

Montana Bureau of Mines and Geology
Open-file Report

Abandoned/Inactive Mines of Montana
U.S. Bureau of Land Management

MBMG No. 348



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by

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Appendix I Field Form

Appendix II List of Mines Inventoried

Appendix III Mine Sites Visited - No Apparent Impacts

Appendix IV Assay Data

Appendix V Water-Quality and Soil Chemistry Data

INTRODUCTION

The U.S. Bureau of Land Management's (BLM) mission is to sustain, the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations. To help accomplish its mission, the BLM needed to identify and characterize the abandoned and inactive mines with environmental, health, and/or safety problems affecting BLM lands. The Montana State Office of the BLM manages public lands in Montana, North Dakota, and South Dakota. The Montana Bureau of Mines and Geology (MBMG), a research department of Montana Tech of The University of Montana, is charged with collecting and distributing information about the geology, mineral resources, and ground water of Montana. These two agencies determined that a cooperative inventory and preliminary characterization of abandoned and inactive mines would be beneficial to the state of Montana and have entered into a series of participating agreements to accomplish this work.

1.1 PROJECT OBJECTIVES

In 1993, the BLM and MBMG entered into an agreement to identify and characterize abandoned and inactive mines on or affecting BLM-administered lands in Montana. The objectives of this discovery process, as defined by the BLM, were as follows:

1. Utilize a formal, systematic program to identify the "Universe" of sites with possible human health, environmental, and/or safety-related problems that are either on or affecting BLM lands.
2. Identify the human health and environmental risks at each site based on site characterization factors, including screening-level soil and water data that have been taken and analyzed in accordance with EPA quality control procedures.
3. Based on site characterization factors, including screening-level sample data where appropriate, identify those sites that are not affecting BLM lands and can therefore be eliminated from further consideration.
4. Cooperate with other state and federal agencies, and integrate the BLM program with their programs.
5. Develop and maintain a data file of site information that will allow the BLM to pro-actively respond to governmental and public interest group concerns.

In addition to the BLM objectives outlined above, the MBMG objectives also included gathering new information on the economic geology and hydrogeology associated with these abandoned and inactive mines. Enacted by the Legislative Assembly of the State of Montana (Section 75-607, R.C.M., 1947, Amended), the scope and duties of the MBMG include "...the collection, compilation, and publication of information on Montana's geology, mining, milling, and smelting operations, and ground water resources; investigations of Montana geology emphasizing economic mineral resources and ground-water quality and quantity."

1.2 ABANDONED AND INACTIVE MINES DEFINED

For the purposes of this study, mines, mills or other processing facilities related to mineral extraction and/or processing are defined as abandoned or inactive as follows:

A mine is considered *abandoned* if there are no identifiable owners or operators for the facilities, or if the facilities have reverted to federal ownership.

A mine is considered to be *inactive* if there is an identifiable owner or operator of the facility, but the facility is not currently operating, and there are no approved authorizations or permits to operate.

1.3 HEALTH AND ENVIRONMENTAL PROBLEMS AT MINES

Abandoned and inactive mines may host a variety of safety, health, and environmental problems. These may include metals that contaminate ground water, surface water, and soils; airborne dust from abandoned tailings impoundments; sedimentation in surface waters from eroding mine and mill waste materials; unstable waste piles with the potential for catastrophic failure; and physical hazards associated with mine openings and dilapidated structures. Although all problems were examined at least visually (See Appendix I - Field Form), the hydrologic environment appears to be affected to the greatest extent. Therefore, this investigation focused most heavily on impacts from the mines to surface water and ground water.

Metals are often transported from a mine by water (ground-water discharges or surface runoff) either by being dissolved, suspended, or carried as part of the bedload. When sulfides are present, acid can form, which increases the solubility of metals. This condition, known as *acid mine drainage* (AMD), is a significant source of metal releases at many of the mine sites in Montana.

1.3.1 Acid Mine Drainage

Trexler *et al.* (1975) identified six components that govern the formation of metal-laden acid mine waters:

- 1) availability of sulfides, especially pyrite
- 2) presence of oxygen
- 3) water in the atmosphere
- 4) availability of leachable metals
- 5) availability of water to transport the dissolved constituents
- 6) mine characteristics, which affect the other five elements

To this list, most geochemists would add the availability of minerals, such as calcite, that can neutralize the acidity. These components occur not only within the mines but can exist within mine dumps and mill tailings piles, making waste materials sources of contamination as well.

Acid mine drainage is formed by the oxidation and dissolution of sulfides, particularly pyrite (FeS_2) and pyrrhotite (Fe_{1-x}S). Other sulfides play a minor role in acid generation. Oxidation of iron sulfides forms sulfuric acid (H_2SO_4), sulfate ($\text{SO}_4^{=}$), and reduced iron (Fe^{2+}). Mining of sulfide-bearing rock exposes the sulfide minerals to atmospheric oxygen and oxygen-bearing water. Consequently, the sulfide minerals are oxidized, and acid mine waters are produced.

The rate limiting step of acid formation is the oxidation of the reduced iron. This oxidation rate can be greatly increased by iron-oxidizing bacteria (*Thiobacillus ferrooxidans*). The oxidized iron produced by biological activity is able to promote further oxidation and dissolution of pyrite, pyrrhotite, and marcasite (FeS_2 - a dimorph of pyrite).

Once formed, the acid can dissolve other sulfide minerals, such as arsenopyrite (FeAsS), chalcopyrite (CuFeS_2), galena (PbS), tetrahedrite [$(\text{CuFe})_{12}\text{Sb}_4\text{S}_{13}$], and sphalerite [$(\text{Zn,Fe})\text{S}$], to produce high concentrations of copper, lead, zinc, and other metals. Aluminum can be leached by the dissolution of aluminosilicates common in soils and waste material found in southwestern Montana. The dissolution of any given metal is depends on the solubility of that metal.

1.3.2 Solubility of Selected Metals and Trace Elements

The solubility of a metal is governed by the solubility products of the minerals in which the metal occurs and by the pH and redox potential of the water.

Other factors affecting the concentration of a metal may include biochemical processes, sorption-desorption properties, presence of colloids, and concentration of complexing ions. A brief discussion on the occurrence and solubility of selected metals is provided below.

Aluminum is one of a common element in rock-forming minerals such as feldspars, micas, and clays. Its solubility in acidic water usually can be calculated using the solubility product of alunite $[\text{KAl}_3(\text{SO}_4)_2(\text{OH})_6]$ or gibbsite $[\text{Al}(\text{OH})_3]$, depending on sulfate concentration. Water having a pH below 4.0 may contain several hundred to several thousand milligrams of aluminum per liter. At near-neutral pH, water usually contains less than 1.0 mg/L aluminum.

Arsenic is a nonmetallic element often associated with sulfide ore deposits. Common sulfide minerals containing arsenic include arsenopyrite (FeAsS), enargite (Cu_3AsS_4), and/or tennantite ($\text{Cu}_{12}\text{As}_4\text{S}_{13}$). It tends to precipitate and adsorb with iron at low pH and de-sorb or dissolve at higher pH. Thus, once oxidized, arsenic will be found in solution in higher pH waters. At pHs between 3 and 7, the dominant arsenic compound is a monovalent arsenate H_2AsO_4^- .

Cadmium is often associated with zinc and copper ore minerals. The equilibrium solubility of the carbonate species octavite (CdCO_3) was suggested by Hem (1972) as a possible limit for concentrations in natural water, but values observed are usually well below saturation. Cadmium may be coprecipitated with manganese oxide or adsorbed on mineral surfaces. In water with low partial pressures of H_2S , CdCO_3 is easily reduced to CdS .

Copper is present in many ore minerals, including chalcopyrite (CuFeS_2), bornite (Cu_5FeS_4), chalcocite (Cu_2S), and tetrahedrite ($\text{Cu}_{12}\text{Sb}_4\text{S}_{13}$). It also occurs as free native metal. Its solubility in natural waters is controlled primarily by the carbonates malachite $[\text{Cu}_2(\text{OH})_2\text{CO}_3]$ and azurite $[(\text{Cu}_3(\text{OH})_2(\text{CO}_3)_2)]$ when CO_3 is available in sufficient concentrations. Copper concentrations may be as great as a several hundred milligrams per liter in acid mine drainage.

Iron is the second most abundant metallic element in the Earth's outer crust. Minerals with high iron content include pyrite (FeS_2), pyrrhotite (Fe_{1-x}S), hematite (Fe_2O_3), magnetite (Fe_3O_4), siderite (FeCO_3), olivine $[(\text{Mg},\text{Fe}_2)\text{SiO}_4]$, biotite $[\text{K}(\text{Mg},\text{Fe})_3(\text{Al},\text{Fe})\text{Si}_3\text{O}_{10}(\text{OH},\text{F})_2]$, and the pyroxene and amphibole groups. Iron also is present in oxyhydroxide precipitates such as limonite that often form brown-orange coatings on streambeds in areas affected by AMD. The solubility of iron depends strongly on the redox potential and pH of the water. High concentrations of dissolved iron can occur when ferric oxyhydroxides are reduced or ferrous sulfides are oxidized. The solubility of iron increases as pH decreases. If present, other metals such as copper, lead, cadmium, zinc, and aluminum often co-precipitate or

adsorb onto ferric oxyhydroxide surfaces (Stumm and Morgan 1981).

Lead occurs in the common ore mineral galena (PbS) and also is present in anglesite (PbSO_4) and cerussite (PbCO_3). The principal dissolved inorganic forms of lead are the free ion Pb^{2+} , hydroxide complexes, and carbonate and sulfate ion pairs (Hem, 1985). As with other metals, concentrations in solution increase with decreasing pH. In the western United States, lead concentrations in surface water are typically less than $1\mu\text{g/L}$ except in urban and mining impacted areas.

Manganese is a common metal in the Earth's crust and often substitutes for iron, magnesium, or calcium in silicate minerals. Minerals with high manganese content include pyrolusite (MnO_2), manganite [$\text{MnO}(\text{OH})$], and rhodochrosite (MnCO_3). The chemistry of manganese is somewhat like that of iron in that both metals participate in redox processes. In natural-water systems, dissolved manganese is typically in the form Mn^{2+} . The complex ion MnHCO_3^+ can be important in solutions having bicarbonate concentrations near $1,000\text{ mg/L}$ as HCO_3 ; the $\text{MnSO}_4(\text{aq})$ ion pair may be important in solutions in which sulfate activity is greater than a few hundred milligrams per liter. When water bearing high concentrations of dissolved manganese mixes with normal stream water, much of the manganese precipitates and forms a black oxide coating on the streambed.

Mercury is found as cinnabar (HgS) in low temperature hydrothermal ores and as native mercury in areas where it was used in the processing of gold ores. It readily vaporizes under atmospheric conditions and thus is most often found in concentrations well below the $25\mu\text{g/L}$ equilibrium concentration. Mercury may form chloride or hydroxide complexes depending on pH and total chloride concentration. Organic complexes such as methyl mercury, HgCH_3^+ , can be produced by methane-generating bacteria in contact with native mercury in stream and lake sediments (Wood *et al.* 1968). In this form the element can become concentrated in successive steps up the food chain so that fish that live in mildly contaminated environments may contain too much mercury to be used safely for food.

Silver substitutes for other cations in common ore minerals such as tetrahedrite and galena and is found in the sulfide minerals argentite (Ag_2S), pyrargyrite (Ag_3SbS_2), and proustite (Ag_3AsS_3). Metallic silver and silver chloride or sulfide solids usually limit the solubility of silver to much less than $10\mu\text{g/L}$ in most natural water.

Zinc occurs in the sulfide mineral sphalerite (ZnS). It has only one significant oxidation state, Zn^{2+} , and tends to be very soluble in natural water. The solubility is controlled by the formation of zinc hydroxide and zinc carbonate. At pHs greater than 8, the equilibrium concentration of zinc in waters with a high bicarbonate content is less than $100\mu\text{g/L}$. At pH less than 5, the solubility is strongly affected

by sulfate concentrations. Thus, production of sulfate from AMD may ultimately control solubility of zinc in water affected by mining. Streams affected by AMD commonly have zinc concentrations higher than 100 $\mu\text{g/L}$.

(References: Hem 1985; Lindsay 1979; Maest and Metesh 1993; Mottana *et al.* 1978; Stumm and Morgan 1981)

1.3.3 The Use of pH and SC to Identify Problems

In similar mine evaluation studies, pH and specific conductance (SC) have been used to distinguish "problem" mine sites from those that have no adverse water-related impacts. The general assumption is that low pH (< 6.8) and high SC (variable) indicate a problem, and that neutral or higher pH and low SC indicate no problem.

Limiting data collection only to pH and SC largely ignores the various controls on solubility and can lead to erroneous conclusions. Arsenic, for example, is most mobile in waters with higher pH values (> 7), and its concentration is strongly dependent on the presence of dissolved iron. Cadmium and lead also may exceed standards in waters with pH values within acceptable limits.

Reliance on SC as an indicator of site conditions can also lead to erroneous conclusions. The SC value of a sample represents 55 to 75% of the total dissolved solids (TDS) depending on the concentration of sulfate. Without knowing the sulfate concentration, an estimate of TDS based on SC has a 25% error range. Further, without having a statistically significant amount of SC data for a study area, it is hard to define what constitutes a high or low SC.

Thus, a water-sample with a near-neutral pH and a moderate SC could be interpreted to mean that no adverse impacts have occurred when, in fact, one or more dissolved-metal species may exceed standards. With this in mind, the evaluation of a mine site for adverse impacts on water and soil must include the collection of samples for analysis of metals, trace elements, and major cations and anions.

1.4 METHODOLOGY

1.4.1 Data Sources

The MBMG began the inventory effort by completing a literature search for all known mines in Montana. The MBMG plotted the published location(s) of the

mines on BLM maps. From the maps, the MBMG developed an inventory of all known mines that are located on or could affect BLM lands in Montana. The following data sources were used:

- 1) the Mineral Industry Location System (MILS) database (U.S. Bureau of Mines)
- 2) the Mineral Resource Data Systems (MRDS) database (U.S. Geological Survey)
- 3) published compilations of mines and prospects data
- 4) state publications on mineral deposits
- 5) U.S. Geological Survey publications on the general geology of some quads
- 6) recent USGS/USBM mineral resource potential studies of proposed wilderness areas
- 7) MBMG mineral property files

During subsequent field visits, the MBMG located numerous mines and prospects for which no previous information existed. Conversely, other mines for which data existed could not be found.

1.4.2 Pre-Field Screening

Field crews visited only sites with the potential to release hazardous substances, and sites for which there was too little information to otherwise make that determination. For problems to exist, a site must have a source of hazardous substances and a mode of transport from the site. Most metal mines contain a source for hazardous substances, but the common transport mechanism, water, is not always present. Consequently, sites on dry ridgetops were assumed to be lacking this transport mechanism, while mines described in the literature as small prospects were considered to have an inconsequential hazardous materials source; neither were visited.

In addition, the MBMG and the BLM developed screening criteria (table 1.1) that they used to determine if a site had the potential to release hazardous substances or posed other environmental or safety hazards. The first page of the Field Form (appendix I) contains the screening criteria. If any of the answers to the criteria were "yes" or "unknown", the site was visited. Personal knowledge of a site and published information were used to answer the questions.

Table 1.1 Screening criteria for the abandoned/inactive mines program.

Yes No

- ☐ ☐ 1. Mill site or tailings present
- ☐ ☐ 2. Adits with discharge or evidence of a discharge
- ☐ ☐ 3. Evidence of or strong likelihood for metal leaching or AMD (water stains, stressed or lack of vegetation, waste below water table, etc.)
- ☐ ☐ 4. Mine waste in flood plain or shows signs of water erosion
- ☐ ☐ 5. Residences, high public use area, or environmentally sensitive area (as listed in HRS) within 200 feet of disturbance
- ☐ ☐ 6. Hazardous wastes/materials (chemical containers, explosives, etc.)
- ☐ ☐ 7. Open adits/shafts, highwalls, or hazardous structures/debris

If the answers to questions 1 through 6 were all "NO" (based on literature, personal knowledge, or site visit), then the site was not further investigated.

Mine sites that were not visited were retained in the database along with the data source(s) that were consulted (see appendix II). However, often these sites were viewed from a distance while visiting another site. In this way the accuracy of the consulted information often was cross-checked.

Limestone and building stone quarries, gravel pits, and phosphate mines were considered to be free of anomalous concentrations of hazardous substances and generally were not examined.

1.4.3 Field Screening

All sites that could not be screened out, as described above, were visited. All visits were conducted in accordance with a Health and Safety Plan that was developed for each Forest. An MBMG geologist usually made the initial field visit. The geologist gathered information on environmental degradation, hazardous mine openings, presence of historical structures, and land ownership. All site locations were refined using conventional field methods. Each site was located by latitude/longitude and by township-range-section-tract. Tract was assigned using a sequence of four letters (A, B, C and/or D) to denote quadrants within a section (figure 1). The first letter denotes the 160-acre tract; the second, the 40-acre tract; the third, the 10-acre tract; and the fourth, the 2.5-acre tract. The letters are assigned in a counterclockwise direction, beginning in the northeast quadrant. If two or more sites were located within the same 2.5-acre tract, numbers were

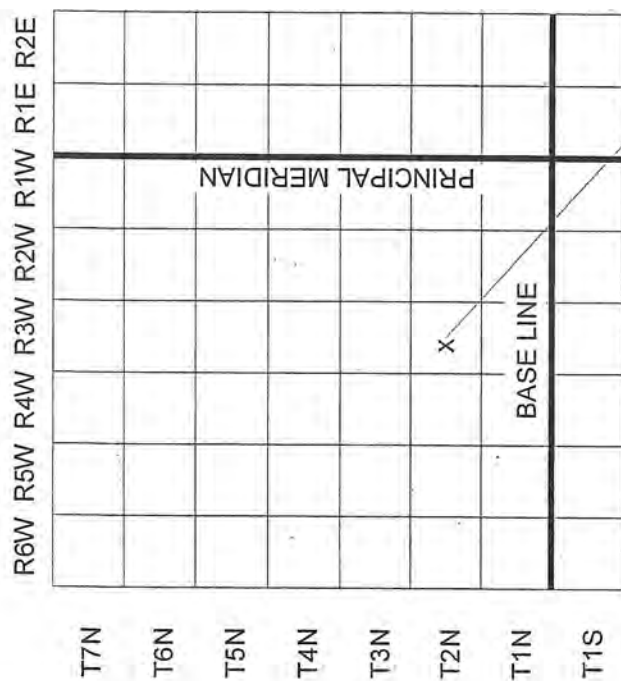


Figure 1.1 Explanation of township-range-section-tract.

T2N R3W Section 16ABDA

R3W

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

T2N

Section 16

B	A	B	A
C	D	C	D
B	A	B	A
C	D	C	D

assigned as suffixes. It is important to note that the order of quarter-tract designations is exactly reversed from that commonly used by surveyors; here the order begins with the largest quarter and progresses to the smallest.

At sites for which little geologic or mining data existed, geologists characterized the geology, collected samples for geochemical analysis, evaluated the deposit, and described workings and processing facilities present.

Sites with potential environmental problems were studied more extensively. The selection of these sites was made during the initial field visit using the previously developed screening criteria (table 1.1). In other words, if at least one of the first six screening criteria was met, the site was studied further. Sites that were not studied further are included in appendix III.

On public lands, sites with ground-water discharge, flowing surface water, or contaminated soils (as indicated by impacts on vegetation) were mapped by the geologist using a Brunton compass and tape. The maps show locations of the workings, exposed geology, dumps, tailings, surface water, and geologic sample locations.

1.4.3.1 Collection of Geologic Samples

The geologist took the following samples, as appropriate:

- 1) select samples - specimens representing a particular rock type taken for assay;
- 2) composite samples - rock and soil taken systematically from a dump or tailings pile for assay, representing the overall composition of material in the source.

The two types of samples were used, respectively, to characterize the economic geology of the deposit and to examine the value and metal content of dumps and tailings. Assay samples (appendix IV) were only taken to provide some information on the types of metals present and a rough indication of their concentrations. Outcrops and waste materials were not sampled extensively enough to provide reliable estimates of tonnages, grades, or economic feasibility.

1.4.4 Field Methods

A hydrogeologist visited each site the geologist determined had the potential

for environmental problems. A hydrogeologist also visited each site that only had evidence of seasonal water discharges, possible sedimentation, airborne dust, mine hazards, or stability problems and determined if there was a potential for significant environmental problems. The hydrogeologist then determined whether sampling was warranted and, if so, selected soil and water sampling locations.

1.4.4.1 Selection of Sample Sites

This project focused on the impact of mining on surface water, ground water, and soils. The reasoning behind this approach was that a mine site may have high total metal concentrations yet may be releasing few metals into the surface water, ground water, or soil. Conversely, another site could have lower total metal content, but could be releasing metals in concentrations that adversely impact the environment.

The hydrogeologist selected and marked water and soil sampling locations based on field parameters (SC, pH, and Eh) and observations (e.g., erosion and staining of soils/streambeds). The hydrogeologist chose sample locations that would provide the best information on the relative impact of the site to surface water and soils. If possible, surface water sample locations were chosen that were upstream, downstream, and at any discharge points associated with the site. Soil sample locations were selected in areas where waste material was obviously impacting natural material. In most cases where applicable, a composite-sample location across a soil/waste mixing area was selected. In addition, all sample sites were located so as to assess conditions on BLM lands; therefore, sample sites were located on BLM lands to the extent ownership boundaries were known.

Because monitoring wells were not installed as part of this investigation, the evaluation of impacts to ground water was limited to strategic sampling of surface water and soils. Background water-quality data are restricted to upstream surface water samples; background soil samples were not collected. Laboratory tests were used to determine the propensity of waste material to release metals and may lend additional insight to possible ground-water contamination at a site.

1.4.4.2 Marking and Labeling Sample Sites

Sample location stakes were placed as close as possible to the actual sample location and labeled with a sample identification number. The visiting hydrogeologist wrote a site sampling and analysis plan (SAP) for each mine site. Each sample location was plotted on the site map or topographic map and described in the SAP; each sample site was given a unique identifier based on its

location as follows:

D DA I L I C

- D: Drainage area - determined from topographic map
- DA: Development area (dominant mine)
- T: Sample type: I - Tailings, W - Waste Rock, D - Soil, A - Alluvium,
 L - Slag, S - Surface Water, G - Ground Water
- L: Sample location (1-9)
- I: Sample interval (default is 0)
- C: Sample concentration (High, Medium, Low) determined by the hydrogeologist based on field parameters.

1.4.4.3 Collection of Water and Soil Samples

Sampling crews collected soil and water samples, and took field measurements (e.g., streamflow) in accordance with the following:

Sampling and Analysis Plan (SAP) - These plans are site specific and they specify the type, location, and number of samples and field measurements to be taken at a site.

Quality Assurance Project Plan or QAPP (Metesh 1992) - This plan guides the overall collection, transportation, storage, and analysis of samples, and the collection of field measurements.

MBMG Standard Field Operating Procedures (SOP) - The SOP specifies how field samples and measurements will be taken.

1.4.4.4 Existing Data

Data collected in previous investigations were neither qualified nor validated under this project. The quality-assurance managers and the project hydrogeologist determined the useability of such data.

1.4.5 Analytical Methods

The MBMG Analytical Division performed the laboratory analyses and conformed, as applicable, to the following:

Contract Laboratory Statement of Work, Inorganic Analyses, Multi-media, Multi-concentration. March 1990, SOW 3/90, Document Number ILM02.0, U.S. EPA, Environmental Monitoring and Support Laboratory, Las Vegas, NV.

Method 200.8 Determination of Trace Metals in Water and Waste by Inductively Coupled Plasma and Mass Spectrometry - U.S. EPA

Method 200.7 Determination of Trace Metals in Water and Waste by Inductively Coupled Plasma and Mass Spectrometry - U.S. EPA

If a Contract Laboratory Procedure method did not exist for a given analysis, the following methods were used:

Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846, 3rd edition, U.S. EPA, Washington D.C.

EPA Method 1312 Acid-rain Simulation Leach Test Procedure - Physical/Chemical Methods, SW-846, 3rd edition, U.S. EPA, Washington D.C., Appendix G.

All analyses performed in the laboratory conformed to the MBMG Laboratory Analytical Protocol (LAP).

1.4.6 Standards

EPA and various state agencies have developed human health and environmental standards for various metals. To put the metal concentrations measured in this inventory into some perspective, they were compared to those developed standards. However, it is understood that metal concentrations in mineralized areas may naturally exceed the standards.

1.4.6.1 Water-Quality Standards

The Safe Drinking Water Act (SDWA) directs EPA to develop standards for **potable** water. Some of these standards are mandatory (primary) and some are recommended (secondary). The standards established under the SDWA are often referred to as primary and secondary maximum contaminant levels (MCLs). Similarly, the Clean Water Act (CWA) directs EPA to develop water-quality standards (acute and chronic) that will protect **aquatic organisms**. These standards may vary with water hardness and are often referred to as the Aquatic Life Standards. The primary and secondary MCLs along with the acute and chronic Aquatic Life Standards for selected metals are listed in table 1.2. In some state investigations, the standards are applied to samples collected as total-recoverable metals. Because total-recoverable-metals concentrations are difficult, if not impossible, to reproduce, this investigation used dissolved metal concentrations.

1.4.6.2 Soil Standards

There are no federal standards for concentrations of metals and other constituents in soils. Acceptable limits for metals are often based on human and/or environmental risk assessments for an area. Because no assessments of this kind have been done, concentrations of metals in soils were compared to the limits postulated by the EPA and the Montana Department of Environmental Quality (formerly Montana Department of Health and Environmental Sciences (MDHES)) for sites within the Clark Fork River basin in Montana. The proposed upper range for lead in soils is 1,000 mg/Kg to 2,000 mg/Kg and 80 to 100 mg/Kg for arsenic in **residential** areas. The Clark Fork Superfund Background Levels (Harrington-MDHES 1993) are listed in table 1.3.

1.4.7 Analytical Results

The results of the sample analyses were used to estimate the nature and extent of potential impact to the environment and human health. Selected results for each site are presented in the discussion; a complete listing of water-quality, and soil chemistry results are presented in appendix V.

All of the data for this project were collated with existing data and were incorporated into a new MBMG abandoned/inactive mines database. The database will eventually include mines and prospects throughout Montana. It is designed to be the most complete compilation available for information on the location, geology, hydrogeology, production history, mine workings, references, and environmental impact of each of Montana's mining properties. The data-fields in the

Table 1.2 Water-quality standards.

	PRIMARY MCL ⁽¹⁾ (mg/L)	SECONDARY MCL ⁽²⁾ (mg/L)	AQUATIC LIFE ACUTE ^(3,4) (mg/L)	AQUATIC LIFE CHRONIC ^(3,5) (mg/L)
Aluminum		0.05-0.2	0.75	0.087
Arsenic	0.05		0.36	0.19
Barium	2			
Cadmium	0.005		0.0039/0.0086 ⁽⁶⁾	0.0011/0.0020 ⁽⁶⁾
Chromium	0.1		1.7/3.1 ^(6,7)	0.21/0.37 ^(6,7)
Copper		1	0.018/0.034 ⁽⁶⁾	0.012/0.012 ⁽⁶⁾
Iron		0.3	1	
Lead	0.05		0.082/0.2 ⁽⁶⁾	0.0032/0.0077 ⁽⁶⁾
Manganese		0.05		
Mercury	0.002		0.0024	0.000012
Nickel	0.1		1.4/2.5 ⁽⁶⁾	0.16/0.28 ⁽⁶⁾
Silver		0.1	0.0041 ⁽⁸⁾	0.000012 ⁽⁸⁾
Zinc		5	0.12/0.21 ⁽⁶⁾	0.11/0.19 ⁽⁶⁾
Chloride		250		
Flouride	4	2		
Nitrate	10 (as N)			
Sulfate	500 ⁽⁹⁾	250		
Silica		250		
pH (Standard Units)		6.5-8.5		

(1) 40 CFR 141; revised through 8/3/93

(2) 40 CFR 143; revised through 7/1/91

(3) Priority Pollutants, EPA Region VIII, August 1990

(4) Maximum concentration not to be exceeded more than once every 3 years.(5) 4-day average not to be exceeded more than once every 3 years.

(6) Hardness dependent. Values are calculated at 100 mg/L and 200 mg/L.

(7) Cr⁺³ species.

(8) Hardness dependent. Values are calculated at 100 mg/L.

(9) Proposed, secondary will be superseded.

Table 1.3 Clark Fork Superfund background levels for metals in soils (mg/Kg).

Reference	As	Cd	Cu	Pb	Zn
U.S. Mean soil	6.7	0.73	24.0	20.0	58
Helena Valley Mean soil	16.5	0.24	16.3	11.5	46.9
Missoula Lake Bed Sediments	-	0.2	25.0	34.0	105
Blackfoot River	4.0	<0.1	13.0	-	-
Phytotoxic Concentration	100	100	100	1,000	500

current database are presented in appendix VI and are compatible with the MBMG Arc/Info geographic information system (GIS).

1.5 BUREAU OF LAND MANAGEMENT IN MONTANA

About 8.1 million surface acres are administered by the Bureau of Land Management in Montana. These lands are divided into three districts: Butte, Lewistown, and Miles City. The districts are subdivided into resource areas as shown in figure 1.2. The character of BLM-administered lands in Montana is diverse, ranging from broad, arid grasslands in the east to semiarid foothills and alpine conifer forest lands in the west.

1.5.1 History of Mining

Some knowledge of the local mining history is helpful in understanding the problems created by the abandoned and inactive mines in Montana. Gold was first discovered in the southwestern part of the state in 1852. By 1860, some gold placer mines were already operating on Gold Creek (Powell County), but most gold placers were discovered about 1865. Associated lode deposits were located soon thereafter (Lyden 1987).

Placers reached their maximum production before 1872, when the richest ones began to play out. By 1870, production from gold and silver lode deposits had become important. Most lode mines had been discovered by the late 1880s, with

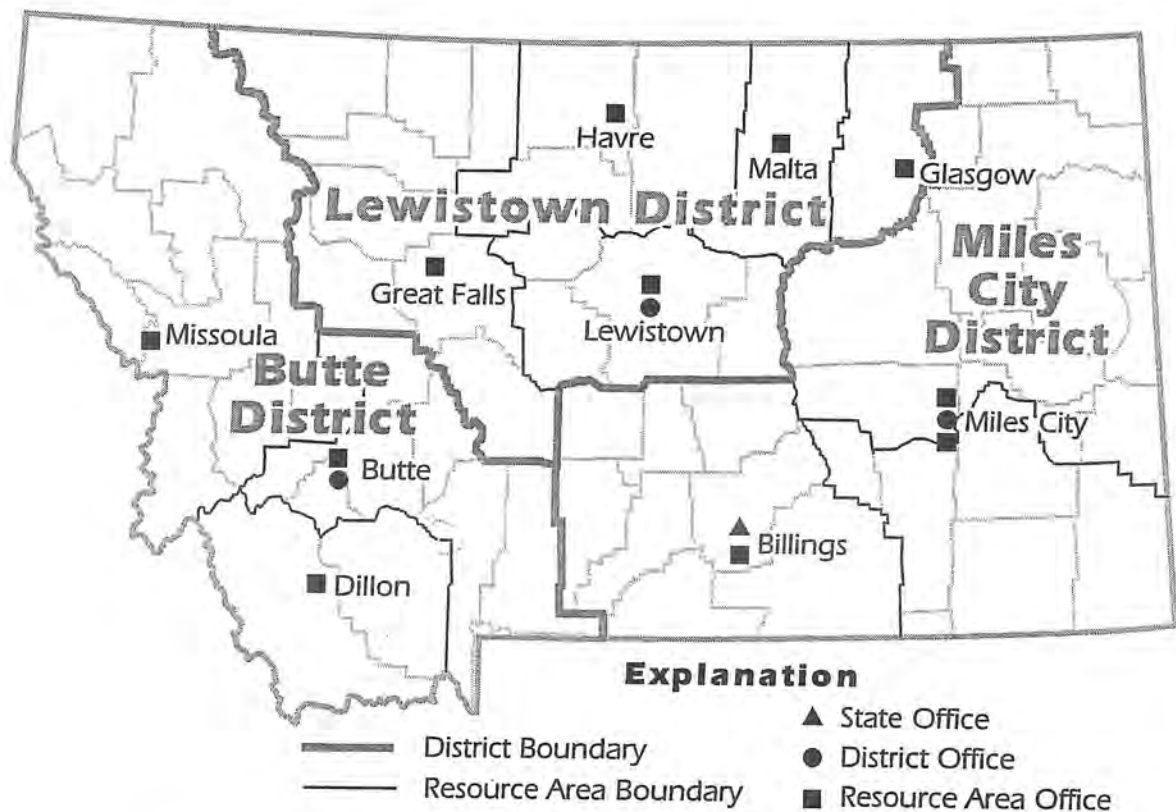


Figure 1.2 BLM office locations and administrative boundaries in Montana.

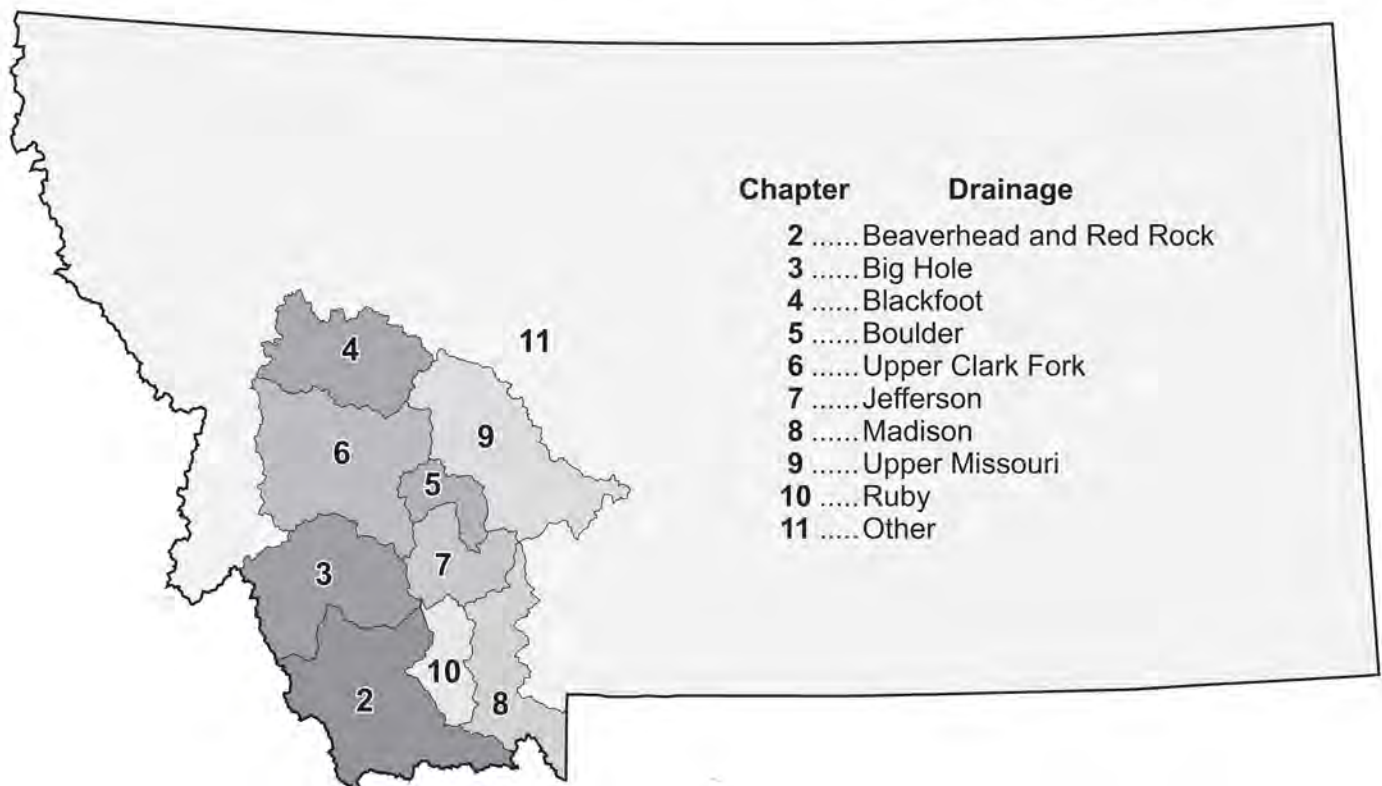


Figure 1.3. Map of the study area discussed in the BLM *Abandoned/Inactive Mines of Montana* report.

the main period of production from 1880 to 1907. Mines with silver as the major commodity were most active from 1883 until 1893, when the silver panic forced the closure of many of these polymetallic mines. Many operations never resumed. Mines yielding gold ores, especially of the "free milling" variety that contain free gold, enjoyed a greater longevity. Some of these gold producers were worked until 1942, when the federal government declared gold mining a non-essential industry and refused to allocate rationed supplies and man power to these properties. At the same time, government price supports and essential industry rulings brought many small to medium copper, lead, and zinc properties into production. Following the war, the increased supply and labor costs coupled with the withdrawal of price supports prematurely closed most of these properties. The Korean conflict brought some of them back on line as once again the government provided price supports. Additional properties were encouraged into production through government contracts as the General Services Administration went through a period of creating stockpiles of critical strategic minerals (USBM 1991).

Towns such as Philipsburg were turned into industrial centers for production of manganese until the stockpiles were completed, and once again, the buying programs and price supports were eliminated creating ghost towns, partially mined deposits, and environmental hazards. For most, it may be decades or centuries before economics will coax them back into production (USBM 1991).

These boom-to-bust cycles were continued by government influence through the 1980's when new environmental standards closed the Anaconda smelter and left many of the mines with no place to sell ore. The resulting inactive/abandoned properties continue to impact the environment.

1.5.1.1 Production

As of 1994, Montana ranked 24th in the nation for the production of metallic and industrial minerals. The rating was based upon a gross production value of \$492 billion. Principal commodities produced were gold, silver, copper, lead, palladium, platinum, zinc, molybdenum, talc, sapphires, and cement. A summary the state's production of selected mineral resources follows:

Silver: Montana has historically been the second largest producer of silver in the United States. The state ranked fourth in domestic silver production in 1994. Silver production totaled 9.60 million troy ounces through 1990. Production figures prior to 1877 may have been included with those of Idaho because much of western Montana was part of the Idaho territory.

Gold: In 1995, Montana had gold production from eight lode and several placer mines. The total recorded gold production for the state exceeded 13.6 million troy ounces by 1990. The state is ranked fourth in the nation for the production of gold.

Base Metals: Copper, lead, and zinc production continues at several locations around the state today. Copper ore as well as molybdenum is produced from the Montana Resources mine in Butte. The total recorded copper production from Butte is more than 1 million short tons.

Other Locatable Metallic Minerals: Other recorded metallic mineral production in Montana includes antimony, chromite, cobalt, iron, manganese, molybdenum, and platinum-group metals. Montana's Stillwater mine is the only platinum-group metals mine in the U.S. Significant resources of chromite occur near the Stillwater mine; these deposits were mined with the help of federal price subsidies during World War II and the Korean War.

Locatable Non-metallic and Industrial Minerals: Non-metallic and Industrial Minerals with recorded production include barite, bentonite, chlorite, gem stones (in particular, sapphires), graphite, gypsum, lime, industrial sand and gravel, peat, talc minerals, and vermiculite. Montana is a leading talc producer.

1.5.1.2 Milling

An understanding of the history of milling developments is essential for interpreting mill sites, understanding tailings characteristics, and determining the potential for the presence of hazardous substances. Mills, usually adjacent to the mine, produce two materials: 1) a product that is either the commodity or a concentrate that is shipped offsite to other facilities for further refinement, and 2) waste, which is called tailings.

In the 1800s, almost all mills treated ore by crushing and/or grinding to a fairly coarse size followed by concentration using gravity methods. Polymetallic sulfide-ores were concentrated and shipped to be smelted (usually to sites off BLM-administered land). Gold was often removed from free-milling ores at the mill by mercury-amalgamation. Cyanidation techniques began to be used in the United States about 1891, and because it resulted in greater recovery rates, it revolutionized gold extraction in many districts. Like amalgamation, cyanidation also worked only on free milling ores, but it required a finer particle size. About 1910, froth flotation became available to concentrate sulfide ores. This process required

that the ore be ground and mixed with reagents to liberate the ore-bearing minerals from the barren rock.

Overall, then, there were two fundamental processes used for ore concentration: gravity and flotation; and there were three main processes used for commodity extraction: amalgamation, cyanidation, and smelting. Each combination of methods produced tailings of different size and composition, each used different chemicals in the process, and each was associated with a different geologic environment.

1.6 SUMMARY OF THE BUREAU OF LAND MANAGEMENT INVESTIGATION

A literature search identified 1,078 sites on or near BLM-administered lands in Montana. Most became inoperative long before environmental regulations were put into effect, so tailings piles, waste-rock dumps, and mine discharges persist to potentially affect the environment today. Table 1.4 summarizes the results of the BLM inventory.

Table 1.4 Summary of Bureau of Land Management investigation.

