will be documented in a Notice of Decision by the AMRB. Public meetings to present the alternatives will be conducted and relevant oral and written comments will be addressed in writing.

8.1 QUANTITATIVE EVALUATION OF THRESHOLD CRITERIA

In the following detailed evaluations of the threshold criteria, each reclamation alternative contains quantitative estimates of risk reduction as well as estimates regarding whether ARARs would be attained by implementing the alternative. To quantitatively assess the threshold criteria (overall protection of human health and the environment and attainment of ARARs), the exposure pathways of concern that were identified in the baseline risk assessment (human health and ecologic) were evaluated to determine the risk reduction required to achieve the desired residual risk level (Hazard Quotient ≤ 1 and Ecologic Quotient ≤ 1). Each alternative was then modeled to ascertain the degree of risk reduction achieved, either through reduced contaminant loadings to an exposure pathway or reduced surface area available for certain exposures. The resulting risk reduction estimates are then compared to one another to determine whether the relative risk reduction provided by a specific alternative is greater than another; these risk reductions are also compared to the reduction required to alleviate excess risk via the specific pathway or media, as determined in the risk assessments. The risk reduction models also estimate resultant contaminant concentrations in the various media, which are then compared to media- and contaminant-specific ARARs. The groundwater model uses an on-site, downgradient exposure point, while the surface water/sediment model uses the sample station location just below most of the sources at the site on Indian Creek (SW4) as the evaluation point.

Modeling estimates and assumptions are used in an attempt to quantify risk reduction and determine whether ARARs would be attained. In the course of performing this quantitative analysis, several assumptions and estimates are necessarily employed. Some of the assumptions are based on standard CERCLA risk assessment guidance, while others are based on-site-specific observation and professional judgement. Many of the estimates are based on conservative (worst case) scenarios, but since alternatives are compared to one another on a relative basis, these assumptions are consistent. The evaluation findings should, therefore, not be considered absolute (e.g., ARARs); however, the relative risk reduction differences between alternatives are meaningful and can be used to evaluate these criteria.

The human health baseline risk assessments determined that the pathways and contaminants of concern at the Park site were soil ingestion of As, Pb, Fe, and Cd, and water ingestion of Pb (modeled groundwater rather than spring water). To effect risk reduction for these contaminants via the corresponding pathways, two scenarios have been modeled: a recreational exposure and a residential exposure. Each reclamation alternative is modeled for the two scenarios and the resultant risk reductions are compared to the reduction required to achieve these levels of protectiveness (recreational and residential): non-carcinogenic As via soil ingestion - 100% (residential), 96% (recreational); Pb via soil ingestion 98% (residential), 79% (recreational); Fe via soil ingestion - 80% (residential); Cd via soil ingestion - 20% (residential); and Pb via water ingestion - 92% (residential).

The ecologic risk assessment identified three exposure scenarios: Indian Creek aquatic life receptors exposed to Zn, Cd, Cu and Pb in surface water, and Pb, As, Zn and Cd in sediments; deer ingesting Pb from tailings surface salts; and plant phytotoxicity to As, Pb, Zn, Cd, and Cu.

The aquatic life scenario requires a surface water loading reduction of 99% to achieve ambient water quality criteria standards (acute-Zn); sediment concentrations require a 96% reduction in additional sediment loading to the creek to achieve preliminary sediment quality criteria - median effect range (Pb). The deer-tailings salt scenario requires a 98% reduction in Pb concentrations or exposed waste surface area to achieve the lowest observed adverse effects level (LOAEL). The plant phytotoxicity scenario requires a 100% reduction in surface concentrations or area to achieve no phytotoxic effects from As.

The four exposure pathways were modeled to evaluate the relative risk reductions and attainment of ARARs afforded by each alternative. These calculations involved a combination of measured data collected at the site (waste and surface water concentrations), and modeled impacts (e.g., groundwater loading). A discussion of how the evaluations were performed and the assumptions used follows for each pathway.

The groundwater pathway was modeled using a simple mathematical model which utilized two components: estimates of leachate concentrations for precipitation water that flows through the waste sources and/or repository and ultimately into groundwater; and estimates of the rate that this water flows through the wastes and/or repository (flux). The first component, leachate concentrations, were obtained by using the TCLP analyses performed during the 1996 RI on each waste source. The second component, water flux through the sources, was estimated using the HELP (Version 3.0) model which uses a variety of site meteorological and physical data to determine the water balance at the site, including estimating the volume of water flux through the bottom of an impoundment. Each source was evaluated, as was the background groundwatershed. Assumptions used to evaluate groundwater impacts (loadings) include the following: inputs from the sources and background were summed, which has the effect of assuming complete dilution and not considering any other contaminant attenuation mechanisms; repository loads were summed with the other loads as a total loading to groundwater.

The surface water pathway was also modeled using a simple mathematical model which utilized two components: measured surface water concentrations above the site (SW6), below most of the site wastes (SW4), and well below the site in Indian Creek (SW2); and, an estimate of the relative increases in surface water loading provided by each source, based on relative contaminant concentrations in each source, the area of the source, and the proximity of each source to a surface water conveyance.

Assumptions used to evaluate surface water impacts (loadings) include the following: a significant portion of surface water loading to Indian Creek (up to 50%) is due to the adit discharge at GW1 which is not part of the planned reclamation; alternatives that employed covers or caps were assigned a 65% long-term effectiveness for preventing erosion into surface water; alternatives that employed only revegetation were assigned a 50% long-term effectiveness for preventing erosion; and, sources placed in a repository or moved off-site were assumed to have been 100% removed from exposures via this pathway. Surface water modeling considered two exposure point concentrations: the first was an on-site concentration at sampling station SW4, considered the worst-case concentration in Indian Creek that drains the Park site; the second was an offsite and downstream concentration corresponding to sample station SW2, which has significantly better water quality due to dilution. The two exposure points are used only in the ARAR attainment projections, not in the risk reduction requirements where only the on-site exposure point is appropriate.

Groundwater and surface water chemical-specific ARARs for each point considered are shown on Table 8-1. Note that surface water ARARs for some contaminants differ for each point considered due to different water hardness values measured at each point (several criteria for specific contaminants are hardness dependant).

TABLE 8-1
GROUNDWATER AND SURFACE WATER ARARS

LOCATION	ARAR CONCENTRATION (μg/L)					
	As	Cd	Cu	Pb	Mn	Zn
On-site Groundwater	18	5	NM	15	NM	5000
Off-site Groundwater	18	5	NM	15	NM	5000
On-site Surface Water (SW-4)	18	2.9	13.8	15	50	93.2
Off-site Surface Water (SW-2)	18	5.7	24.3	15	50	155.6

Groundwater ARARs are Federal MCLs or State HHSs, whichever are lowest.
Surface water ARARs are State HHSs or Acute AWQC, whichever are lowest.
NM = Contaminant not modeled (Cu, Fe and Mn not included in TCLP suite).

The air and soil exposure pathways were empirically modeled using only reductions in surface area to estimate reduction in exposures. Both pathways assumed a 65% long-term effectiveness for maintaining adequate cover to preventing exposure due to the likelihood of long-term deterioration of the covers, and 50% reductions where only recontouring and revegetation were employed with no clean soil cover. Sources placed in the repository were assumed to have been 100% removed from exposures via these pathways.

8.2 ALTERNATIVE 1: NO ACTION

The no action alternative is required for analysis by CERCLA and the NCP when evaluating alternatives in detail; the no action alternative is used to provide a baseline for comparing other alternatives. Under this alternative, no permanent reclamation activities would be implemented. Consequently, long-term human health and environmental risks associated with the on-site contamination would remain unchanged, with the contaminant sources at the site continuing to pose a threat to human health and environmental resources.

8.2.1 Overall Protection of Human Health and the Environment

The no action alternative provides no control of exposures to contaminated materials and no reduction in risk to human health or the environment. It allows for the continued migration of contaminants and further degradation of groundwater and surface water quality.

Protection of human health would not be achieved under the no action alternative. Prevention of human exposure to CoCs via the pathways of concern, as identified in the human health risk assessment, would not occur. Soil ingestion exposure to As, Pb, Fe, and Cd via contaminated surface soil would not be reduced, meeting none of the risk reduction levels; and exposure to Pb via groundwater ingestion would also not be reduced.

Protection of the environment would also not be achieved under the no action alternative. Prevention of ecologic exposures via all the scenarios identified in the ecologic risk assessment, would not occur: aquatic life exposure to Zn, Cd, Cu, and Pb via water and Pb, As, Zn, and Cd via sediment; deer exposure to Pb via ingestion; and plant phytotoxicity to As, Pb, Zn, Cd, and Cu.

A risk reduction achievement matrix (Table 8-2) was developed to assess whether the alternative affords sufficient protection to human health and the environment for the pathways and CoCs identified in the human health risk assessment (Section 5.1) and the ecological risk assessment (Section 5.2). The conclusions presented in the table are based on worst-case modeling results subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

8.2.2 Compliance with ARARs

A comprehensive list of federal and state ARARs has been developed for the Park site and is summarized in Section 4.0 and presented in detail in Appendix C. ARARs are divided into contaminant-specific, location-specific, and action-specific requirements. Contaminant-specific ARARs are waste-related requirements which specify how a waste must be managed, treated, and/or disposed depending upon the classification of the waste material. Location-specific ARARs specify how the remedial activities must take place depending upon where the wastes are physically located (i.e., in a stream or floodplain, wilderness area, or sensitive environment, etc.), or where the wastes may be treated or disposed, and what authorizations (permits) may be required. Action-specific ARARs are technology- or activity-based requirements, or are limitations on actions taken with respect to hazardous substances. Action-specific ARARs do not determine the preferred reclamation alternative, but indicate how the selected alternative must be achieved.

Under the no action alternative, no contaminated materials would be treated, removed, or actively managed. Consequently, the no action alternative would not satisfy federal or state ARARs. A water quality ARARs attainment matrix (Table 8-3) was developed to assess whether the alternative can achieve ARARs for those contaminants and media where they are exceeded. The conclusions presented in the table are based on worst-case modeling results subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-2
RISK REDUCTION ACHIEVEMENT MATRIX FOR ALTERNATIVE 1

Alternative 1	As	Cd	Cu	Pb	Zn	Overall
Human Health Exposure Pathways:						
Soil Ingestion	None	Recr.	Res.	None	Res.	None
Water Ingestion	Recr.	Res.	Res.	Recr.	Res.	Recr.
Ecologic Exposure Pathways:						
Surface Water	--	No	No	No	No	No
Sediments	No	No	--	No	No	No
Deer Salt Ingestion	--	--	--	No	--	No
Plant Phytotoxicity	No	No	No	No	No	No

-- = Risk reduction not required for the contaminant for that pathway.
None = Does not achieve required risk reduction for any exposure scenario.
Recr. = Achieves required risk reduction for the recreational exposure scenario.
Res. = Achieves required risk reduction for the residential exposure scenario (most protective).

TABLE 8-3
WATER QUALITY ARARS ATTAINMENT FOR ALTERNATIVE 1

Alternative 1	As	Cd	Cu	Pb	Zn
Onsite Groundwater (μg/L)	11	2.5	NM	220	NM
Onsite Surface water (μg/L)	59	15	45	35	2060
Offsite Surface Water (μg/L)	51	6.5	7.3	6.0	1180
Onsite Groundwater ARARs	Yes	Yes	--	No	--
Onsite Surface Water ARARs	No	No	No	No	No
Offsite Surface Water ARARs	No	No	Yes	Yes	No

Groundwater ARARs are State HHSs.
Surface water ARARs are State HHSs or Acute AWQC, whichever is lower.
NM = Contaminant not modeled (Cu and Zn not included in TCLP suite).

On-site groundwater would exceed water quality ARARs for lead. On-site surface water would exceed water quality ARARs for As (HHS) and for Cd, Cu, Pb and Zn (Acute AWQC); offsite surface water would exceed water quality ARARs for As (HHS) and for Cd and Zn (Acute AWQC) .

8.2.3 Long-Term Effectiveness and Permanence

No controls or long-term measures would be placed on the contaminated materials at the site; consequently, all current and future risks would remain the same as described in the baseline risk assessment (Section 5). Therefore, the no action alternative would not be effective at minimizing risks from exposure to these materials.

8.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The no action alternative would provide no reduction in toxicity, mobility, or volume of the contaminated materials.

8.2.5 Short-Term Effectiveness

In the short-term, the no action alternative would pose no additional threats to the community or the environment as the current site conditions. The time required until reclamation objectives are reached (by natural contaminant degradation and erosion) would be indefinite and would most likely be measured in terms of geologic time frames.

8.2.6 Implementability

There would be no implementability concerns posed by the no action alternative since no action would be taken.

8.2.7 Costs

The cost for implementing this alternative would be zero since no action would be taken.

8.3 <u>ALTERNATIVE 3 (Solid Media): IN-PLACE CONTAINMENT</u>

Generally, in-place containment strategies for reclaiming mined lands involve establishing vegetation on the surfaces of the solid media contaminant sources. The purpose of establishing vegetation is to stabilize the surface (provide erosion protection) and to decrease net infiltration through the waste medium by increasing evapotranspiration processes. Containment technologies may involve establishing vegetation directly on the waste source or may involve applying a cover over the waste source upon which the vegetation is established. Covers may range from a simple, single-layered soil cover to a complex, multi-layered cover consisting of various composite materials.

Under Alternative 3 the waste rock dumps at the site would be recontoured and reclaimed in-place. Dumps with lower acid-producing potential would be reclaimed by incorporating proper amendments into the dump material before establishing vegetation. Dumps with higher acid producing potential would be reclaimed by placing a cover soil cap over the recontoured dumps. The discrete tailings piles (TP-1 through 5) would be removed from their present locations and consolidated with WR-4 prior to capping. Approximately one foot of contaminated underlying soils would also be removed from beneath the tailings. Because the lower waste rock dumps (WR-1, WR-2, WR-7 and WR-8) are located very near Indian Creek, the portions immediately adjacent to the current creek channel would be excavated and regraded, and extensive run-on controls would be designed as an integral part of the containment strategy. Portions of other waste rock dumps located near areas with high potential for erosion from surface water run-off channels (WR-6 and WR-10) would be regraded and extensive run-on controls would be designed as an integral part of the containment strategy. A detailed description of this alternative is included in Section 7.

8.3.1 Overall Protection of Human Health and the Environment

This alternative would provide a means of reducing soil ingestion exposure to the CoCs and would partially stabilize the surfaces of the sources with respect to migration to surface water. However, while implementing this alternative would be an improvement over current site conditions, several waste sources (WR-1, WR-2, WR-6, WR-7 and WR-10) would still be physically located along Indian Creek and the potential for future contaminant releases to surface water would continue to exist. Consequently, the reduction in risk to human health and the environment would not be sufficient to achieve the risk reductions dictated by the risk assessment. Alternative 3 would allow for the continued, though reduced, migration of contaminants and degradation of groundwater and surface water quality, though it does provide significant but insufficient reduction of soil ingestion exposure.

Some protection of human health would be achieved under this alternative. Reduction of human exposures to CoCs via the pathways of concern, as identified in the human health risk assessment, would occur. Soil ingestion exposure to As, Pb, Fe, and Cd via contaminated surface soil would be reduced, but only Cd would be reduced enough to meet the residential risk reduction levels; and exposure to Pb via groundwater ingestion would not be reduced enough for residential risk.

Limited protection of the environment would also be achieved under this alternative. Reduction of most ecologic exposures, via the scenarios identified in the ecologic risk assessment, would not occur: aquatic life exposure to Zn, Cd, Cu, and Pb via water and Pb, As, Zn, and Cd via sediment would not be sufficiently reduced; deer exposure to Pb via ingestion would not be reduced to acceptable levels; and plant phytotoxicity to As, Pb, Zn, Cd, and Cu would not be sufficiently reduced.

A risk reduction achievement matrix (Table 8-4) was developed to assess whether the alternative affords sufficient protection to human health and the environment for the pathways and CoCs

TABLE 8-4
RISK REDUCTION ACHIEVEMENT MATRIX FOR ALTERNATIVE 3

Alternative 3	As	Cd	Cu	Pb	Zn	Overall
Human Health Exposure Pathways:						
Soil Ingestion	None	Res.	Res.	None	Res.	None
Water Ingestion	Res.	Res.	Res.	Recr.	Res.	Recr.
Ecologic Exposure Pathways:						
Surface Water	--	No	No	No	No	No
Sediments	No	No	--	No	No	No
Deer Salt Ingestion	--	--	--	No	--	No
Plant Phytotoxicity	No	No	No	No	No	No

-- = Risk reduction not required for the contaminant for that pathway.
None = Does not achieve required risk reduction for any exposure scenario.
Recr. = Achieves required risk reduction for the recreational exposure scenario.
Res. = Achieves required risk reduction for the residential exposure scenario (most protective).

identified in the human health risk assessment (Section 5.1) and the ecological risk assessment (Section 5.2). The conclusions presented in the table are based on worst-case modeling results subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

8.3.2 Compliance with ARARs

There are no ARARs that apply to in-place stabilization/containment of contaminated solid media. Some water quality ARARs are not expected to be achieved under this alternative. A water quality ARARs attainment matrix (Table 8-5) was developed to assess whether the alternative can achieve ARARs for those contaminants and media where they are exceeded. The conclusions presented in the table are based on worst-case modeling results subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

On-site groundwater would still exceed water quality ARARs for lead. On-site surface water would exceed water quality ARARs for As (HHS) and for Cd, Cu, Pb and Zn (Acute AWQC); offsite surface water would exceed water quality ARARs for As (HHS) and for Cd and Zn (Acute AWQC). Note that a large portion of the surface water loadings are derived from the adit discharge at GW1 and without treatment of this discharge, ARARs cannot be met.

TABLE 8-5
WATER QUALITY ARARS ATTAINMENT FOR ALTERNATIVE 3

Alternative 3	As	Cd	Cu	Pb	Zn
On-site Groundwater (μg/L)	9	1.3	NM	66	NM
On-site Surface water (μg/L)	43	14	32	24	1990
Offsite Surface Water (μg/L)	47	6.4	4.1	3.3	1160
On-site Groundwater ARARs	Yes	Yes	--	No	--
On-site Surface Water ARARs	No	No	No	No	No
Offsite Surface Water ARARs	No	No	Yes	Yes	No

Groundwater ARARs are State HHSs.
Surface water ARARs are State HHSs or Acute AWQC, whichever is lower.
NM = Contaminant not modeled (Cu and Zn not included in TCLP suite).

Implementation of this alternative is expected to satisfy air quality regulations because the vegetative covers would stabilize the sources with respect to fugitive emissions. Occupational Safety and Health Administration (OSHA) requirements would be met by requiring appropriate safety training for all on-site workers during the construction phase.

The Park Mine site was determined to be eligible for listing on the National Register of Historic Places because it is a historic district with an intact collection of vernacular architecture. Some of these structures are located on or near waste sources and would need to be removed in order to remove or reclaim the area. Appropriate actions need to be taken to ensure that all necessary agreements are made and actions are taken to facilitate reclamation.

The remaining location-specific ARARs are expected to be met without any conflicts. Contacts with appropriate agencies regarding wetlands, floodplains, and paleontological remains would be required.

All action-specific ARARs are anticipated to be met including the hydrological regulations contained in the Strip and Underground Mine Reclamation Act. The mining wastes were derived from the beneficiation and extraction of ores and are, therefore, assumed to be exempt from federal government regulation through RCRA as a hazardous waste. Additionally, revegetation requirements contained in the Surface Mining Control and Reclamation Act would be met. State of Montana dust suppression and control requirements are applicable for earth-moving activities associated with this alternative for the control of fugitive dust emissions; these requirements would be met via water application to roads receiving heavy vehicular traffic and to excavation areas, as necessary.

The reclamation investigation indicated that some hydrocarbon contamination was present in the seep from WR-2. The exact nature and extent of the contamination is unknown. Additional sampling is needed to characterize the contamination and to determine if actions are needed to address the source. If the presence of the hydrocarbon contamination is confirmed additional ARARs may apply to this source.

8.3.3 Long-Term Effectiveness and Permanence

Under this alternative, the consolidated waste rock area and certain waste rock dumps (those with high liming rates) will be graded, capped with cover soils and revegetated. The revegetated caps would stabilize these sources by providing an erosion-resistant, vegetated surface that would provide protection from surface water and wind erosion, and would reduce net infiltration through the contaminated media by increasing evapotranspiration processes. Run-on controls and grading would reduce infiltration by directing upgradient flows around the area, as well as by eliminating ponding and promoting run-off from the caps. The caps and run-on controls would have to be maintained to ensure that they continue to perform as designed, and, consequently, long-term monitoring and frequent inspection and maintenance would be required. The caps would be susceptible to possible settlement, erosion, and disruption of cover integrity by vehicles, deep-rooting vegetation, and burrowing animals. However, the cover could be easily inspected and the required maintenance could be easily determined.

Grading and direct revegetation of the remaining waste rock dumps would stabilize these sources by providing an erosion-resistant, vegetated surface that would provide protection from surface water and wind erosion, and would reduce net infiltration through the contaminated media by increasing evapotranspiration processes. Run-on controls and grading would reduce infiltration by directing upgradient flows around the area, as well as by eliminating ponding and promoting run-off from the caps. Revegetation would consequently reduce the threat of direct contact and inhalation of airborne contaminants by on-site and nearby receptors. The long-term effectiveness of revegetation would be enhanced by carefully determining proper amendments, and selecting appropriate plant species, adapted to short growing seasons and high altitudes (as opposed to selecting native species exclusively).

In the long-term, the water quality and sediment environment (benthic community) in Indian Creek is expected to be improved by implementing this alternative. Also the downstream Indian Creek fishery is expected to benefit because the contaminant sources potentially impacting the stream would be stabilized with respect to surface water erosion. Additionally, the in-place containment strategy would improve the aesthetic quality of the area. The long-term effectiveness should be monitored by frequent inspections of the capped/reclaimed wastes (subsequent maintenance should be performed when necessary) and extended surface water and sediment monitoring in Indian Creek.

8.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The primary objective of this alternative is to provide a reduction in contaminant mobility: the volume or toxicity of the contaminants would not be reduced by implementing this alternative. Covering and revegetating or in-place grading and revegetation of the mine waste sources would stabilize these sources and reduce contaminant mobility via surface water and wind erosion. Groundwater impacts would also be reduced by decreasing infiltration through the waste sources by increasing the evapotranspiration process and by grading the reclaimed areas to prevent ponding and promote run-off. Removing the tailings located immediately adjacent to the creek and consolidating the tailings with waste rock away from the creek would reduce contaminant mobility and surface water impacts by increasing the distance between these wastes and the creek. Removing portions of waste rock dumps located adjacent to the creek, recontouring and stabilizing the stream channel would reduce contaminant mobility by reducing direct contact with the stream and reducing potential for surface water erosion. Based on modeling results, this alternative is expected to reduce the mobility of the on-site contaminants to an extent that would result in an overall human health risk reduction (all pathways and all routes of exposure considered) of 51% and an overall ecological risk reduction of 29%.

8.3.5 Short-Term Effectiveness

It is anticipated that the construction phase of this alternative would be accomplished in a relatively short time period (one field season); therefore, impacts associated with construction would be short-term. Short-term impacts to the surrounding community are expected to be minimal because of the remote location of the project site and the lack of a resident population. However, short term air quality impacts to the surrounding environment may occur due to the relatively large volumes of wastes requiring excavation and transportation. On-site workers would be adequately protected during the construction phase by utilizing appropriate personal protective equipment and by following proper operating and safety procedures. Control of fugitive dust emissions would be provided by applying water (via water truck) to surfaces receiving heavy vehicular traffic, or in excavation areas, etc.

Another potential short-term impact to the surrounding community would involve increased vehicle traffic (and associated safety hazards and dust generation) in the vicinity of private property along the access roads. The section of Indian Creek road below the west fork of Indian Creek is already subject to significant heavy truck traffic as a result of mine operations at the Continental Lime and the Diamond Hill facilities. These operations already employ various traffic and dust control measures on the main access road and additional controls may not be necessary in these areas. Application of water and/or dust suppressants to the roads in these areas may become necessary if dust generation is significant. The access road above the west fork of Indian Creek will require improvement to provide reasonable access for heavy equipment. In addition to the increased dust and vehicle traffic hazards associated with the construction, the road construction may cause short-term impacts on storm water run-off related to the construction activities. Traditional construction BMPs would be employed and can effectively reduce adverse impacts on surface water from the construction activities.

Under this alternative some wastes which are located directly in or near Indian Creek would be removed and/or re-contoured to stabilize the creek channel. These construction activities would occur directly in or very near the current stream channel and may cause significant short-term adverse impacts to water quality in the creek. For these reasons the creek would be diverted away from construction areas as needed to minimize these short-term impacts. Stormwater run-off from other general construction activities may also cause short-term adverse impacts to water quality in the creek. Traditional construction BMPs would be employed to address these sources, and can effectively reduce adverse impacts on surface water from the construction activities.

8.3.6 Implementability

This alternative is both technically and administratively feasible, and could be implemented in a relatively short period of time (one construction season). The road construction, excavation, consolidation, grading, capping, and revegetation steps required are considered conventional construction practices; materials and construction methods are readily available. Also, design methods and requirements are well documented and well understood. However, the construction steps required to implement this alternative are considered moderately difficult (due, in part, to the rough terrain and the remote location), and should only be performed by experienced contractors utilizing large-capacity equipment. Small capacity equipment and/or inexperienced contractors and crews would likely prolong the construction phase and may result in increased costs.

8.3.7 Costs

The total present worth cost for this alternative has been estimated at $1.24 million, which represents the remediation of all solid media contaminant sources present at the Park Mine site (tailings and waste rock). Table D-1 (Appendix D) presents the cost details associated with implementing this alternative. The total cost includes the present worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

8.4 ALTERNATIVE 4b (Solid Media): PARTIAL REMOVAL (Excluding Streamside Tailings) AND IN-PLACE CONTAINMENT

Alternative 4b is very similar to Alternative 3 in that it involves in-place containment of some of the waste sources present at the site. However, Alternative 4b involves completely removing most wastes which are located near Indian Creek and moving them to another location on-site. These wastes would be consolidated or contained with WR-4. The streamside tailings present as thin deposits on the floodplain of Indian Creek below the site are largely (>90%) vegetated. These tailings are mixed with alluvium present in the creek channel and floodplain. Because these tailings deposits are largely vegetated, segregation of the tailings from the alluvium would be difficult, and reclamation would cause severe disruption of the existing vegetation, these deposits will not be addressed under this alternative. Consolidation of wastes at the Park Mine site would be advantageous because it will increase the distance from the wastes to surface water. The other waste rock dumps would be recontoured and reclaimed in place. A detailed description of this alternative is presented in Section 7.

8.4.1 Overall Protection of Human Health and the Environment

This alternative would provide a means of reducing soil ingestion exposure and reducing exposure via groundwater to the CoCs and would stabilize the surfaces of the sources with respect to migration to surface water. However, while implementing this alternative would be a significant improvement over current site conditions, the potential for exposures to contaminant sources would continue to exist via soil ingestion, groundwater ingestion, and surface water contamination. Consequently, the reduction in risk to human health and the environment allows for the continued exposure to contaminants and degradation of groundwater and surface water quality.

Significant protection of human health would be achieved under this alternative. Reduction of human exposures to CoCs via the pathways of concern, as identified in the human health risk assessment, would occur. Soil ingestion exposure to As via contaminated surface soil would be reduced 73%, but would not meet the recreational level; and water ingestion exposure to Pb via groundwater would decrease 76%, but would remain at the recreational level.

Limited protection of the environment would also be achieved under this alternative. Reduction of most ecologic exposures, via the scenarios identified in the ecologic risk assessment, would not occur: aquatic life exposure to Zn, Cd, and Cu via surface water would not be sufficiently reduced; deer exposure to Pb via ingestion would not be reduced to acceptable levels; and plant phytotoxicity to As, Cd, Pb, and Zn would not be sufficiently reduced.

A risk reduction achievement matrix (Table 8-6) was developed to assess whether the alternative affords sufficient protection to human health and the environment for the pathways and CoCs identified in the human health risk assessment (Section 5.1) and the ecological risk assessment (Section 5.2). The conclusions presented in the table are based on worst-case modeling results subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

8.4.2 Compliance with ARARs

There are no ARARs that are required to be met for contaminated solid media. Some water quality ARARs are not expected to be achieved by this alternative. A water quality ARARs attainment matrix (Table 8-7) was developed to assess whether the alternative can achieve ARARs for those contaminants and media where they are exceeded. The conclusions presented in the table are based on worst-case modeling results subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-6
RISK REDUCTION ACHIEVEMENT MATRIX FOR ALTERNATIVE 4b

Alternative 4b	As	Cd	Cu	Pb	Zn	Overall
Human Health Exposure Pathways:						
Soil Ingestion	None	Res.	Res.	None	Res.	None
Water Ingestion	Res.	Res.	Res.	Recr.	Res.	Recr.
Ecologic Exposure Pathways:						
Surface Water	--	No	No	Yes	No	No
Sediments	Yes	Yes	--	Yes	Yes	Yes
Deer Salt Ingestion	--	--	--	No	--	No
Plant Phytotoxicity	No	No	Yes	No	No	No

-- = Risk reduction not required for the contaminant for that pathway.
None = Does not achieve required risk reduction for any exposure scenario.
Recr. = Achieves required risk reduction for the recreational exposure scenario.
Res. = Achieves required risk reduction for the residential exposure scenario (most protective).

TABLE 8-7
WATER QUALITY ARARS ATTAINMENT FOR ALTERNATIVE 4b

Alternative 4b	As	Cd	Cu	Pb	Zn
On-site Groundwater (μg/L)	8	0.6	NM	55	NM
On-site Surface water (μg/L)	18	7	8	5	1050
Offsite Surface Water (μg/L)	41	5	2	2	930
On-site Groundwater ARARs	Yes	Yes	--	No	--
On-site Surface Water ARARs	Yes	No	Yes	Yes	No
Offsite Surface Water ARARs	No	Yes	Yes	Yes	No

Groundwater ARARs are State HHSs.
Surface water ARARs are State HHSs or Acute AWQC, whichever is lower.
NM = Contaminant not modeled (Cu and Zn not included in TCLP suite).

On-site groundwater would still exceed water quality ARARs for lead. On-site surface water would exceed water quality ARARs for Cd and Zn (Acute AWQC); offsite surface water would exceed water quality ARARs for As (HHS) and for Zn (Acute AWQC). Note that a large portion of the surface water loadings are derived from the adit discharge at GW1 and without treatment of this discharge, ARARs cannot be met.

Implementation of this alternative is expected to satisfy air quality regulations because the vegetative covers would stabilize the sources with respect to fugitive emissions. OSHA requirements would be met by requiring appropriate safety training for all on-site workers during the construction phase.

The Park Mine site was determined to be eligible for listing on the National Register of Historic Places because it is a historic district with an intact collection of vernacular architecture. Some of these structures are located on or near waste sources and would need to be removed in order to remove or reclaim the area. Appropriate actions need to be taken to ensure that all necessary agreements are made and actions are taken to facilitate reclamation.

The remaining location-specific ARARs are expected to be met without any conflicts. Contacts with appropriate agencies regarding wetlands, floodplains, and paleontological remains would be required.

All action-specific ARARs are anticipated to be met including the hydrological regulations contained in the Strip and Underground Mine Reclamation Act. The mining wastes were derived from the beneficiation and extraction of ores and are therefore assumed to be exempt from federal government regulation through RCRA as a hazardous waste. Additionally, revegetation requirements contained in the Surface Mining Control and Reclamation Act would be met. State of Montana dust suppression and control requirements are applicable for earth-moving activities associated with this alternative for the control of fugitive dust emissions; these requirements would be met via water application to roads receiving heavy vehicular traffic and to excavation areas, if necessary.

The reclamation investigation indicated that some hydrocarbon contamination was present in the seep from WR-2. The exact nature and extent of the contamination is unknown. Additional sampling is needed to characterize the contamination and to determine if actions are needed to address the source. Under this alternative WR-2 would be removed from its current location. The presence of hydrocarbon contamination in the waste rock may make additional ARARs applicable to the excavation and relocation of this wastes source.

8.4.3 Long-Term Effectiveness and Permanence

Under this alternative, the consolidated waste rock area and waste rock dumps will be graded, capped with cover soils and revegetated. The revegetated caps would stabilize these sources by providing an erosion-resistant, vegetated surface that would provide protection from surface water and wind erosion, and would reduce net infiltration through the contaminated media by increasing evapotranspiration processes. Run-on controls and grading would reduce infiltration by directing upgradient flows around the area, as well as by eliminating ponding and promoting run-off from the caps. The caps and run-on controls would have to be maintained to ensure that they continue to perform as designed, and, consequently, long-term monitoring and frequent inspection and maintenance would be required. The caps would be susceptible to possible settlement, erosion, and disruption of cover integrity by vehicles, deep-rooting vegetation, and burrowing animals. However, the cover could be easily inspected and the required maintenance could be easily determined.

The cover soils and revegetation would consequently reduce the threat of direct contact and inhalation of airborne contaminants by on-site and nearby receptors. The long-term effectiveness of the cap would be enhanced by carefully determining proper amendments, and selecting appropriate plant species, adapted to short growing seasons and high altitudes (as opposed to selecting native species exclusively).

In the long-term, the water quality and sediment environment (benthic community) in Indian Creek is expected to be improved by implementing this alternative. Also the downstream Indian Creek fishery is expected to benefit because the contaminant sources potentially impacting the stream would be stabilized with respect to surface water erosion. Additionally, the in-place containment strategy would improve the aesthetic quality of the area. The long-term effectiveness should be monitored by frequent inspections of the capped/reclaimed wastes (subsequent maintenance should be performed when necessary) and extended surface water and sediment monitoring in Indian Creek.

8.4.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The primary objective of this alternative is to provide a reduction in contaminant mobility: the volume or toxicity of the contaminants would not be reduced by implementing this alternative. Covering and revegetating the mine waste sources would stabilize these sources and reduce contaminant mobility via surface water and wind erosion. Groundwater impacts would also be reduced by decreasing infiltration through the waste sources by increasing the evapotranspiration process and by grading the reclaimed areas to prevent ponding and promote run-off. Removing the tailings and waste rock located immediately adjacent to the creek and consolidating these wastes away from the creek would reduce contaminant mobility and surface water impacts by increasing the distance between these wastes and the creek and eliminating direct contact with Indian Creek. Removal of WR-2, in particular, is expected to have significant effects on surface water quality because it is expected to reduce seepage from the waste rock dump and subsequent discharge to Indian Creek. Based on modeling results, this alternative is expected to reduce the mobility of the on-site contaminants to an extent that would result in an overall human health risk reduction (all pathways and all routes of exposure considered) of 73% and an overall ecological risk reduction of 79%.

8.4.5 Short-Term Effectiveness

It is anticipated that the construction phase of this alternative would be accomplished in a relatively short time period (one field season); therefore, impacts associated with construction would be short-term. Short-term impacts to the surrounding community are expected to be minimal because of the remote location of the project site and the lack of a resident population. However, short term air quality impacts to the surrounding environment may occur due to the relatively large volumes of wastes requiring excavation and transportation. On-site workers would be adequately protected during the construction phase by utilizing appropriate personal protective equipment and by following proper operating and safety procedures. Control of fugitive dust emissions would be provided by applying water (via water truck) to surfaces receiving heavy vehicular traffic, or in excavation areas, etc.

Another potential short-term impact to the surrounding community would involve increased vehicle traffic (and associated safety hazards and dust generation) in the vicinity of private property along the access roads. The section of Indian Creek road below the west fork of Indian Creek is already subject to significant heavy truck traffic as a result of mine operations at the Continental Lime and the Diamond Hill facilities. These operations already employ various traffic and dust control measures on the main access road and additional controls may not be necessary in these areas. Application of water and/or dust suppressants to the roads in these areas may become necessary if dust generation is significant. The access road above the west fork of Indian Creek will require improvement to provide reasonable access for heavy equipment. In addition to the increased dust and vehicle traffic hazards associated with the construction, the road construction may cause short-term impacts on storm water run-off related to the construction activities. Traditional construction BMPs would be employed and can effectively reduce adverse impacts on surface water from the construction activities.

Under this alternative wastes which are located directly in or near Indian Creek would be removed and/or re-contoured to stabilize the creek channel. These construction activities would occur directly in or very near the current stream channel and may cause significant short-term adverse impacts to water quality in the creek. For these reasons the creek would be diverted away from construction areas as needed to minimize these short-term impacts. Stormwater run-off from other general construction activities may also cause short-term adverse impacts to water quality in the creek. Traditional construction BMPs would be employed to address these sources, and can effectively reduce adverse impacts on surface water from the construction activities.

8.4.6 Implementability

This alternative is both technically and administratively feasible, and could be implemented in a relatively short period of time (one construction season). The excavation, consolidation, grading, capping, and revegetation steps required are considered conventional construction practices; materials and construction methods are readily available. Also, design methods and requirements are well documented and well understood. However, the construction steps required to implement this alternative are considered moderately difficult (due, in part, to the rough terrain, potentially complex construction sequencing, and the remote location), and should only be performed by experienced contractors utilizing large-capacity equipment. Small capacity equipment and/or inexperienced contractors and crews would likely prolong the construction phase and may result in increased costs.

8.4.7 Costs

The total present worth cost for this alternative has been estimated at $1.38 million, which represents the remediation of all solid media contaminant sources present at the Park Mine site (tailings and waste rock). Table D-3 (Appendix D) presents the cost details associated with implementing this alternative. The total cost includes the present worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

8.5 ALTERNATIVE 5b (Solid Media): PARTIAL REMOVAL/DISPOSAL OF SOLID MEDIA ON-SITE IN A MODIFIED RCRA REPOSITORY AND PARTIAL IN-PLACE CONTAINMENT

Alternative 5b involves removing the solid media contaminant sources at the Park Mine site which exhibit hazardous waste characteristics (toxicity) and disposing of these wastes in a constructed repository; however, instead of constructing a repository that fully satisfies all RCRA Subtitle C criteria, a modified repository design (as shown on Figure 7-6) would be used. The repository would be located in the vicinity of the reservoir and would cover approximately 1.1 acre to contain approximately 16,500 cubic yards of tailings. The other waste sources which are currently located adjacent to Indian Creek, but which do not exhibit hazardous waste characteristics would be removed from the creek channel and consolidated near WR-4. The remaining waste rock dumps would be recontoured and reclaimed in-place. A detailed description of this alternative is presented in Section 7.

8.5.1 Overall Protection of Human Health and the Environment

This alternative would provide a means of significantly reducing soil ingestion and groundwater ingestion exposure to the CoCs and would stabilize the surfaces of the sources with respect to migration to surface water. However, while implementing this alternative would be a significant improvement over current site conditions, the potential for exposures to contaminant sources would continue to exist via soil ingestion and surface water contamination. Consequently, the reduction in risk to human health and the environment allows for the continued exposure to contaminants and degradation of surface water quality.

Significant protection of human health would be achieved under this alternative. Reduction of human exposures to CoCs via the pathways of concern, as identified in the human health risk assessment, would occur. Soil ingestion exposure to As via contaminated surface soil would be reduced 81%, but would not meet the recreational level; water ingestion exposure to Pb via groundwater would decrease 96% and would meet the residential risk level.

Limited protection of the environment would also be achieved under this alternative. Reduction of most ecologic exposures, via the scenarios identified in the ecologic risk assessment, would not occur: aquatic life exposure to Zn, Cd, and Cu via surface water would not be sufficiently reduced; deer exposure to Pb via ingestion would not be reduced to acceptable levels; and plant phytotoxicity to As, Cd, Pb, and Zn would not be sufficiently reduced.

A risk reduction achievement matrix (Table 8-8) was developed to assess whether the alternative affords sufficient protection to human health and the environment for the pathways and CoCs identified in the human health risk assessment (Section 5.1) and the ecological risk assessment (Section 5.2). The conclusions presented in the table are based on worst-case modeling results subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-8
RISK REDUCTION ACHIEVEMENT MATRIX FOR ALTERNATIVE 5b

Alternative 5b	As	Cd	Cu	Pb	Zn	Overall
Human Health Exposure Pathways:						
Soil Ingestion	None	Res.	Res.	Recr.	Res.	None
Water Ingestion	Res.	Res.	Res.	Res.	Res.	Res.
Ecologic Exposure Pathways:						
Surface Water	--	No	No	Yes	No	No
Sediments	Yes	Yes	--	Yes	Yes	Yes
Deer Salt Ingestion	--	--	--	No	--	No
Plant Phytotoxicity	No	No	Yes	No	No	No

-- = Risk reduction not required for the contaminant for that pathway.
None = Does not achieve required risk reduction for any exposure scenario.
Recr. = Achieves required risk reduction for the recreational exposure scenario.
Res. = Achieves required risk reduction for the residential exposure scenario (most protective).

8.5.2 Compliance with ARARs

There are no ARARs that are required to be met for contaminated solid media. Some water quality ARARs are not expected to be achieved by this alternative. A water quality ARARs attainment matrix (Table 8-9) was developed to assess whether the alternative can achieve ARARs for those contaminants and media where they are exceeded. The conclusions presented in the table are based on worst-case modeling results subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-9
WATER QUALITY ARARS ATTAINMENT FOR ALTERNATIVE 5b

Alternative 5b	As	Cd	Cu	Pb	Zn
On-site Groundwater (μg/L)	7	0.4	NM	8	NM
On-site Surface water (μg/L)	18	7	8	5	1050
Offsite Surface Water (μg/L)	41	5	2	2	930
On-site Groundwater ARARs	Yes	Yes	--	Yes	--
On-site Surface Water ARARs	Yes	No	Yes	Yes	No
Offsite Surface Water ARARs	No	Yes	Yes	Yes	No

Groundwater ARARs are State HHSs.
Surface water ARARs are State HHSs or Acute AWQC, whichever is lower.
NM = Contaminant not modeled (Cu and Zn not included in TCLP suite).

On-site groundwater would meet water quality ARARs. On-site surface water would exceed water quality ARARs for Cd and Zn (Acute AWQC); offsite surface water would exceed water quality ARARs for As (HHS) and for Zn (Acute AWQC). Note that a large portion of the surface water loadings are derived from the adit discharge at GW1 and without treatment of this discharge, ARARs cannot be met.

Implementation of this alternative is expected to satisfy air quality regulations because the repository cap and vegetative covers would stabilize the sources with respect to fugitive emissions. OSHA requirements would be met by requiring appropriate safety training for all on-site workers during construction activities.

The Park Mine site was determined to be eligible for listing on the National Register of Historic Places because it is a historic district with an intact collection of vernacular architecture. Some of these structures are located on or near waste sources and would need to be removed in order to remove or reclaim the area. Appropriate actions need to be taken to ensure that all necessary agreements are made and actions are taken to facilitate reclamation.

The remaining location-specific ARARs are expected to be met without any conflicts. Contacts with appropriate agencies regarding wetlands, floodplains, and paleontological remains would be required.

All action-specific ARARs are anticipated to be met including the hydrological regulations contained in the Strip and Underground Mine Reclamation Act. The mining wastes were derived from the beneficiation and extraction of ores and are therefore assumed to be exempt from federal regulation through RCRA as a hazardous waste. Additionally, revegetation requirements contained in the Surface Mining Control and Reclamation Act would be met. State of Montana dust suppression and control requirements are applicable for earth-moving activities associated with this alternative for the control of fugitive dust emissions; these requirements would be met via water application to roads receiving heavy vehicular traffic and to excavation areas, if necessary.

The reclamation investigation indicated that some hydrocarbon contamination was present in the seep from WR-2. The exact nature and extent of the contamination is unknown. Additional sampling is needed to characterize the contamination and to determine if actions are needed to address the source. Under this alternative WR-2 would be removed from its current location. The presence of hydrocarbon contamination in the waste rock may make additional ARARs applicable to the excavation and relocation of this wastes source.

8.5.3 Long-Term Effectiveness and Permanence

Under this alternative, the constructed repository would have to be maintained to ensure that it continues to perform as designed. The actual design life of the repository is not certain, and, consequently, long-term monitoring and routine inspection and maintenance would be required. The repository cap would likely be the component most vulnerable to any damage or degradation that might occur. Multilayered caps are susceptible to settlement, ponding of surface water, erosion, and disruption of cover integrity by vehicles, deep-rooting vegetation, and burrowing animals. However, the cap could be easily inspected and the required maintenance could be easily determined and performed. Additionally, the leachate collection and removal system may require routine maintenance including clearing of piping (clearing vegetation and/or soil) and evaporation pond maintenance.

The consolidated waste rock area and waste rock dumps will be graded, capped with cover soils and revegetated. The revegetated caps would stabilize these sources by providing an erosion-resistant, vegetated surface that would provide protection from surface water and wind erosion, and would reduce net infiltration through the contaminated media by increasing evapotranspiration processes. Run-on controls and grading would reduce infiltration by directing upgradient flows around the area, as well as by eliminating ponding and promoting run-off from the caps. The caps and run-on controls would have to be maintained to ensure that they continue to perform as designed, and, consequently, long-term monitoring and frequent inspection and maintenance would be required. The caps would be susceptible to possible settlement, erosion, and disruption of cover integrity by vehicles, deep-rooting vegetation, and burrowing animals. However, the cover could be easily inspected and the required maintenance could be easily determined.

The cover soils and revegetation would consequently reduce the threat of direct contact and inhalation of airborne contaminants by on-site and nearby receptors. The long-term effectiveness of the cap would be enhanced by carefully determining proper amendments, and selecting appropriate plant species, adapted to short growing seasons and high altitudes (as opposed to selecting native species exclusively).

In the long-term, the water quality and sediment environment (benthic community) in Indian Creek is expected to be improved by implementing this alternative. Also the downstream Indian Creek fishery is expected to benefit because the contaminant sources potentially impacting the stream would be stabilized with respect to surface water erosion. Additionally, the in-place containment strategy would improve the aesthetic quality of the area. The long-term effectiveness should be monitored by frequent inspections of the capped/reclaimed wastes (subsequent maintenance should be performed when necessary) and extended surface water and sediment monitoring in Indian Creek.

8.5.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The primary objective of this alternative is to provide a significant reduction in contaminant mobility: the volume or toxicity of the contaminants would not be physically reduced. The primary waste sources of concern would be rendered essentially immobile in an engineered structure and physical location which is protected from erosion problems. The engineered repository would eliminate the direct contact and surface water erosion exposure pathways, and would nearly eliminate leaching of contaminants to groundwater.

Covering and revegetating the remaining mine waste sources would stabilize these sources and reduce contaminant mobility via surface water and wind erosion. Groundwater impacts would also be reduced by decreasing infiltration through the waste sources by increasing the evapotranspiration process and by grading the reclaimed areas to prevent ponding and promote run-off. Removing the tailings and waste rock located immediately adjacent to the creek and consolidating these wastes away from the creek would reduce contaminant mobility and surface water impacts by increasing the distance between these wastes and the creek and eliminating direct contact with Indian Creek. Removal of WR-2, in particular, is expected to have significant effects on surface water quality because it is expected to reduce seepage from the waste rock dump and subsequent discharge to Indian Creek. Based on modeling results, this alternative is expected to reduce the mobility of the on-site contaminants to an extent that would result in an overall human health risk reduction (all pathways and all routes of exposure considered) of 81% and an overall ecological risk reduction of 79%.

8.5.5 Short-Term Effectiveness

It is anticipated that the construction phase of this alternative would be accomplished in a relatively short time period (one field season); therefore, impacts associated with construction would be short-term. Short-term impacts to the surrounding community are expected to be minimal because of the remote location of the project site and the lack of a resident population. However, short term air quality impacts to the surrounding environment may occur due to the relatively large volumes of wastes requiring excavation and transportation. On-site workers would be adequately protected during the construction phase by utilizing appropriate personal protective equipment and by following proper operating and safety procedures. Control of fugitive dust emissions would be provided by applying water (via water truck) to surfaces receiving heavy vehicular traffic, or in excavation areas, etc.

Another potential short-term impact to the surrounding community would involve increased vehicle traffic (and associated safety hazards and dust generation) in the vicinity of private property along the access roads. The section of Indian Creek road below the west fork of Indian Creek is already subject to significant heavy truck traffic as a result of mine operations at the Continental Lime and the Diamond Hill facilities. These operations already employ various traffic and dust control measures on the main access road and additional controls may not be necessary in these areas. Application of water and/or dust suppressants to the roads in these areas may become necessary if dust generation is significant. The access road above the west fork of Indian Creek will require improvement to provide reasonable access for heavy equipment. In addition to the increased dust and vehicle traffic hazards associated with the construction, the road construction may cause short-term impacts on storm water run-off related to the construction activities. Traditional construction BMPs would be employed and can effectively reduce adverse impacts on surface water from the construction activities.