Total Number of Abandoned/Inactive Mine Sites that were	
<u>PART A and B - Field Form</u>	
Located on or near BLM-administered land according to Literature Search	1,078
Screened out by description in literature	- 253
Not found (location inaccurate)	-101
Visited by geologist	724
Screened out by geologist	- 654
Visited by hydrogeologist	70
Screened out by hydrogeologist	- 5
<u>PART C - Field Form</u>	
Sampled (water and/or soil)	65

A separate discussion of each of the 65 sites is included in this report. All 1,078 sites that were inventoried are listed in appendix II.

1.7 MINING DISTRICTS AND DRAINAGE BASINS

For this study, mines have been grouped on the basis of drainage basins, rather than traditional mining districts. Many mining districts are not well-defined, have no legal basis, and/or they straddle one or more drainage divides. The drainage basin approach provides a convenient way to separate the BLM lands into manageable areas for discussion of both geology and hydrology; and perhaps more important, it is an aid to the assessment of cumulative environmental impacts on each drainage. The drainage basins discussed are:

Chapter 2	Beaverhead and Red Rock Rivers
Chapter 3	Big Hole River
Chapter 4	Blackfoot River
Chapter 5	Boulder River
Chapter 6	Upper Clark Fork River
Chapter 7	Jefferson River
Chapter 8	Madison River
Chapter 9	Upper Missouri
Chapter 10	Ruby River
Chapter 11	Other Areas in Montana

Figure 1.3 shows the locations of these areas.

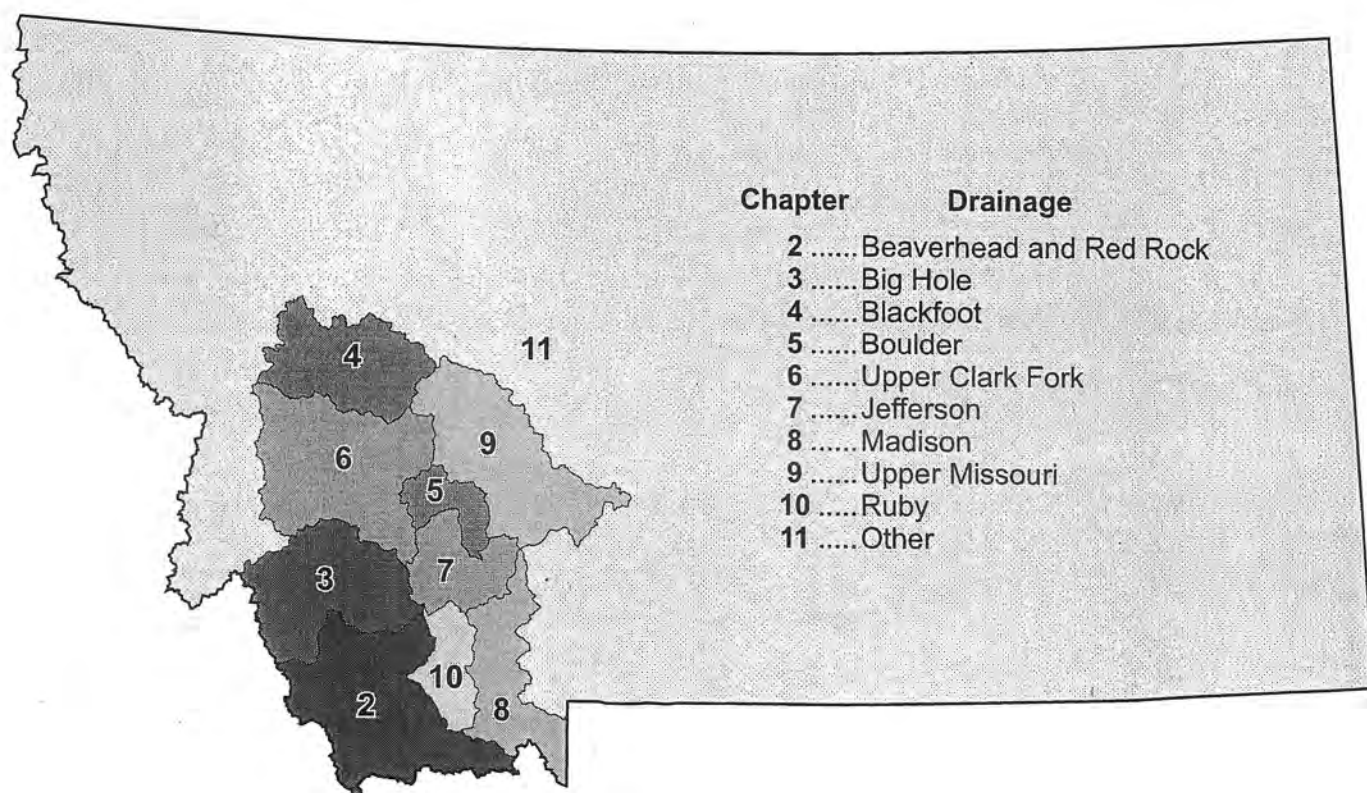


Figure 1.3. Map of the study area discussed in the BLM *Abandoned/Inactive Mines of Montana* report.

BEAVERHEAD AND RED ROCK RIVER DRAINAGES

2.1 GEOLOGY

2.1.1 Beaverhead River Drainage

A regional perspective of this area as mapped by Ruppel *et al.* (1993) spans from Precambrian Missoula Group sediments near the Big Hole Pass area in the west, to a complexly folded and faulted area near the Bannack-Bald Mountain area to the Beaverhead River valley filled with Tertiary Bozeman Group sediment and Tertiary volcanic rocks. A northeast-trending range front fault bounds the western edge of the Ruby Range on the east side of the Beaverhead valley. The west side of the Ruby Mountains is characterized by northwest-trending faults cutting Archean quartzofeldspathic gneisses, schists, marbles, and Middle Proterozoic diabbases. The Ruby Mountains and the Blacktail Range are host to metamorphic-type deposits including minerals: talc, graphite, sillimanite, corundum, iron, manganese, and pegmatites (Geach 1972). The main metal-producing districts (Argenta, Baldy Mountain, Bannack, etc.) lie in an area that has been overthrust and has high-angle normal faults (Lowell 1965).

There are numerous references for the Beaverhead River drainage, which falls entirely in Beaverhead and Madison counties. Winchell (1914) gave brief descriptions of the mining districts of the Dillon quadrangle. Shenon (1931) described specifically the Bannack and Argenta districts. Sassman (1941) wrote a historical perspective of the metal mining in Beaverhead County. Lyden (1948) included this area in his report on placer mining. Geach (1972) described many of the mines and mineral prospects of Beaverhead County. Loen and Pearson (1989) give concise mine summaries for the Dillon 1° x 2° quadrangle. There have been numerous theses and dissertations on the various mining districts including Schutz (1986) who wrote a comprehensive study of the mineralization of the Baldy Mountain district, and Meyer (1980) who wrote the only study on the small Grasshopper prospect. The geology of the Dillon 1° x 2° sheet has recently been mapped by Ruppel *et al.* (1993) at a scale of 1:250,000.

2.1.2 Red Rock River Drainage

This area includes the districts around Clark Canyon Reservoir, Lima Reservoir, east to the Red Rocks Lakes area, and southward to the Idaho border (and Continental Divide). The Red Rock River drainage falls on three 1° x 2°

quadrangles: Dillon, Ashton, and Dubois. Important geological features in this area include the Horse Prairie/Medicine Lodge Creek valley, the Tendoy Mountains, and the Centennial valley. In the mountains, Paleozoic and Mesozoic sedimentary rocks are exposed. In the valleys, there are broad areas of Tertiary sediment and Quaternary alluvium cover, especially in the Red Rocks Lake area. The Horse Prairie area has Belt Missoula Group and a small area of metamorphic rocks associated with it.

2.2 ECONOMIC GEOLOGY

2.2.1 Beaverhead River Drainage

The Beaverhead River drains an area of BLM land that includes the Argenta, Badger Pass, Baldy Mountain, Bannack, and Blue Wing metal-producing districts and additionally, nebulous "areas" such as the Blacktail Mountains area, the Big Hole-Divide area, and the west flank of the Ruby Mountains area (Loen and Pearson 1989). Although some of the sites found on the Dillon and Dubois 1° x 2° sheets drain into the Red Rock drainage, they are included here because of their geographic proximity.

Ore deposits in the metal-producing districts are generally hosted in Paleozoic and lower Mesozoic rocks that have been intruded by small granodiorite to monzogranite stocks. Most are replacements and veins in carbonate rocks (Loen and Pearson 1989). At Bannack and Blue Wing, most substantial deposits are in the Madison limestone, where it is in contact with an intrusive body (Sahinen 1934). In the Bald Mountain district, mineralization is also hosted by Paleozoic limestones but this time associated with the Mount Torrey (Pioneer) batholith.

In all these districts, gold and silver have been the principal commodities, with lesser amounts of lead, copper, and zinc. The Argenta district has been a primarily lead-silver district, with lesser amounts of gold, copper, and zinc.

Phosphate and other industrial minerals occur locally throughout the area. The Permian Phosphoria Formation hosts phosphatic shale that was explored in the late 1950s and 1960s by the U.S. Bureau of Mines, among others. Isolated occurrences of volcanic ash and zeolites have been explored for and mined to a limited extent. Tungsten is found in skarns in the Baldy Mountain district (most notably at the Little Hawk mine).

The west side of the Ruby Mountains hosts numerous talc occurrences in Archean gneiss and marble. There also are magnetite occurrences in the banded iron formations (Loen and Pearson 1989) also. The Blacktail Mountains area has

very minor amounts of mineralization, primarily industrial minerals and an isolated copper occurrence.

Placers occur in most of the secondary drainages associated with mining districts in the Beaverhead River drainage. Gold was discovered in Grasshopper Creek at Bannack in 1862 (Sahinen 1934) before discoveries of most of the other major placer deposits of Montana. Dyer Creek, Cold Spring Creek (an extremely small deposit), Jeff Davis Gulch, and Rattlesnake Creek and its tributaries—French and Watson creeks, and Frying Pan basin—all contained placers.

2.2.2 Red Rock River Drainage

The Red Rock River drains an area containing widely scattered small mining districts. The river drains the Beaverhead Mountains south of the Big Hole Pass and includes the Chinatown, Lemhi Pass, Trail Creek, and Monument districts (Geach 1972). A granite gneiss hosts the deposits of the Chinatown district. The Lemhi Pass district is noted for its rare-earth and thorium occurrences.

2.3 HYDROLOGY AND HYDROGEOLOGY

The Beaverhead and Red Rock River drainage area originates at the Montana-Idaho border (the Continental Divide) and extends downstream to the confluence of the Beaverhead River with the Ruby and Big Hole rivers, which form the Jefferson River. Larger tributaries of the drainage include Odell Creek, Red Rock River, Bloody Dick-Horse Prairie Creek, Grasshopper Creek, Rattlesnake Creek, and Blacktail Deer Creek. USGS streamflow data are limited to the main drainages and are presented in Table 2.1.

Table 2.1 Stream-gaging data for the Beaverhead River drainage.

Gage Location	Period of Record	Drainage Area (mi ²)	Mean Flow (cfs)
Odell Cr. near Lakeview	1993-1994	17.7	78
Red Rock R. near Monida	1911-1994	570	143
Beaverhead R. at Barretts	1908-1994	2,737	441
Beaverhead R. near Twin Bridges	1935-1994	3,619	405

Source: Shields *et al.* 1995

The drainage is bounded on the northeast by the Snowcrest Range (9,900 ft above mean sea level (amsl)), on the south by the Beaverhead Mountains (11,400 ft amsl) and the Centennial Range (10,000 feet amsl), on the west by the Pioneer Mountains (11,150 ft amsl), and on the north by the Ruby Range (9,200 ft amsl).

The higher elevations of the Pioneer Mountains and some areas of the Snowcrest Range have been glaciated. Several drainages in both ranges contain terminal moraines. Tertiary age lake-bed deposits are common on the valley margins of tributary drainages of the Red Rock River and the Beaverhead River. Secondary Quaternary stream terraces are found on the valley margins of the Beaverhead River and some of its tributaries (Alden 1953). Quaternary alluvium is found along nearly the entire length of the Red Rock and Beaverhead River bottoms.

Climate in the Red Rock-Beaverhead River drainage is semi-arid; precipitation ranges from 12 inches in the valleys to 20 inches in the mountain areas. The uppermost areas of the Pioneer Mountains receive up to 40 inches annually (Montagne *et al.* 1982). Average annual temperatures range from 45°F in the valleys to 25°F in the mountains (Bergantino 1978).

Ground-water development in the Beaverhead-Red Rock River basin is greatest in the unconsolidated valley fill and minimal in the bedrock aquifers. Ground-water use includes domestic and municipal water-supply. The Lima Reservoir is used for irrigation, flood control, recreation on the Red Rock River. The useable reservoir capacity is 84,050 acre-feet (acre-ft); in water-year 1994, the storage volume ranged from 80,820 to 8,560 acre-ft. The Clark Canyon Dam controls the Beaverhead River for irrigation, flood control, and recreation. The useable reservoir capacity is 255,600 acre-ft; in water-year 1994, the storage volume ranged from 179,000 to 76,000 acre-ft (Shields *et al.* 1995).

2.4 SUMMARY OF THE BEAVERHEAD AND RED ROCK RIVER DRAINAGES

For the abandoned/inactive mine inventory for the Bureau of Land Management, the MBMG investigated 214 mine and/or mill sites within the Beaverhead and Red Rock River drainages (see figure 2.1 and table 2.2). Of these sites, 175 were found to have no environmental impact on BLM-administered land, two may pose environmental problems, and 37 could not be located. The problems at the two sites with potential environmental impacts, the Cable mine and mill and the Ermont mill tailings, are due to erosion and runoff from tailings left from milling of ore. These two sites were investigated in detail and are discussed in the following sections.

If mine openings or other dangerous features (unstable structures, steep waste-rock dumps, high walls) were observed at a site, then the site was designated unsafe, or hazardous, in table 2.2. Of the 214 sites inventoried, 32 were found to have safety concerns. The only sites that were screened for safety hazards in detail were those where soil and/or water samples were collected. Hazards may exist at many of the other sites, but they may not have been noted or observed.

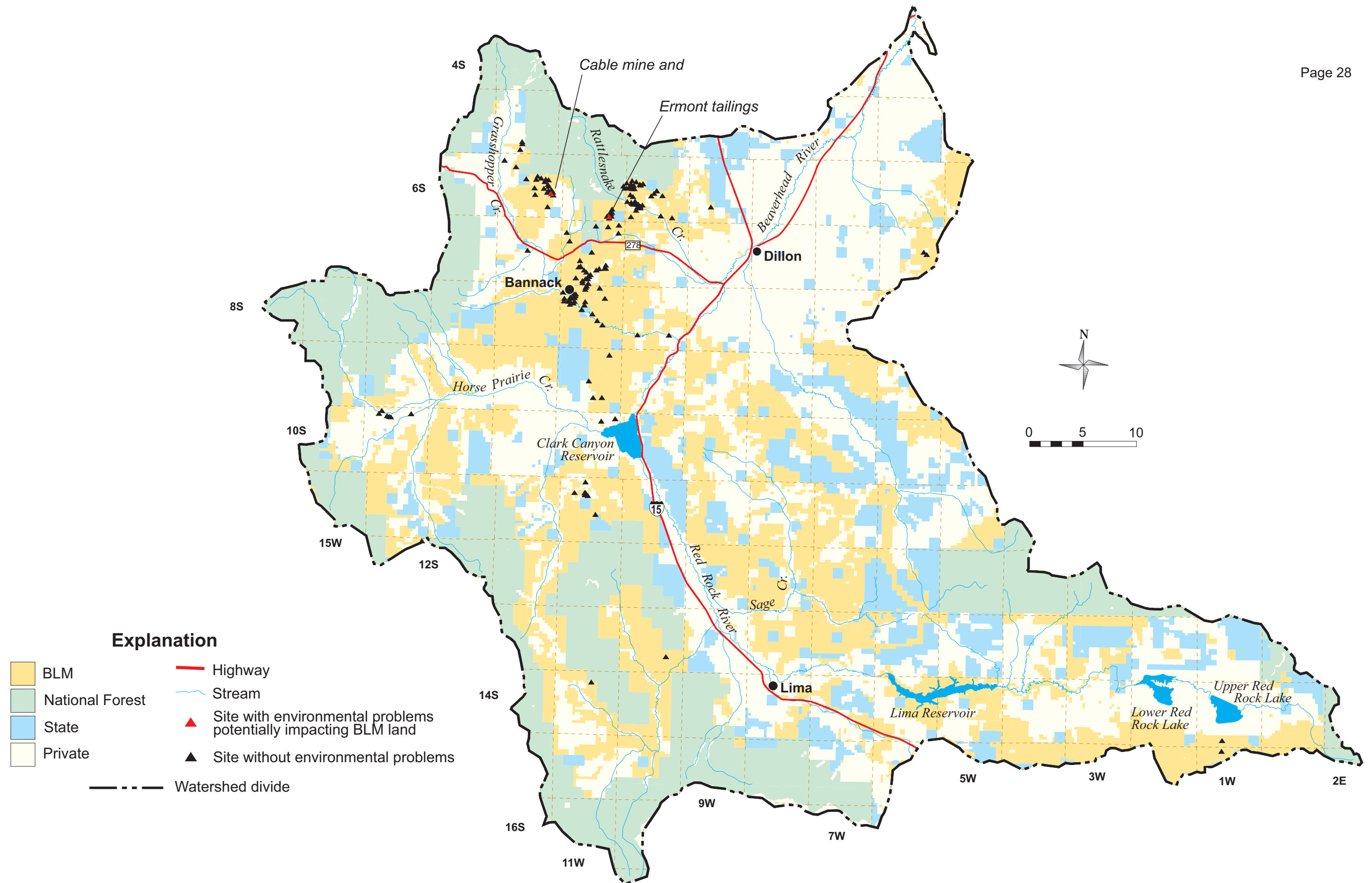


Figure 2.1. Abandoned/inactive mines inventoried in the Beaverhead and Red Rock River drainages.

Table 2.2 Summary of sites inventoried in the Beaverhead and Red Rock River drainages. Site name in **bold type** indicates potential environmental problems. "Y" in hazard column indicates a safety concern at the site.

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Agnes Lode	BLM	Y	N	Y	Open adit. Dry.
Amaranth	UNK	N	N	NE	Unable to locate.
American Chemet	MIX	Y	N	N	Dry.
Anaconda	PRV	Y	N	NE	Walked general area. Part of Ermont Group.
Anita	UNK	N	N	NE	Unable to locate.
Arctic Claim	PRV	Y	N	N	One grated shaft, one shallow inclined shaft.
Armstead Area Deposit	UNK	N	N	NE	Sillimanite deposit. Screened out in office.
Badger	BLM	Y	N	Y	Open adit. Dry.
Baltic	MIX	Y	N	N	No impact.
Bannack Mines	PRV	Y	N	N	Reclaimed and stabilized by DSL-AMRB.
Bannock Placer	MIX	Y	N	N	No hazards.
Bea Ann Claim	BLM	Y	N	Y	Open shaft/stope. Most of site has been reclaimed.
Beaverhead (Sierra Strip) Mine	BLM	N	N	NE	Active mine in 1995. Operated by Luzenac America, Inc.
Bell Ranch Clay Prospect	BLM	Y	N	N	Dry. Clay prospect.
Bella	UNK	N	N	NE	Unable to locate.
Bennett Owen Claim	BLM	Y	N	N	Talc deposit. Reclaimed.
Billings Creek Placer	PRV	N	N	NE	Screened out in office.
Black Rock	MIX	N	N	NE	Screened out in office. Surface trenches.
Blue Dot	PRV	N	N	NE	Active? Part of New Departure.

Table 2.2 Summary of sites inventoried in the Beaverhead and Red Rock River drainages (continued).

SITE¹	OWNER²	VISIT	SAMPLE³	HAZARD⁴	REMARKS
Blue Wing	MIX	Y	N	Y	Open adit. Part of Kent?
Blue Wing District Placer	PRV	Y	N	N	Creek is dry. No evidence of placer.
Boaz	BLM	Y	N	Y	Partially collapsed adit. Dry.
Bon	BLM	Y	N	N	Dry.
Bonnie Group	BLM	Y	N	N	Collapsed adits. Dry.
Brenner Placer	PRV	N	N	NE	Screened out in office.
Brown Bear and Frying Pan	BLM	Y	N	N	No impact.
Brownell	PRV	Y	N	Y	Open adit. Dry. Part of Ermont Group.
Cable Mine and Mill⁵	MIX	Y	Y	Y	Streamside tailings close to BLM lands.
Camp Frigid	BLM	N	N	NE	Screened out in office.
Capitol Claim	PRV	Y	N	N	Openings secured. Dry.
Carbonate	BLM	Y	N	Y	Open adit. Dry.
Cedar Creek Syncline	MIX	Y	N	N	Phosphate occurrence. Dry.
Cedar Creek	BLM	N	N	NE	Screened in office. Phosphate prospect.
Centennial Mountains District	BLM	N	N	NE	Screened out in office.
Charter Oak	BLM	Y	N	N	Reclaimed. Dry.
Comstock	BLM	Y	N	N	Dry.
Coolidge	PRV	N	N	NE	Dry ridge on map.
Copper Bell	PRV	Y	N	NE	Viewed site from a distance.
Cottontail Group	UNK	N	N	NE	Unable to locate.
Davis Syndicate Placer (Bon Accord)	MIX	Y	N	Y	Highwalls. Open tunnels. Dry.

Table 2.2 Summary of sites inventoried in the Beaverhead and Red Rock River drainages (continued).

SITE¹	OWNER²	VISIT	SAMPLE³	HAZARD⁴	REMARKS
Del Monte	PRV	Y	N	N	Reclaimed. Dry.
Dexter	BLM	Y	N	Y	Open adit. Dry.
Dillon	PRV	Y	N	Y	Open shaft/stope.
Divide Nos. 1 & 2 Claims	BLM	Y	N	N	Dozer trenches and waste rock. Dry.
Durham Bull	PRV	N	N	NE	Unable to locate.
Dyer Creek Placer	MIX	Y	N	N	Active/historical operation.
Elsie	PRV	Y	N	Y	Highwalls. Dry.
Ermont Group	BLM	Y	N	Y	Many mines and prospects.
Ermont No. 19	BLM	Y	N	Y	Open adit. Dry. Part of Ermont Group.
Ermont No. 2	BLM	Y	N	Y	Open adit. Dry. Part of Ermont Group.
Ermont Mill Tailings⁵	BLM	Y	Y	Y	Tailings along ephemeral drainage. Open shaft. Vertical high walls.
Excelsior	PRV	Y	N	N	Opening secured.
Faithful	PRV	Y	N	N	Tailings in dry streambed.
Farlin Creek	PRV	N	N	N	Dry.
Ferdinand	PRV	Y	N	NE	May have environmental problems, but unlikely to affect BLM lands.
Firehole	PRV	N	N	NE	Unable to locate.
Fisher	UNK	N	N	NE	Unable to locate.
Fleming's "Halloysite" Prospect	UNK	N	N	NE	Unable to locate.

Table 2.2 Summary of sites inventoried in the Beaverhead and Red Rock River drainages (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Florida Claim	PRV	Y	N	NE	Part of Tuscarora Group.
Fraction Claim	PRV	Y	N	NE	Part of Tuscarora Group.
Francis H.	PRV	Y	N	N	Dry.
French Lode	PRV	Y	N	N	Openings secured.
Frying Pan Complex Area	UNK	N	N	NE	Unable to locate.
Frying Pan Basin Placer	UNK	N	N	NE	Unable to locate.
G & G	BLM	N	N	NE	Screened out in office. Prospect pit on ridge top.
Galena	BLM	Y	N	N	Dry.
Gem Claim	BLM	Y	N	N	Talc Prospect.
Gold Day	UNK	N	N	NE	Unable to locate.
Gold Bug & Blue Grass Claims	PRV	Y	N	Y	Highwalls. Openings secured.
Golden Gate Mining Co.	BLM	Y	N	NE	Visited general area. Dry.
Golden Leaf Mine/Sleeping Princess	PRV	Y	N	N	Openings secured.
Goldsmith	PRV	Y	N	NE	Visited general area. Dry.
Goodview	BLM	Y	N	N	Dry.
Governor Tilden	PRV	Y	N	NE	Dry. Part of the Tuscarora Group.
Grasshopper Prospect	BLM	N	N	NE	Exploration only.
Grasshopper Placer No. 1 and No. 2	MIX	N	N	NE	Screened out.
Grasshopper Placer	MIX	Y	N	N	No hazards.
Grasshopper Creek Occurrence	MIX	N	N	NE	Volcanic ash. Screened out.

Table 2.2 Summary of sites inventoried in the Beaverhead and Red Rock River drainages (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Grasshopper Claim No. 1	BLM	Y	N	N	Dry. No visible impact.
Gray Goose	MIX	Y	N	N	Dozer trenches and waste rock. Dry.
Graybird	BLM	Y	N	N	Dry.
Grizzly Bear	PRV	Y	N	Y	Open adits. Dry.
Ground Hog	PRV	Y	N	NE	Active workings with 2 lined leach ponds.
Gulch Placer	MIX	Y	N	N	No hazards.
H & S	BLM	N	N	NE	Screened out in office.
Hand (Mauldin)	PRV	Y	N	Y	Open adit. Viewed from a distance. Dry. Part of Ermont Group.
Hendricks/Graeter	PRV/STA	Y	N	N	Active tourist attraction.
Henneberry Ridge Syncline	BLM	N	N	NE	Screened in office. Phosphate prospect.
Hidden Pasture Creek	BLM	Y	N	N	Dozer trenches and waste rock. Dry.
High Line	UNK	N	N	NE	Unable to locate.
Hillside Placer Mine/Thompson	PRV	Y	N	N	Openings secured. Dry.
Hope Placer	PRV	Y	N	N	Dry. No visible impact.
Horn Silver	PRV	Y	N	NE	Dry ridge. Visited general area.
Huron/Cottontail	BLM	Y	N	N	Openings secured. Dry.
Ingersol	MIX	Y	N	N	Openings secured. Dry.
Ingersol Group	UNK	N	N	NE	Unable to locate. Same as Ingersol?
Iola Prospect	UNK	N	N	NE	Unable to locate.
Iron Age Claim	PRV	N	N	NE	Located near New Departure. Iron mine.

Table 2.2 Summary of sites inventoried in the Beaverhead and Red Rock River drainages (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Iron Mask	PRV	Y	N	N	Caved shaft. Dry.
Iron Mountain	PRV	N	N	NE	Screened out in office.
Jack Rabbit	PRV	Y	N	NE	Dry. Viewed from a distance.
Jeanette Claim	BLM	Y	N	N	Caved adit and prospects. Dry.
Jeff Davis Gulch	PRV	N	N	NE	Screened out in office.
Joker	UNK	N	N	NE	Unable to locate.
Judy Quartz	BLM	N	N	NE	Prospects. Screened out in office.
Junction	PRV	Y	N	N	Visited general area. Secured with fences and grates. Dry.
Jung Frau	MIX	Y	N	Y	Hazardous mine opening.
Kent	MIX	Y	N	Y	Standing water in adit on private land.
Kissick Creek Property	UNK	N	N	NE	Unable to locate.
Laurilene No. 1 Claim	BLM	Y	N	N	Openings secured. Dry.
Leah May	UNK	N	N	NE	Unable to locate.
Leonie Tunnel Prospect	BLM	Y	N	N	Caved adit in granodiorite. Dry.
Little Hawk	MIX	Y	N	Y	Open adit. Dry.
Little Hawk Mill ⁵	BLM	Y	N	Y	Dry tailings. Mill in poor condition.
Little Water Canyon	UNK	N	N	NE	Unable to locate.
Lively	PRV	N	N	NE	Screened out in office.
Logan	UNK	N	N	NE	Unable to locate.
Lone Wolf	BLM	Y	N	N	Visited general area. Dry.

Table 2.2 Summary of sites inventoried in the Beaverhead and Red Rock River drainages (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Lookout	BLM	Y	N	NE	Visited general area. May have been reclaimed.
Lookout No. 3	PRV	N	N	NE	Dry.
Lookout No. 1 Claim	MIX	N	N	NE	Screened out in office.
Lost Cloud (District)	PRV	N	N	NE	Screened out in office. Same as Polaris.
Loumont Claims	UNK	N	N	NE	Unable to locate.
Maiden Creek Placer	STA	N	N	NE	Screened out in office.
Mayflower	MIX	Y	N	N	Dry. One patented claim.
Midnight	PRV	Y	N	NE	Dry ridge. Viewed from a distance.
Miss Grundy	PRV	N	N	NE	Screened out. Patented claim.
Missouri Prospect/Box X	BLM	Y	N	N	Openings secured. Dry.
Monida Placer	UNK	N	N	NE	Unable to locate.
Monida Claims	PRV	N	N	NE	Screened out in office.
Monument	PRV	Y	N	Y	Hazardous mine opening.
Nelson Prospect	PRV	N	N	NE	Screened out.
Nevada Group	MIX	N	N	NE	Screened out in office.
New Departure	PRV	N	N	NE	Active in 1994.
Nick Preen	BLM	Y	N	N	8 caved adits. Dry.
Old Favorite ⁵	MIX	Y	N	N	Dry tailings. Patented claims.
Osterly	BLM	Y	N	NE	Investigated general area.
Owen-McGovern Prospect (Talc)	BLM	Y	N	N	Dry.

Table 2.2 Summary of sites inventoried in the Beaverhead and Red Rock River drainages (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
P & R	UNK	N	N	NE	Unable to locate.
Paul Property	UNK	N	N	NE	Unable to locate.
Pegmatite on State Land	STA	N	N	NE	Unable to locate.
Peterson Creek	MIX	Y	N	N	Phosphate prospect. Dry.
Pioneer	PRV	Y	N	N	Openings secured. Dry.
Polar Bear	UNK	N	N	NE	Unable to locate.
Polaris	PRV	N	N	NE	Screened out.
Pomeroy	MIX	Y	N	N	Reclaimed. Dry.
Priscilla	PRV	Y	N	N	Previously studied by DSL-AMRB, Pioneer Technical Services, Northern Testing.
Randall	PRV	Y	N	N	Openings secured. Dry.
Rattlesnake Creek Placer	MIX	N	N	NE	Mostly private placering.
Rena	MIX	Y	N	N	Dry.
Royal	MIX	Y	N	N	No impact.
Ruby View	BLM	Y	N	N	Possibly talc prospect.
Ruth	BLM	Y	N	N	Visited approximate location. Small prospects.
S.S. & R.	UNK	N	N	NE	Unable to locate.
Salt Mountain	UNK	N	N	NE	Unable to locate.
Sassman's Prospect	PRV	N	N	NE	Screened out in office.
Senator-Arcata	PRV	Y	N	N	Visited area. No hazards. Dry.
Shafer-Renz	UNK	N	N	NE	Unable to locate.
Shear Zone Vein	BLM	Y	N	N	No impact.

Table 2.2 Summary of sites inventoried in the Beaverhead and Red Rock River drainages (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Siderock-Greenhorn Area	UNK	N	N	NE	Unable to locate.
Sierra Strip/Beaverhead	BLM	N	N	NE	Same as Beaverhead mine.
Silver Water	UNK	N	N	NE	Unable to locate.
Silver Star (Lone Star)	MIX	Y	N	N	Openings secured. Dry.
Silver Belle Group	PRV	Y	N	N	Openings secured. Same as Pomeroy. Patented.
Silver Queen	MIX	N	N	NE	Screened out in office.
Silver Buckle Group	PRV	Y	N	N	Openings secured. Same as Pomeroy. Patented.
Silver Fissure/Polaris	PRV	N	N	NE	Screened out in office.
Silver King	PRV	N	N	NE	Screened out.
Silver Rose	MIX	Y	N	Y	Open adit and shaft. Dry.
Sir Walter Scott	PRV	Y	N	NE	Visited general area. Dry.
Sleeping Princess Group/Golden L	PRV	Y	N	N	Openings secured.
Snow White Talc	BLM	Y	N	N	Several cat cuts.
Spring Prospect	PRV	Y	N	N	Dry. Part of Tuscarora Group.
Stapleton	UNK	N	N	NE	Unable to locate.
Starlight (1)	PRV	Y	N	N	No impact.
Starlight (2)	UNK	N	N	NE	Unable to locate in field using MILS coordinates.
Stevenson	BLM	Y	N	Y	Open adit in limestone. Dry.
Stringer	UNK	N	N	NE	Unable to locate.
Sunrise (1)	BLM	Y	N	N	Dry.

Table 2.2 Summary of sites inventoried in the Beaverhead and Red Rock River drainages (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Sunrise (2)	PRV	Y	N	N	Dry.
Sunshine	MIX	Y	N	N	No impact.
Sweeney	UNK	N	N	NE	Unable to locate.
T.D.-6	BLM	Y	N	Y	Large, trench-like cut. Manganese ore.
Talc Occurrence	BLM	Y	N	N	Dry.
Taylor	PRV	Y	N	N	One caved adit. Dry.
Thompson Mine/ Hillside Placer	PRV	Y	N	N	Openings secured.
Treasure Chest	MIX	N	N	NE	Same location as Tri-State Strip Mine. Active mine of Barretts Minerals, Inc.
Tri-State Strip	MIX	N	N	NE	Dry. At one time owned by Tri-State Minerals.
Tuscarora Group	PRV	Y	N	Y	Vertical high wall. Water flowing from stock tank into waste rock. No impact to BLM lands.
Unnamed 07S06W11DDCA Prospect	BLM	Y	N	N	Reclaimed talc prospect.
Unnamed 09S07W12CCAB Prospect	BLM	Y	N	N	Dry.
Unnamed Adit	BLM	Y	N	N	Dry.
Unnamed Aluminum	UNK	N	N	NE	Unable to locate.
Unnamed Copper Prospect	BLM	Y	N	N	Dry.
Unnamed Gold	BLM/ STA	Y	N	Y	Open adits. Dry.
Unnamed Kaolin	UNK	N	N	NE	Unable to locate.
Unnamed Nickel	BLM	N	N	NE	Screened out in office based on commodity.

Table 2.2 Summary of sites inventoried in the Beaverhead and Red Rock River drainages (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Unnamed Pb-Ag	BLM	Y	N	Y	Partially open adit. Dry.
Unnamed Pyrophyllite Occurrence	UNK	N	N	NE	Unable to locate.
Unnamed Quartz, Feldspar	UNK	N	N	NE	Screened out in office.
Unnamed Talc 07S06W02CDBD	BLM	Y	N	N	Several cuts. Dry.
Unnamed Talc 07S06W03DDDD	BLM	Y	N	N	Dry.
Vanadinite	BLM	Y	N	N	Same as Unnamed Adit?
Vanguard	PRV	N	N	NE	Screened out.
Wadams	PRV	Y	N	N	Openings secured.
Wallace Lode	PRV	Y	N	N	Openings secured.
Washington	PRV	Y	N	N	Openings secured.
West Ermont	BLM	Y	N	Y	Hazardous mine opening.
Wheal Rose	PRV	Y	N	N	Gated adit. Dry.
White Lime	BLM	Y	N	N	Dry.
Whitney Claims	BLM	Y	N	N	Talc prospect.
Wild Bat	BLM	Y	N	N	Dozer cut and two shallow shafts or prospect pits. Dry.
Wooley	PRV	Y	N	NE	Part of Tuscarora Group.
Yellow Bird	BLM	Y	N	Y	Same as West Ermont?

1) Mines in bold may pose environmental problems and are discussed in the text; others are included only in appendix II (all mines) and appendix III (sites visited).

2) Administration/Ownership Designation

BLM: Bureau of Land Management

PRV: Private

MIX: Mixed (BLM and private)

STA: State of Montana

UNK: Owner unknown

3) Solid and/or water samples (including leach samples)

4) Y: Physical safety hazards exist at the site.

NE: Physical safety hazards were not evaluated.

5) Mill site present

2.5 CABLE MINE AND MILL TAILINGS

2.5.1 Site Location and Access

The Cable mine and mill tailings (T6S R12W Sec 24 CCAB) are located along an unnamed creek fed by Old Faithful Spring. The unnamed creek is a tributary to the East Fork of Dyce Creek. Although the main workings are on private land, BLM property is located a short distance upstream and downstream of the site. The site can be accessed via the road that follows Dyce Creek.

2.5.2 Site History - Geologic Features

The main adit at the Cable mine is 170 ft long and explored an irregular fissure vein striking N25°W and dipping 30° to 54°NE in buff calcareous sandstone (Cambrian Hasmark?). A geologic plan map of the adit can be found in Geach (1972). The adit is intact but has been sealed with a culvert and locking grate. There also are three collapsed adits at the site. Minerals found on the dumps near the adits include red-brown oxides with some copper staining, and some chalcedony/jasperoid. A chip sample of copper-stained vein material (Geach 1972) assayed 0.006 opt Au, 0.35 opt Ag, and 4.93% Cu. Lead and zinc concentrations were below the detection limits.

Ore extracted at the site was apparently processed by a small mill on the hillside north of the unnamed creek. A small volume of tailings can be found near the old mill foundation. Tailings also are present within the flood plain of the unnamed creek. They may have been placed in the creek as a dam to make water available for placering. An assay sample of the tailings (PGCB-1) ran 0.083 opt Au, 0.17% Ag, 0.34% Cu, 0.01% Pb, 0.02% Zn, 2 ppm Hg, and 36 ppm Bi. There is no record of production for the mine or mill (Geach 1972).

2.5.3 Environmental Condition

Two breached tailings dams are located along a 150-ft reach of the unnamed creek southwest of the old mill foundation (see figure 2.2). The impoundments behind the dams also contain tailings. Although the tailings appear stable, they are within the flood plain of the creek and may erode during high runoff events.

Upstream and downstream of the tailings dams, there are spoil piles of cobbles and gravel left from placering the creek bed and banks. The spoils are not mineralized and do not appear to have a detrimental impact on the creek or nearby vegetation.

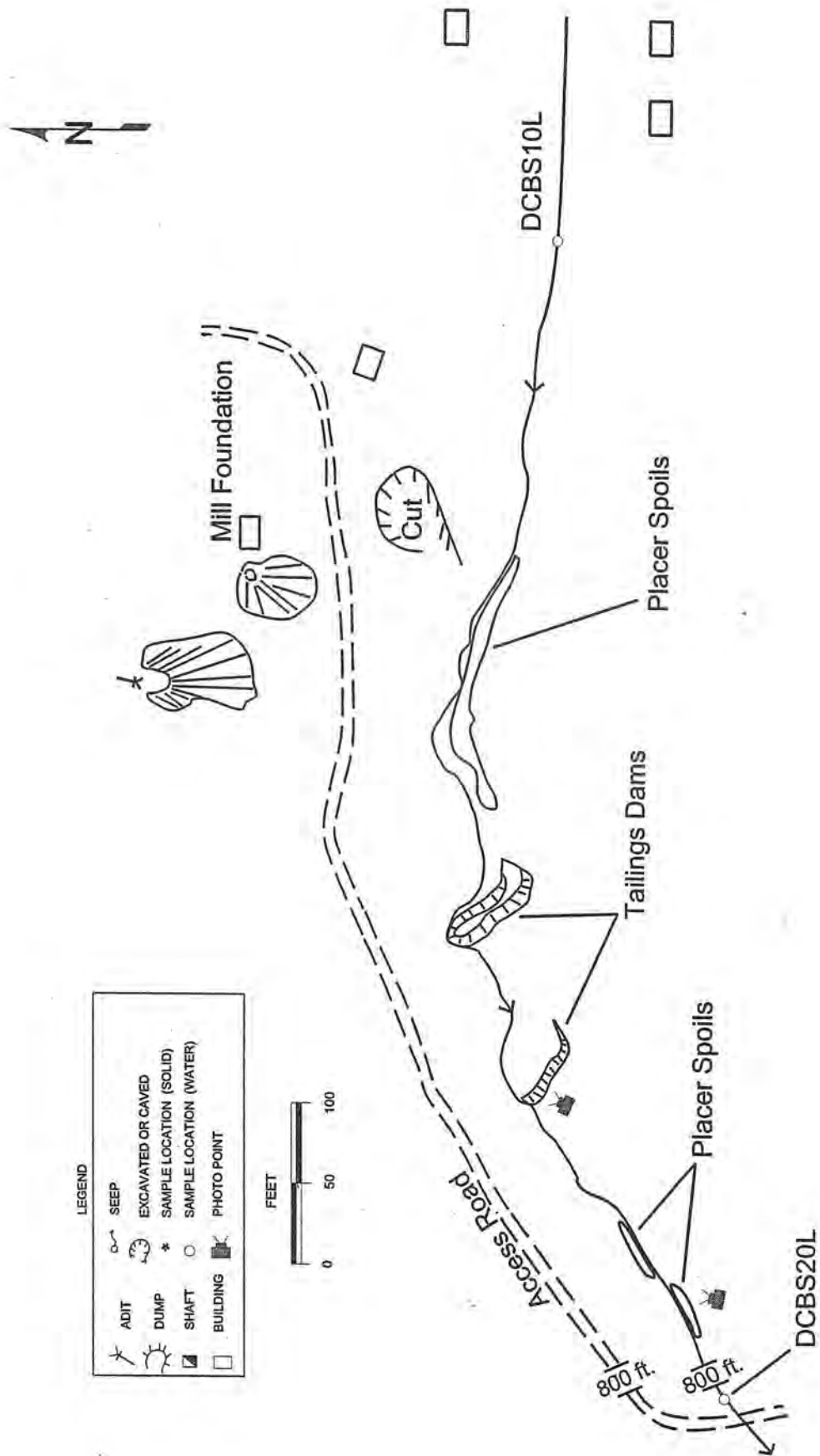


Figure 2.2 Site map of the Cable mine and mill, September 1994.



Figure 2.3 Trees and grasses have taken root in tailings along the unnamed creek.



Figure 2.4 Small piles of placer spoils are located along the banks of the unnamed creek, a short distance downstream of the site.

2.5.3.1 Site Features - Sample Locations

Water-quality samples were collected from the unnamed creek where it crosses BLM property upstream (DCBS10L) and downstream (DCBS20L) of the tailings dams. On the day the samples were collected (September 22, 1994), the flow rates at the upstream and downstream locations were 39.2 and 34.9 gpm, respectively.

2.5.3.2 Soil

No tailings or spoil piles were observed on BLM lands; therefore, no soil samples were collected at the site.

2.5.3.3 Water

The unnamed creek had no water-quality exceedances upstream or downstream of the site.

Table 2.3 Water-quality exceedances at the Cable mine and mill site.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Unnamed Creek - upstream of site (DCBS10L)																			
Unnamed Creek - downstream of site (DCBS20L)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in Appendix V.

2.5.3.4 Vegetation

The vegetation along the drainage appears healthy. The tailings dams are moderately to densely vegetated with riparian grasses, willows, and conifers.

2.5.3.5 Summary of Environmental Condition

The healthy vegetation growing on and around the tailings dams suggests that the tailings are not particularly toxic. Also, water quality downstream of the dams is good. Erosion of tailings during a major flooding event might result in a high suspended sediment load; however, this scenario seems unlikely because the tailings are stabilized with vegetation, and no rills or gullies currently exist on the surface of the tailings.

2.5.4 Structures

A small, red tar-paper shack is located north of the unnamed creek and south of the site access road. Several hundred feet east of the shack, there is a log cabin in poor condition. Across the creek from this cabin are the collapsed remnants of two more cabins. A mill foundation is located on the hillside above the tar-paper shack. All of these structures are on private property.

2.5.5 Safety

Although the main adit on the property is intact, it has been secured with a culvert and locked grate. The only other safety concern at the site is related to the structural stability of the cabins. These buildings are in poor condition and could be a safety hazard if someone were to enter them.

2.6 ERMONT GROUP MINES AND MILL

2.6.1 Site Location and Access

The Ermont Group mines and mill (T6S R11W Sec 35 DBB) are at the upper end of Ermont Gulch, approximately 15 miles west of Dillon. Access to the area is by the Ermont Road off Montana Highway 278. The mill site and most of the mines in this area are on BLM land.

2.6.2 Site History - Geologic Features

The Ermont Group includes 34 unpatented claims spread over a 1 ½ mi² area. Major mines (claims) include the Ermont 2, Ermont 19, Golden Gate, Lone Wolf, West Ermont (or Yellow Bird), Comstock, and Badger (or North Ermont). A claim map of the area and one underground mine map exist in files maintained by the MBMG.

Most mines of the Ermont Group explore the contact between an andesite sill and Devonian Jefferson-Three Forks formations (Geach 1972). The formations exposed in the area dip 23° to 30° east (Geach 1972). Ore bodies associated with the sill include gold-bearing quartz and iron oxide disseminated in dolomite and disseminations/veinlets along fracture zones in altered andesite (Geach 1972). This deposit was the largest single lode producer of gold in Beaverhead County for many years. Production was recorded in 1932-1933, 1935-1942, 1949-1950, and 1963; total production was 189,649 tons of ore yielding 4,789 pounds of copper, 6,999 ounces of silver, and 41,255 ounces of gold.

A 100-ton cyanide mill was constructed at the site to process the ore; water was piped four miles from Rattlesnake Creek to supply the operation (Sassman 1941). Only the cement foundations of the mill buildings remain. A six-acre tailings impoundment is located to the north and east of the mill (see figure 2.5), and tailings are spread along Ermont Gulch for more than a mile below the site.

2.6.3 Environmental Condition

Although the tailings impoundment is dry most of the year, gullies and rills have been cut into the face of the main tailings dam by episodic runoff events. Most of the eroded tailings have been redeposited in a flat, grassy area several hundred feet below the impoundment. Transport farther below the site currently does not occur because of exploration trenches that cut across the bottom of the

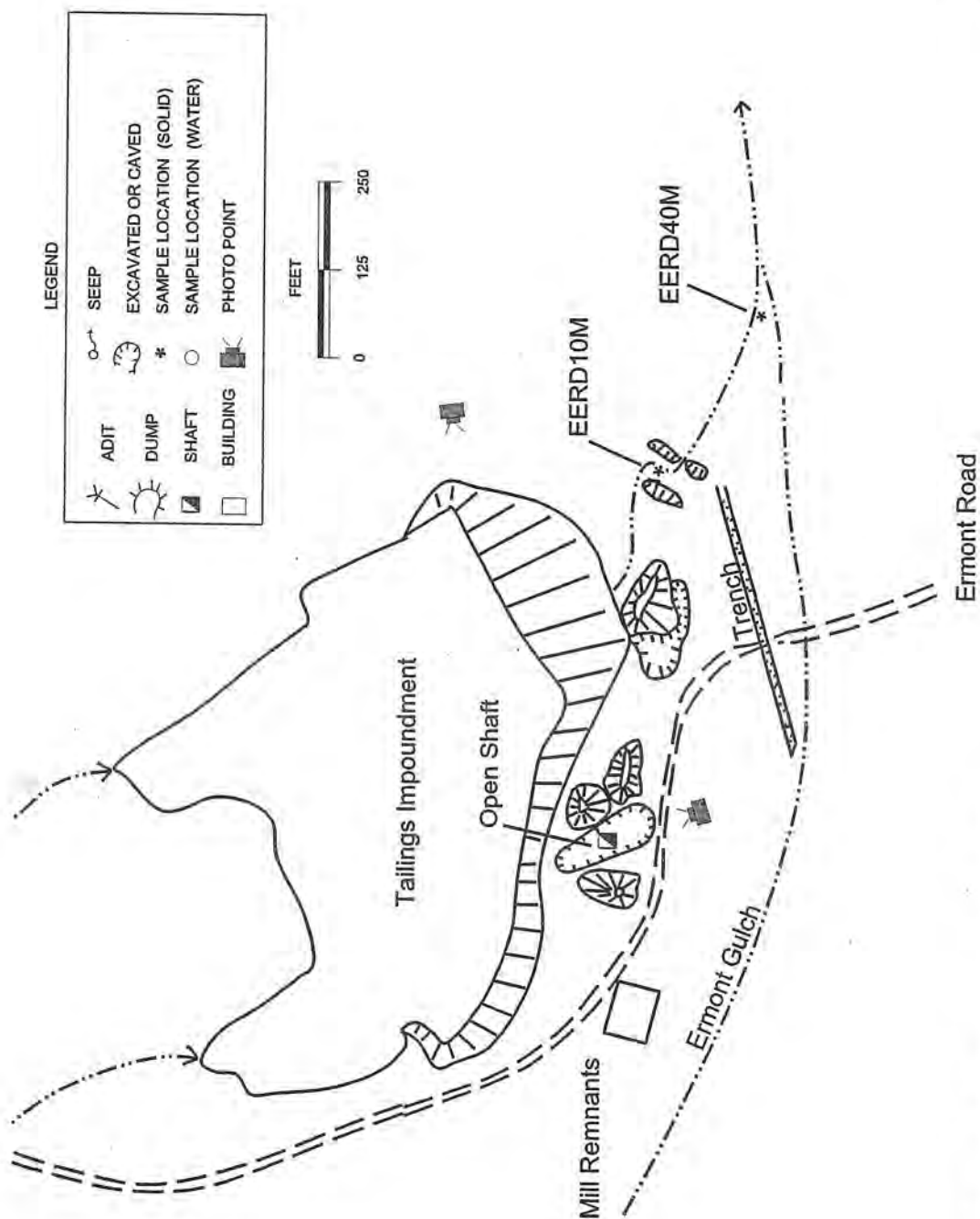


Figure 2.5 Site map of the Ermont mill tailings area, August 1994.



Figure 2.6 The main tailings impoundment covers a six-acre area to the northeast of the mill.



Figure 2.7 An open shaft immediately south of the main tailings impoundment has been sealed with a steel grate; however, caving of soil and rock around the edges of the grate have made the shaft hazardous once again.

Ermont Gulch drainage. The tailings farther down the gulch were apparently released during flushing events when the mill was operational.

Another environmental concern at the site is an oil spill near the old mill foundation. Waste oil from an overturned five-gallon bucket has stained the soil and killed nearby vegetation. This spill was reported to the BLM's Butte District Office when it was discovered in August 1994.

2.6.3.1 Site Features - Sample Locations

Four soil samples were collected at the site on August 25, 1995. Sample EERD10M was collected along a runoff channel that breaches a small tailings dam below the main tailings impoundment. Sample EERD40M was collected in the flat, grassy area approximately 700 ft below the main impoundment. Sample EERD30M was collected along Ermont Gulch about half a mile below the site. Sample EERD20L was collected along Ermont Gulch more than a mile from the site. At all of these locations, the tailings could be easily distinguished from native soil based on color and grain size.

2.6.3.2 Soil

Arsenic exceeded the phytotoxic limit at three of the four soil sampling locations. None of the other targeted analytes had exceedances. The results of the soil analyses are summarized in table 2.4.

Table 2.4 Soil sampling results from the Ermont mill tailings.

Sample Location	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
Soil along runoff channel that breaches small tailings dam (EERD10M)	153 ^{1,2}	<0.41	1.05	1.30	8.87
Soil in flat, grassy area - 700 ft. below main impoundment (EERD40M)	140 ^{1,2}	<0.41	1.03	1.07	6.85
Soil along Ermont Gulch - approx. half a mile below site (EERD20L)	18.6	<0.41	0.84	1.65	7.85

Table 2.4 Soil sampling results from the Ermont mill tailings (continued).

Sample Location	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
Soil along Ermont Gulch - approx. 1 mile below site (EERD30M)	125 ^{1,2}	<0.41	1.23	1.42	9.03

(1) Exceeds one or more Clark Fork Superfund background levels (table 1.3)

(2) Exceeds phytotoxic levels (table 1.3)

2.6.3.3 Water

No water was observed in the vicinity of the site; therefore, no water samples were collected.

2.6.3.4 Vegetation

The tailings impoundment is moderately vegetated with grasses. The drainage below the tailings impoundment is moderately to densely vegetated with grasses, sage brush, and rabbit brush. In general, the vegetation looks healthy.

2.6.3.5 Summary of Environmental Condition

Because of the arid conditions at this site, it is unlikely that the tailings significantly degrade water quality in the area. Although the tailings contain levels of arsenic above the phytotoxic limit, vegetation has managed to take hold within the tailings impoundment and along the Ermont Gulch drainage. With time, natural revegetation of the entire area will probably occur.

2.6.4 Structures

Scraps of lumber and the concrete foundations of the mill buildings are the only remnants of the structures that once stood at the site.

2.6.5 Safety

South of the tailings impoundment, there is a shaft located within a 150-ft long pit. An attempt has been made to seal the shaft with a steel grate; however, subsidence of the loose rock around the edges of the grate has made the opening hazardous once again. Southeast of the mill, there is an open pit with 20-ft highwalls. Other Ermont Group sites with hazards mine openings include the Ermont No. 2, the Ermont No. 19, the West Ermont, and the Badger.

Windblown tailings may pose a health concern for people who drive recreational vehicles around the mill site. The tailings impoundment is crisscrossed with numerous ATV tracks.

2.7 SUMMARY OF MINING IMPACTS ON BLM-ADMINISTERED LAND: BEAVERHEAD AND RED ROCK RIVER DRAINAGES

The Cable mine and mill and the Ermont mill tailings were the only sites identified within the Beaverhead and Red Rock drainages that have potential environmental impacts on BLM-administered land. At the Cable site, tailings are deposited along a small stream that drains into the East Fork of Dyce Creek. The tailings are stabilized with vegetation and do not appear to impact water quality under base-flow conditions. The Ermont mill tailings are located on BLM-administered land near the head of Ermont Gulch. The tailings contain elevated concentrations of arsenic and are eroded by wind and water. Because of the area's arid climate, it is unlikely that the tailings significantly degrade water quality; however, wind-blown tailings may pose an inhalation hazard.

Thirty-two sites were identified that have safety concerns (see table 2.2). Of these sites, 26 have hazardous mine openings; six sites have dangerous highwalls or steep-sided open cuts; and two sites have unstable structures. Twenty-four of the sites are on or immediately adjacent to BLM-administered land.

BIG HOLE RIVER DRAINAGE

3.1 GEOLOGY

The entire Big Hole drainage area has been comprehensively mapped by O'Neill (unpublished), and this work has been incorporated into the 1:250,000 Dillon map by Ruppel *et al.* (1993). Dresser (1995) also mapped in detail some of the structurally complex areas near the mouths of Soap Gulch and Camp Creek.

The southern portion of the Rochester area is dominated by an early Proterozoic gneiss dome (O'Neill 1995), consisting of high-grade metamorphic rocks and cut by Proterozoic to Cretaceous, recurrently active, northwest-striking faults. Farther north, the east-west Camp Creek fault separates these metamorphic rocks from late Proterozoic Belt sediment. This fault marks the southern limit of the Helena salient of the Belt basin and was a Proterozoic depositional boundary. Paleozoic sedimentary rock lie unconformably on metamorphic rocks and Belt formations. These rocks were affected by late Cretaceous compression, which produced tight folds and older-over-younger and younger-over-older thrust faults. The northwest-trending faults also were probably active during the Cretaceous, and possibly into the Cenozoic. Small intrusions, presumably related to the Boulder batholith, are scattered throughout the area.

3.2 ECONOMIC GEOLOGY

The Big Hole drainage encompasses the following mining areas and districts (Loen and Pearson 1989) including: the Anaconda Range, Big Hole Divide and Beaverhead Mountains "areas"; the Pioneer, Wisdom, Calvert Hill, French Gulch, Divide Creek, Quartz Hill-Vipond, Hecla, Moose Creek, Melrose, McCartney Mountain, Birch Creek, Rock Creek/Lost Creek, and (most of the) Rochester districts. A large part of these mining districts are administered by the U.S. Forest Service, Beaverhead and Deerlodge forests. BLM-administered land falls largely along the Big Hole River from Dickie Bridge to Wise River and a large block southwest of the Highland Mountains (Humbug Spires/Rochester/Soap Gulch/Camp Creek/ and McCartney Mountain areas).

Economic geology was comprehensively described for the Rochester district (Sahinen 1939), and for the carbonate-hosted deposits south of Camp Creek (McClernan 1977) but has only been erratically reported for the rest of the area. Ore deposits appear to vary according to host-rock type. Those of the Rochester district and others hosted by metamorphic rocks consist of quartz-gold-arsenopyrite-pyrite veins (Loen and Pearson 1989). Deposits hosted by the

Cambrian Meagher Formation tend to be silver-lead rich, and McClernan (1977) likened them to Mississippi Valley-type deposits. Belt rocks host some stratabound massive-sulfide deposits (Thorson 1984). Mineral deposits hosted by Precambrian rocks appear to be controlled by reactivated Precambrian faults: the northeast and southwest Rochester faults and the Camp Creek fault. Cambrian deposits are conformable with bedding but may have been controlled by bedding-parallel thrusts.

Only the Rochester district has been an important producer: One hundred thousand ounces of gold with minor amounts of other metals (Sahinen 1939). Other areas have had minimal production.

Lyden (1948) reported minimal placer production from Camp Creek, Soap Gulch, Moose Creek drainages; total production value was probably in the thousands of dollars at best. Small placers also were mined in the French Gulch area northwest of Dickie Peak and in the Pioneer district west of the Big Hole Battlefield.

3.3 HYDROLOGY AND HYDROGEOLOGY

The Big Hole River drainage begins at the Continental Divide near Skinner Lake in southwest Montana and flows in a large loop around the Pioneer Mountains. At Twin Bridges, the Big Hole and Beaverhead rivers join to form the Jefferson River. The tributaries of the Big Hole River are numerous; the larger tributaries of the drainage include the North Fork of the Big Hole, Fishtrap Creek, Deep Creek, Wise River, Divide Creek, and Willow Creek. The USGS maintains two gaging stations on the river (table 3.1).

Table 3.1 Stream-gaging data for the Big Hole River drainage.

Gage Location	Period of Record	Drainage Area (mi ²)	Annual Mean Flow (cfs)
Big Hole River below Big Lake Cr. (seasonal records only)	1988-1994	575	467*
Big Hole River near Melrose	1923-1994	2,476	1,118

*Mean of April through September only

Source: Shields *et al.* 1995

The outer boundary of the Big Hole River "loop" is formed by the Beaverhead Range (Continental Divide - 10,630 amsl) on the west, by the Anaconda Range (Continental Divide - 10,655 amsl) on the north, and the Highland Mountains on the east. The Pioneer Mountains (11,154 amsl) are located inside the loop.

Nearly all of the mountain ranges around the Big Hole valley were glaciated. This is especially true for the Beaverhead and Anaconda ranges, where glacial moraines are common in the upper tributary drainages of the Big Hole River. Glacial lake bed sediments and old stream terraces are extensive on the valley margins above Fish Trap Creek (Alden 1953). Near-stream deposits, however, are Quaternary alluvial deposits in the upper and lower reaches of the river.

Precipitation in the Big Hole valley ranges from 12 to 16 inches annually; up to 40 inches of precipitation fall in the upper mountains (Montagne *et al.* 1982). Average annual temperatures range from 45°F in the valleys to 25°F in the mountains (Bergantino 1978).

The Big Hole valley is extensively irrigated using water from the Big Hole River; the USGS (Shields *et al.* 1995) estimate 136,000 acres are irrigated above Melrose. Stream flow in late summer and early fall can be as low as one-tenth of the average annual flow (Shields *et al.* 1995). The City of Butte intercepts and pumps water from a point about six miles upstream of Divide to Butte for the municipal water supply. With only a few small towns in the basin, ground-water development is generally limited to irrigation and domestic use.

3.4 SUMMARY OF THE BIG HOLE RIVER DRAINAGE

For the abandoned/inactive mine inventory for the Big Hole River drainage, the MBMG investigated 137 mine and/or mill sites on or near BLM-administered land (see figure 3.1 and table 3.2). Of these sites, 119 were found to have no impact on BLM land, 11 may pose environmental problems, and 7 could not be located. Of the 11 sites with potential environmental impacts (listed in **bold** in table 3.2), 4 have flooded workings or adit discharges, 4 have problems related to erosion of and runoff from waste materials, and 3 have both discharge and waste erosion problems. These 11 sites are discussed in the proceeding sections.

If mine openings or other dangerous features (unstable structures, steep waste-rock dumps, high walls) were observed at a site, then the site was designated unsafe, or hazardous, in table 3.2. Of the 137 sites inventoried, 28 were found to have safety concerns. The only sites that were screened for safety hazards in detail were those where soil and/or water samples were collected.

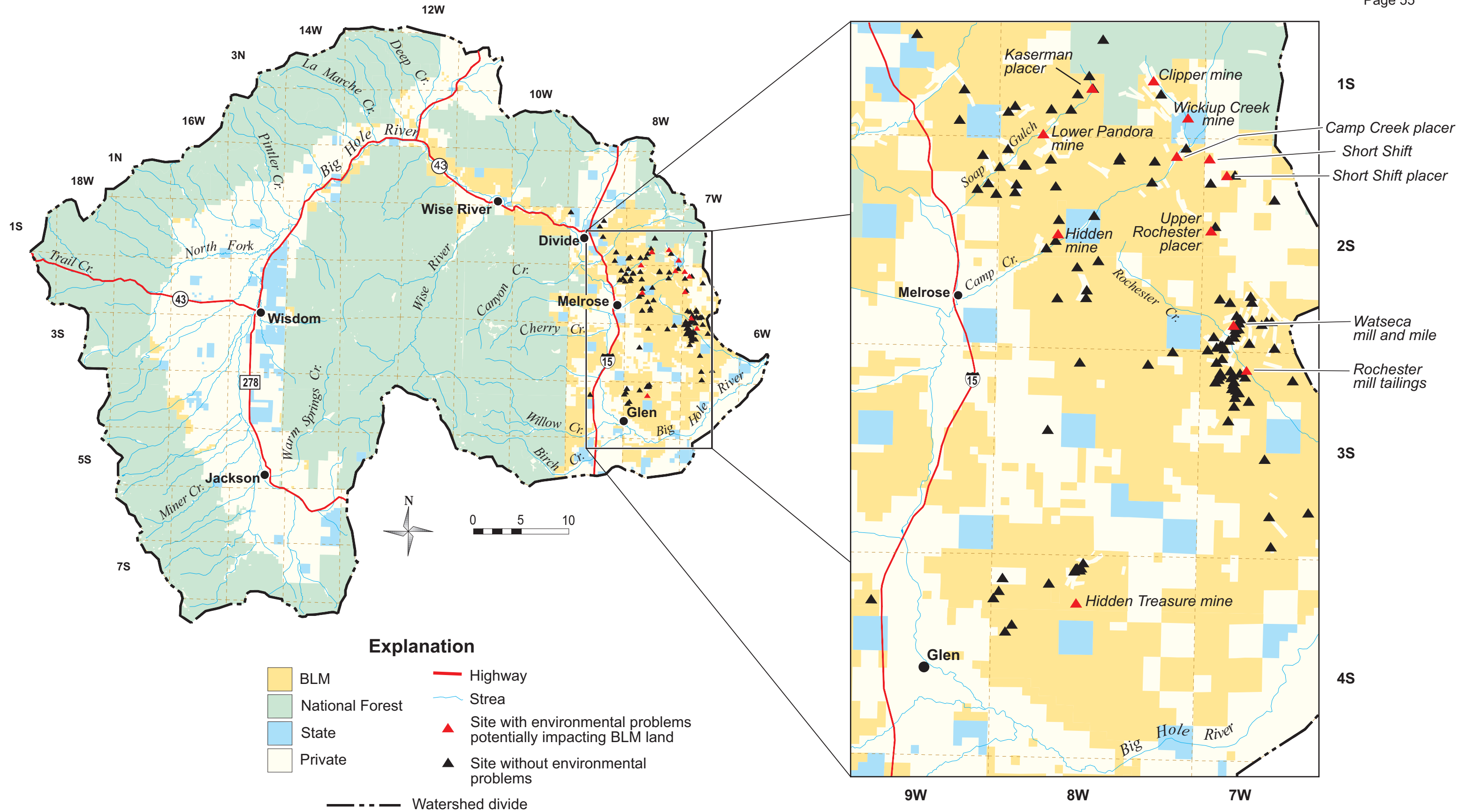


Figure 3.1. Abandoned/inactive mines inventoried in the Big Hole River drainage.

Table 3.2 Summary of sites inventoried in the Big Hole River drainage. Site name in **bold type** indicates potential environmental problems. "Y" under Hazard indicates physical safety concern.

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
300930170 Unnamed	PRV	Y	N	N	Dry.
Ajax	BLM	Y	N	N	Dry.
Antonioli's Quarry	PRV	N	N	NE	Screened out in office.
Anything	MIX	Y	N	N	Dry.
Apex No. 2 Claim	BLM	N	N	NE	Screened out in office.
April Claims	BLM	Y	N	N	Dry.
Beacon Light	PRV	Y	N	N	Dry.
Berlin	MIX	N	N	NE	Screened out in office.
Blowout	UNK	N	N	NE	Unable to locate.
Brown Prospect	BLM	Y	N	N	Dry.
Buffalo	MIX	Y	N	N	Dry.
Calvin	PRV	Y	N	Y	Dry, open adits.
Calvin South	PRV	Y	N	Y	Dry, open adit.
Camp Creek Placer	PRV	Y	Y	N	Unmineralized streamside spoils.
Camp Creek Mine and Mill ⁵	BLM	Y	N	Y	Open adit. Dry. No tailings.
Canyon Creek Phosphate	MIX	Y	N	Y	Partially open adit in colluvium.
Carpenter	MIX	Y	N	N	Dry.
Champion	PRV	Y	N	N	Dry.
Chlorite Gulch	BLM	Y	N	Y	Mine openings. Dry.
Christiansen Group	BLM	Y	N	N	Dry.
Clipper	PRV	Y	Y	Y	Mine openings. Adit discharge and streamside waste.
Columbia	PRV	Y	N	N	Dry.
Cooper	BLM	Y	N	NE	Dry.

Table 3.2 Summary of sites inventoried in the Big Hole River drainage (continued).

SITE¹	OWNER²	VISIT	SAMPLE³	HAZARD⁴	REMARKS
Copper Hill (1)	BLM	N	N	NE	Screened out in office.
Copper Hill (2)	BLM	Y	N	Y	Mine opening. Dry.
Dick and Billy Jane	MIX	Y	N	N	Dry.
Earl's	PRV	Y	N	N	Dry. Adit collar.
East Soap Gulch Iron Deposit	BLM	Y	N	N	Dry.
Elgin	PRV	Y	N	N	Dry.
Emma Nevada	PRV	Y	N	N	Dry.
Emma Nevada II	PRV	Y	N	N	Dry. Associated with Gold King (1).
Emma	MIX	Y	N	N	Dry.
Eureka	PRV	Y	N	Y	Dry, open shaft.
Germania	MIX	Y	N	N	Dry.
Gold King (1)	MIX	Y	N	N	Dry.
Gold King (2)	MIX	Y	N	Y	Open adit. Dry.
Gold Nugget	MIX	Y	N	N	Dry.
Gold Seal	BLM	Y	N	N	Dry.
Grey Lock West	BLM	Y	N	N	Dry.
Grey Lock	BLM	Y	N	Y	Dry, open adit.
Helehan	PRV	N	N	NE	Screened out in office.
Hidden Treasure	BLM	Y	Y	Y	Open stopes, one with water.
Hidden	BLM	Y	Y	Y	Adit discharge; partially collapsed workings.
Horn Silver	PRV	Y	N	Y	Two open shafts. Dry.
Index	PRV	Y	N	N	Dry.
Jackrabbit	BLM	Y	N	Y	Open incline. Dry.
Kaserman Placer	BLM	Y	N	N	Streamside placer spoils.

Table 3.2 Summary of sites inventoried in the Big Hole River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Little Butte Ore	MIX	Y	N	N	Dry.
Longfellow	MIX	Y	N	N	Dry.
Lower Soap Gulch Placer	BLM	Y	N	NE	Dry. Active in 1994.
Lower Pandora	PRV	Y	Y	N	Adit discharge, streamside dump.
Lucky Strike	MIX	Y	N	N	Dry.
Mahogany	PRV	Y	N	Y	Two open adits. Dry.
Maiden Rock	MIX	N	N	NE	Active in 1996.
Maiden Rock Silica	PRV	Y	N	N	Active in 1996.
McCartney Creek Placer	BLM	Y	N	N	Dry.
Monte Clark	MIX	Y	N	N	Dry.
Mueller	PRV	Y	N	N	Dry.
Mullens	BLM	Y	N	Y	At least 3 open adits and an open stope. Dry.
Mutch	PRV	N	N	NE	Screened out in office.
New	PRV	Y	N	N	Dry.
Nez Perce	PRV	Y	N	Y	Open incline. Dry.
Nez Perce North	BLM	Y	N	Y	Three open shafts. Dry.
Nez Perce South	PRV	Y	N	N	Three covered shafts. Dry.
North Central	PRV	Y	N	Y	Boarded up adit, but accessible.
Nyhart-Cox	BLM	Y	N	N	No impact.
Old Glory	PRV	N	N	NE	Dry ridgetop. Viewed from a distance.
Old Glory (North) Iron Deposit	PRV	Y	N	N	Dry.
Orphan Boy	PRV	Y	N	Y	Partially caved shaft. Dry.

Table 3.2 Summary of sites inventoried in the Big Hole River drainage (continued).

SITE¹	OWNER²	VISIT	SAMPLE³	HAZARD⁴	REMARKS
Peabody	MIX	Y	N	Y	Two open adits and an open shaft. Dry.
Picard	UNK	N	N	NE	Unable to locate.
Polly Jane Group	BLM	Y	N	N	Secured adits. Dry.
Red Horse	UNK	N	N	NE	Unable to locate.
Reservoir Spring	BLM	Y	N	N	Caved prospect. Dry.
Rochester Mill Tailings	BLM	Y	Y	N	Tailings near flood plain. Spring adjacent to site.
Ruth and Copper Bottom	BLM	N	N	NE	Ridgetop location, screened in office.
SBME-1	PRV	Y	N	Y	At least 3 open adits. Dry.
Section 8	BLM	Y	N	N	Dry.
Shoemaker	BLM	Y	N	N	Dry.
Short Shift	BLM	Y	N	Y	Dry. Open shaft, unstable structures.
Short Shift Mill⁵	BLM	Y	Y	Y	Tailings. Unstable structure. Spring downgradient of site.
Short Shift Placer	MIX	Y	N	N	Dry placer spoils.
Short Shift West	PRV	Y	N	N	Dry.
Shortfellow	MIX	Y	N	N	Dry.
Silver	UNK	N	N	NE	Unable to locate.
Silver King	PRV	Y	N	N	Dry. Associated with Mueller.
Silver Note	MIX	Y	N	N	Dry.
Soap Gulch Barite Occurrence	BLM	N	N	NE	Dry location. Screened out.
Soap Gulch Iron	BLM	Y	N	N	Dry.
Soap Gulch Placer	MIX	Y	N	N	Dry.

Table 3.2 Summary of sites inventoried in the Big Hole River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
South of Dewey Shaft	BLM	Y	N	N	Two dry prospects and two shallow shafts.
Stateland	STA	Y	N	N	Dry.
Sugar Bowl	UNK	N	N	NE	Unable to locate.
Sunrise Shaft	MIX	Y	N	N	Dry.
Union	BLM	Y	N	Y	Dry. Open adit.
Unnamed 01S09W35ADCC	BLM	Y	N	Y	Dry. Open adits.
Unnamed 02S07W32CBBB	PRV	Y	N	N	Dry.
Unnamed 02S07W31DCCA	MIX	Y	N	N	Dry.
Unnamed 02S07W29CCCD	UNK	N	N	NE	Unable to locate.
Unnamed 02S07W30DABD	PRV	Y	N	N	Dry.
Unnamed 02S07W31DAAD	PRV	Y	N	N	Dry.
Unnamed 02S07W31DCDB	MIX	Y	N	N	Dry.
Unnamed 02S07W32BBAC	PRV	Y	N	N	Dry.
Unnamed 02S07W32BBDC	MIX	Y	N	N	Dry.
Unnamed 02S07W32BCBC	MIX	Y	N	N	Dry.
Unnamed 02S07W32BCCB	PRV	Y	N	N	Dry.
Unnamed 02S07W32BCDB	PRV	Y	N	N	Dry.
Unnamed 02S08W13AADD	BLM	Y	N	N	Dry.

Table 3.2 Summary of sites inventoried in the Big Hole River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Unnamed 02S08W29DABD Prospects	BLM	Y	N	N	Dry.
Unnamed 0300570760	BLM	Y	N	N	Dry. Adit collar.
Unnamed 03S07W06BBAA	PRV	Y	N	N	Dry.
Unnamed 03S07W06DBCA	MIX	Y	N	N	Dry.
Unnamed 03S07W06DBCD	MIX	Y	N	N	Dry.
Unnamed 03S07W06DCAC	MIX	Y	N	N	Dry.
Unnamed 03S07W06DCBB	MIX	Y	N	N	Dry.
Unnamed 03S07W06DDAB	MIX	Y	N	N	Dry.
Unnamed 03S07W06DDDA	MIX	Y	N	N	Dry.
Unnamed 03S07W06DDDD	MIX	Y	N	N	Dry.
Unnamed 03S07W08BBCB1	BLM	Y	N	N	Dry.
Unnamed 03S07W08BBCB2	BLM	Y	N	N	Dry.
Unnamed 03S07W08BBDC	BLM	Y	N	N	Dry.
Unnamed 03S07W08CBCB	BLM	Y	N	N	Dry.
Unnamed 03S07W18AABA	BLM	Y	N	N	Dry.
Unnamed 04S08W07BBDA	BLM	Y	N	N	Dry.
Unnamed 03S07W06BDAD	MIX	Y	N	N	Dry.

Table 3.2 Summary of sites inventoried in the Big Hole River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Unnamed Nitrogen	MIX	Y	N	Y	Open adits. Dry.
Unnamed Silver	PRV	Y	N	N	Dry.
Unnamed 04S08W07BCCA	BLM	Y	N	N	Secured adits. Dry.
Upper Pandora	BLM	Y	N	N	Dry.
Upper Rochester Placer	MIX	Y	Y	N	Streamside placer spoils.
Uranium Claim	UNK	N	N	NE	Unable to locate.
Vermont	MIX	Y	N	N	Dry.
Warren Prospect	BLM	Y	N	N	Dry.
Water Tank	BLM	Y	N	N	Dry.
Watseca Mine and Mill⁵	PRV	Y	Y	Y	Streamside waste. Open workings. Iron-stained springs below workings.
White	MIX	Y	N	N	Dry.
Wickiup Creek	PRV	Y	Y	N	Adit discharge.

1) Mines in **bold** may pose environmental problems and are discussed in the text; others are included only in appendix II (all mines) and appendix III (sites visited).

2) Administration/Ownership Designation
 BLM: Bureau of Land Management
 PRV: Private
 MIX: Mixed (BLM and private)
 STA: State of Montana
 UNK: Owner unknown

3) Solid and/or water samples (including leach samples)

4) Y: Physical safety hazards exist at the site.

NE: Physical safety hazards were not evaluated.

5) Mill site present

3.5 KASERMAN PLACER

3.5.1 Site Location and Access

The Kaserman mine (T1S R8W Sec 28 ACD) is along the upper reaches of Soap Gulch, a tributary to the Big Hole River. The site is on BLM land (Headwaters Resource Area) and can be accessed via the road that follows Soap Gulch from near the town of Melrose.

3.5.2 Site History - Geologic Features

The Kaserman placer consists of small spoil piles located along the bottom of the Soap Gulch drainage. The spoil material ranges in size from sand to gravel and contains no sulfides. A small earthen dam is located upstream of the spoils; it was probably used to collect water for the placer operation.

3.5.3 Environmental Condition

When the site was visited in July 1994, water was present several hundred yards upstream and downstream of the site, but none was flowing along the section of the drainage that had been placered. Flow probably occurs during large rainfall and snowmelt events, but it has not been enough to erode the placer spoils appreciably.

An old steel-cased well is located northeast of a road that crosses Soap Gulch downstream of the site. The depth of the well is unknown, and it is not capped.

3.5.3.1 Site Features - Sample Locations

Since the placer spoils were not mineralized and erosion was not a problem, no soil or water samples were collected at the site.

3.5.3.2 Soil

Native soils near the placer did not appear to be impacted; therefore, no soil samples were collected.

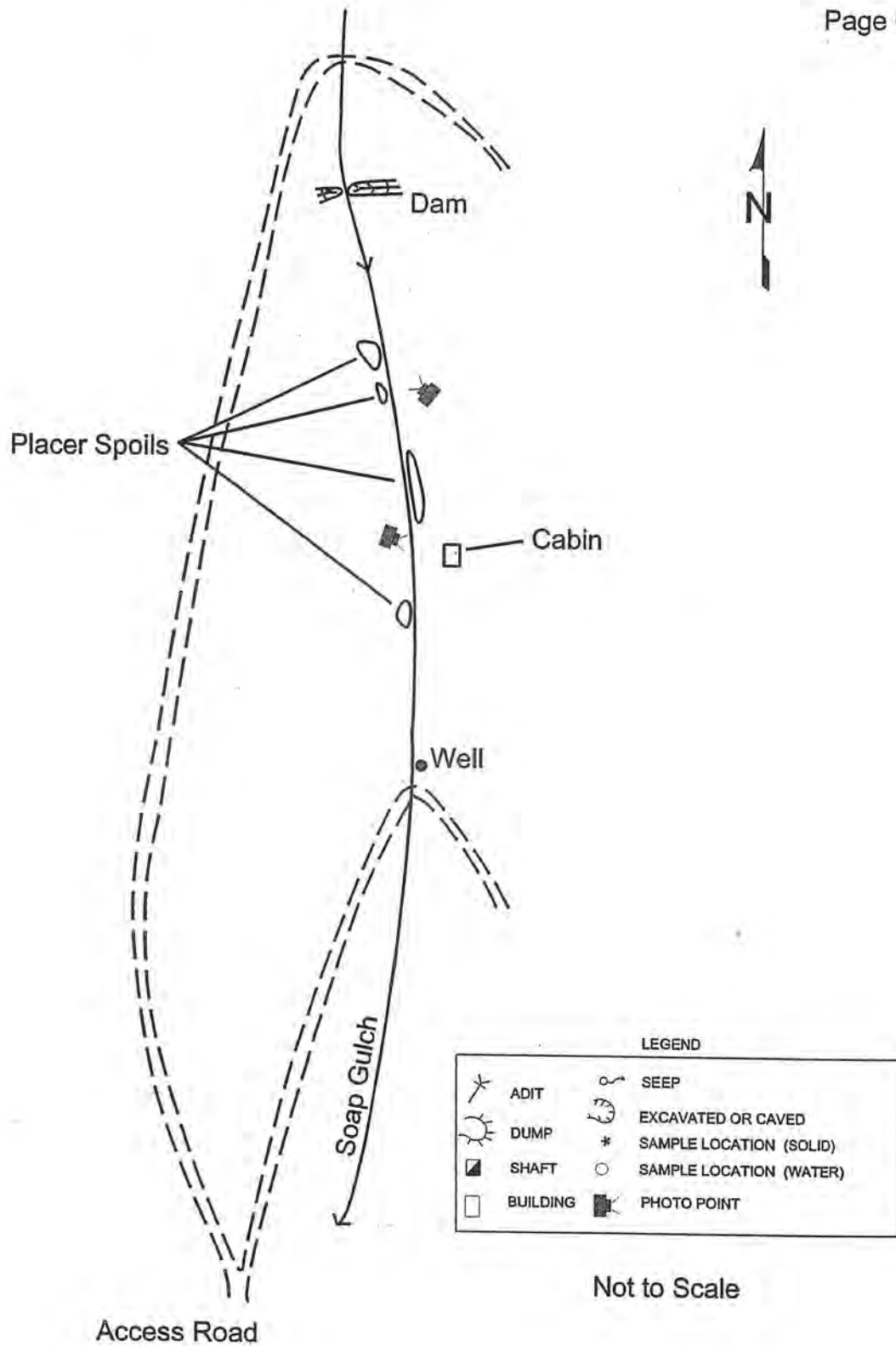


Figure 3.2 Site map of the Kaserman placer, July 1994.



Figure 3.3 Most of the placer spoils along Soap Gulch have revegetated with grasses and sage brush.



Figure 3.4 A log cabin is the only structure near the Kaserman placer.

3.5.3.3 Water

The water flowing from a spring downstream of the site had a pH of 7.13 and an SC of 148 umhos/cm @ 25°C; water-quality upstream of the site was similar. No water-quality samples were collected because the spoil materials were not mineralized and were not in contact with the surface water.

3.5.3.4 Vegetation

The vegetation along the drainage appears healthy. Much of the spoil material has naturally revegetated with grasses and sage brush.

3.5.3.5 Summary of Environmental Condition

The Kaserman placer does not appear to be adversely impacting the Soap Gulch drainage. However, an open well below the site may pose a risk to ground water. It should be capped or properly abandoned.

3.5.4 Structures

A log cabin is located on the mountainside east of the placer. All of its walls are intact, but the roof has collapsed.

3.5.5 Safety

The cabin may be a safety concern because of its poor condition. No other safety concerns were noted at the site.

3.6 LOWER PANDORA MINE

3.6.1 Site Location and Access

The Lower Pandora mine (T1S R8W Sec 32 ACCC) is on the northeast bank of Soap Gulch, 5.1 miles up the Soap Gulch Road. The entire site is on private land.

3.6.2 Site History - Geologic Features

A 200-ft caved adit has been driven into dark gray, thinly laminated rusty-weathering pyritic shales. Some rock on the dump is cherty and contains pyrite, sphalerite, and pyrrhotite (?). This mine probably sought the massive sulfide deposits described by Thorson (1984). A composite dump sample contained 0.0005 oz/ton gold, 1.0 ppm silver, 51 ppm copper, 34 ppm lead, 66 ppm zinc, and 26 ppm arsenic.

3.6.3 Environmental Condition

A ferric oxyhydroxide-stained seep flows from the collapsed adit, through a culvert under the road, and then down a steep embankment into Soap Gulch. Although the discharge looks bad, vegetation is growing along its path.