Under this alternative wastes which are located directly in or near Indian Creek would be removed and/or re-contoured to stabilize the creek channel. These construction activities would occur directly in or very near the current stream channel and may cause significant short-term adverse impacts to water quality in the creek. For these reasons the creek would be diverted away from construction areas as needed to minimize these short-term impacts. Stormwater run-off from other general construction activities may also cause short-term adverse impacts to water quality in the creek. Traditional construction BMPs would be employed to address these sources, and can effectively reduce adverse impacts on surface water from the construction activities.

8.5.6 Implementability

This alternative is both technically and administratively feasible. It is anticipated that the alternative could be implemented in a relatively short period of time (one field season). The construction of a lined repository with a multilayered cap, and grading and revegetation of mine wastes are conventional construction practices; materials and construction methods are readily available. Also, design methods and requirements are well documented and well understood. However, the construction steps required to implement this alternative are considered moderately difficult (due to the rough terrain, potentially complex construction sequencing, and the remote location), and should only be performed by experienced contractors utilizing large-capacity equipment. Small capacity equipment and/or inexperienced contractors and crews would likely prolong the construction phase and may result in increased costs and compromised performance.

Technical feasibility may be limited by the area available to construct a repository on-site. It may not be feasible to construct a repository with the required capacity for this alternative. Even if a repository with adequate capacity is constructed on-site, it will require disturbing a significant amount of previously unimpacted land.

A component which could potentially prolong the implementation of this alternative as planned includes the potential for discovering unsatisfactory subsurface construction conditions in the repository area. Potential unsatisfactory subsurface construction conditions in the repository area may include discontinuous natural soils and/or shallow bedrock or abundant coarse rock. These conditions may require the addition of clay in areas of the repository subgrade, or may require a modification in the repository layout, which could substantially increase the cost of this alternative.

8.5.7 Costs

The total present worth cost of this alternative has been estimated at $1.71 million. Table D-5 (Appendix D) presents the cost details associated with this alternative. The total cost includes the present worth value of 30 years of annual maintenance and monitoring costs in addition to the capital costs.

8.6 ALTERNATIVE 5c: PARTIAL REMOVAL AND DISPOSAL IN AN UNLINED REPOSITORY AND IN-PLACE CONTAINMENT

This alternative is similar to Alternative 5a and 5b discussed previously with the exception of the repository design. Instead of a repository that fully satisfies RCRA Subtitle C criteria or a modified repository design, an unlined repository with a composite cap would be used. Further, the entire waste consolidation area at WR-4 would be covered with the composite cap. Under this scenario all of the higher-risk wastes (tailings, near stream wastes, and wastes which failed the TCLP test) would be excavated and disposed in an unlined repository. A typical cross-section of the Alternative 5c repository is shown on Figure 7-8. The location of the consolidated wastes would be the same as for previous alternatives. A detailed description of this alternative is presented in Section 7.

8.6.1 Overall Protection of Human Health and the Environment

This alternative would provide a means of significantly reducing soil ingestion exposure and reducing exposure via groundwater to the CoCs and would stabilize the surfaces of the sources with respect to migration to surface water. However, while implementing this alternative would be a significant improvement over current site conditions, the potential for exposures to contaminant sources would continue to exist via soil ingestion and surface water contamination. Consequently, the reduction in risk to human health and the environment allows for the continued exposure to contaminants and degradation of groundwater and surface water quality.

Significant protection of human health would be achieved under this alternative. Reduction of human exposures to CoCs via the pathways of concern, as identified in the human health risk assessment, would occur. Soil ingestion exposure to As via contaminated surface soil would be reduced 84%, but would not meet the recreational risk level; water ingestion exposure to Pb via groundwater would decrease 95%, achieving the residential level.

Limited protection of the environment would also be achieved under this alternative. Reduction of most ecologic exposures, via the scenarios identified in the ecologic risk assessment, would not occur; aquatic life exposure to Zn, Cd, and Cu via surface water would not be sufficiently reduced; deer exposure to Pb via ingestion would not be reduced to acceptable levels; and plant phytotoxicity to As, Pb, and Zn would not be sufficiently reduced.

A risk reduction achievement matrix (Table 8-10) was developed to assess whether the alternative affords sufficient protection to human health and the environment for the pathways and CoCs identified in the human health risk assessment (Section 5.1) and the ecological risk assessment (Section 5.2). The conclusions presented in the table are based on worst-case modeling results subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-10
RISK REDUCTION ACHIEVEMENT MATRIX FOR ALTERNATIVE 5c

Alternative 5c	As	Cd	Cu	Pb	Zn	Overall
Human Health Exposure Pathways:						
Soil Ingestion	None	Res.	Res.	Recr.	Res.	None
Water Ingestion	Res.	Res.	Res.	Res.	Res.	Res.
Ecologic Exposure Pathways:						
Surface Water	--	No	No	Yes	No	No
Sediments	Yes	Yes	--	Yes	Yes	Yes
Deer Salt Ingestion	--	--	--	No	--	No
Plant Phytotoxicity	No	Yes	Yes	No	No	No

-- = Risk reduction not required for the contaminant for that pathway.
None = Does not achieve required risk reduction for any exposure scenario.
Recr. = Achieves required risk reduction for the recreational exposure scenario.
Res. = Achieves required risk reduction for the residential exposure scenario (most protective).

8.6.2 Compliance with ARARs

There are no ARARs that are required to be met for contaminated solid media. Some water quality ARARs are not expected to be achieved by this alternative. A water quality ARARs attainment matrix (Table 8-11) was developed to assess whether the alternative can achieve ARARs for those contaminants and media where they are exceeded. The conclusions presented in the table are based on worst-case modeling results subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-11
WATER QUALITY ARARS ATTAINMENT FOR ALTERNATIVE 5c

Alternative 5c	As	Cd	Cu	Pb	Zn
Onsite Groundwater (ug/L)	7	0.2	NM	12	NM
Onsite Surface water (ug/L)	18	7	8	5	1050
Offsite Surface Water (ug/L)	41	5	2	2	930
Onsite Groundwater ARARs	Yes	Yes	--	Yes	--
Onsite Surface Water ARARs	Yes	No	Yes	Yes	No
Offsite Surface Water ARARs	No	Yes	Yes	Yes	No

Groundwater ARARs are State HHSs.
Surface water ARARs are State HHSs or Acute AWQC, whichever is lower.
NM = Contaminant not modeled (Cu and Zn not included in TCLP suite).

On-site groundwater would meet water quality ARARs. On-site surface water would exceed water quality ARARs for Cd and Zn (Acute AWQC); off-site surface water would exceed water quality ARARs for As (HHS) and for Zn (Acute AWQC). Note that a large portion of the surface water loadings are derived from the adit discharge at GW1 (approximately 50%) and without treatment of this discharge, ARARs cannot be met.

Implementation of this alternative is expected to satisfy air quality regulations because the repository cap and vegetative covers would stabilize the sources with respect to fugitive emissions. OSHA requirements would be met by requiring appropriate safety training for all on-site workers during construction activities.

The Park Mine site was determined to be eligible for listing on the National Register of Historic Places because it is a historic district with an intact collection of vernacular architecture. Some of these structures are located on or near waste sources and would need to be removed in order to remove or reclaim the area. Appropriate actions need to be taken to ensure that all necessary agreements are made and actions are taken to facilitate reclamation.

The remaining location-specific ARARs are expected to be met without any conflicts. Contacts with appropriate agencies regarding wetlands, floodplains, and paleontological remains would be required.

All action-specific ARARs are anticipated to be met including the hydrological regulations contained in the Strip and Underground Mine Reclamation Act. The mining wastes were derived from the beneficiation and extraction of ores and are therefore assumed to be exempt from federal regulation through RCRA as a hazardous waste. Additionally, revegetation requirements contained in the Surface Mining Control and Reclamation Act would be met. State of Montana dust suppression and control requirements are applicable for earth-moving activities associated with this alternative for the control of fugitive dust emissions; these requirements would be met via water application to roads receiving heavy vehicular traffic and to excavation areas, if necessary.

The reclamation investigation indicated that some hydrocarbon contamination was present in the seep from WR-2. The exact nature and extent of the contamination is unknown. Additional sampling is needed to characterize the contamination and to determine if actions are needed to address the source. Under this alternative WR-2 would be removed from its current location. The presence of hydrocarbon contamination in the waste rock may make additional ARARs applicable to the excavation and relocation of this waste source.

8.6.3 Long-Term Effectiveness and Permanence

Under this alternative, the composite cap would have to be maintained to ensure that it continues to perform as designed. The actual design life of the repository is not certain, and, consequently, long-term monitoring and routine inspection and maintenance would be required. The repository cap would likely be the component most vulnerable to any damage or degradation that might occur. Multilayered caps are susceptible to settlement, ponding of surface water, erosion, and disruption of cover integrity by vehicles, deep-rooting vegetation, and burrowing animals. However, the cap could be easily inspected and the required maintenance could be easily determined and performed. The cap is also expected o have higher long-term effectiveness than a soil cover alone. Additionally, the leachate collection and removal system may require routine maintenance including clearing of piping (clearing vegetation and/or soil) and evaporation pond maintenance.

The consolidated waste rock area and waste rock dumps will be graded, capped with cover soils and revegetated. The revegetated caps would stabilize these sources by providing an erosion-resistant, vegetated surface that would provide protection from surface water and wind erosion, and would reduce net infiltration through the contaminated media by increasing evapotranspiration processes. Run-on controls and grading would reduce infiltration by directing upgradient flows around the area, as well as by eliminating ponding and promoting run-off from the caps. The caps and run-on controls would have to be maintained to ensure that they continue to perform as designed, and, consequently, long-term monitoring and frequent inspection and maintenance would be required. The caps would be susceptible to possible settlement, erosion, and disruption of cover integrity by vehicles, deep-rooting vegetation, and burrowing animals. However, the cover could be easily inspected and the required maintenance could be easily determined.

The cover soils and revegetation would consequently reduce the threat of direct contact and inhalation of airborne contaminants by on-site and nearby receptors. The long-term effectiveness of the cap would be enhanced by carefully determining proper amendments, and selecting appropriate plant species, adapted to short growing seasons and high altitudes (as opposed to selecting native species exclusively).

In the long-term, the water quality and sediment environment (benthic community) in Indian Creek is expected to be improved by implementing this alternative. Also the downstream Indian Creek fishery is expected to benefit because the contaminant sources potentially impacting the stream would be stabilized with respect to surface water erosion. Additionally, the in-place containment strategy would improve the aesthetic quality of the area. The long-term effectiveness should be monitored by frequent inspections of the capped/reclaimed wastes (subsequent maintenance should be performed when necessary) and extended surface water and sediment monitoring in Indian Creek.

8.6.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The primary objective of this alternative is to provide a significant reduction in contaminant mobility; the volume or toxicity of the contaminants would not be physically reduced. The primary waste sources of concern would be rendered essentially immobile in an engineered structure and physical location which is protected from erosion problems. The engineered repository would eliminate the direct contact and surface water erosion exposure pathways, and would greatly reduce leaching of contaminants to groundwater.

Covering and revegetating the remaining mine waste sources would stabilize these sources and reduce contaminant mobility via surface water and wind erosion. Groundwater impacts would also be reduced by decreasing infiltration through the waste sources by increasing the evapotranspiration process and by grading the reclaimed areas to prevent ponding and promote run-off. Removing the tailings and waste rock located immediately adjacent to the creek and consolidating these wastes away from the creek would reduce contaminant mobility and surface water impacts by increasing the distance between these wastes and the creek and eliminating direct contact with Indian Creek. Removal of WR-2, in particular, is expected to have significant effects on surface water quality because it is expected to reduce seepage from the waste rock dump and subsequent discharge to Indian Creek. Based on modeling results, this alternative is expected to reduce the mobility of the on-site contaminants to an extent that would result in an overall human health risk reduction (all pathways and all routes of exposure considered) of 84% and an overall ecological risk reduction of 82%.

8.6.5 Short-Term Effectiveness

It is anticipated that the construction phase of this alternative would be accomplished in a relatively short time period (one field season); therefore, impacts associated with construction would be short-term. Short-term impacts to the surrounding community are expected to be minimal because of the remote location of the project site and the lack of a resident population. However, short term air quality impacts to the surrounding environment may occur due to the relatively large volumes of wastes requiring excavation and transportation. On-site workers would be adequately protected during the construction phase by utilizing appropriate personal protective equipment and by following proper operating and safety procedures. Control of fugitive dust emissions would be provided by applying water (via water truck) to surfaces receiving heavy vehicular traffic, or in excavation areas, etc.

Another potential short-term impact to the surrounding community would involve increased vehicle traffic (and associated safety hazards and dust generation) in the vicinity of private property along the access roads. The section of Indian Creek road below the West Fork of Indian Creek is already subject to significant heavy truck traffic as a result of mine operations at the Continental Lime and the Diamond Hill facilities. These operations already employ various traffic and dust control measures on the main access road and additional controls may not be necessary in these areas. Application of water and/or dust suppressants to the roads in these areas may become necessary if dust generation is significant. The access road above the West Fork of Indian Creek will require improvement to provide reasonable access for heavy equipment. In addition to the increased dust and vehicle traffic hazards associated with the construction, the road construction may cause short-term impacts on storm water run-off related to the construction activities. Traditional construction BMPs would be employed and can effectively reduce adverse impacts on surface water from the construction activities.

Under this alternative wastes which are located directly in or near Indian Creek would be removed and/or re-contoured to stabilize the creek channel. These construction activities would occur directly in or very near the current stream channel and may cause significant short-term adverse impacts to water quality in the creek. For these reasons the creek would be diverted away from construction areas as needed to minimize these short-term impacts. Stormwater run-off from other general construction activities may also cause short-term adverse impacts to water quality in the creek. Traditional construction BMPs would be employed to address these sources, and can effectively reduce adverse impacts on surface water from the construction activities.

8.6.6 Implementability

This alternative is both technically and administratively feasible. It is anticipated that the alternative could be implemented in a relatively short period of time (one field season). The construction of a lined repository with a multilayered cap, and grading and revegetation of mine wastes are conventional construction practices; materials and construction methods are readily available. Also, design methods and requirements are well documented and well understood. However, the construction steps required to implement this alternative are considered moderately difficult (due to the rough terrain, potentially complex construction sequencing, and the remote location), and should only be performed by experienced contractors utilizing large-capacity equipment. Small capacity equipment and/or inexperienced contractors and crews would likely prolong the construction phase and may result in increased costs and compromised performance.

Technical feasibility may be limited by the area available to construct a repository on-site. It may not be feasible to construct a repository with the required capacity for this alternative. Even if a repository with adequate capacity is constructed on-site, it will require disturbing a significant amount of previously unimpacted land. Construction of the repository on the waste rock foundation may be particularly complex and will require careful quality control to ensure the stability of the repository.

A component which could potentially prolong the implementation of this alternative as planned includes the potential for discovering unsatisfactory subsurface construction conditions in the repository area. Potential unsatisfactory subsurface construction conditions in the repository area may include discontinuous natural soils and/or shallow bedrock or abundant coarse rock. These conditions may require the addition of clay in areas of the repository subgrade, or may require a modification in the repository layout, which could substantially increase the cost of this alternative.

8.6.7 Costs

The total present worth cost of this alternative has been estimated at $1.67 million. Table D-6 (Appendix D) presents the cost details associated with this alternative. The total cost includes the present worth value of 30 years of annual maintenance and monitoring costs in addition to the capital costs.

9.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section provides a comparison of the solid media reclamation alternatives retained for the Park Mine site. The comparison focuses mainly on the following criteria: 1) the relative protectiveness of human health and the environment provided by the alternatives; 2) the long-term effectiveness provided by the alternatives; and 3) the estimated attainment of ARARs for each alternative. Modeling results are used in the comparisons to contrast the two threshold criteria of "overall protection of human health and the environment" and "compliance with ARARs" for each alternative. The primary balancing criteria are also compared; although the evaluation of each of these criteria is very similar due to the technical similarities in the alternatives themselves, with the exception of costs. Table 9-1 presents a summary of the alternatives with respect to the first seven evaluation criteria.

Of the alternatives retained for the site, Alternatives 4b, 5b and 5c provide the greatest overall protectiveness of human health and the environment. These alternatives are expected to achieve compliance with action- and location-specific ARARs. However, while each alternative significantly reduces the risks associated with groundwater and surface water, none of them are expected to satisfy all groundwater and surface water quality ARARs. Alternative 4b, involves removing all wastes located near the creek and consolidating the wastes away from the creek and provided a 73% human health risk reduction and a 79% reduction in the ecological risk. Alternative 5b involves removing all wastes located near the creek and consolidating the wastes away from the creek and disposing all wastes which failed the TCLP test in an on-site Modified RCRA-C repository and provided an 81% human health risk reduction and an 79% reduction in the ecological risk. Alternative 5c involves removing all wastes located near the creek and all wastes which failed the TCLP test and disposing the wastes in an unlined repository with a composite cap near WR-4 and provided an 84% human health risk reduction and an 82% reduction in the ecological risk.

Alternatives 3 is also expected to satisfy action- and location-specific ARARs, but would also not satisfy groundwater and surface water ARARs. Because of the smaller reduction in contaminant mobility provided by this alternative, less risk reduction is provided and more groundwater and surface water standards are exceeded for more contaminants than in Alternatives 4b, 5b and 5c. Comparison of Alternative 1 (no action) to the other alternatives shows no net reduction in risk provided, as well as non-attainment of several ARARs.

The wastes would not be treated to reduce contaminant volume or toxicity under any of the alternatives evaluated in detail. Under Alternative 6 the wastes which failed the TCLP test would be treated to remove their hazardous characteristics before disposal in a Class II landfill. However, this alternative was determined to be cost prohibitive and may not have been technically difficult to implement, and was not considered in detail. All of the alternatives (except the no action alternative) would provide varying degrees of reduction in contaminant mobility.

TABLE 9-1: COMPARATIVE ANALYSIS OF ALTERNATIVES (SOLID MEDIA - TAILINGS AND WASTE ROCK)

Assessment Criteria	**Alternative 1:** No Action	**Alternative 3:** In-Place Containment	**Alternative 4b:** Partial Removal (excluding Streamside Tailings) and In-Place Containment	**Alternative 5b:** Partial Removal and Disposal in an On-Site Modified RCRA C Repository	**Alternative 5c:** Partial Removal and Disposal in an On-Site Modified RCRA C Repository
Overall Protectiveness of Public Health, Safety, and Welfare -	No reduction in risk.	Containment and stabilization of sources is expected to reduce human exposure risk by 51% overall.	Partial removal and containment/stabilization of sources is expected to reduce human exposure risk by 73% overall.	Encapsulation and stabilization of sources is expected to reduce human exposure risk by 81%.	Encapsulation and stabilization of sources is expected to reduce human exposure risk by 84%.
Environmental Protectiveness -	No protection offered.	Containment and stabilization of sources is expected to reduce ecological exposure risk by 29% overall.	Partial removal and containment/stabilization of sources is expected to reduce ecological exposure risk by 79% overall.	Encapsulation and stabilization of sources is expected to reduce ecological exposure risk by 79% overall.	Encapsulation and stabilization of sources is expected to reduce ecological exposure risk by 82% overall.
Compliance with ARARs -					
Chemical Specific	HHS for Pb in on-site GW not attained. HHS for As, Cd, & Pb in SW not attained. Acute ALS for Cd, Cu, & Zn in SW not attained.	HHS for Pb in on-site GW not attained. HHS for As, Cd, & Pb in SW not attained. Acute ALS for Cd, Cu & Zn in SW not attained.	HHS for Pb in on-site GW not attained. HHS for Cd in SW not attained. Acute ALS for Cd & Zn in SW not attained.	HHS for Cd in SW not attained. Acute ALS for Cd and Zn in SW not attained.	HHS for Cd in SW not attained. Acute ALS for Cd and Zn in SW not attained.
Location Specific	None Apply	All location-specific ARARs would be met.	All location-specific ARARs would be met.	All location-specific ARARs would be met.	All location-specific ARARs would be met.
Action Specific	None Apply	All action-specific ARARs would be met.	All action-specific ARARs would be met.	All action-specific ARARs would be met.	All action-specific ARARs would be met.
Long-Term Effectiveness and Permanence -					
Magnitude of Residual Risk	No reduction in CoC levels in any environmental media, except by natural degradation/erosion.	40% risk reduction expected overall. Level of risk reduction would not attain residential or recreational user compliance for the site.	76% risk reduction expected overall. Level of risk reduction would not attain residential or recreational user compliance for the site.	80% risk reduction expected overall. Level of risk reduction would attain residential GW use compliance for the site.	83% risk reduction expected overall. Level of risk reduction would attain residential GW use compliance for the site.
Adequacy and Reliability of Controls	No controls over any on-site contamination, no reliability.	Containment controls are adequate for intended purposes; however, long-term reliability is questionable due to physical location of wastes on the Indian Creek flood plain.	Primary sources of concern near Indian Creek will be removed and covered to reduce exposure from human and environmental receptors. Other sources stabilized via proven methods.	Primary sources of concern will be reliably isolated from human and environmental receptors. Other sources stabilized via proven methods.	Primary sources of concern will be reliably isolated from human and environmental receptors. Other sources stabilized via proven methods.
Reduction of Toxicity, Mobility, and Volume -					
Treatment Process Used and Materials Treated	None.	In-place cover/containment and revegetation of the tailings and waste rock will reduce mobility of CoCs. Future impacts to surface water (Indian Creek) likely due to physical location of wastes in unstable areas along creek channel.	Removal and stabilization of primary sources of concern near the creek and capping/ reclamation of other sources is expected to provide significant reduction in mobility of CoCs for all pathways.	Removal and encapsulation of primary sources of concern from near the creek and capping/ reclamation of other sources is expected to provide significant reduction in mobility of CoCs for all pathways.	Removal and encapsulation of primary sources of concern from near the creek and capping/ reclamation of other sources is expected to provide significant reduction in mobility of CoCs for all pathways.

TABLE 9-1: COMPARATIVE ANALYSIS OF ALTERNATIVES (SOLID MEDIA - TAILINGS AND WASTE ROCK)

Assessment Criteria	**Alternative 1:** No Action	**Alternative 3:** In-Place Containment	**Alternative 4b:** Partial Removal (excluding Streamside Tailings) and In-Place Containment	**Alternative 5b:** Partial Removal and Disposal in an On-Site Modified RCRA C Repository	**Alternative 5c:** Partial Removal and Disposal in an On-Site Modified RCRA C Repository
Volume of Contaminated Materials Treated	No reduction in CoC toxicity, mobility, or volume.	No volume actively treated; however, approximately 74,500 cubic yards capped/ revegetated to reduce exposure to human and environmental receptors.	No volume actively treated; however, approximately 35,000 CY removed from near the stream and a total of 74,500 CY capped/revegetated to reduce exposure to human and environmental receptors.	No volume actively treated; however, approximately 35,000 CY removed from near the stream, 16,500 CY effectively isolated from human and environmental receptors in the repository. A total of 74,500 CY capped/reclaimed to reduce human/ environmental exposure	No volume actively treated; however, approximately 35,000 CY removed from near sensitive receptors and effectively isolated from human and environmental receptors in the repository. A total of 74,500 CY capped/reclaimed to reduce human/ environmental exposure
Expected Degree of Reduction	Minimal, via natural degradation only. (potential for future increases in mobility of contaminants).	Volume of wastes would not be reduced; however, mobility of CoCs would be moderately reduced.	Vol. or tox. of CoCs not reduced; however, significant reduction in mobility expected.	Vol. or tox. of CoCs not reduced; however, significant reduction in mobility expected.	Vol. or tox. of CoCs not reduced; however, significant reduction in mobility expected.
Short-Term Effectiveness -					
Protection of Community During Reclamation Action	Not applicable.	Fugitive emissions control may be required during construction.	Fugitive emissions control may be required during construction.	Fugitive emissions control may be required during construction.	Fugitive emissions control may be required during construction.
Protection of On-Site Workers During Reclamation Action	Not applicable.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.
Environmental Impacts	Same as baseline conditions.	Environmental (SW) impacts possible due to construction activities in active stream channel and floodplain of Creek.	Environmental (SW) impacts possible due to waste excavation activities in active stream channel and floodplain of Indian Creek.	Environmental (SW) impacts possible due to waste excavation activities in active stream channel and floodplain of Indian Creek.	Environmental (SW) impacts possible due to waste excavation activities in active stream channel and floodplain of Indian Creek.
Time Until Reclamation Action Objectives are Achieved	Not applicable.	One field season.	One field season.	One field season.	One field season.
Implementability -					
Ability to Construct and Operate	No construction or operation involved.	Moderately difficult to implement due to location and steepness of terrain.	Moderately difficult to implement due to location and steepness of terrain.	Moderately difficult to implement due to location and steepness of terrain.	Moderately difficult to implement due to location and steepness of terrain.
Ease of Implementing More Action if Necessary	Not applicable.	Easily implementable (additional armoring/ stabilization, etc.) if determined to be necessary.	Easily implementable (additional armoring/ stabilization, etc.) if determined to be nec.	Easily implementable (additional armoring/ stabilization, etc.) if determined to be nec.	Easily implementable (additional armoring/ stabilization, etc.) if determined to be nec.
Availability of Services and Capacities	Not applicable.	Available locally and within the state.	Available locally and within the state.	Available locally and within the state.	Available locally and within the state.
Availability of Equipment and Materials	Not applicable.	Available locally and within the state.	Available locally and within the state.	Available locally and within the state.	Available locally and within the state.
Estimated Total Present Worth Cost	**$0.00**	**$1,239,000**	**$1,380,000**	**$1,710,000**	**$1,672,000**

The short-term effectiveness is expected to be similar for each of the action alternatives. The alternatives are all technically similar, and the construction steps required to implement them would be similar as well. It is anticipated that any of the action alternatives could be completed in a single construction season. All alternatives may have short term impacts on residents or recreational users of the forest in the vicinity because of the need for road access improvements and the need for imported materials.

The implementability of most alternatives is expected to be similar. All alternatives use conventional design and construction techniques. Alternatives 5b and 5c may be more technically difficult to implement than the other alternatives because of limited space available on-site to construct a repository with the needed capacity.

For ease of construction, Alternative 3 would probably be the easiest alternative to implement because all of the wastes which would be recontoured and reclaimed in-place. Alternative 4b represents moderate technical difficulty because wastes would simply be excavated, loaded out, and transported to the consolidation area. Alternative 5b would likely be the most difficult to implement because of the lack of space available on-site for the repository and complexities arising from building the repository floor at the waste consolidation area. Alternative 5c would also be difficult to implement because of complexities constructing the composite cap over the entire waste consolidation area and potential geotechnical concerns related to the long slope along the face of the repository. All alternatives would require a significant amount of lime, compost, and cover soils to be imported: availability and scheduling of delivery may make any alternative somewhat difficult to implement.

Due to the large-scale nature of this reclamation project, in conjunction with the technical requirements applicable to constructing diversions, sedimentation basins, and dewatering structures, and possibly repositories, only properly trained and experienced contractors/crews utilizing large-capacity equipment should perform the specified work. Small capacity equipment and/or inexperienced contractors and crews would likely prolong the construction phase and may result in increased costs and compromised performance.

Table 9-1 indicates the estimated total costs associated with each action alternative evaluated in detail. Of the various action alternatives considered for the site, Alternative 3 is the least costly, and Alternative 5b is the most costly. Although Alternative 3 is the least costly, the estimated residual risk would not be reduced to acceptable levels by implementing this alternative. Alternative 5b provides slightly higher reduction than does Alternatives 4b at a slightly higher cost (Alternative 4b provided a 73% human health risk reduction and a 79% reduction in the ecological risk. and Alternative 5b provided an 81% human health risk reduction and an 79% reduction in the ecological risk). Alternative 5c provides the highest overall risk reduction of all alternatives considered in detail at a slightly lower cost that Alternative 5b. While none of the alternatives satisfy all ARARs, Alternatives 5b and 5c provide the greatest reduction in ecological risks. Alternative 5c is more attractive than Alternative 5b because it has the highest overall risk reduction, isolates the highest risk wastes at a single location in an engineered facility, would provide the greatest protection from direct exposure hazards, provides the greatest degree of groundwater protection and costs less than Alternative 5b. Table 9-2 summarizes the estimated cost per unit risk reduction for each action alternative.

TABLE 9-2
ALTERNATIVE COST-EFFECTIVENESS COMPARISON SUMMARY

Alternative	Overall Human Health Risk Reduction	Total Present Worth Value	Cost per 1% Reduction in Risk
Alternative 3	51%	$1.24 Million	$24,300
Alternative 4b	73%	$1.38 Million	$18, 900
Alternative 5b	81%	$1.71 Million	$21,100
Alternative 5c	84%	$1.67 Million	$19,900

10.0 PREFERRED ALTERNATIVE

Based on the information provided above, Alternative 5c (Partial Removal and Disposal in an On-site Un-lined Repository with Partial In-Place Containment) is the preferred alternative for the solid media at the Park Mine site. It should be noted that this alternative is only implementable if a suitable repository location is present at the site. If the repository is not constructed, another alternative must be selected.

For the purpose of this evaluation, the conceptual design for Alternative 5c includes removing WR-1, WR-2, WR-3, WR-7, WR-8, WR-10, TP-1, TP-2, TP-3, TP-4 and TP-5 from their current locations and disposing these wastes in an unlined repository near WR-4, and recontouring and reclaiming in place all other waste sources at the site (WR-5, WR-6, WR-9). The wastes which are generally regarded as higher-risk wastes (wastes which fail the TCLP test and tailings) would be placed higher in the consolidation area to increase the distance to groundwater. After placing the wastes and grading, the entire waste disposal area would be covered with the composite cap. Existing surface water diversions would be improved and new diversions constructed to direct mine water discharges away from reclaimed areas. Diversions would also be constructed to prevent run-on to reclaimed areas. Run-off diversions would be installed to prevent erosion and direct run-off to sediment removal facilities in order to remove solids eroded from the site (before vegetation is re-established) prior to discharge to Indian Creek. The stream channel would be reconstructed and armoring installed where wastes are removed from near the stream. Physical hazards (unstable slopes, open adits and shafts) would be mitigated as a portion of the reclamation.

This alternative is projected to reduce risks to human health by 84% and ecological risks by 82%. The alternative is not expected to attain all ARARs for groundwater and surface water, however. (None of the solid media alternatives considered are able to satisfy these ARARs primarily because of the GW-1 adit discharge). Attaining these ARARs may not be feasible or practical, considering background concentrations of the CoCs, both naturally occurring and/or from nearby anthropogenic sources.

The following issues were considered when selecting this alternative:

- it provided the highest risk reduction of any of the solid media alternatives considered;
- it provided a higher risk reduction than Alternative 5b at a lower overall cost;
- implementabililty of this alternative is expected to be simpler than other alternatives that provided comparable risk reductions (i.e., RCRA C repository and off-site disposal); and
- the on-site repository will effectively reduce the contaminant mobility of the highest risk wastes at the site and consolidate these wastes in a single location away from the creek.

Alternative 5c provides a comparable risk reduction to Alternative 5b at a slightly lower cost. Further, the unlined repository covers a larger surface area and has a higher effectiveness at isolating these wastes from direct contact. Therefore, Alternative 5c is the preferred alternative.

11.0 REFERENCES

ARCO, Personal communication with Construction Managers, Anaconda, Montana, August 1994.

ATSDR, 1991a. Toxicological Profile for Arsenic (draft). Agency for Toxic Substances and Disease Registry, Atlanta GA. Page 30.

ATSDR, 1991b. Toxicological Profile for Cadmium (draft). Agency for Toxic Substances and Disease Registry, Atlanta GA. Page 33.

ATSDR, 1991c. Toxicological Profile for Lead (draft). Agency for Toxic Substances and Disease Registry, Atlanta GA. Page 72.

Canonie Environmental Services Corp., 1992. Remedial Technology Guidance Document for Solid Media, Clark Fork River Basin.

Caterpillar, Inc., 1986. Caterpillar Performance Handbook, Edition 17.

Colbert, T.A., 1991. Reclamation of Acid Forming Materials in the Western United States. Presented at the Engineering and Environmental Aspects of Mine Waste Disposal SME Short Course, Denver, Colorado.

Earll, F.N., 1964. Economic Geology and Geochemical Study of Winston Mining District, Broadwater County, Montana, Montana Bureau of Mines and Geology Bulletin 41, November 1964.

Eisler, 1988. Arsenic Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Biological Report 85 (1.12). 92pp.

Frisbee, N.M., 1993. Four Foot Lime Incorporation at the Jewett Lignite Mine, Jewett, Texas. Presented at the Lime Products Technology and Reclamation Conference, August 19, 1993.

Hedin, R.S., R. Hammack, and D. Hyman, 1989. "The Potential Importance of Sulfate Reduction Processes in Wetlands Constructed to Treat Mine Drainage" in Constructed Wetlands for Wastewater Treatment.

Hydrosphere, Inc., 1992. Climate Data, Summary of the Day Database. King's Hill Meteorological Station near Showdown, Montana.

Kabata-Pendias and Pendias, 1989. Trace elements in soil and plants. CRC Press, Inc., Boca Raton, FL.

Long and Morgan, 1991. The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. National Oceanographic and Atmospheric Administration, Seattle, WA.

Maita et al, 1981. Subacute toxicity studies with zinc sulfate in mice and rats. J. Pest. Sci. 6:327-336.

MAPS, 1995. Montana Agricultural Potentials System Database, Version 5.0, Bozeman, Montana.

Montana Bureau of Mines and Geology, 1993. Well Log Database, September 8, 1993.

Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau-Pioneer Technical Services, 1994. Hazardous Materials Inventory Site Investigation Log Sheet for Bullion King, June 20, 1994.

Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau-Pioneer Technical Services, 1993. Hazardous Materials Inventory Site Investigation Log Sheet for Park, July 27, 1993.

Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau, 1990. Procedures Manual, October 1990.

Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau, 1988. Abandoned Mine Reclamation Inventory Field Form for Park, May 23, 1988.

Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau, 1986. Abandoned Mine Reclamation Portal Inventory Form for the Whitehead Ranch site, October 22, 1986.

Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau, 1982. Abandoned Mine Lands National Inventory, Phase II Problem Area Data Sheet for Park mine, December 20, 1982.

Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau-Pioneer Technical Services, 1995a. Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau. Draft Expanded Engineering Evaluation/Cost Analysis for the Vosburg Mine and Millsite. Prepared by Pioneer Technical Services, Inc. March 1995.

Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau-Pioneer Technical Services, 1995b. Montana Department of Environmental Quality/Abandoned

Mine Reclamation Bureau. Final Expanded Engineering Evaluation/Cost Analysis for the Brooklyn Mine. Prepared by Pioneer Technical Services, Inc. April 1995.

Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau-Pioneer Technical Services, 1996a. Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau. Park Mine Reclamation Investigation Workplan. Prepared by Pioneer Technical Services, Inc. June 1995.

Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau-Pioneer Technical Services, 1996b. Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau. Park Mine Reclamation Investigation Field Sampling plan. Prepared by Pioneer Technical Services, Inc. June 1995.

Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau-Pioneer Technical Services. Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau. Park Mine Final Reclamation Investigation Report. Prepared by Pioneer Technical Services, Inc. November 1996.

Montana Department of Fish, Wildlife and Parks, 1989. Montana Rivers Information System Report, Version 2.0, December 1989.

Montana Department of Environmental Quality/WQB, 1995. Montana Department of Environmental Quality/Water Quality Bureau. Montana Numeric Water Quality Standards, Circular WQB-7. July 1995.

MSE, Inc., 1994. Practical Applications of Sulfate-Reducing Bacteria to Control Acid Mine Drainage at the Lily/Orphan Boy Mine Near Elliston, MT. Mine Waste Technology Pilot Program, Activity III, Project 3.

MSE, Inc., 1993. Final Sludge Remediation and Reclamation Report for the Arro Refinery Site, Lewistown, Montana.

MSE, Inc., 1992a. Final Feasibility Study Report, Remediation of the Arro Refinery Sludge Pit Site, Lewistown, Montana.

MSE, Inc., 1991. Phase II Arro Refinery Lead Contaminated Soils Removal Action Construction Activities Report, Lewistown, Montana.

MSE, 1993. Resource Recovery Project Technology Characterization Interim Report. February 12, 1993.

NAS, 1980. Recommended Daily Allowances. 9th Ed. pp. 151-154. National Academy of Sciences, Food and Nutrition Board, Washington, D.C.

Neuman, D.R., F.F. Munshower, D.J. Dollhopf, S.R. Jennings, W.M. Schafer, and J.D. Goering, 1993. Streambank Tailings Revegetation - Silver Bow Creek, Montana.

Pelletier et al, 1995. Subaqueous Deposition of Tailings Summary of Canadian Research and Applications. Paper presented at the Mine Design, Operations, and Closure Conference, Whitefish, Montana. April 11-13, 1995.

Reed, Glenn C., 1951. Mines and Mineral Deposits (Except Fuels) Broadwater County, Montana, U.S. Bureau of Mines Information Circular 7592, April 1951.

Schafer, W.M., 1993. Mitigation of Acid Mining Waste using Lime Application in the Upper Clark Fork Basin. Presented at the Lime Products Technology and Reclamation Conference, August 19, 1993.

Smith, 1995. Risk-Based Concentration Table, July-December, 1995. Prepared by USEPA, Region III, Office of RCRA, Technical and Program Support Branch. Memorandum from Dr. Roy L. Smith dated October 20, 1995.

TetraTech, 1996. Risk-Based Cleanup Guidelines for Abandoned Mine Sites. Prepared for Montana Department of Environmental Quality, Abandoned Mine Reclamation Bureau by TetraTech, Inc.

U.S. Department of Agriculture, 1974. U.S. Department of Agriculture. Evaporation Pond Design for Agricultural Disposal, USDA Soil Conservation Service, Montana Technical Note: Environment No. 7. February 1974.

U.S. Department of Agriculture, 1975. U.S. Department of Agriculture. 1958-1972 Average Annual Snowfall in Inches, Montana, USDA Soil Conservation Service Map. April 1975.

U.S. Department of Agriculture, Soil Conservation Service, 1992. Montana Annual Data Summary, Water Year 1992. Tizer Basin.

U.S. Department of Agriculture, 1995. Personal Communication with U.S. Department of Agriculture/Forest Service, Helena National Forest personnel. Salt ingestion data taken from "Elk of North America".

U.S. Environmental Protection Agency, 1995. U.S. Environmental Protection Agency. Retrieval from the Integrated Risk Information System (IRIS), Office of Health and Environmental Assessment.

U.S. Environmental Protection Agency, 1993. U.S. Environmental Protection Agency. Drinking Water Regulations and Health Advisories.

U.S. Environmental Protection Agency, 1991. Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals and Part C, Risk Evaluation of Remedial Alternatives), December 1991.

U.S. Environmental Protection Agency, 1990a, Cost of Remedial Actions Model (CORA), Version 3.0, April 15, 1990.

U.S. Environmental Protection Agency, 1990b. National Oil and Hazardous Substance Pollution Contingency Plan (NCP); Final Rule (40CFR 300). Federal Register 55(46): 8666-8865, March 8, 1990.

U.S. Environmental Protection Agency, 1989a. Hydrological Evaluation of Landfill Performance (HELP) Version 2.05, September 1989.

U.S. Environmental Protection Agency, 1989b. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Interim Final). U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C. EPA/540/1-89/002.

U.S. Environmental Protection Agency, 1989c. Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference. U.S. Environmental Protection Agency, Environmental Research Laboratory, Corvallis, OR. EPA/600/3-89/013.

U.S. Environmental Protection Agency, 1988a. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, OSWER Directive 9355.3-01, October 1988.

U.S. Environmental Protection Agency, 1988b. Screening Procedures for Estimating the Air Quality Impact of Stationary Sources. Roger W. Brode, Source Receptor Analysis Branch, Technical Support Division. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. EPA/450/4-88/010.

U.S. Environmental Protection Agency, 1986. Superfund Remedial Design and Remedial Action Guidance, OSWER Directive 9355.0-4A, June 1986.

U.S. Geological Survey, 1986. Topographic Map of Giant Hill, Montana, 7 1/2 minute Quadrangle, 1986.

APPENDIX A

RECLAMATION INVESTIGATION CHEMICAL DATA

TABLE A-1

PARK MINE SOIL DATA

FIELD ID	Al (mg/Kg)	Sb (mg/Kg)	As (mg/Kg)	Ba (mg/Kg)	Be (mg/Kg)	Cd (mg/Kg)	Ca (mg/Kg)	Cr (mg/Kg)	Co (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Pb (mg/Kg)
04-012-WR1-C1		34.8 J	12200	67.6		32.3 J	1460	27.0	11.5	295	75200	16000
04-012-WR1-C2		5.0 UJ	346	146		1.0 J	3570	25.4	12.9	16.0	30100	304
04-012-WR1-C3		12.7 J	5270	129		48.2 J	3000	18.1	26.2	212	56300	7340
04-012-WR2-C1		13.1 J	6080	52.4		18.6 J	2310	2.1 U	9.9	160	53200	7820
04-012-WR2-C2		8.9 UJ	767	176		34.9 J	4640	17.2	11.5	231	32800	839
04-012-WR2-C3		24.4 J	7490	97.7		50.3 J	5000	2.3	17.7	214	64500	12600
04-012-WR3-C1		15.4 J	4790	42.0		20.5 J	779	2.1 U	6.7	141	53100	7540
04-012-WR3-C2		5.5 UJ	12800	160		3.5 J	680	7.2	10.1	68.6	49400	1980
04-012-WR3-C3		22.6 J	6470	52.3		24.5 J	1740	2.2 U	16.7	217	61000	11400
04-012-WR3-C5		4.8 UJ	1960	23.3		1.1 J	1550	2.2 U	2.4	115	40900	6070
04-012-WR3-C6		37.5 J	9920	68.3		78.7 J	2300	2.1 U	28.6	243	79700	11400
04-012-WR4-C1		8.5 J	11100	49.5		10.1 J	1080	4.6	8.8	139	61300	7200
04-012-WR4-C2		6.0 UJ	14600	334		9.4 J	977	7.4	12.8	215	49100	1260
04-012-WR4-C3		8.5 J	12200	55.7		13.4 J	1500	2.1 U	11.2	166	55000	8140
04-012-WR4-C5		5.2 UJ	12300	147		4.8 J	586	6.3	10.4	49.8	45400	1400
04-012-WR5-C1		4.7 UJ	100	190		1.4 J	6870	2.1 U	26.1	20.1	40600	164
04-012-WR5-C2		4.8 UJ	14.8	66.3		0.92 U	2760	4.2	9.2	9.1	18800	16.3
04-012-WR5-C3		4.6 UJ	110	170		1.1 J	6120	2.1 U	28.9	16.7	45900	131
04-012-WR6-C1		8.3 J	12400	71.1		19.6 J	939	2.1 U	10.5	209	95600	16300
04-012-WR6-C2		9.4 UJ	15600	61.8		3.9 J	345	4.2 U	3.4 U	86.1	72500	914
04-012-SE1	10800	8.4 U	955 J	78.9	0.43 U	24.1 J	3410	8.1 J	23.1 J	39.8	27700	784 J
04-012-SE2	6990	9.9 U	932 J	36.9	0.50 U	18.1 J	4840	8.7 J	14.8 J	67.9	20000	2450 J
04-012-SE4	10700	9.3 U	1080 J	42.5	0.47 U	14.9 J	2580	13.9 J	14.6 J	40.6	25400	2430 J
04-012-SE5	8950	10.0 U	92.9 J	50.8	0.51 U	10.2 J	2260	8.0 J	14.7 J	30.8	13500	69.8 J
04-012-SE6	7410	9.1 U	23.3 J	72.2	0.46 U	0.95 UJ	2480	13.7 J	11.7 J	8.0	18900	18.3 J
04-012-SE7	15200	7.8 U	1700 J	47.8	0.40 U	13.9 J	1600	6.9 J	13.4 J	65.3	45000	983 J
04-012-SE8	10800	11.0 U	178 J	75.2	0.56 U	6.5 J	3990	2.7 UJ	11.9 J	18.4	22600	435 J
04-012-BG1	13600	7.9 U	154 J	183	0.40 U	4.2 J	1820	7.2 J	12.2 J	14.2	19500	546 J
04-012-BG2	19000	8.9 U	96.7 J	439	0.45 U	1.1 J	3100	14.4 J	15.5 J	25.0	22300	34.4 J
04-012-BG3	14500	8.3 U	34.4 J	132	0.42 U	1.4 J	4030	7.9 J	10.1 J	15.7	19500	27.7 J
04-012-BG4	15200	8.4 U	22.9 J	179	0.43 U	0.88 UJ	3840	4.9 J	13.0 J	20.6	23300	25.7 J
04-012-BG5	27100	8.8 U	79.6 J	335	0.45 U	2.4 J	2440	14.0 J	12.5 J	16.2	22800	71.9 J
04-012-WR6-C3		16.4 J	9410	56.9		17.4 J	1590 J	2.1 U	9.0	190 J	84000	12700
04-012-WR8-C1		8.4 UJ	7830	82.9		7.8 J	2630 J	17.8	5.6	145 J	49300	7800
04-012-WR8-C2		10.4 UJ	11800	207		4.5 J	2800 J	10.7	13.7	59.7 J	60000	1290
04-012-WR8-C3		26.4 J	17900	42.3		28.5 J	4240 J	17.9	9.3	487 J	88200	26300
04-012-WR9-C1		8.1 UJ	5370	130		7.7 J	2730 J	2.0 U	7.5	209 J	107000	2870
04-012-WR9-C2		9.7 UJ	1560	262		2.7 J	2570 J	10.9	21.2	85.1 J	56100	150
04-012-WR9-C3		8.6 UJ	4730	105		3.1 J	2410 J	2.1 U	7.6	95.6 J	61400	1610
04-012-WR10-C1		15.5 J	14400	65.1		6.6 J	499 J	1.9 U	3.2	427 J	88900	20500
04-012-WR10-C2		19.7 J	10300	65.3		8.4 J	988 J	2.0 U	4.3	240 J	91400	30100
04-012-TP2-C1		11.7 J	5320	34.8		1.7 J	1780 J	2.1 B	2.9	37.6 J	32800	8310
04-012-TP2-C2		9.7 UJ	2800	248		1.0 U	1470 J	10.8	8.7	49.0 J	36500	1190
04-012-TP2-C3		8.7 UJ	2030	48.0		1.1 J	6350 J	2.1 U	2.2	34.4 J	36000	3980
04-012-TP3-C1		8.7 UJ	29900	43.2		48.6 J	7960 J	3.8	13.3	182 J	117000	7850
04-012-TP3-C3		8.7 UJ	25700	47.9		38.5 J	7210 J	3.4	10.1	182 J	104000	8340
04-012-TP4-C1		8.4 UJ	7170	103		2.7 J	6800 J	9.6	8.4	115 J	56300	2900
04-012-TP4-C3		9.8 UJ	5890	148		21.7 J	12700 J	19.4	14.1	284 J	60900	4600
04-012-TP4-C5		8.6 UJ	5240	150		7.7 J	12300 J	18.2	11.3	205 J	60200	3880
04-012-TP4-C6		14.3 J	12400	159		50.1 J	12600 J	16.1	14.2	252 J	79400	6820
04-012-TP5		9.9 UJ	10100	140		4.1 J	4990 J	8.1	6.6	99.6 J	69300	4280