The toe of the mineralized waste-rock dump lies in the path of Soap Gulch and is being actively eroded. Because the dump contains sulfide minerals, it is possible that the eroded material is degrading the water quality of the stream.

Upstream and downstream of the site, there are several natural springs that are stained with iron precipitates. These colorful waters may be percolating through the massive sulfide deposits in the area.

3.6.3.1 Site Features - Sample Locations

Because the site is on private property, no samples could be collected from the adit discharge and the waste-rock dump. Instead, water-quality samples were collected from Soap Gulch upstream (BPAS20H) and downstream (BPAS10H) of the site. The flow rates at these locations were 12 and 46 gpm, respectively. A third sample (BPAS30H) was collected from one of the iron-stained springs on BLM land upstream of the site. The spring was flowing at a rate of 2.1 gpm. All samples were collected on August 26, 1994.

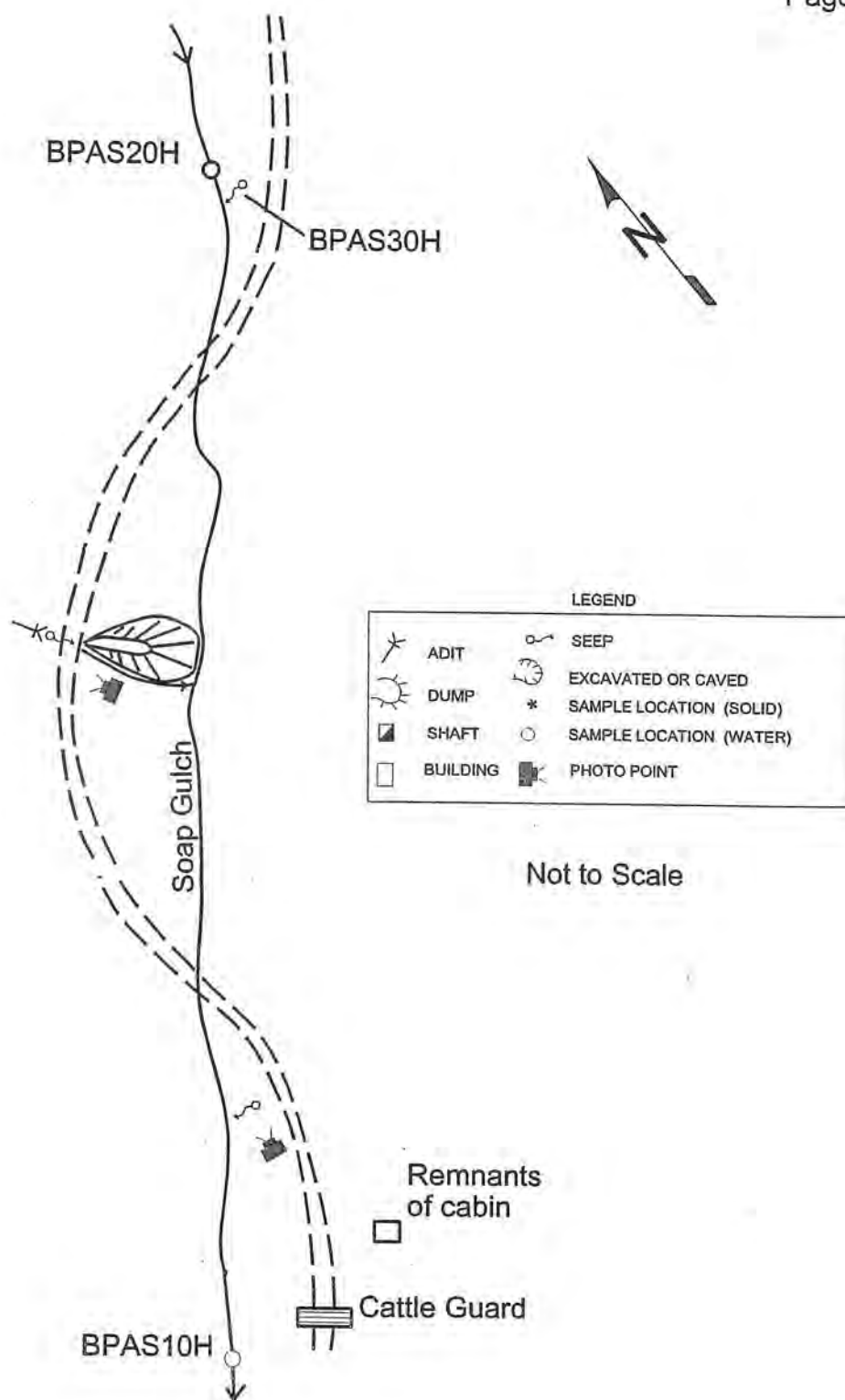


Figure 3.5 Site map of the Lower Pandora mine, August 1994.



Figure 3.6 An iron-stained discharge flows from the collapsed adit at the Lower Pandora site.



Figure 3.7 Several iron-stained springs are located along Soap Gulch upstream and downstream of the site.

3.6.3.2 Soil

No impact to soil was observed on BLM land downstream of the site; therefore, no soil samples were collected.

3.6.3.3 Water

Soap Gulch had no water-quality exceedances upstream or downstream of the site. The iron-stained spring exceeded the secondary MCL for manganese.

Table 3.3 Water-quality exceedances Lower Pandora mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Soap Gulch - upstream of site (BPAS20H)																			
Soap Gulch - downstream of site (BPAS10H)																			
Iron-stained seep upstream of site (BPAS30H)									S										

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in Appendix V.

3.6.3.4 Vegetation

The streamside waste-rock dump is sparsely vegetated. Vegetation surrounding the site appears healthy.

3.6.3.5 Summary of Environmental Condition

The adit discharge and streamside waste at the Lower Pandora do not appear to impact the water quality of Soap Gulch. The iron-stained seep that was

sampled exceeded the secondary MCL for manganese; however, this seep and others nearby are natural. No detrimental impacts to BLM land were observed.

3.6.4 Structures

The foundation of a cabin can be found on private land, several hundred yards downstream of the site. No structures are present on BLM land.

3.6.5 Safety

No safety hazards were observed at this site.

3.7 CLIPPER AND WICKIUP CREEK MINES

3.7.1 Site Locations and Access

The Clipper mine (T1S R8W Sec 26 BAD) is on private land near the headwaters of Wickiup Creek. The Wickiup Creek mine (T1S R8W Sec 36 BACD) is on State of Montana land, about 1.5 miles downstream of the Clipper. Both sites can be accessed by following the Camp Creek Road from the town of Melrose.

3.7.2 Site History - Geologic Features

The Clipper was a fairly large operation, with three caved adits and four caved shafts evident today. According to Sahinen (1950), a vein 4-10 feet wide, striking N28°W and dipping northeast, was mined. It is probably the same zone mined by the nearby Columbia mine. The vein consisted of quartz, pyrite, and chalcopyrite within thin-bedded black Belt shales and contained up to 25% copper, which must have been the major commodity.

At the Wickiup mine, two caved adits are present: one is 500-1000 feet long; the other is only a few hundred feet. Adit geometry indicates a N80°E-striking structure was mined. The vein consisted of quartz, fine-grained pyrite, and galena (?) in the Proterozoic LaHood Formation. A waste-rock sample contained 0.0005 oz/ton gold, 3.8 ppm silver, 63 ppm copper, 900 ppm lead, 232 ppm zinc, and 200 ppm arsenic.

3.7.3 Environmental Condition

At the Clipper, two discharges are present: one flows from a collapsed adit on the west side of the access road; the other flows from a nearby waste-rock dump. The sediment along the path of the adit discharge has a gray-green color, possibly due to the precipitation of copper carbonates; the waste-rock seep is the usual iron-oxyhydroxide orange. Both discharges flow into Wickiup Creek. Another environmental concern at the site is streamside waste material. Two dumps are within the creek's flood plain. Neither is vegetated, so they have a high erosion potential.

At the Wickiup Creek mine, an adit on the hillside west of the creek has an iron-stained discharge that flows into a meadow and sinks into the ground. The discharge may impact the ground water that discharges into the creek in this area. A second, but lesser, concern at the site is a small streamside waste-rock dump. The dump contains only minor sulfide mineralization.

3.7.3.1 Site Features - Sample Locations

Because the sites are not on BLM lands, surface water and soil samples could not be collected from the discharges and streamside dumps. Instead, surface water samples were collected on federal land upstream (BWCS20M) and downstream (BWCS30M) of the two sites. Upstream of the sites, the measured flow of the creek was 8.7 gpm; downstream it was 92 gpm. All samples were collected on September 20, 1994.

3.7.3.2 Soil

No impact to soil was observed on BLM-administered land.

3.7.3.3 Water

Concentrations of all analytes considered were less than their respective water-quality limits.

Table 3.4 Water-quality exceedances at the Clipper and Wickiup Creek mines.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Wickiup Creek - upstream of both sites (BWCS20M)																			
Wickiup Creek - downstream of both sites (BWCS30M)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in Appendix V.

3.7.3.4 Vegetation

At both sites, the waste-rock dumps are barren to sparsely vegetated. Vegetation is abundant and healthy away from the dumps and discharges.



Figure 3.8 At the Clipper, a gray-green adit discharge flows between two streamside waste-rock dumps and into Wickiup Creek.



Figure 3.9 At the Wickiup Creek mine, an iron-stained discharge flows from an adit on the hillside west of Wickiup Creek.

3.7.3.5 Summary of Environmental Condition

No surface water- or soil-quality problems were identified on BLM-administered land downstream of the two sites. However, both sites have bad-looking discharges and streamside dumps that may affect soil and water quality on a more localized level.

3.7.4 Structures

No structures were observed at the Wickiup Creek mine. At the Clipper, the remnants of an ore bin or head frame were apparently used to backfill one of the collapsed shafts. No structures were observed on federal land.

3.7.5 Safety

At the Clipper, the most obvious mine openings have been fenced and warning signs have been posted. However, collapse features can still be found on the surrounding hillsides.

No safety problems were identified at the Wickiup Creek mine or on the federal land upstream and downstream of the two sites.

3.8 CAMP CREEK PLACER

3.8.1 Site Location and Access

The Camp Creek placer (T2S R8W Sec 1 BC) is on the Camp Creek drainage, approximately eight miles east of Melrose, Montana. The site is accessible by vehicle from the rough road that follows the creek. All of the disturbed area is on private property, but it is bounded by BLM lands upstream and downstream.

3.8.2 Site History - Geologic Features

The Camp Creek placer consists of small spoil piles of gravel and cobbles along a half-mile stretch of Camp Creek. The source area appears to be to the south.

3.8.3 Environmental Condition

Small placer spoil piles are located along the banks of Camp Creek. The spoil material is generally coarse and does not contain sulfide minerals.

3.8.3.1 Site Features - Sample Locations

Two samples were collected upstream of the site: BWCS40M from Camp Creek and BWCS30M from Wickiup Creek (see section 3.7). The flow rates at these locations were 1,300 and 92 gpm, respectively. A third sample (BWCS10M) was collected from Camp Creek downstream of the site. Here, the flow rate was 740 gpm. All samples were collected on September 20, 1994.

3.8.3.2 Soil

Because the placer spoils are not eroding and do not contain sulfide minerals, it is unlikely that soils on BLM land downstream of the site have been impacted. Therefore, no soil samples were collected.

3.8.3.3 Water

Camp Creek exceeded the secondary MCL for iron upstream and downstream of the site. No other water-quality problems were noted.



Figure 3.10 The placer spoils along Camp Creek are well vegetated.



Figure 3.11 Water sample BWCS10M was collected from Camp Creek downstream of the placer spoils.

Table 3.5 Water-quality exceedances at the Camp Creek placer.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Camp Creek - upstream of site (BWCS40M)							S												
Wickiup Creek - upstream of site (BWCS30M)																			
Camp Creek - downstream of site (BWCS10M)							S												

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in Appendix V.

3.8.3.4 Vegetation

The placer spoils have naturally revegetated with grasses, willows, and young cottonwoods. All of the vegetation is healthy.

3.8.3.5 Summary of Environmental Condition

The streamside placer spoils have no detrimental impacts on Camp Creek and the BLM land downstream. High concentrations of dissolved iron found upstream and downstream of the site are unrelated to the placer.

3.8.4 Structures

No structures were observed on either the private or BLM lands near the site.

3.8.5 Safety

No safety problems were identified at the site.

3.9 SHORT SHIFT MILL

3.9.1 Site Location and Access

The Short Shift mill (T2S R7W Sec 6 BCDB) is located on BLM-administered land along a small unnamed tributary to Camp Creek. The site can be accessed by following the rough road that turns east off the Camp Creek Road just beyond the Camp Creek placer.

3.9.2 Site History - Geologic Features

The Short Shift mill apparently treated oxidized ore from the nearby Short Shift mine (T2S R7W Sec 6 DDDDB). Less than 10 tons of tailings are present at the site.

3.9.3 Environmental Condition

When the site was visited in August 1994, the first water that could be found along the drainage was several hundred feet below the mill. At the mill, there was a small muddy spot in the middle of a small tailings impoundment, but there was no standing water.

3.9.3.1 Site Features - Sample Locations

The muddy spot in the middle of the tailings impoundment suggests that the mill tailings may intercept shallow ground water. Therefore, sample BSSS10H was collected from the spring below the mill. On the day the spring was sampled (9/19/95), it was flowing at a rate of 2 gpm.

3.9.3.2 Soil

Impacts to soils were not evident at the mill; therefore, no soil samples were collected.

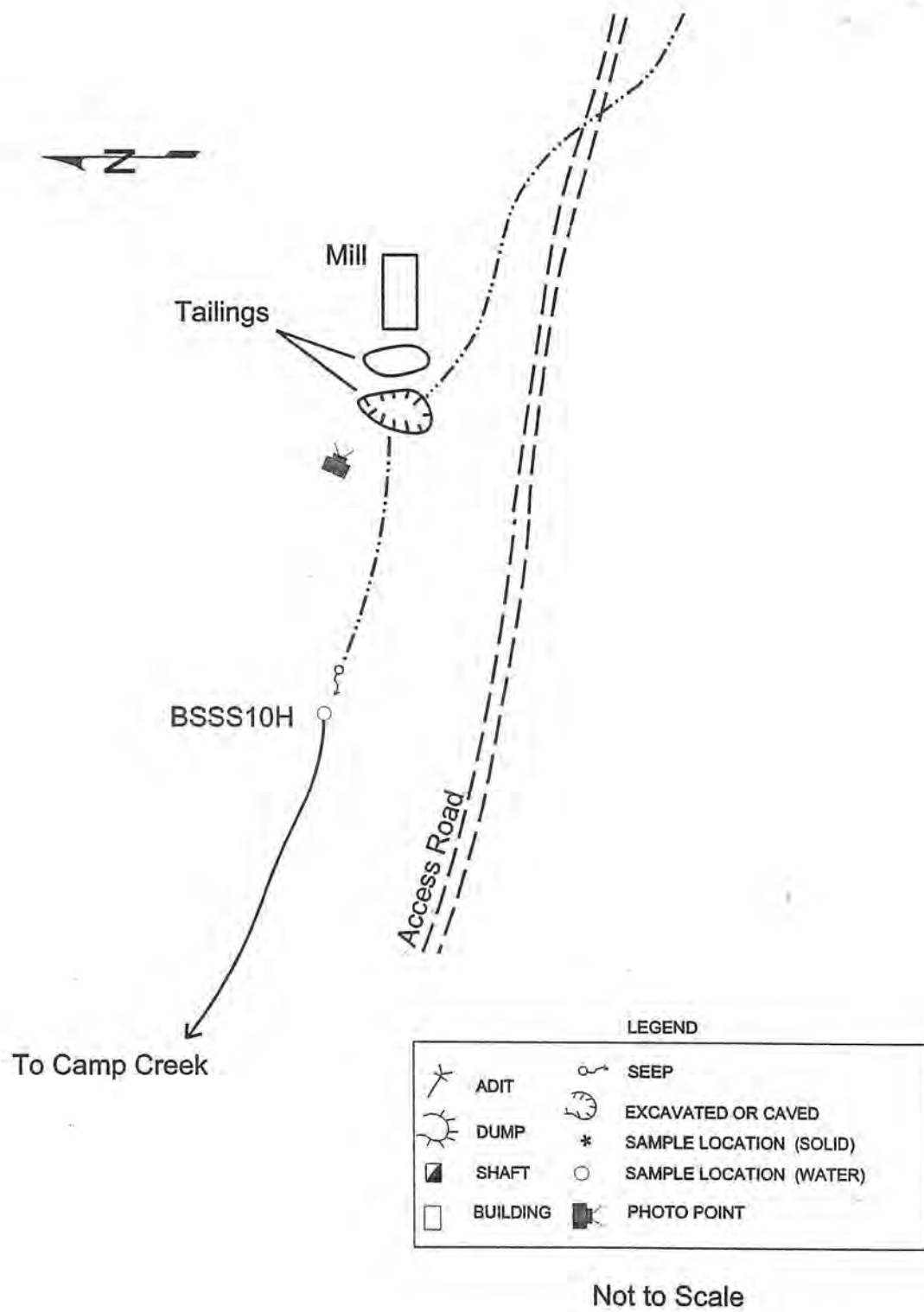


Figure 3.12 Site map of the Short Shift mill, September 1995.



Figure 3.13 Small tailings piles are located in front of the Short Shift mill building.



Figure 3.14 The Short Shift placer is naturally revegetating with grasses and sage brush.

3.9.3.3 Water

The sample from the spring below the mill exceeded water-quality standards for iron and manganese (table 3.6). Because no water could be found above the site, it is uncertain if the exceedances are related to the tailings or to high background levels in the area.

Table 3.6 Water-quality exceedances at the Short Shift mill.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Spring below mill (BSSS10H)							S,A		S										

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in Appendix V.

3.9.3.4 Vegetation

The mill tailings are moderately vegetated with grasses. Along the drainage below the mill, healthy willows are growing.

3.9.3.5 Summary of Environmental Condition

The spring below the Short Shift mill has concentrations of iron and manganese that exceed water-quality standards. The mill tailings at the site may be the source of these metals, but an alternative possibility is that natural background concentrations are high in this area. One or two monitoring wells would have to be installed and sampled to adequately resolve this issue.

3.9.4 Structures

At the Short Shift mill, the main mill building is still standing, but most of its contents have been removed.

3.9.5 Safety

The mill building is a safety concern. Access to the building is not restricted, and there are numerous slip-trip-fall hazards inside.

3.10 HIDDEN MINE

3.10.1 Site Location and Access

The Hidden mine (T2S R8W Sec 17 DACC) is on a dry wash north of Camp Creek. Access to the site is by a four-wheel drive road that follows the Camp Creek drainage from Melrose. The last eighth of a mile up the side drainage to the site must be hiked. The entire site is on BLM land.

3.10.2 Site History - Geologic Features

A partially caved adit with less than 200 feet of workings is located in Precambrian metamorphic rocks along the Southwest Rochester Fault (see figure 3.15). The structure exposed by the workings strikes N70°W and dips 68°NE. Small pieces of quartz-pyrite vein are scattered about the dump. A dump composite sample was taken which contained less than 0.0005 oz/ton gold, less than 0.02 ppm silver, 89 ppm copper, 18 ppm lead, 66 ppm zinc, and 8 ppm arsenic.

3.10.3 Environmental Condition

Small discharges flow from two partially caved entrances to the adit. The discharges sink into the waste-rock a short distance from the adit. The only other water near the site is a spring located in a grassy area several hundred feet north of the adit.

3.10.3.1 Site Features - Sample Locations

Samples were collected from the discharges flowing from the adit entrances, BHNS10H from the east entrance and BHNS20H from the west. The flow rates at these locations were 0.04 and 0.05 gpm, respectively. A third sample, BHNS30H, was collected from the spring on the hillside above the site. The flow rate at this location was 0.4 gpm. All samples were collected on July 10, 1995.

3.10.3.2 Soil

Soils around the site did not appear to be adversely impacted by erosion of or runoff from waste materials; therefore, no soil samples were collected.

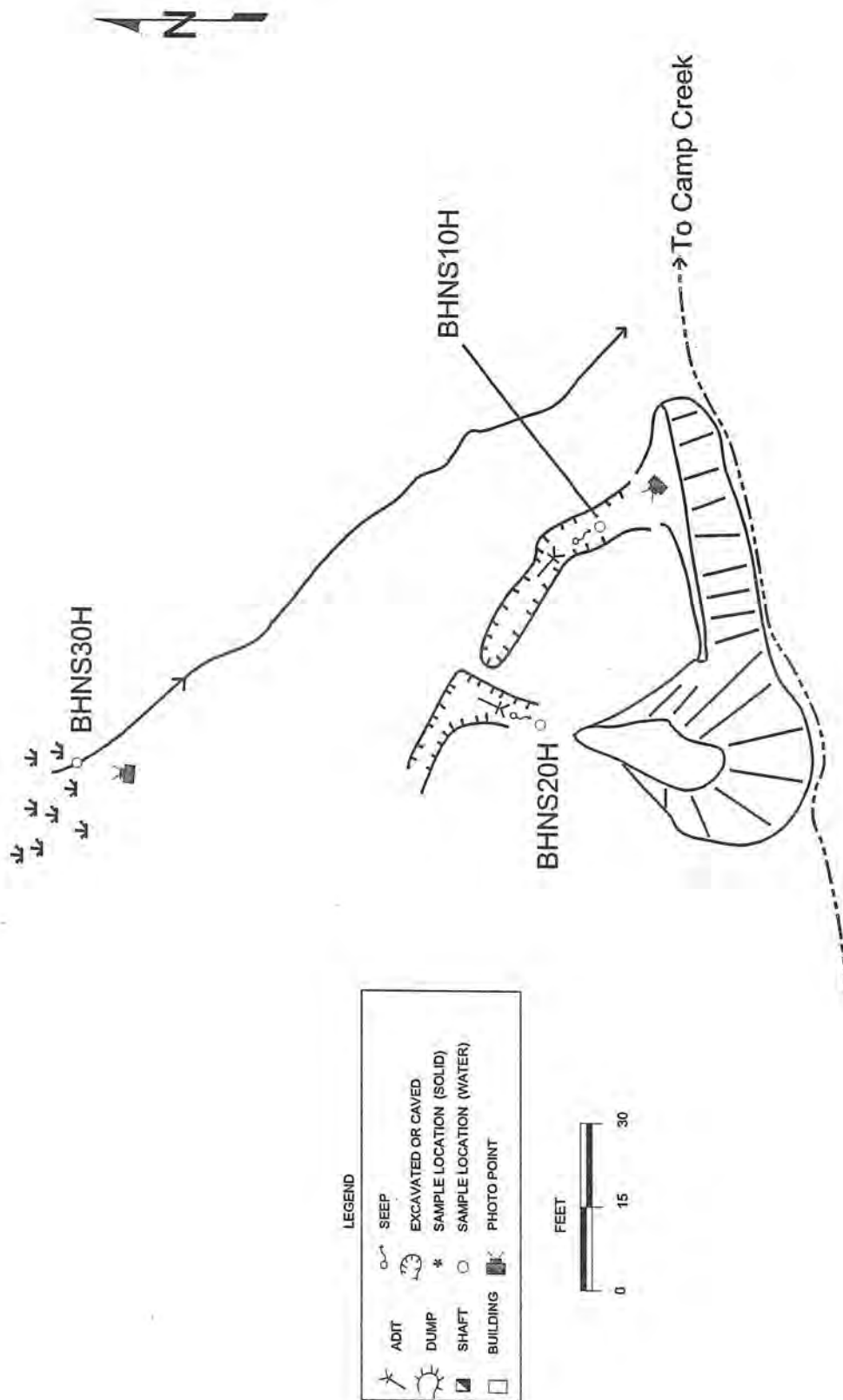


Figure 3.15 Site map of the Hidden mine, July 1995



Figure 3.16 Sample BHNS10H was collected from the east entrance to the adit.



Figure 3.17 A grassy spring is located on the mountainside above the adit. Sample BHNS30H was collected here.

3.10.3.3 Water

Mercury concentrations in the adit discharges were at the laboratory detection limit of 0.1 $\mu\text{g/L}$ and thus exceeded the chronic aquatic life criteria (0.012 $\mu\text{g/L}$). No other exceedances were observed.

Table 3.7 Water-quality exceedances at the Hidden mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Discharge from west adit entrance (BHNS20H)										C									
Discharge from east adit entrance (BHNS10H)										C									
Spring on mountainside above mine (BHNS30H)																			

Exceedance codes:

- P - Primary MCL
- S - Secondary MCL
- A - Aquatic Life Acute
- C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V.

3.10.3.4 Vegetation

The waste-rock dump is sparsely vegetated with grasses and sage brush. Vegetation near the adit discharges appears healthy. No obvious stress to vegetation occurs outside of the disturbed areas.

3.10.3.5 Summary of Environmental Condition

The mercury concentration in the water flowing from the adit was found to exceed the chronic aquatic life standard; however, the concentration was at the laboratory detection limit. Additional samples should be collected and analyzed to confirm the initial findings. No other environmental problems were noted at the site.

3.10.4 Structures

No structures are located at the site.

3.10.5 Safety

The partially collapsed adit is a safety concern because the workings are still accessible by crawling into the collapsed zone around the upper entrance.

3.11 HIDDEN TREASURE MINE

3.11.1 Site Location and Access

The Hidden Treasure mine (T4S R8W Sec 9 BAAB) is on the southeast side of McCartney Mountain, approximately 10 miles southeast of Melrose, Montana. The site is located along an ephemeral drainage that joins Reservoir Gulch, a tributary to Choke Cherry Gulch. Choke Cherry Gulch, in turn, is a tributary to the Big Hole River. Access to the site is by a four-wheel drive road that follows Choke Cherry Gulch and then Reservoir Gulch. The last quarter mile to the site must be hiked. The entire site is on BLM-administered land.

3.11.2 Site History - Geologic Features

The Hidden Treasure mine is not mentioned in many of the standard references for the McCartney Mountain area, such as Loen and Pearson (1989). In 1935, MBMG Memoir 15, lists the mine as having seven claims, five adits, with a five-ton amalgamation ball mill. In 1940, MBMG Memoir 20 states that this property consisted of 400 feet of workings (tunnels and winzes) with gold, silver and bismuth produced from 10 unpatented mining claims. This report gives the alternative names of "Bieber" and "Keith" mine, named after previous mine owners. It also states that, at the time, there was a 10-ton amalgamation and gravity concentration plant operating. MBMG Bulletin 100 (1976) mentions that some activity was taking place here as a gold prospect; it does not specify to what the extent the mine was being developed.

The mine is found on the southern flank of McCartney Mountain, one mile due south of the Silver King and Mueller mines, on the Nez Perce Hollow 7 ½' quadrangle. Deposits of the McCartney Mountain area are generally associated with a Late Cretaceous or Tertiary stock that intruded Cretaceous sandstones and shales that were previously folded and thrust (Loen and Pearson 1989). The mine occurs in the Cretaceous Colorado Group according to Brandon (1984), and the local dominant structural trend is a slight tilting of the rocks around the McCartney Mountain stock. The intrusive crops out less than a mile away and the mineralization may be associated with it at depth. Brandon shows no major faults associated with the mine.

3.11.3 Environmental Condition

A pool of water is located in an open stope above one of the collapsed adits (see figure 3.18). The water is four to five feet below the ground surface and

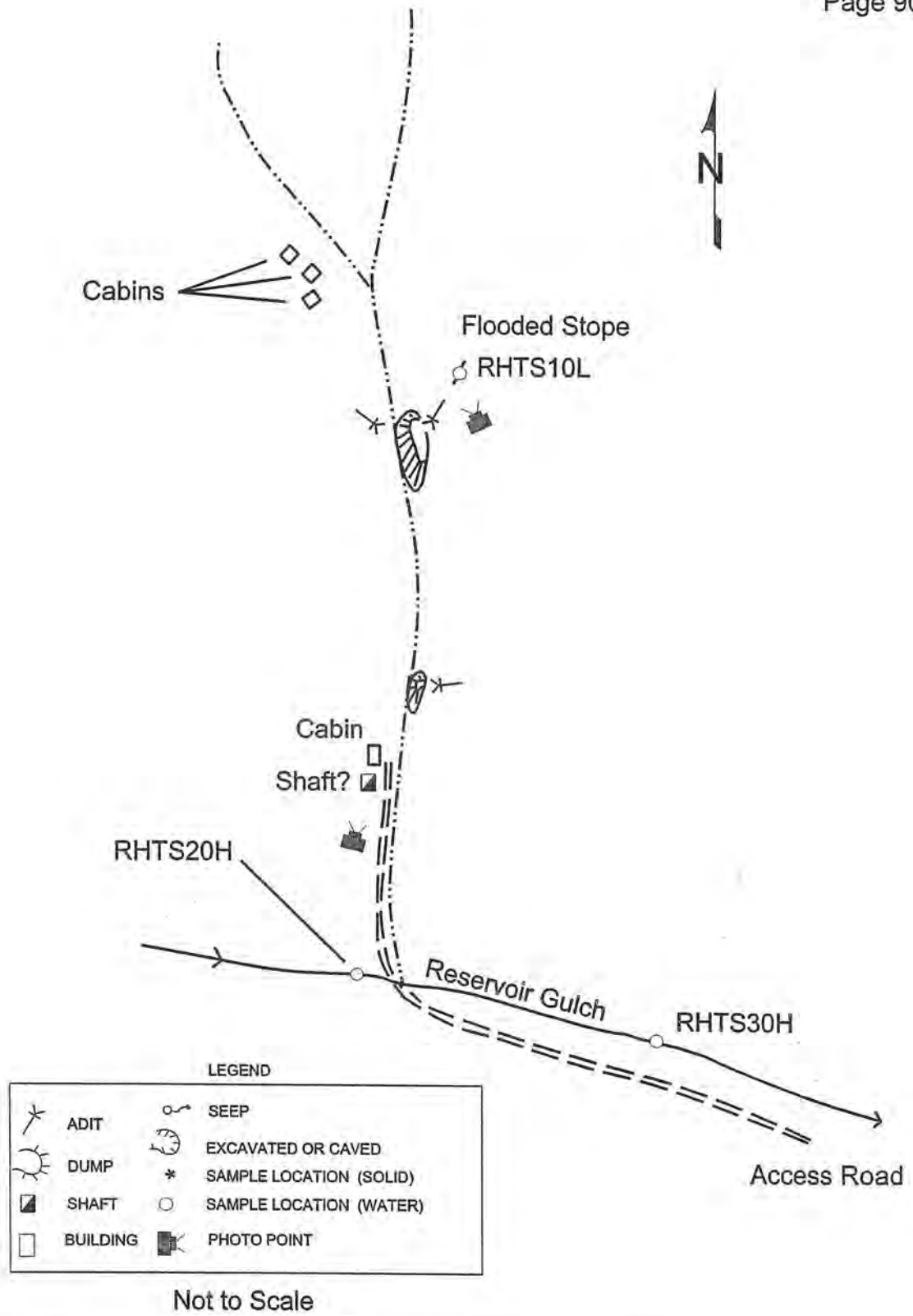


Figure 3.18 Site map of the Hidden Treasure mine, September 1994.



Figure 3.19 A pool of water is located in an open stope at the Hidden Treasure mine.



Figure 3.20 A dilapidated cabin and some collapsed working are located at the south end of the unnamed drainage, close to where it joins Reservoir Gulch.

appears to be at least several feet deep. The water may be from snow and ice that melts in stope during the spring. An alternative possibility is that the stope has been flooded with ground water. The only other surface water that occurs near the site is found in Reservoir Gulch, several hundred yards below the lowermost workings.

Two waste-rock dumps are located along the bottom of the drainage. However, no appreciable erosion has occurred because the drainage appears to be dry most of the year. Only the northern dump (associated with the collapsed adit and open stope) has appreciable sulfide mineralization.

3.11.3.1 Site Features - Sample Locations

On September 22, 1994, water-quality samples were collected from the pool of water in the stope (RHTS10L) and from Reservoir Gulch above (RHTS20H) and below (RHTS30H) where it is joined by the tributary drainage. The flow rate of Reservoir Gulch was 5.5 gpm.

3.11.3.2 Soil

Soils around the site did not appear to be adversely impacted by erosion of waste materials; therefore, no soil samples were collected.

3.11.3.3 Water

The water sampled from the open stope had an arsenic concentration that exceeded primary drinking water and chronic aquatic life standards. Aluminum, iron, and manganese exceeded secondary drinking water standards. Several other elements also were present in high concentrations. The water samples collected from Reservoir Gulch had no exceedances.

Table 3.8 Water-quality exceedances at the Hidden Treasure mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Pool of water in open stope (RHTS10L)	S,C	P,C		C		A,C	S,A	C	S				A,C						

Table 3.8 Water-quality exceedances at the Hidden Treasure mine (continued).

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Reservoir Gulch - upstream of unnamed drainage (RHTS20H)																			
Reservoir Gulch - downstream of unnamed drainage (RHTS30H)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V.

3.11.3.4 Vegetation

The northern waste-rock dump is sparsely vegetated with grass and conifers; the southern dump is moderately vegetated. No obvious stress to vegetation occurs outside of the disturbed areas.

3.11.3.5 Summary of Environmental Condition

The water in the open stope is of very poor quality, perhaps due to sulfide mineralization or evaporative concentration. It is not clear whether the water in the stope is from ground water that has flooded the workings or snow and ice that have melted in the opening year after year. Ground-water quality in the area may be poor, but monitoring wells would be necessary to make this determination.

The Reservoir Gulch drainage has good-quality water and does not appear to be adversely impacted by the mine.

Soils at the site are impacted minimally by waste materials; only a small volume of waste is present, and erosion is not a problem.

3.11.4 Structures

Four cabins are located at the site: one along the drainage below the working and three above. All of the structures are in poor condition.

3.11.5 Safety

The open stope is a serious safety concern at the site. If someone were to fall in, it would be extremely difficult to crawl out because of the near-vertical sides. Also, the person might have to know how to swim because since the water in the stope may be quite deep.

3.12 UPPER ROCHESTER PLACER

3.12.1 Site Location and Access

The Upper Rochester placer (T2S R7W Sec 18 CAB) is near the headwaters of Rochester Creek, a tributary that flows into the Big Hole River near Twin Bridges. Access to the site is via the road up Rochester Creek. Most of the site is on BLM land.

3.12.2 Site History - Geologic Features

The Upper Rochester placer consists of small, densely vegetated spoil piles along an ephemeral segment of Rochester Creek. The grain size of the spoils varies from silt to gravel. No sulfide minerals are present. Several shallow prospect trenches (3-5 feet deep) have been dug with a backhoe in the spoil materials. No production records were found for this site.

3.12.3 Environmental Condition

A small spring emerges within the placered area and flows along the drainage for several hundred feet before sinking into the ground. Another spring is located a short distance upstream of the site, but it disappears before reaching the placer. Erosion of spoil materials appears to be minimal.

3.12.3.1 Site Features - Sample Locations

On August 31, 1994, water samples were collected at the site. One sample (RURS20H) was collected from the spring that originates within the placered area; a second sample (RURS10H) was collected about 50 feet downstream of the placer, where the water from the spring sinks into the ground; a third sample (RURS30H) was collected from the spring upstream of the site. This sample was for background water quality. The flow rate of the upstream spring was 3.2 gpm. The spring within the placer was flowing at 1.4 gpm. The flow rate at location RURS10H downstream of the placer was 0.6 gpm.

3.12.3.2 Soil

Because no sulfide mineralization was present and the spoils were not being actively eroded, no soil samples were collected.

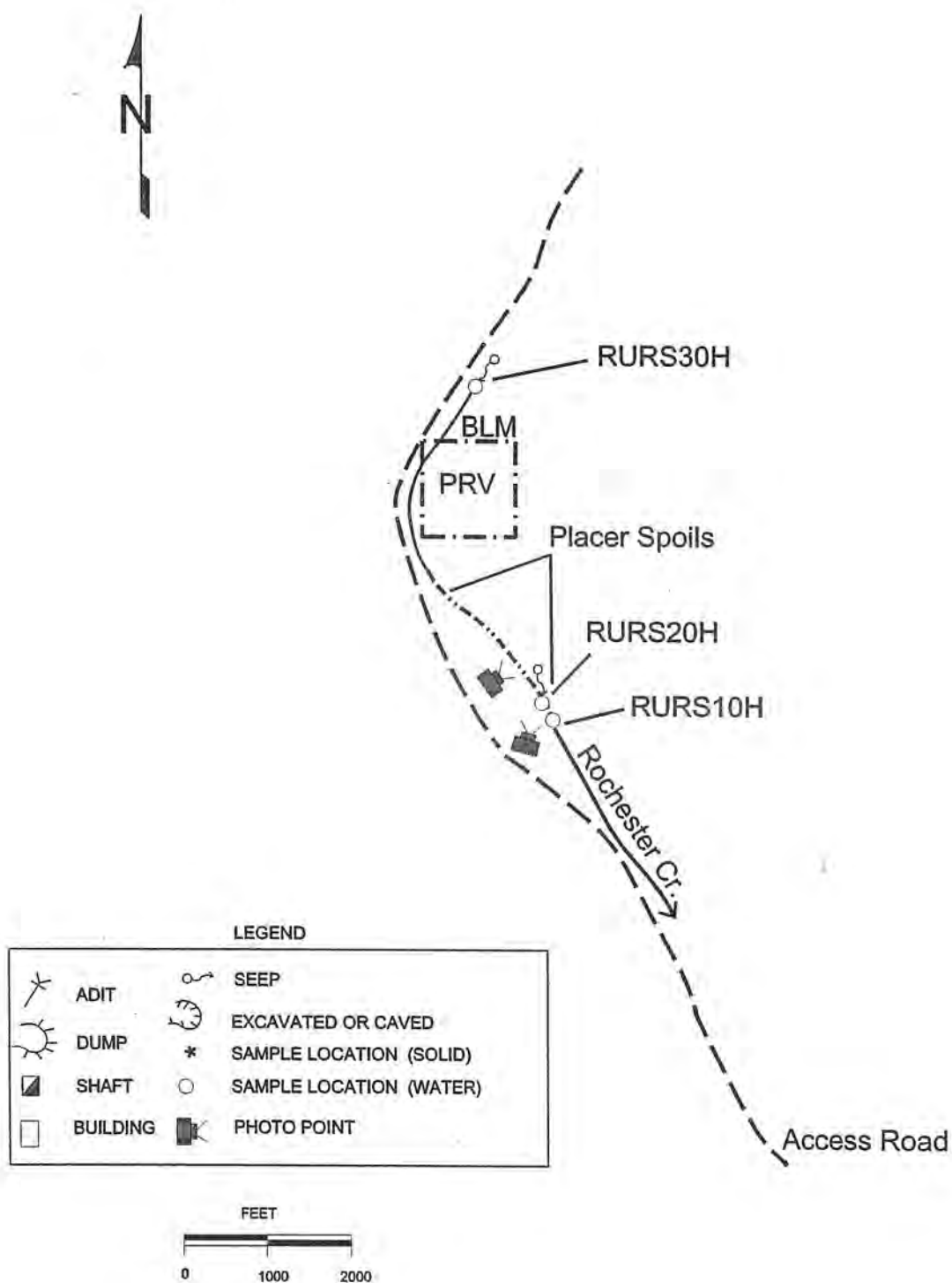


Figure 3.21 Site map of the Upper Rochester placer, August 1994.



Figure 3.22 Water sample RURS20H was collected from a spring within the placered portion of the drainage.



Figure 3.23 Several backhoe trenches have been dug in the placer spoils.

3.12.3.3 Water

No water-quality standards were exceeded at the site.

Table 3.9 Water-quality exceedances at the Upper Rochester placer.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Spring - upstream of site (RURS30H)																			
Spring within placer (RURS20H)																			
Water from placer spring - downstream of site (RURS10H)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V.

3.12.3.4 Vegetation

The spoil piles are moderately to densely vegetated with grasses and sage brush. The vegetation near the springs is healthy and prolific.

3.12.3.5 Summary of Environmental Condition

Although spoils at the site are in contact with flowing water, no sulfide mineralization is present, and no erosion problems were evident. Water quality upstream and downstream of the site is good.

3.12.4 Structures

No structures were observed at the site.

3.12.5 Safety

No safety concerns were noted at the site.

3.13 WATSECA MINE AND MILL

3.13.1 Site Location and Access

The Watseca mine and mill (T2N R7W Sec 31 ADDD) are located on Rochester Creek, approximately 10 miles northwest of Twin Bridges. The site is accessible by the road that follows Rochester Creek. All site features are on private property, but BLM lands are present along the drainage above and below the site.

3.13.2 Site History - Geologic Features

Numerous shafts, adits, prospects, a mill, and a tailings impoundment are present within a large block of private ground. The mill looks as though it has been operated recently, but it is inactive now. No production records were found for the mine or mill.

3.13.3 Environmental Condition

Two environmental concerns were noted at the site. First, several iron hydroxide-stained springs emerge along the East Fork of Rochester Creek, immediately downstream of a series of NE/SW-trending prospects. A short distance downstream, the water sinks back into the ground. Water does not reappear in the drainage for another mile downstream. Second, the tailings impoundment associated with the mill still contains ponded water. Although the impoundment appears to be in good condition, it could not be observed closely because it is on private land.