FIELD ID	Mg (mg/Kg)	Mn (mg/Kg)	Hg (mg/Kg)	Ni (mg/Kg)	K (mg/Kg)	Se (mg/Kg)	Ag (mg/Kg)	Na (mg/Kg)	Tl (mg/Kg)	V (mg/Kg)	Zn (mg/Kg)	CYANIDE (mg/kg)
04-012-WR1-C1	4230	1780	0.43 J	3.9 U			45.5 J				2260	
04-012-WR1-C2	7770	644	0.028 U	14.4			1.4 UJ				328	
04-012-WR1-C3	7910	8130	0.28 J	3.9 U			27.3 J				3540	
04-012-WR2-C1	6400	1160	0.45 J	3.8 U			28.4 J				1830	
04-012-WR2-C2	4850	1610	0.16 J	7.2 U			2.5 UJ				4410	
04-012-WR2-C3	6780	4060	0.39 J	3.8 U			41.4 J				3020	
04-012-WR3-C1	3890	576	0.48 J	3.8 U			35.0 J				1780	
04-012-WR3-C2	3480	1190	0.07 J	4.7			6.4 J				527	
04-012-WR3-C3	7790	1120	0.61 J	3.9 U			58.7 J				2750	
04-012-WR3-C5	5500	174	0.21 J	3.9 U			47.0 J				585	
04-012-WR3-C6	6260	3070	2.1 J	3.9 U			47.4 J				4310	
04-012-WR4-C1	6040	619	0.39 J	3.9 U			21.6 J				1030	
04-012-WR4-C2	5080	873	0.13 J	5.1			3.6 J				741	
04-012-WR4-C3	6690	865	1.1 J	3.8 U			22.8 J				1070	
04-012-WR4-C5	4720	1910	0.07 J	4.2 U			2.0 J				599	
04-012-WR5-C1	5500	6240	0.63 J	3.8 U			1.9 J				195	
04-012-WR5-C2	6640	536	0.026 U	5.1			1.4 UJ				59.8	
04-012-WR5-C3	6290	7140	0.81 J	5.1			2.2 J				149	
04-012-WR6-C1	4690	1470	0.69 J	3.8 U			35.5 J				1490	
04-012-WR6-C2	898	350	0.14 J	7.7 U			4.9 J				219	
04-012-SE1	8290	2310 J	0.064 J	4.5	914 J	15.6 U	3.4 J	54.1	11.1 U	32.9 J	2570	
04-012-SE2	5180	1690 J	0.13 J	6.5	504 J	18.3 U	3.5 J	43.7	13.0 U	18.8 J	2110	
04-012-SE4	8860	1370 J	0.10 J	7.0	653 J	17.3 U	1.5 UJ	39.5	12.3 U	34.8 J	1790	
04-012-SE5	7060	1290 J	0.040 J	7.8	863 J	18.5 U	1.6 UJ	46.6	13.2 U	15.1 J	1180	
04-012-SE6	5790	534 J	0.035 J	12.4	1400 J	16.9 U	1.4 UJ	45.1	12.1 U	26.0 J	55.0	
04-012-SE7	8240	910 J	0.099 J	5.3	1490 J	14.5 U	3.2 J	59.6	11.1	40.2 J	1790	
04-012-SE8	8220	1140 J	0.11 J	7.2	1030 J	20.5 U	2.5 J	107	14.6 U	29.2 J	1320	
04-012-BG1	5000	1910 J	0.050 J	6.2	1140 J	14.7 U	1.3 UJ	50.1	10.4 U	27.8 J	487	
04-012-BG2	3420	6260 J	0.074 J	4.1 U	1340 J	16.6 U	1.5 J	73.1	11.8 U	30.8 J	276	
04-012-BG3	7320	669 J	0.056 J	4.5	3750 J	15.4 U	1.3 UJ	50.1	11.0 U	26.7 J	131	
04-012-BG4	9260	780 J	0.063 J	3.9 U	5780 J	15.7 U	1.3 UJ	76.0	11.2 U	41.5 J	70.2	
04-012-BG5	4720	2930 J	0.072 J	8.8	1560 J	16.3 U	1.7 J	86.3	11.6 U	34.4 J	250	
04-012-WR6-C3	6160 J	1070	0.82	3.8 U			103				1490	
04-012-WR8-C1	6100 J	631	0.13	4.8			27.6				700	
04-012-WR8-C2	5300 J	939	0.050	5.1			2.6 B				488	
04-012-WR8-C3	4180 J	621	0.33	3.7 U			95.9				1700	
04-012-WR9-C1	5940 J	257	0.60	3.7 U			14.3				884	
04-012-WR9-C2	10800 J	1130	0.031	6.1			1.5 U				427	
04-012-WR9-C3	4510 J	295	0.82	3.9 U			16.8				490	
04-012-WR10-C1	3700 J	170	0.47	3.5 U			56.8				794	
04-012-WR10-C2	3580 J	338	0.60	3.7 U			108				866	
04-012-TP2-C1	2930 J	169	0.13	3.8 U			33.2				354	<0.279
04-012-TP2-C2	3000 J	241	0.13	5.2			7.9				157	<0.317
04-012-TP2-C3	1170 J	69.5	0.093	4.0 U			27.5				228	<0.282
04-012-TP3-C1	2130 J	797	0.19	4.0 U			22.7				5600	<0.306
04-012-TP3-C3	2070 J	1020	0.18	4.0 U			26.3				5120	<0.298
04-012-TP4-C1	4890 J	289	0.30	3.8 U			9.7				313	<0.279
04-012-TP4-C3	6650 J	1300	0.51	17.6			17.9				2840	<0.324
04-012-TP4-C5	5520 J	552	0.27	11.3			10.6				1010	<0.310
04-012-TP4-C6	8180 J	2320	0.25	17.2			35.0				6780	<0.358
04-012-TP5	4750 J	346	0.22	5.9			13.0				495	<0.339

U = Analyte Not Detected
J = Estimated Concentration

TABLE A-2

PARK MINE TCLP METALS RESULTS

SAMPLE NO.	As (ug/L)	Ag (ug/L)	Ba (ug/L)	Cd (ug/L)	Cr (ug/L)	Hg (ug/L)	Pb (ug/L)	Se (ug/L)
04-012-WR1-C4	106	6.2 U	263	83.4	9.7 U	0.082	341	64.4 U
04-012-WR2-C4	134	6.2 U	142	151	13.2	0.11	1270	64.4 U
04-012-WR3-C4	46.8	6.2 U	102	256	14.1	0.18	32800	64.4 U
04-012-WR4-C4	139	6.2 U	85.6	29.9	15.3	0.13	801	64.4 U
04-012-WR5-C4	43.3 U	6.2 U	199	4.1 U	12.0	0.064	40.8 U	64.4 U
04-012-WR6-C4	46.9	6.2 U	79.9	87.6	17.2	0.088	5130	64.4 U
04-012-WR8-C4	62.0	6.2 U	96.5	80.4	9.7 U	0.064	25800	64.4 U
04-012-WR9-C4	43.3 U	6.2 U	105	15.1	9.7	0.070	40.8 U	64.4 U
04-012-WR10-C4	43.7	6.2 U	125	105	10.2	0.056 U	24400	64.4 U
04-012-TP2-C4	179	6.2 U	120	4.1 U	9.7 U	0.065	2950	64.4 U
04-012-TP3-C4	12400	6.2 U	145	124	9.7 U	0.067	15700	64.4 U
04-012-TP4-C4	2700	6.2 U	329	193	11.6	0.087	11700	64.4 U
MAXIMUM CONCENTRATION (REGULATORY LIMIT)	**5000**	**5000**	**100000**	**1000**	**5000**	**200**	**5000**	**1000**

U = Analyte Not Detected

TABLE A-3

PARK MINE ACID BASE ACCOUNTING RESULTS

SAMPLE NO.	TOTAL SULFUR %	Sulfate Sulfur %	Insoluble sulfide sulfur %	Sulfide Sulfur %	Organic Sulfur %	Neut. Pot. t/1000t	T. S. AB t/1000t	T. S. ABP t/1000t	PyrS AB t/1000t	PyrS ABP t/1000t	SMP Buffer (t/1000t)	Potential Acidity	Lime Req. Dollhopf (t/1000t)	Lime Req. Dollhopf (t/ac.) 1ft.
04-012-WR1-1	0.38	0.08	0.08	0.23	<0.01	5.00	12.00	-7.00	8.90	-3.90	0.26	9.06	-11.04	-23.19
04-012-WR2-1	1.80	0.46	0.38	0.97	<0.01	0.25	57.00	-56.00	39.00	-39.00	0.71	41.09	-50.16	-105.33
04-012-WR2-2	0.62	0.04	0.23	0.35	<0.01	6.90	19.00	-12.00	16.00	-9.40	0.31	11.88	-14.41	-30.25
04-012-WR3-1	2.20	0.15	0.47	1.60	0.00	0.50	70.00	-69.00	61.00	-61.00	0.51	53.52	-64.90	-136.28
04-012-WR4-1	1.60	0.24	0.44	0.90	<0.01	<0.01	50.00	-50.00	39.00	-39.00	1.21	33.75	-41.06	-86.23
04-012-WR4-2	2.20	0.44	0.41	1.30	0.04	<0.01	69.00	-69.00	51.00	-51.00	1.72	52.19	-63.61	-133.58
04-012-WR5-1	<0.01	<0.01	<0.01	<0.01	<0.01	36.00	<0.01	36.00	<0.01	36.00	-0.97	0.00	-1.21	-2.55
04-012-WR6-1	1.10	0.21	0.38	0.49	0.02	<0.01	34.00	-34.00	24.00	-24.00	0.84	20.86	-25.46	-53.47
04-012-WR6-1Dup	1.20	0.20	0.40	0.50	<0.01	<0.01	37.00	-37.00	25.00	-25.00				
04-012-WR6-2	2.60	0.26	0.78	1.50	<0.01	<0.01	80.00	-80.00	66.00	-66.00	1.20	52.97	-64.34	-135.11
04-012-WR8-1	2.90	1.27	0.76	0.91	<0.01	<0.01	92.00	-92.00	46.00	-46.00	1.16	58.21	-71.62	-150.40
04-012-WR9-1	4.70	0.67	1.83	2.20	<0.01	<0.01	146.00	-146.00	111.00	-111.00	1.04	84.45	-102.82	-215.92
04-012-WR9-2	0.58	0.11	0.20	0.27	<0.01	2.00	18.00	-16.00	13.00	-11.00	0.69	11.02	-13.43	-28.21
04-012-WR10-1	2.30	0.26	0.68	1.30	<0.01	<0.01	72.00	-72.00	58.00	-58.00	0.87	46.72	-56.77	-119.23
04-012-TP2-C4	2.80	0.24	0.17	2.30	<0.01	<0.01	86.00	-86.00	77.00	-77.00	0.17	77.50	-94.00	-197.40
04-012-TP3	9.40	0.01	1.04	7.70	0.76	3.50	293.00	-290.00	264.00	-260.00	-0.24	264.61	-321.44	-675.02
04-012-TP4-1	3.10	0.37	0.14	2.60	<0.01	27.00	98.00	-71.00	85.00	-59.00	-0.84	89.92	-110.20	-231.43
04-012-TP4-2	0.86	0.24	0.21	0.41	<0.01	9.30	27.00	-18.00	18.00	-8.50	-0.02	18.44	-22.56	-47.38

TABLE A-4

PARK MINE AGRONOMIC PROPERTIES

SAMPLE NO.	ORGANIC MATTER	PHOSPHORUS P1		PHOSPHORUS P2		POTASSIUM		MAGNESIUM		CALCIUM		SODIUM		NITRATE NO3-N		Boron		pH	C.E.C.	PERCENT BASE SATURATION					SOLUBLE SALTS
	(%)	(ppm)	(lbs./A)*	(ppm)	(lbs./A)*	(ppm)	(lbs./A)**	(ppm)	(lbs./A)*	(ppm)	(lbs./A)*	(ppm)	(lbs./A)*	(ppm)	(lbs./A)*	(ppm)			(meq/100g)	% K	% Mg	% Ca	% H	% Na	(mmhos/cm)
04-012-WR1-C4	0.7	23	105.8	131	602.6	106	254.4	180	828	1455	6693	12	55.2	2	4	2.3	U	4.6	19.8	1.4	7.6	36.8	54	0.3	1.4
04-012-WR2-C4	0.9	12	55.2	58	266.8	94	225.6	135	621	2377	10934	12	55.2	1	2	2.3	B	4.4	35	0.7	3.2	33.9	62	0.1	4.3
04-012-WR3-C4	0.4	23	105.8	107	492.2	55	132	97	446.2	991	4558.6	14	64.4	1	2	2.3	U	3.7	12.5	1.1	6.5	39.6	52	0.5	1.8
04-012-WR4-C4	1	17	78.2	95	437	42	100.8	89	409.4	477	2194.2	13	59.8	1	2	2.2	U	3.2	26.3	0.4	2.8	9.1	87	0.2	2.5
04-012-WR5-C4	0.4	4	18.4	26	119.6	103	247.2	130	598	2056	9457.6	11	50.6	1	2	2.3	U	7.4	11.7	2.3	9.3	88	0	0.4	1
04-012-WR6-C4	0.7	12	55.2	89	409.4	47	112.8	115	529	1369	6297.4	12	55.2	1	2	2.2	U	3	86.1	0.1	1.1	7.9	90	0.1	5.8
04-012-WR8-C4	0.7	12	55.2	71	326.6	56	134.4	186	855.6	4151	19095	14	64.4	1	2	2.2	U	4	95.6	0.2	1.6	21.7	76	0.1	5.8
04-012-WR9-C4	1.1	15	69	87	400.2	43	103.2	166	763.6	3162	14545	10	46	1	2	2.2	U	2.9	0	0	0.6	7.4	91	0	6.9
04-012-WR10-C4	1	21	96.6	97	446.2	31	74.4	83	381.8	1085	4991	13	59.8	1	2	2.3	U	2.5	0	0.1	0.6	4.9	94	0.1	4.6
04-012-TP2-C4	0.7	21	96.6	58	266.8	30	72	51	234.6	4126	18980	10	46	1	2	2.5	U	2.5	0	0	0.1	5.4	94	0	5.9
04-012-TP3-C4	6.1	57	262.2	103	473.8	54	129.6	104	478.4	5306	24408	11	50.6	1	2	2.5	U	4.4	72.6	0.2	1.2	36.6	62	0.1	4
04-012-TP4-C4	2.3	6	27.6	111	510.6	84	201.6	171	786.6	2528	11629	11	50.6	1	2	2.7	U	6	16.9	1.3	8.5	75	15	0.3	3.7
04-012-R1	1.2	8	36.8	43	197.8	71	170.4	286	1315.6	1695	7797	19	87.4	2	4	2.2	U	6.2	12.6	1.4	18.9	67	12	0.7	0.4
04-012-B1	0.7	7	32.2	94	432.4	97	232.8	406	1867.6	1985	9131	28	128.8	2	4	2.3	U	6.3	15.3	1.6	22.1	64.9	10	0.8	0.4
04-012-B3	0.7	15	69	56	257.6	100	240	362	1665.2	1792	8243.2	26	119.6	1	2	2.2	U	6.4	13.6	1.9	22.2	66	9	0.8	0.4
04-012-B4	2.4	6	27.6	20	92	132	316.8	372	1711.2	1616	7433.6	19	87.4	2	4	2.3	U	5.8	14.3	2.4	21.6	56.4	19	0.6	0.4

* = POUNDS OF ELEMENTAL P, Mg, Ca, Na, or N PER ACRE (Based on soil depth of 6-2/3 inches)
** = POUNDS OF K2O PER ACRE (Based on soil depth of 6-2/3 inches)
C.E.C. = CATION EXCHANGE CAPACITY

TABLE A-5

PARK MINE PHYSICAL PROPERTIES

SAMPLE NO.	SAMPLE TEXTURE	USCS Soil Classification (ASTM D 2487)	PARTICAL SIZE DISTRIBUTION (Cumulative Percent Passing)				SPECIFIC GRAVITY (weighted)	STANDARD PROCTOR		ATTERBERG LIMITS		POROSITY (%)	FIELD WATER CAPACITY (%)	WILTING POINT (%)
			#200 Sieve	#4 Sieve	3/4 " Sieve	3" Sieve		Max. Dry Density (lbs./cu. ft.)	Optimum Moisture Content (%)	Liquid Limit	Plasticity Index			
04-012-B1-C4	Clayey Sand with Gravel	SC	41.3	77	87.5	100	2.78	130.5	10.2	NR	NR	0.25	NR	NR
04-012-B1	Silty Sand with Gravel	SM	41.3	77	87.5	100	2.47	128.4	10.6	NR	N R	0.17	19.49	9.8
04-012-B3-7 ft + Depth	Silty Sand with Gravel	SM	33.3	72	80.9	100	2.83	NR	NR	NR	NR	NR	NR	NR
04-012-B3-Physical	Silty Sand with Gravel	SM	36.3	80	91.1	100	2.82	NR	NR	NR	NR	NR	NR	NR
04-012-B4-C4	Organic Silty Sand with Gravel	SM	37.2	73.2	91.8	100	2.08	NR	NR	NR	NR	NR	NR	NR
04-012-R1	Silty Sand with Gravel	SM	33.7	72.8	90.6	100	2.72	128.2	12.2	NR	NR	0.24	16.41	9.62
04-012-TP2-C4	Silt	ML	85.5	99.7	100	100	2.77	93.5	22	NR	NR	0.46	35.21	16.78
04-012-TP3-C4	Silt with Sand	ML	73.9	96.7	100	100	3.25	115.3	19.2	NR	NP	0.43	25.61	9.36
04-012-TP4-C4	Silt	ML	87.9	100	100	100	2.88	100.1	25	29	5	0.44	32.73	16.74
04-012-WR10-C4	Silty Gravel with Sand	GM	16.1	53.2	88.7	100	2.88	124.8	13.1	29	5	0.31	20.39	11.59
04-012-WR1-C4	Silty Gravel with Sand	GM	12.3	43	78.7	100	2.58	NR	NR	NR	NR	NR	18.72	11.88
04-012-WR2-C4	Poorly Graded Gravel with Silt and Sand	GP-GM	9	42.5	83.6	100	2.74	136.5	9.3	NR	NR	0.20	15.68	8.68
04-012-WR3-C4	Poorly Graded Gravel with Silt and Sand	GP-GM	10	47.8	88.1	100	2.69	131.7	10.6	NR	NR	0.22	19.42	10.82
04-012-WR4-C4	Well Graded Gravel with Silt and Sand	GW-GM	9.8	52.3	90.2	100	2.79	133.8	9.7	NR	NR	0.23	14.38	7.02
04-012-WR5-C4	Poorly Graded Gravel with Silt and Sand	GP-GM	7.5	37.7	76.8	100	2.65	129.8	8.1	NR	NR	0.22	14.82	9.39
04-012-WR6-C4	Well Graded Gravel with Silt and Sand	GW-GM	11.4	46.6	86.8	100	2.53	133.1	11.1	NR	NR	0.16	15.98	8.87
04-012-WR8-1	NR	NR	NR	NR	NR	NR	NR	129.7	11.6	NR	NR	NR	16.41	9.62
04-012-WR8-C4	Silty Sand with Gravel	SM	12.2	57.2	95	100	2.76	126.9	11.5	NR	NR	0.26	18.19	9.87
04-012-WR9-C4	Silty Gravel with Sand	GM	24.4	57.9	93.6	100	2.73	123.6	12.9	NR	NR	0.27	23.78	12.58

NR = Analysis Not Requested
NP = Non-Plastic

TABLE A-6

1996 PARK MINE WATER DATA

(EXCLUDING ADIT SAMPLES)

FIELD ID		Al (ug/L)	Sb (ug/L)	As (ug/L)	Ba (ug/L)	Be (ug/L)	Cd (ug/L)	Ca (ug/L)	Cr (ug/L)	Co (ug/L)	Cu (ug/L)	Fe (ug/L)	Pb (ug/L)
04-012-SW1	Tot. Metals	94.2	3.9 UJ	64.1	22.5	1.9 U	3.7	35800	9.2 U	9.5 U	3.0 U	103	2.8
04-012-SW2	Tot. Metals	150	6.5 J	50.8	22.6	1.9 U	6.5	43600	9.2 U	9.5 U	7.3	107	6.0
04-012-SW3	Tot. Metals	69.4	7.1 J	89.2	13.8	1.9 U	4.6	62200	9.2 U	9.5 U	3.0 U	201	9.9
04-012-SW4	Tot. Metals	1220	8.0 J	58.7	23.3	1.9 U	14.5	22400	9.2 U	9.5 U	45.2	787	34.8
04-012-SW5	Tot. Metals	890	7.2 J	21.5	18.8	1.9 U	26.8	21800	9.2 U	9.5 U	44.0	358	13.3
04-012-SW6	Tot. Metals	350	7.2 J	1.7 U	27.4	1.9 U	0.11 U	7660	9.2 U	9.5 U	3.0 U	376	1.9
04-012-SW7	Tot. Metals	106	6.9 J	49.2	30.5	1.9 U	0.95	37100	9.2 U	9.5 U	3.0 U	80.5	0.89 U
04-012-GW3	Tot. Metals	34.4	7.8 J	1.7 U	1.4 U	1.9 U	0.11 U	16.7	9.2 U	9.5 U	3.0 U	22.3	0.89 U
04-012-GW5	Tot. Metals	282	9.5 J	7.1	4.1	1.9 U	0.11 U	9670	9.2 U	9.5 U	3.0 U	241	0.89 U
04-012-GW6	Tot. Metals	261	5.9 J	13.4	11.1	1.9 U	0.31	30300	9.2 U	9.5 U	3.0 U	322	2.1
04-012-SW3	Dis. Metals	119	3.9 U	101	15.1	1.9 U	4.5	65100	9.2 U	9.5 U	3.0 U	26.2	9.8
04-012-GW3	Dis. Metals	26.2 U	3.9 U	2.4	1.4 U	1.9 U	0.11 U	17.6	9.2 U	9.5 U	3.0 U	20.3 U	0.89 U
04-012-GW5	Dis. Metals	26.2 U	3.9 U	10.9	3.2	1.9 U	0.11 U	9380	9.2 U	9.5 U	3.0 U	21.8	0.89 U
04-012-GW6	Dis. Metals	40.2	3.9 U	13.0	9.3	1.9 U	0.24	28200	9.2 U	9.5 U	3.0 U	26.2	2.3

FIELD ID		Mg (ug/L)	Mn (ug/L)	Hg (ug/L)	Ni (ug/L)	K (ug/L)	Se (ug/L)	Ag (ug/L)	Na (ug/L)	Tl (ug/L)	V (ug/L)	Zn (ug/L)	HARDNESS (mg CaCo3/L))
04-012-SW1	Tot. Metals	6720	39.2	0.062	17.1 U	884	1.3 U	0.56 U	4250	0.87 U	3.4 U	410	
04-012-SW2	Tot. Metals	7670	111	0.056 U	17.1 U	1110	1.6	0.56 U	4570	0.87 U	4.0	1180	
04-012-SW3	Tot. Metals	10100	44.6	0.056 U	17.1 U	1170	1.5	0.56 U	5310	0.87 U	3.4 U	1130	
04-012-SW4	Tot. Metals	4960	482	0.056	17.1 U	1180	1.3	0.56 U	4040	0.87 U	3.4 U	2060	
04-012-SW5	Tot. Metals	4710	735	0.056 U	17.1 U	1090	1.6	0.56 U	3780	0.87 U	3.4 U	3240	
04-012-SW6	Tot. Metals	2200	29.8	0.056 U	17.1 U	1980	1.3 U	0.56 U	3540	0.87 U	3.4 U	15.2 U	
04-012-SW7	Tot. Metals	7730	10.8	0.056 U	17.1 U	821	1.3 U	0.56 U	5640	0.87 U	3.4 U	78.4	
04-012-GW3	Tot. Metals	15.6 U	4.2 U	0.056 U	17.1 U	40.0 U	1.3 U	0.56 U	18.7	0.87 U	3.4 U	15.2 U	
04-012-GW5	Tot. Metals	2630	6.8	0.056 U	17.1 U	1350	1.7	0.56 U	3690	0.87 U	3.4 U	15.2 U	
04-012-GW6	Tot. Metals	6030	10.8	0.056 U	17.1 U	791	1.3 U	0.56 U	4310	0.87 U	3.4 U	15.2 U	
04-012-SW3	Dis. Metals	10400	44.7	0.16	17.1 U	1210	3.9 J	0.56 U	5670	0.87 U	3.4 U	1080	205
04-012-GW3	Dis. Metals	17.7	4.2 U	0.056 U	17.1 U	40.0 U	1.3 UJ	0.56 U	43.4	0.87 U	3.4 U	15.2 U	0.12
04-012-GW5	Dis. Metals	2570	4.2 U	0.056 U	17.1 U	1330	2.7 J	0.56 U	3890	0.91	3.4 U	15.2 U	34.0
04-012-GW6	Dis. Metals	5690	4.2 U	0.056 U	17.1 U	783	2.8 J	0.56 U	4310	0.87 U	3.4 U	15.2 U	93.8

U = Analyte Not Detected
J = Estimated Concentration
***= Data in water table has not been validated for outliers, updated table will be included in the final report

TABLE A-7

1996 PARK MINE WET CHEMISTRY RESULTS
Results in mg/L

FIELD ID	TDS	Cl-	SO4-2	Nitrate/ Nitrite-N	Hardness
04-012-SW1	190	<5	83	NA	117.00
04-012-SW2	217	<5	103	NA	140.00
04-012-SW3	302	<5	158	NA	197.00
04-012-SW4	140	<5	63	NA	76.40
04-012-SW5	138	<5	67	NA	73.80
04-012-SW6	92	<5	<5	NA	28.20
04-012-SW8	172	<5	42	NA	124.00
04-012-GW5	69	<5	8	NA	35.00
04-012-GW6	151	<5	64	NA	100

TABLE A-8

PARK ADIT SAMPLING TOTAL METALS DATA SUMMARY

	DATE	Al ug/l	Sb ug/l	As ug/l	Ba ug/l	Be ug/l	Cd ug/l	Ca ug/l	Cr ug/l	Co ug/l	Cu ug/l	Fe ug/l	Pb ug/l
PARK-1	09/28/95	29700	2.7U	353	15.8B	2.8B	410	79500	9.6U	88.7	657	5550	49.6
PARK-1	01/24/96	297	2B	62.0	8.7B	1.2U	61.4	56300	7.8U	9U	44.9	1510.0	15.9
PARK-1	06/06/96	1630	2.7U	482.0	5.1B	1.9U	35.6	22600	9.7U	7.7U	64.9	3210	106.0
PARK-1	08/27/96	596	1.8U	145	5.8B	1.9U	55	39200	9.2U	9.5U	63	1880	34.4
PARK-2	09/28/95	847	2.7U	271	6.3B	2.0U	62.2	42100	9.6U	10.9U	75.8	3490	49
PARK-2	01/24/96	1540	2.2B	42.2	9.6B	1.2U	21.4	15200	7.9B	9U	34.0	882	13.3
PARK-2	06/06/96	4930	2.7U	342.0	10.9B	1.9U	87.1	49200	9.7U	15.9B	210.0	3080	365.0
PARK-2A	08/27/96	3920	2.9B	90	16.3B	1.9U	51.4	26900	9.2U	14.2B	80.8	728	49.1
PARK-2B	08/27/96	9960	2.7B	1200	21.8B	1.9U	220	103000	9.2U	29.8B	417	6420	493
PARK-4	10/16/95	557	.9B	70.1	4.2B	1.5U	5.6	17400	8.7U	8.3U	10.8B	618.0	26.9
PARK-4	06/06/96	713	2.7U	195.0	5B	1.9U	15.4	11700	9.7U	7.7U	20.1B	1270	38.8
PARK-4	08/27/96	749	2.7B	120	5.4B	1.9U	4.6B	15800	9.2U	9.5U	12.7B	923	32.4
PARK-BK	10/16/95	2110	2.0B	26.0	10.7B	1.5U	7.9	17500	8.7U	8.3U	64.0	2870	21.4
PARK-BK	06/06/96	327	2.7U	21.4	1.8B	1.9U	2.4B	10200	9.7U	7.7U	35.9	1260	18.1
PARK-BK	08/27/96	488	1.8U	6.8B	7.4B	1.9U	6.6	17000	10B	9.5U	40.6	299	7.8
		Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb

	DATE	Mg ug/l	Mn ug/l	Hg ug/l	Ni ug/l	K ug/l	Se ug/l	Ag ug/l	Na ug/l	Tl ug/l	V ug/l	Zn ug/l
PARK-1	09/28/95	2980	10200	0.16U	27.3B	1310B	55.8U	1.7B	4910B	42.8U	6.1U	43800
PARK-1	01/24/96	9030	2790.0	0.14U	10.7U	1150B	1.3B	0.37U	4920B	2B	3.8U	9970
PARK-1	06/06/96	5050	863.0	0.11U	17.6U	1030B	0.97U	0.56U	3110B	1.1U	3.9U	5160
PARK-1	08/27/96	6700	1750.0	0.056U	17.1U	956B	1.3U	0.75U	4140B	2.5B	3.4U	8490
PARK-2	09/28/95	6960	2020	0.16U	13.9U	945B	55.8U	0.47B	4250B	42.8U	6.1U	9170
PARK-2	01/24/96	4580B	822	0.14U	10.7U	817B	1.3U	0.37U	3800B	1.8B	3.8U	3120.0
PARK-2	06/06/96	8470	2460	0.11U	17.6U	1460B	0.97U	0.82B	3310B	1.1U	5.7B	11100.0
PARK-2A	08/27/96	7230	1410.0	0.056U	17.1U	1130B	1.3U	0.75U	4370B	3.4B	4.4B	6960
PARK-2B	08/27/96	15600	6140	0.056U	17.4B	2920B	1.3U	0.75U	4370B	3.5B	6.7B	24200.0
PARK-4	10/16/95	3640B	29.0	0.14U	16.9U	982B	2.2U	0.25B	3520B	0.97U	4.4U	1010
PARK-4	06/06/96	2700B	134	0.11U	17.6U	723B	0.97U	0.56U	2560B	1.1U	3.9U	1680.0
PARK-4	08/27/96	3540B	42	0.056U	17.1U	899B	1.3U	0.75U	3390B	2.3B	3.4U	815.0
PARK-BK	10/16/95	3070B	165	0.14U	16.9U	1370B	2.2U	0.21U	4250B	2.1B	4.4U	772.0
PARK-BK	06/06/96	1460B	33	0.11U	17.6U	786B	0.97U	0.56U	2840B	1.1U	3.9U	452.0
PARK-BK	08/27/96	2630B	104	0.056U	17.1U	1130B	1.3U	0.75U	4100B	2.9B	3.4U	707.0
		Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn

U- denotes that analyte was undetectable

B- analyte was detected; however, concentration was less than the CRDL

TABLE A-9

PARK ADIT SAMPLING DISSOLVED METALS DATA SUMMARY

		Al ug/l	Sb ug/l	As ug/l	Ba ug/l	Be ug/l	Cd ug/l	Ca ug/l	Cr ug/l	Co ug/l	Cu ug/l	Fe ug/l	Pb ug/l
PARK-1	09/28/95		2.7U	9.7J	6.4		66.9	43700	9.6U	10.9U	65.2	1010	4.9J
PARK-1	01/24/96	110B	2U	5.9B	8.4B	1.2U	63	57300	7.8U	9U	39.2	679	1.9B
PARK-1	06/06/96	1690	4.8B	13.1	6.1B	1.9U	45.8	24500	9.7U	7.7U	68	860	56.4
PARK-1	08/27/96	313	4B	8.3B	6.8B	1.9U	66	42200	14.5	9.5U	70.4	821	6.5
PARK-2	09/28/95		2.7U	5.2B	15.6B		411	78900	9.6U	94.2	654	486	54.9
PARK-2	01/24/96	17.7U	2U	2.3U	9.6B	1.2U	20.4	15600	7.8U	9U	10B	204	1.6U
PARK-2	06/06/96	4770	4.7B	22	9.7B	1.9U	98.5	59300	9.7U	15.1B	249	1600	254
PARK-2A	08/27/96	172B	4B	1.1B	17.8B	1.9U	64.6	29000	9.2U	9.5U	70.6	48.7B	8.4
PARK-2B	08/27/96	7740	3.5B	32.6	11.9B	2.1B	234	111000	14.1	28.4B	426	3470	93.9
PARK-4	10/16/95	23.9B	1.9U	23	3B	1.5U	4B	18900	8.7U	8.3U	3.3B	14.2U	1.6U
PARK-4	06/06/96	48.9B	6.9B	3.5B	4.6B	1.9U	17.5	10900	9.7U	7.7U	11.3B	42.1B	5.4
PARK-4	08/27/96	26.2U	3.2B	19.9	3.8B	1.9U	2.9B	17000	11.3	9.5U	3.9B	20.3U	0.96B
PARK-BK	10/16/95	53.6B	1.9U	1.5U	2.0B	2.2B	8.2	109B	8.7U	8.3U	4.4B	14.2U	2.6B
PARK-BK	06/06/96	143B	3.1B	1.7B	1.4B	1.9U	4.3B	10300	9.7U	7.7U	31.2	172	5.5
PARK-BK	08/27/96	240	2.2B	1U	8.7B	1.9U	6.5	17800	9.2U	9.5U	46.9	24.4B	4.8
		Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb

	DATE	Mg ug/l	Mn ug/l	Hg ug/l	Ni ug/l	K ug/l	Se ug/l	Ag ug/l	Na ug/l	Tl ug/l	V ug/l	Zn ug/l
PARK-1	09/28/95	7260	2090	0.16U	13.9U			0.22				9510J
PARK-1	01/24/96	8950	2830	0.14U	10.7U	1260B	2.2U	0.37U	5030	0.97U	3.8U	10000
PARK-1	06/06/96	5270	913	0.11U	17.6U	1090B	3.4B	0.56U	3360B	2.9B	3.9U	5460
PARK-1	08/27/96	7430	1870	0.056U	17.1U	1100B	1.4B	0.75U	4990B	0.87U	3.4U	9100
PARK-2	09/28/95	3000	10100	0.16U	15.2B			1.5B				43400
PARK-2	01/24/96	4530B	828	0.14U	10.7U	885B	2.2U	0.52B	3960B	0.97U	3.8U	3000
PARK-2	06/06/96	8470	2750	0.11U	17.6U	1430B	3.4B	0.77U	3240B	2.7B	3.9U	11900
PARK-2A	08/27/96	7940	1480	0.056U	17.1U	1240B	1.8B	0.75U	5170	0.87U	3.4U	7410
PARK-2B	08/27/96	16600	6570	0.056U	17.1U	3120B	2.9B	0.75U	5130	0.87U	3.4U	25500
PARK-4	10/16/95	3840B	6.1B	0.14U	16.9U	587B	2.2U	0.21U	3450B	0.97U	4.4U	833
PARK-4	06/06/96	2560B	128	0.11U	17.6U	706B	2.8B	0.56U	2510B	2.3B	3.9U	1570
PARK-4	08/27/96	3690B	7.1B	0.056U	17.1U	915B	1.7B	0.75U	4080B	0.87U	3.4U	551
PARK-BK	10/16/95	51.6B	3.4U	0.14U	16.9U	243B	2.2U	0.21U	370B	0.97U	4.4U	9.1U
PARK-BK	06/06/96	1470B	31.1	0.11U	17.6U	845B	3.2B	0.56U	3100B	2.4B	3.9U	425
PARK-BK	08/27/96	2880B	114	0.056U	17.1U	1280B	1.9B	0.75U	4900B	0.87U	3.4U	762
		Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn

U- denotes that analyte was undetectable

B- analyte was detected; however, concentration was less than the CRDL

TABLE A-10

PARK ADIT SAMPLING METALS SPECIATION SUMMARY

SITE NAME	Date	Fe Total Metals (mg/l)	Fe Speciation Total (mg/l)	Fe+2 (mg/l)	Fe+3 (mg/l)	As Diss. Metals (ug/l)	As Speciation Total (ug/l)	As+3 (ug/l)	As+5 (ug/l)	% Recovered
PARK-1	01/24/96	1.51	1.9	1.59	0.31	5.9B	NA	NA	NA	NA
PARK-1	06/06/96	3.21	3.09	1.34	1.75	13.1	<20	NA	NA	NA
PARK-1	08/27/96	1.88	2.7	2	0.68	8.3	<20	NA	NA	NA
PARK-2	01/24/96	0.88	1.26	1.08	0.18	2.3U	NA	NA	NA	NA
PARK-2	06/06/96	3.08	3.06	2.08	0.98	22	<20	NA	NA	NA
PARK-2A	08/27/96	0.73	0.55	0.48	0.07	1.1B	<20	NA	NA	NA
PARK-2B	08/27/96	6.42	4.4	2.7	1.7	32.6	29.4	2.86	28.5	107
PARK-4	06/06/96	1.27	1.14	1.02	0.12	3.5B	<20	NA	NA	NA
PARK-4	08/27/96	0.92	0.31	0.21	0.1	19.9	<20	NA	NA	NA
PARK-BK	06/06/96	1.26	1.18	1.14	0.04	1.7B	<20	NA	NA	NA
PARK-BK	08/27/96	0.3	0.56	0.5	0.06	1U	<20	NA	NA	NA

NA- Did Not Speciate
B- detected but below contract required detection limit (CRDL)
U- Analyte Not Detected

TABLE A-11

PARK ADIT SUMMARY

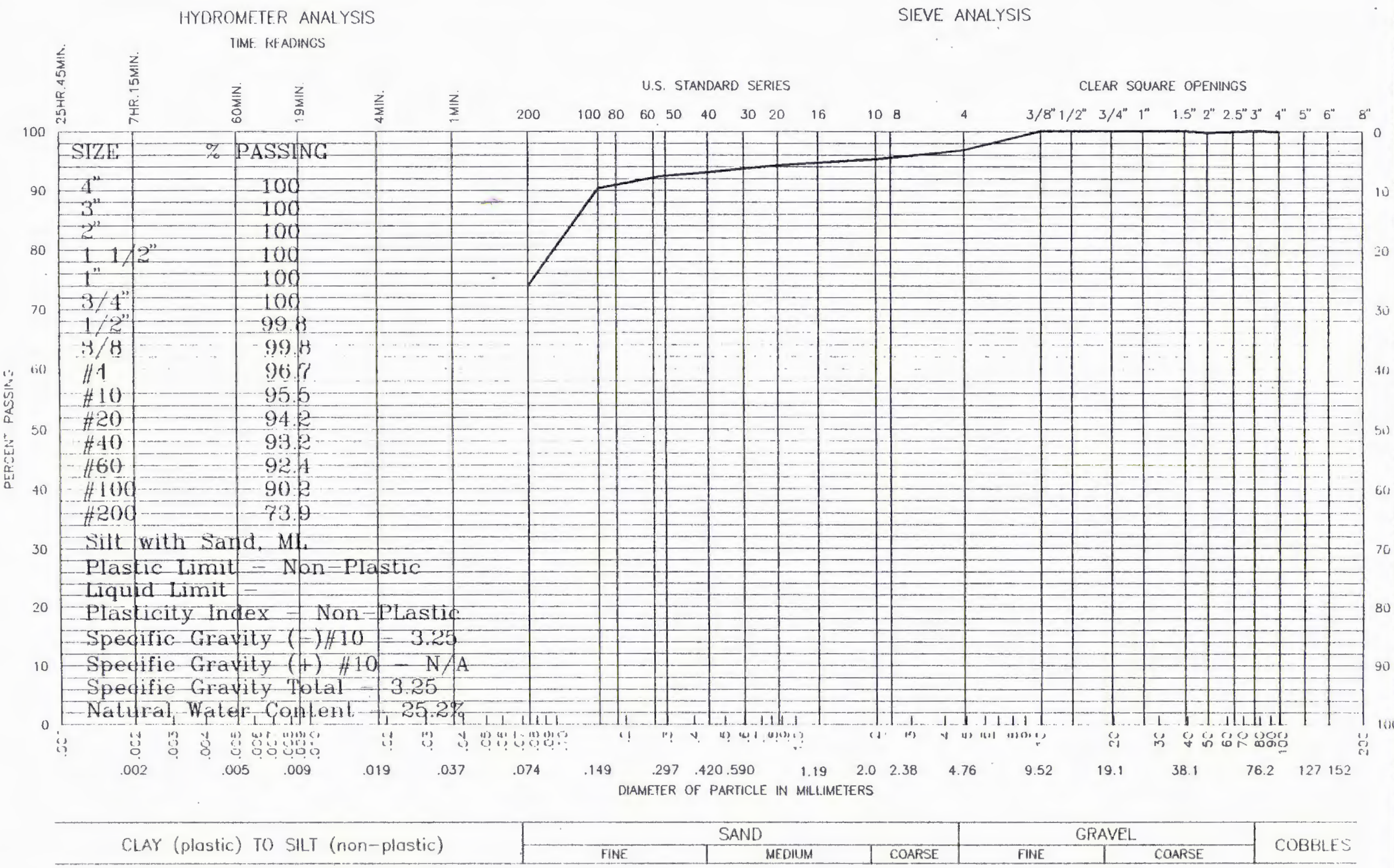
SITE	DATE	FLOW (GPM)	pH (SU)	EH (mV)	SC (uS/cm)	Alk (mg/l)	D.O. (mg/l)	TEMP (Celsius)	Chloride (mg/l)	TDS (mg/l)	Sulfate (mg/l)	Hardness (mg/l) as CaCo3
PARK 1	09/28/95	15	6.16	179.8	361	7	NM	6.1	<5	232	146	134
PARK 1	01/24/96	1.5	5.54	220.4	572	6	7.33	3.7	<5	310	220	178
PARK 1	06/06/96	120	3.74	357.2	265	0	7.83	6.4	<5	163	104	82.9
PARK 1	08/27/96	12.1	5.7	254.3	345	2	3.74	7.1	<5	327	158	136
PARK 2	09/28/95	5	4.83	206	980	0	NM	7.4	<5	864	622	321
PARK 2	01/24/96	5.6	6.71	171.9	150	31	8.16	5	<5	112	47	56.9
PARK 2	06/06/96	45	4.31	375.1	449	0	7.51	8.1	<5	264	170	183
PARK 2A	08/27/96	12	5.81	255.3	283	9	3.74	8.5	<5	211	114	105.1
PARK 2B	08/27/96	1	3.6	434.4	969	0	3.22	10	<5	707	442	346
PARK 4	10/16/95	<1	7.15	NM	45*	25	NM	10	<5	104	37	58.4
PARK 4	06/06/96	87	5.73	249.7	115	18	8.12	7	<5	91	29	37.8
PARK 4	08/27/96	<1**	6.32	233.3	144	34	4.32	15.4	<5	102	39	57.6
PARK-BK	10/16/95	<1	5.96	NM	37.8*	6	NM	6.1	<5	115	55	56.3
PARK-BK	06/06/96	52	6.42	206.2	101	12	8.12	7	<5	100	30	31.8
PARK-BK	08/27/96	0.6	5.65	300.5	164	7	3.4	10.8	<5	142	54	56.3

NM- not measured
*= measured with blue meter
**= flow estimated

APPENDIX B

MISCELLANEOUS RECLAMATION INVESTIGATION DATA

PHYSICAL SOILS DATA



SIZE	% PASSING
4"	100
3"	100
2"	100
1 1/2"	100
1"	100
3/4"	100
1/2"	99.8
3/8	99.8
#4	96.7
#10	95.5
#20	94.2
#40	93.2
#60	92.4
#100	90.2
#200	73.9

Silt with Sand, ML

Plastic Limit = Non-Plastic

Liquid Limit =

Plasticity Index = Non-PLastic

Specific Gravity (-)#10 = 3.25

Specifie Gravity (+) #10 = N/A

Specific Gravity Total = 3.25

Natural Water Content = 25.2%

PARK_G2.DWG

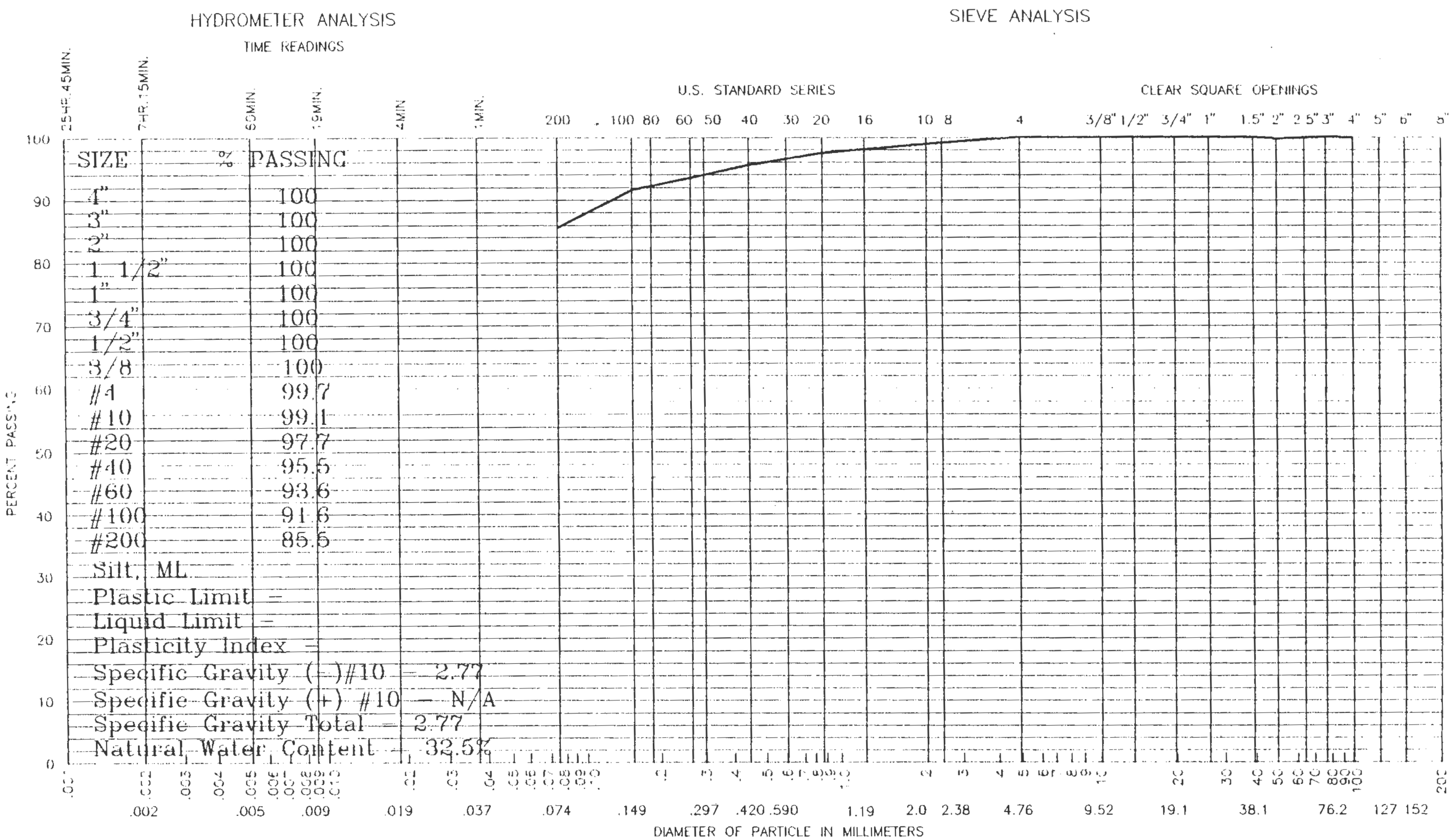
FLOW TECH

1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

PARTICLE SIZE ANALYSIS

Pioneer Technical Services– Park Mine

Sample 04-012-TP3-C4



SIZE	% PASSING
4"	100
3"	100
2"	100
1 1/2"	100
1"	100
3/4"	100
1/2"	100
3/8	100
#4	99.7
#10	99.1
#20	97.7
#40	95.5
#60	93.6
#100	91.6
#200	85.5

Silt, ML

Plastic Limit =

Liquid Limit =

Plasticity Index =

Specific Gravity (-)#10 = 2.77

Specifie Gravity (+) #10 — N/A

Specifie Gravity Total = 2.77

Natural Water Content = 32.5%

CLAY (plastic) TO SILT (non-plastic)	SAND			GRAVEL		COBBLES
	FINE	MEDIUM	COARSE	FINE	COARSE	