3.13.3.1 Site Features - Sample Locations

A water-quality sample (RWAS20H) was collected from one of the iron-stained springs that surfaces on BLM land below the NE/SW-trending prospects. A second sample (RWAS10H) was collected several hundred yards downstream, where the water from the springs sank back into the ground. The flow rates at these locations were 10 and 5.7 gpm, respectively. Samples also were collected from the East Fork of Rochester Creek upstream of the site (RWAS30H) and Rochester Creek downstream of the site (RROS20H). The flow rates at these locations were 43.8 and 0.65 gpm, respectively. All samples were collected on August 31, 1994.



Figure 3.24 Sample WRAS20H was collected from an iron-stained spring below a series of NE/SW-trending prospects.



Figure 3.25 The tailings impoundment associated with the inactive Watseca mill still contains ponded water.

3.13.3.2 Soil

Because erosion of waste materials in the area appeared negligible, no soil samples were collected.

3.13.3.3 Water

Concentrations of mercury exceeded water-quality standards at the iron-stained spring below the prospects and the spring on Rochester Creek downstream of the site. At the location where the iron-stained spring sinks back into the ground, the chronic aquatic life standard for copper was exceeded. Also, the field pH (3.88) of this sample fell outside the secondary MCL bounds; however, the laboratory pH (8.07) was within acceptable limits. Upstream of the mine and mill, the only water-quality exceedance was for manganese.

Table 3.10 Water-quality exceedances Watseca mine and mill.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
East Fork Rochester Creek - upstream of site (RWAS30H)									S										
Fe-stained spring on BLM land (RWAS20H)										C									
Spring water sinks into ground (RWAS10H)						C													S*
Rochester Creek - spring approx. 1 mile below site (RROS20H)										C									

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

* Laboratory pH was within the secondary MCL range

Note: The analytical results are listed in Appendix V.

3.13.3.4 Vegetation

Many of the waste-rock dumps in the area are barren to sparsely vegetated. Along the East Fork and Rochester Creek drainages grasses, willows and sage brush are growing. The vegetation near the iron-stained springs appears healthy.

3.13.3.5 Summary of Environmental Condition

The mercury concentration in the water downstream of the site ($0.64 \mu\text{g/L}$) is significantly higher than that upstream ($<0.1 \mu\text{g/L}$). One explanation for the increase is that mercury could have been used in the past to extract gold from ore and/or placer deposits. Waste materials deposited along the drainage could then be releasing the mercury to the ground water. Another possible explanation is that naturally high concentrations of mercury occur in the bedrock in this area. Consequently, ground water that has flowed through the rock would have elevated levels of mercury. Additional sampling and ground-water characterization is necessary to resolve this issue.

No other serious environmental problems were noted on BLM lands near the site.

3.13.4 Structures

The mill building is in fairly good condition but has suffered from vandalism in the recent past. Several headframes are still standing over shafts in the area. All of these structures are on private land.

3.13.5 Safety

Numerous mine openings are present in the area. They are a serious safety concern, but are on private land. The mill building and tailings impoundment may also be safety concerns, but they also are on private land and therefore were not inspected closely.

3.14 ROCHESTER MILL TAILINGS

3.14.1 Site Location and Access

The Rochester mill tailings (T3S R7W Sec 5 DCCA) are located on Rochester Creek, approximately nine miles northwest of Twin Bridges. The site is accessible by the road that follows Rochester Creek. The entire site is on BLM.

3.14.2 Site History - Geologic Features

Historical background of the tailings is uncertain; they may be from a flotation mill that operated from 1929 until 1932 near the Emma mine (Sahinen 1939).

3.14.3 Environmental Condition

A two-acre area covered by tailings is separated from Rochester Creek by a dike of unmineralized material. There is much evidence of wind transport of tailings at the northwest end of the site.

Runoff from the site drains to the southeast and collects in shallow depressions excavated in the tailings. White salts and iron stains are present along the runoff channels. A portion of the water that collects in the depressions presumably infiltrates the ground, possibly impacting ground-water quality. A large spring is located a short distance downgradient of the site.

3.14.3.1 Site Features - Sample Locations

A water-quality sample (RROS20H) was collected from a spring along Rochester Creek upstream of the site. The flow rate of the spring was 0.65 gpm. A second sample (RROS10H) was collected from the spring below the site. The flow rate at this location was 66 gpm. All samples were collected on August 30, 1994.

3.14.3.2 Soil

The BLM previously sampled the soils and waste at the site; therefore, no samples were collected for this project.

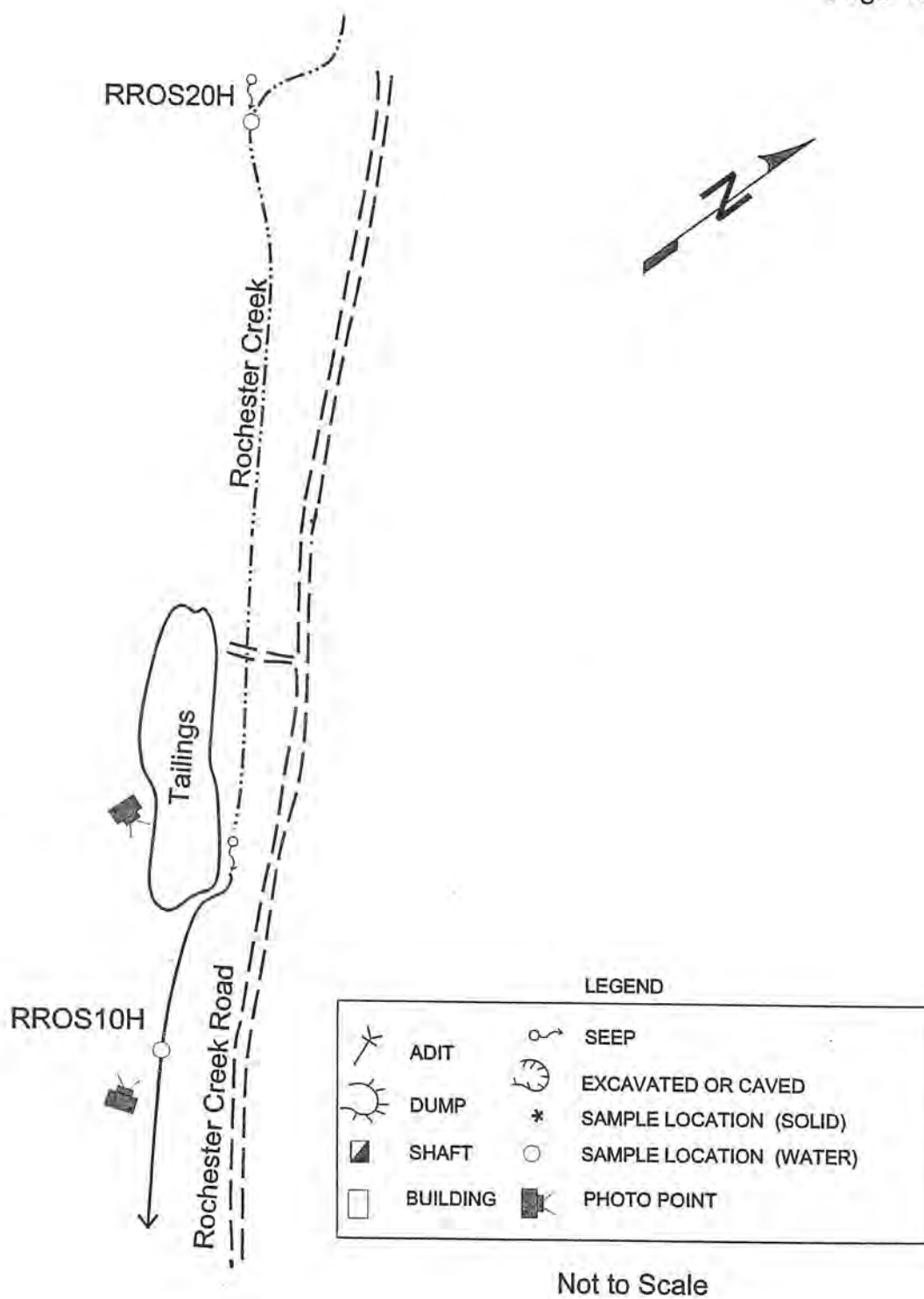


Figure 3.26 Site map of the Rochester mill tailings, August 1994.



Figure 3.27 Stormwater runoff ponds in shallow depressions at the southeast end of the site.



Figure 3.28 Sample RROS10H was collected from a spring below the site.

3.14.3.3 Water

The mercury concentrations in the springs above and below the site exceeded the chronic aquatic life criteria; however, the concentration in the upgradient spring ($0.64 \mu\text{g/L}$) was higher than that in the downgradient spring ($0.12 \mu\text{g/L}$), which suggests that the tailings are not the only possible source of this contaminant. The concentration of arsenic was slightly elevated in the downgradient spring ($13.6 \mu\text{g/L}$ vs. $2.9 \mu\text{g/L}$) but was still well within acceptable limits.

Table 3.11 Water-quality exceedances at the Rochester mill tailings.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Rochester Creek - spring upstream of site (RROS20H)										C									
Rochester Creek - downstream of site (RROS10H)										C									

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

* Laboratory pH was within the secondary MCL range

Note: The analytical results are listed in Appendix V.

3.14.3.4 Vegetation

The tailings are almost devoid of vegetation, but a few clumps of sage brush are still hanging on here and there. At the northwest end of the site, the windblown tailings have choked out all of the grasses and low plants, but sage brush is still growing. The vegetation near the spring below the site is dense and appears healthy.

3.14.3.5 Summary of Environmental Condition

The lack of vegetation and the presence salts and iron-stained areas suggest that the tailings are having an adverse environmental impact on the area. Soil and tailings samples have been collected previously by the BLM (October 1993) and

analyzed using the toxicity characteristic leaching procedure (TCLP). Results indicate that lead (maximum: 14.6 mg/L) is the only contaminant which exceeds its maximum allowable concentration (5.0 mg/L).

Water quality downgradient of the site may be slightly degraded by trace metals leaching from the tailings. Ground-water sampling and additional surface-water sampling would be advisable at this site.

3.14.4 Structures

No structures are present on the site.

3.14.5 Safety

No physical safety hazards were noted at the site.

3.15 SUMMARY OF MINING IMPACTS ON BLM-ADMINISTERED LAND - BIG HOLE RIVER DRAINAGE

Of the 11 sites with potential environmental problems in the Big Hole drainage, the Hidden Treasure mine on the north side of McCartney Mountain had the poorest water quality. A sample collected from an open stope at the site contained elevated concentrations of aluminum, arsenic, cadmium, copper, lead, and zinc. Fortunately, the water-quality problem at the site appears to be restricted to the area near the workings; Reservoir Gulch, which flows along the drainage below the site, had no water-quality exceedances. The Rochester tailings is another site with environmental problems. At this site, vegetation is struggling and wind blown tailings are being transported off the site. Water ponding on and subsequently infiltrating the tailings may be impacting ground-water quality locally; however, no ground-water samples were collected as part of the inventory. Other sites with relatively minor water-quality problems include the Short Shift mill, Hidden mine, and Watseca mine and mill. The Hidden Treasure, Rochester tailings, Short Shift mill, and Hidden mine are all on BLM-administered land; the Watseca mine and mill are on private land.

Three other sites, the Lower Pandora, Clipper and Wickiup mines, have discharges which appear to be contaminated with metals. However, these sites are on private land, so the discharges could not be sampled directly. Samples collected on BLM-administered land downstream of the sites had no water-quality exceedances.

The three placer sites (Kaserman, Camp Creek, and Upper Rochester) that were investigated in the Big Hole drainage were found to have no adverse environmental impacts. These sites are naturally revegetating.

Twenty-eight sites were identified that have safety concerns (see table 3.2). Of these sites, 27 have hazardous mine openings and 2 have unstable structures. Seventeen of the sites are on or immediately adjacent to BLM-administered land.

BLACKFOOT RIVER DRAINAGE

4.1 GEOLOGY

The area drained by the Blackfoot River lies primarily on the north half of the Butte and the south half of the Choteau 1° x 2° sheets. This area includes rocks from the Precambrian Belt Series, Proterozoic diorite and Tertiary/Cretaceous granodiorite stocks. These rocks include Missoula Group and Ravalli Group sediments as shown on the Choteau 1° x 2° quadrangle (Mudge *et al.* 1983). Belt rocks also crop out in the area mapped by Wallace *et al.* (1987) on the Butte 1° x 2° quadrangle, which also drains southward into the Blackfoot system. The area to the south of the Blackfoot also has Paleozoic and Mesozoic as well as Precambrian Belt rocks. The area to the north of the Blackfoot has been glaciated, and the valleys are presently filled with glacial gravels.

Authors who have mapped in this area include: Bierwagen (1964), the Black Mountain area, Lewis and Clark, and Powell counties; Brenner (1968), Lubrecht Experimental Forest; Desormier (1975), northern boundary of the Sapphire tectonic block; Kauffman and Earll (1963), Garnet-Bearmouth area; Melson (1964 and 1971) and Shea (1947), Lincoln area; and Wallace *et al.* (1987), who mapped the Butte 1° x 2° sheet and Mudge *et al.* (1983) who mapped the Choteau 1° x 2° sheet.

Theses in the area include: McGroder (1984) who described the Belt, Garnet Range Formation. Pearson (1978) mapped the Cambrian Hasmark's carbonate petrology in the vicinity of the Garnet Range. Cantwell (1980) conducted a gravity study in the Blackfoot-Nevada valley area.

4.2 ECONOMIC GEOLOGY

The area drained by the Blackfoot River encompasses many small mining districts as shown by Elliot *et al.* (1992). McClernan (1976 and 1983) published bulletins on the mines and mineral deposits of Powell, and Lewis and Clark counties, respectively. The main districts involving the Bureau of Land Management land are in the north half of the Garnet Mountains: Coloma, Elk Creek, Copper Cliff, the N½ of Clinton, Top O'Deep, and the N½ of Garnet districts. The south half of the Garnets drains toward the Clark Fork River. Other districts drained by the Blackfoot include Big Blackfoot, Lincoln Gulch, McClellan Gulch, Finn, W½ of Stemple-Gould, Seven-Up Pete Gulch, and the general "Blackfoot River area." Most of the other mining districts involve Helena, Lolo, and Lewis and Clark National Forest land with the margins locally administered by BLM. A small area of BLM land

around Mineral Hill and Marcum Mountain has had some prospecting for lead, silver, and zinc. Most deposits in the upper Blackfoot valley are associated with Precambrian Belt rock with or without intruded diorite sills or stocks (Shea 1947).

The mines in the Garnets are largely associated with the Cretaceous Garnet granodiorite stock which intruded Precambrian Belt rocks (Clinton), Cambrian Hasmark Formation (Coloma), or both (Garnet), or Devonian Jefferson carbonates. The Copper Cliff area is slightly different in that quartzites of the Precambrian Garnet Range Formation, shale and limestone of the Cambrian Silver Hill Formation, and dolomite of the Cambrian Hasmark Formation have been intruded by Tertiary volcanics. These rocks were then brecciated and mineralized in pipes.

The Garnet Range area in general was known as a large producer of silver, lead, manganese, and limestone (Elliot *et al.* 1992). Most named small districts in this area were known as gold, silver, and copper producers. Additionally, the Coloma district has produced barite; the Clinton district -- lead and zinc.

Mineralization is usually in veins in shear zones or in skarns associated with the Garnet stock. In the Garnet district, veins and replacement deposits are conformable to bedding (Elliot *et al.* 1992). Stout (1949) described the mines in the Ogden Mountain mining district. Clawson (1957) wrote a study on the Greenough barite mine.

Placers in the Blackfoot drainage include those up Poorman Creek, Lincoln Creek, McClellan Creek and the areas around Lincoln and those in the Garnets such as Coloma and Elk Creek. In Powell County, small placers such as Washington, American, Jefferson, Madison, Chicken and Deer Creek flow southwest from the Finn district into Nevada Creek (Lyden 1948).

4.3 HYDROLOGY AND HYDROGEOLOGY

The Blackfoot River in west-central Montana begins at the Continental Divide west of Lincoln and flows westward to its confluence with the Clark Fork River at Bonner. Major tributaries include Nevada Creek, Douglas Creek, Elk Creek, the Clearwater River (which includes Seeley Lake, Placid Lake, and Salmon Lake), and Union Creek. The mean annual discharge of the Black Foot near its confluence with the Clark Fork River is presented in table 4.1.

Table 4.1 Stream-gaging data for the Blackfoot River drainage.

Gage Location	Period of Record	Drainage Area (mi ²)	Annual Mean Flow (cfs)
Blackfoot R. near Bonner	1898-1994 *	2,290	2,480

*Based on data from 1900-01, 1904, 1940-1994

Source: Shields *et al.* 1995

The Blackfoot River is within the Rocky Mountain Physiographic Province. The drainage is bounded on the north by the Mission (6,233 amsl) and Swan ranges (6,693 amsl), on the east by the Continental Divide (8,660 amsl), and on the south by the Garnet Range (7,511 amsl).

All of the mountain ranges within the drainage were extensively glaciated. The area between the headwater of the Blackfoot River and its confluence with the Clearwater River is predominantly covered by terminal moraine, ground moraine, and alluvium. Below the confluence with the Clearwater River, Glacial Lake Missoula sediment covers the valley floor (Alden 1953).

Average annual temperatures in the Blackfoot River drainage are generally moderate, ranging from 40-45°F in the valley to 30-35°F in the mountains (Bergantino 1978). Average annual precipitation ranges from 16 inches in the valley to 20 inches in the Garnet Range to 40 inches in the higher elevations of the Mission Range and Swan Range (Montagne *et al.* 1982).

With no large population centers, ground-water development in the Blackfoot River drainage is generally limited to domestic and irrigation use. Well densities are greatest in the lower drainage above Bonner. Crop irrigation in the upper drainage is supplied by ground water and surface water. Recreational use (fishing and boating) of surface water is in high demand in the Clearwater tributary. Fishing is an important water use in the main drainage as well.

4.4 SUMMARY OF THE BLACKFOOT RIVER DRAINAGE

For the abandoned/inactive mine inventory, the MBMG investigated 69 mine and/or mill sites that are on or near BLM-administered land within the Blackfoot River drainage (see figure 4.1 and table 4.2). Of these sites, 49 were found to have no impact on BLM land, 3 may pose environmental problems, and 17 could not be located. The three sites with potential environmental problems are the Charcoal

(Shawbut) mine, the Mountain View mine and mill, and the Unnamed Barite (1) mine (listed in **bold** in table 4.2). These sites were investigated in detail and are discussed in the following sections.

If mine openings or other dangerous features (unstable structures, steep waste-rock dumps, high walls) were observed at a site, then the site was designated unsafe, or hazardous, in table 4.2. Of the 63 sites inventoried, seven were found to have safety concerns. It should be noted that the only sites screened for safety hazards in detail were those where soil and/or water samples were collected. Hazards may exist at many of the other sites, but they were not noted or observed during the inventory.

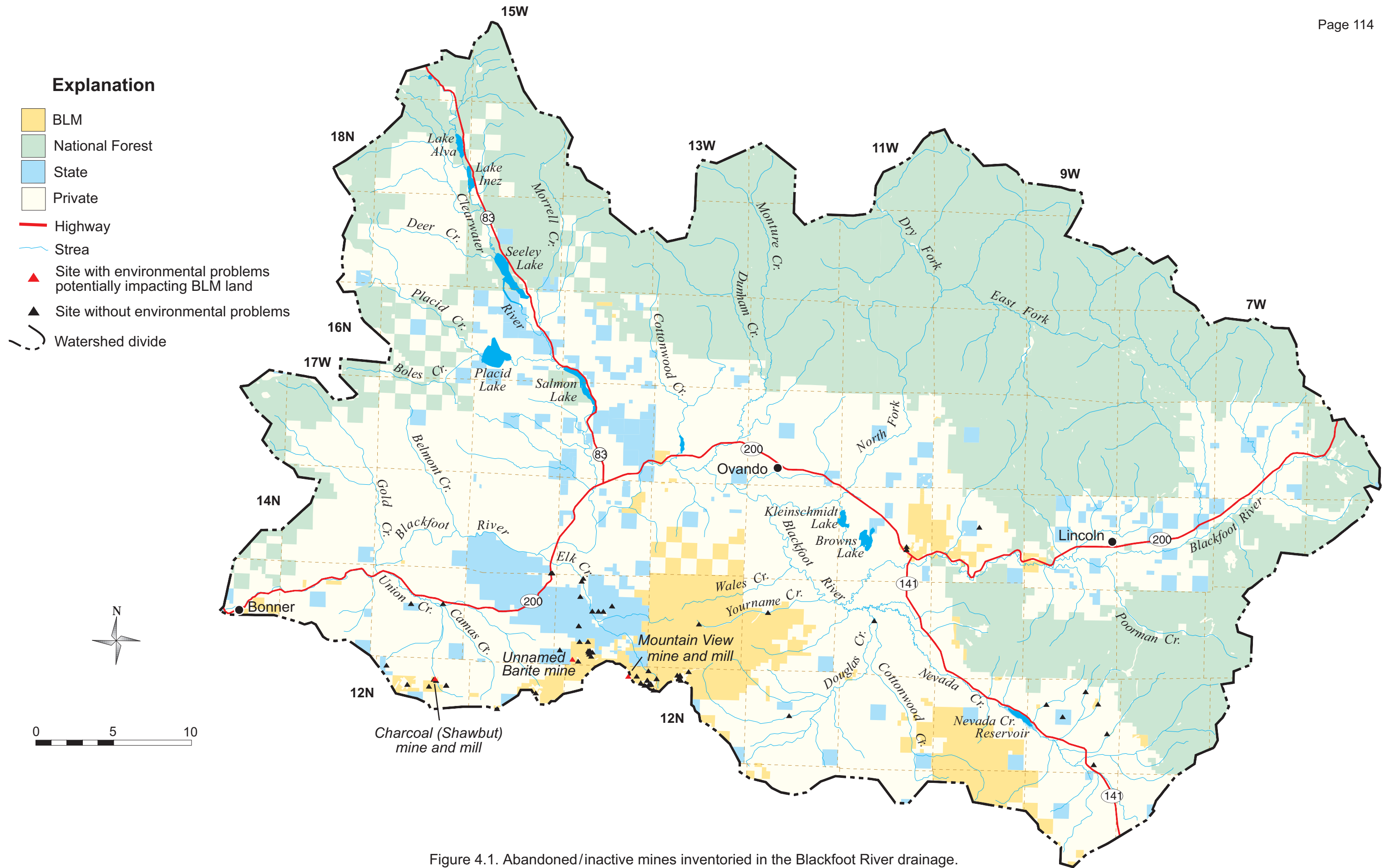


Figure 4.1. Abandoned/inactive mines inventoried in the Blackfoot River drainage.

Table 4.2 Summary of sites inventoried in the Blackfoot River drainage.
 Site name in **bold** indicates potential environmental problems. "Y" under Hazard indicates physical safety concern.

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Adaline	PRV	N	N	NE	Unable to locate.
Alabama	PRV	N	N	NE	Patented claim. Screened out in office.
Arkansaw	PRV	N	N	NE	Screened out in office.
Bilk and Weasel Gulch	MIX	Y	N	N	Mostly patented placer. Dry.
Blue Bird	UNK	N	N	NE	Unable to locate.
Boston	PRV	Y	N	N	Patented. Dry.
Buffalo Gulch	PRV	N	N	NE	Screened out.
Cato	PRV	Y	N	N	Dry.
Charcoal (Shawbut)⁵	PRV	Y	Y	Y	Open adit with discharge, streamside waste-rock dump.
Chester	UNK	N	N	NE	Unable to locate.
Clemantha	PRV	Y	N	N	Dry. Reclaimed.
Coloma Barite Vein	MIX	N	N	NE	Active in 1994. Reclaimed in 1996.
Coloma Placer	STA	N	N	NE	Screened out in office.
Copper Cliff	PRV	Y	N	Y	One partially open shaft. Dry.
Copper King	STA	N	N	NE	Screened out in office.
Crystal Springs	PRV	Y	N	N	Dry.
Daisy	PRV	Y	N	N	Ephemeral spring. No effect on BLM.
Dandy	PRV	N	N	NE	Patented claim. Screened out in office.
Dixie	PRV	N	N	NE	Unable to locate.
Douglas Creek Basin Bentonite	PRV	N	N	NE	Screened out in office.

Table 4.2 Summary of sites inventoried in the Blackfoot River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Elk Creek and Tributaries (1)	BLM	Y	N	N	Dry.
Elk Cr. and Tributaries (2)	BLM	Y	N	N	Placer workings.
Elk Creek Barite Deposit	STA	N	N	NE	Screened out in office.
Elk Creek Placer	STA	N	N	NE	Screened out in office.
Frostbite Deposit	STA	N	N	NE	Screened out in office.
Gold Leaf	PRV	Y	N	N	Patented claim. Dry.
Golden Angel	PRV	Y	N	N	Patented claim. Dry.
Gowrie	PRV	N	N	NE	Screened out in office.
Greenough Deposits	STA	N	N	NE	Screened out in office.
Haparanda	PRV	N	N	NE	Unable to locate.
Hartford	UNK	N	N	NE	Unable to locate.
Herzer and Green Property	PRV	N	N	NE	Unable to locate.
Humdinger	Unk	N	N	NE	Probably same as Humdinger Group at T13N R9W Sec 35.
Idaho	PRV	N	N	NE	Screened out in office.
Jefferson Creek Placer	UNK	N	N	NE	Screened out in office.
Jenlo	UNK	N	N	NE	Unable to locate.
Joyce Number Two	STA	N	N	NE	Screened out in office.
Lead King (2)	PRV	N	N	NE	Screened out in office.
Leonard	BLM	Y	N	Y	Partially open adit. Dry.
Lincoln Valley Bentonite	PRV	N	N	NE	Screened out. Bentonite deposit.
Madison Gulch Placer	UNK	N	N	NE	Screened out.
Mammoth	PRV	Y	N	N	Dry.
Marcum Hill	MIX	Y	N	N	No impact.

Table 4.2 Summary of sites inventoried in the Blackfoot River drainage (continued).

SITE¹	OWNER²	VISIT	SAMPLE³	HAZARD⁴	REMARKS
Masculine	PRV	N	N	NE	Unable to locate.
Mineral Hill	MIX	Y	N	N	No impact.
Missoula Limestone	UNK	N	N	NE	Unable to locate.
Mongar	UNK	N	N	NE	Unable to locate.
Montana Barite	PRV	N	N	NE	Screened out in office.
Morse & Kennedy	PRV	N	N	NE	Placer on Elk Cr.?
Mountain View Mine and Mill⁵	BLM	Y	Y	Y	Adit discharges, streamside wastes. Openings, unstable structure.
Nellie	BLM	Y	N	Y	Mine openings.
Nelson and Dan 1 and 2	UNK	N	N	NE	Unable to locate.
Ohio and Buckeye	PRV	N	N	NE	Screened out in office.
Olympiad (Comet)	BLM	Y	N	Y	Partially caved adit. Dry.
Pearl	PRV	Y	N	N	Dry.
Powers Placer	BLM	Y	N	N	Placer workings.
Rambler	PRV	Y	N	N	Dry.
Roselle	MIX	Y	N	N	No impact.
Royal	PRV	N	N	NE	Screened out in office.
Silver Reef	UNK	N	N	NE	Unable to locate.
Stinkwater Pit	PRV	N	N	NE	Screened out in office.
Sumpter	PRV	N	N	NE	Unable to locate.
Unnamed 13N14W16ACDD	STA	N	N	NE	Screened out in office.
Unnamed Barite (1)	BLM	Y	Y	Y	Flooded quarry. Highwalls.
Unnamed Barite (3)	STA	Y	N	N	Dry.
Unnamed Gold	STA	N	N	NE	Screened out in office.

Table 4.2 Summary of sites inventoried in the Blackfoot River drainage (continued).

SITE¹	OWNER²	VISIT	SAMPLE³	HAZARD⁴	REMARKS
Valley	PRV	Y	N	N	Dry.
Washington Gulch	UNK	N	N	NE	Unable to locate.
Yourname Placer	PRV	N	N	NE	Screened out in office.

1) Mines in **bold** may pose environmental problems and are discussed in the text; others are included only in appendix II (all mines) and appendix III (sites visited).

2) Administration/Ownership Designation

BLM: Bureau of Land Management

PRV: Private

MIX: Mixed (BLM and private)

STA: State of Montana

UNK: Owner unknown

3) Solid and/or water samples

4) Y: Physical safety hazards exist at the site.

NE: Physical safety hazards were not evaluated.

5) Mill site present

4.5 MOUNTAIN VIEW MINE AND MILL

4.5.1 Site Location and Access

The Mountain View mine and mill (T12N R14W Sec 2 CBDA) are located on BLM land at the head of McManus Gulch. McManus Gulch is a tributary to Elk Creek, which flows into the Blackfoot River. The site is accessible via an unmarked road that begins a short distance from the parking lot for the Garnet ghost town.

4.5.2 Site History - Geologic Features

Workings at the Mountain View include at least 8 adits (3 open and 5 collapsed), and a couple of prospect pits and open-cuts (see figure 4.2). In addition, there are several small to medium-sized waste-rock dumps; the dump next to the mill contains waste-rock mixed with tailings. Host rock is Precambrian Belt quartzite (Garnet Range Formation?). It appears that a vein deposit with white, coarsely crystalline quartz gangue was mined. The only apparent sign of mineralization is masses of limonite embedded in the quartz. Trauerman and Waldron (1940) indicated that the site was a gold prospect. An assay sample collected from the dump next to the mill contained 38 ppm lead, 26 ppm zinc, 143 ppm copper, 3.4 ppm silver, 0.225 ounces of gold, and less than 2 ppm arsenic. Information on mine history and production is incomplete; the company purportedly shut down operations in 1939 (Trauerman and Waldron 1940).

4.5.3 Environmental Condition

A small discharge flows from the open adit (A1) immediately southeast of the mill. The discharge flows around the east side of the medium-sized dump next to the mill and then sinks into the ground. On the drainage above the mill, there is a second adit (A3) with a discharge. This discharge flows past the remains of a cabin and then sinks into the top of a waste-rock dump. A seep emerges from the side of the dump and drains into a small marshy area next to an old haul road. From there, the water runs down the natural drainage, eventually flowing past the west side of the mill. This is the headwater of McManus Gulch.

4.5.3.1 Site Features - Sample Locations

Water-quality samples were collected at the site on June 28 and 29, 1995. Sample MMVS10H was collected from the adit discharge southeast of the mill; sample MMVS40M was collected below the waste-rock dump, where the discharge sinks into the ground. The flow rates at these two locations were 5.5 and 3 gpm,

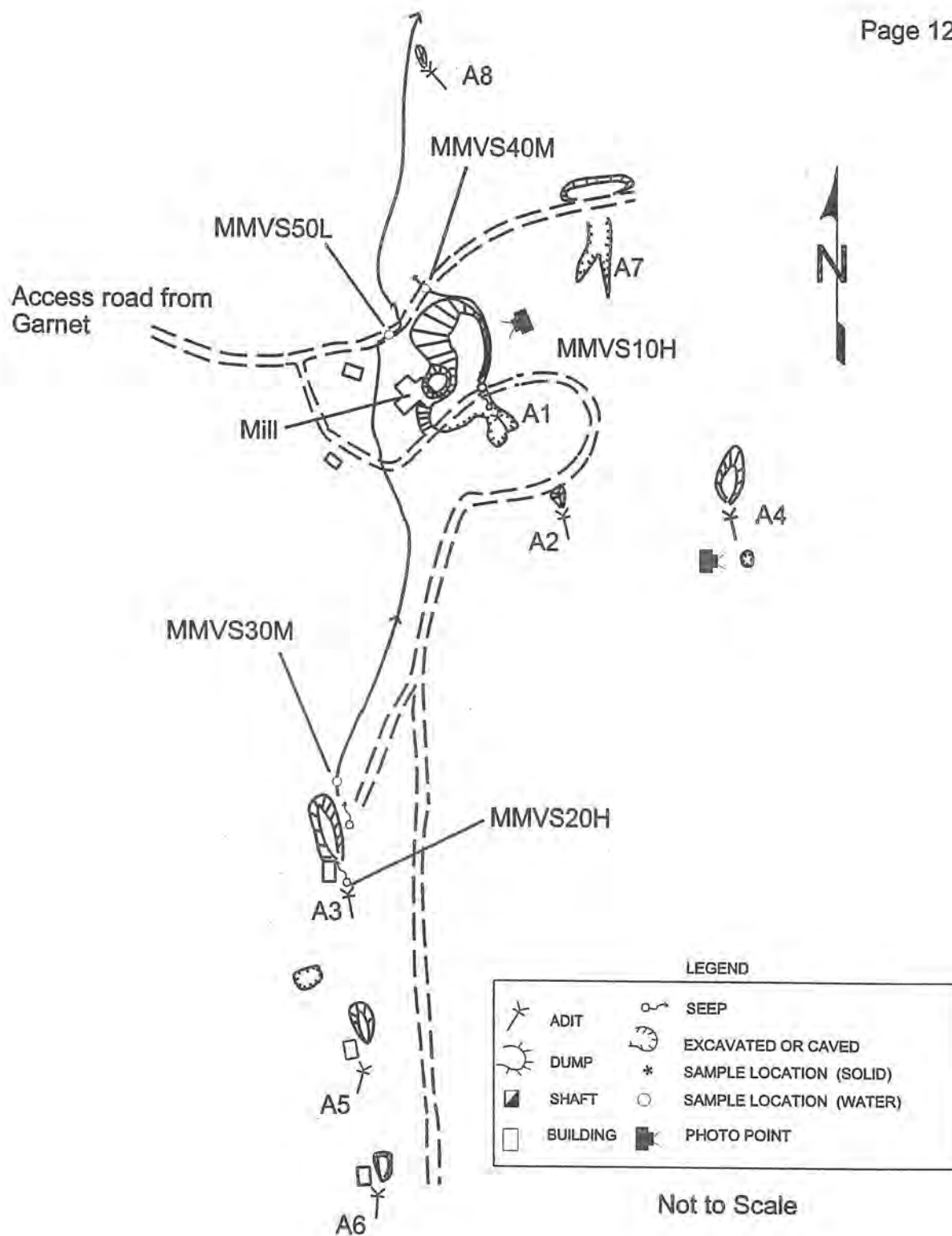


Figure 4.2 Sketch map of the Mountain View mine and mill, June 1995.



Figure 4.3 The mill building at the Mountain View is in poor condition.



Figure 4.4 Several hazardous mine openings are located around the site, including this collapse feature associated with adit A4.

No evidence of soil contamination was observed along the drainage below the mine; therefore, no soil samples were collected.

The pH's of both the adit-A3 discharge and waste-rock seep fell below the lower secondary MCL limit of 6.5; however, no metals exceeded water-quality standards. The sample from McManus Gulch had a low pH and a high concentration of aluminum.

[illegible]

Table 4.3 Water-quality exceedances at the Mountain View mine and mill (continued).

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
McManus Gulch - below the mill (MMVS50L)	S																		S*

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

* pH measured in laboratory was within acceptable MCL range of 6.5 to 8.5.

4.5.3.4 Vegetation

In general, the waste-rock dumps at the site are moderately vegetated with grasses, brush, and small trees. The vegetation along the drainage below the site is dense and appears healthy.

4.5.3.5 Summary of Environmental Condition

Although water from some of the discharges at the site is slightly acidic, aluminum appears to be the only metal leaching from the soil. Aluminum can be highly toxic to aquatic life, so there is a potential that impacts from the site may extend down McManus Gulch. Impacts to soils around the site appeared minimal. Much of the site has naturally re-vegetated.

4.5.4 Structures

The ruins of a 25-ton amalgamation mill (M11), two cabins (C1 and C2), and a powder storage room are found near the lower workings at the site. The remains of two other cabins (C3 and C4) can be found near workings farther up the drainage.

4.5.5 Safety

There are a number of serious safety concerns at the Mountain View. First,

there are two open adits (A2 and A4) which are accessible. The A2 adit has been closed with a cable net; however, a person could easily fit between the anchor points. The A4 adit was previously sealed, but vandals have removed the cable net. Another hazardous mine opening is located on the hillside a short distance above the A4 adit. The opening is about 8 feet wide and 20 feet deep and is apparently an open stope or air shaft related to the adit. Finally, the mill building is a potential safety problem because of its poor condition.

4.6 UNNAMED BARITE (1) MINE

4.6.1 Site Location and Access

The Unnamed Barite (1) mine (T13N R14W Sec 32 CBCA) is located on BLM-administered land near the head of Washoe Creek. Washoe Creek flows into Union Creek, a tributary to the Blackfoot River. The site is accessible by following the Washoe Creek Spur Road west from the Coloma ghost town.

4.6.2 Site History - Geologic Features

Workings at the Unnamed Barite (1) mine consist of a moderate-sized open pit with multiple dumps. Host rock appears to be a medium to dark gray quartzite, which is micaceous in part (Precambrian Garnet Range Formation?). The white, creme-colored, and yellowish barite occurs in a vein several feet thick. Some of the barite exhibits limonite staining and has manganese dendrites. An igneous dike is exposed near the vein (in the middle portion of the quarry); the rock appears to be a trachyte porphyry.

4.6.3 Environmental Condition

A fairly large freshwater pond is found in the open pit at this site. The pond is apparently fed by ground water since there is no surface inflow. A spring located along a small drainage several hundred yards northwest of the open pit is the only other water close to the site.

4.6.3.1 Site Features - Sample Locations

Water-quality samples were collected from the pond in the open pit (WUBS10L) and the spring northwest of the site (WUBS20M). The flow rate of the spring was 10 gpm. Both samples were collected on June 29, 1995.

4.6.3.2 Soil

No evidence of soil contamination was observed around the site; therefore, no soil samples were collected.

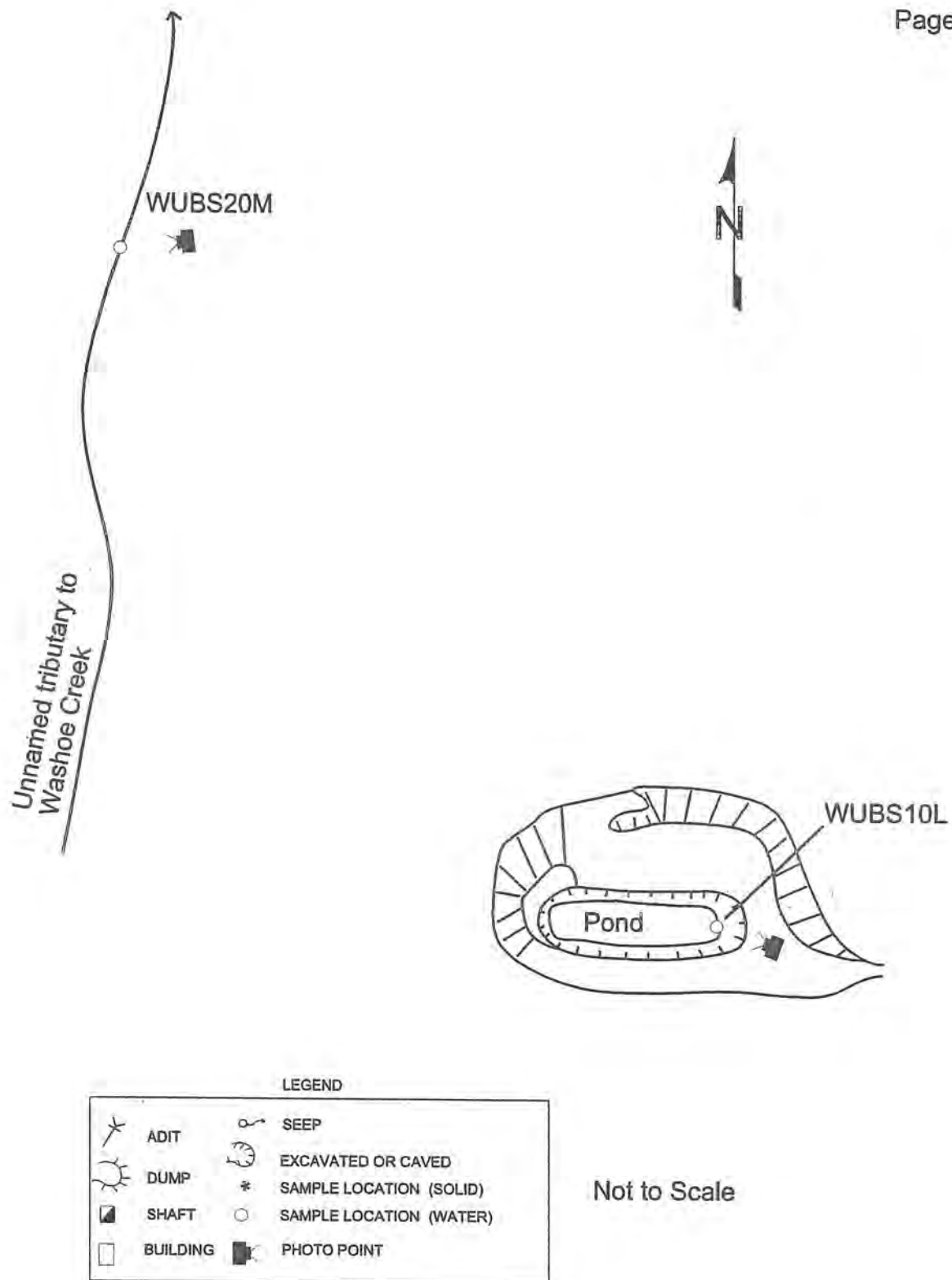


Figure 4.5 Sketch map of the Unnamed Barite mine, June 1995.



Figure 4.6 The open pit at the Unnamed Barite (1) mine is partially flooded.



Figure 4.7 Sample WUBS20M was collected from a spring along the small drainage northwest of the mine.

4.6.3.3 Water

The water in the open pit contained an elevated concentration of aluminum. No other water-quality standards were exceeded at the site.

Table 4.4 Water-quality exceedances at the Unnamed Barite (1) mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Pond in open pit (WUBS10L)	S,C																		
Spring along drainage northwest of mine (WUBS20M)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

4.6.3.4 Vegetation

The waste-rock dumps at the site are sparsely vegetated with grasses and weeds. Vegetation in the undisturbed area surrounding the site appears healthy.

4.6.3.5 Summary of Environmental Condition

Water in the open pit has a high aluminum concentration, but there is no surface outflow from this area. Environmental problems at the site probably are restricted to the area near the pit. Water quality below of the site appears good.

4.6.4 Structures

No structures were observed at the site.

4.6.5 Safety

The open pit poses a hazard because of the steep highwalls and deep water.

4.7 CHARCOAL (SHAWBUT) MINE

4.7.1 Site Location and Access

The Charcoal (Shawbut) mine (T12N R16W Sec 10 AACB) is a patented claim along the East Fork of Ashby Creek. Ashby Creek flows into Camas Creek, a tributary to the Blackfoot River. The site is accessible by following the Ashby Creek Road south from Potomac.

4.7.2 Site History - Geologic Features

The Charcoal (Shawbut) workings consist of a partially collapsed adit, the ruins of a mill, and a waste-rock dump (see figure 4.8). Total surface disturbance is approximately 1.5 acres.

Host rock at the Charcoal (Shawbut) is granodiorite; one segment of the dump rock appears to be coarsely crystalline and may represent a sill or dike encountered in underground workings. There is minor iron-oxide staining of the wall rock above the adit and on the waste rock in the dump.

4.7.3 Environmental Condition

At this site, there is a streamside waste-rock dump and an adit with a small discharge. The streamside dump extends for approximately 200 feet along the edge of the East Fork of Ashby Creek, so there is a potential for erosion problems. The adit discharge, which has a flow rate of several gallons per minute, sinks into the ground a short distance from the portal but may still impact the nearby creek.

4.7.3.1 Site Features - Sample Locations

Water-quality samples were collected on BLM-administered land upstream (ACHS10H) and downstream (ACHS20H) of the site. The flow rate of the creek was 480 gpm at the upstream location and 600 gpm at the downstream location. Both samples were collected on August 8, 1995.

4.7.3.2 Soil

No evidence of soil contamination was observed downstream of the site, so no soil samples were collected.

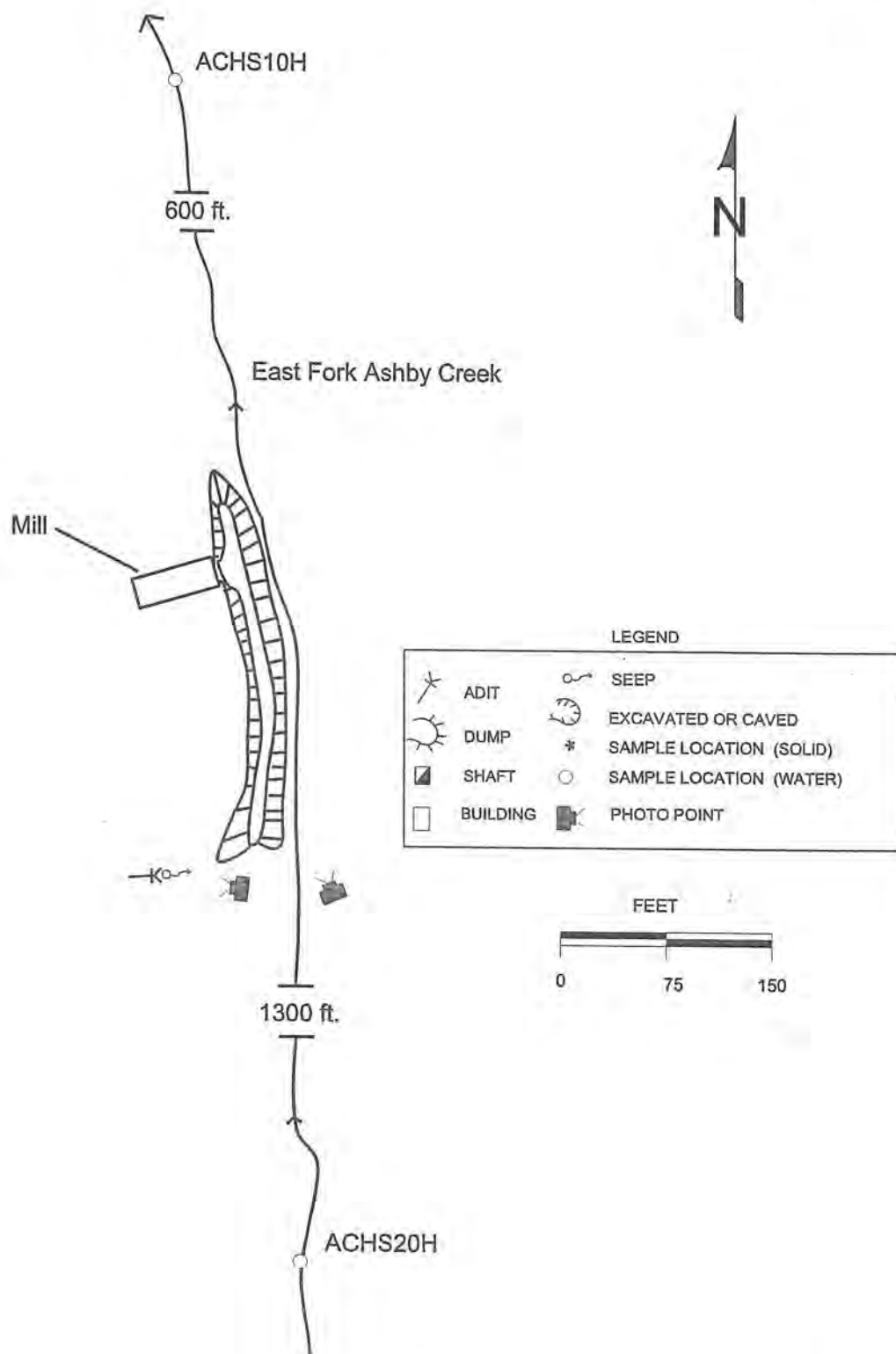


Figure 4.8 Site map of the Charcoal (Shawbut) mine and mill, August 1995.



Figure 4.9 A discharge flows from the open portal at the Charcoal (Shawbut) mine.



Figure 4.10 The streamside waste-rock dump is easily visible from the access road along the East Fork of Ashby Creek.

4.7.3.3 Water

The pH of the creek upstream and downstream of the site was above the secondary MCL upper limit of 8.5. No other analytes exceeded water-quality standards.

Table 4.5 Water-quality exceedances at the Charcoal (Shawbut) mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
E. Fk. Ashby Cr. - upstream of site (ACHS10H)																			S
E. Fk. Of Ashby Cr. - downstream of site (ACHS20H)																			S

Exceedance codes:

- P - Primary MCL
- S - Secondary MCL
- A - Aquatic Life Acute
- C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

4.7.3.4 Vegetation

Near the adit portal, abundant mosses and grass are growing. The streamside dump is barren of vegetation except for grasses that grow along the edge next to the creek. Vegetation on the BLM-administered land downstream appears healthy.

4.7.3.5 Summary of Environmental Condition

The streamside dump and adit discharge at the Charcoal (Shawbut) have the potential to impact the East Fork of Ashby Creek, but no evidence of soil or water contamination was found on BLM-administered land downstream.

4.7.4 Structures

The remnants of a mill are located on private land next to the streamside dump. No structures were observed on BLM-administered land.

4.7.5 Safety

The adit portal is a safety concern because it is open and easily seen from the road that passes the site.

4.8 SUMMARY OF MINING IMPACTS ON BLM-ADMINISTERED LAND - BLACKFOOT RIVER DRAINAGE

Of the 69 sites inventoried in the Blackfoot River drainage, three were found to have potential environmental problems affecting BLM-administered land. At the Unnamed Barite (1) mine, water in a flooded open pit contains elevated concentrations of aluminum. At the Mountain View site, an adit discharge and a seep from a waste-rock dump have pH's below the lower MCL limit of 6.5; also, the concentration of aluminum in a small stream below the site was found to be above the secondary MCL limit. The Unnamed Barite (1) and the Mountain View are located on BLM-administered land. At the Charcoal (Shawbut) mine, which is on private land, there is an adit discharge and a streamside waste-rock dump. Water samples collected from the East Fork of Ashby Creek upstream and downstream of the site had elevated pH's. Although no metals exceeded standards, sediment from the streamside waste rock could potentially wash into the creek during flooding events and thus contribute to metal loading.

Seven sites were identified that have safety concerns (see table 4.2). Of these sites, five have hazardous mine openings (Charcoal (Shawbut), Copper Cliff, Leonard, Nellie, and Olympiad (Comet)), one has dangerous highwalls (Unnamed Barite (1)), and one has both an unstable structure and mine openings (Mountain View). Five of the sites are on or immediately adjacent to BLM-administered land.

BOULDER RIVER DRAINAGE

5.1 GEOLOGY

BLM mine sites in the Boulder drainage are mostly contained within the Boulder and Amazon mining districts. Their geology was well described by Becraft *et al.* (1963), who mapped the Jefferson City 15-minute quadrangle and examined mines and prospects, and Roby *et al.* (1960), who described mines and prospects in Jefferson County. BLM land also runs along the Boulder from the I-90 Interstate Highway near Cardwell to the Devil's Fence area to the southwest side of the Elkhorn Mountains; this area has few mines, mostly small clay prospects and small lead-zinc-silver prospects.

In the area, quartz monzonite and granodiorite of the Cretaceous Boulder batholith have intruded quartz latite and andesite of the comagmatic Elkhorn Mountains volcanics (Rutland 1985; Watson 1986). Tertiary Lowland Creek volcanics and younger Tertiary rhyolite unconformably overlie portions of the batholith.

5.2 ECONOMIC GEOLOGY

The majority of mines and prospects explore veins of quartz, tourmaline, pyrite, galena, tetrahedrite, sphalerite, arsenopyrite, chalcopyrite, and siderite that occupy east-trending, late Cretaceous, extensional (Woodward 1986) shear zones in the batholith and adjacent areas of the Elkhorn Mountains volcanics. The veins are concentrated in several elliptical centers of mineralization. In these mineralization centers, veins are closely spaced, wide (up to 40 feet), and have alteration haloes with concentric quartz-sericite-pyrite, kaolinite-siderite, and montmorillonite-chlorite alteration products (Pinckney 1965). The veins can be several miles in length, but on their distal ends they narrow, have less wallrock alteration, bear fewer sulfides, and contain more siderite, chalcedony, and calcite. They were mined mainly for their silver and base metal content, although some contain appreciable amounts of gold. Silver-to-gold ratios are very high.

Production totals for the the Boulder and Amazon mining districts are 47,080 ounces of gold, 3,602,190 ounces of silver, 2,653,460 pounds of copper, 30,875,520 pounds of lead, and 23,919,840 pounds of zinc, worth \$17,569,440 at the time (Elliott *et al.* 1992). Most of this production came from a single mine, the Comet, in the High Ore Creek drainage. This mine also is responsible for most of the environmental damage in the area.

Uranium mineralization is associated with the late stages of hydrothermal activity in these veins (Becraft 1956; Thurlow and Reyner 1952). As a result, slightly elevated gamma radiation levels can be detected at many of the dumps and tailings piles. No uranium production from the area has been recorded.

5.3 HYDROLOGY AND HYDROGEOLOGY

The Boulder River drainage, in west-central Montana, east of the Continental Divide, flows from Elk Park Pass northward to Boulder and then southward to its confluence with the Jefferson River near Cardwell. Major tributaries include Bison Creek, Basin Creek, Cataract Creek, and Elkhorn Creek. Streamflow is monitored at one station in the drainage: on the Boulder River near Boulder (table 5.1).

Table 5.1 Stream-gaging data for the Boulder River drainage.

Gage Location	Period of Record	Drainage Area (mi ²)	Annual Mean Flow (cfs)
Boulder R. near Boulder	1929-1994*	381	117

*Specifically: May 1929 - December 1932, March 1934 - September 1972, and October 1984 - present.

Source: Shields *et al.* 1995

South and west of the town of Boulder, the drainage is bounded by the Continental Divide. The Elkhorn Mountains and Bull Mountain bound the north and east sides of the drainage below Boulder. The higher elevations of the Continental Divide and the Elkhorn Mountains were glaciated. Quaternary glacial moraines are found in several tributaries in the Continental Divide. The shallow deposits in Elk Park in the upper drainage and below Boulder in the lower part of the drainage are terrace and alluvial fan deposits (Alden 1953). The valley bottom is generally Quaternary alluvium between Basin and Boulder.

Average annual precipitation ranges from 12 inches in the lower valleys to 20 inches in the mountains (Montagne *et al.* 1982). Average annual temperatures range from 35-40°F in the valleys to 30-35°F in the mountains (Bergantino 1978).

Water use in the Boulder River drainage includes municipal water supplies at Basin (surface water) and Boulder (ground water), and domestic use and irrigation. There are about 3,500 acres of irrigated land above Boulder (Shields *et al.* 1995). Hot springs and wells have been developed at Boulder and at Boulder Hot Springs.

A moderate-size mining venture on Bull Mountain in the lower part of the drainage utilizes cyanide heap-leaching and retention ponds.

5.4 SUMMARY OF THE BOULDER RIVER DRAINAGE

The MBMG inventoried 45 sites on or near BLM-administered land within the Boulder River drainage (see figure 5.1 and table 5.2). Of these sites, 28 were found to have no environmental impact on BLM land, 15 may pose environmental problems, and 2 could not be located. The names of the 15 sites with potential environmental impacts are listed in **bold** in table 5.2. These sites were investigated in detail and are discussed in the following sections.

If mine openings or other dangerous features (unstable structures, highwalls, steep waste-rock dumps) were observed at a site, then the site is designated unsafe, or hazardous, in table 5.2. Of the 45 sites inventoried, eight were found to have safety concerns. The only sites carefully screened for safety hazards were those where soil and/or water samples were collected. Hazards may exist at many of the other sites, but they may not have been noted or observed during the inventory.

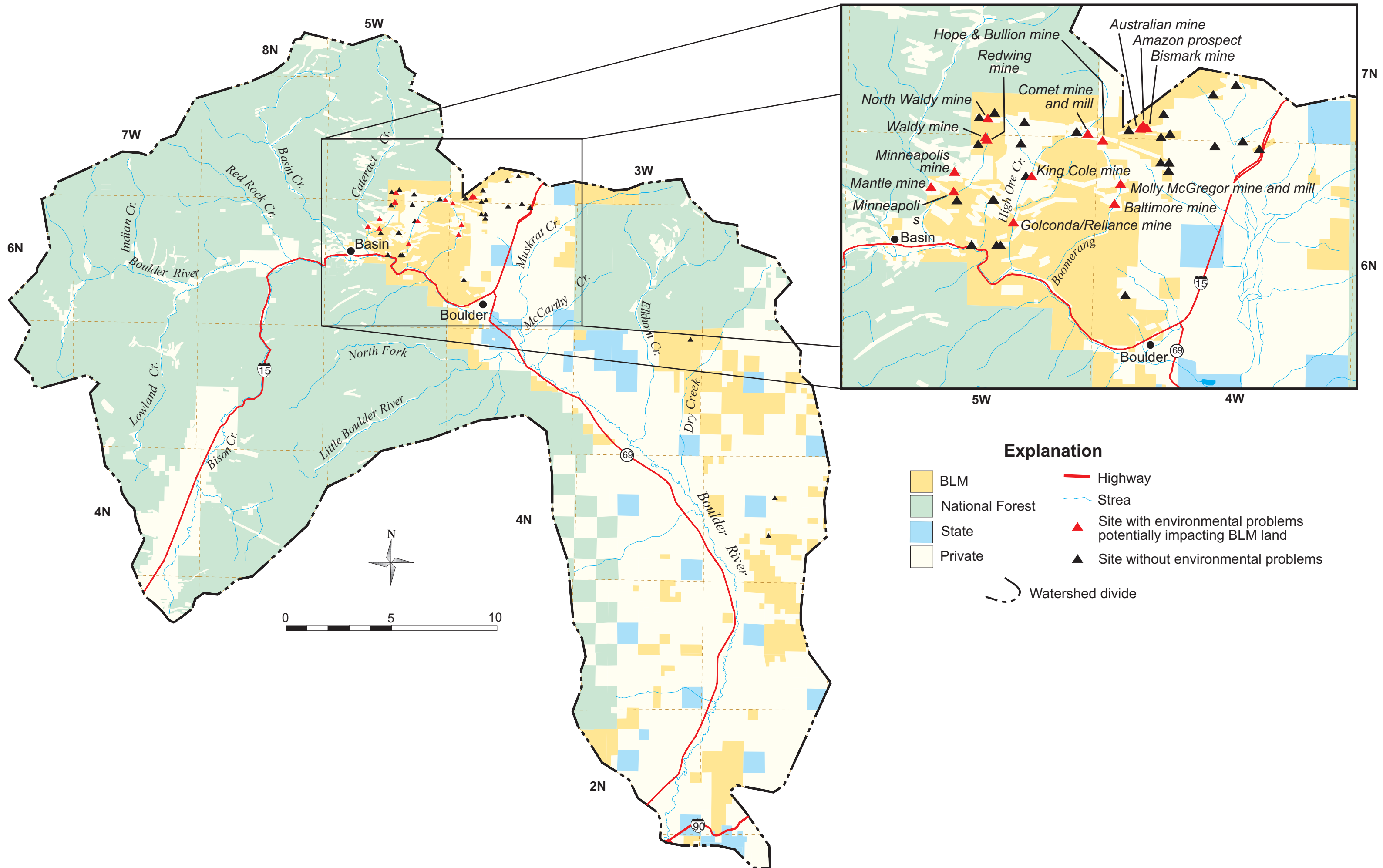


Figure 5.1. Abandoned/inactive mines inventoried in the Boulder River drainage.

Table 5.2 Summary of sites inventoried in the Boulder River drainage. Site name in **bold** indicates potential environmental problems. "Y" under Hazard indicates physical safety concern.

SITE¹	OWNER²	VISIT	SAMPLE³	HAZARD⁴	REMARKS
Amazon Prospect	BLM	Y	Y	N	Seep from waste-rock dump.
Australian	PRV	Y	Y	Y	Flooded open adit. Discharge.
Australian West	PRV	Y	N	N	Dry.
Baltimore	PRV	Y	Y	Y	Adit discharge. Open stope and adit.
Big Jim	PRV	N	N	NE	Screened in office.
Big Limber	UNK	N	N	NE	Unable to locate.
Bishop Creek	PRV	Y	N	N	Small discharge; no receiving stream.
Bismark	MIX	Y	Y	N	Adit discharge.
Bob Ingersoll	PRV	Y	N	N	Dry.
Boulder Iron	BLM	N	N	NE	Dry ridge.
Cleveland	PRV	Y	N	NE	Dry.
Comet⁵	PRV	Y	Y	Y	Streamside tailings and waste-rock dumps. Hazardous highwalls, mine openings, and structures.
Comstock	PRV	Y	N	N	Dry.
Copper King	PRV	N	N	NE	Observed from a distance. Dry.
Fairview	MIX	Y	N	NE	Dry, open cut.
Free Enterprise	PRV	Y	N	N	Dry.
Freeburg	PRV	N	N	NE	Screened in office. Dry, ridgetop location.
Golconda/Reliance	MIX	Y	Y	Y	Streamside waste-rock dump. Collapse area around adit.
Gray Eagle	PRV	Y	N	N	Dry.

Table 5.2 Summary of sites inventoried in the Boulder River drainage (continued).

SITE¹	OWNER²	VISIT	SAMPLE³	HAZARD⁴	REMARKS
Hiawatha	PRV	Y	N	N	Dry
High Ore	PRV	N	N	NE	Operating permit.
Hope and Bullion	PRV	Y	Y	Y	Discharge and streamside waste-rock dumps. Hazardous material and structures.
Ida	PRV	Y	N	N	Dry.
Independence	UNK	N	N	NE	Unable to locate.
J & F #1	MIX	Y	N	N	Dry.
King Cole	PRV	Y	Y	N	Streamside waste-rock dump.
Mantle	PRV	Y	Y	Y	Streamside waste-rock dump. Open adit on BLM land upstream of mine.
Minneapolis	PRV	Y	Y	N	Adit discharge.
Minneapolis Placer and Prospect	MIX	Y	Y	Y	Open adit. Mine waste in flood plain.
Molly McGregor Mine and Mill ⁵	PRV	Y	Y	Y	Streamside tailings. Hazardous structure.
Mono	PRV	N	N	NE	Screened out in office.
Mount Thompson	BLM	Y	N	NE	Dry.
North Waldy	BLM	Y	Y	N	Adit discharge.
Obelisk	PRV	N	N	NE	Screened in office. Dry hillside.
Pilot	PRV	N	N	NE	Screened out in office.
Queen of the Hills	PRV	N	N	NE	Observed from a distance. Dry.
Redwing	PRV	Y	Y	N	Adit discharge and streamside waste-rock dump.
Robert Emmet	PRV	Y	N	N	Dry.
Silmont	PRV	N	N	NE	Screened in office. Dry ridgetop.

Table 5.2 Summary of sites inventoried in the Boulder River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Silver Hill	PRV	Y	N	N	Part of Comet.
Unnamed Lead	PRV	N	N	NE	Screened in office.
Van Armin	PRV	Y	N	N	Dry.
Virginia	PRV	N	N	NE	Viewed from a distance. Dry ridge.
Waldy	BLM	Y	Y	N	Streamside waste-rock dump, seeps, and possible adit discharge.
Wilber Silver	PRV	Y	N	N	Dry.

1) Mines in **bold** may pose environmental problems and are discussed in the text; others are included only in appendix II (all mines) and appendix III (sites visited).

2) Administration/Ownership Designation

BLM: Bureau of Land Management

PRV: Private

MIX: Mixed (BLM and private)

UNK: Owner unknown

3) Solid and/or water samples (including leach samples)

4) Y: Physical safety hazards exist at the site.

NE: Physical safety hazards were not evaluated.

5) Mill site present

5.5 NORTH WALDY MINE

5.5.1 Site Location and Access

The North Waldy mine (T7N R5W 34 CABD) is on BLM land, about 3.5 miles northeast of Basin, Montana. The site can be accessed by a primitive road near the head of Big Limber Gulch.

5.5.2 Site History - Geologic Features

The site consists of a collapsed adit with a small, mineralized waste-rock dump. No record of this site was found in the literature.

5.5.3 Environmental Condition

A small discharge flows from the adit and down the south side of the waste-rock dump (figure 5.2). A short distance downhill, the discharge infiltrates the ground. Big Limber Gulch is located 300 feet east, so it may receive a small ground-water contribution from this area.

5.5.3.1 Site Features - Sample Locations

Water-quality samples were collected at the site on October 12, 1993. One sample was collected from the adit discharge (BWAS20M), which had a flow rate of 1.0 gpm. Another two samples were collected from Big Limber Gulch, upstream (BRWS90M) and downstream (BRWS10M) of the area likely to receive ground-water discharge from the site. The flow rate at the upstream location was 7.5 gpm; at the downstream location, the flow rate was 6.9 gpm.

5.5.3.2 Soil

Because the dump is not eroding appreciably, no soil samples were collected at the site.

5.5.3.3 Water

The adit discharge and Big Limber Gulch had no water-quality exceedances.

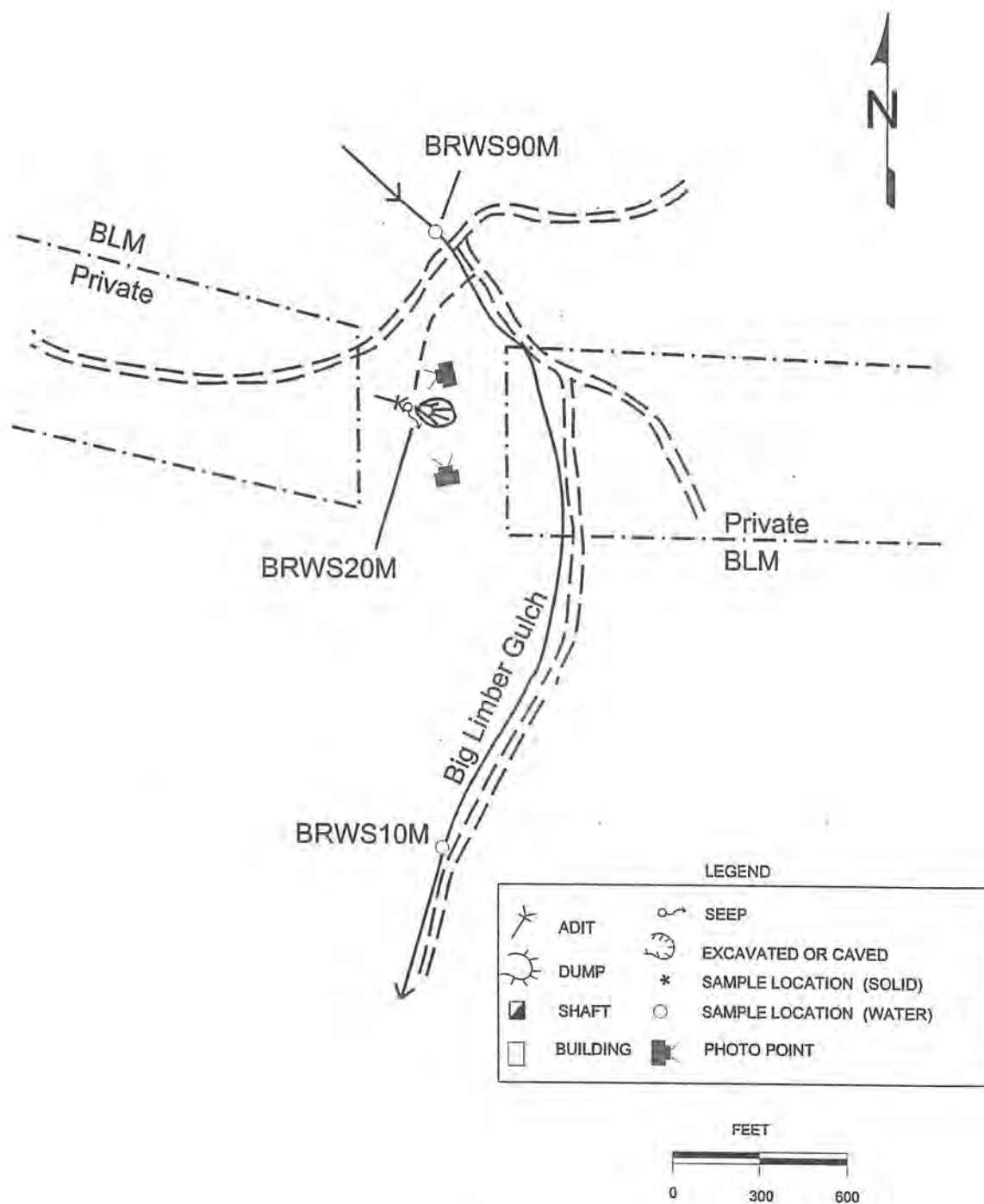


Figure 5.2 Site map of the North Waldy mine, October 1993.



Figure 5.3 At the North Waldy mine, a small discharge flows from a collapsed adit.



Figure 5.4 The adit discharge flows down the south side of the sparsely vegetated waste-rock dump.

Table 5.3 Water-quality exceedances at the North Waldy mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit A-1 discharge (BWAS20M)																			
Big Limber Gulch - upstream of site (BRWS90M)																			
Big Limber Gulch - downstream of site (BRWS10M)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in appendix V.

5.5.3.4 Vegetation

The vegetation along the path of the adit discharge appears healthy. The waste-rock dump is sparsely vegetated with grasses and conifers. The vegetation below the site appears to be healthy and unaffected.

5.5.3.5 Summary of Environmental Condition

Although a small discharge flows from the collapsed adit, the water quality is good. No environmental problems were identified at the site.

5.5.4 Structures

Some corrugated sheet metal is strewn about the top of the dump. It may be the remnants of an old mine building. No other structures were observed at the site.

5.5.5 Safety

The scrap metal on the dump may pose a slip-trip-fall hazard. Also, the steep embankments around the collapsed adit entrance may be a minor concern.

5.6 WALDY MINE

5.6.1 Site Location and Access

The Waldy mine (T6N R5W 3 BABA) is on Big Limber Gulch, about three miles northeast of Basin, Montana. The site is on BLM land and can be accessed by the road that runs along the gulch. The site is several hundred feet upstream of the Redwing mine, which is discussed in section 2.7.

5.6.2 Site History - Geologic Features

The Waldy consists of two crosscuts on a west-trending vein of chalcedony, pyrite, and siderite. A composite sample from the site's waste-rock dump contained 0.0105 oz/ton gold, 9.8 ppm silver, 63 ppm copper, 2,580 ppm lead, 982 ppm zinc, 316 ppm arsenic.

5.6.3 Environmental Condition

Several potential environmental problems exist at the site. First, Big Limber Gulch flows across the top and down the west side of the site's small waste-rock dump (figure 5.5). Some erosion is evident, so the dump is contributing at least a small amount to the stream's sediment load. Second, a small discharge flows from a collapsed adit at the north end of the dump; this water flows directly into Big Limber Gulch as the stream crosses the top of the dump. And third, near the base of the waste-rock dump, there is a marshy area that contributes a small volume of water to the stream.

5.6.3.1 Site Features - Sample Locations

Water samples were collected from the adit discharge (BRWS30H) and the marshy area below the dump (BRWS20H); the flow rates were 5.0 and 0.4 gpm, respectively. Samples were also collected from Big Limber Gulch upstream (BRWS10M) and downstream (BRWS40H) of the site. The upstream flow rate was 6.9 gpm; the downstream rate was 22.2 gpm.

A soil sample (BRWD10M) was collected along the west side of the dump, which is being eroded by the stream. All samples were collected on October 12, 1995.

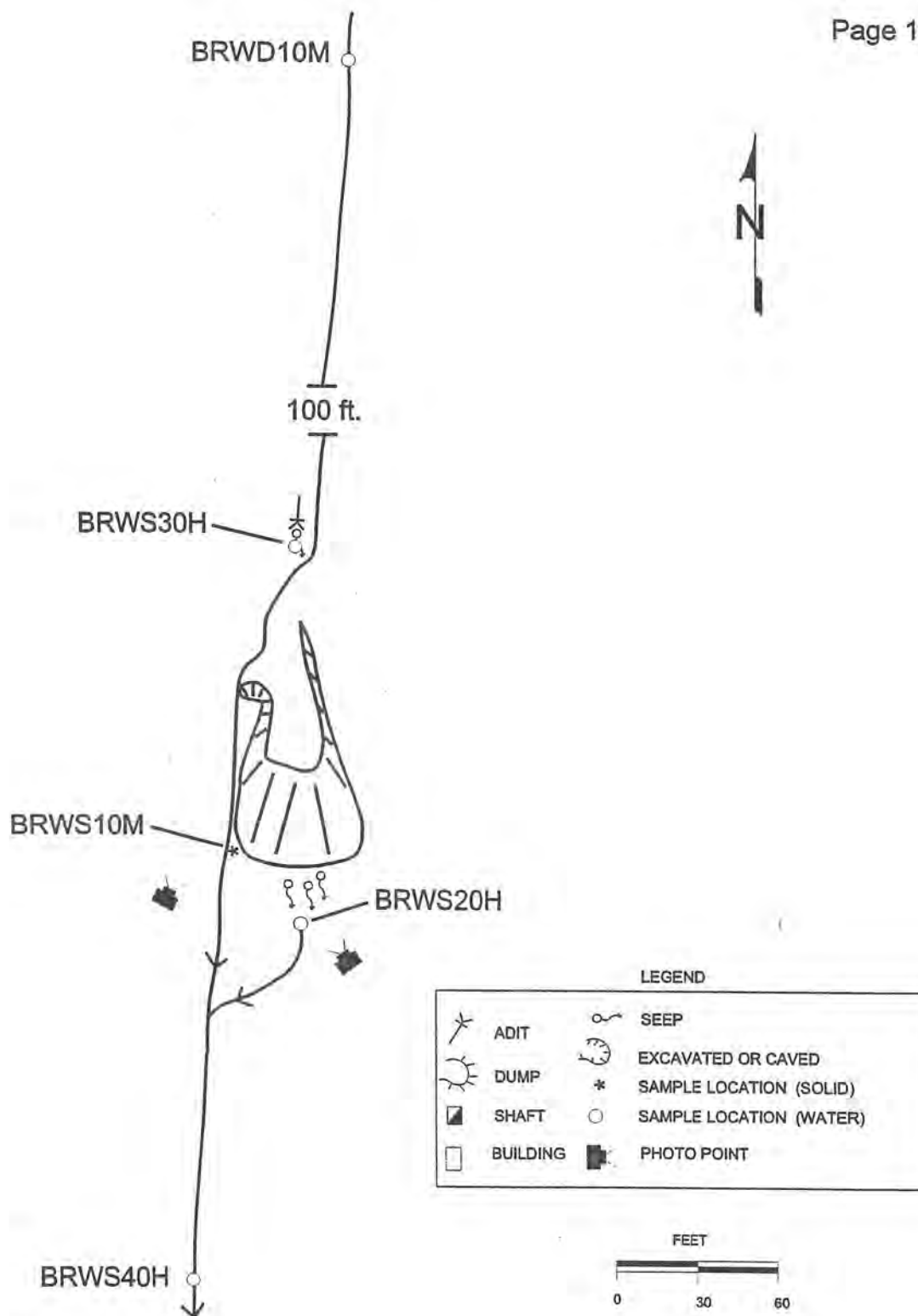


Figure 5.5 Site map of the Waldy mine, October 1995.



Figure 5.6 Big Limber Gulch flows down the west side of the waste-rock dump at the Waldy mine.



Figure 5.7 A marshy area at the base of the waste-rock dump contributes a small volume of water to Big Limber Gulch.

Table 5.5 Water-quality exceedances at the Waldy mine (continued).

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Big Limber Gulch - downstream of site (BRWS40H)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in appendix V.

5.6.3.4 Vegetation

Riparian grasses grow along the path of the adit discharge and within the marshy area below the waste-rock dump. Willows are present on the top of the dump, but the face of the dump is only sparsely vegetated with grasses. The vegetation below the site appears to be healthy and unaffected by the discharges from the site.

5.6.3.5 Summary of Environmental Condition

Although a small discharge flows from the collapsed adit and into Big Limber Gulch, the water quality of stream is not seriously impacted. Sediment eroded from the waste-rock dump may be a source of metals in the stream, especially during large runoff events.

5.6.4 Structures

No structures were observed at the site.

5.6.5 Safety

No safety hazards were observed at the site.

5.7 REDWING MINE

5.7.1 Site Location and Access

The Redwing mine (T6N R5W 3 BACA) is on BLM land along Big Limber Gulch. The site is a short distance downstream of the Waldy mine (see section 2.6) and can be accessed by the road that runs along the gulch.

5.7.2 Site History - Geologic Features

The Redwing consists of two adits and a streamside waste-rock dump (figure 5.8). Becraft *et al.* (1963) provide much information on the site. Veins striking N80°E and dipping 80°N were mined from the eastern extension of the Custer-Hiawatha zone. The veins were up to six inches wide and contained quartz, pyrite, galena, and sphalerite. A vein sample collected at the site contained a surprising 0.462 oz/ton gold, 131.5 ppm silver, 373 ppm copper, 4.18% lead, 2.60% zinc, and 2,170 ppm arsenic. The upper adit is 425 feet long, caved, and discharges some water. The associated dump adjoins the creek. A composite sample of this dump material contained 0.0040 oz/ton gold, 31 ppm silver, 50 ppm copper, 334 ppm lead, 360 ppm zinc, and 192 ppm arsenic.

5.7.3 Environmental Condition

Environmental concerns at the site include the streamside waste-rock dump and an intermittent discharge that flows from the upper adit into Big Limber Gulch. Near the confluence of the discharge and the stream, there is a patch of barren ground that has apparently been impacted by metals leaching from the dump.

5.7.3.1 Site Features - Sample Locations

Water-quality samples were collected at the site on October 12, 1993. One sample was collected from the adit discharge (BRWS60H), which was flowing at 0.2 gpm. Another two samples were collected from Big Limber Gulch immediately upstream (BRWS40H) and downstream (BRWS50H) of the site. The flow rates at these locations were 22.2 and 21.8 gpm, respectively. A fourth water sample was collected from Big Limber Gulch a quarter mile downstream of the site, at the approximate BLM/private property boundary. The flow rate at this location was 20.0 gpm.

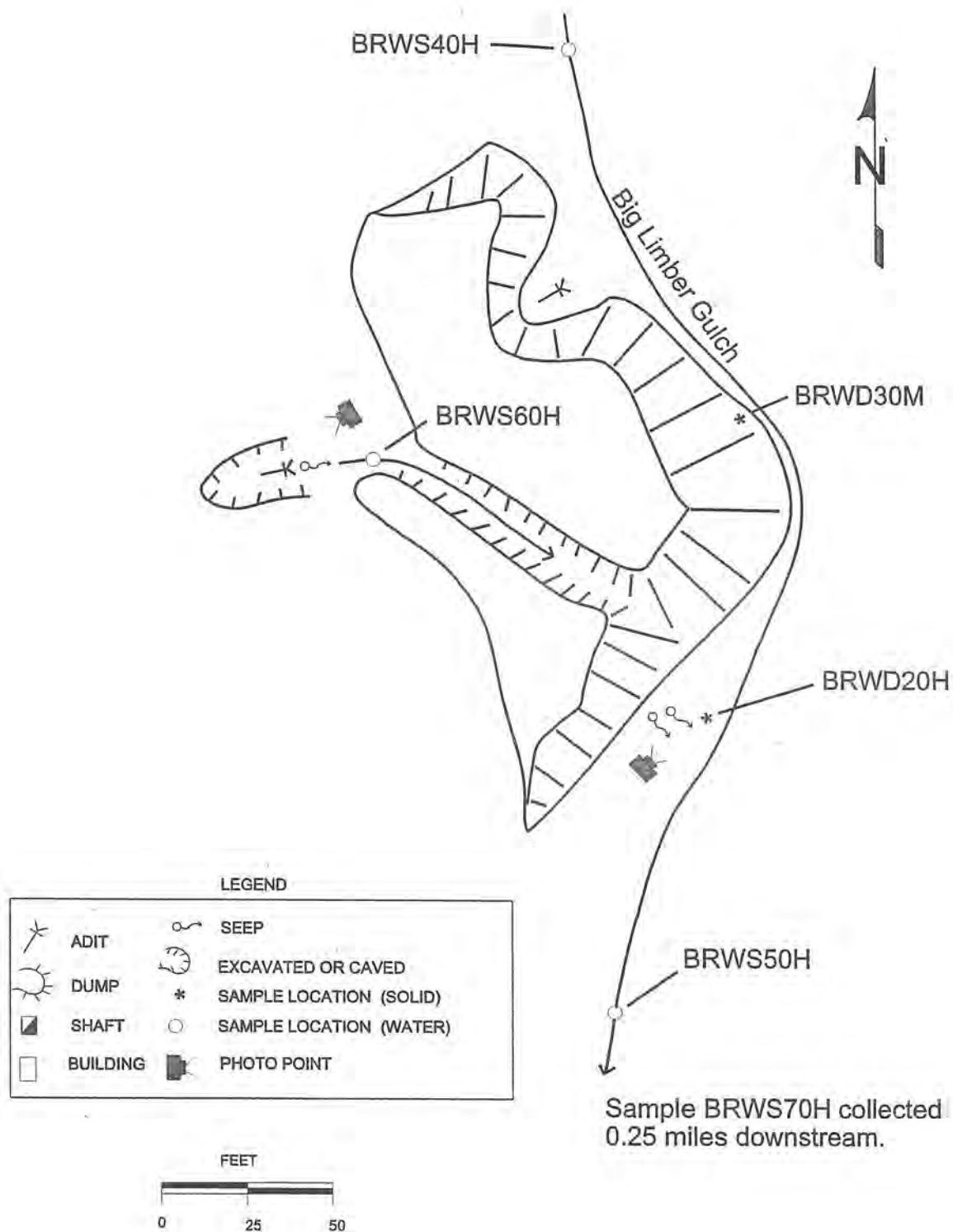


Figure 5.8 Site map of the Redwing mine, October 1993.