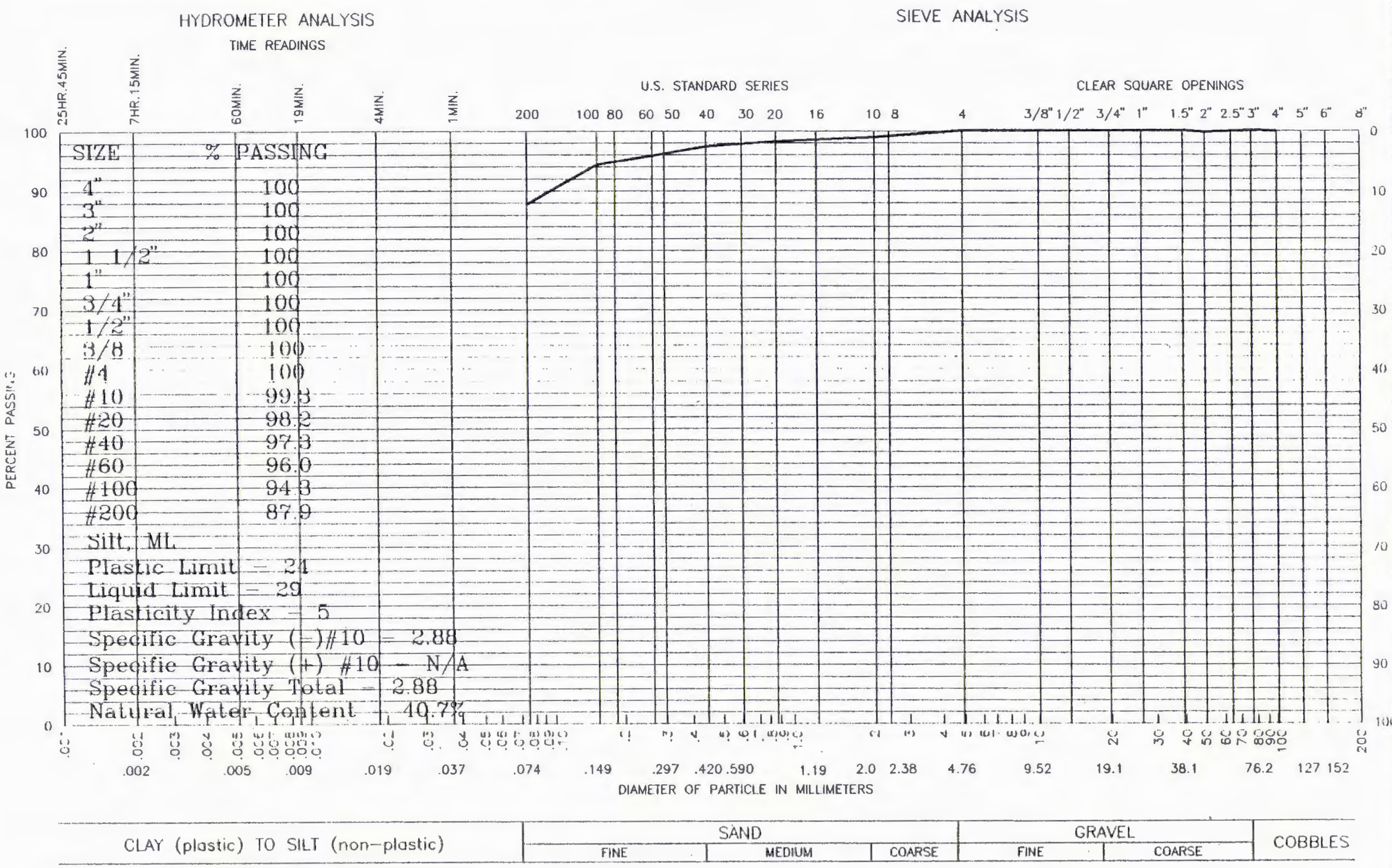
FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

PARTICLE SIZE ANALYSIS

Pioneer Technical Services– Park Mine

Sample 04-012-TP2-C4

PARK_G1.DWG



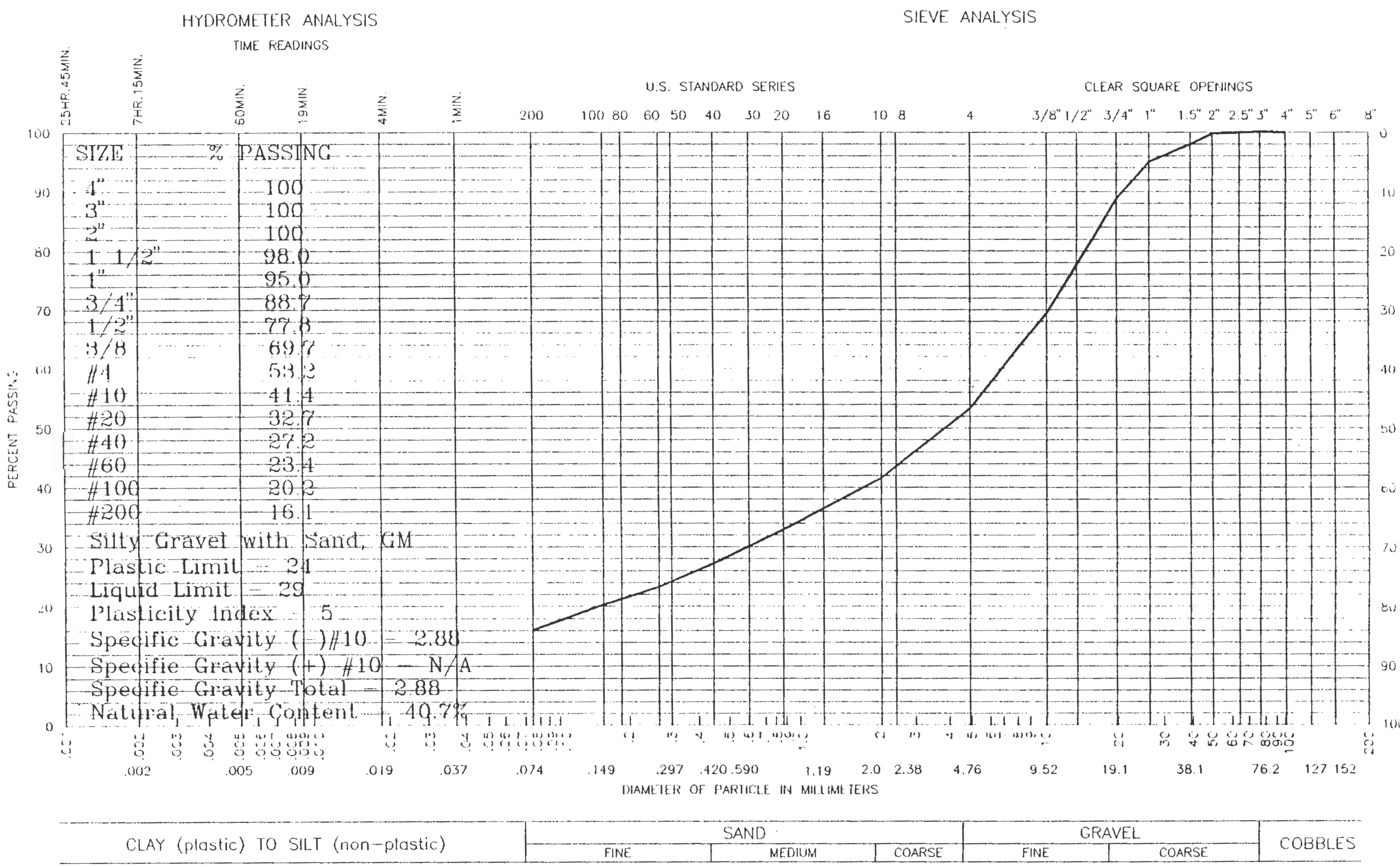
SIZE	% PASSING
4"	100
3"	100
2"	100
1 1/2"	100
1"	100
3/4"	100
1/2"	100
3/8	100
#4	100
#10	99.8
#20	98.2
#40	97.8
#60	96.0
#100	94.8
#200	87.9

Silt, ML
Plastic Limit = 24
Liquid Limit = 29
Plasticity Index = 5
Specific Gravity (-)#10 = 2.88
Specific Gravity (+) #10 = N/A
Specific Gravity Total = 2.88
Natural Water Content = 40.7%

PARK_G3.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

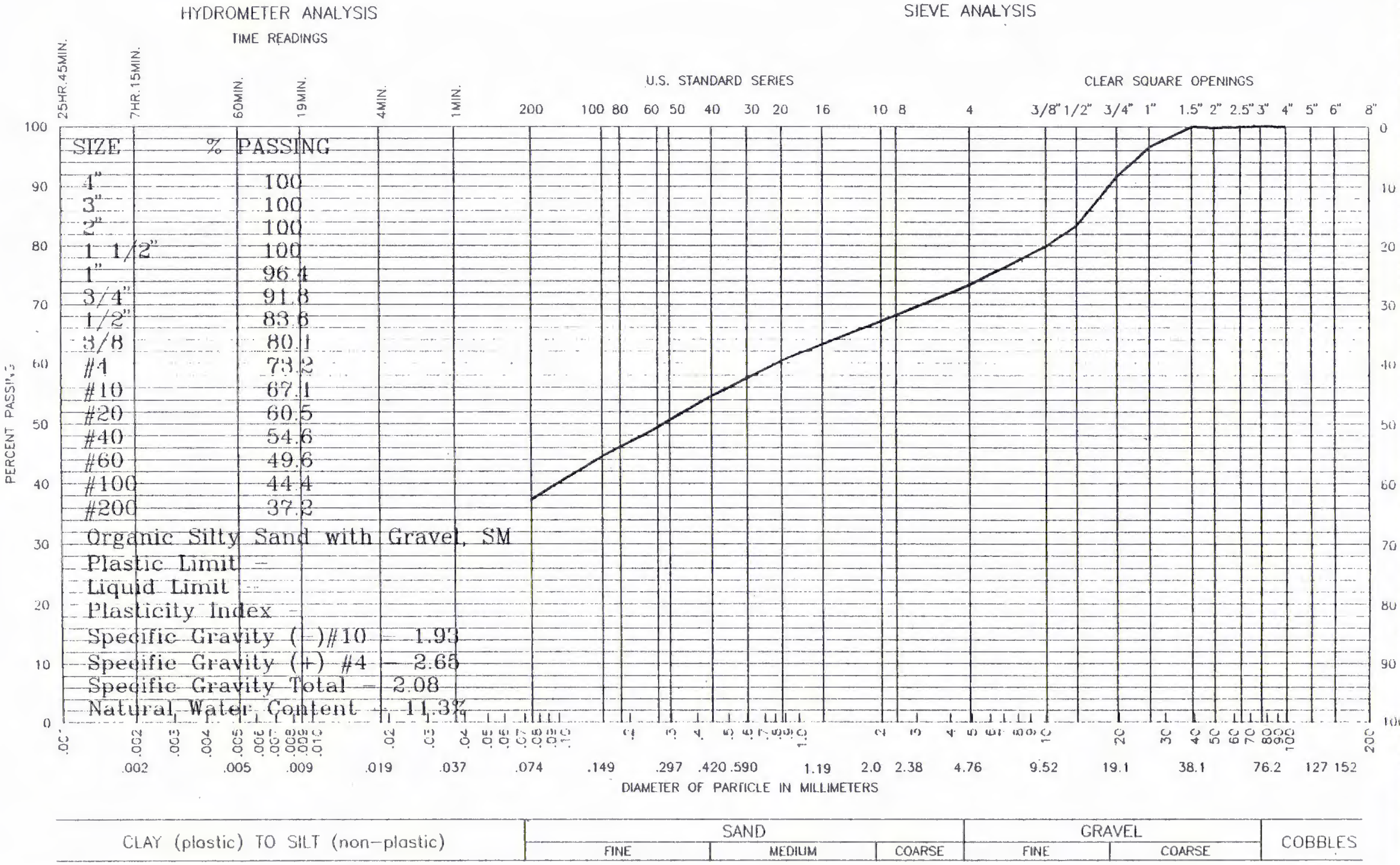
PARTICLE SIZE ANALYSIS
Pioneer Technical Services– Park Mine
Sample 04-012-TP4-C4



PARK_G4.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

PARTICLE SIZE ANALYSIS
Pioneer Technical Services– Park Mine
Sample 04-012-WR10-C4



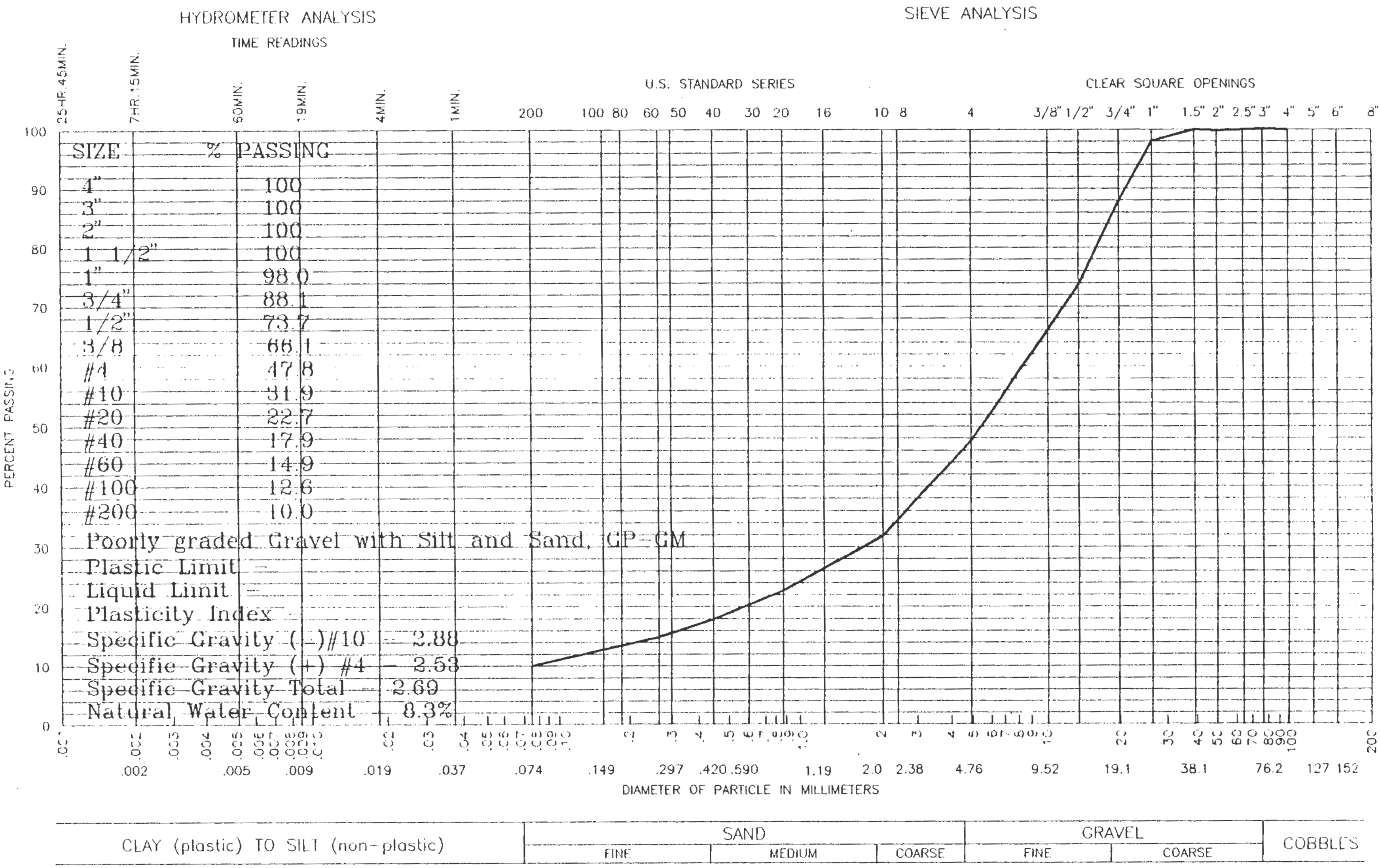
SIZE	% PASSING
4"	100
3"	100
2"	100
1 1/2"	100
1"	96.4
3/4"	91.8
1/2"	83.6
3/8	80.1
#4	73.2
#10	67.1
#20	60.5
#40	54.6
#60	49.6
#100	44.4
#200	37.2

Organic Silty Sand with Gravel, SM
Plastic Limit =
Liquid Limit =
Plasticity Index =
Specific Gravity (-)#10 = 1.93
Specific Gravity (+) #4 = 2.65
Specific Gravity Total = 2.08
Natural Water Content = 11.3%

PARK_G5.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

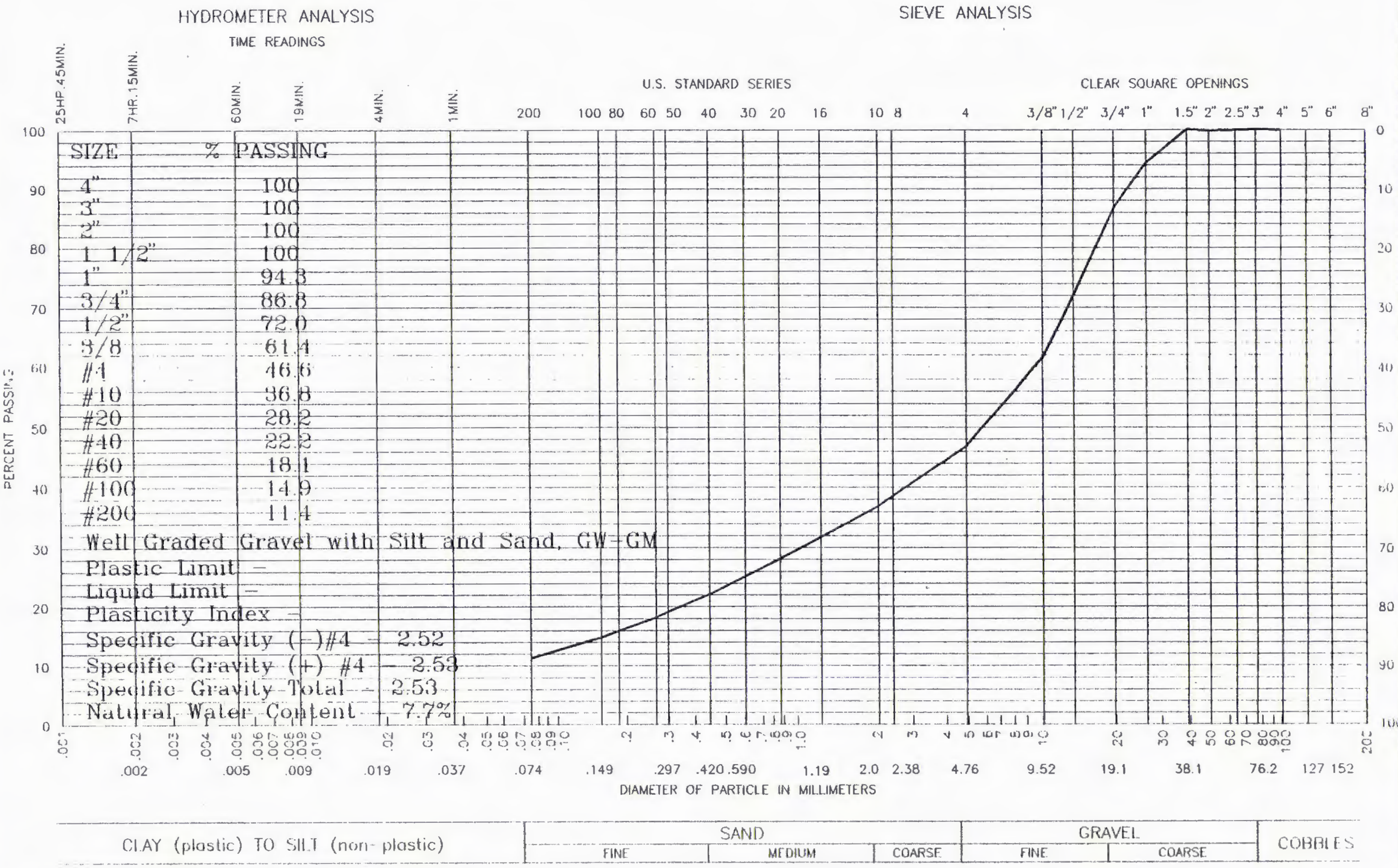
PARTICLE SIZE ANALYSIS
Pioneer Technical Services– Park Mine
Sample 04-012-B4-C4



PARK_G6.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

PARTICLE SIZE ANALYSIS
Pioneer Technical Services- Park Mine
Sample 04-012-WR3-C4



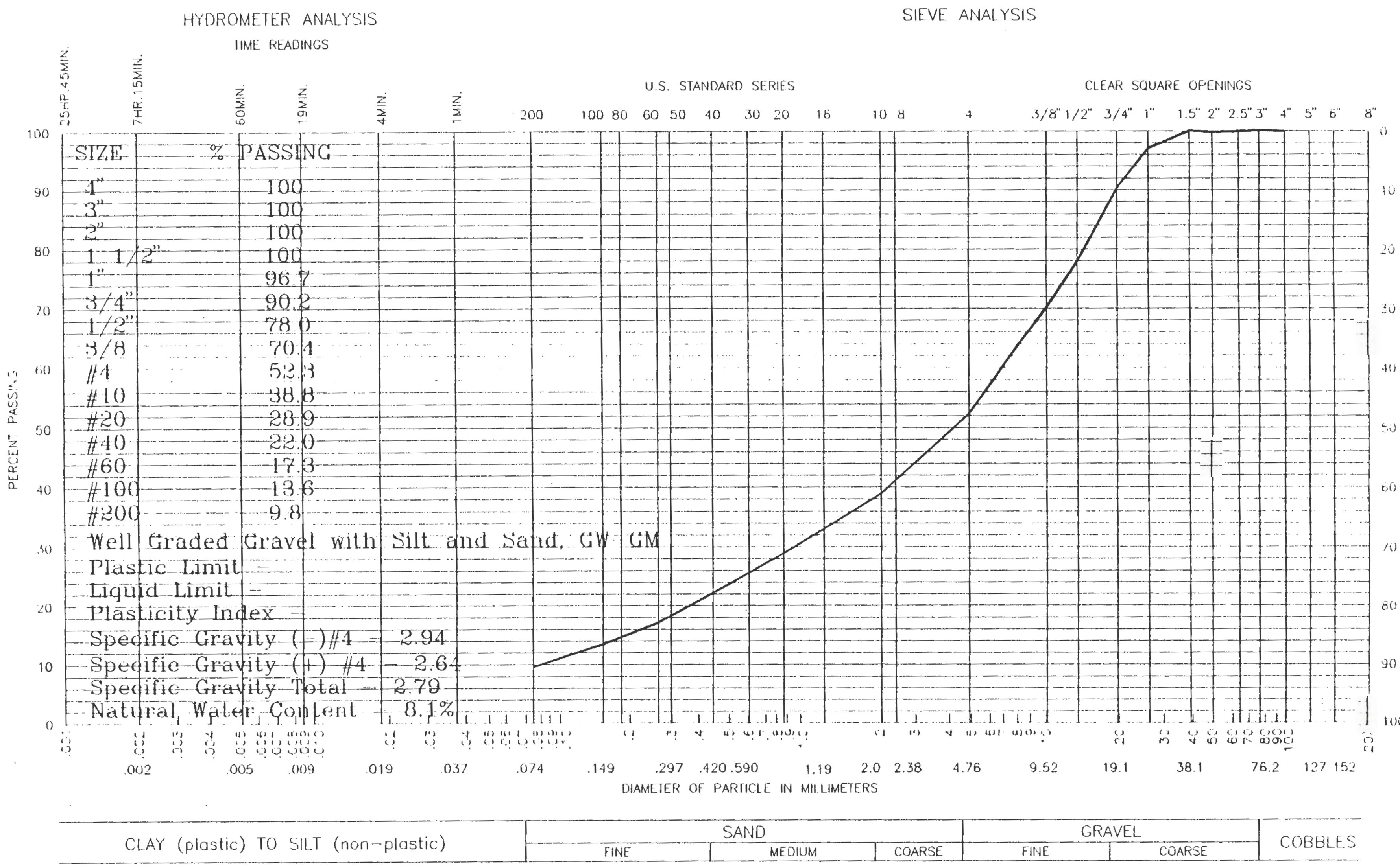
SIZE	% PASSING
4"	100
3"	100
2"	100
1 1/2"	100
1"	94.3
3/4"	86.8
1/2"	72.0
3/8	61.4
#4	46.6
#10	36.8
#20	28.2
#40	22.2
#60	18.1
#100	14.9
#200	11.4

Well Graded Gravel with Silt and Sand, GW-GM
Plastic Limit –
Liquid Limit –
Plasticity Index –
Specific Gravity (–)#4 – 2.52
Specific Gravity (+) #4 – 2.53
Specific Gravity Total – 2.53
Natural Water Content – 7.7%

PARK_G7.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

PARTICLE SIZE ANALYSIS
Pioneer Technical Services– Park Mine
Sample 04-012-WR6-C4



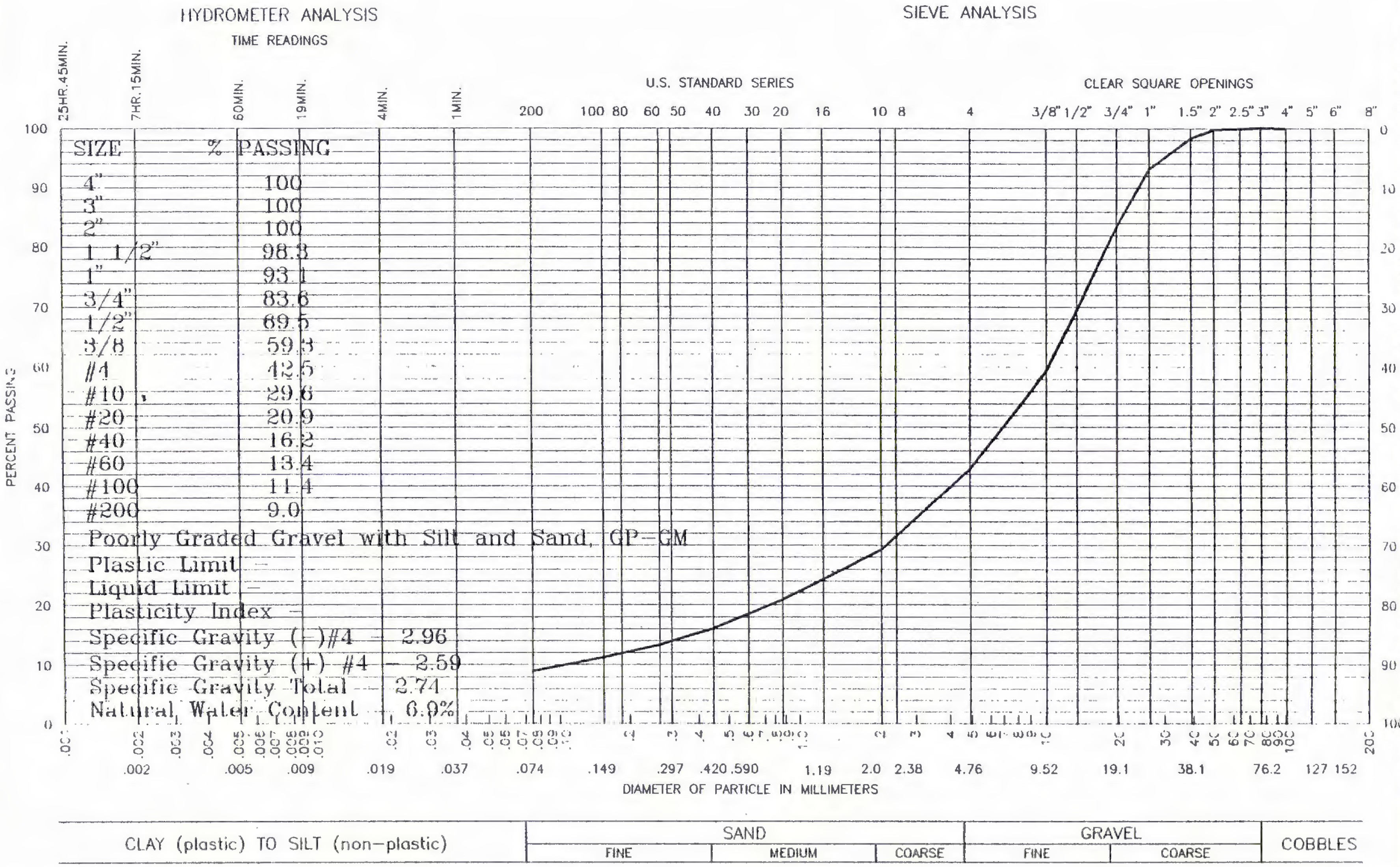
SIZE	% PASSING
4"	100
3"	100
2"	100
1 1/2"	100
1"	96.7
3/4"	90.2
1/2"	78.0
3/8	70.4
#4	52.3
#10	38.8
#20	28.9
#40	22.0
#60	17.3
#100	13.6
#200	9.8

Well Graded Gravel with Silt and Sand, GW GM
Plastic Limit =
Liquid Limit =
Plasticity Index =
Specific Gravity (-)#4 = 2.94
Specific Gravity (+) #4 = 2.64
Specific Gravity Total = 2.79
Natural Water Content = 8.1%

PARK_G8.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

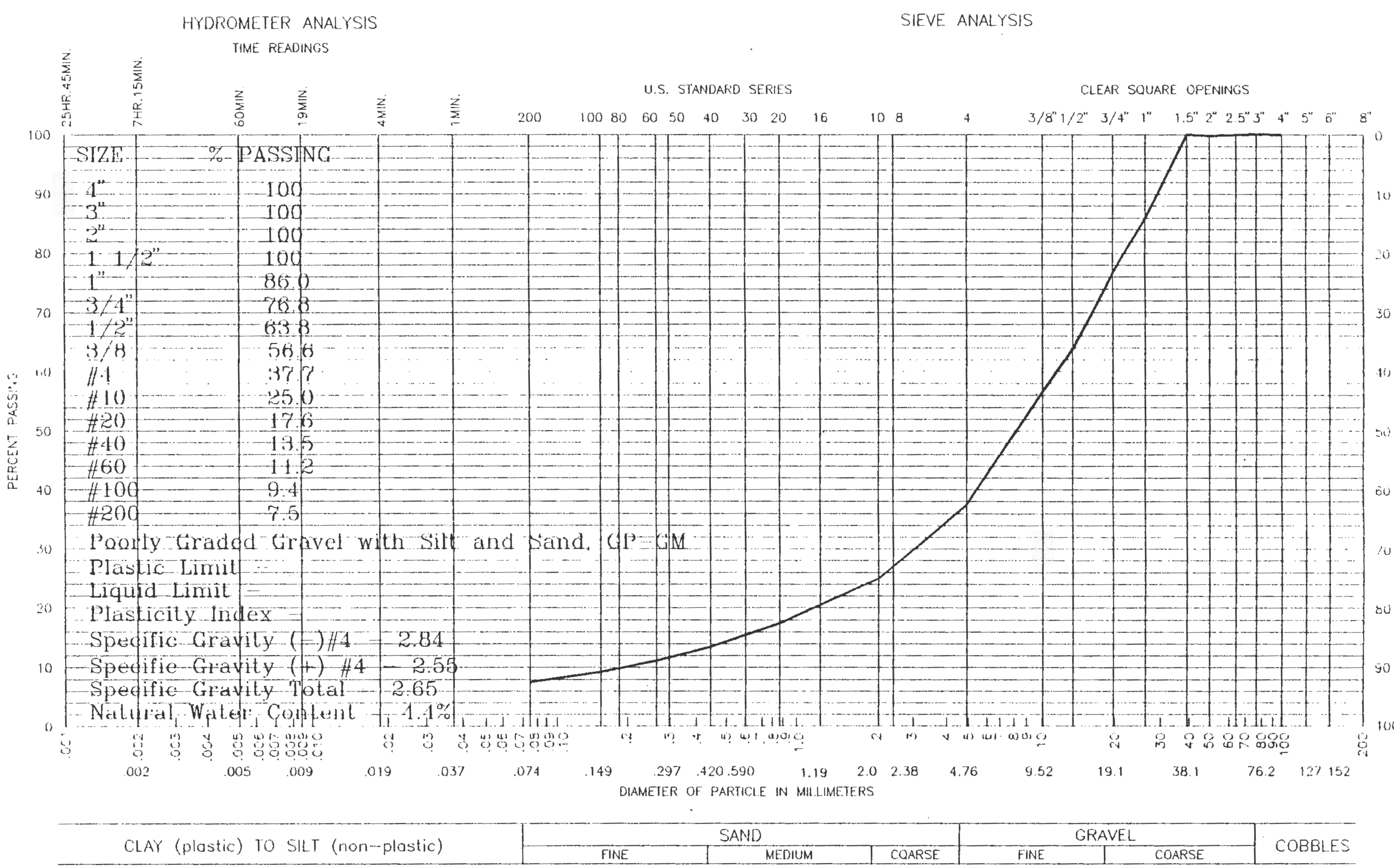
PARTICLE SIZE ANALYSIS
Pioneer Technical Services– Park Mine
Sample 04-012-WR4-C4



PARK_G9.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

PARTICLE SIZE ANALYSIS
Pioneer Technical Services– Park Mine
Sample 04-012-WR2-C4



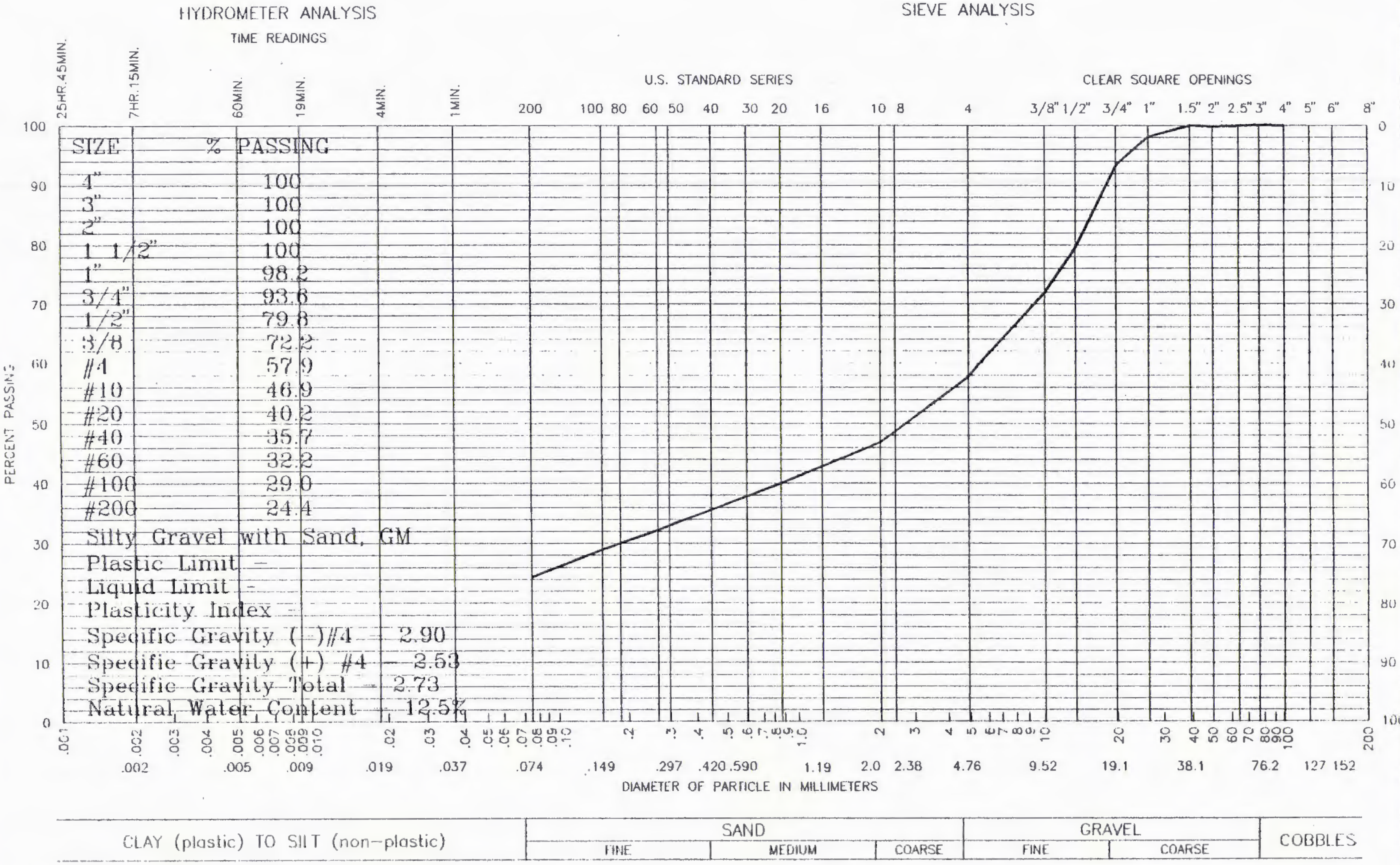
SIZE	% PASSING
4"	100
3"	100
2"	100
1 1/2"	100
1"	86.0
3/4"	76.8
1/2"	63.8
3/8	56.6
#4	37.7
#10	25.0
#20	17.6
#40	13.5
#60	11.2
#100	9.4
#200	7.5

Poorly Graded Gravel with Silt and Sand, GP-GM
Plastic Limit =
Liquid Limit =
Plasticity Index =
Specific Gravity (-)#4 = 2.84
Specifie Gravity (+) #4 = 2.55
Specific Gravity Total = 2.65
Natural Water Content = 4.4%

PARK_G10.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

PARTICLE SIZE ANALYSIS
Pioneer Technical Services– Park Mine
Sample 04-012-WR5-C4



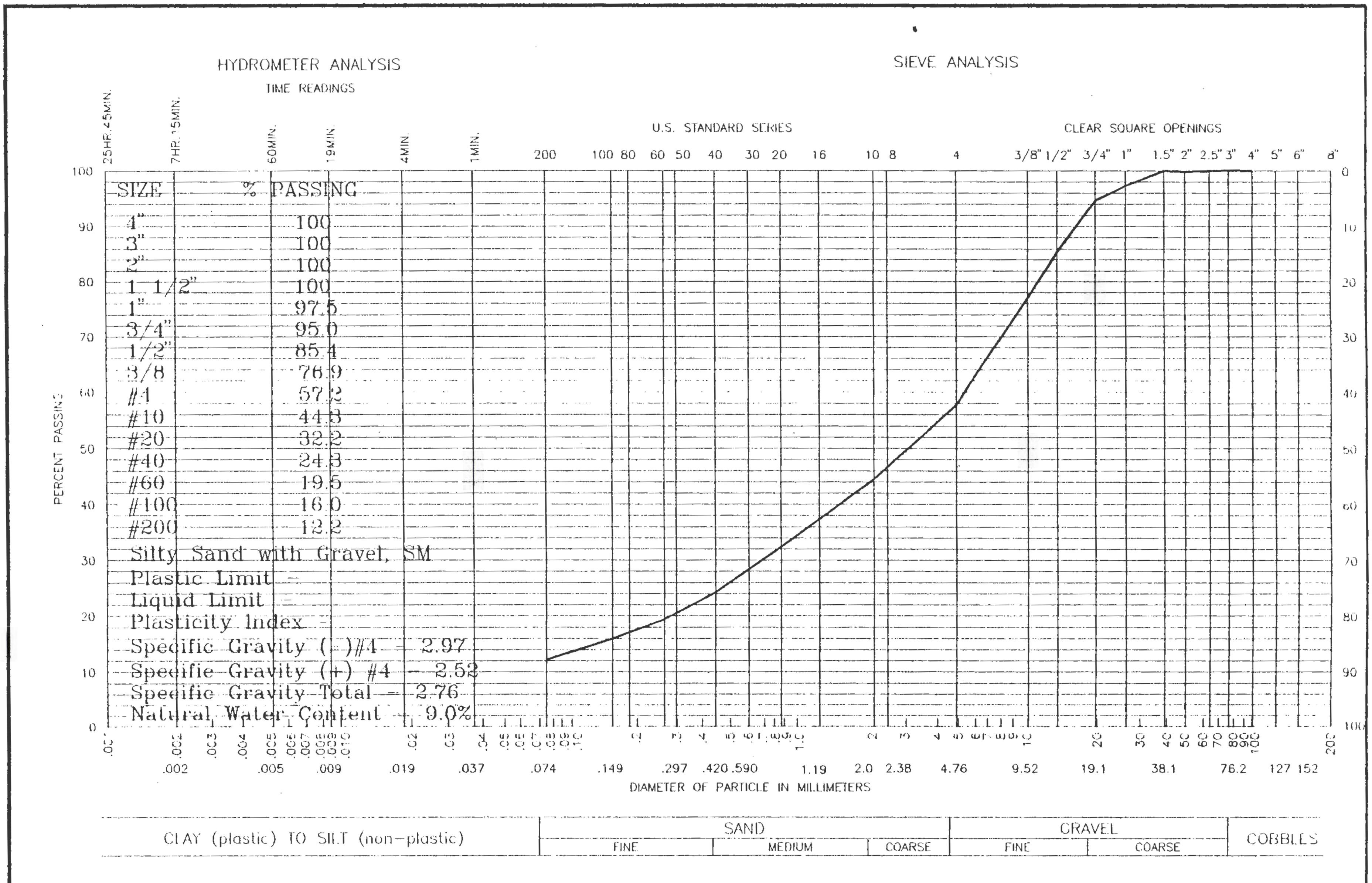
SIZE	% PASSING
4"	100
3"	100
2"	100
1 1/2"	100
1"	98.2
3/4"	93.6
1/2"	79.8
3/8	72.2
#4	57.9
#10	46.9
#20	40.2
#40	35.7
#60	32.2
#100	29.0
#200	24.4

Silty Gravel with Sand, GM
Plastic Limit –
Liquid Limit –
Plasticity Index –
Specific Gravity (–)#4 – 2.90
Specific Gravity (+) #4 – 2.53
Specific Gravity Total – 2.73
Natural Water Content – 12.5%

PARK_G11.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

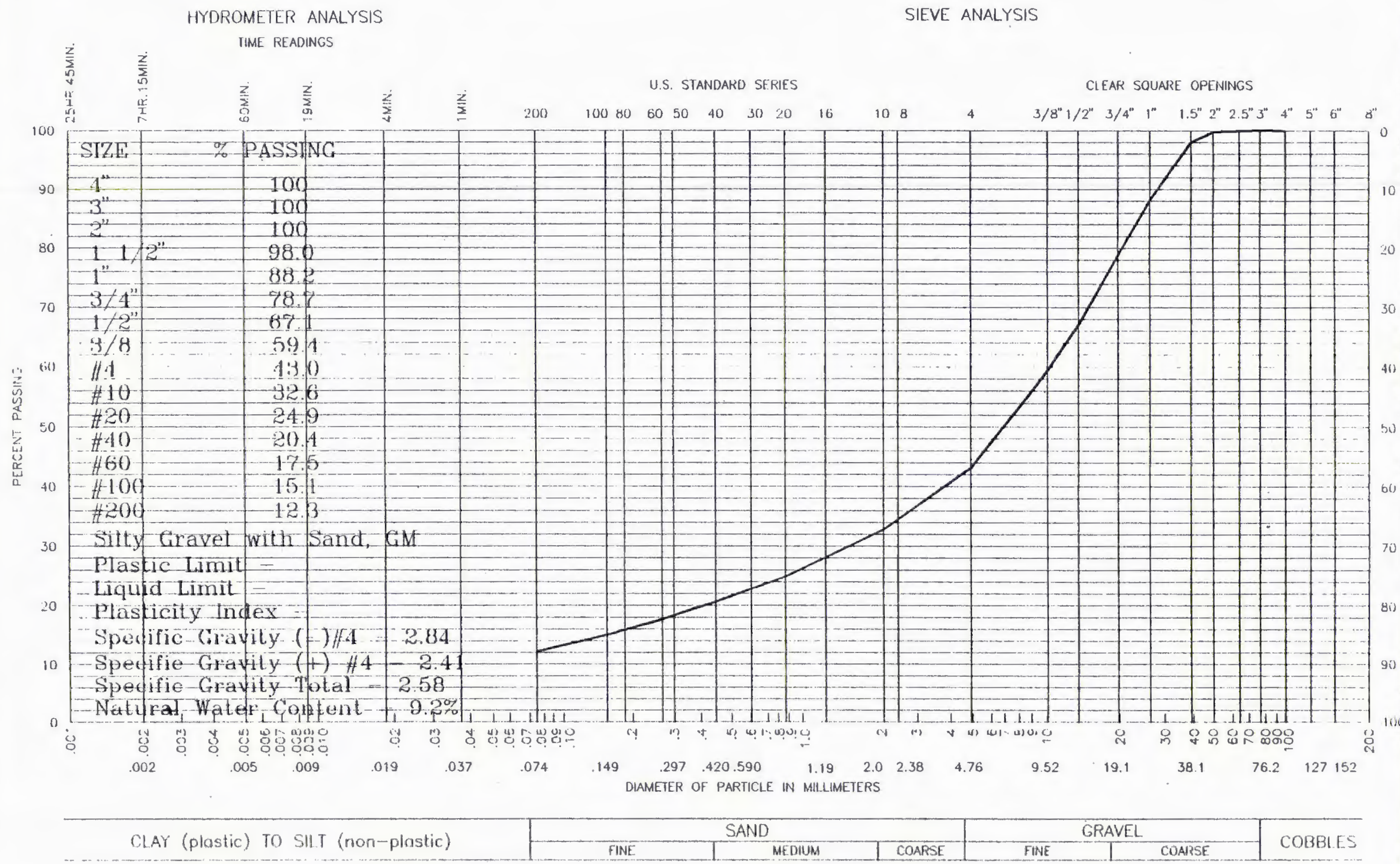
PARTICLE SIZE ANALYSIS
Pioneer Technical Services– Park, Mine
Sample 04-012-WR9-C4



PARK_G12.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

PARTICLE SIZE ANALYSIS
Pioneer Technical Services– Park Mine
Sample 04-012-WR8-C4



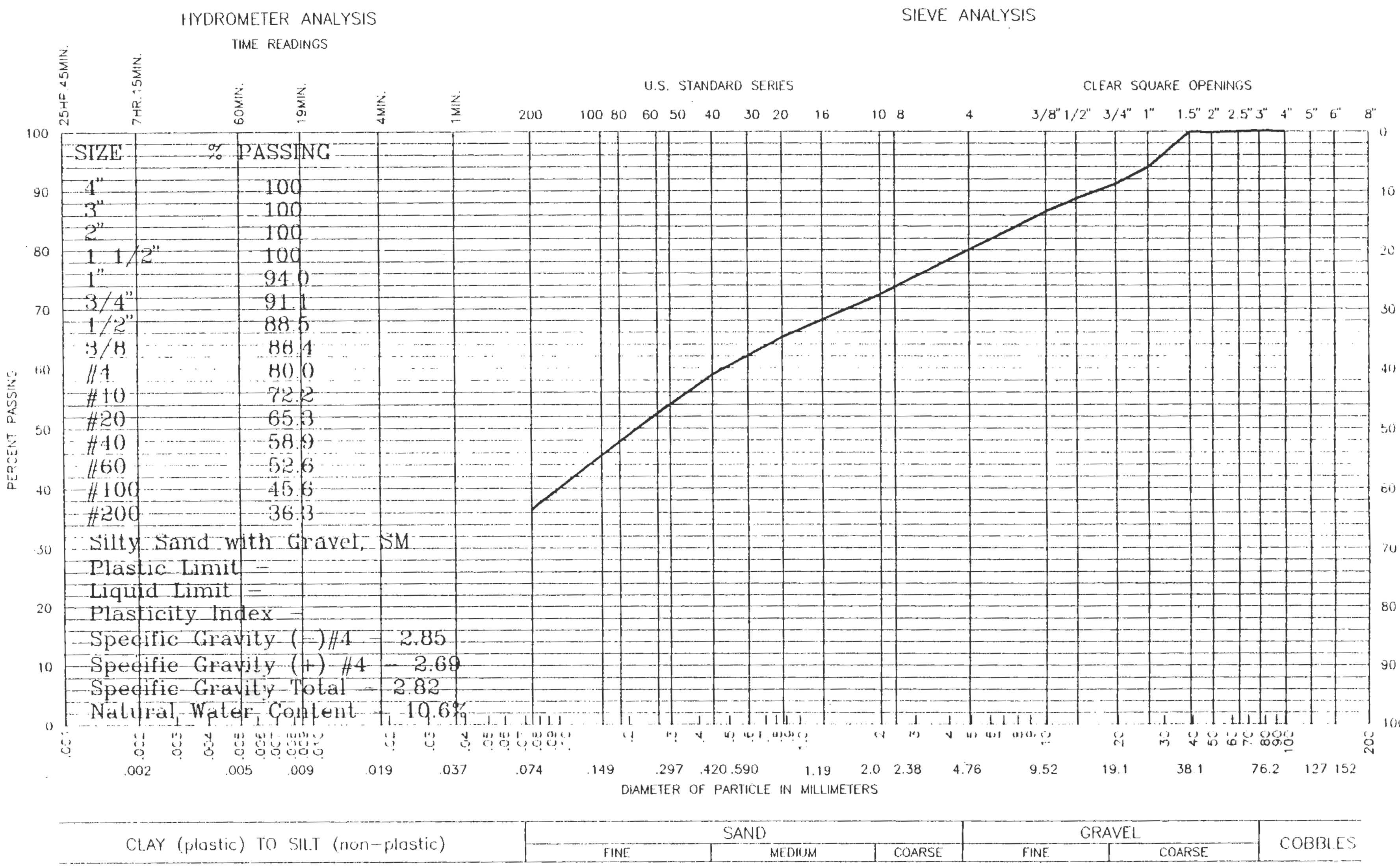
PARK_G13.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

PARTICLE SIZE ANALYSIS

Pioneer Technical Services– Park Mine

Sample 04-012-WR1-C4



SIZE	% PASSING
4"	100
3"	100
2"	100
1 1/2"	100
1"	94.0
3/4"	91.1
1/2"	88.5
3/8	86.4
#4	80.0
#10	72.2
#20	65.3
#40	58.9
#60	52.6
#100	45.6
#200	36.3

Silty Sand with Gravel, SM
Plastic Limit =
Liquid Limit =
Plasticity Index =
Specific Gravity (-)#4 = 2.85
Specific Gravity (+) #4 = 2.69
Specific Gravity Total = 2.82
Natural Water Content = 10.6%

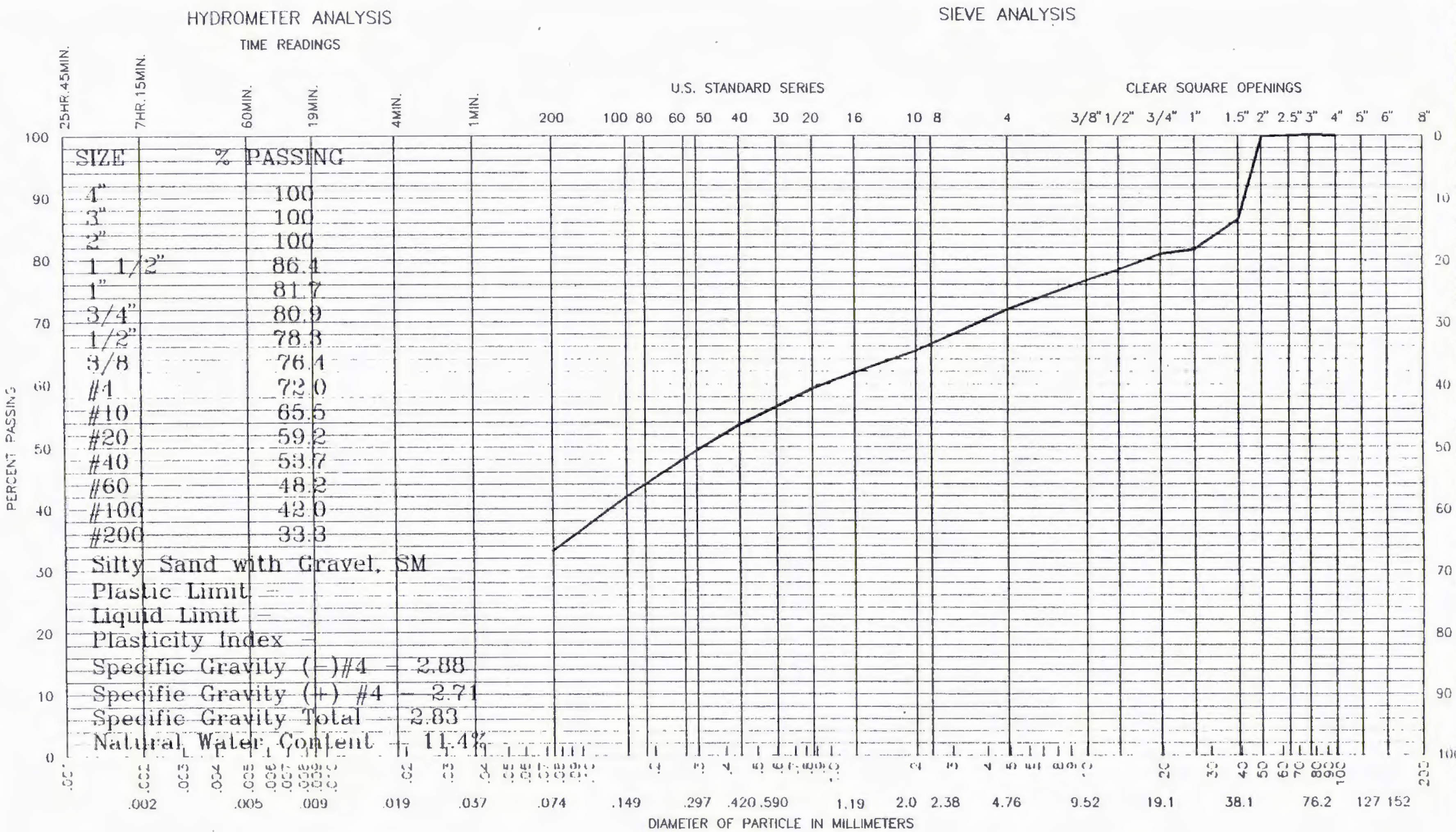
FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

PARTICLE SIZE ANALYSIS

Pioneer Technical Services– Park Mine

Sample 04-012-B3-Physical

PARK_G14.DWG



SIZE	% PASSING
4"	100
3"	100
2"	100
1 1/2"	86.4
1"	81.7
3/4"	80.9
1/2"	78.8
3/8	76.4
#4	72.0
#10	65.5
#20	59.2
#40	53.7
#60	48.2
#100	42.0
#200	33.3

Silty Sand with Gravel, SM
Plastic Limit –
Liquid Limit –
Plasticity Index –
Specific Gravity (–)#4 – 2.88
Specific Gravity (+) #4 – 2.71
Specific Gravity Total – 2.83
Natural Water Content – 11.4%

CLAY (plastic) TO SILT (non-plastic)	SAND			GRAVEL		COBBLES
	FINE	MEDIUM	COARSE	FINE	COARSE	

PARK_G15.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

PARTICLE SIZE ANALYSIS
Pioneer Technical Services– Park Mine
Sample 04-012-B3-7'+ Depth

SAMPLE NO. 04-012-TP2-04 ELEVATION ________

SOIL ________

LOCATION Park Mine

OPTIMUM MOISTURE CONTENT (UNCORRECTED) 22.0 %

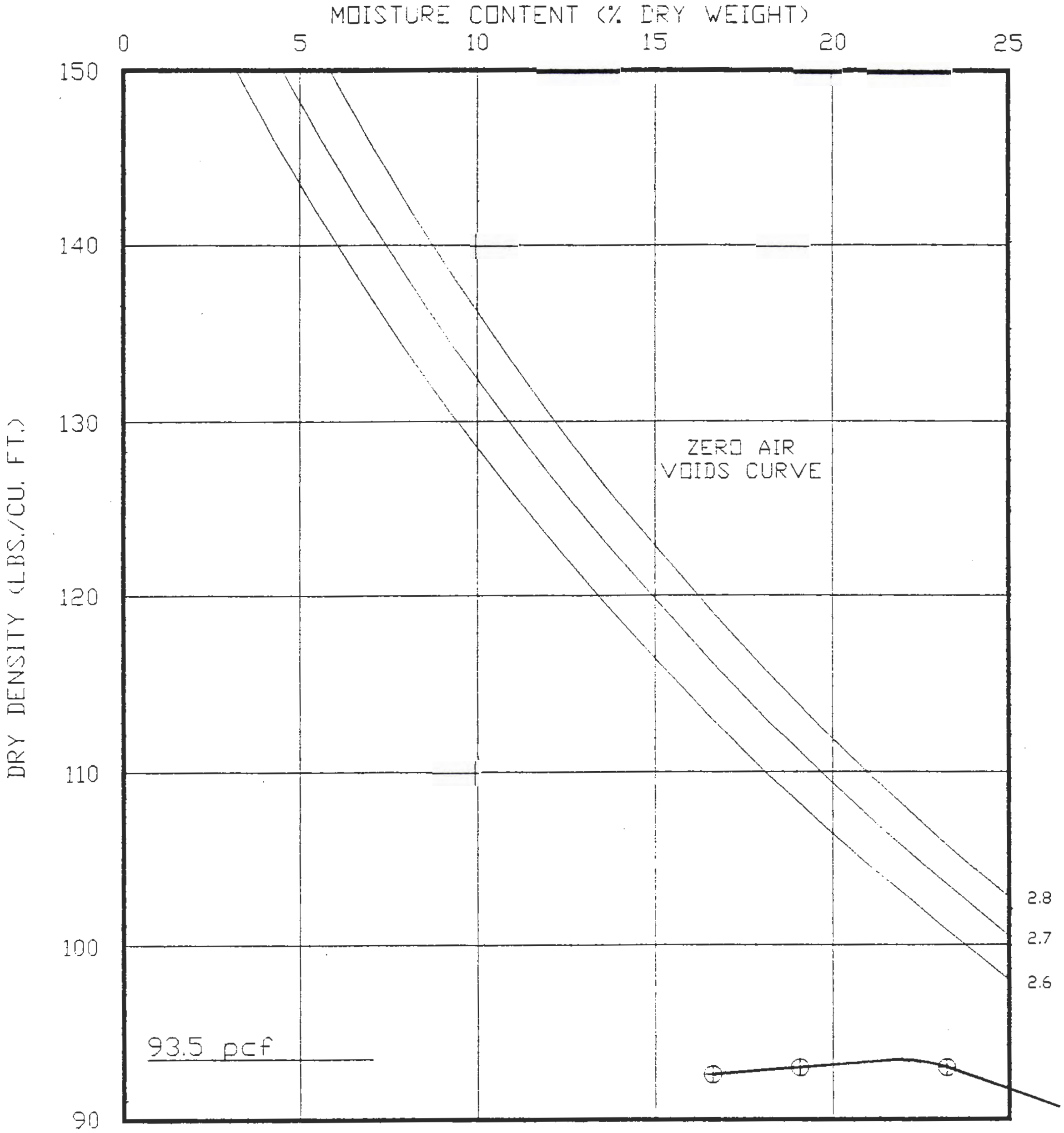
MAXIMUM DRY DENSITY (UNCORRECTED) 93.5 PCF

OPTIMUM MOISTURE CONTENT (CORRECTED) 22.0 %

MAXIMUM DRY DENSITY (CORRECTED) 93.5 PCF

METHOD OF COMPACTION ASTM D-698, METHOD A

SPECIFIC GRAVITY (COARSE) 2.77 ABSORPTION ________ %



PARK_P12.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

Pioneer Technical Service

CHECKED: PLR APPRV'D: PLR

PROJECT NO.: ________

FIGURE NO.:

SAMPLE NO. 04-012-TP3-C4 ELEVATION ________

SOIL ________

LOCATION Park Mine

OPTIMUM MOISTURE CONTENT (UNCORRECTED) 19.2 %

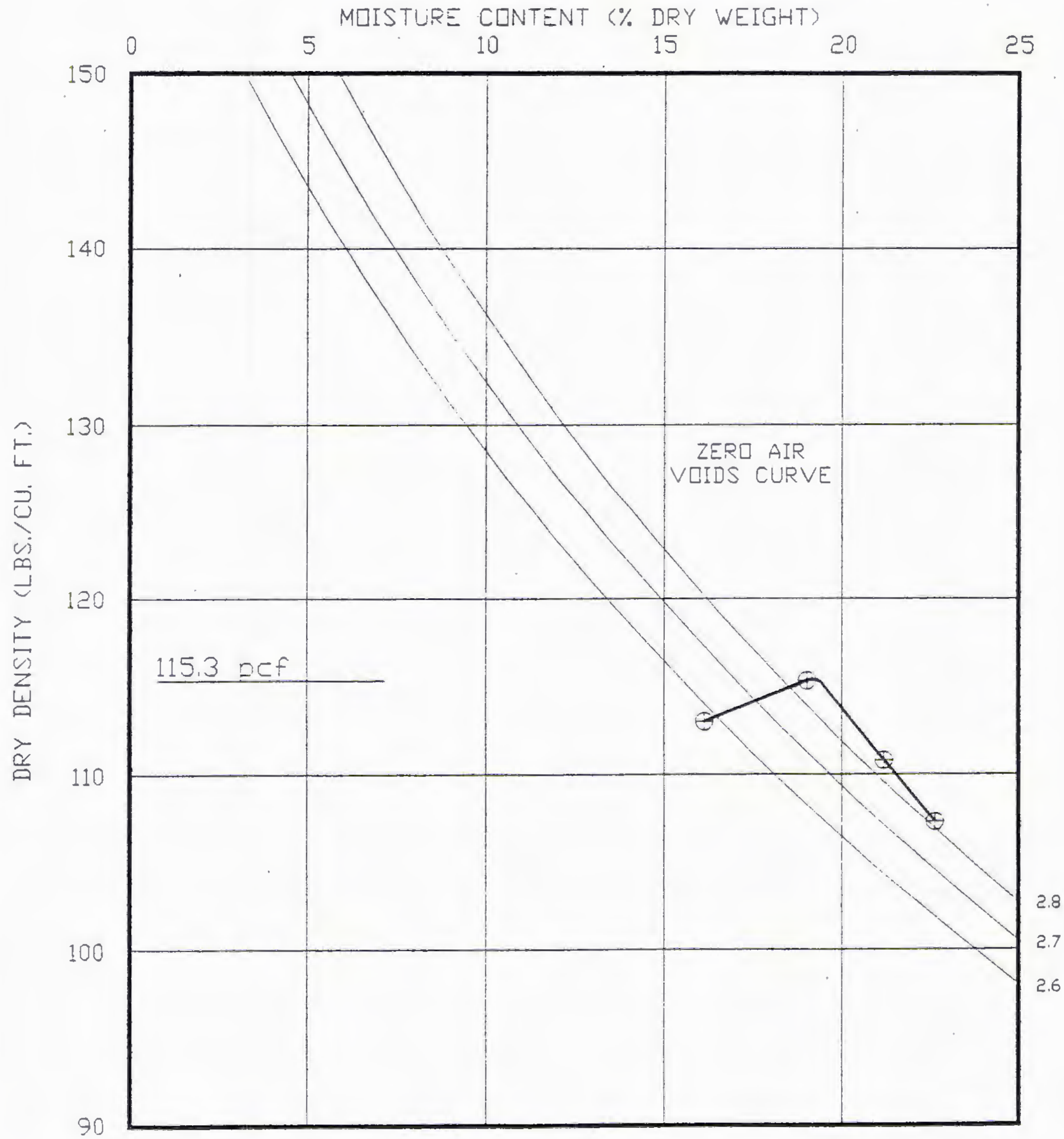
MAXIMUM DRY DENSITY (UNCORRECTED) 115.3 PCF

OPTIMUM MOISTURE CONTENT (CORRECTED) 19.2 %

MAXIMUM DRY DENSITY (CORRECTED) 115.3 PCF

METHOD OF COMPACTION ASTM D-698, METHOD A

SPECIFIC GRAVITY (COARSE) 3.25 ABSORPTION ________ %



PARK_P11.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

Pioneer Technical Service

CHECKED: PLR APPRV'D: PLR

PROJECT NO.: ________

FIGURE NO.

SAMPLE NO. 04-012-TP4-C4 ELEVATION ______

SOIL ______

LOCATION Park Mine

OPTIMUM MOISTURE CONTENT (UNCORRECTED) 25.0 %

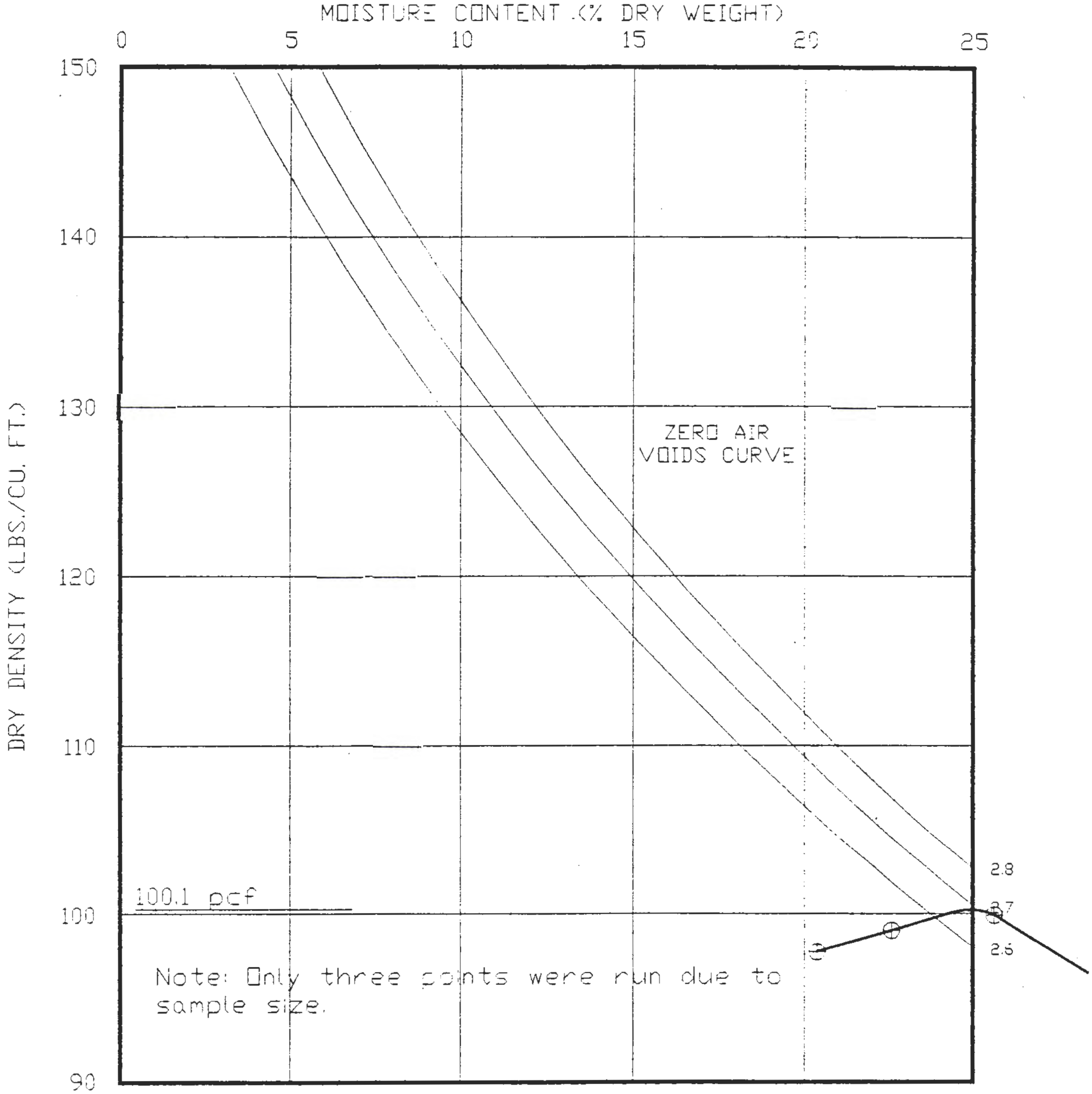
MAXIMUM DRY DENSITY (UNCORRECTED) 100.1 PCF

OPTIMUM MOISTURE CONTENT (CORRECTED) 25.0 %

MAXIMUM DRY DENSITY (CORRECTED) 100.1 PCF

METHOD OF COMPACTION ASTM D-698, METHOD A

SPECIFIC GRAVITY (COARSE) 2.88 ABSORPTION ______ %



PARK_P10.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

Pioneer Technical Service

CHECKED: PLR APPRV'D: PLR

PROJECT NO.: ______

FIGURE NO.

SAMPLE NO. 04-012-WR10-C4 ELEVATION ______

SOIL ______

LOCATION Park Mine

OPTIMUM MOISTURE CONTENT (UNCORRECTED) 14.0 %

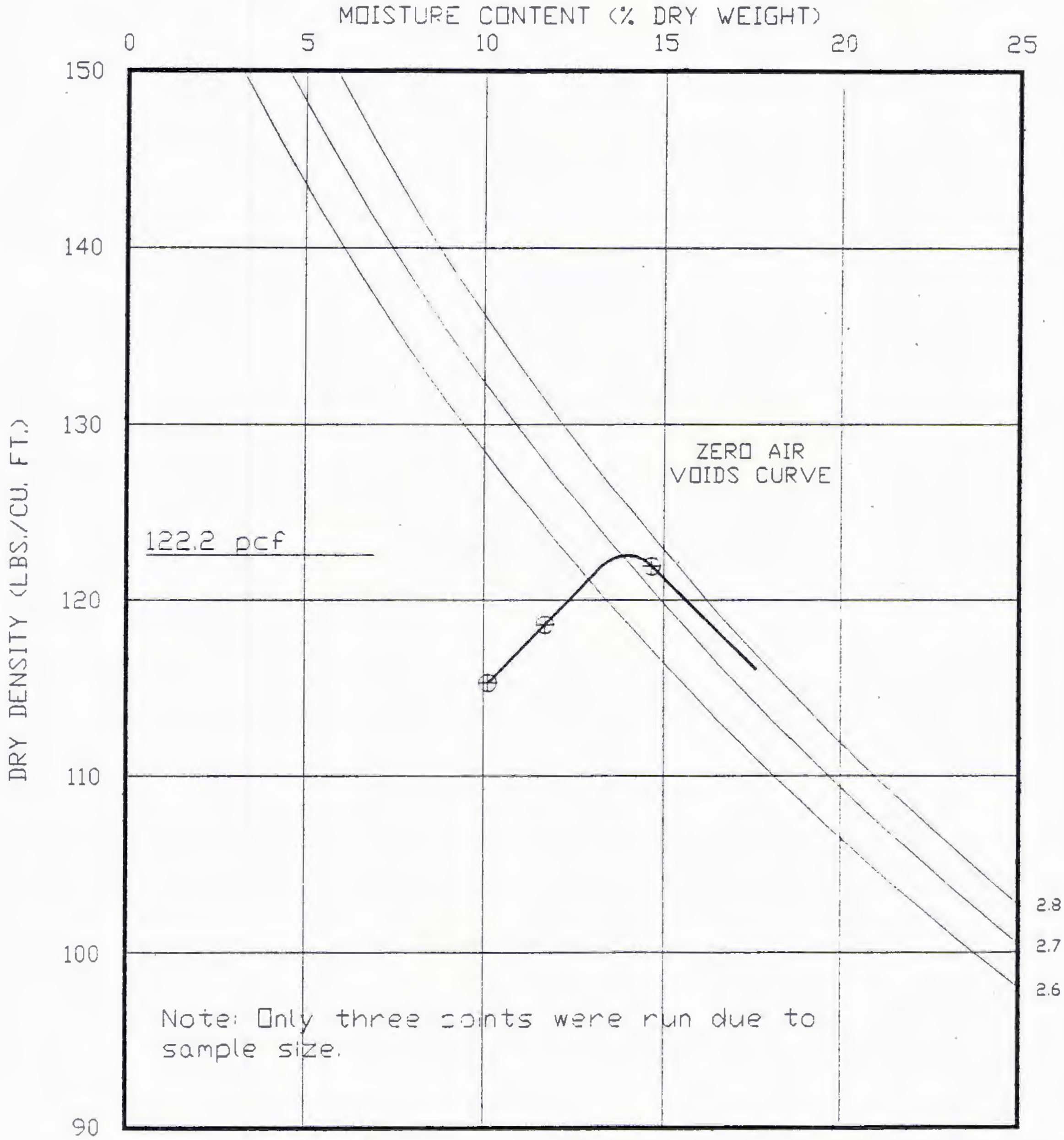
MAXIMUM DRY DENSITY (UNCORRECTED) 122.2 PCF

OPTIMUM MOISTURE CONTENT (CORRECTED) 13.1 %

MAXIMUM DRY DENSITY (CORRECTED) 124.8 PCF

METHOD OF COMPACTION ASTM D-698, METHOD C

SPECIFIC GRAVITY (COARSE) 2.40 ABSORPTION 5.7 %



PARK_P9.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

Pioneer Technical Service

CHECKED: PLR APPRV'D: PLR

PROJECT NO.: ______

FIGURE NO.

SAMPLE NO. 04-012-WR3-C4 ELEVATION ______

SOIL ______

LOCATION Park Mine

OPTIMUM MOISTURE CONTENT (UNCORRECTED) 11.5 %

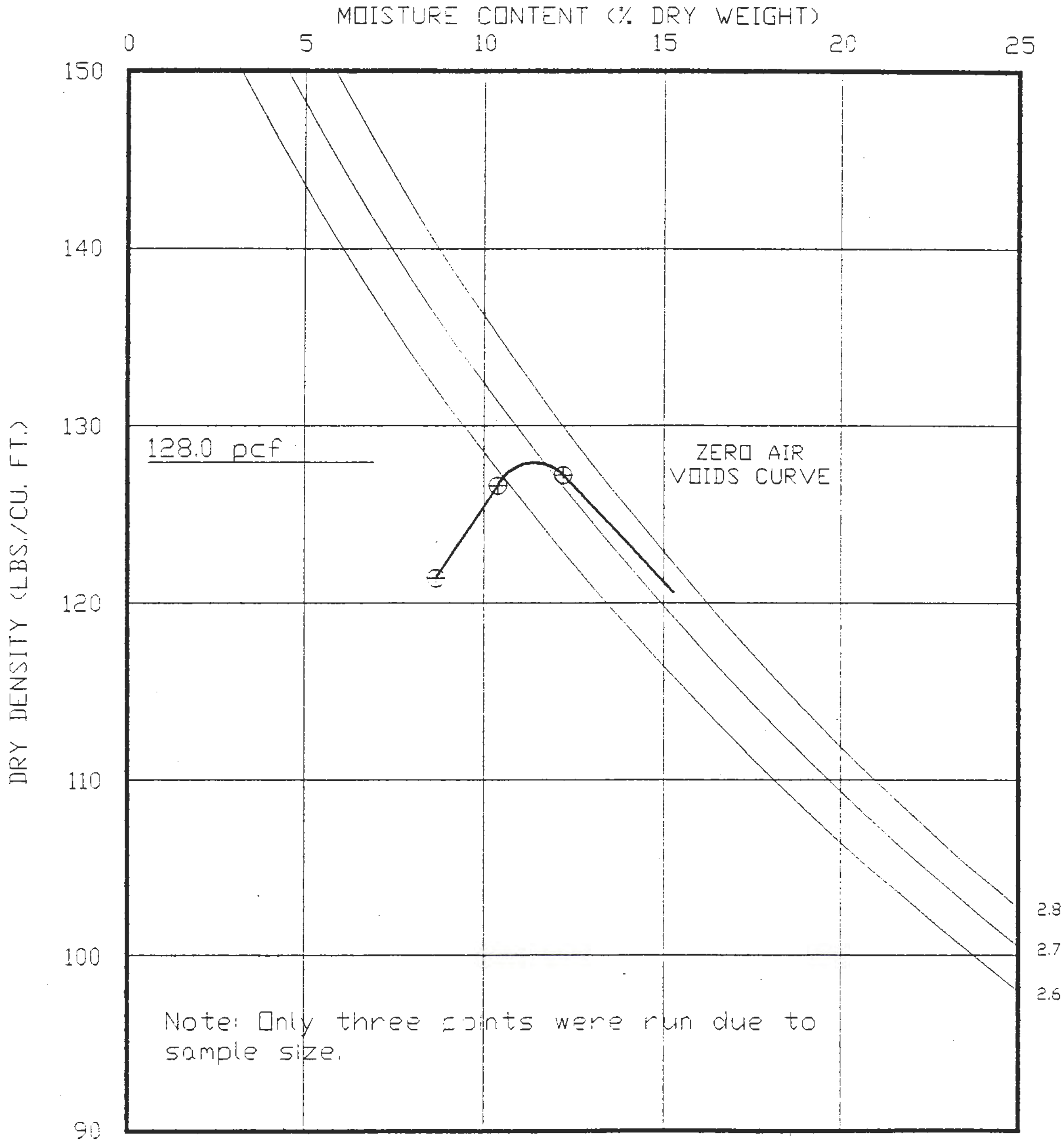
MAXIMUM DRY DENSITY (UNCORRECTED) 128.0 PCF

OPTIMUM MOISTURE CONTENT (CORRECTED) 10.6 %

MAXIMUM DRY DENSITY (CORRECTED) 131.7 PCF

METHOD OF COMPACTION ASTM D-698, METHOD C

SPECIFIC GRAVITY (COARSE) 2.53 ABSORPTION 3.9 %



PARK_P8.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

[redacted]

Pioneer Technical Service

CHECKED: PLR APPRV'D: PLR

PROJECT NO.: ______

FIGURE NO.

SAMPLE NO. 04-012-wR6-C4 ELEVATION ________

SOIL ________

LOCATION Park Mine

OPTIMUM MOISTURE CONTENT (UNCORRECTED) 12.2 %

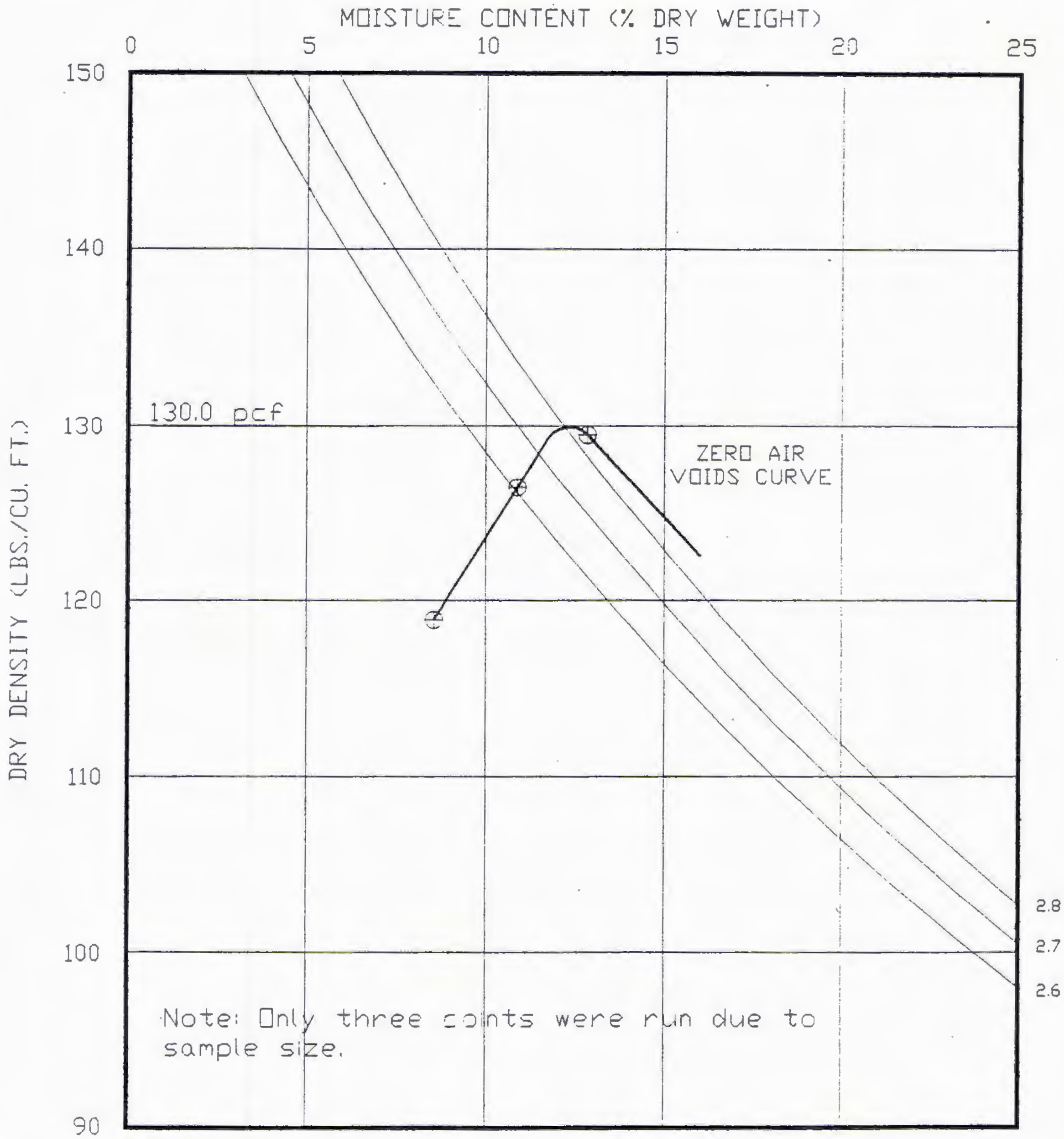
MAXIMUM DRY DENSITY (UNCORRECTED) 130.0 PCF

OPTIMUM MOISTURE CONTENT (CORRECTED) 11.1 %

MAXIMUM DRY DENSITY (CORRECTED) 133.1 PCF

METHOD OF COMPACTION ASTM D-698, METHOD C

SPECIFIC GRAVITY (COARSE) 2.53 ABSORPTION 4.2 %



PARK_P7.DWG

FLOW TECH 1205 Apples's Way Belgrade, Montana 59714 406-388-0105	Pioneer Technical Service
CHECKED: PLR APPRV'D: PLR PROJECT NO.: ________	FIGURE NO.

SAMPLE NO. 04-012-AR4-C4 ELEVATION ______

SOIL ______

LOCATION Park Mine

OPTIMUM MOISTURE CONTENT (UNCORRECTED) 10.5 %

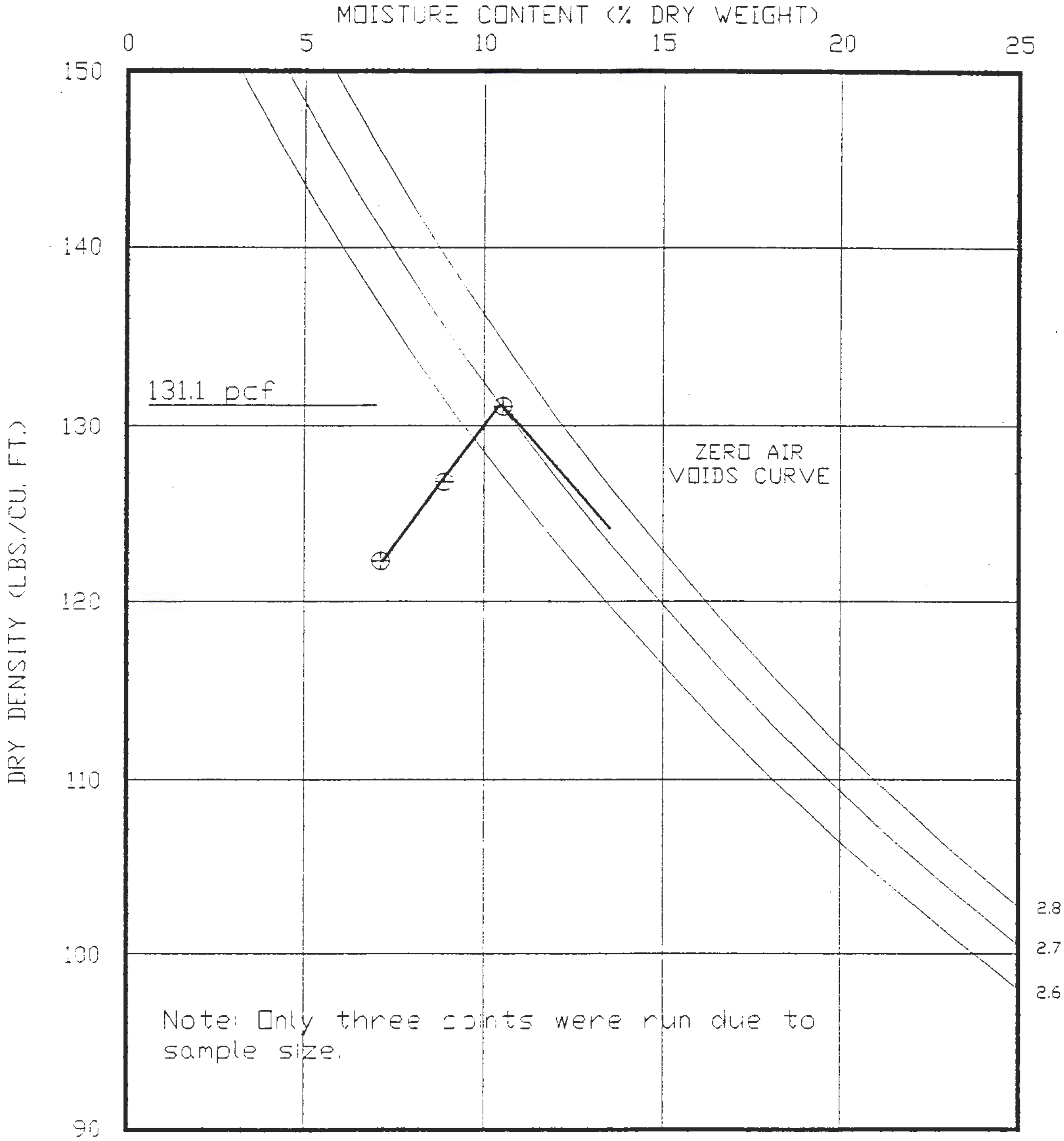
MAXIMUM DRY DENSITY (UNCORRECTED) 131.1 PCF

OPTIMUM MOISTURE CONTENT (CORRECTED) 9.7 %

MAXIMUM DRY DENSITY (CORRECTED) 133.8 PCF

METHOD OF COMPACTION ASTM D-698, METHOD C

SPECIFIC GRAVITY (COARSE) 2.64 ABSORPTION 2.8 %



PARK_P6.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

Pioneer Technical Service

CHECKED: PLR APPRV'D: PLR

PROJECT NO.: ______

FIGURE NO.

SAMPLE NO. 04-012-wP2-04 ELEVATION ________

SOIL ________

LOCATION Park Mine

OPTIMUM MOISTURE CONTENT (UNCORRECTED) 10.5 %

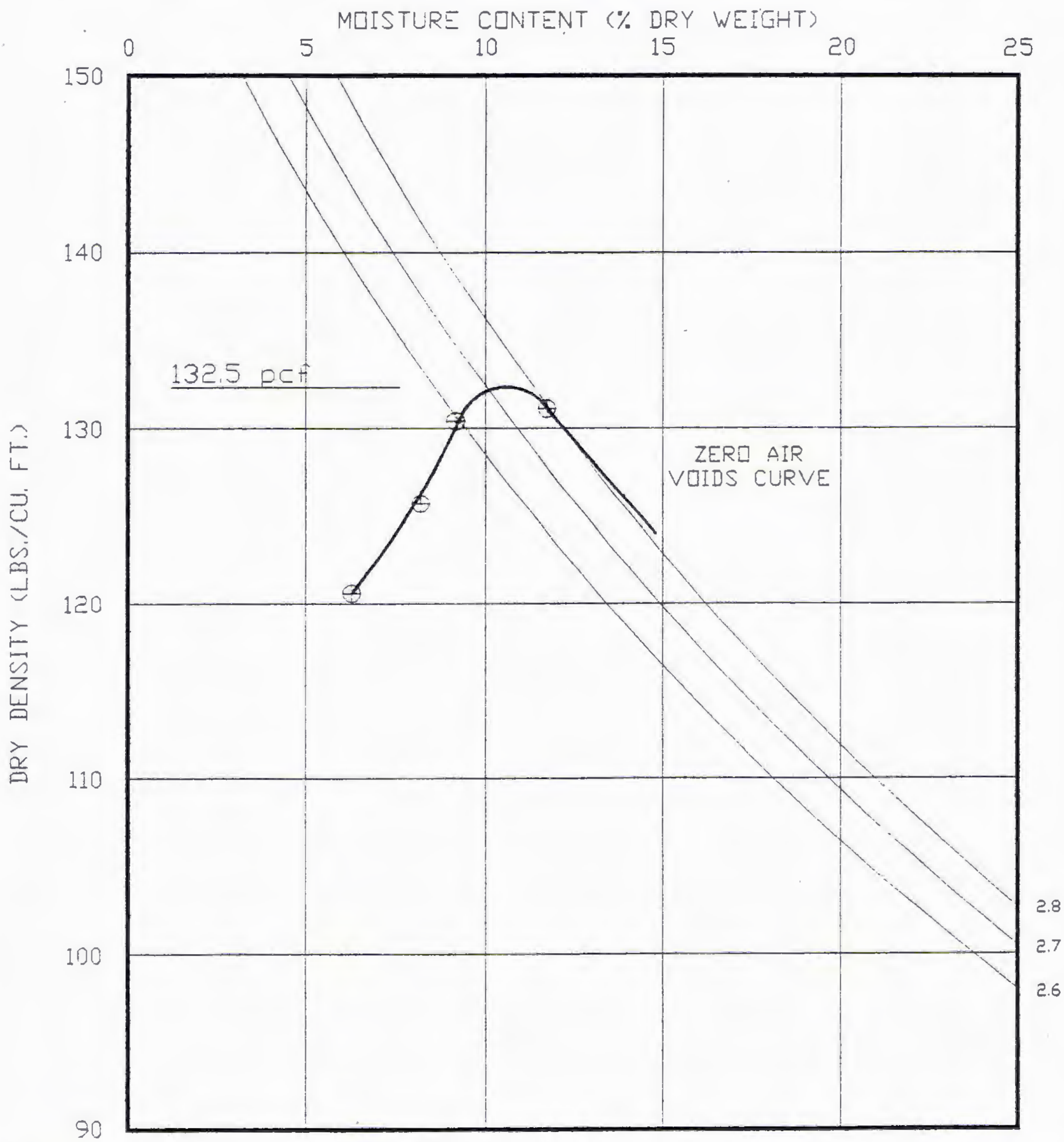
MAXIMUM DRY DENSITY (UNCORRECTED) 132.5 PCF

OPTIMUM MOISTURE CONTENT (CORRECTED) 9.3 %

MAXIMUM DRY DENSITY (CORRECTED) 136.5 PCF

METHOD OF COMPACTION ASTM D-698, METHOD C

SPECIFIC GRAVITY (COARSE) 2.59 ABSORPTION 3.1 %



PARK_P5.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

Pioneer Technical Service

CHECKED: PLR APPRV'D: PLR

PROJECT NO.: ________

FIGURE NO.

SAMPLE NO. 04-012-WR5-C4 ELEVATION ______

SOIL ______

LOCATION Park Mine

OPTIMUM MOISTURE CONTENT (UNCORRECTED) 9.5 %

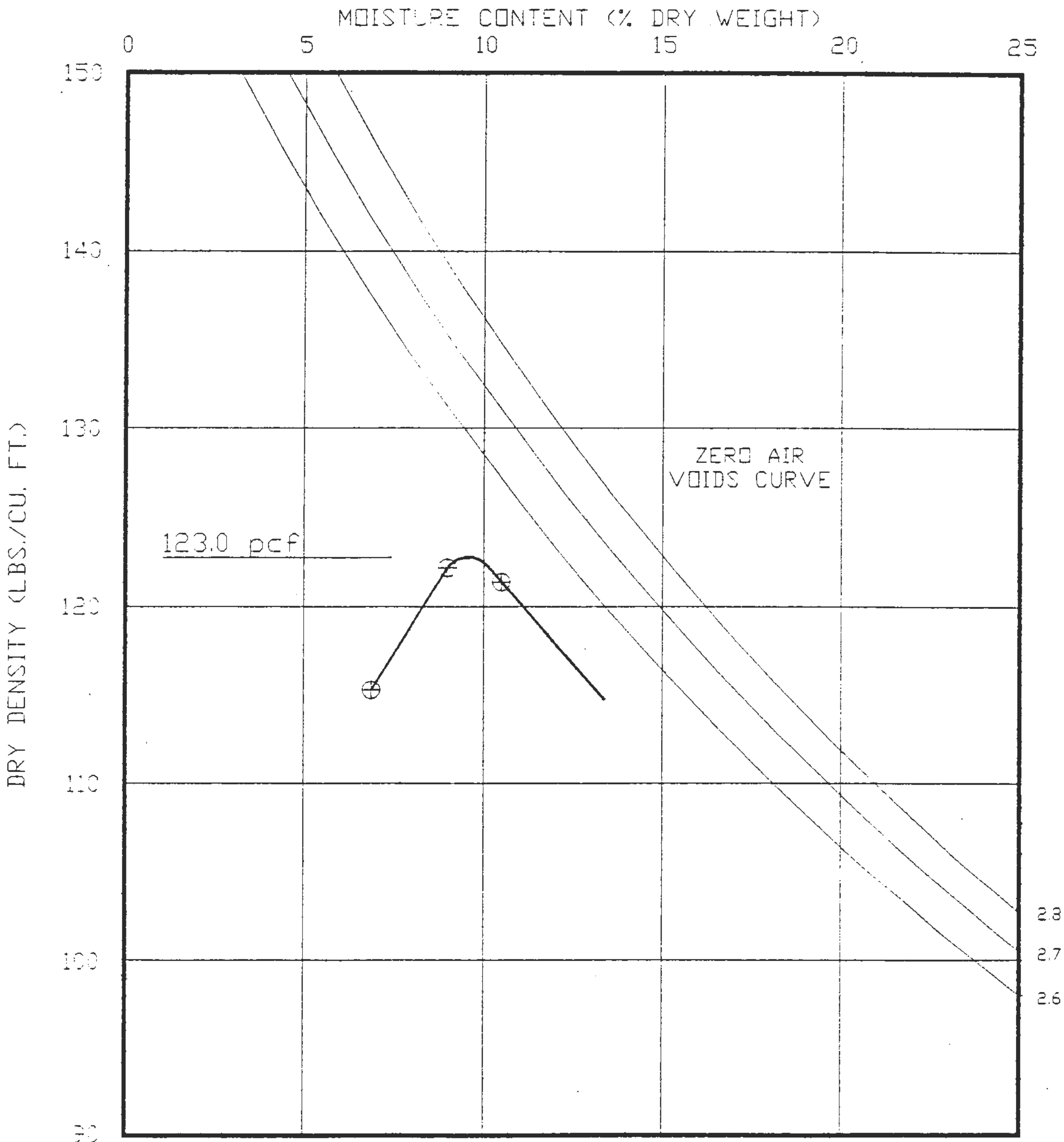
MAXIMUM DRY DENSITY (UNCORRECTED) 123.0 PCF

OPTIMUM MOISTURE CONTENT (CORRECTED) 8.1 %

MAXIMUM DRY DENSITY (CORRECTED) 129.8 PCF

METHOD OF COMPACTION ASTM D-698, METHOD C

SPECIFIC GRAVITY (COARSE) 2.55 ABSORPTION 3.5 %



PARK_P4.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

Pioneer Technical Service

CHECKED: PLR APPRV'D: PLP

PROJECT NO.: ______

FIGURE NO.