Figure 5.9 A small, intermittent discharge flows from the collapsed upper adit at the Redwing site.



Figure 5.10 Only moss grows on this small patch of ground that is impacted by the adit discharge.

A composite soil sample was collected along the edge of the dump adjacent to the stream. A second soil sample was collected from the barren patch of ground described previously.

5.7.3.2 Soil

Arsenic and zinc concentrations in the soil adjacent to the stream exceeded phytotoxic levels. Soil from the barren area had concentrations of arsenic and copper that exceeded phytotoxic levels. The analytical results are summarized in table 5.6.

Table 5.6 Soil sampling results for the Redwing mine.

Sample Location	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
Streamside waste-rock dump (BRWD30M)	198 ^{1,2}	6.03 ¹	69.4 ¹	613 ¹	1,040 ^{1,2}
Barren patch of ground near path of adit discharge (BRWD20H)	122 ^{1,2}	4.61 ¹	193 ^{1,2}	165 ¹	349 ¹

(1) Exceeds one or more Clark Fork Superfund background levels (table 1.3)

(2) Exceeds phytotoxic levels (table 1.3)

5.7.3.3 Water

The concentration of manganese in the adit discharge (0.074 mg/L) exceeded the secondary MCL (0.05 mg/L). The manganese MCL was also exceeded in Big Limber Gulch immediately downstream of the site (0.066 mg/L); however, farther downstream, no exceedance was noted. These results suggest that the site has a limited impact on the Big Limber Gulch drainage.

Table 5.7 Water-quality exceedances at the Redwing mine.

[illegible]

Table 5.7 Water-quality exceedances at the Redwing mine (continued).

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit A-1 discharge (BRWS60H)									S										
Big Limber Gulch - 125 ft. downstream of site (BRWS50H)									S										
Big Limber Gulch - 0.25 miles downstream of site (BRWS70H)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in appendix V.

5.7.3.4 Vegetation

The waste-rock dump is sparsely vegetated with grasses, weeds, and conifers. Downstream of the site, the vegetation appears healthy.

5.7.3.5 Summary of Environmental Condition

The soil at the edge of the waste dump adjoining Big Limber Gulch contains high metal concentrations. During high flow events, this material may add to the metal load in the stream. The small discharge from the upper adit has a manganese concentration that exceeds the secondary MCL; it appears that the discharge is impacting Big Limber Gulch for at least a short distance downstream.

5.7.4 Structures

An outhouse is the only structure at the site.

5.7.5 Safety

No serious safety hazards were noted at the mine.

5.8 MINNEAPOLIS MINE AND PLACER

5.8.1 Site Location and Access

The Minneapolis mine (T6N R5W 4 DCBD) and placer (T6N R5W 9 ACBC) are located along a small, unnamed tributary to Big Limber Gulch. The placer is a short distance upstream of where the tributary crosses Big Limber Gulch Road. The mine is approximately 0.6 miles farther upstream and can be accessed by hiking along an overgrown logging road. According to a BLM land ownership map (1:24k), the placer is on private and BLM property; the mine is on private property.

5.8.2 Site History - Geologic Features

Two caved adits at the Minneapolis total 4,000 feet in length (Roby *et al.* 1960). They drift on several 4-6 foot thick, east-west veins of quartz, pyrite, galena, sphalerite, and copper sulfides (Pardee 1933). The deposit was discovered about 1900, and worked intermittently from 1905 until 1949, with recorded production of 1,113 tons of ore bearing 97 ounces of gold, 19,031 ounces of silver, 6,640 pounds of copper, and 149,364 pounds of lead (Roby *et al.* 1960). The mine appears to be centered in a large area of altered, iron-stained quartz monzonite.

Small placer spoils and two small ponds are located along the stream about a half mile below the mine. On the hillside to the west of the ponds, there is a prospect with an adit and waste-rock dump. No production records were found for either the placer or the prospect.

5.8.3 Environmental Condition

At the mine, a ferric hydroxide-stained seep flows from one of the caved adits and sinks into the top of the mineralized waste-rock dump. During wet periods, the discharge may flow into the drainage adjacent to the site.

The placer spoils along the drainage below the mine are in contact with the stream. Although no sulfide mineralization was observed, mercury may have been used for extracting gold in the past. Therefore, the placer wastes may be an environmental concern.

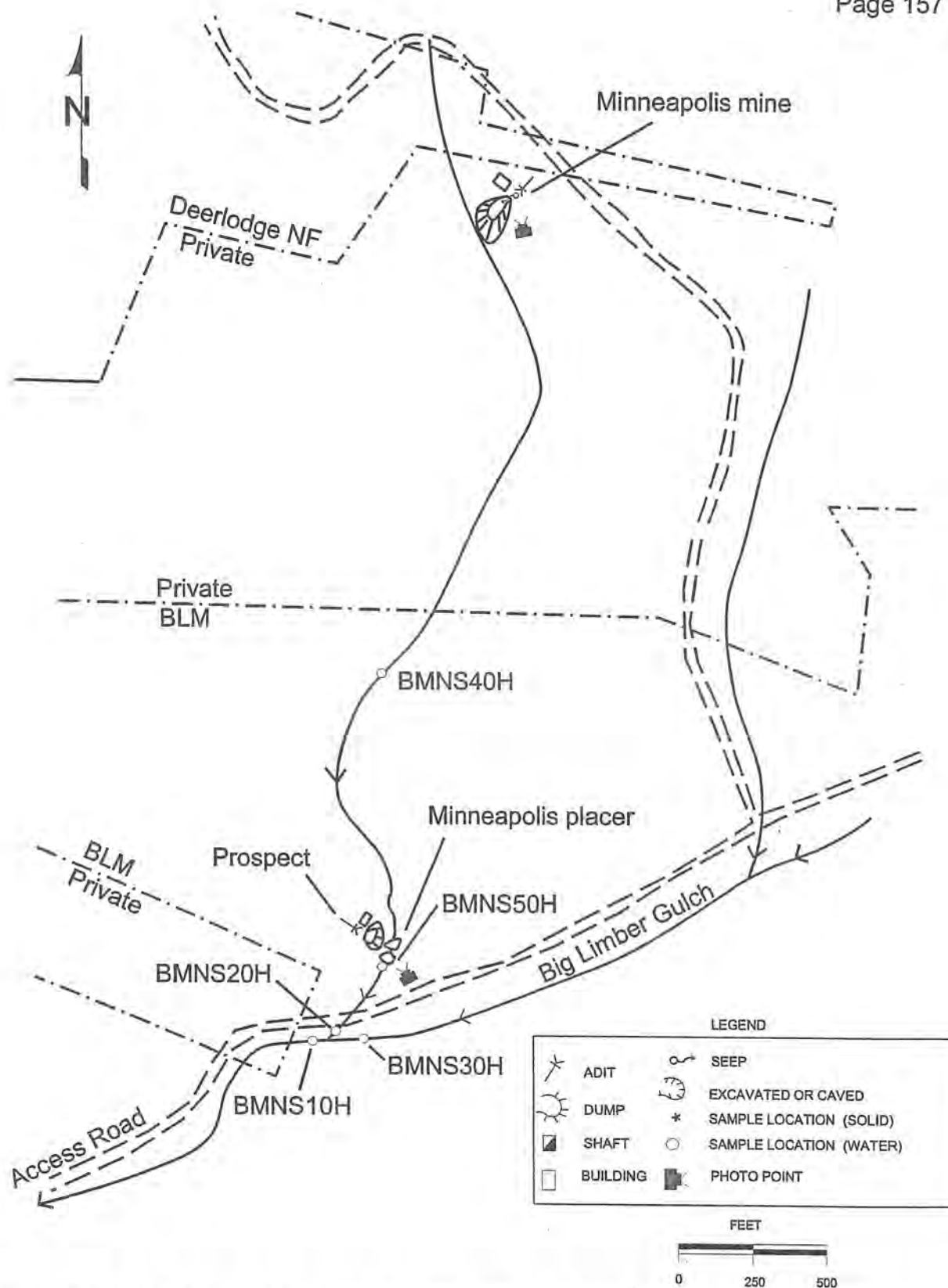


Figure 5.11 Site map of Minneapolis mine, prospect, and placer, October 1993.



Figure 5.12 At the Minneapolis mine, an iron-stained adit discharge flows into a grassy area on top of the waste-rock dump and then sinks into the ground.



Figure 5.13 Two ponds are located along the the unnamed tributary to Big Limber Gulch. They may have provided sluice water for the placer operation.

Table 5.8 Water-quality exceedances at the Minneapolis mine and placer (continued).

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Unnamed tributary - near confluence w/ Big Limber Gulch (BMNS20H)										C									
Big Limber Gulch - upstream of confluence with tributary (BMNS30H)								C											
Big Limber Gulch - downstream of confluence with tributary (BMNS10H)																			

Exceedance codes:

- P - Primary MCL
- S - Secondary MCL
- A - Aquatic Life Acute
- C - Aquatic Life Chronic

Note: The analytical results are listed in appendix V.

5.8.3.4 Vegetation

The waste-rock dump at the mine is barren to sparsely vegetated. Along the unnamed tributary, vegetation is generally dense. Most of the placered area has naturally re-vegetated with willows, cottonwoods, grasses, and weeds. The dump on the hillside above the placer ponds is sparsely vegetated.

5.8.3.5 Summary of Environmental Condition

The adit discharge has no apparent impact on the drainage below the mine. However, mercury is present in the surface water downstream of the placered area. As noted previously, mercury may have been used at the site for extracting gold from the placer deposit. Further sampling will be required to verify and characterize the occurrence of this contaminant.

5.8.4 Structures

At the mine, the only structure is the remnants of a cabin. At the prospect on the hillside above the placer ponds, there is a trailer that contains some machinery (possibly a compressor?).

5.8.5 Safety

The prospect on the hillside above the placer ponds has an adit that has previously been sealed with a culvert and grate. However, the soil and rock around the top of the culvert have collapsed, leaving an opening large enough for an adult to crawl through. This feature may be on BLM land.

5.9 MANTLE MINE

5.9.1 Site Location and Access

The Mantle mine (T6N R5W 9 BBCC) is on the west side of Cataract Creek, approximately a half mile upstream of the confluence with Big Limber Gulch. The site is on private land, but BLM property is located a short distance both upstream and downstream (see figure 5.14). The site can be accessed by following the Cataract Creek Road from Basin.

5.9.2 Site History - Geologic Features

The Mantle exploited a thin (6 to 16 inches) quartz-pyrite-galena vein for gold--an unusual major commodity in Boulder batholith deposits. Between 1921 and 1939, 326 tons of ore were processed to acquire 489 ounces of gold, only 637 ounces of silver, 184 pounds of copper, and 4868 pounds of lead. The property contained two 300-400 foot adits, a 100 foot shaft, and a 165-foot shaft, along with a water-powered gravity mill (Roby *et al.* 1960). In addition, there is a small adit on BLM land upstream from the site.

5.9.3 Environmental Condition

The Mantle has a large streamside waste-rock dump that is being actively eroded by Cataract Creek. The dump appears to be highly mineralized. No tailings were observed at the site.

5.9.3.1 Site Features - Sample Locations

Water-quality samples were collected on BLM property upstream (CMAS20M) and downstream (CMAS10M) of the site. The flow rates at these locations were 13.6 and 11.6 cfs, respectively. Both samples were collected on October 13, 1993.

5.9.3.2 Soil

No waste-rock or tailings were found on BLM land downstream of site; therefore, no soil samples were collected.

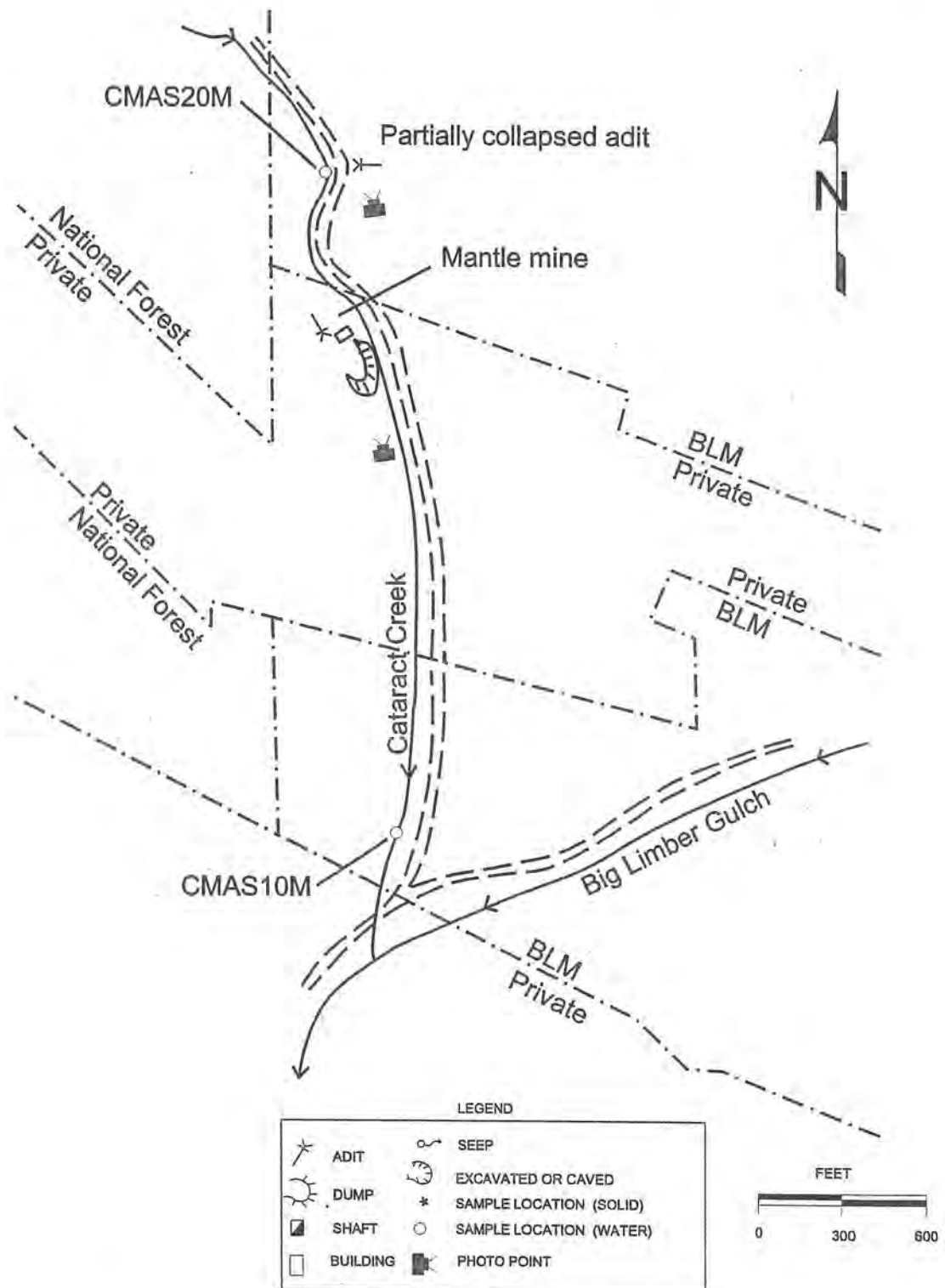


Figure 5.14 Site map of the Mantle mine, October 1993.



Figure 5.15 A large streamside waste-rock dump is being actively eroded by Cataract Creek at the Mantle mine.



Figure 5.16 A mine opening is located next to the road a short distance from the Mantle mine.

5.9.3.3 Water

Cadmium, copper, manganese, and zinc exceed water-quality standards upstream and downstream of the site. The similarity of the concentrations at the two locations suggests that the mine wastes from the Mantle are not contributing significantly to the dissolved metal load in the creek. The sources of the metals are mine wastes and discharges farther up the watershed (see Metesh *et al.* 1995).

Table 5.9 Water-quality exceedances at the Mantle mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Cataract Creek - upstream of mine (CMAS20M)				C		A,C			S				A,C						
Cataract Creek - downstream of mine (CMAS10M)				C		A,C			S				A,C						

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in appendix V.

5.9.3.4 Vegetation

The waste-rock dump is barren to sparsely vegetated. The vegetation downstream of the mine appears healthy.

5.9.3.5 Summary of Environmental Condition

Materials from the waste-rock dump do not contribute appreciably to the dissolved metal load in Cataract Creek under low flow conditions. However, during high flow events, the dump may be a significant source of metal-laden sediment.

5.9.4 Structures

A mine building is located at the north end of the waste-rock dump. It appears to be in fair condition.

5.9.5 Safety

The partially collapsed adit on BLM property upstream of the mine is a safety concern. The adit is adjacent to the road, making it easily accessible.

5.10 COMET MINE AND MILL

5.10.1 Site Location and Access

The Comet mine and mill (T7N R5W 36 DC) are situated along High Ore Creek, approximately four miles northeast of Basin, Montana. The main workings are on private property, but the site has extensively impacted BLM lands downstream. Access to the site is by the High Ore Creek Road, off Interstate 15.

5.10.2 Site History - Geologic Features

The Comet has been by far the largest producer of ore and environmental problems in the area. Knopf (1913), Pardee and Schrader (1933), Billingsley and Grimes (1917), Becraft (1956), Roby *et al.* (1960), and Becraft *et al.* (1963) provide the following information. The mine operated at least intermittently from 1880 until 1941. The orebody consisted of a 150-foot-wide mineralized zone of sericitized and tourmalinized granite with three main veins of sulfides and quartz. Sulfide minerals included galena, sphalerite, pyrite, chalcopyrite, tetrahedrite, and arsenopyrite. The ore also contained up to 0.52% uranium. The mineralized zone strikes N80°W and dips steeply north. Unpublished maps (MBMG files) show more than 20,000 feet of underground workings, including a 900-foot shaft. A large open pit is also present. Recorded production since 1902 has been 42,443 ounces of gold, 3,117,779 ounces of silver, 2,235,676 pounds of copper, 28,535,228 pounds of lead, and 23,486,020 pounds of zinc from 496,000 tons of ore.

A gravity mill was built in 1889, and a flotation mill operated from the late 1920's until 1941. Several hundred thousand tons of tailings still remain. Water in High Ore Creek has been diverted around the tailings, but previous to that tailings were washed and deposited by High Ore Creek for miles downstream. The tailings also have some seeps that flow into the creek.

5.10.3 Environmental Condition

Features at the site include two shafts, a large open pit, a mill, two tailings impoundments, and several large waste-rock dumps. The Silver Hill shaft, on the west side of the site, is flooded. Because all of these features are on private property, no site map was constructed.

As noted previously, a past reclamation project has attempted to route High Ore Creek around the tailings and waste-rock dumps, but these efforts have been largely ineffectual. Ferric-hydroxide stained seeps flow from the tailings and



Figure 5.17 Water collects in the tailings impoundment at the Comet mine and mill.



Figure 5.18 Vegetation has been visibly impacted by streamside tailings along High Ore Creek.

contribute about 10 gpm of water to the creek. Also, a large volume of tailings has been eroded and subsequently deposited along the entire length of High Ore Creek downstream of the site.

Two other mines, the King Cole and the Golconda/Reliance, are located along High Ore Creek downstream of the Comet. These sites have streamside waste-rock dumps that may contribute to the degradation of the creek but to a much lesser extent than the tailings from the Comet (see sections 2.6 and 2.7).

5.10.3.1 Site Features - Sample Locations

Streamside tailings up to several feet thick cover the banks of High Ore Creek for hundreds of feet immediately downstream of the site. BLM administers much of the property along this portion of the creek. Samples HCOD10H and HCOD20H were collected in this area. Farther down the drainage, the tailings deposits become thin and discontinuous. Samples HKCD10M, HGCD30M, and HGCD40M were collected from tailings deposits on BLM lands two to four miles downstream from the site.

To evaluate the site's impact on water quality, surface-water samples were collected from High Ore Creek immediately upstream (HCOS10M) and downstream (HCOS20H) of the mine. The flow rates of the creek at these two locations were 179 and 314 gpm, respectively. Additional samples (HKCS20H, HGCS10H, HGCS30H, HGCS40H, HGCS50H, and HGCS60H) were collected at points further down the drainage. Flow rates at these locations were 538, 493, 672, 627, 717 and 582 gpm, respectively. Samples HKCS10M and HGCS20H were collected from an unnamed stream and Peters Gulch. Both of these tributaries join High Ore Creek downstream of the site. The unnamed stream had a flow rate of 40 gpm; the flow rate of Peters Gulch was 2.8 gpm. Samples HKCS10M and HKCS20H were collected on September 29, 1993; all other samples were collected on September 28, 1993.

5.10.3.2 Soil

All of the soil samples collected along the High Ore Creek drainage had concentrations of arsenic, cadmium, copper, lead, and zinc in excess of Clark Fork background levels. The results of the soil analyses are summarized in table 5.10.

Table 5.10 Soil sampling results for the Comet mine and mill (mg/Kg).

Sample Location	As	Cd	Cu	Pb	Zn
Streamside tailings, 0.3 miles below Comet (HCOD10H)	4,600 ^{1,2}	34.1 ¹	482 ^{1,2}	2,520 ^{1,2}	3,650 ^{1,2}
Streamside tailings, 0.4 miles below Comet (HCOD20H)	1,290 ^{1,2}	8.54 ¹	188 ^{1,2}	1,470 ^{1,2}	885 ^{1,2}
Streamside tailings, 2.5 miles below Comet (HKCD10M)	2,840 ^{1,2}	41.2 ¹	380 ^{1,2}	2,170 ^{1,2}	7,330 ^{1,2}
Streamside tailings, 3.6 miles below Comet (HGCD30M)	1,250 ^{1,2}	15.0 ¹	144 ^{1,2}	695 ¹	2,080 ^{1,2}
Streamside tailings, 3.8 miles below Comet (HGCD40M)	2,810 ^{1,2}	6.77 ¹	239 ^{1,2}	1,470 ^{1,2}	923 ^{1,2}

(1) Exceeds one or more Clark Fork Superfund background levels (table 1.3)

(2) Exceeds phytotoxic levels (table 1.3)

5.10.3.3 Water

All of the samples collected from High Ore Creek downstream of the site exceeded water-quality criteria for cadmium, manganese, and zinc (see table 5.11). In addition, sample HGCS50H exceeded the chronic aquatic life standard for lead, and HGCS10H exceeded the secondary maximum contaminant level (MCL) for field pH. However, the laboratory pH of the sample did not exceed the standard.

The concentrations of metals and other constituents in High Ore Creek upstream of the site met all water-quality standards considered. The two tributaries that join High Ore Creek downstream of the site met all of the standards for metals; however, the field pH (8.9) for Peters Gulch exceeded the secondary MCL. The laboratory pH (8.1) of the sample did not exceed the MCL.

Table 5.11 Water-quality exceedances at the Comet mine and mill.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
High Ore Cr. - upstream of Comet (HCOS10M)																			
High Ore Cr. - 0.3 miles below site (HCOS20H)				P,A C					S				A,C						
Unnamed tributary of High Ore Cr. (HKCS10M)																			
High Ore Cr. - 0.6 miles below site (HKCS20H)				P,A C					S				A,C						
High Ore Cr. - 2.5 miles below Comet (HGCS10H)				A,C					S				A,C						S*
Peters Gulch - at confluence with High Ore Cr. (HGCS20H)																			S*
High Ore Cr. - 2.9 miles below site (HGCS30H)				P,A C					S				A,C						
High Ore Cr. - 3.2 miles below site (HGCS40H)				A,C					S				A,C						
High Ore Cr. - 3.6 miles below site (HGCS50H)				P,A C				C	S				A,C						
High Ore Cr. - 3.8 miles below site (HGCS60H)				P,A C					S				A,C						

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

* pH measured in laboratory was within acceptable MCL range of 6.5 to 8.5.

Note: The analytical results are listed in appendix V.

5.10.3.4 Vegetation

The tailings impoundments and waste-rock dumps at the site are barren. The streamside tailings within a mile downstream of the site are also barren. Farther downstream, the streamside tailings are barren to sparsely vegetated.

5.10.3.5 Summary of Environmental Conditions

The water and soil quality data collected along High Ore Creek indicate that BLM lands have been impacted by the mill tailings and discharges from the Comet site. The soils along the creek have elevated concentrations of metals from streamside tailings, and metal concentrations in the creek downstream of the site are substantially higher than those upstream and in the surrounding tributaries. The most severely impacted BLM land is immediately downstream of the site. In this area, there are thick streamside tailings deposits that are devoid of vegetation.

Although an attempt has been made to reduce the erosion of tailings from the Comet site by re-routing High Ore Creek, these efforts appear to have been ineffective. Release of tailings continues to impact soil and water quality along the entire drainage.

5.10.4 Structures

No buildings or structures are located on BLM lands along the creek. However, there are several mine and mill buildings at the site, and the town of Comet, adjacent to the mine, is one of the best preserved ghost towns in Montana. A mobile home in the middle of the town appears to be occupied year round.

5.10.5 Safety

Hazards at the Comet site include highwalls, steep slopes, and a flooded shaft. In addition, the structural integrity of the buildings is unknown. Because the site is easily accessible and there is a residence nearby, safety concerns are amplified. All of the noted concerns are on private lands. No physical safety hazards were observed on BLM-administered lands.

5.11 KING COLE MINE

5.11.1 Site Location and Access

The King Cole mine (T6N R5W 2 CDCA) is on private land along High Ore Creek, approximately 1.5 miles southwest of the Comet site. The mine is next to a camping/picnic area for the High Ore Radon Health mine. Small portions of BLM land are located upstream and downstream of the site. Access to the site is via the High Ore Creek Road off Interstate 15.

5.11.2 Site History - Geologic Features

Two adits, 700 and 900 feet long, drifted on an east-striking vein of quartz, galena, chalcopyrite, sphalerite, and pyrite. Recorded production is 160 tons of ore which yielded 13 ounces of gold, 2090 ounces of silver, and 378 pounds of copper (Roby *et al.* 1960).

5.11.3 Environmental Condition

A medium-sized waste-rock dump is located along the east bank of High Ore Creek. The waste is a mix of mineralized fines, sand, and gravel that is easily eroded. A seep flows from the east side of the dump into High Ore Creek. Because the site is on private land, no site map was constructed.

5.11.3.1 Site Features - Sample Locations

Surface water samples were collected from High Ore Creek on BLM lands upstream (HKCS20H) and downstream (HGCS10H) of the site. The flow rate of the creek at the upstream location was 538 gpm; at the downstream location, the flow rate was 380 gpm. The site was sampled on September 28 and 29, 1993.

5.11.3.2 Soil

No soil samples were collected because the site is on private land.



Figure 5.19 High Ore Creek flows around the west side of the waste-rock dump at the King Cole mine. A seep is located on the east side of the dump.

5.11.3.3 Water

Both the upstream and downstream samples collected from High Ore Creek exceeded water-quality standards for cadmium, manganese, and zinc. The downstream sample also exceeded the upper limit of the pH secondary MCL. Because the concentrations of metals upstream and downstream of the site are so similar (see appendix V), it appears that the site is not contributing much to the degradation of water quality in the creek. Instead, the sources of the metals are the discharges and streamside tailings associated with the Comet site (see section 5.10).

Table 5.12 Water-quality exceedances at the King Cole mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
High Ore Creek - upstream of site (HKCS20H)				P,A C					S				A,C						
High Ore Creek - downstream of site (HGCS10H)				A,C					S				A,C						S*

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

* pH measured in laboratory was within acceptable MCL range of 6.5 to 8.5

Note: The analytical results are listed in appendix V.

5.11.3.4 Vegetation

The waste-rock dump at the site is sparsely vegetated with grasses. The surrounding undisturbed area is moderately vegetated with grasses, willows, and conifers.

5.11.3.5 Summary of Environmental Condition

The streamside waste-rock dump and seep at the King Cole mine are not significantly impacting the water quality of High Ore Creek. The high concentrations

of cadmium, manganese, and zinc in the creek are related to the discharges and tailings from the Comet site.

5.11.4 Structures

A cabin in poor condition is located on private land northeast of the waste-rock dump. No buildings were observed on BLM lands.

5.11.5 Safety

The cabin may pose a minor safety risk because of its poor condition. No significant safety hazards were observed on BLM lands upstream and downstream of the site.

5.12 GOLCONDA/RELIANCE

5.12.1 Site Location and Access

The Golconda/Reliance mine (T6N R5W 14 BBBB) is on High Ore Creek, about 1.0 miles north of Interstate 15. According to a BLM property boundary map (1:24k), most of the site is on federal land. Access to the site is via High Ore Creek Road.

5.12.2 Site History - Geologic Features

Two caved adits with less than 1000 feet of combined length, investigate parallel N75°E veins of unknown mineralogy. Dump material is mostly quartz monzonite with kaolinite, siderite, and chlorite alteration products. Both dumps are adjacent to High Ore Creek. A composite sample from the mineralized portion of the lower dump contained 0.0015 oz/ton gold, 28.8 ppm silver, 494 ppm copper, 1,220 ppm lead, 6,670 ppm zinc, and 190 ppm arsenic. Roby *et al.* (1960) provided production records from 1905 to 1907: 254 tons of ore yielded one ounce of gold, 5,417 ounces of silver, 18,914 pounds of copper, and 16,022 pounds of lead.

5.12.3 Environmental Condition

Two mineralized waste-rock dumps are located on the banks of High Ore Creek. The areal extent of each dump is about 0.1 acre. Figure 5.20 is a map of the site.

5.12.3.1 Site Features - Sample Locations

Two soil samples, HGCD10H and HGCD20H, were collected from around the streamside edges of dumps W-2 and W-1, respectively. In addition, water-quality samples were collected from High Ore Creek upstream (HGCS30H) and downstream (HGCS40H) of the site to determine if the dumps contribute significantly to the metal load in the creek. The flow rate of the creek upstream of the site was 672 gpm; downstream of the site, the flow rate was 627 gpm. All samples were collected on September 28, 1993.

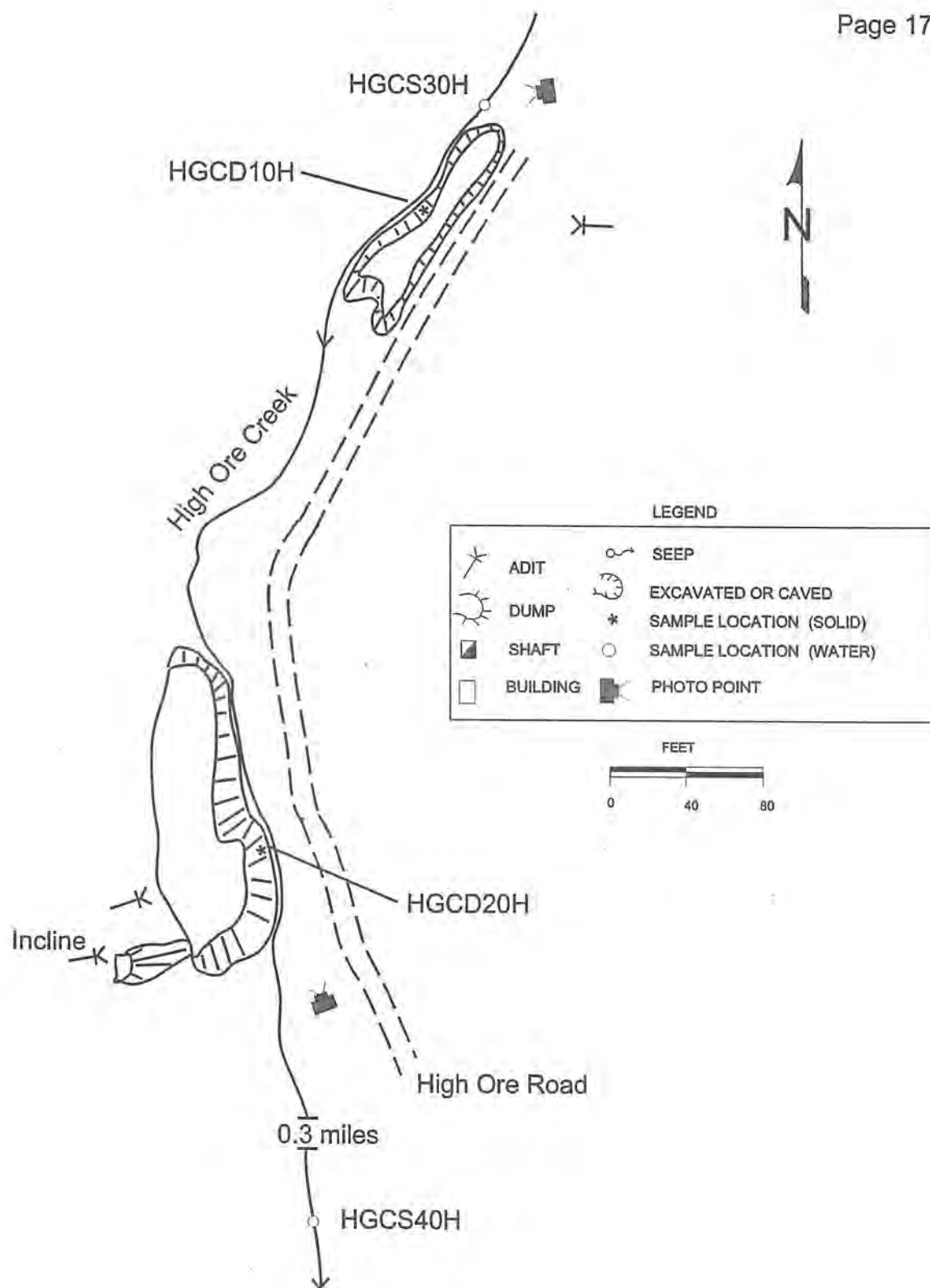


Figure 5.20 Site map of the Golconda/Reliance mine, September 1993.



Figure 5.21 High Ore Creek flows around two waste-rock dumps at the Golconda/Reliance site.



Figure 5.22 Water-quality samples were collected from High Ore Creek upstream and downstream of the site.

5.12.3.2 Soil

The soils adjacent to the waste-rock dumps and creek have concentrations of arsenic, copper, lead, and zinc that exceed phytotoxic levels. Although the dumps may be the source of the contamination, an alternate possibility is that the metals are from the streamside tailings washed down from the Comet mill (see section 2.5). Regardless of source, these soils are likely to erode into the creek during runoff events.

Table 5.13 Soil sampling results for the Golconda/Reliance mine.

Sample Location	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
Soil along streamside edge of dump W-2 (HGCD10H)	2520 ^{1,2}	21.1 ¹	364 ^{1,2}	1460 ^{1,2}	3130 ^{1,2}
Soil along streamside edge of dump W-1 (HGCD20H)	1730 ^{1,2}	18.1 ¹	357 ^{1,2}	2000 ^{1,2}	2820 ^{1,2}

(1) Exceeds one or more Clark Fork Superfund background levels (table 1.3)

(2) Exceeds phytotoxic levels (table 1.3)

5.12.3.3 Water

Both the upstream and downstream samples from High Ore Creek had concentrations of cadmium, manganese, and zinc that exceeded water-quality criteria (table 5.14). Because the upstream and downstream metal concentrations are so similar (see appendix V), it is unlikely that the waste-rock dumps are contributing significantly to the metal load in the creek.

Table 5.14 Water-quality exceedances at the Golconda/Reliance mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
High Ore Creek - upstream of site (HGCS30H)				P,A C					S				A,C						

Table 5.14 Water-quality exceedances at the Golconda/Reliance mine (continued)

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
High Ore Creek - downstream of site (HGCS40H)				A,C					S				A,C						

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in appendix V.

5.12.3.4 Vegetation

The undisturbed portions of the site are vegetated with grasses, willows, and conifers. The waste-rock dump is sparsely vegetated.

5.12.3.5 Summary of Environmental Condition

The soils adjacent to the streamside dumps have high concentrations of several metals. The source of the metals could be the mineralized material from the dumps, or could be tailings washed down from the Comet, or both. The dumps do not appear to impact the water quality of High Ore Creek. However, during high flow events, mineralized material and soil from around the dumps may wash into the creek.

5.12.4 Structures

No structures were observed at the site.

5.12.5 Safety

The only hazardous feature at the site is a collapse zone around adit A-2. In this area, the soil is loose and the slopes are very steep. The adit appears to be on private property.

5.13 HOPE AND BULLION MINE

5.13.1 Site Location and Access

The Hope and Bullion mine (T6N R4W Sec 6 BBAB) is on private land along Boomerang Gulch, a small tributary to the Boulder River. The site is accessible via a road that follows the drainage up from the town of Boulder.

5.13.2 Site History - Geologic Features

Although many bulldozer cuts give the Hope and Bullion a devastated look, its underground workings consist of only two 100 foot shafts and a 100 foot adit. The workings investigated a N80°W, 50 foot wide, 2,500-foot-long bleached zone (Roby *et al.* 1960) in quartz monzonite that contains discontinuous lenses of quartz, galena, pyrite, sphalerite, and cerussite (Becraft *et al.* 1963).

5.13.3 Environmental Condition

One of the shafts has partially flooded and has a ferric oxyhydroxide-stained seep. The discharge runs down a large cut through some waste rock and drains into a marshy area southeast of the site. Water from the marsh eventually flows into Boomerang Gulch. On the east end of the site, there is an open pit that contains a shallow pond that drains to Boomerang Gulch. The material exposed in the pit does not appear to be sulfide-bearing rock.

5.13.3.1 Site Features - Sample Locations

Sampling was conducted on October 13, 1993 and was restricted to BLM land along Boomerang Gulch upstream and downstream of the site. At the upstream sampling location (BHBS20M), the flow rate of Boomerang Gulch was 10 gpm; at the downstream location (BHBS10H), the flowrate of the stream was 20 gpm.

5.13.3.2 Soil

The soils on BLM land downstream of the site do not appear to have been impacted by waste material from the site; therefore, no soil samples were collected.



Figure 5.23 A seep begins near the flooded shaft and flows into a marshy area southeast of the mine.



Figure 5.24 A powder shed on the east end of the site contained several bags of nitro-carbo-nitrate, a chemical used for making explosives.

5.13.3.3 Water

Arsenic, copper, and zinc concentrations are slightly higher in the sample collected downstream of the site, but no water-quality standards were exceeded.

Table 5.15 Water-quality exceedances at the Hope and Bullion mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Boomerang Gulch - upstream of mine (BHBS20M)																			
Boomerang Gulch - downstream of mine (BHBS10H)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in appendix V.

5.13.3.4 Vegetation

The waste-rock dumps and the open pit are sparsely vegetated with grasses and weeds.

5.13.3.5 Summary of Environmental Condition

Although there are two discharges from the workings at the site, they do not strongly impact the water quality along the Boomerang Gulch drainage. No soil or water problems were observed on BLM land.

5.13.4 Structures

Several structures, including two mine buildings, a powder room, and a head frame, are on private land. A log cabin in fair condition is on BLM land next to the road approximately one mile below the site.

5.13.5 Safety

The powder room on the east end of the site contained four bags labeled "Nitro-carbo-nitrate" with an "oxidizer 5" warning. The chemical was apparently used for making explosives and was manufactured by Lavelle Powder Co. of Butte, Montana. The discovery of this material was reported to the BLM Headwaters office and the Boulder police department. It is unknown if any action was taken.

No safety hazards were observed on BLM land near the site.

5.14 MOLLY MCGREGOR MINE AND MILL AND BALTIMORE MINE

5.14.1 Site Location and Access

The Molly McGregor mine and mill (T6N R4W Sec 7 ABBB) are on the west side of Boomerang Gulch, approximately 1.2 miles south of the Hope and Bullion mine (see section 2.13). The Baltimore mine (T6N R4W Sec 7 CAA) is a half mile farther downstream, on the east side of the stream. Both sites are on private land and are accessible by road from the town of Boulder.

5.14.2 Site History - Geologic Features

At the Molly McGregor, five short adits and five short shafts explored a vertical N80°E vein at least 3,000 feet in strike length and 5-15 feet wide (Roby *et al.* 1960). Production records from 1911-1941 show that 65 ounces of gold, 2,364 ounces of silver, 315 pounds of copper, and 33,553 pounds of lead were extracted from 200 tons of ore (Roby *et al.* 1960). To the east, there is a heavily prospected, wide zone of iron-stained, silicified rock with quartz veinlets; some is brecciated, and some contains minor pyrite and galena. A sample of this material ran 0.003 oz/ton gold, 1.6 ounces/ton silver, 5 ppm copper, 60 ppm lead, 466 ppm zinc, and 1,705 ppm arsenic.

A gravity mill apparently operated at the Molly McGregor site for a time; there are some coarse tailings on a hillside composed mostly of quartz fragments.