SAMPLE NO. 04-012-wR9-C4 ELEVATION ______

SOIL ______

LOCATION Park Mine

OPTIMUM MOISTURE CONTENT (UNCORRECTED) 13.5 %

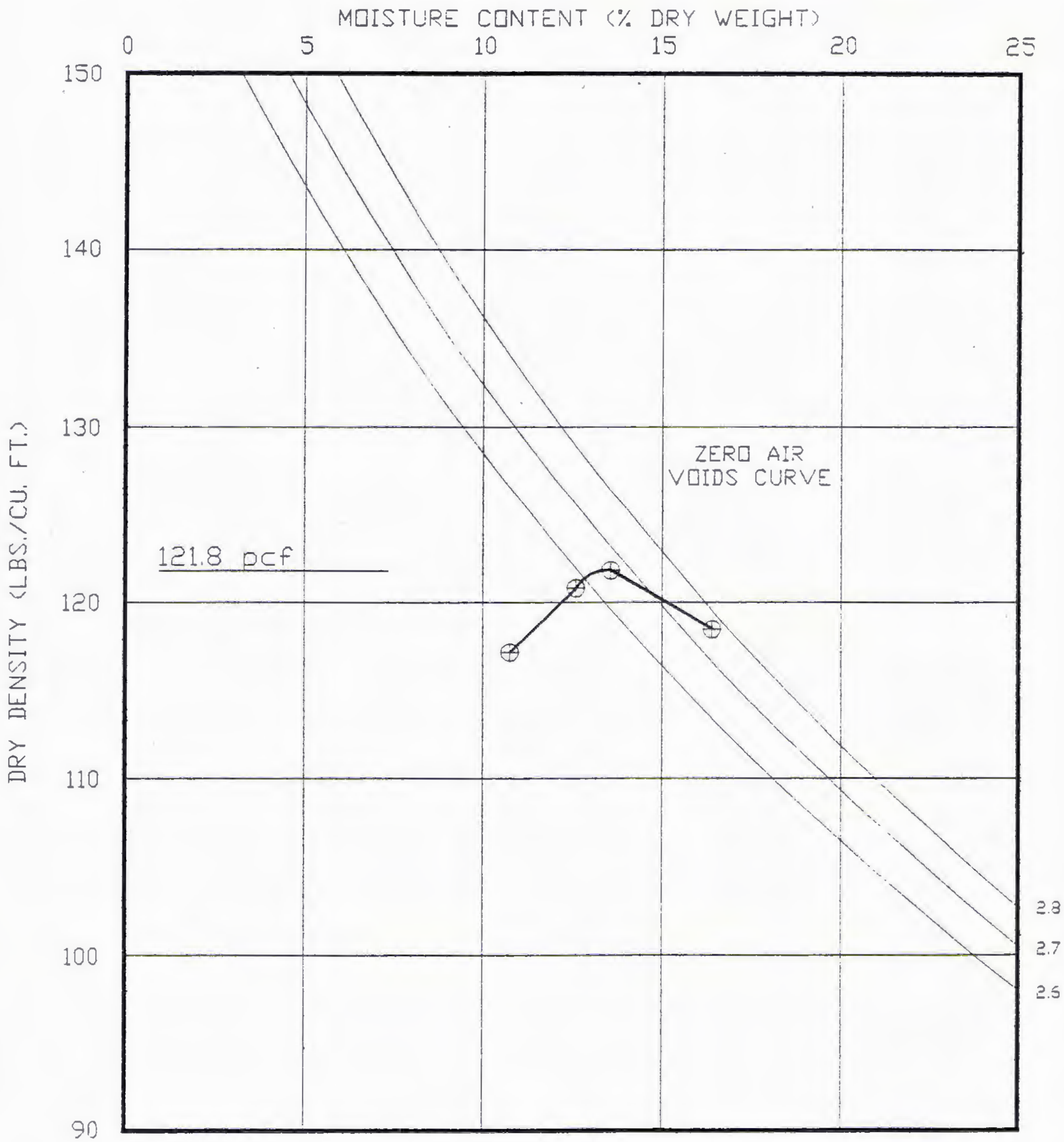
MAXIMUM DRY DENSITY (UNCORRECTED) 121.8 PCF

OPTIMUM MOISTURE CONTENT (CORRECTED) 12.9 %

MAXIMUM DRY DENSITY (CORRECTED) 123.6 PCF

METHOD OF COMPACTION ASTM D-698, METHOD C

SPECIFIC GRAVITY (COARSE) 2.53 ABSORPTION 4.2 %



PARK_P3.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

Pioneer Technical Service

CHECKED: PLR APPRV'D: PLR

PROJECT NO.: ______

FIGURE NO.

SAMPLE NO. 04-012-WR1-4 ELEVATION ______

SOIL ______

LOCATION Park Mine

OPTIMUM MOISTURE CONTENT (UNCORRECTED) 13.0 %

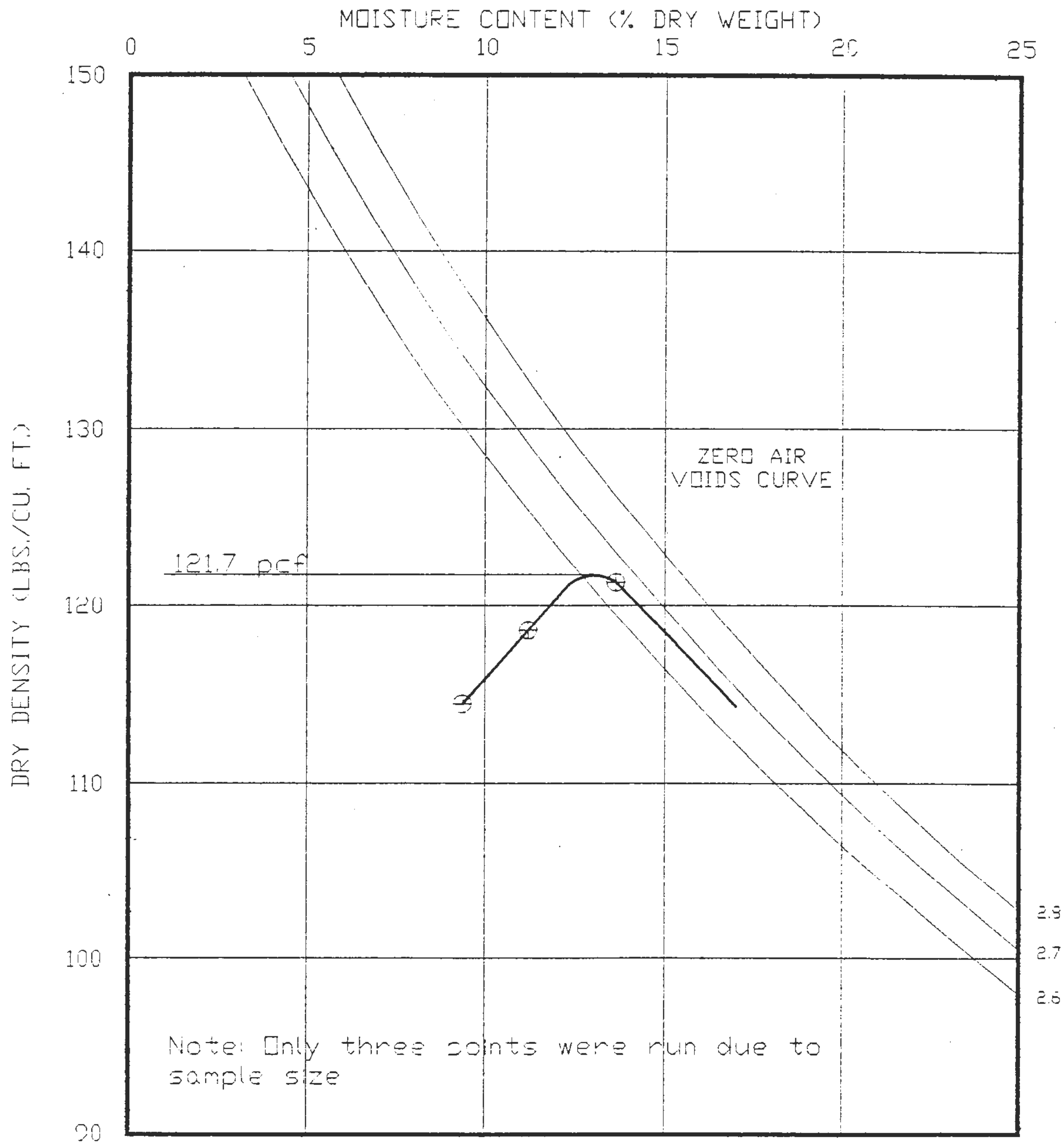
MAXIMUM DRY DENSITY (UNCORRECTED) 121.7 PCF

OPTIMUM MOISTURE CONTENT (CORRECTED) 11.5 %

MAXIMUM DRY DENSITY (CORRECTED) 126.9 PCF

METHOD OF COMPACTION ASTM D-698, METHOD C

SPECIFIC GRAVITY (COARSE) 2.41 ABSORPTION 5.7 %



PARK_P1.DWG

FLOW TECH
1205 Apples's Way
Belgrade, Montana 59714
406-388-0105

Pioneer Technical Service

CHECKED: PLR APPRV'D: PLR

PROJECT NO.: ______

FIGURE NO.

SAMPLE NO. 04-012-[illegible]R8-1 ELEVATION ________

SOIL ________

LOCATION Park Mine

OPTIMUM MOISTURE CONTENT (UNCORRECTED) 12.0 %

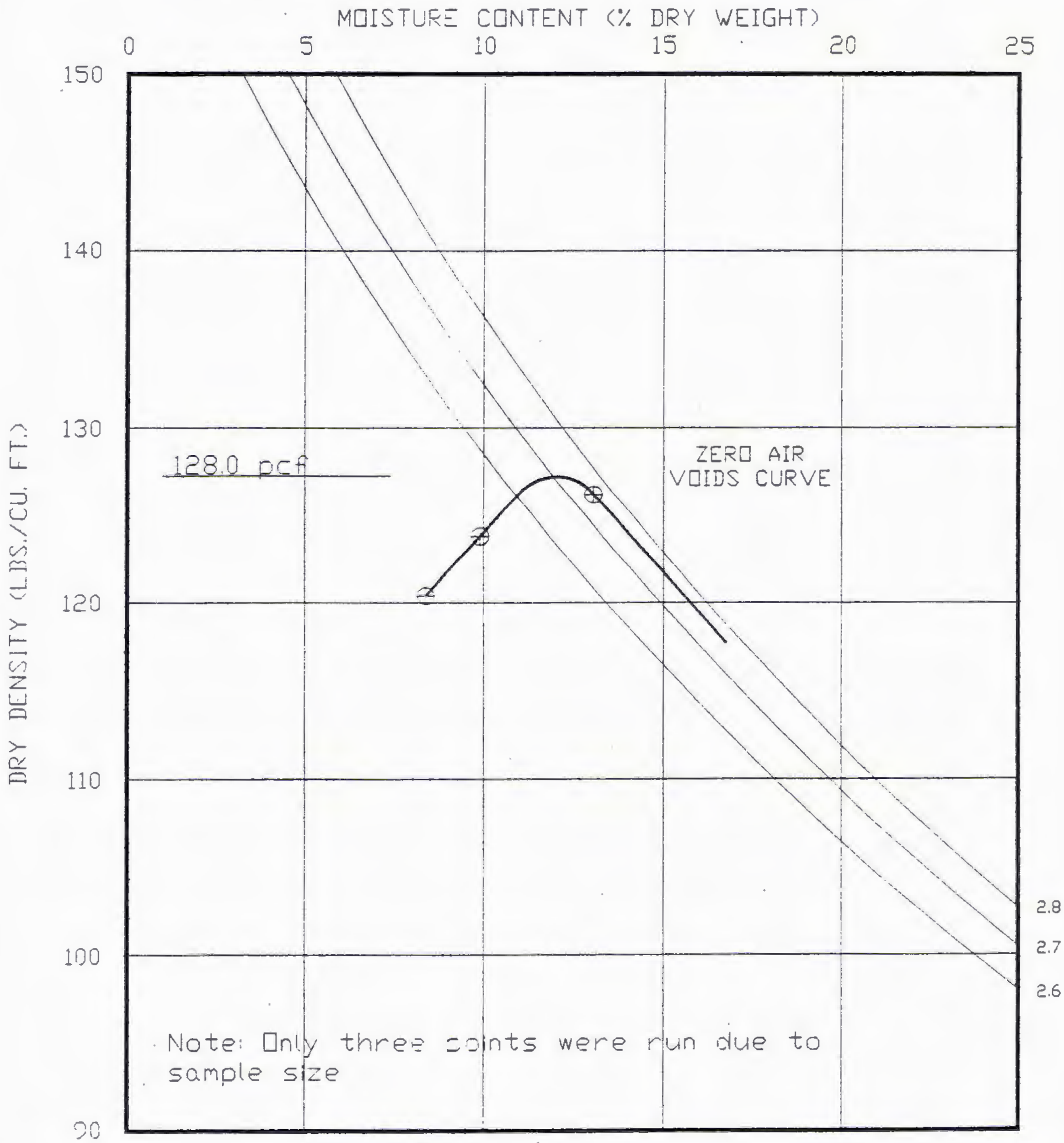
MAXIMUM DRY DENSITY (UNCORRECTED) 128.0 PCF

OPTIMUM MOISTURE CONTENT (CORRECTED) 11.6 %

MAXIMUM DRY DENSITY (CORRECTED) 129.7 PCF

METHOD OF COMPACTION ASTM D-698, METHOD C

SPECIFIC GRAVITY (COARSE) 2.52 ABSORPTION 4.4 %



PARK_P2.DWG

FLOW TECH 1205 Apples's Way Belgrade, Montana 59714 406-388-0105	Pioneer Technical Service	
	CHECKED: PLR APPRV'D: PLR PROJECT NO.: ________	FIGURE NO.

HYDRAULIC CONDUCTIVITY FOR RIGID-WALL TEST SAMPLES

Client: Pioneer Technical Services, Inc. Project: Park Mine

Sample Description: Sample Number 04-012-R1; Clayey Sand with Gravel, SC

Plasticity Index:No Test Liquid Limit: No Test Plastic Limit: No Test Specific Gravity: 2.78

% Gravel: 27.2 % Sand: 39.1 % Fines: 33.7 Porosity: 31.1%

Void Ratio:0.45 % Saturation Initial: 93% % Saturation Final: 96%

Length(cm): 11.63 Diameter(cm): 10.16 Area(sq.cm.): 81.07 a=0.899cm^2

k=(aL/At) ln (h1/h2)

Increment Number	Initial Reading	Final Reading	Time Increment	Applied Pressure Differential	Initial Head	Final Head	Average Hydraulic Gradient	Hydraulic Conductivity	Hydraulic Conductivity w/Temp. Corr.
	(ml)	(ml)	(Minutes)	(psi)	(cm)	(cm)	(cm/cm)	(cm/sec)	(cm/sec)
1	0.6	15.3	1499	10	747.43	731.09	63.55	3.2E-08	3.3E-08
2	1.2	22.6	2135	10	746.77	722.97	63.17	3.3E-08	3.3E-08
3	1.1	23.9	2516	10	746.88	721.52	63.11	3.0E-08	3.0E-08
4	0.7	18.9	1762	10	747.32	727.08	63.37	3.3E-08	3.4E-08
5	1.9	15.5	1482	10	745.99	730.86	63.48	3.0E-08	3.0E-08
6	0.8	16	1881	10	747.21	730.31	63.50	2.6E-08	2.7E-08
7	1.2	24.1	2138	10	746.77	721.30	63.10	3.5E-08	3.6E-08
8	1.3	19.2	1465	10	746.65	726.75	63.33	4.0E-08	4.1E-08
9	0.7	23.4	2021	10	747.32	722.08	63.16	3.7E-08	3.7E-08
10	1	15.6	1323	10	746.99	730.75	63.51	3.6E-08	3.7E-08
11	0.8	17.9	1663	10	747.21	728.20	63.41	3.3E-08	3.4E-08
12	0.9	16.2	1513	10	747.10	730.09	63.49	3.3E-08	3.4E-08
13	0.8	11.6	1063	10	747.21	735.20	63.71	3.3E-08	3.4E-08
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									

Final Hydraulic conductivity = 3.5 x 10E-08 cm/sec

STREAMFLOW MEASUREMENTS

PROJECT: Park Mine & Mill Site Reclamation Investigation
SUBJECT: Stream Flow Measurement - Indian Creek
DATE: 07/29/96

LOCATION: SW-8
Approx. 25 ft. upstream from abandoned 10-stamp mill

SECTION	WIDTH (ft)	DEPTH (ft)	AVG. VEL. (ft/s)	FLOW (cfs)
1	0.4	0.1	0	0.00
2	0.4	0.05	0	0.00
3	0.5	0.175	0	0.00
4	0.5	0.35	0	0.00
5	0.5	0.425	0	0.00
6	0.5	0.4	0	0.00
7	0.5	0.675	0	0.00
8	0.5	0.6	1	0.30
9	0.5	0.75	0.5	0.19
10	0.5	0.6	1	0.30
11	0.5	0.65	2	0.65
12	0.5	0.4	0.8	0.16
13	0.5	0.3	0	0.00
14	0.5	0.05	0	0.00
TOTALS	6.8			1.60

PROJECT: Park Mine & Mill Site Reclamation Investigation
SUBJECT: Stream Flow Measurement - Indian Creek
DATE: 07/29/96

LOCATION: SW-1
Approx. 22 ft. below breached dam below TP3E

SECTION	WIDTH (ft)	DEPTH (ft)	AVG. VEL. (ft/s)	FLOW (cfs)
0	0	0.55	0	0.00
1	0.25	0.55	0.7	0.10
2	0.25	0.6	0.9	0.14
3	0.25	0.625	1.1	0.17
4	0.25	0.75	1.5	0.28
5	0.25	0.45	1.4	0.16
6	0.25	0.3	0.4	0.03
7	0.25	0.5	0.4	0.05
8	0.25	0.1	0	0.00
TOTALS	2			0.92

PROJECT: Park Mine & Mill Site Reclamation Investigation
SUBJECT: Stream Flow Measurement - Indian Creek
DATE: 07/29/96

LOCATION: SW-2
Approx. 35 ft. downstream from WR2

SECTION	WIDTH (ft)	DEPTH (ft)	AVG. VEL. (ft/s)	FLOW (cfs)
0	0.3	0.275	0.9	0.07
1	0.3	0.3	1.2	0.11
2	0.3	0.3	0.6	0.05
3	0.3	0.1	0	0.00
4	0.3	0.3	0.6	0.05
5	0.3	0.225	1.9	0.13
6	0.3	0.2	2.5	0.15
7	0.3	0.05	2.8	0.04
8	0.3	0.3	3.1	0.28
9	0.3	0.2	0.6	0.04
10	0.3	0.1	0	0.00
11	0.3	0.025	0	0.00
TOTALS	3.6			0.93

PROJECT: Park Mine & Mill Site Reclamation Investigation
SUBJECT: Stream Flow Measurement - Indian Creek
DATE: 07/29/96

LOCATION: SW-3
Discharge from adit above settling pond below main site

SECTION	WIDTH (ft)	DEPTH (ft)	AVG. VEL. (ft/s)	FLOW (cfs)
0	0	0.15	1.6	0.00
1	0.25	0.14	0.7	0.02
2	0.25	0.175	0	0.00
3	0.25	0.15	1.2	0.05
4	0.25	0.2	2.1	0.11
5	0.25	0.2	2	0.10
6	0.25	0.225	1.6	0.09
7	0.25	0.2	2.3	0.12
TOTALS	1.75			0.48

PROJECT: Park Mine & Mill Site Reclamation Investigation
SUBJECT: Stream Flow Measurement - Indian Creek
DATE: 07/29/96

LOCATION: SW-4
Immediately downstream from tailings (TP1)

SECTION	WIDTH (ft)	DEPTH (ft)	AVG. VEL. (ft/s)	FLOW (cfs)
0	0	0.175	0	0.00
1	0.25	0.125	0	0.00
2	0.25	0.1	0	0.00
3	0.25	0.175	0.5	0.02
4	0.25	0.2	1	0.05
5	0.25	0.075	1.1	0.02
6	0.25	0.15	1.1	0.04
7	0.25	0.15	1.2	0.05
8	0.25	0.2	0.8	0.04
9	0.25	0.15	0	0.00
10	0.25	0.1	0	0.00
TOTALS	1.75			0.18

PROJECT: Park Mine & Mill Site Reclamation Investigation
SUBJECT: Stream Flow Measurement - Indian Creek
DATE: 07/29/96

LOCATION: SW-5
Downstream of road - north side of WR1

SECTION	WIDTH (ft)	DEPTH (ft)	AVG. VEL. (ft/s)	FLOW (cfs)
0	0	0.075	0	0.00
1	0.25	0.1	0	0.00
2	0.25	0.14	0	0.00
3	0.25	0.175	0.5	0.02
4	0.25	0.15	1	0.04
5	0.25	0.225	1.1	0.06
6	0.25	0.2	1.1	0.06
7	0.25	0.21	1.2	0.06
8	0.25	0.1	0.8	0.02
9	0.25	0.075	0	0.00
10	0.25	0.1	0	0.00
TOTALS	1.75			0.24

PROJECT: Park Mine & Mill Site Reclamation Investigation
SUBJECT: Stream Flow Measurement - Indian Creek
DATE: 07/29/96

LOCATION: SW-6
Immediately upstream of road

SECTION	WIDTH (ft)	DEPTH (ft)	AVG. VEL. (ft/s)	FLOW (cfs)
0	0.1	0.3	1.4	0.04
TOTALS	0.1			0.04

ORGANIC COMPOUND DATA

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.

P.O. BOX 30916 • 1120 SOUTH 27TH STREET • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-735-4489

LABORATORY REPORT

TO: Doug Richmond
ADDRESS: Pioneer Technical Services
PO Box 3445
Butte, MT 59701

DATE: 09/06/96

WATER ANALYSES
Park Mine RI

Sampled: 08/27/96
Submitted: 08/29/96

Identification Lab No.	Date Analyzed	Gasoline Range Organics (µg/Liter (ppb))	Gasoline Range Organics as Gasoline (µg/Liter (ppb))	Total Purgeable Hydrocarbons (µg/Liter (ppb))	(1)Surrogate Recovery, %	Sample Initial pH
04-012-GW2B, Sampled @ 1515						
96-52087	09/06/96	66	<20 (2)	69	89	<2
Method Blank	09/06/96	<20	<20	<20	91	N/A

COMMENTS:
(1) Surrogate added to the sample for quality assurance purposes. Surrogate recovery control limits are 50-150%.
(2) Sample chromatogram was not characteristic of gasoline. The hydrocarbons present consisted mainly of an unknown peak eluting at 16.79 minutes.

NOTE1: Gasoline Range Organics are defined as all hydrocarbons eluting between 2-Methylpentane and 1,2,4-Trimethyl benzene.

NOTE2: Gasoline Range Organics as Gasoline are defined by the analyst as the portion of the chromatogram between 2-Methylpentane and 1,2,4-Trimethylbenzene that resembles gasoline.

NOTE3: Total Purgeable Hydrocarbons are defined as the total hydrocarbon responses regardless of elution time. This value is equivalent to EPA method 8015 modified TPH as gasoline.

File No. 52087 Typist dsm

GASOLINE RANGE ORGANICS CONTINUING CALIBRATION REPORT

This continuing calibration report applies to the following analysis runs:
96-52087

Sample Name: cc gro
Area File: C:\DIRECT\DATA3\0905PE1B.32A
Date & Time Collected: Sep 6, 1996 09:13:55
Method File: C:\DIRECT\DATA3\3P1B.MET
Calibration File: C:\DIRECT\DATA4\3P1B.CAL

COMPOUND	ACTUAL	MEASURED	%RECOVERY	%RECOVERY LIMITS
2-Methylpentane	150	143	95	75-125
Benzene	50	49	97	75-125
224-Trimethylpentane	150	147	98	75-125
n-Heptane	50	43	86	75-125
Toluene	150	142	95	75-125
Ethylbenzene	50	47	94	75-125
M&P-Xylenes	200	194	97	75-125
O-Xylene	100	96	96	75-125
124-Trimethylbenzene	100	93	93	75-125
TOTAL GRO	1000	953	95	75-125

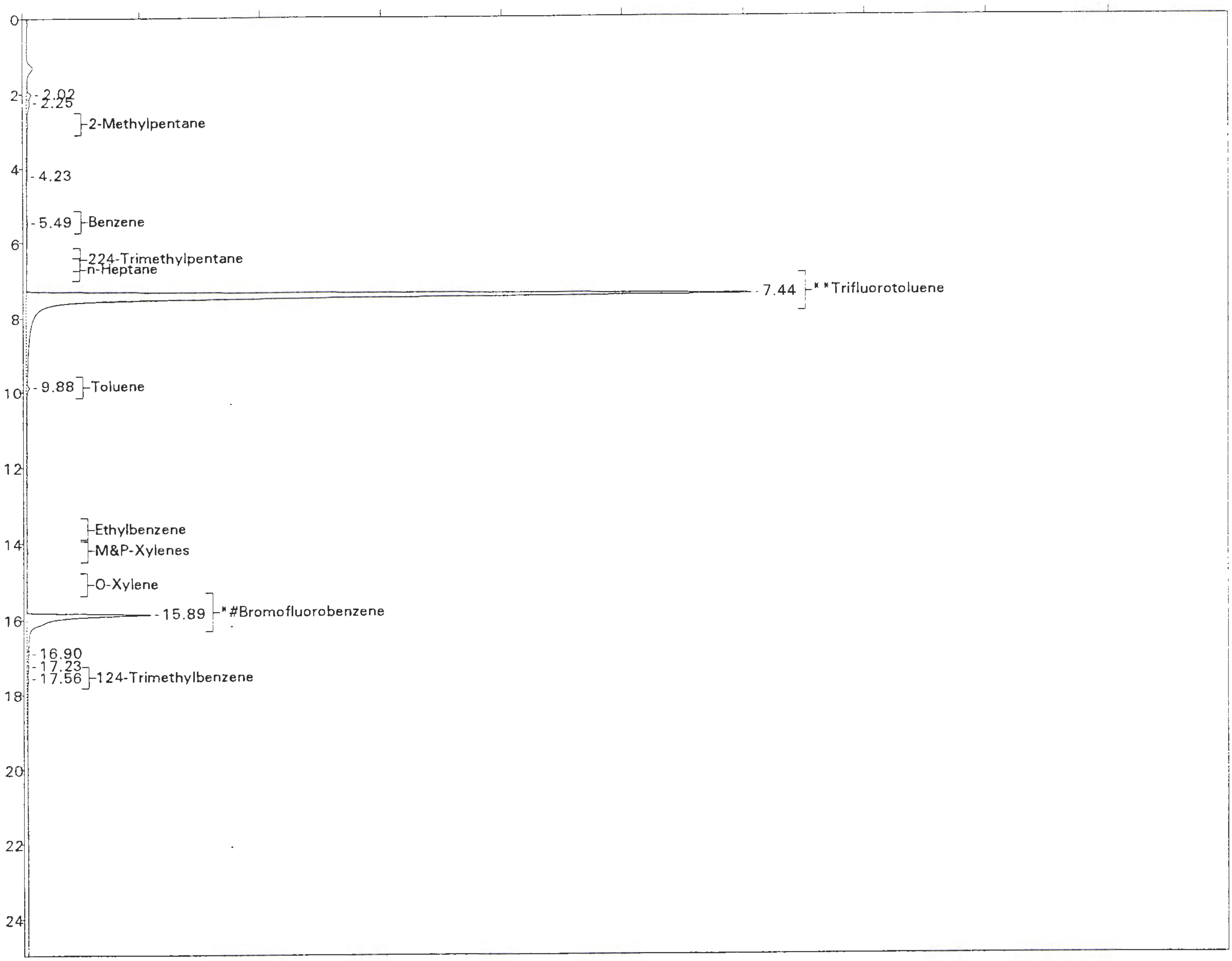
SURROGATE CMPND	ACTUAL	MEASURED	%RECOVERY	%RECOVERY LIMITS
**Trifluorotoluene	250	242	97	75-125

LABORATORY CONTROL SAMPLE REPORT

Date Analyzed: Sep 6, 1996 09:55:22

Unleaded Gasoline	ACTUAL	MEASURED	%RECOVERY	%RECOVERY LIMITS
as Gasoline Range	1000	612	61	50-150
as Total Purgeable	1000	729	73	50-150

File=G:\ORG\PE1\0905PE1B.34R Date printed=09-06-1996 Time= 17:28:47
Sample Name=96-blank ;rr740
0.0 to 25.0 min. Low Y=13.397 High Y=163.397 mv Span=150.0



GASOLINE RANGE ORGANICS CHROMATOGRAM
Sample Name: 96-blank ;rr740
Area File: G:\ORG\PE1\0905PE1B.34A
Date & Time Collected: Sep 6, 1996 10:32:59
Method File: G:\ORG\PE1\3P1B.MET
Calibration File: G:\ORG\PE1\3P1B.CAL
Sample Weight: 5 Dilution: 1
Peaks subtracted from Total:

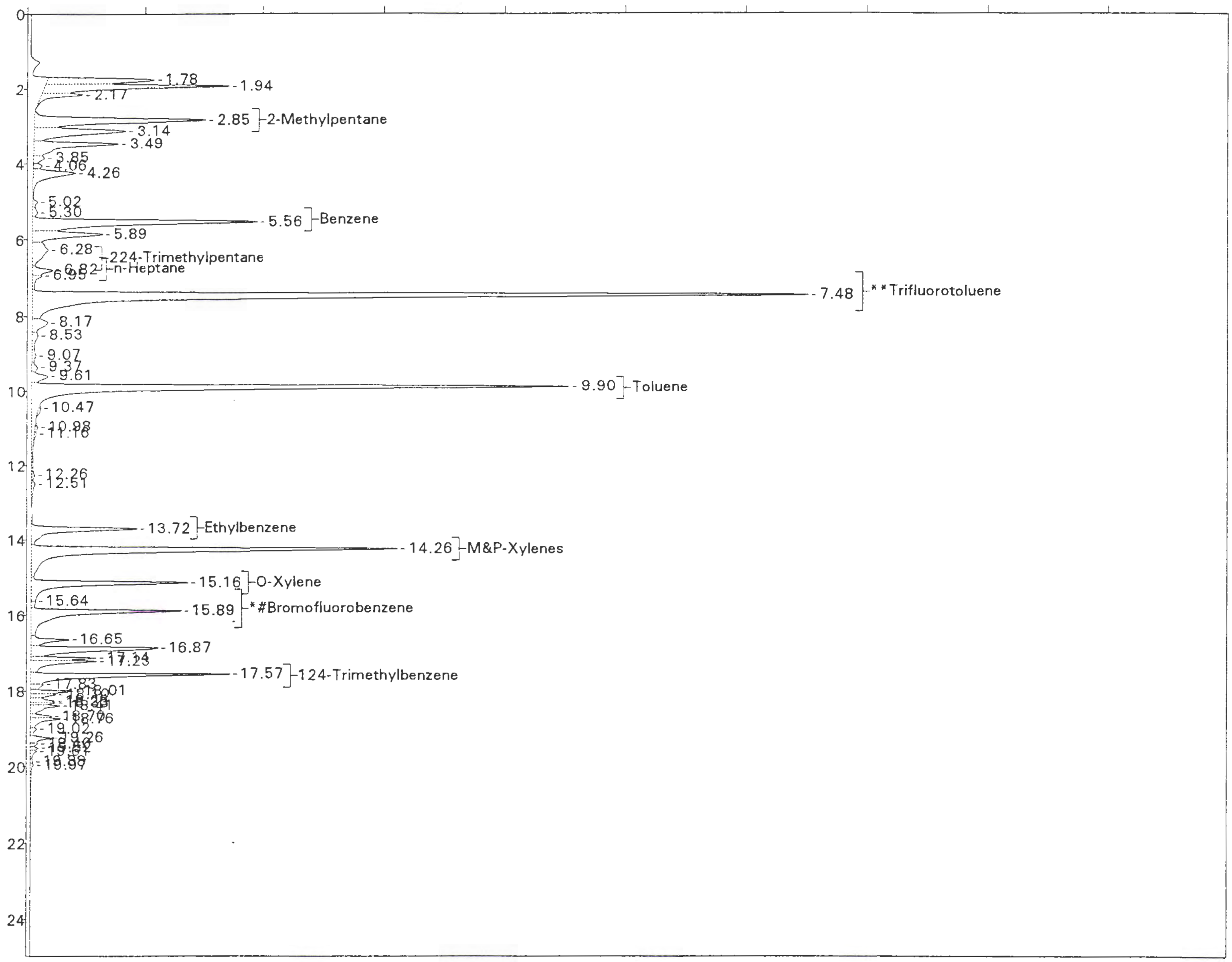
Compound Name	RT	Area	Amount	%Recovery
**Trifluorotoluene	7.4	815,968	46	91
*#Bromofluorobenze	15.9	135,985	9	89

GRO Area 40,677 Quant: 1.8
TPH Area 61,570 Quant: 2.8
0 file(s) copied

File=G:\ORG\PE1\0905PE1B.33R Date printed=09-06-1996 Time= 17:29:14

Sample Name=lc gas

0.0 to 25.0 min. Low Y=13.436 High Y=163.436 mv Span=150.0



GASOLINE RANGE ORGANICS CHROMATOGRAM

Sample Name: lc gas

Area File: G:\ORG\PE1\0905PE1B.33A

Date & Time Collected: Sep 6, 1996 09:55:22

Method File: G:\ORG\PE1\3P1B.MET

Calibration File: G:\ORG\PE1\3P1B.CAL

Sample Weight: 1 Dilution: 1

Peaks subtracted from Total:

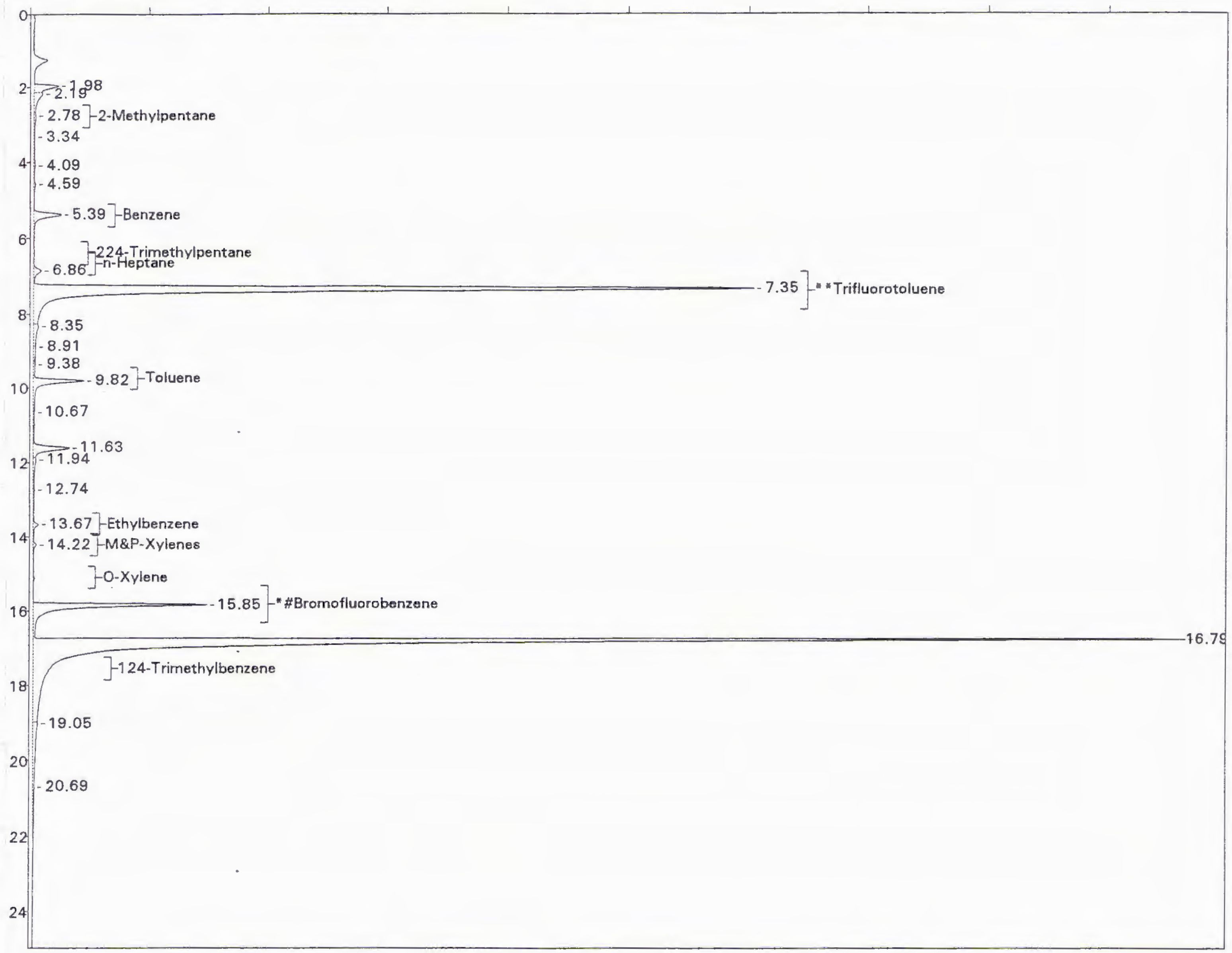
Compound Name	RT	Area	Amount	%Recovery
**Trifluorotoluene	7.5	845,155	236	95
*#Bromofluorobenze	15.9	170,537	56	111

GRO Area 2,704,031 Quant: 611.9

TPH Area 3,220,142 Quant: 728.7

0 file(s) copied

ile=G:\ORG\PE1\0905PE1B.35R Date printed=09-06-1996 Time= 17:28:20
Sample Name=96-52087 ;rr740
.0 to 25.0 min. Low Y=13.387 High Y=163.387 mv Span=150.0



GASOLINE RANGE ORGANICS CHROMATOGRAM
ample Name: 96-52087 ;rr740
rea File: G:\ORG\PE1\0905PE1B.35A
Date & Time Collected: Sep 6, 1996 11:38:43
Method File: G:\ORG\PE1\3P1B.MET
alibration File: G:\ORG\PE1\3P1B.CAL
Sample Weight: 5 Dilution: 1
Peaks subtracted from Total:

ompound Name	RT	Area	Amount	%Recovery
**Trifluorotoluene	7.3	792,102	44	89
#Bromofluorobenze	15.8	158,989	10	104

RO Area 1,448,042 Quant: 65.5
PH Area 1,529,380 Quant: 69.2
0 file(s) copied

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1120 SOUTH 27TH STREET • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-735-4489

LABORATORY REPORT

TO: Doug Richmond
ADDRESS: Pioneer Technical Services
PO Box 3445
Butte, MT 59701

DATE: 09/09/96

WATER ANALYSIS
Park Mine RI

Sampled: 08/27/96
Submitted: 08/29/96

Identification Lab No.	Date Extracted	Date Analyzed	Diesel Range Organics (mg/Liter (ppm))	Diesel Range Organics as Diesel (mg/Liter (ppm))	Total Extractable Hydrocarbons (mg/Liter (ppm))	(1) Surrogate Recovery, %
04-012-GW2B, Sampled @ 1515						
96-52087	09/03/96	09/08/96	<0.50	<0.50	<0.50	74
Method Blank	08/22/96	08/26/96	<0.50	<0.50	<0.50	83

COMMENTS:
(1) Surrogate added to the sample for quality assurance purposes. Surrogate recovery control limits are 50-150%.

NOTE1: Diesel Range Organics are defined as all hydrocarbons eluting between C10 and C28.
NOTE2: Diesel Range Organics as Diesel Fuel are defined by the analyst as that portion of the chromatogram between C10 and C28 that resembles diesel fuel.
NOTE3: Total Extractable Hydrocarbons are defined as the total hydrocarbon responses regardless of elution time. This value is equivalent to EPA method 8015 Modified TPH as Diesel.

File No. 52087 Typist dd

DIESEL RANGE ORGANICS CONTINUING CALIBRATION REPORT

This continuing calibration report applies to the following analysis runs:
Method Blk, Blank Spk, Blank Spk Dup for 22Aug96

Sample Name: cc dro std
Area File: G:\ORG\FIS\0826DROF.02A
Date & Time Collected: Aug 26, 1996 17:08:49
Method File: G:\ORG\FIS\DROFR.MET
Calibration File: G:\ORG\FIS\DROF112R.CAL

COMPOUND	ACTUAL(UG/ML)	MEASURED(UG/ML)	%RECOVERY	%RECOVERY LIMITS
n-Decane	200	190	95	75-125
n-Dodecane	200	175	87	75-125
n-Tetradecane	200	180	90	75-125
n-Hexadecane	200	168	84	75-125
n-Octadecane	200	185	93	75-125
n-Eicosane	200	180	90	75-125
n-Docosane	200	202	101	75-125
n-Tetracosane	200	190	95	75-125
n-Hexacosane	200	210	105	75-125
n-Octacosane	200	198	99	75-125
TOTAL DRO	2000	1866	93	75-125

SURROGATE CMPND	ACTUAL(UG/ML)	MEASURED(UG/ML)	%RECOVERY	%RECOVERY LIMITS
* o-Terphenyl	200	219	110	75-125

LABORATORY CONTROL SAMPLE REPORT

Date Analyzed: Aug 26, 1996 22:04:29

	ACTUAL(UG/ML)	MEASURED(UG/ML)	%RECOVERY	%RECOVERY LIMITS
#2 Diesel Fuel	15000	13007	87	50-150

LABORATORY CONTROL SAMPLE REPORT

Date Analyzed: Aug 26, 1996 22:52:40

	ACTUAL(UG/ML)	MEASURED(UG/ML)	%RECOVERY	%RECOVERY LIMITS
#2 Diesel Fuel	15000	13856	92	50-150

DIESEL RANGE ORGANICS CONTINUING CALIBRATION REPORT

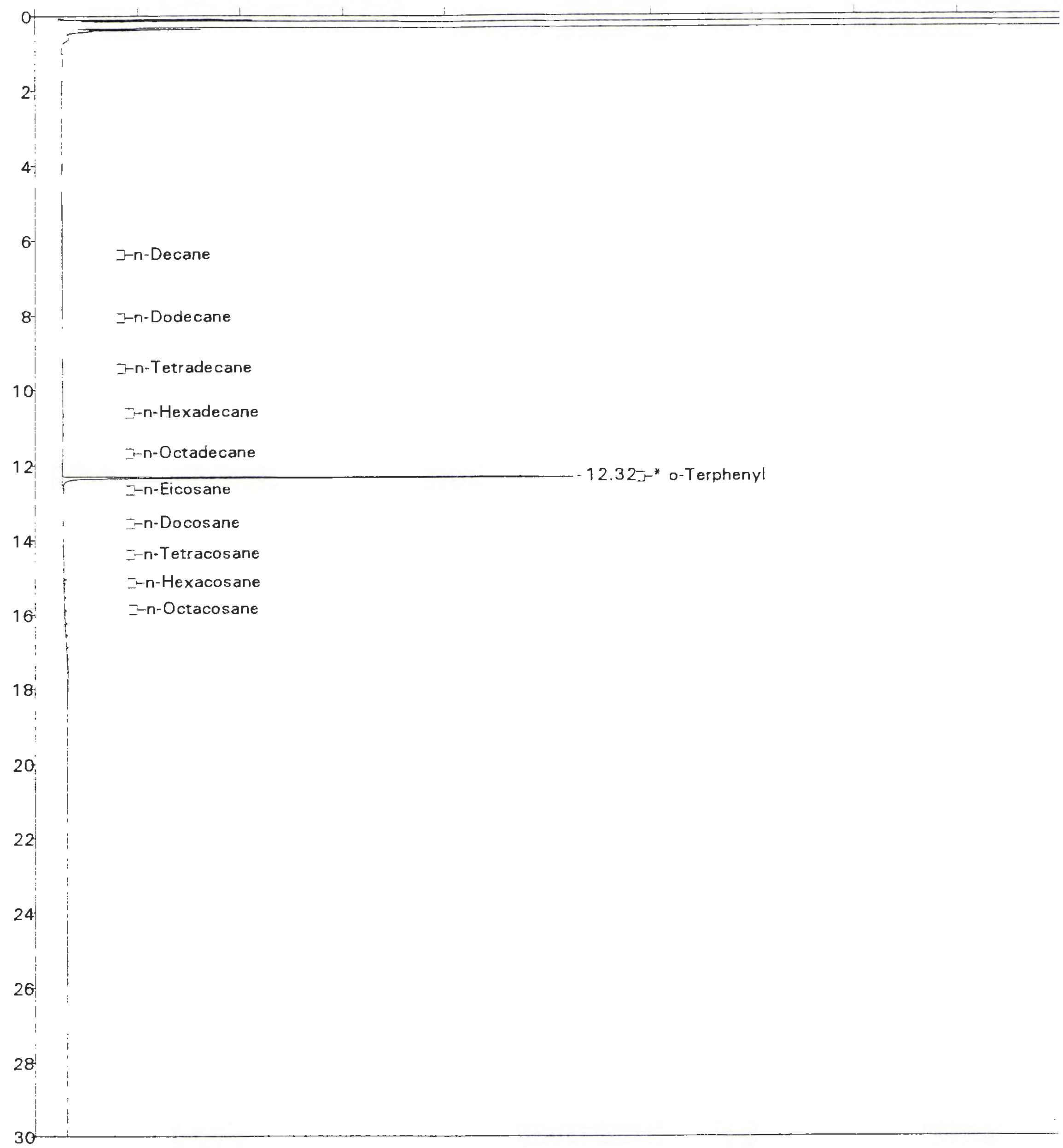
This continuing calibration report applies to the following analysis runs:
96-52087

Sample Name: cc dro std
Area File: G:\ORG\FIS\0907DROF.16A
Date & Time Collected: Sep 8, 1996 07:44:49
Method File: G:\ORG\FIS\DROFS.MET
Calibration File: G:\ORG\FIS\DROF112S.CAL

COMPOUND	ACTUAL(UG/ML)	MEASURED(UG/ML)	%RECOVERY	%RECOVERY LIMITS
n-Decane	200	187	93	75-125
n-Dodecane	200	171	85	75-125
n-Tetradecane	200	177	89	75-125
n-Hexadecane	200	167	83	75-125
n-Octadecane	200	180	90	75-125
n-Eicosane	200	172	86	75-125
n-Docosane	200	194	97	75-125
n-Tetracosane	200	182	91	75-125
n-Hexacosane	200	202	101	75-125
n-Octacosane	200	190	95	75-125
TOTAL DRO	2000	1812	91	75-125

SURROGATE CMPND	ACTUAL(UG/ML)	MEASURED(UG/ML)	%RECOVERY	%RECOVERY LIMITS
* o-Terphenyl	200	169	84	75-125

File=G:\ORG\FIS\0907DROF.21R Date printed=09-09-1996 Time= 11:50:58
Sample Name=96-52087 ;rr740
0.0 to 30.0 min. Low Y=-5.0 High Y=100.0 mv Span=105.0

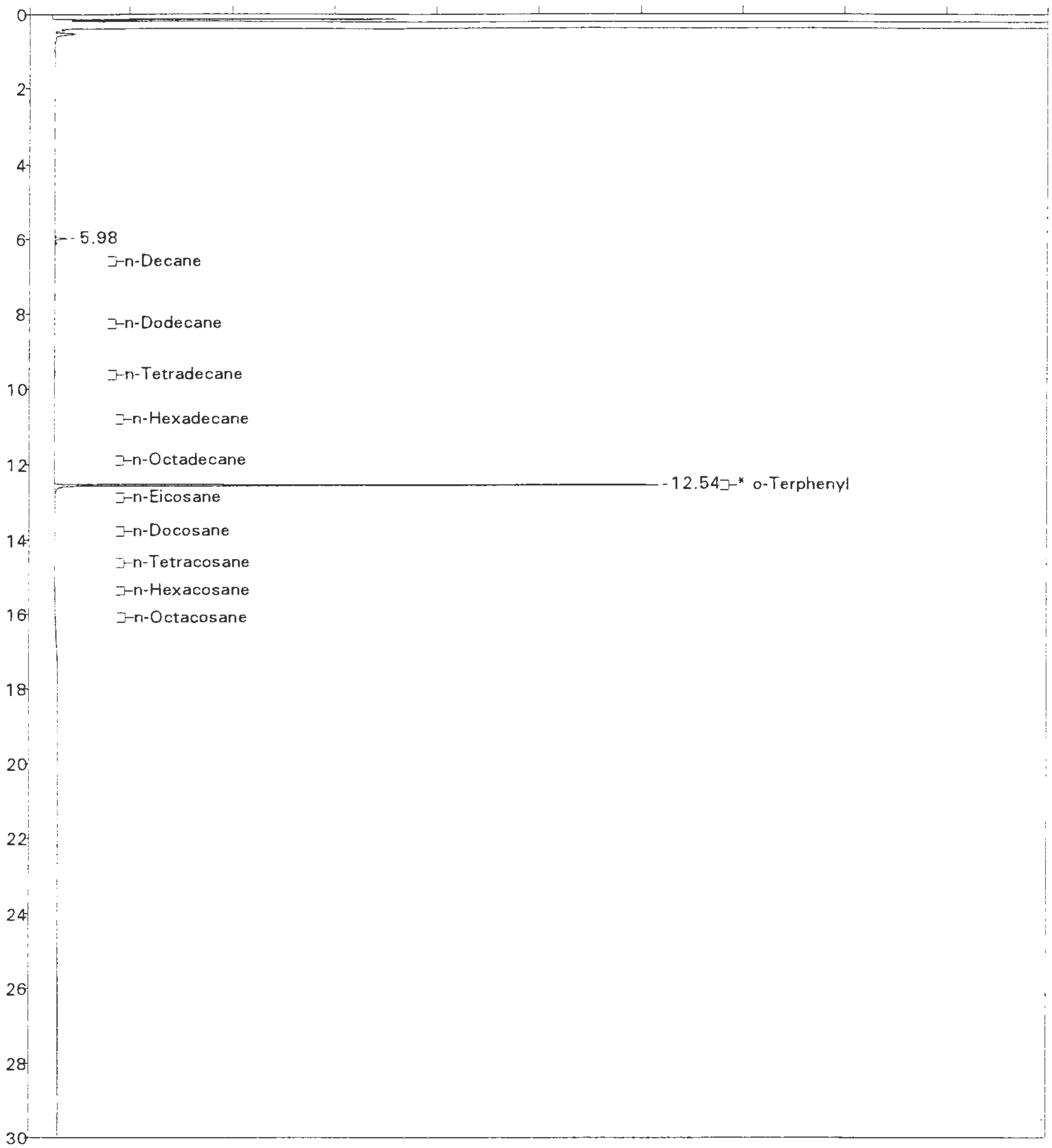


DIESEL RANGE ORGANICS CHROMATOGRAM
Sample Name: 96-52087 ;rr740
Area File: G:\ORG\FIS\0907DROF.21A
Date & Time Collected: Sep 8, 1996 11:35:36
Method File: G:\ORG\FIS\DROFS.MET
Calibration File: G:\ORG\FIS\DROF112S.CAL
Sample Weight: 1000 Dilution: 1
Peaks subtracted from Total:

Compound Name	RT	Area	Amount	%Recovery
* o-Terphenyl	12.3	90,466	147	74
DRO Area	7,299	DRO AMOUNT		0.01
TEH Area	17,394	TEH AMOUNT		0.03

0 file(s) copied

File=G:\ORG\FIS\0826DROF.07R Date printed=09-09-1996 Time= 16:13:18
Sample Name=Meth Blk 22Aug96 Drow-20 ;rr887 ;rr740 ;rr771 ;rr841 ;rr842
0.0 to 30.0 min. Low Y=-5.0 High Y=100.0 mv Span=105.0

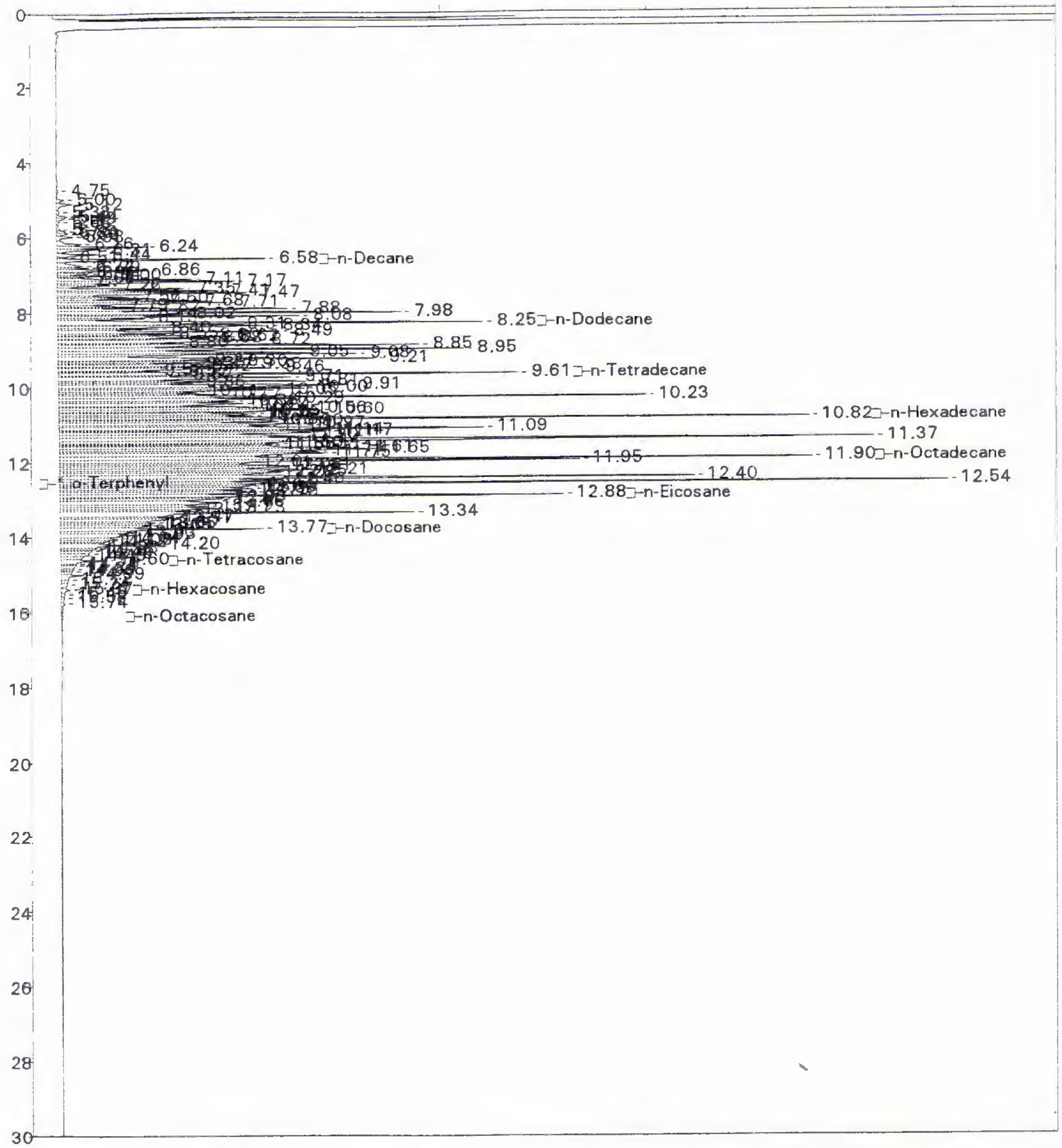


DIESEL RANGE ORGANICS CHROMATOGRAM
Sample Name: Meth Blk 22Aug96 Drow-20 ;rr887 ;rr740 ;rr771 ;rr841 ;rr842
Area File: G:\ORG\FIS\0826DROF.07A
Date & Time Collected: Aug 26, 1996 21:15:46
Method File: G:\ORG\FIS\DROFR.MET
Calibration File: G:\ORG\FIS\DROF112R.CAL
Sample Weight: 1000 Dilution: 1
Peaks subtracted from Total:

Compound Name	RT	Area	Amount	%Recovery
* o-Terphenyl	12.5	101,586	166	83
DRO Area	4,063	DRO AMOUNT		0.01
TEH Area	14,132	TEH AMOUNT		0.02

0 file(s) copied

File=G:\ORG\FIS\0826DROF.08R Date printed=09-09-1996 Time= 16:15:15
Sample Name=lc BlkSpk 22Aug96 drow-20 1000ml
0.0 to 30.0 min. Low Y=-5.0 High Y=100.0 mv Span=105.0

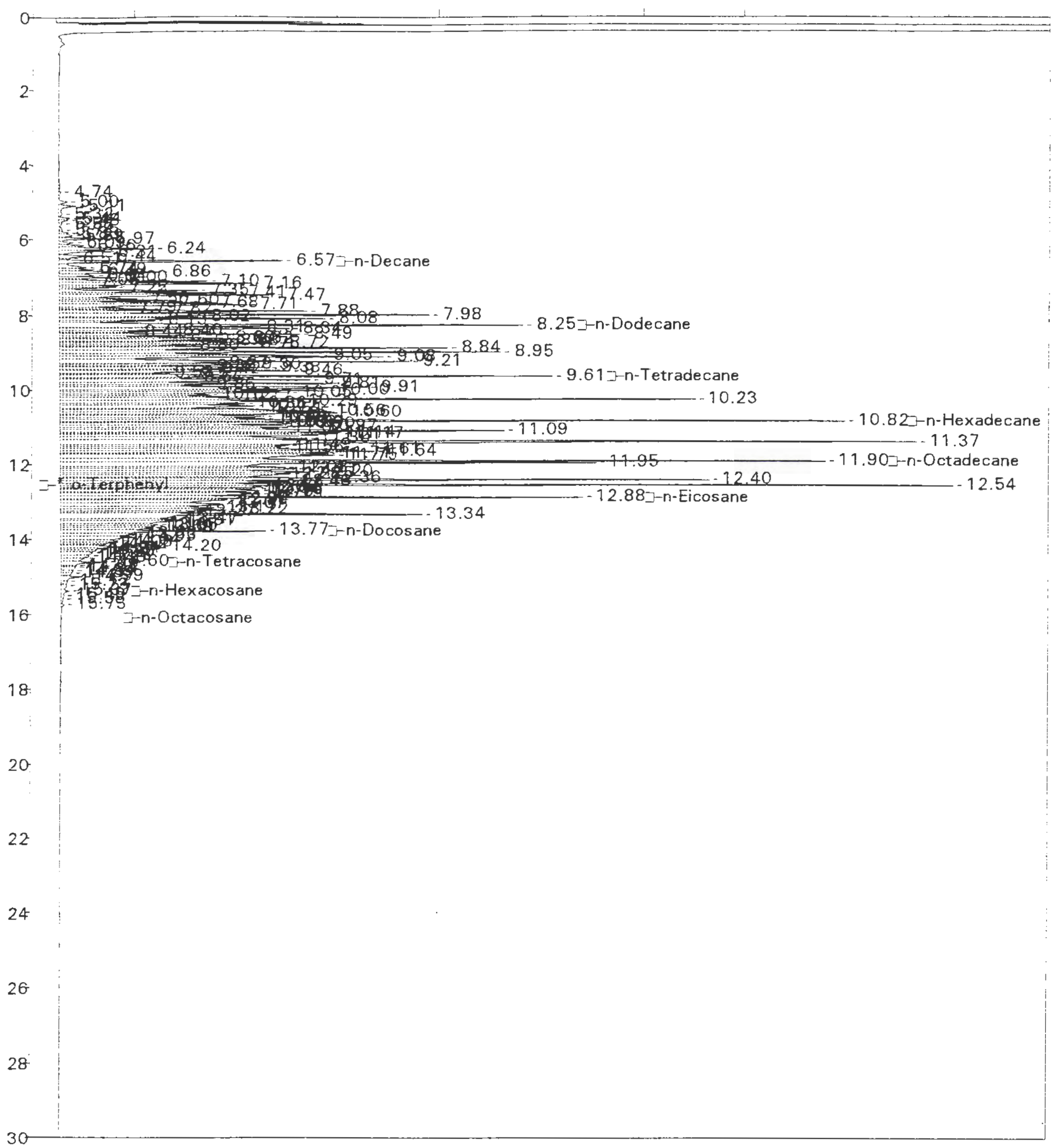


DIESEL RANGE ORGANICS CHROMATOGRAM
Sample Name: lc BlkSpk 22Aug96 drow-20 1000ml
Area File: G:\ORG\FIS\0826DROF.08A
Date & Time Collected: Aug 26, 1996 22:04:29
Method File: G:\ORG\FIS\DROFR.MET
Calibration File: G:\ORG\FIS\DROF112R.CAL
Sample Weight: 1 Dilution: 1
Peaks subtracted from Total:

Compound Name	RT	Area	Amount	%Recovery
* o-Terphenyl	12.5	190,135	310	155
DRO Area	7,556,074		DRO AMOUNT	13,006.54
TEH Area	7,655,237		TEH AMOUNT	13,177.23

0 file(s) copied

File=G:\ORG\FIS\0826DROF.09R Date printed=09-09-1996 Time= 16:18:33
Sample Name=lc BlkSpkDup 22Aug96 drow-20 1000ml
0.0 to 30.0 min. Low Y=-5.0 High Y=100.0 mv Span=105.0



DIESEL RANGE ORGANICS CHROMATOGRAM
Sample Name: lc BlkSpkDup 22Aug96 drow-20 1000ml
Area File: G:\ORG\FIS\0826DROF.09A
Date & Time Collected: Aug 26, 1996 22:52:40
Method File: G:\ORG\FIS\DROFR.MET
Calibration File: G:\ORG\FIS\DROF112R.CAL
Sample Weight: 1 Dilution: 1
Peaks subtracted from Total:

Compound Name	RT	Area	Amount	%Recovery
* o-Terphenyl	12.5	190,264	310	155

DRO Area 8,049,830 DRO AMOUNT 13,856.46
TEH Area 8,168,465 TEH AMOUNT 14,060.67
0 file(s) copied

Lab No.: 96-52087

Date: 29-AUG-96

Received by: Pam Fink

Logged in by: Pam Fink

SAMPLE CONDITION QA/QC REPORT

This report provides information about the condition of the sample(s) and associated sample custody information on receipt at the laboratory.

Chain of Custody Form Completed & Signed	Yes	Comments:
Chain of Custody Seal	No	Comments:
Intact	N/A	Comments:
Signature Match Chain of Custody vs. Seal	N/A	Comments:
Samples Received Cold	Yes	Comments:
Samples Received Within Holding Time	Yes	Comments:
Samples Received in Proper Containers	Yes	Comments:
Samples Received Properly Preserved	Yes	Comments:

Samples requiring analysis for volatile organics are tested for proper preservation at the time of analysis. Any preservation problems encountered for these samples are noted on the analytical parameter report pages.

Client notified about sample discrepancies:

Who: ______ By: ______ Date/Time: ______

Method of Shipping: Fed Ex 1674423612

Additional comments: ______

CHAIN OF CUSTODY

PROJECT CODE

PROJECT NAME: Park Mine

SAMPLERS (SIGNATURE): Greg Liebelt

ANALYSIS REQUESTED

	SAMPLE INDENTIFICATION	SAMPLED DATE	SAMPLED TIME	Proctor	Particle Size Dist.	Moisture Content	Specific Gravity	Atterberg Limits	Permeability	REMARKS
✓✓	04-012-B1-C4	7/31/96	1300	X	X	X	X		X	2-1 gal bags
	04-012-B3-C4	7/31/96	1605	X	X	X	X			1 gal bag
	04-012-B4-C4	7/31/96	1700	X	X	X	X			1 gal bag
										5 gal bucket composite of B1, B3, & B4 for proctor.
✓✓	04-012-R1-C4	7/31/96	1110		X	X	X		X	2-1 gal bags

RELINQUISHED BY (SIGN.)	DATE TIME	RECIEVED BY (SIGN.)	RELINQUISHED BY (SIGN.)	DATE TIME	RECIEVED BY (SIGN.)
RELINQUISHED BY (SIGN.)	DATE TIME	RECIEVED BY (SIGN.)	RELINQUISHED BY (SIGN.)	DATE TIME	RECIEVED BY (SIGN.)
RELINQUISHED BY (SIGN.)	DATE TIME	RECIEVED FOR LAB (SIGN.)	DATE TIME		

REMARKS

PIONEER TECHNICAL SERVICES, INC.
P.O. BOX 3445
BUTTE, MT 59701
PHONE (406)-782-5177
FA 06) 586

CHAIN OF CUSTODY

PROJECT CODE	PROJECT NAME
	Park Mine

SAMPLERS (SIGNATURE): Julie Flammang

SAMPLE INDENTIFICATION	SAMPLED DATE	SAMPLED TIME	Proctor	Particle Size Dist.	Moisture Content	Specific Gravity	Atterberg Limits	Permeability		REMARKS
04-012-WR1-C4	7/31/96	0930	X	X	X	X				1 gal bag & 5 gal. bucket
04-012-WR2-C4	7/30/96	1500	X	X	X	X				1 gal bag & 5 gal. bucket
04-012-WR3-C4	7/31/96	1210	X	X	X	X				1 gal bag & 5 gal bucket
04-012-WR4-C4	7/30/96	1400	X	X	X	X				1 gal bag & 5 gal bucket
04-012-WR5-C4	7/31/96	1030	X	X	X	X				1 gal bag & 5 gal bucket
04-012-WR6-C4	7/30/96	1200	X	X	X	X				1 gal bag & 5 gal bucket
~~04-012-WR7-C4~~ GA										
04-012-WR8-C4	7/31/96	0835	X	X	X	X				1 gal bag & 5 gal bucket
04-012-WR9-C4	7/30/96	1000	X	X	X	X				1 gal bag & 5 gal bucket
04-012-WR10-C4	7/30/96	1115	X	X	X	X				1 gal bag & 5 gal bucket
04-012-TP2-C4	7/24/96	1130	X	X	X	X				1 gal bag & 5 gal bucket
04-012-TP3-C4	7/31/96	1635	X	X	X	X	X			1 gal bag & 5 gal bucket
04-012-TP4-C4	7/31/96	1750	X	X	X	X	X			1 gal bag & 5 gal bucket

RELINQUISHED BY (SIGN.)	DATE TIME	RECIEVED BY (SIGN.)	RELINQUISHED BY (SIGN.)	DATE TIME	RECIEVED BY (SIGN.)

RELINQUISHED BY (SIGN.)	DATE TIME	RECIEVED BY (SIGN.)	RELINQUISHED BY (SIGN.)	DATE TIME	RECIEVED BY (SIGN.)

RELINQUISHED BY (SIGN.)	DATE TIME	RECIEVED FOR LAB (SIGN.)	DATE TIME

REMARKS:

PIONEER
TECHNICAL SERVICES, INC.
P.O. BOX 3445
BUTTE, MT 59701
PHONE (406)-782-5177
FAX (406)-782-5866

CHAIN OF CUSTODY

PROJECT CODE	PROJECT NAME
	PARK MINE RI

SAMPLERS (SIGNATURE) [signature]

SAMPLE INDENTIFICATION	SAMPLED DATE	SAMPLED TIME	DRO	GRO						REMARKS
04-012-GW2B	8/27/96	1515	X	X						1000ml w/ H_2SO_4 preserve 2@40ml w/ HCl preserve Sample is groundwater from abandoned mine site sheen and zero to faint odor. Organics unknown. Water contains heavy metals

ANALYSIS REQUESTED

RELINQUISHED BY (SIGN.)	DATE TIME	RECIEVED BY (SIGN.)	RELINQUISHED BY (SIGN.)	DATE TIME	RECIEVED BY (SIGN.)
[signature]	8/28/96 1300				
RELINQUISHED BY (SIGN.)	DATE TIME	RECIEVED BY (SIGN.)	RELINQUISHED BY (SIGN.)	DATE TIME	RECIEVED BY (SIGN.)
RELINQUISHED BY (SIGN.)	DATE TIME	RECIEVED FOR LAB (SIGN.)	DATE TIME		
		[signature]	08/27/96 1648		

REMARKS Results to D. Richmond →

THANKS

PIONEER
TECHNICAL SERVICES, INC.
P.O. BOX 3445
BUTTE, MT 59701
PHONE: (406)-782-5177
FAX: (406)-782-5866

VEGETATION SPECIES LIST

The Park mine is located on a mountainous hillside. Grassland, riparian and timbered communities occur in the study area. The potential natural vegetation of the grassland is *Festuca idahoensis/ Agropyron spicatum* (Mueggler and Stewart, 1980). Timbered areas are capable of supporting a *Pseudotsuga menzesii/ Calamagrostis rubescens* plant association (Pfister et al. 1977). The current dominant vegetation is listed in appendix A. No sensitive, threatened, or endangered species were found at the site. Two species of noxious weeds occur at the site: Dalmatian Toadflax and Canada Thistle. Presently, these plants occur in small numbers along roadsides and on waste rock. However, during reclamation care should be taken so that the populations do not spread. Control with herbicides is appropriate here as the plants occur away from surface water.

Riparian areas occur in the study area along small tributaries forming the headwaters of Indian Creek. The riparian communities are classified as *Salix drummondiana/ Deschampsia caespitosa* habitat types (Hansen et al. 1995). Most of the riparian areas on the site are affected by the mine waste and are non-functioning. Areas above mining activity are functioning but at risk due to browsing and grazing pressure.

Plant List: Park Mine 8/29/95

Meadows:

(habitat type: *Festuca idahoensis/ Agropyron spicatum*)

Shrubs:

Ribes setosum	Missouri Gooseberry

Grasses:

Danthonia intermedia	Timber Oatgrass
Stipa columbiana	Columbia Needlegrass
Phleum pratense	Timothy
Festuca idahoensis	Idaho Fescue
Agropyron spicatum	Bluebunch Wheatgrass
Agropyron trachycaulum	Slender wheatgrass

Forbs:

Geranium viscossimum	Sticky Geranium
Potentilla gracillis	Cinquefoil
Agoseris glauca	False Dandelion
Achillea millefolium	Yarrow
Antennaria microphylla	Pussytoes
Campanula rotundifolia	Harebell
Solidago missouriensis	Goldenrod
Geum trifolium	Prarie Smoke
Iris missouriensis	Wild Iris

Forest:

(Habitat type: *Pseudotsuga menzesii/ Calamagrostis rubescens*)

Trees:

Pinus contorta	Lodgepole Pine
Pinus flexillis	Limber Pine
Abies lasiocarpa	Subalpine Fir
Pseudotsuga menzesii	Douglas Fir

Shrubs:

Vaccinium scoparium	Grouse Whortleberry
Juniperus communis	Common Juniper
Spirea betulifolia	Spirea
Rubus ideaus	Raspberry

Grasses:

Trisetum spicatum	Spike Trisetum
Phleum pratense	Timothy
Bromus marginatus	Mountain Brome
Calamagrostis rubescens	Pinegrass

Forbs:

Lupinus argentea	Silvery Lupine
Arnica cordifolia	Heart-leaved Arnica
Antennaria racemosa	Pussytoes
Aster occidentalis	Western Mountain Aster

Park Mine cont'd

Riparian Area:

(Habitat type: *Salix drummondiana/Deschampsia caespitosa*)

Shrubs:

Alnus sinuata	Alder
Salix bebbiana	Bebb's Willow
Salix drummondiana	Drummond's Willow

Graminoids:

Carex rostrata	Beaked Sedge
Phleum pratense	Timothy
Agrostis stolonifera	Redtop
Calamagrostis canadensis	Bluejoint Reedgrass
Deschampsia caespitosa	Tufted harigrass
Juncus regelii	Regel's Rush
Luzula parviflora	Small Flowered Woodrush

Forbs:

Achillea millefolium	Yarrow
Trifolium repens	White Clover
Equesteum arvense	Horsetail
Habenaria saccata	Bog Orchid
Senecio triangularis	Arrowleaf Groundsel

Park Mine Plant Inventory: 8/29/95

I. Meadow East of WR?(highest large dump, can't read number):

Danthonia intermedia	Timber Oatgrass
Stipa columbiana	Columbia Needlegrass
Phleum pratense	Timothy
Festuca idahoensis	Idaho Fescue
Agropyron spicatum	Bluebunch Wheatgrass
Agropyron trachycaulum	Slender wheatgrass
Carex praegracillis	Clustered Field Sedge
Fragaria vesca	Wild Strawberry
Geranium viscossimum	Sticky Geranium
Potentilla gracillis	Cinquefoil
Agoseris glauca	False Dandelion
Achillea millefolium	Yarrow
Antennaria microptera	Pussytoes
Frasera speciosa	Giant Frasera
Gentiana affinis	Prarie Gentian
Penstemon procurus	Penstemon
Campanula rotundifolia	Harebell
Cirsium hookeranium	Hooker's Thistle
Solidago missouriensis	Goldenrod
Geum trifolium	Prarie Smoke
Iris missouriensis	Wild Iris
Erigonium umbellatum	Sulfer Buckwheat
Pedicularis spp.	

II. Open Forest E. of Site I:

Pinus contorta	Lodgepole Pine
Pinus flexillis	Limber Pine
Abies lasiocarpa	Subalpine Fir
Festuca idahoensis	Idaho fescue
Geranium viscossimum	Sticky Geranium

Park mine plant inventory, cont'd

III. Disturbed Area on Waste Rock (Same Dump):

Pinus contotra	Lodgepole Pine
Juniperus communis	Common juniper
Rubus ideaus	Raspberry
Agrostis scabra	Rough bentgrass
Poa pratensis	Kentucky Bluegrass
Carex praegracillis	Clustered Field Sedge
Agropyron spicatum	Bluebunch Wheatgrass
Epilobium angustifolium	Fireweed
Erigonium umbellatum	Sulfer buckwheat
Campanula rotundifolia	Harebell
Aster occidentalis	Western Mountain Aster
Achillea millefolium	Yarrow
Penstemon procurus	Penstemon
Gentiana affinis	Prarie Gentian
Cirsium hookeranium	Hooker's Thistle
Lupinus argenteus	Silky Lupine
Phacelia hastata	Silver Leaf Phacelia
Rumex spp.	
Solidago missourienses	Goldenrod

IV. Adit at Same Waste Rock Dump:

Carex rostrata	Beaked Sedge
Deschampsia caespitosa	Tufted Hairgrass
Phleum pratense	Timothy
Juncus balticus	Baltic Rush

V. a. Small dump above WR5, edge of forest and meadow:

Pinus flexilis	Limber Pine
Juniperus communis	Common Juniper
Lupinus argenteus	Silvery Lupine
Campanula rotundiflora	Harebell
Agropyron spicatum	Bluebunch Wheatgrass
Agropyron trachycaulum	Slender wheatgrass
Poa spp.	
Antennaria racemosa	Pussytoes
Rubus ideaus	Raspberry
Penstemon procurus	Penstemon
Erigonium umbellatum	Sulfer Buckwheat

Park mine plant inventory cont'd

V. b. Natural vegetation next to dump:

Pseudotsuga menzesii	Douglas Fir
Spirea betulifolia	Spirea
Trisetum spicatum	Spike Trisetum
Phleum pratense	Timothy
Bromus marginatus	Mountain Brome
Calamagrostis rubescens	Pinegrass
Astragalus miser	Miser vetch
Lupinus argentea	Silvery Lupine
Arnica cordifolia	Heart-leaved Arnica
Epilobium angustifolium	Fireweed
Potentilla gracilis	Cinquefoil
Antennaria racemosa	Raceme Pussytoes
Taraxicum officionale	Dandelion
Aster occidentalis	Aster

V. c. Natural vegetation near WR5:

Pinus contorta	Lodgepole Pine
Vaccinium scoparium	Grouse Whortleberry
Juniperus communis	Common Juniper
Rosa woodsii	Woods Rose

VI. Smaller Dumps in meadow, Not on Map:

Rubus ideaus	Raspberry
Stipa columbiana	Columbia Needlegrass
Agropyron spicatum	Bluebunch Wheatgrass
Campanula rotundiflora	Harebell

VII: Thick Forest, natural vegetation:

Pinus contorta	Lodgepole Pine
Vaccinium scoparium	Grouse Whortleberry
Rosa sayi	Prickly Rose
Calmagrostis rubescens	Pinegrass
Phleum pratense	Timothy
Trisetum spicatum	Spike trisetum
Stipa columbiana	Columbia Needlegrass
Agrostis scabra	Rough bentgrass
Antennaria racemosa	Pussytoes
Arnica cordifolia	Heart-leaved arnica

Park Mine plant inventory cont'd

IX: Meadow Above Reservoir:

Ribes setosum	Missouri Gooseberry	
Phleum pratense	Timothy	
Bromus marginatus	Mountain Brome	
Stipa columbiana	Columbia Needlegrass	
Juncus spp (ensifolius ?)	Dagger-leaf Rush	
Poa pratensis	Kentucky Bluegrass	
Danthonia intermedia	Timber Oatgrass	
Agrostis stolonifera	Redtop	
Festuca idahoensis	Idaho Fescue	
Agropyron trachycaulum	Slender wheatgrass	
Agropyron spicatum	Bluebunch Wheatgrass	
Trifolium repens	White Clover	
Arnica longifolia	Arnica	
Gentiana affinis	Gentian	
Galium boreale	Bedstraw	
Geranium viscossimum	Sticky geranium	
Linaria dalmatica	**Dalmatian toadflax**	noxious
Achillea millefolium	Yarrow	
Potentilla gracillis	Cinquefoil	
Fragaria vesca	Strawberry	
Cirsium hookeranium	Hooker's thistle	
Campanula rotundiflora	Harebell	
Lupinus arguata	Lupine	
Aster occidentalis	Aster	
Iris missouriensis	Wild Iris	
Perideridia gairdneri	Yampah	
Antennaria microphylla	Pussytoes	

X. Riparian area in Meadow:

Pseudotsuga menzesii	Douglas fir
Picea englemannii	Engleman Spruce
Pinus contorta	Lodgepole Pine
Alnus sinuata	Alder
Salix bebbiana	Bebb's Willow
Salix drummondiana	Drummond's Willow
Carex rostrata	Beaked Sedge
Phleum pratense	Timothy
Agrostis stolonifera	Redtop
Calamagrostis canadensis	Bluejoint Reedgrass
Deschampsia caespitosa	Tufted harigrass
Juncus regelii	Regel's Rush
Luzula parviflora	Small Flowered Woodrush
Achillea millefolium	Yarrow
Trifolium repens	White Clover
Equesteum arvense	Horsetail
Habenaria saccata	Bog Orchid
Senecio triangularis	Groundsel

Park mine plant inventory cont'd

XI. Main Waste rock area:

Phleum pratense	Timothy	
Poa pratensis	Kentucky Bluegrass	
Agropyron spicatum	Bluebunch Wheatgrass	
Danthonia intermedia	Timbered Oatgrass	
Iris missouriensis	Wild Iris	
Agrostis scabra	Rough Bentgrass	
Aster occidentalis	Western Mountain Aster	
Cirsium arvense	**Canada Thistle**	noxious
Chrysothamnuis nauseosis	Rabbitbrush	
Fragaria vessca	Strawberry	
Solidago missouriensis	Goldenrod	

XIIa. Loadout dump in creek:

Pseudotsuga menzessii	Douglas Fir	
Pinus contorta	Lodgepole pine	
Alnus sinuata	Alder	
Ribes setosum	Missouri Gooseberry	
Juniperus communis	Common Juniper	
Artemesia ludoviciana	Prarie Sagewort	
Bromus marginatus	Mountain Brome	
Poa pratensis	Kentucky Bluegrass	
Phleum pratensis	Timothy	
Agropyron trachycaulum	Slender Wheatgrass	
Agrsotis stolonifera	Redtop	
Solidago missouriensis	Goldenrod	
Verbascum thapsus	Mullein	
Agoserus glauca	False Dandelion	
Achillea millefolium	Yarrow	
Cirsium arvense	**Canada Thistle**	noxious
Aster occidentalis	Western Mountain Aster	
Linaria dalmatica	**Dalmation Toadflax**	noxious

Park mine plant inventory cont'd

XIIb. TP1:

Pseudotsuga menzessii	Douglas Fir
Pinus contorta	Lodgepole pine
Rubus ideaus	Raspberry
Poa pratensis	Kentucky Bluegrass
Phleum pratensis	Timothy
Agropyron spicatum	Bluebunch Wheatgrass
Agrostis scabra	Rough Bentgrass
Agropyron trachycaulum	Slender Wheatgrass
Solidago missouriensis	Goldenrod
Rumex spp.	Dock
Phacelia hastata	Phacelia
Taraxicum officionale	Dandelion
Achillea millefolium	Yarrow
Penstemon procurus	Penstemon
Verbascum thapsus	Mullein
Aster occidentalis	Western Mountian Aster
Potentilla gracilis	Cinquefoil
Trifolium repens	White Clover
Lupinus argentea	Silky Leaved Lupine

XIIc. Breached Tailings:

Pseudotsuga menzessii	Douglas Fir
Rubus ideaus	Raspberry
Salix planifolia	Willow
Salix drummondiana	Drummond's willow
Salix bebbiana	Bebb's Willow
Salix candida	Willow
Agrostis stolonifera	Redtop
Agrostis scabra	Rough bentgrass
Poa pratensis	Kentucky Bluegrass
Carex rostrata	Beaked Sedge
Juncus balticus	Baltic Rush
Juncus ensifolius	Dagger-leaved Rush
Phleum pratense	Timothy
Agrostis scabra	Rough Bentgrass
Glyceria striata	Fowl Mannagrass
Iris missouriensis	Wild Iris
Equisetum fluvitale	Horsetail
Equisetum arvense	Horsetail
Aster occidentalis	Western Mountain Aster
Solidago missouriensis	Goldenrod
Achillea millefolium	Yarrow
Cirsium hookeranium	Hooker's Thistle
Geum macrophyllum	Large-leaved Avens
Mimulus guttatus	Monkeyflower
Aster Hesperius	Marsh Aster
Arnica longifolia	Seep-spring Arnica

APPENDIX C

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

INTRODUCTION

Reclamation actions undertaken pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the Comprehensive Environmental Cleanup and Responsibility Act (CECRA), Montana Code Annotated (MCA) §§ 75-10-701 et seq., must "attain a degree of cleanup of the hazardous or deleterious substance and control of a threatened release or further release of that substance that assures protection of public health, safety, and welfare and of the environment." § 75-10-721(1), MCA. Additionally, the Montana Department of Environmental Quality (MDEQ) "shall require cleanup consistent with applicable state or federal applicable or relevant and appropriate requirements" and "may consider substantive state or federal applicable or relevant and appropriate requirements that are relevant to the site conditions." Section 75-10-721(2)(a) and (b) (emphasis added).

A distinction exists between "applicable" requirements and those that are "relevant." "Applicable" requirements are those requirements that would legally apply at the site regardless of the action. "Relevant" requirements are those requirements that are not applicable, but address situations or problems sufficiently similar to those at the site and, therefore, are relevant for use at the site. Attainment of "applicable" requirements is mandatory under CERCLA and CECRA. "Relevant" requirements may be considered by MDEQ. Within this document, MDEQ has identified applicable or relevant state and federal environmental requirements for the proposed reclamation action plan at the Park Mine Site. Additionally, pursuant to § 75-10-721(6), MDEQ may exempt any portion of a reclamation action that is conducted entirely on site from a state or local permit that would, in the absence of the reclamation action, be required if the reclamation action is carried out in accordance with the standards established under §§ 75-10-701 et seq.

Applicable or relevant and appropriate requirements are grouped into three categories: contaminant-specific, location-specific, and action-specific. Contaminant-specific requirements are those that establish an allowable level or concentration of a hazardous or deleterious substance in the environment or that prescribe a level or method of treatment for a hazardous or deleterious substance. Location-specific requirements are those that serve as restrictions on the concentration of a hazardous or deleterious substance or the conduct of activities solely because they are in specific locations. Action-specific requirements are those that are relevant to implementation of a particular remedy. Action-specific requirements do not in themselves determine the remedy, but rather indicate the manner in which a remedy must be implemented.

The ARARs contained in this document are tailored to the various reclamation alternatives proposed in the Reclamation Work Plan for the Park Mine site. If a different plan or reclamation action were proposed, preferred, chosen or implemented for the Park site, the ARARs contained herein might be substantially different. Therefore, the ARARs contained herein are intended to apply exclusively to the various reclamation alternatives proposed in the Reclamation Work Plan for the Park site.

CERCLA and CECRA define as cleanup requirements only state and federal applicable or relevant and appropriate requirements. Reclamation design, implementation, operation and maintenance must, nevertheless, comply with all other applicable laws, both state and federal. Many such laws, while not strictly environmental, have environmental impacts.

Also contained in this list are policies, guidance and other sources of information which are "to be considered" in the implementation of the reclamation action plan at the Park site. Although not enforceable requirements, these documents are important sources of information which the State of Montana Department of Environmental Quality (MDEQ) may consider or find appropriate during selection and implementation of the reclamation action plan.

Finally, this list contains a non-exhaustive list of other legal provisions or requirements which should be complied with during the implementation of the reclamation action plan.

Many requirements listed here are promulgated as identical or nearly identical requirements in both federal and state law, usually pursuant to delegated environmental programs administered by EPA and the states, such as the requirements of the federal Clean Water Act and the Montana Water Quality Act. The preamble to the new NCP states that such a situation results in citation to the state provision as the appropriate standard, but treatment of the provision as a federal requirement. ARARs and other laws which are unique to state law are identified separately by the State of Montana.

FEDERAL ARARs

1. FEDERAL CONTAMINANT SPECIFIC REQUIREMENTS

a. Groundwater Standards - Safe Drinking Water Act

The National Primary Drinking Water Standards (40 CFR Part 141), better known as maximum contaminant levels and maximum contaminant level goals (MCLs and MCLGs), are relevant to the Park site area because the aquifer underlying the area is a current or potential source of drinking water. Groundwater use through private wells does occur in the area, and some of the groundwater in the area is a current source of drinking water.

Use of these standards for this action is fully supported by EPA regulations and guidance. The Preamble to the NCP clearly states that MCLs are relevant and appropriate for groundwater that is a current or potential source of drinking water (55 Fed. Reg. 8750, March 8, 1990), and this determination is further supported by requirements in the regulations governing conduct of RI/FS studies found at 40 CFR § 300.430(e)(2)(i)(B). EPA's guidance on Remedial Action for Contaminated Groundwater at Superfund Sites states that "MCLs developed under the Safe Drinking Water Act generally are ARARs for current or potential drinking water sources." MCLGs which are above zero are relevant and appropriate under the same conditions (55 Fed. Reg. 8750-8752, March 8, 1990). See also, State of Ohio v. EPA, 997 F.2d 1520 (D.C. Cir. 1993), which upholds EPA's application of MCLs and non-zero MCLGs as ARAR standards for groundwater which is a potential drinking water source.

As noted above, standards such as the MCL and MCLG standards are promulgated pursuant to both federal and state law. Under the Safe Drinking Water Act, EPA has granted the State of Montana primacy in implementation and enforcement of the Safe Drinking Water Act. Nevertheless, both federal and state promulgated standards are potential ARARs for the Park site.

Chemical	MCLG	MCL
Arsenic	N.A.[1]	0.05 milligrams per liter (mg/l)[2]
Cadmium	0.005 mg/l[3]	0.005 mg/l[4]
Copper	1.3 mg/l[5]	1.3 mg/l[6]
Lead	N.A.[7]	0.015 mg/l[8]
Mercury	0.002 mg/l[9]	0.002 mg/l[10]

b. Air Standards - Clean Air Act (Applicable)

Limitations on air emissions resulting from cleanup activities or emissions resulting from wind erosion of exposed hazardous substances are set forth in the action specific requirements, below.

2. FEDERAL ACTION SPECIFIC REQUIREMENTS

a. Solid Waste (Relevant), Surface Mining Control and Reclamation (Relevant), and RCRA (Relevant) Requirements

The contamination at the Park site is primarily mining waste and solid waste from various man-made sources. This waste may not be RCRA hazardous waste, although MDEQ reserves its rights to make a more formal determination in this regard at a later date. For any management (i.e., treatment, storage, or disposal) or removal or retention of that contamination, the following requirements are ARARs.

---

1 The MCLG for arsenic is zero.

2 40 CFR § 141.11, 60 Fed. Reg. 33926 (June 29, 1995).

3 40 CFR § 141.51

4 40 CFR § 141.62.

5 40 CFR § 141.51

6 40 CFR § 141.80(c).

7 The MCLG for lead is zero.

8 40 CFR § 141.80(c).

9 40 CFR § 141.51.

10 40 CFR § 141.62.

1. Requirements described at 40 CFR §§ 257.3-1(a), 257.3-3, and 257.3-4, governing waste handling, storage, and disposal, including retention of the waste, are relevant in general[11].

2. For any discrete waste units which are addressed by the Park site cleanup, reclamation and closure regulations found at 30 CFR Parts 816 and 784, governing coal and to a lesser extent, non-coal mining, are relevant requirements.[12]

3. RCRA regulations found at 40 CFR §§ 264.116 and .119 (governing notice and deed restrictions), 264.228(a)(2)(i) (addressing de-watering of wastes prior to disposal), and 264.228(a)(2)(iii)(B), (C), and (D) and .251(c), (d), and (f) (regarding run-on and run-off controls), are relevant requirements for the any waste management units created or retained at the Park site.[13]

b. Air Standards - Clean Air Act (Applicable)

These standards, promulgated pursuant to section 109 of the Clean Air Act (Applicable),[14] are applicable to releases into the air from any Park site cleanup activities.

i. Lead: No person shall cause or contribute to concentrations of lead in the ambient air which exceed 1.5 micrograms per cubic meter ($\mu g/m^3$) of air, measured over a 90-day average.

These standards are promulgated at ARM 16.8.815 (Applicable) as part of a federally approved State Implementation Plan (SIP), pursuant to the Clean Air Act of Montana, §§ 75-2-101 et seq., MCA (Applicable). Corresponding federal regulations are found at 40 CFR § 50.12 (Applicable).[15]

---

11 Solid Waste regulations are promulgated pursuant to the federal Solid Waste Disposal Act, as amended by the Resource Conversation and Recovery Act, 42 U.S.C. 6901 et seq. They are relevant regulations, although the State of Montana has the lead role in regulating solid waste disposal in the State of Montana.

12 The Surface Mining Control and Reclamation Act is promulgated at 30 U.S.C. Sections 1201 - 1326.

13 As noted earlier, federal RCRA regulations are incorporated by reference into applicable State Hazardous Waste Management Act regulations. See ARM 16.44.702. Use of select RCRA regulations to mining waste is appropriate when discrete units are addressed by a cleanup and site conditions are distinguishable from EPA's generic determination of low toxicity/high volume status for mining waste. See Preamble to the Final NCP, 55 Fed. Reg. 8763 - 8764 (March 8, 1990), CERCLA Compliance with Other Laws Manual, Volume II (August 1989 OSWER Dir. 9234.1-02) p. 6-4; Preamble to Proposed NCP, 53 Fed. Reg. 51447 (Dec. 21, 1988), and guidance entitled "Consideration of RCRA Requirements in Performing CERCLA Responses at Mining Wastes Sites," August 19, 1986 (OSWER).

14 42 U.S.C. §§ 7401 et seq.

15 The ambient air standards established as part of Montana's approved State Implementation Plan in many cases provide more stringent or additional standards. The federal standards by themselves apply only to "major sources", while the State standards are fully applicable throughout the state and are not limited to "major sources". See ARM 16.8.808 and 16.8.811-.821. As part of an EPA-approved State Implementation Plan, the state standards are also federally enforceable. Thus, the state standards which are equivalent to the federal standards are identified in this section together. A more detailed list of State standards, which include standards which are not duplicated in federal regulations, is contained in the State ERCL identification section.

ii. Particulate matter that is 10 microns in diameter or smaller (PM-10):

No person shall cause or contribute to concentrations of PM-10 in the ambient air which exceed:

- 150 $\mu g/m^3$ of air, 24 hour average, no more than one expected exceedence per calendar year;

- 50 $\mu g/m^3$ of air, annual average.

These regulations are promulgated at ARM 16.8.821 (Applicable) as part of a federally approved SIP, pursuant to the Clean Air Act of Montana, §§ 75-2-101 et seq., MCA. Corresponding federal regulations are found at 40 CFR § 50.6 (Applicable).

Ambient air standards under section 109 of the Clean Air Act are also promulgated for carbon monoxide, hydrogen sulfide, nitrogen dioxide, sulfur dioxide, and ozone. If emissions of these compounds were to occur at the site in connection with any cleanup action, these standards would also be applicable. See ARM 16.8.811 and 40 CFR Part 50.

c. Point Source Controls - Clean Water Act (Applicable)

If point sources of water contamination are retained or created by any Park site voluntary cleanup plan activity, applicable Clean Water Act standards would apply to those discharges. The applicable regulations are discussed in the contaminant specific ARAR section, above, and in the State of Montana identification of ARARs. These applicable regulations would include storm water runoff regulations found at ARM 16.20.1301-1347, which sets out the Montana Pollutant Discharge Elimination System (MPDES) permit requirements, most specifically, a general permit scheme for various types of storm water discharges, see, ARM 16.20.1314 and 16.20.1317; and 40 CFR Parts 121, 122, and 125 (general conditions and industrial activity conditions). These would also include applicable requirements for best management practices and monitoring found at 40 CFR §§ 122.44(i) and 440.148, for point source discharges.

d. Transportation of Hazardous or Contaminated Waste (Relevant)

40 CFR Part 263 establishes regulations for the transportation of hazardous waste. These regulations would govern any on-site transportation of material. Any off-site transportation would be subject to applicable regulations.

STATE OF MONTANA ARARs

3. MONTANA CONTAMINANT SPECIFIC REQUIREMENTS

a. Water Quality

i. Groundwater Pollution Control System (Applicable)

In addition to the standards set forth below, relevant MCLs and MCLGs are included in the federal ARARs identified above.

ARM 16.20.1002 (Applicable) classifies groundwater into Classes I through IV based on the present and future most beneficial uses of the groundwater, and states that groundwater is to be classified according to actual quality or actual use, whichever places the groundwater in a higher class. Class I is the highest quality class; class IV the lowest. Based upon its specific conductance, the groundwater in the Park site should be considered Class I groundwater. [16]

ARM 16.20.1003 (Applicable) establishes the groundwater quality standards applicable with respect to each groundwater classification. Concentrations of dissolved substances in Class I or II groundwater (or Class III groundwater which is used as a drinking water source) may not exceed the human health standards listed in department Circular WQB-7. For the primary contaminants of concern these levels are listed below.

Chemical	WQB-7 Human Health Standard
Arsenic	18 μg/l
Cadmium	5 μg/l
Copper	1000 μg/l
Lead	15 μg/l
Zinc	5000 μg/L

Concentrations of other dissolved or suspended substances must not exceed levels that render the waters harmful, detrimental or injurious to public health. Maximum allowable concentration of these substances also must not exceed acute or chronic problem levels that would adversely affect existing or designated beneficial uses of groundwater of that classification. ARM 16.20.1003 specifies certain references that may be used as a guide in determining problem levels unless local conditions make these values inappropriate.

An additional concern with respect to ARARs for groundwater is the impact of groundwater upon the surface water. If significant loadings of contaminants from groundwater sources to surface water contribute to the inability of the surface water to meet the I class standards, then alternatives to alleviate such groundwater loading must be evaluated and, if appropriate, implemented. Groundwater in certain areas may need to be cleaned up to levels more stringent

[16] ARM 16.20.1002 provides that Class I groundwaters have a specific conductance of less than 1000 micromhos per centimeter at 25° C; Class II groundwaters: 1000 to 2500; Class III groundwaters: 2500 to 15,000; and Class IV groundwaters: over 15,000.

than the groundwater classification standards for certain parameters in order to achieve the standards for affected surface water. See Compliance with Federal Water Quality Criteria, OSWER Publication 9234.2-09/FS (June 1990)("Where the ground water flows naturally into the surface water, the ground-water remediation should be designed so that the receiving surface-water body will be able to meet any ambient water-quality standards (such as State WQSs or FWQC) that may be ARARs for the surface water.")

b. Air Quality

In addition to the standards identified in the federal action specific ARARs above, the State of Montana has identified certain air quality standards in the action specific section of the State ARARs below.

4. MONTANA LOCATION SPECIFIC REQUIREMENTS

a. Solid Waste Management Regulations (Applicable)

Regulations promulgated under the Solid Waste Management Act, §§ 75-10-201 et seq., MCA, specify requirements that apply to the location of any solid waste management facility.[17] Under ARM 16.14.505 (Applicable), a facility for the treatment, storage or disposal of solid wastes:

> (a) must be located where a sufficient acreage of suitable land is available for solid waste management;
>
> (b) may not be located in a 100-year floodplain;
>
> (c) may be located only in areas which will prevent the pollution of ground and surface waters and public and private water supply systems;
>
> (d) must be located to allow for reclamation and reuse of the land;
>
> (e) drainage structures must be installed where necessary to prevent surface runoff from entering waste management areas; and
>
> (f) where underlying geological formations contain rock fractures or fissures which may lead to pollution of the ground water or areas in which springs exist that are hydraulically connected to a proposed disposal facility, only Class III disposal facilities may be approved.[18]

---

17 These requirements apply, inter alia, to the treatment, storage, or disposal of solid waste. See ARM 16.14.502(17). While "solid waste" does not include "mining wastes regulated under the mining and reclamation laws administered by the Department of Environmental Quality," see § 75-10-203(11), MCA, as amended by Chapter 418, Laws of Montana 1995, the mining wastes found in the Joslyn Street Tailings Site are not regulated under the mining and reclamation laws administered by the Department of Environmental Quality. Therefore, these requirements are applicable to the treatment, storage or disposal of mining wastes pursuant to the voluntary cleanup action plan.

18 Group III wastes consist of primarily inert wastes, including "industrial mineral wastes which are essentially inert and non-water soluble and do not contain hazardous waste constituents." ARM 16.14.503(1)(b).

Even Class III landfills (which can accept only materials which are essentially inert and do not contain hazardous waste constituents) may not be located on the banks of or in a live or intermittent stream or water saturated area, such as a marsh or deep gravel pit which contains exposed ground water. ARM 16.14.505(2)(j).

In addition, § 75-10-212 (Applicable) prohibits dumping or leaving any debris or refuse upon or within 200 yards of any highway, road, street, or alley of the State or other public property, or on privately owned property where hunting, fishing, or other recreation is permitted. However, the restriction relating to privately owned property does not apply to the owner, his agents, or those disposing of debris or refuse with the owner's consent.

B. Montana State Antiquities Act (Relevant)

This Act, contained in section 22-3-435, MCA, requires that any person who conducts activities, including survey, excavation or construction, and who finds that an operation licensed or otherwise entitled by the state may damage heritage properties or paleontological remains on any state lands shall promptly report to the historic preservation officer the discovery and take all reasonable steps to ensure preservation of the heritage property or paleontological remains.

5. MONTANA ACTION SPECIFIC REQUIREMENTS

a. Water Quality

i. Groundwater Act (Applicable)

Section 85-2-505, MCA, (Applicable) precludes the wasting of groundwater. Any well producing waters that contaminate other waters must be plugged or capped, and wells must be constructed and maintained so as to prevent waste, contamination, or pollution of groundwater.

ii. Public Water Supply Regulations (Applicable)

If reclamation action at the site requires any reconstruction or modification of any public water supply line or sewer line, the construction standards specified in ARM 16.20.401(3) (Applicable) must be observed.

b. Air Quality

i. Air Quality Regulations

Dust suppression and control of certain substances likely to be released into the air as a result of earth moving, transportation and similar actions may be necessary to meet air quality requirements. Certain ambient air standards for specific contaminants and particulates are set forth in the federal action specific section above. Additional air quality regulations under the state Clean Air Act, §§ 75-2-101 et seq., MCA, (Applicable) are discussed below.

ARM 16.8.815 (Applicable) specifies that no person shall cause or contribute to concentrations of lead in the ambient air which exceed the following: 90-day average--1.5 micrograms per cubic meter of air, 90-day average not to be exceeded.

ARM 16.8.817 (Applicable) specifies that no person shall cause or contribute to concentrations of ozone in the ambient air which exceed the following: 90-day average--1.5 micrograms per cubic meter of air, 90-day average not to be exceeded.

ARM 16.8.1401(1) and (2) (Applicable) provides that no person shall cause or authorize the production, handling, transportation or storage of any material; or cause or authorize the use of any street, road, or parking lot; or operate a construction site or demolition project, unless reasonable precautions to control emissions of airborne particulate matter are taken. Emissions of airborne particulate matter must be controlled so that they do not "exhibit an opacity of twenty percent (20%) or greater averaged over six consecutive minutes." ARM 16.8.1401(1) and (2) (Applicable) and ARM 16.8.1404 (Applicable).

ARM 16.8.1424 (Applicable) provides emission standards for hazardous air pollutants.

In addition, state law provides an ambient air quality standard for settled particulate matter. Particulate matter concentrations in the ambient air shall not exceed the following 30-day average: 10 grams per square meter. ARM § 16.8.818 (Applicable).

ARM 16.8.1427 (Applicable). Odors. If a business or other activity will create odors, those odors must be controlled, and no business or activity may cause a public nuisance.

ARM 26.4.761 (Relevant) specifies a range of measures for controlling fugitive dust emissions during mining and reclamation activities. Some of these measures could be considered relevant to control fugitive dust emissions in connection with excavation, earth moving and transportation activities conducted as part of the remedy at the site. Such measures include, for example, paving, watering, chemically stabilizing, or frequently compacting and scraping roads, promptly removing rock, soil or other dust-forming debris from roads, restricting vehicle speeds, revegetating, mulching, or otherwise stabilizing the surface of areas adjoining roads, restricting unauthorized vehicle travel, minimizing the area of disturbed land, and promptly revegetating regraded lands.

c. Solid Waste Regulations

As noted above, the Solid Waste Management Regulations are applicable to the management of the tailings and similar wastes within the reclamation plan. Certain of these regulations are identified in the state Location Specific ARARs above. Other applicable requirements are discussed here.

ARM 16.14.505(2) (Applicable) specifies standards for solid waste management facilities, including the requirements that:

1. if there is the potential for leachate migration, it must be demonstrated that leachate will only migrate to underlying formations which have no hydraulic continuity with any state waters;

2. adequate separation of such wastes from underlying or adjacent water must be provided, considering terrain, type of underlying soil formations, and facility design; and

3. no new disposal units or lateral expansions may be located in wetlands.

ARM 16.14.523 (Relevant) requires that such waste must be transported in such a manner as to prevent its discharge, dumping, spilling, or leaking from the transport vehicle.

Section 75-10-206, MCA, (Relevant) allows variances to be granted from solid waste regulations if failure to comply with the rules does not result in a danger to public health or safety or compliance with specific rules would produce hardship without producing benefits to the health and safety of the public that outweigh the hardship. In light of the nature of the wastes at issue and the likelihood that any repository would contain only a single type of waste, i.e. tailings and related materials, and considering available Superfund procedures for the maintenance of remedies and the ability of the agencies, within the Superfund process, to consider the characteristics of the particular wastes at issue in appropriately determining and designing repositories, many of the following applicable Solid Waste Regulations may appropriately be subject to variance in selecting and implementing a remedy at this site: design of landfills, ARM 16.14.506, operational and maintenance requirements, ARM 16.14.520-521, and landfill closure requirements and post-closure care, ARM 16.14.530-531.

d. Reclamation Requirements

i. <u>Reclamation Activities - Hydrology Regulations (Relevant)</u>

The hydrology regulations promulgated under the Strip and Underground Mine Reclamation Act, §§ 82-4-201 <u>et seq.</u>, MCA, provide detailed guidelines for addressing the hydrologic impacts of mine reclamation activities and earth moving projects and are relevant for addressing these impacts at the Park site.

ARM 26.4.631 (Relevant) provides that long-term adverse changes in the hydrologic balance from mining and reclamation activities, such as changes in water quality and quantity, and location of surface water drainage channels shall be minimized. Water pollution must be minimized and, where necessary, treatment methods utilized. Diversions of drainages to avoid contamination must be used in preference to the use of water treatment facilities. Other pollution minimization devices must be used if appropriate, including stabilizing disturbed areas through land shaping, diverting runoff, planting quickly germinating and growing stands of temporary vegetation, regulating channel velocity of water, lining drainage channels with rock or vegetation, mulching, and control of acid-forming, and toxic-forming waste materials.

ARM 26.4.633 (Relevant) states that all surface drainage from a disturbed area must be treated by the best technology currently available (BTCA). Treatment must continue until the area is stabilized.

ARM 26.4.634 (Relevant) provides that, in reclamation of drainages, drainage design must emphasize channel and floodplain dimensions that approximate the premining configuration and that will blend with the undisturbed drainage above and below the area to be reclaimed. The average stream gradient must be maintained with a concave longitudinal profile. This regulation provides specific requirements for designing the reclaimed drainage to:

1. meander naturally;

2. remain in dynamic equilibrium with the system;

3. improve unstable premining conditions;

4. provide for floods; and

5. establish a premining diversity of aquatic habitats and riparian vegetation.

ii. <u>Reclamation and Revegetation Requirements</u>

ARM 26.4.501 and 501A (Relevant) give general backfilling and final grading requirements.

ARM 26.4.504 (Relevant) provides that permanent impoundments that meet the requirements of ARM 26.4.642 may be retained in mined and reclaimed sites, provided that all highwalls are eliminated by grading to appropriate contours and the postmining land use and protection of hydrologic balance provisions are satisfied. No impoundments may be constructed on top of areas in which excess materials are deposited.

ARM 26.4.514 (Relevant) sets out contouring requirements.

ARM 26.4.519 (Relevant) provides that an operator may be required to monitor settling of regraded areas.

ARM 26.4.520 (Relevant) provides that spoil material may be placed in a controlled (engineered) manner in a disposal area other than the mine workings or excavations. Also provides various other relevant requirements, including, but not limited to, those for water protection, i.e., that leachate and surface runoff from the fill must not degrade surface or ground waters or exceed effluent limitations.

ARM 26.4.641 (Relevant) provides that drainage from acid- and toxic-forming spoil into ground and surface water must be avoided by several enumerated means, all of which are relevant.

ARM 26.4.642 (Relevant) prohibits permanent impoundments except under certain circumstances. Also provides other construction requirements for embankments, dams and diversion ditches.

ARM 26.4.643-646 (Relevant) provides for protection of groundwater and groundwater recharge, and provides requirements for monitoring surface and groundwater.

ARM 26.4.650 (Relevant) provides for postmining rehabilitation of sedimentation ponds, diversion, impoundments and treatment facilities before abandonment of the permit area.

ARM 26.4.638 (Relevant) specifies sediment control measures to be implemented during operations.

ARM 26.4.702 (Relevant) requires that during the redistributing and stockpiling of soil (for reclamation):

1. regraded areas must be deep-tilled, subsoiled, or otherwise treated to eliminate any possible slippage potential, to relieve compaction, and to promote root penetration and permeability of the underlying layer; this preparation must be done on the contour whenever possible and to a minimum depth of 12 inches;

2. redistribution must be done in a manner that achieves approximate uniform thicknesses consistent with soil resource availability and appropriate for the postmining vegetation, land uses, contours, and surface water drainage systems; and

3. redistributed soil must be reconditioned by subsoiling or other appropriate methods.

ARM 26.4.703 (Relevant) When using materials other than, or along with, soil for final surfacing in reclamation, the operator must demonstrate that the material (1) is at least as capable as the soil of supporting the approved vegetation and subsequent land use, and (2) the medium must be the best available in the area to support vegetation. Such substitutes must be used in a manner consistent with the requirements for redistribution of soil in ARM 26.4.701 and 702.

ARM 26.4.711 (Relevant) requires that a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area of land to be affected shall be established except on road surfaces and below the low-water line of permanent impoundments. Vegetative cover is considered of the same seasonal variety if it consists of a mixture of species of equal or superior utility when compared with the natural (or pre-existing) vegetation during each season of the year. (See also ARM 26.4.716 below regarding substitution of introduced species for native species.)

ARM 26.4.713 (Relevant) provides that seeding and planting of disturbed areas must be conducted during the first appropriate period for favorable planting after final seedbed preparation but may not be more than 90 days after soil has been replaced.

ARM 26.4.714 (Relevant) requires use of a mulch or cover crop or both until an adequate permanent cover can be established. Use of mulching and temporary cover may be suspended under certain conditions.

ARM 26.4.716 (Relevant) establishes the required method of revegetation, and provides that introduced species may be substituted for native species as part of an approved plan.

ARM 26.4.718 (Relevant) requires the use of soil amendments and other means such as irrigation, management, fencing, or other measures, if necessary to establish a diverse and permanent vegetative cover.

ARM 26.4.720 (Relevant) requires annual state inspection of seeded areas.

ARM 26.4.721 (Relevant) requires rills and gullies forming in areas that have been regraded or resoiled must be filled, graded or otherwise stabilized and the area reseeded or replanted under certain circumstances.

ARM 26.4.723 (Relevant) requires periodic monitoring and data review of vegetation, soils, wildlife and other items at the site by the operator as prescribed or approved by the state.

ARM 26.4.724 (Relevant) provides revegetation comparison standards.

ARM 26.4.725 (Relevant) establishes commencement of the minimum period of responsibility for reestablishing vegetation.

ARM 26.4.726 (Relevant) establishes vegetation production, cover, diversity, density and utility requirements for revegetation and reclamation success.

ARM 26.4.728 (Relevant) sets forth requirements for the composition of vegetation on reclaimed areas.

ARM 26.4.730-731 (Relevant) requires season of use standards and analysis of toxicity if such toxicity is suspected due to the effects of disturbance caused by the reclamation technique.

6. OTHER LAWS (NON-EXCLUSIVE LIST)

The following "other laws" are included here to provide a reminder of other legally applicable requirements for actions being conducted at the Park site. They do not purport to be an exhaustive list of such legal requirements, but are included because they set out related concerns that must be addressed and, in some cases, may require some advance planning. They are not included as ARARs because they are not "environmental or facility siting laws." As applicable laws other than ARARs, they are not subject to ARAR waiver provisions.

a. Other Federal Laws

i. <u>Occupational Safety and Health Regulations</u>

The federal Occupational Safety and Health Act regulations found at 29 CFR § 1910 are applicable to worker protection during conduct of the reclamation plan.

b. Other Montana Laws

i. <u>Groundwater Act</u>

Section 85-2-516, MCA, states that within 60 days after any well is completed a well log report must be filed by the driller with the DNRC and the appropriate county clerk and recorder.

ii. <u>Occupational Health Act</u>, §§ 50-70-101 <u>et seq</u>., MCA.

ARM § 16.42.101 addresses occupational noise. In accordance with this section, no worker shall be exposed to noise levels in excess of the levels specified in this regulation. This regulation is applicable only to limited categories of workers and for most workers the similar federal standard in 29 CFR § 1910.95 applies.

ARM § 16.42.102 addresses occupational air contaminants. The purpose of this rule is to establish maximum threshold limit values for air contaminants under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. In accordance with this rule, no worker shall be exposed to air contaminant levels in excess of the threshold limit values listed in the regulation. This regulation is applicable only to limited categories of workers and for most workers the similar federal standard in 29 CFR § 1910.1000 applies.

iii. <u>Montana Safety Act</u>

Sections 50-71-201, 202 and 203, MCA, state that every employer must provide and maintain a safe place of employment, provide and require use of safety devices and safeguards, and ensure that operations and processes are reasonably adequate to render the place of employment safe. The employer must also do every other thing reasonably necessary to protect the life and safety of its employees. Employees are prohibited from refusing to use or interfering with the use of safety devices.

APPENDIX D

COST ESTIMATE TABLES

TABLE D-1

PARK MINE SITE
PRELIMINARY COST ESTIMATE - ALTERNATIVE 3
IN-PLACE CONTAINMENT OF WASTE

	Quantity	Units	Unit Price	Cost	Unit Cost Reference
CAPITAL COSTS					
Mobilization, Bonding, & Insurance	1	L.S.	$100,000	$100,000	Engineering Estimate
Road Improvement/Road Construction	5.5	MI.	$10,500	$57,750	Engineering Estimate
Adit Discharge Diversion	3	EA.	$2,000	$6,000	Engineering Estimate
Stream Diversion	3	EA.	$5,000	$15,000	Piegan Gloster Bid Tab
Silt Fence along Indian Creek	1750	LF.	$3.25	$5,688	Maxville Bid Tabulation
Site Clearing/Preparation	1	L.S.	$6,000	$6,000	Engineering Estimate
Adit Closure	9	EA.	$2,500	$22,500	Engineering Estimate
Shaft Closure	1	EA.	$5,000	$5,000	Engineering Estimate
Structures and Debris Disposal	1	L.S.	$15,000	$15,000	Engineering Estimate
New Access Roads to Dumps	7600	LF.	$4	$30,400	Maxville Bid Tabulation
Excavate Waste Rock - move away from creek	1500	C.Y.	$6	$9,000	Brooklyn Bid Tabulation
Waste Rock Grading	8.8	Acres	$10,000	$88,000	Maxville Bid Tabulation
Tailings Grading	0.59	Acres	$12,000	$7,080	Engineering Estimate
Lime Rock Capillary Break over regraded Waste (4")	2340	C.Y.	$26	$60,021	Engineering Estimate
Imported Cover Soil	22805	C.Y.	$14	$319,270	Engineering Estimate
Cover Soil Application/Grading	22805	C.Y.	$1	$22,805	Engineering Estimate
Lime Application - WR1,2,5,10, misc. dumps	315	Tons	$200	$63,000	Brooklyn Bid Tabulation
Organic Amendment - WR1,2,5,10,misc. dumps	4.6	Acres	$9,000	$41,400	Vosburg Bid Tabulation
Fertilize and Drill Seed	9.4	Acres	$2,000	$18,780	Maxville Bid Tabulation
Fertilize and HydroSeed (Obliterated Roadways)	2.3	Acres	$2,200	$5,060	Maxville Bid Tabulation
Straw Mulch	9.4	Acres	$2,000	$18,780	Maxville Bid Tabulation

TABLE D-1 Continued

HydroMulch (Obliterated Roadways)	2.3	Acres	$4,300	$9,890	Maxville Bid Tabulation
Rip Rap Screening and Placement	1100	C.Y.	$20	$22,000	Engineering Estimate
Runon Control Ditch Construction	5150	L.F.	$5	$25,750	Maxville Bid Tabulation
Install Fences	7190	L.F.	$5	$35,950	Maxville Bid Tabulation
Obliterate and Reclaim Temporary Roads - WR	7600	L.F.	$2	$15,200	Maxville Bid Tabulation
Stream Reconstruction - WR2	500	L.F.	$35	$17,500	Brooklyn Bid Tabulation
Subtotal				$1,042,824	
Construction Oversight (4%)				$41,713	
Subtotal Capital Costs				$1,084,536	
Remote/Rough Terrain Contingency (10%)				$108,454	
TOTAL CAPITAL COSTS				**$1,193,000**	

POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	2	/Year	$500	$1,000	Estimate
Sampling and Analysis	4	/Year	$600	$2,400	Estimate
Maintenance	1	L.S.	$1,000	$1,000	Estimate
Subtotal				$4,400	
Contingency (10%)				$440	
ANNUAL 30 YEAR O&M COST				**$4,840**	

TOTAL CAPITAL COSTS	$1,193,000
PRESENT WORTH, POST-CLOSURE MAINTENANCE AND MONITORING (10%)	$45,593
TOTAL PRESENT WORTH COST	**$1,239,000**

TABLE D-2

PARK MINE SITE
PRELIMINARY COST ESTIMATE - ALTERNATIVE 4a
PARTIAL REMOVAL AND IN-PLACE CONTAINMENT

	Quantity	Units	Unit Price	Cost	Unit Cost Reference
CAPITAL COSTS					
Mobilization, Bonding, & Insurance	1	L.S.	$137,000	$137,000	Engineering Estimate
Road Improvement/Road Construction	5.5	MI.	$10,500	$57,750	Engineering Estimate
Adit Discharge Diversion	3	EA.	$2,000	$6,000	Engineering Estimate
Stream Diversion	3	EA.	$5,000	$15,000	Piegan Gloster Bid Tab
Silt Fence along Indian Creek	1750	LF.	$3.25	$5,688	Maxville Bid Tabulation
Site Clearing/Preparation	1	L.S.	$6,000	$6,000	Engineering Estimate
Adit Closure	9	EA.	$2,500	$22,500	Engineering Estimate
Shaft Closure	1	EA.	$5,000	$5,000	Engineering Estimate
Structures and Debris Disposal	1	L.S.	$15,000	$15,000	Engineering Estimate
New Access Roads to Dumps	7600	LF.	$4	$30,400	Maxville Bid Tabulation
Excavate/Transport & Place Waste Rock	21500	C.Y.	$6	$129,000	Brooklyn Bid Tabulation
Excavate/Transport & Place Soils Underlying WR	9750	C.Y.	$6	$58,500	Brooklyn Bid Tabulation
Waste Rock Grading - Consolidation Area	2	Acres	$10,000	$20,000	Maxville Bid Tabulation
Excavate/Transport & Place Tailings Piles	2980	C.Y.	$6.50	$19,370	Brooklyn Bid Tabulation
Excavate/Transport & Place Soils Underlying TP	800	C.Y.	$6.50	$5,200	Brooklyn Bid Tabulation
Lime Rock Capillary Break over Waste Consol. (4")	2025	C.Y.	$26	$51,941	Engineering Estimate
Imported Cover Soil - Excavated Areas	18628	C.Y.	$14	$260,792	Engineering Estimate
Cover Soil Application/Grading	18628	C.Y.	$1	$18,628	Engineering Estimate
Lime Application - Consolidation Area Cover	180	Tons	$200	$36,000	Brooklyn Bid Tabulation
Organic Amendment - Consolidation Area Cover	5.5	Acres	$9,000	$49,500	Vosburg Bid Tabulation

TABLE D-2 Continued

Grade Waste Rock Piles WR5,6,9, misc. dumps	3.5	Acres	$10,000	$35,000	Maxville Bid Tabulation
Fertilize and Drill Seed	12.2	Acres	$2,000	$24,426	Maxville Bid Tabulation
Fertilize and HydroSeed	2.3	Acres	$2,200	$5,060	Maxville Bid Tabulation
Straw Mulch	12.2	Acres	$2,000	$24,426	Maxville Bid Tabulation
HydroMulch (Obliterated Roadways)	2.3	Acres	$4,300	$9,890	Maxville Bid Tabulation
Rip Rap Screening and Placement	1100	C.Y.	$20	$22,000	Engineering Estimate
Runon Control Ditch Construction	5150	L.F.	$5	$25,750	Maxville Bid Tabulation
Install Fences	7190	L.F.	$5	$35,950	Maxville Bid Tabulation
Obliterate and Reclaim Temporary Roads - WR	7600	L.F.	$2	$15,200	Maxville Bid Tabulation
Stream Reconstruction	1100	L.F.	$35	$38,500	Brooklyn Bid Tabulation
STREAMSIDE TAILINGS:					
New Access Roads to Streamside Tailings	3400	LF.	$5	$17,000	Engineering Estimate
Silt Fence along Indian Creek	5400	LF.	$3.25	$17,550	Maxville Bid Tabulation
Stream Crossing	3	EA	$500	$1,500	Engineering Estimate
Excavate/Transport & Place Tailings	1730	C.Y.	$20	$34,600	Engineering Estimate
Backfill, Regrade with Imported Cover Soil	1730	C.Y.	$20	$34,600	Engineering Estimate
Stream Reconstruction	200	LF.	$70	$14,000	Engineering Estimate
Fertilize and DrillSeed	4	Acres	$2,000	$8,000	Maxville Bid Tabulation
Straw Mulch	4	Acres	$2,000	$8,000	Maxville Bid Tabulation
Install Fences	11000	L.F.	$5	$55,000	Maxville Bid Tabulation
Obliterate and Reclaim Temporary Roads	3400	L.F.	$2	$6,800	Maxville Bid Tabulation
Subtotal				$1,382,521	
Construction Oversight (4%)				$55,301	
Subtotal Capital Costs				$1,437,822	
Remote/Rough Terrain Contingency (10%)				$143,782	
TOTAL CAPITAL COSTS				**$1,582,000**	

TABLE D-2 Continued

POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	2	/Year	500	1000	Estimate
Sampling and Analysis	4	/Year	600	2400	Estimate
Maintenance	1	L.S.	1000	1000	Estimate
Subtotal				4400	
Contingency (10%)				440	
ANNUAL 30 YEAR O&M COST				$4,840	

TOTAL CAPITAL COSTS	1582000
PRESENT WORTH, POST-CLOSURE MAINTENANCE AND MONITORING (10%)	45593
TOTAL PRESENT WORTH COST	**$1,628,000**

park4a.wk4

TABLE D-3

PARK MINE SITE
PRELIMINARY COST ESTIMATE - ALTERNATIVE 4b
PARTIAL REMOVAL (Excluding Streamside Tailings) AND IN-PLACE CONTAINMENT

	Quantity	Units	Unit Price	Cost	Unit Cost Reference
CAPITAL COSTS					
Mobilization, Bonding, & Insurance	1	L.S.	$118,000	$118,000	Engineering Estimate
Road Improvement/Road Construction	5.5	MI.	$10,500	$57,750	Engineering Estimate
Adit Discharge Diversion	3	EA.	$2,000	$6,000	Engineering Estimate
Stream Diversion	3	EA.	$5,000	$15,000	Piegan Gloster Bid Tab
Silt Fence along Indian Creek	1750	LF.	$3.25	$5,688	Maxville Bid Tabulation
Site Clearing/Preparation	1	L.S.	$6,000	$6,000	Engineering Estimate
Adit Closure	9	EA.	$2,500	$22,500	Engineering Estimate
Shaft Closure	1	EA.	$5,000	$5,000	Engineering Estimate
Structures and Debris Disposal	1	L.S.	$15,000	$15,000	Engineering Estimate
New Access Roads to Dumps	7600	LF.	$4	$30,400	Maxville Bid Tabulation
Excavate/Transport & Place Waste Rock	21500	C.Y.	$6	$129,000	Brooklyn Bid Tabulation
Excavate/Transport & Place Soils Underlying WR	9750	C.Y.	$6	$58,500	Brooklyn Bid Tabulation
Waste Rock Grading - Consolidation Area	2	Acres	$10,000	$20,000	Maxville Bid Tabulation
Excavate/Transport & Place Tailings Piles	2980	C.Y.	$6.50	$19,370	Brooklyn Bid Tabulation
Excavate/Transport & Place Soils Underlying TP	800	C.Y.	$6.50	$5,200	Brooklyn Bid Tabulation
Lime Rock Capillary Break over Waste(4")	2025	C.Y.	$26	$51,941	Engineering Estimate
Imported Cover Soil - Excavated Areas	18628	C.Y.	$14	$260,792	Engineering Estimate
Cover Soil Application/Grading	18628	C.Y.	$1	$18,628	Engineering Estimate
Lime Application	180	Tons	$200	$36,000	Brooklyn Bid Tabulation
Organic Amendment	5.5	Acres	$9,000	$49,500	Vosburg Bid Tabulation
Grade Waste Rock Piles WR5,6,9, misc. dumps	3.5	Acres	$10,000	$35,000	Maxville Bid Tabulation

TABLE D-3 Continued

Fertilize and Drill Seed	12.2	Acres	$2,000	$24,426	Maxville Bid Tabulation
Fertilize and HydroSeed	2.3	Acres	$2,200	$5,060	Maxville Bid Tabulation
Straw Mulch	12.2	Acres	$2,000	$24,426	Maxville Bid Tabulation
HydroMulch (Obliterated Roadways)	2.3	Acres	$4,300	$9,890	Maxville Bid Tabulation
Rip Rap Screening and Placement	1100	C.Y.	$20	$22,000	Engineering Estimate
Runon Control Ditch Construction	5150	L.F.	$5	$25,750	Maxville Bid Tabulation
Install Fences	7190	L.F.	$5	$35,950	Maxville Bid Tabulation
Obliterate and Reclaim Temporary Roads - WR	7600	L.F.	$2	$15,200	Maxville Bid Tabulation
Stream Reconstruction	1100	L.F.	$35	$38,500	Brooklyn Bid Tabulation
Subtotal				$1,166,471	
Construction Oversight (4%)				$46,659	
Subtotal Capital Costs				$1,213,130	
Remote/Rough Terrain Contingency (10%)				$121,313	
TOTAL CAPITAL COSTS				$1,334,000	

TABLE D-3 Continued

POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	2	/Year	500	1000	Estimate
Sampling and Analysis	4	/Year	600	2400	Estimate
Maintenance	1	L.S.	1000	1000	Estimate
Subtotal				4400	
Contingency (10%)				440	
ANNUAL 30 YEAR O&M COST				$4,840	

TOTAL CAPITAL COSTS	1334000
PRESENT WORTH, POST-CLOSURE MAINTENANCE AND MONITORING (10%)	45593
TOTAL PRESENT WORTH COST	**$1,380,000**

TABLE D-4

PARK MINE SITE
PRELIMINARY COST ESTIMATE - ALTERNATIVE 5a
PARTIAL REMOVAL/DISPOSAL ON-SITE IN A CONSTRUCTED RCRA SUBTITLE C REPOSITORY AND PARTIAL IN-PLACE CONTAINMENT

	Quantity	Units	Unit Price	Cost	Unit Cost Reference
CAPITAL COSTS					
Mobilization, Bonding, & Insurance	1	L.S.	$150,000	$150,000	Engineering Estimate
Road Improvement/Road Construction	5.5	MI.	$10,500	$57,750	Engineering Estimate
Adit Discharge Diversion	3	EA.	$2,000	$6,000	Engineering Estimate
Stream Diversion	3	EA.	$5,000	$15,000	Piegan Gloster Bid Tab
Silt Fence along Indian Creek	1750	LF.	$3.25	$5,688	Maxville Bid Tabulation
Site Clearing/Preparation	1	L.S.	$6,000	$6,000	Engineering Estimate
Adit Closure	9	EA.	$2,500	$22,500	Engineering Estimate
Shaft Closure	1	EA.	$5,000	$5,000	Engineering Estimate
Structures and Debris Disposal	1	L.S.	$15,000	$15,000	Engineering Estimate
Repository Excavation	15000	C.Y.	$2	$30,000	Brooklyn Bid Tabulation
Grade and Compact Subgrade	5500	S.Y.	$1	$2,750	Brooklyn Bid Tabulation
GCL Bottom Liner	5500	S.Y.	$5	$27,500	Brooklyn Bid Tabulation
HDPE Liner	11000	S.Y.	$6.50	$71,500	Engineering Estimate
Geocomposite (Drainage Layer)	11000	S.Y.	$5.00	$55,000	Brooklyn Bid Tabulation
Leachate Collection/Removal System (2)	1	L.S.	$15,000	$15,000	Engineering Estimate
Excavate/Transport Waste Rock & Tailings	22610	C.Y.	$6	$135,660	Brooklyn Bid Tabulation
Install GCL Cap Liner	5500	S.Y.	$5	$27,500	Brooklyn Bid Tabulation
Install Membrane Cap Liner	5500	S.Y.	$6.50	$35,750	Engineering Estimate
Geocomposite (Drainage Layer)	5500	S.Y.	$5.00	$27,500	Brooklyn Bid Tabulation
Excavate/Transport & Place Waste Rock & Tailings	16540	C.Y.	$6	$99,240	Brooklyn Bid Tabulation

TABLE D-4 Continued

Excavate/Transport & Place Soils Underlying WR	6070	C.Y.	$6	$36,420	Brooklyn Bid Tabulation
Lime Rock Capillary Break over Waste (4")	2030	C.Y.	$26	$52,070	Engineering Estimate
Imported Cover Soil	21056	C.Y.	$14	$294,784	Engineering Estimate
On-site Cover soil - Amended	3226	C.Y.	$2	$6,452	Engineering Estimate
Place 2' Repository Cover Soil (On-site soils)	3650	C.Y.	$2	$7,300	Engineering Estimate
Cover Soil Application/Grading	27932	C.Y.	$1	$27,932	Engineering Estimate
Lime Application	250	Tons	$200	$50,000	Brooklyn Bid Tabulation
Organic Amendment	2.8	Acres	$9,000	$25,200	Vosburg Bid Tabulation
Waste Rock Grading	6.3	Acres	$10,000	$63,000	Maxville Bid Tabulation
Fertilize and Drill Seed	13.6	Acres	$2,000	$27,278	Maxville Bid Tabulation
Fertilize and HydroSeed (Obliterated Roadways)	2.3	Acres	$2,200	$5,060	Maxville Bid Tabulation
Straw Mulch	13.6	Acres	$2,000	$27,278	Maxville Bid Tabulation
HydroMulch (Obliterated Roadways)	2.3	Acres	$4,300	$9,890	Maxville Bid Tabulation
Rip Rap Screening and Placement	1230	C.Y.	$20	$24,600	Engineering Estimate
Runon Control Ditch Construction	5650	L.F.	$5	$28,250	Maxville Bid Tabulation
Install Fences	8000	L.F.	$5	$40,000	Maxville Bid Tabulation
Obliterate and Reclaim Temporary Roads - WR	7600	L.F.	$2	$15,200	Maxville Bid Tabulation
Stream Reconstruction	1100	L.F.	$35	$38,500	Brooklyn Bid Tabulation
Subtotal				$1,589,551	
Construction Oversight (4%)				$63,582	
Subtotal Capital Costs				$1,653,133	
Remote/Rough Terrain Contingency (10%)				$165,313	
TOTAL CAPITAL COSTS				$1,818,000	

TABLE D-4 Continued

POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	2	/Year	$500	$1,000	Estimate
Sampling and Analysis	6	/Year	$600	$3,600	Estimate
Maintenance	1	L.S.	$1,500	$1,500	Estimate
Subtotal				$6,100	
Contingency (10%)				$610	
ANNUAL 30 YEAR O&M COST				$6,710	

TOTAL CAPITAL COSTS	$1,818,000
PRESENT WORTH, POST-CLOSURE MAINTENANCE AND MONITORING (10%)	$63,208
TOTAL PRESENT WORTH COST	**$1,881,000**

park5a.wk4

TABLE D-5

PARK MINE SITE
PRELIMINARY COST ESTIMATE - ALTERNATIVE 5b
PARTIAL REMOVAL/DISPOSAL ON-SITE IN A CONSTRUCTED MODIFIED RCRA SUBTITLE C REPOSITORY AND PARTIAL IN-PLACE CONTAINMENT

	Quantity	Units	Unit Price	Cost	Unit Cost Reference
CAPITAL COSTS					
Mobilization, Bonding, & Insurance	1	L.S.	$140,000	$140,000	Engineering Estimate
Road Improvement/Road Construction	5.5	MI.	$10,500	$57,750	Engineering Estimate
Adit Discharge Diversion	3	EA.	$2,000	$6,000	Engineering Estimate
Stream Diversion	3	EA.	$5,000	$15,000	Piegan Gloster Bid Tab
Silt Fence along Indian Creek	1750	LF.	$3.25	$5,688	Maxville Bid Tabulation
Site Clearing/Preparation	1	L.S.	$6,000	$6,000	Engineering Estimate
Adit Closure	9	EA.	$2,500	$22,500	Engineering Estimate
Shaft Closure	1	EA.	$5,000	$5,000	Engineering Estimate
Structures and Debris Disposal	1	L.S.	$15,000	$15,000	Engineering Estimate
Repository Excavation	15000	C.Y.	$2	$30,000	Brooklyn Bid Tabulation
Grade and Compact Subgrade	5500	S.Y.	$1	$2,750	Brooklyn Bid Tabulation
GCL Bottom Liner	5500	S.Y.	$5	$27,500	Brooklyn Bid Tabulation
Geocomposite (Drainage Layer)	5500	S.Y.	$5.00	$27,500	Brooklyn Bid Tabulation
Leachate Collection/Removal System	1	L.S.	$10,000	$10,000	Engineering Estimate
Excavate/Transport Waste Rock & Tailings	22610	C.Y.	$6	$135,660	Brooklyn Bid Tabulation
Install GCL Cap Liner	5500	S.Y.	$5	$27,500	Brooklyn Bid Tabulation
Geocomposite (Drainage Layer)	5500	S.Y.	$5.00	$27,500	Brooklyn Bid Tabulation
Excavate/Transport & Place Waste Rock & Tailings	16540	C.Y.	$6	$99,240	Brooklyn Bid Tabulation
Excavate/Transport & Place Soils Underlying WR	6070	C.Y.	$6	$36,420	Brooklyn Bid Tabulation
Lime Rock Capillary Break over Waste (4")	2030	C.Y.	$26	$52,070	Engineering Estimate

TABLE D-5 Continued

Imported Cover Soil	21056	C.Y.	$14	$294,784	Engineering Estimate
On-site Cover soil - Amended	3226	C.Y.	$2	$6,452	Engineering Estimate
Place 2' Repository Cover Soil (On-site soils)	3650	C.Y.	$2	$7,300	Engineering Estimate
Cover Soil Application/Grading	27932	C.Y.	$1	$27,932	Engineering Estimate
Lime Application	250	Tons	$200	$50,000	Brooklyn Bid Tabulation
Organic Amendment	2.8	Acres	$9,000	$25,200	Vosburg Bid Tabulation
Waste Rock Grading	6.3	Acres	$10,000	$63,000	Maxville Bid Tabulation
Fertilize and Drill Seed	13.6	Acres	$2,000	$27,278	Maxville Bid Tabulation
Fertilize and HydroSeed (Obliterated Roadways)	2.3	Acres	$2,200	$5,060	Maxville Bid Tabulation
Straw Mulch	13.6	Acres	$2,000	$27,278	Maxville Bid Tabulation
HydroMulch (Obliterated Roadways)	2.3	Acres	$4,300	$9,890	Maxville Bid Tabulation
Rip Rap Screening and Placement	1230	C.Y.	$20	$24,600	Engineering Estimate
Runon Control Ditch Construction	5650	L.F.	$5	$28,250	Maxville Bid Tabulation
Install Fences	8000	L.F.	$5	$40,000	Maxville Bid Tabulation
Obliterate and Reclaim Temporary Roads - WR	7600	L.F.	$2	$15,200	Maxville Bid Tabulation
Stream Reconstruction	1100	L.F.	$35	$38,500	Brooklyn Bid Tabulation
Subtotal				$1,439,801	
Construction Oversight (4%)				$57,592	
Subtotal Capital Costs				$1,497,393	
Remote/Rough Terrain Contingency (10%)				$149,739	
TOTAL CAPITAL COSTS				**$1,647,000**	

TABLE D-5 Continued

POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	2	/Year	$500	$1,000	Estimate
Sampling and Analysis	6	/Year	$600	$3,600	Estimate
Maintenance	1	L.S.	$1,500	$1,500	Estimate
Subtotal				$6,100	
Contingency (10%)				$610	
ANNUAL 30 YEAR O&M COST				**$6,710**	

TOTAL CAPITAL COSTS	$1,647,000
PRESENT WORTH, POST-CLOSURE MAINTENANCE AND MONITORING (10%)	$63,208
TOTAL PRESENT WORTH COST	**$1,710,000**

TABLE D-6

PARK MINE SITE
PRELIMINARY COST ESTIMATE - ALTERNATIVE 5c
PARTIAL REMOVAL (Excl. SST) / IN-PLACE CONTAINMENT IN CONSTRUCTED REPOSITORY
UNLINED REPOSITORY @ WR4 AREA WITH COMPOSITE CAP

	Quantity	Units	Unit Price	Cost	Unit Cost Reference
CAPITAL COSTS					
Mobilization, Bonding, & Insurance	1	L.S.	$130,000	$130,000	Engineering Estimate
Road Improvement/Road Construction	5.5	MI.	$10,500	$57,750	Engineering Estimate
Adit Discharge Diversion	3	EA.	$2,000	$6,000	Engineering Estimate
Stream Diversion	3	EA.	$5,000	$15,000	Piegan Gloster Bid Tab
Silt Fence along Indian Creek	1750	LF.	$3.25	$5,688	Maxville Bid Tabulation
Site Clearing/Preparation	1	L.S.	$6,000	$6,000	Engineering Estimate
Adit Closure	9	EA.	$2,500	$22,500	Engineering Estimate
Shaft Closure	1	EA.	$5,000	$5,000	Engineering Estimate
Structures and Debris Disposal	1	L.S.	$15,000	$15,000	Engineering Estimate
Waste Rock Grading - Consolidation Area	2	Acres	$10,000	$20,000	Maxville Bid Tabulation
Excavate/Transport Waste Rock & Tailings	22610	C.Y.	$6	$135,660	Brooklyn Bid Tabulation
Install Geomembrane Cap Liner	9680	S.Y.	$6.50	$62,920	Brooklyn Bid Tabulation
Geocomposite (Drainage Layer)	9680	S.Y.	$5	$48,400	Brooklyn Bid Tabulation
Excavate/Transport & Place Waste Rock & Tailings	16540	C.Y.	$6	$99,240	Brooklyn Bid Tabulation
Excavate/Transport & Place Soils Underlying WR	6070	C.Y.	$6	$36,420	Brooklyn Bid Tabulation
Imported Cover Soil	21056	C.Y.	$14	$294,784	Engineering Estimate
On-site Cover soil - Amended	3226	C.Y.	$2	$6,452	Engineering Estimate
Place 2' Repository Cover Soil (On-site soils)	0	C.Y.	$2	$0	Engineering Estimate
Cover Soil Application/Grading	0	C.Y.	$1	$0	Engineering Estimate
Lime Application	250	Tons	$200	$50,000	Brooklyn Bid Tabulation
Organic Amendment	2.8	Acres	$9,000	$25,200	Vosburg Bid Tabulation

TABLE D-6 Continued

Cover Soil Application/Grading	24282	C.Y.	$1	$24,282	Engineering Estimate
Lime Application	250	Tons	$200	$50,000	Brooklyn Bid Tabulation
Organic Amendment	2.8	Acres	$9,000	$25,200	Vosburg Bid Tabulation
Waste Rock Grading	6.3	Acres	$10,000	$63,000	Maxville Bid Tabulation
Fertilize and Drill Seed	12.5	Acres	$2,000	$25,000	Maxville Bid Tabulation
Fertilize and HydroSeed (Obliterated Roadways)	2.3	Acres	$2,200	$5,060	Maxville Bid Tabulation
Straw Mulch	12.5	Acres	$2,000	$25,000	Maxville Bid Tabulation
HydroMulch (Obliterated Roadways)	2.3	Acres	$4,300	$9,890	Maxville Bid Tabulation
Rip Rap Screening and Placement	1100	C.Y.	$20	$22,000	Engineering Estimate
Runon Control Ditch Construction	5150	L.F.	$5	$25,750	Maxville Bid Tabulation
Install Fences	7190	L.F.	$5	$35,950	Maxville Bid Tabulation
Obliterate and Reclaim Temporary Roads - WR	7600	L.F.	$2	$15,200	Maxville Bid Tabulation
Stream Reconstruction	1100	L.F.	$35	$38,500	Brooklyn Bid Tabulation
Subtotal				$1,406,846	
Construction Oversight (4%)				$56,274	
Subtotal Capital Costs				$1,463,119	
Remote/Rough Terrain Contingency (10%)				$146,312	
TOTAL CAPITAL COSTS				$1,609,000	

TABLE D-6 Continued

POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	2	/Year	$500	$1,000	Estimate
Sampling and Analysis	6	/Year	$600	$3,600	Estimate
Maintenance	1	L.S.	$1,500	$1,500	Estimate
Subtotal				$6,100	
Contingency (10%)				$610	
ANNUAL 30 YEAR O&M COST				$6,710	

TOTAL CAPITAL COSTS	$1,609,000
PRESENT WORTH, POST-CLOSURE MAINTENANCE AND MONITORING (10%)	$63,208
TOTAL PRESENT WORTH COST	**$1,672,000**

TABLE D-7

PARK MINE SITE
PRELIMINARY COST ESTIMATE - ALTERNATIVE 6
REMOVAL/TREATMENT/DISPOSAL AT A PERMITTED OFF-SITE WASTE DISPOSAL FACILITY

	Quantity	Units	Unit Price	Cost	Unit Cost Reference
CAPITAL COSTS					
Mobilization, Bonding, & Insurance	1	L.S.	$500,000	$500,000	Engineering Estimate
Road Improvement/Road Construction	5.5	MI.	$10,500	$57,750	Engineering Estimate
Adit Discharge Diversion	3	EA.	$2,000	$6,000	Engineering Estimate
Stream Diversion	3	EA.	$5,000	$15,000	Piegan Gloster Bid Tab
Silt Fence along Indian Creek	1,750	LF.	$3.25	$5,688	Maxville Bid Tabulation
Site Clearing/Preparation	1	L.S.	$6,000	$6,000	Engineering Estimate
Adit Closure	9	EA.	$2,500	$22,500	Engineering Estimate
Shaft Closure	1	EA.	$5,000	$5,000	Engineering Estimate
Structures and Debris Disposal	1	L.S.	$15,000	$15,000	Engineering Estimate
New Access Roads to Dumps	7,600	LF.	$4	$30,400	Maxville Bid Tabulation
Waste Excavation/Loadout	16,500	C.Y.	$6	$99,000	Brooklyn Bid Tabulation
Treatment/Transport Disposal - Class II Landfill	24,000	TONS	$100.00	$2,400,000	Nellie Grant EEE/CA
Excavate/Transport & Place Waste Rock & Tailings	16540	C.Y.	$6	$99,240	Brooklyn Bid Tabulation
Excavate/Transport & Place Soils Underlying WR	6070	C.Y.	$6	$36,420	Brooklyn Bid Tabulation
Imported Cover Soil	21,056	C.Y.	$14	$294,784	Engineering Estimate
Cover Soil Grading	21,056	C.Y.	$1	$21,056	Vosburg Bid Tabulation
Lime Application	250	Tons	$200	$50,000	Brooklyn Bid Tabulation
Organic Amendment	2.8	Acres	$9,000	$25,200	Vosburg Bid Tabulation
Waste Rock Grading	6.3	Acres	$10,000	$63,000	Maxville Bid Tabulation
Fertilize and Drill Seed	12.5	Acres	$2,000	$25,000	Maxville Bid Tabulation
Fertilize and HydroSeed (Obliterated Roadways)	2.3	Acres	$2,200	$5,060	Maxville Bid Tabulation

TABLE D-7 Continued

Straw Mulch	12.5	Acres	$2,000	$25,000	Maxville Bid Tabulation
HydroMulch (Obliterated Roadways)	2.3	Acres	$4,300	$9,890	Maxville Bid Tabulation
Rip Rap Screening and Placement	1,100	C.Y.	$20	$22,000	Engineering Estimate
Runon Control Ditch Construction	5,150	L.F.	$5	$25,750	Maxville Bid Tabulation
Install Fences	7,190	L.F.	$5	$35,950	Maxville Bid Tabulation
Ocliterate and Reclaim Temporary Roads	7,600	L.F.	$2	$15,200	Maxville Bid Tabulation
Stream Reconstruction	1,100	L.F.	$35	$38,500	Brooklyn Bid Tabulation
Subtotal				$3,954,388	
Construction Oversight (4%)				$158,176	
Subtotal Capital Costs				$4,112,563	
Remote/Rough Terrain Contingency (10%)				$411,256	
TOTAL CAPITAL COSTS				**$4,524,000**	

POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	2	/Year	$500	$1,000	Estimate
Sampling and Analysis	4	/Year	$600	$2,400	Estimate
Maintenance	1	L.S.	$500	$500	Estimate
Subtotal				$3,900	
Contingency (10%)				$390	
ANNUAL 30 YEAR O&M COST				**$4,290**	

TOTAL CAPITAL COSTS	$4,524,000
PRESENT WORTH, POST-CLOSURE MAINTENANCE AND MONITORING (10%)	$40,412
TOTAL PRESENT WORTH COST	**$4,564,000**

park6.wk4

APPENDIX E

GROUNDWATER MODELING DOCUMENTATION

Standard groundwater models could not be used for the Park site since the only groundwater data collected were from springs near the site. Data regarding direction and rate of groundwater flow, background and downgradient water quality, and contaminant flux rates are all unknown and were not collected during the RI. Since there were no data to input into these conventional models, a simple mathematical model was developed for use at this site. Two components were needed for this simple model: an estimate of leachate concentrations for precipitation water that flows through the waste sources and ultimately into groundwater; and an estimate of the rate that this water flows through the wastes (flux). Both these components were also derived for the entire groundwatershed above the Park site.

The first component, leachate concentrations were directly obtained from the TCLP analyses performed for each of the sources. The following list of analytes were run for the TCLP samples: As, Ag, Ba, Cd, Cr, Hg, Pb, and Se. This list includes the 2 contaminants of concern in groundwater, As and Pb. Background groundwater concentrations were estimated using the upgradient spring sample collected above the Park mine, and were used as the "leachate" concentrations for the groundwater basin.

The second component, water flux through the sources, was estimated using the HELP model. This model uses a variety of site meteorological data (temperature, precipitation, humidity, wind speed, and latitude) and physical data (area, slope, slope length, soil texture, and permeability) to estimate the volume of water flux through the bottom of an impoundment. The various sources were evaluated as impoundments as was the background groundwatershed. Meteorological data were gathered from the Helena weather station; physical data were collected for several sources and the repository site (background) during the RI. The results of the HELP model are as follows, with the Pb example for groundwater loading:

Source Name	HELP Model Water Flux in gallons/year	Pb in mg/L	Pb Loading to Groundwater lb/yr
WR1	107,136	0.341	0.3049
WR2	263,670	1.27	2.794
WR3	61,252	32.8	16.77
WR4	93,983	0.801	0.6282
WR5	30,652	0.0408u	0.0052
WR6	108,924	5.13	4.663
WR8	201,433	25.8	43.37
WR9	95,030	0.0408u	0.0162
WR10	35,244	24.4	7.177
TP1	1,225	2.95	0.0302

Source Name/	HELP Model Water Flux in gallons/year	Pb in mg/L	Pb Loading to Groundwater lb/yr
TP2	1,348	2.95	0.0332
TP3	5,724	15.7	0.7500
TP4	11,782	11.7	1.150
Groundwater Basin (non-sources)	40,826,962	0.00089u	0.1516
Totals	41,844,365 (sum)	0.223 (calc.)	77.84 (sum)

Combination of the flux data and the concentration data (adjusted by unit constants) yields groundwater loadings (in lb/yr) for each source at the site and the background groundwatershed. Summing the loads, dividing by the sum of the water fluxes and adjusting for units, yields an estimated downgradient groundwater concentration.

Several assumptions are implicit in the development and use of this simple model. First, the contaminant loadings flowing through the bottom of the sources are assumed to be directly added to the groundwater basin with no attenuation by precipitation, adsorption, or dispersion (three significant natural contaminant concentration reduction processes); this overestimates the downgradient concentrations. Secondly, the contaminant loads are assumed to be completely mixed with and diluted by background groundwater prior to the downgradient exposure point; this has the effect of underestimating the downgradient concentrations and probably offsets the previous overestimate.