Becraft *et al.* (1963) compiled information on the Baltimore mine from all other sources, including Knopf (1913), Billingsly and Grimes (19??), Pardee and Schrader (1933), and Roby *et al.* (1960). They reproduced mine maps as well. The Baltimore was worked in the 1880s and then intermittently until 1930. The mine contained at least 3,000 feet of workings developed over a vertical distance of 400 feet. An open stope on the property follows a vertical, sinuous vein that strikes approximately N70°E. Becraft *et al.* (1963) stated that several veins (6 to 10 feet wide, and composed of quartz, pyrite, chalcopryrite, chalcocite, sphalerite, galena, and arsenopyrite) were mined in a 200 foot wide zone. Recorded production of 22,823 tons of ore averaged 0.076 oz/ton gold, 12 oz/ton silver, 0.59% copper, and 2.7% lead. A select vein sample of vein material with quartz, chalcedony, pyrite, galena, and tetrahedrite contained 0.1900 oz/ton gold, 32.9 oz/ton silver, 3,490 ppm copper, 1.88% lead, 754 ppm, 1,015 ppm arsenic.

5.14.3 Environmental Condition

At the Molly McGregor mill site, tailings are strewn down a hillside and into the flood plain of Boomerang Gulch. On the hillside, the tailings are sparsely vegetated, but within the flood plain, they are well vegetated with willows and grasses. Because vegetation in the area does not appear to be stressed and no seeps were observed, it is doubtful that the tailings adversely impact the watershed.

At the Baltimore mine, two mineralized waste-rock dumps are within the Boomerang Gulch flood plain. In addition, an iron-stained seep flows from the base of one of the dumps into the stream.

5.14.3.1 Site Features - Sample Locations

Since the sites are on private land, the seep and waste materials could not be sampled directly. Instead, water-quality samples were collected from Boomerang Gulch as it crossed BLM lands upstream (BHBS10H) and downstream (BMBS10H) of the sites. The flow rate at the upstream location was 20 gpm; the downstream flow rate was 50 gpm. The samples were collected on October 13, 1993.

5.14.3.2 Soil

No waste rock or tailings were observed on the BLM property downstream of the sites; therefore, no soil samples were collected.

5.14.3.3 Water

A comparison of the upstream and downstream samples indicates almost no change in water quality. Only the concentration of mercury ($0.12 \mu\text{g/L}$) exceeds the chronic aquatic life standard in the downstream sample. The mercury perhaps is from prospecting for placer gold in the past.



Figure 5.25 Tailings from the Molly McGregor mill run down the hillside into the flood plain of Boomerang Gulch. Within the flood plain, the tailings are densely vegetated.



Figure 5.26 At the Baltimore mine, a seep flows from the base of a streamside waste-rock dump into Boomerang Gulch.

Table 5.16 Water-quality exceedances at the Molly McGregor mill tailings and Baltimore mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Boomerang Gulch - upstream of sites (BHBS10H)																			
Boomerang Gulch - downstream of sites (BMBS10H)										C									

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in appendix V.

5.14.3.4 Vegetation

The tailings-covered hillside at the Molly McGregor mill is sparsely vegetated with grasses and young lodgepole pines. Within the flood plain, the tailing are densely vegetated with willows and grasses. At the Baltimore mine, the streamside waste-rock dumps are barren to sparsely vegetated.

Downstream of the two sites, Boomerang Gulch is vegetated with grasses, weeds, willows, and young cottonwoods and evergreens. The vegetation appears healthy.

5.14.3.5 Summary of Environmental Condition

The flood-plain area where the Molly McGregor tailings lie appears stable. Re-working of the tailings by the stream may occur in the future, but the amount of tailings exposed at any given time is likely to be minor. Also, the tailings do not appear to have a high metal concentration.

The streamside waste-rock dumps at the Baltimore mine appear stable under low-flow conditions; however, large runoff events could trigger erosion of the mineralized material.

Neither the streamside waste materials nor the seep from the waste-rock dump have much impact on the water quality of Boomerang Gulch. The only water-

quality problem identified downstream of the sites was related to mercury. The origin of the mercury is uncertain, and further sampling will be required to confirm and characterize its occurrence along this reach of the watershed.

5.14.4 Structures

A gravity mill foundation is located on the hillside above the tailings at the Molly McGregor site. At the Baltimore mine, several ore bins and the remnants of some cabins can be found on the mountainside above Boomerang Gulch.

5.14.5 Safety

At the Baltimore mine, an open stope and at least two open adits pose a very serious safety concern. The stope is 5-10 feet wide and up to 40 feet deep in places. One of the open adits can be seen from the road along Boomerang Gulch. No measures have been taken to mitigate these hazards, all of which are on private land.

No safety concerns were noted on BLM property above and below the sites.

5.15 AMAZON PROSPECT, AUSTRALIAN MINE, AND BISMARK MINE

5.15.1 Site Location and Access

The Amazon prospect (T7N R4W Sec 32 CBBC), Australian mine (T7N R4W Sec 32 CCBB), and Bismark mine (T7N R4W Sec 32 CBDC) are near the headwaters of Amazon Creek, about 5.5 miles north of Boulder, Montana. The sites are accessible by a four-wheel drive road that crosses from the Boomerang Gulch drainage to the upper end of Amazon Creek. Most of the Amazon prospect site is on BLM land; the Australian and Bismark mines are on private lands.

5.15.2 Site History - Geologic Features

The Amazon prospect consists of a long prospect trench and a sulfide-rich waste-rock dump that are situated in the bottom of the Amazon Creek drainage (see figure 5.27). The trench is located downhill of the dump, so it seems unlikely that the dump material was excavated from the trench; however, no workings were located immediately above the dumps. No production records were found for the site, but it is closely associated with the Australian and Bismark mines, which are discussed below.

The Australian is well-described by Becraft *et al.* (1963) and Roby *et al.* (1960). The mine was worked from 1873 until 1895, and again from 1911-1919. It is comprised of three short adits and two shallow shafts, with about 400 feet of total workings. A vertical N75°E vein of quartz, pyrite, sphalerite, galena, arsenopyrite, and chalcopyrite was mined (Becraft *et al.* 1963). The vein was three to six feet wide. Production records from 1908 show that 692 tons of ore were produced, and yielded 122 ounces of gold, 8999 ounces of silver, 3613 pounds of copper, 76,783 pounds of lead, and 21 pounds of zinc. Currently, all mine openings are caved, and a small but colorful discharge issues from the lower adit, which is reportedly 285 feet long (Becraft *et al.* 1963).

The Bismark exploited the same N75°E north-dipping vein as the Australian (Becraft *et al.* 1963). The vein was 8-15 feet wide and contained quartz, sphalerite, galena, and chalcopyrite (Knopf 1913). Becraft *et al.* (1963) include a partial underground map. Recorded production was 1342 tons of ore which averaged 0.25 oz/ton gold, 19 oz/ton silver, a trace of copper, 8.9% lead, and 6.4% zinc (Roby *et al.* 1960). Country rock is Elkhorn Mountain volcanics intensely altered to clays and sericite. Several thousand feet of workings appear to be present.

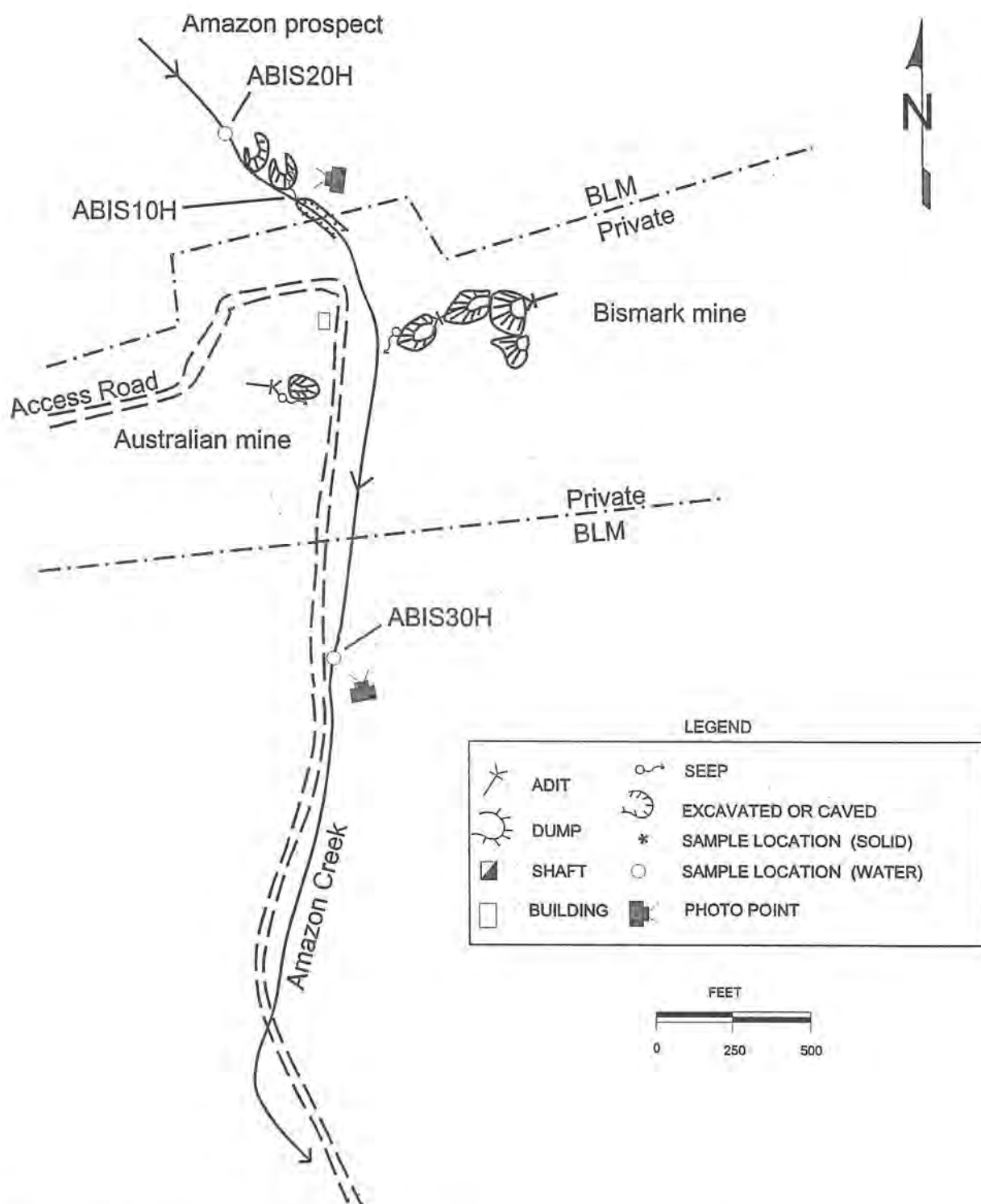


Figure 5.27 Site map of Amazon prospect, Australian mine and Bismark mine, September 1993.



Figure 5.28 At the Amazon prospect, a seep flows from the waste-rock dump into Amazon Creek.



Figure 5.29 The vegetation along Amazon Creek below the mines and prospect appears healthy.

5.15.3 Environmental Condition

At the Amazon prospect, Amazon Creek flows around the southwest edge of the waste-rock dump and then into the prospect trench, which forms the creek bed for several hundred feet. The terrain is steep and the creek is obviously eroding some of the mineralized dump material. Also, a small seep flows from the side of the dump into the creek.

As the creek flows past the Bismark site, it is fed by a seep that flows from the lowermost waste-rock dump. The dump is within the flood plain of the creek but has not been eroded appreciably.

As noted previously, the lowermost adit at the Australian site has a small, bright orange discharge with a flow rate of several gallons per minute. The discharge runs down the side of the associated waste-rock dump and infiltrates the ground. Although it is several hundred feet from the creek, the discharge may impact ground water that feeds into the drainage.

5.15.3.1 Site Features - Sample Locations

Water samples were collected from Amazon Creek upstream (ABIS20H) and downstream (ABIS30H) of the mines and prospect. The flow rates at these locations were 1.0 and 4.8 gpm, respectively. A sample was also collected from the creek a short distance downstream of where it is joined by the seep at the Amazon prospect. The flow rate here was 1.7 gpm. A composite soil sample (ABID10M) was collected along the drainage in this same area because of the material eroding from the dump. All samples were collected on September 29, 1993.

5.15.3.2 Soil

The concentrations of arsenic and zinc in the soil along Amazon Creek below the Amazon prospect dump exceeded phytotoxic levels. The source of these contaminants is probably material eroding from the dump.

Table 5.17 Soil sampling results for the Amazon prospect.

Sample Location	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
Soil along Amazon Creek below prospect dump (ABID10M)	223 ^{1,2}	4.82 ¹	77.2 ¹	374 ¹	661 ^{1,2}

(1) Exceeds one or more Clark Fork Superfund Background Levels (table 1.3)

(2) Exceeds Phytotoxic levels (table 1.3)

5.15.3.3 Water

Upstream and downstream of the disturbances, no water-quality criteria were exceeded. However, at the location downstream of the prospect seep, copper, lead, and zinc occurred in concentrations that exceeded chronic aquatic life standards. Zinc also exceeded the acute aquatic life standard.

Table 5.18 Water-quality exceedances at the Amazon prospect, Australian mine, and Bismark mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Amazon Creek - upstream of disturbances (ABIS20H)																			
Amazon Creek - below prospect seep (ABIS10H)						C		C					A,C						
Amazon Creek - downstream of disturbances (ABIS30H)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in appendix V.

5.15.3.4 Vegetation

Vegetation is barren to sparse on all of the waste-rock dumps associated with these sites. On BLM land downstream of the sites, the vegetation consists of healthy grasses, willows, evergreens, and cottonwoods.

5.15.3.5 Summary of Environmental Condition

Along the drainage immediately below the Amazon prospect's dump, soil and water quality have been adversely impacted by metals from the mine waste. The adit discharge at the Australian and the waste-rock seep at the Bismark may also be sources of heavy metal contamination; however, their impact is limited since no water-quality problems were observed on BLM land farther down the drainage.

5.15.4 Structures

A cabin in fair condition is located on private land next to the access road. No structures were observed on BLM lands.

5.15.5 Safety

The lower adit at the Australian mine is partially flooded but accessible. It might be a safety concern if someone decided to go for a subterranean swim.

5.16 SUMMARY OF MINING IMPACTS ON BLM LAND - BOULDER RIVER DRAINAGE

Of all the drainages investigated for the BLM inventory, the Boulder was the most severely impacted by past mining activity. Much of the region is underlain by the Boulder batholith, a formation well known for its sulfide ore deposits. Forty-five sites were investigated within the drainage, and fifteen were found to have potential environmental problems. Particularly noteworthy sites include the Comet mine and mill, the Golconda/Reliance mine, and the Mantle mine. Tailings from the Comet mill have been deposited along the entire length of High Ore Creek, releasing high concentrations of cadmium, manganese, and zinc into the water. At the Golconda/Reliance, another site on High Ore Creek, there is a streamside waste-rock dump that has high concentrations of arsenic, cadmium, copper, lead, and zinc. During storm and runoff events, material eroded from the dump probably adds to the metal load in the creek. At the Mantle, located on Cataract Creek, there is another large streamside waste-rock dump. Because the dump is on private land, it was not sampled; however, the dump appears to contain abundant sulfide minerals. Rills, gullies and slumps provide visual evidence that that dump is contributing to the sediment load of the creek during storm and runoff events. It should be noted that the water-quality of Cataract Creek is impaired upstream of the Mantle by mines such as the Crystal that lie within the Deerlodge National Forest (See Abandoned/inactive Mines of the Deerlodge National Forest, Vol. 2, Cataract Creek Drainage).

Sites with lesser environmental problems include the Waldy mine, Redwing mine, and Amazon prospect. Discharges at each of these sites contain slightly elevated concentrations of one or more metals. Also, each of the sites has metal-laden waste material close to or in contact with flowing water. The erosion potential of the waste materials, however, was deemed less severe than at the Comet, Golconda/Reliance, and Mantle.

The nine remaining sites with potential environmental problems were found to have little, if any, impact on BLM-administered lands. The Australian, Bismark, Hope and Bullion, King Cole, Minneapolis, and North Waldy mines have discharges or seeps, but the water quality of the streams below the sites is not impaired. Samples collected downstream of the Minneapolis placer, Molly McGregor mill tailings, and Baltimore mine had concentrations of mercury above chronic aquatic life standards; however, the measured concentrations were close to the laboratory detection limit of 0.1 $\mu\text{g/L}$. Additional sampling would be required to confirm these exceedances.

Eight of the 45 inventoried sites were found to have safety concerns. Five of the sites (the Australian, Baltimore, Golconda/Reliance and Mantle mines, and the

Minneapolis placer and prospect) had hazardous mine openings; two sites (the Molly McGregor and the Hope and Bullion) had unstable structures; and one (the Comet) had a combination of these hazards plus highwalls. The Golconda/Reliance mine and the Minneapolis placer and prospect are the only sites where the hazards may be on BLM-administered land.

UPPER CLARK FORK RIVER DRAINAGE

6.1 GEOLOGY

Tertiary basin fill deposits dominate the central portion of the Deer Lodge valley, through which the Clark Fork River flows. Lowland Creek and Elkhorn Mountains volcanics are found at the east end of the drainage basin, Paleozoic sedimentary rocks and isolated intrusives are to the northeast, Belt rocks and overlying volcanics are to the northwest in the Garnet Mountains, and Cretaceous and Jurassic rocks are associated with the east flank of the Flint Creek Mountains (Elliot *et al.* 1992).

Geology of the area was first mapped by Calkins and Emmons (1915), then in more detail by Csejtey (1962). Regional geology of the basin was mapped at the 1:250,000 scale by Wallace (1987) and Ruppel *et al.* (1993). Geology of the eastern side of the upper Clark Fork basin is dominated by granitic igneous rocks of the Boulder batholith. The geology of the western side is characterized by Proterozoic to Mesozoic sedimentary rocks that were complexly folded and faulted during late Cretaceous compression. They were then intruded by Cretaceous to Tertiary small granitic to dioritic plutons, which provided the heat source for the hydrothermal mineralization in the area. High-angle normal faulting followed, as did Tertiary volcanism, which covered portions of the area.

6.2 ECONOMIC GEOLOGY

The upper Clark Fork drainage contains all or part of 25 mining districts, defined by the U.S. Geological Survey (Loen and Pearson 1989; Elliott *et al.* 1992). The drainage includes the Deer Lodge valley area, Butte district, Oro Fino, west half of the South Boulder Mountains area, Emery and Elliston districts, the North Boulder Mountains area, Ophir district, Dog Creek area, Garrison district, Garnet Range area, Bear Creek, parts of Top O'Deep, Copper Cliff, Clinton, and Garnet districts, Dunkleberg district, Pioneer district, Rose Mountain district, Racetrack district, Lost Creek, Johnson basin, Blue-Eyed Nellie, Olson Gulch, and the north half of the Anaconda Range area.

Most metallic mineral deposits are related to Cretaceous igneous activity. Mineral deposit types include gold-rich skarns, polymetallic veins, and lead-zinc replacement deposits in limestone. More detailed discussion on geology and economic geology is available in the following references:

Orofino, Pipestone, Homestake, Little Pipestone, and Boulder Mountains districts: Roby *et al.* 1960; Ruppel 1961; Federspiel and Mayerle 1988.

Pioneer and Rose Mountain districts: Calkins and Emmons 1915; Mutch 1961; Allen 1962; Hawley 1974; Baken 1984; Elliott *et al.* 1985; Emmons and Calkins 1913; McClernan 1976; Avery 1983; Loen 1993.

Johnson Basin, Olson Gulch, Blue-Eyed Nellie, and Lost Creek districts: Calkins and Emmons 1915; Csejtey 1962; Emmons and Calkins 1913; Earll 1972.

Racetrack district: Csejtey 1962; Allen 1962; Hawley 1974; Earll 1972; McClernan 1976.

Dunkleberg district: Calkins and Emmons 1915; Pardee 1917; Mutch 1961; McGill 1959; Baken 1984; Popoff 1953.

Emery district: Robertson 1953; Ruppel 1961; Derkey 1986; McClernan 1976; Al-Khirbash 1982.

Silver Lake district: Calkins and Emmons 1915; Poulter 1957; Lidke and Wallace 1992; Emmons and Calkins 1913; Walker 1960.

Red Lion district: Calkins and Emmons 1915; Emmons and Calkins 1913; Earll 1972.

The area was an important producer, as production totals indicate: \$10,781,060 from 349,472 ounces of gold, 1,874,722 ounces of silver, 93,497 pounds of copper, 15,493,098 pounds of lead, and 6,051,558 pounds of zinc (Elliott *et al.* 1992).

6.3 HYDROLOGY AND HYDROGEOLOGY

The upper Clark Fork drainage in west-central Montana begins in the Butte area and extends downstream to its confluence with the Blackfoot River near Missoula. For the purposes of this report, the upper Clark Fork drainage includes the Flint Creek and Rock Creek drainages. Larger tributaries of the drainage include Blacktail Creek, Silver Bow Creek, Warm Springs Creek, Flint Creek, Rock Creek, and the Little Blackfoot River. The mean annual discharge for selected U.S. Geological Survey gaging stations is presented in table 6.1.

Table 6.1 Stream-gaging data for the upper Clark Fork River drainage.

Gage Location	Period of Record	Drainage Area (mi ²)	Annual Mean Flow (cfs)
Blacktail Cr. at Butte	1989-1994	95.4	11.1
Silver Bow Cr. below Blacktail Cr.	1984-1994	103	21.6
Warm Springs Cr. at Warm Springs	1984-1994	163	41.4
Clark Fork R. at Deerlodge	1979-1994	1,005	260
Flint Cr. near Drummond	1991-1994	490	91.1
Little Blackfoot R. near Garrison	1973-1994	407	155
Rock Cr. near Clinton	1973-1994	885	513
Clark Fork R. near Bonner	1986-1994	3,641	1,032

Source: Shields *et al.* 1995

The terrain is typical of the Northern Rocky Mountains Physiographic Province; broad, flat valleys bounded by high, rugged mountains. The drainage is bounded on the east by the Continental Divide, on the south by the Highland Mountains (elevations up to 10,188 feet amsl), the Anaconda Range (10,655 feet amsl), on the west by the Sapphire Mountains (8,492 feet amsl) and Flint Creek Range (10,170 feet amsl), and on the north by the Garnet Range (7,438 feet amsl).

The Highland Mountains, the Pintlar Range, the Sapphire Mountains, and the Flint Creek Range were glaciated and exhibit typical post-glacial terrain. The lower extent of glaciation is commonly marked by terminal moraines in the small valleys that contribute to the Clark Fork River. Tertiary-age lake bed deposits are common on the east valley margin of the Clark Fork River from Butte to Garrison and in the south valley margin from Garrison to Drummond. The river generally flows through Quaternary alluvium in this area. Quaternary Glacial Lake Missoula sediment marks the valley margins and bottom from Drummond to just upstream of Clinton; downstream of Clinton the valley bottom is Quaternary alluvium bounded by Lake Missoula sediment (Alden 1953). The most recent deposits of note are the tailings and other mining-related wastes deposited along the entire length of the Clark Fork River. As many as 12 smelters and mills in the Butte area contributed an unknown amount of waste material to the river over a 100-year period. Until

the late 1970s, much of the acid-mine discharge from the Butte mines was released to the river as well.

Like most of western Montana, the area is characterized as semi-arid; the average annual precipitation in the valleys range from 12 inches in the valleys to 40 inches in the high mountains (Montagne *et al.* 1982). Potential evapotranspiration generally exceeds precipitation by 8 to 10 inches per year. Most of the precipitation occurs in the spring and early summer months and winters are relatively dry. Average annual temperature ranges from 40°F in the valleys to 20°F in the mountains (Bergantino 1978).

As is the case with all of western Montana, ground-water development in the upper Clark Fork River basin is greatest in the unconsolidated valley fill and minimal in the bedrock underlying the basin and exposed in the mountains. Ground-water use includes domestic and municipal water-supply, irrigation, and isolated industrial use. Surface-water uses include crop irrigation and stock watering. A small amount of surface water is used for municipal water supply.

6.4 SUMMARY OF THE UPPER CLARK FORK RIVER DRAINAGE

The MBMG inventoried 135 sites on or near BLM-administered land within the upper Clark Fork River drainage (see figure 6.1 and table 6.2). Of these sites, 108 were found to have no environmental impact on BLM land, 14 may pose environmental problems, and 13 could not be located. The names of the 14 sites with potential environmental impacts are listed in **bold** in table 6.2. These sites were investigated in detail and are discussed in the following sections.

If mine openings or other dangerous features (unstable structures, highwalls, steep waste-rock dumps) were observed at a site, then the site is designated unsafe, or hazardous, in table 6.2. Of the 135 sites inventoried, 24 were found to have safety concerns. The only sites carefully screened for safety hazards were those where soil and/or water samples were collected. Hazards may exist at many of the other sites, but they were not noted or observed during the inventory.

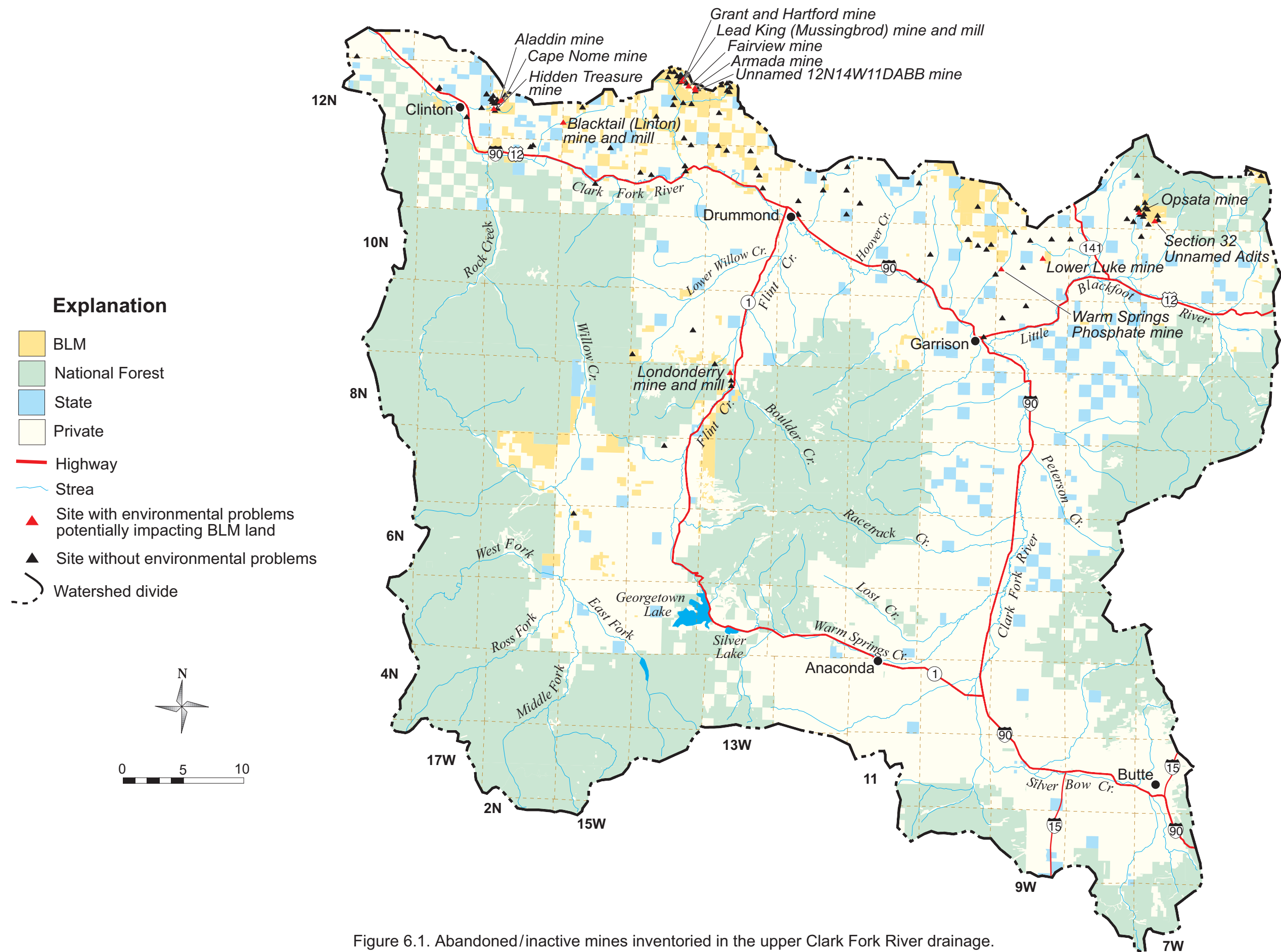


Figure 6.1. Abandoned/inactive mines inventoried in the upper Clark Fork River drainage.

Table 6.2 Summary of sites inventoried in the upper Clark Fork River drainage. Site name in **bold** indicates potential environmental problems. "Y" in hazard column indicates physical safety concern.

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Aladdin	PRV	Y	Y	N	Streamside waste rock.
Anderson	PRV	N	N	NE	Screened out in office.
Armada	PRV	Y	Y	Y	Springs in high sulfide quarry. Highwalls.
Baker & Sullivan	PRV	N	N	NE	Screened out in office.
Bald Butte	PRV	N	N	NE	Screened out in office.
Bear Creek (1)	PRV	Y	N	N	Placer. No impact on BLM.
Bear Creek (2) (Bearmouth Placer)	PRV	Y	N	N	Placer. No impact on BLM.
Bearmouth Placer	PRV	Y	N	N	No impact.
Bellview	BLM	Y	N	Y	Small spring on site. Open shaft.
Bert Creek	STA	N	N	NE	Screened out in office.
Big Horn Calcium Quarry	MIX	N	N	NE	Screened out in office.
Big Sky Ready Mix Sand	PRV	N	N	NE	Screened out in office.
Big View	BLM	Y	N	N	Dry. No impact.
Blacktail (Linton)⁵	MIX	Y	Y	Y	Streamside waste-rock and tailings. Mine opening. 70% BLM; 30% private.
Blue Lode	PRV	N	N	NE	Screened out in office.
Blue Moon	BLM	Y	N	Y	Open adit.
Bohrer	PRV	N	N	NE	Screened out in office.
Bonita	PRV	N	N	NE	Screened out in office.
Brock Creek Area	PRV	N	N	NE	Screened out in office.
Brock	PRV	N	N	NE	Screened out in office.

Table 6.2 Summary of sites inventoried in the upper Clark Fork River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Butterfly	PRV	N	N	NE	Prospects and caved shafts.
Cape Nome	PRV	Y	Y	Y	Streamside waste rock. Unstable ore bin.
Cascade	PRV?	N	N	NE	Probably patented.
Chloride	PRV	N	N	NE	Screened out in office.
Clark Fork	PRV	N	N	NE	Screened out in office.
Clark Fork of the Columbia River	PRV	N	N	NE	Screened out in office.
Clinton Pit	PRV	N	N	NE	Screened out in office.
Cook Prospect	PRV	N	N	NE	Screened out in office.
Coons Tungsten	BLM	Y	N	Y	Dry. Highwalls.
Copper Bell	PRV	N	N	NE	Screened out in office.
Copper State	BLM	Y	N	Y	Mine opening. Dry.
Denver	MIX	Y	N	N	Dry. No impact.
Dewey	PRV	Y	N	N	Dry.
Drummond Quarry	PRV	N	N	NE	Screened out in office.
Dry & Wet Mulkey Gulches	UNK	N	N	NE	Unable to locate.
Durand	PRV	Y	N	N	Dry. No impact.
Edwards Gulch	PRV	N	N	NE	Screened out in office.
Elmo Placer	UNK	N	N	NE	Unable to locate.
Eureka Mining Co.	PRV	N	N	NE	Screened out in office.
Eureka Gulch Placer	PRV	N	N	NE	No impact on BLM.
Fairview (2)	MIX	Y	N	NE	Viewed from a distance. No impact.
Fairview (1)	MIX	Y	Y	Y	Adit discharge. Open adit.
Garnet	UNK	N	N	NE	Unable to locate.

Table 6.2 Summary of sites inventoried in the upper Clark Fork River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Gimlet	PRV	N	N	NE	Access across deeded land. Not visited.
Grant and Hartford	PRV	Y	Y	Y	Streamside waste-rock dump. Hazardous structure.
Grass Widow	PRV	N	N	NE	Screened out in office.
Graveley	PRV	N	N	NE	Screened out in office.
Half-way Sixmile Creek Bentonite	PRV	N	N	NE	Screened out in office.
Hidden Tunnel	STA	N	N	NE	Screened out in office.
Hidden Treasure	PRV	Y	Y	Y	Adit discharge and waste-rock dump seep. Gated adit has been vandal-ized. Ore bin.
Hitchcock Quarry	PRV	N	N	NE	Screened out in office.
Hobo	UNK	N	N	NE	Unable to locate.
Hoover Creek	PRV	N	N	NE	Screened out in office.
Independence Prospect	BLM	Y	N	N	Dry.
International	PRV	Y	N	N	Patented claim. Dry.
Jack Pot	PRV	N	N	NE	Screened out in office.
Jackie Marie (Spokane)	BLM	N	N	NE	Screened out in office.
Jens Area	PRV	N	N	NE	Screened out in office.
Katie Allen	MIX	Y	N	Y	Dry. Open adit.
Kennebeck	PRV	N	N	NE	Screened out in office.
Klondike	PRV	N	N	NE	Screened out in office.
Lannen Placer	PRV	N	N	NE	Screened out in office.
Lead King (1) (Mussigbrod Claims)⁵	MIX	Y	Y	Y	Adit discharge and streamside waste. Open adit, unstable structure, highwall.
Lehsou	PRV	Y	N	N	Placer workings. Dry.

Table 6.2 Summary of sites inventoried in the upper Clark Fork River drainage (continued).

SITE¹	OWNER²	VISIT	SAMPLE³	HAZARD⁴	REMARKS
Lenore & Myrna Claims	STA	N	N	NE	Screened out in office.
Leprechaun Placer	MIX	Y	N	N	No indications of placering. Inaccurate location?
Limestone Quarry	UNK	N	N	NE	Unable to locate.
Limestone Occurrence (2)	PRV	N	N	NE	Screened out in office.
Limestone Occurrence (1)	PRV	N	N	NE	Screened out in office.
Lois	PRV	N	N	NE	Screened out in office.
Londonderry	PRV	Y	Y	Y	Open adit with discharge. Stream-side dump. Reclaimed in 1996.
Lower Luke	PRV	Y	Y	Y	Phosphate deposit. Open adit with discharge. Visited and sampled at request of BLM.
Lowery	MIX	Y	N	N	Patented claim. Dry.
Lucky Boy Prospect	UNK	N	N	NE	Screened out.
Lynx	PRV	Y	N	N	Dry.
Magone & Anderson	PRV	Y	N	Y	Partially open adit. Dry.
McQuarrie Quarry	PRV	N	N	NE	Screened out in office.
Mitchell Prospect	BLM	Y	N	N	Dry. No impact.
Mitchell Copper	PRV	N	N	NE	Screened out in office.
Morris Creek	PRV	N	N	NE	Screened out in office.
Mountain Ram	PRV	Y	N	Y	Open adits. Dry.
Mountain	BLM	Y	N	Y	Open shaft. Dry.
Mountain Group	UNK	N	N	NE	Unable to locate.
Mussingbrod Claims/Lead King	MIX	Y	Y	Y	Same as Lead King (1) (Mussigbrod Claims).

Table 6.2 Summary of sites inventoried in the upper Clark Fork River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Nancy Hanks	PRV	Y	N	N	Dry.
Neenan	BLM	Y	N	N	Dry.
New Seattle	MIX	Y	N	Y	Mine opening. Dry.
Ophir (2)	UNK	N	N	NE	Unable to locate.
Ophir Creek (2)	MIX	Y	N	NE	Active placer operation in 1994.
Ophir Creek (1)	UNK	N	N	NE	Unable to locate. Same as Ophir Creek (2)?
Ophir (1)	UNK	N	N	NE	Unable to locate.
Opsata	BLM	Y	Y	Y	Mine waste adjacent to ditch. Open adit.
Peggy Ann	UNK	N	N	NE	Unable to locate.
Penobscot	PRV	Y	N	N	Dry.
Queen Mary	PRV	N	N	NE	Screened out in office.
Red Rock	UNK	N	N	NE	Unable to locate.
Red Cloud	PRV	Y	N	N	Dry.
Relyea	PRV	N	N	NE	Screened out in office.
Relyea Mill ⁵	PRV	N	N	NE	Screened out in office.
Reservoir and Ophir Patents	PRV	Y	N	N	Dry.
Rock Creek Quarry	PRV	N	N	NE	Screened out in office.
Sallie Mellen Claim	BLM	Y	N	N	Dry.
Sec 32 Unnamed Adits	MIX	Y	Y	N	Small adit discharge and streamside waste.
Senate	PRV	N	N	NE	Screened out in office.
Shamrock	MIX	Y	N	N	Dry. Mostly reclaimed.
Sierra	BLM	Y	N	N	Dry.
Silver Reef	UNK	N	N	NE	Unable to locate.
Silver King	PRV	Y	N	Y	Mine openings.

Table 6.2 Summary of sites inventoried in the upper Clark Fork River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
South Luke	PRV	N	N	NE	Screened out in office.
South End of Garrison Anticline	PRV	N	N	NE	Screened out in office.
Spokane	BLM	N	N	NE	Screened out in office.
Spring Gulch (1)	BLM	N	N	NE	Screened out in office. Limestone quarry.
Spring Gulch Quarry	BLM	N	N	NE	Screened out in office. Limestone quarry.
Spring Gulch (2)	PRV	N	N	NE	Screened out in office. Limestone quarry.
State Prison Brick Plant	PRV	N	N	NE	Screened out in office.
Stone Placer	MIX	Y	N	N	Dry.
T & H Extension Claim	PRV	N	N	NE	Screened out in office.
Ten Mile Placer	PRV	Y	N	N	Dry.
Tie Gulch	MIX	N	N	NE	Dry ridge. Screened out in office.
Tiger	MIX	Y	N	N	Dry.
Triangle	PRV	N	N	NE	Screened out in office.
Twin Buttes (Heilman)	BLM	Y	N	NE	Observed from a distance.
Unnamed Barite (2)	PRV	N	N	NE	Screened out in office.
Unnamed Carpenter Creek Adit	BLM	Y	N	Y	Mine opening. Dry.
Unnamed Lead- Silver Prospect	BLM	Y	N	N	Dry.
Unnamed Phosphate	PRV	N	N	NE	Screened out in office.
Unnamed Placer	PRV	Y	N	NE	Adjacent to road. No impact on BLM land.
Unnamed 09N09W07	PRV	N	N	NE	Screened out in office.
Unnamed 10N10W12	PRV	N	N	NE	Screened out in office.

Table 6.2 Summary of sites inventoried in the upper Clark Fork River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Unnamed 12N14W11DABB	BLM	Y	Y	Y	Open adit with discharge. Remnants of mine building.
Upper Deep Creek	MIX	Y	N	N	Dry.
Wallace Creek Mill ⁵	BLM	Y	N	N	Tailings present. Site undergoing reclamation in 1996.
Warm Springs Creek	PRV	N	N	NE	Screened out in office.
Warm Springs Creek Quarry	PRV	N	N	NE	Screened out in office.
Warm Springs Phosphate	PRV	Y	Y	Y	Discharge from mine. Unstable structure. Visited and sampled at request of BLM.

1) Mines in **bold** may pose environmental problems and are discussed in the text; others are included only in appendix II (all mines) and appendix III (sites visited).

2) Administration/Ownership Designation
 BLM: Bureau of Land Management
 PRV: Private
 MIX: Mixed (BLM and private)
 STA: State of Montana
 UNK: Owner unknown

3) Solid and/or water samples

4) Y: Physical safety hazards exist at the site.

NE: Physical safety hazards were not evaluated.

5) Mill site present

6.5 SECTION 32 - UNNAMED ADITS

6.5.1 Site location and Access

Access is via Highway 141 turning east 2.4 miles north of Avon on the road to Blackfoot City (forest service access road). Take the right fork before Blackfoot City, cross Ophir Creek, and travel east to the Carpenter Creek road. This site lies north on, and east of, the Carpenter Creek road just as the canyon narrows in T11N R7W Sec 32 BCBB (Ophir Creek 7.5-min. quadrangle).

6.5.2 Site History - Geologic Features

No mention of this specific mine could be found in literature except for the Pioneer Technical Services, Inc. report to the Montana DSL-Abandoned Mine Reclamation Board (1994, p. 5-248) who called it "NE NW S32." Carpenter Creek was placered as early as the 1860s and 1870s. Carpenter Bar, one of the richest placers in the area yielding >150,000 ounces gold (Pardee and Schrader 1933; Loen 1990) lies less than one half mile downstream to the south of this site. Immediately to the south of this site, a patented placer claim -- the Down Hour-- lies parallel to the creek bed, according to Loen's (1990) map. There are two adits, both caved <10 feet from the portal but with one set of timbers remaining in each (figures 6.2 and 6.3). The adits trend in opposite directions (one N20°W; the other N60°E) in unaltered quartz monzonite; no vein or lead is apparent.

The site is located in Cretaceous quartz monzonite to the south of a major NW-trending fault and at the eastern edge of the Blackfoot City stock where it intruded into Permian/Pennsylvanian Phosphoria and Quadrant formations.

6.5.3 Environmental Condition

Water discharges from the easternmost adit at a rate of 0.8 gpm. There is evidence that the western adit also discharges water at times but also not in great quantities. The waste is adjacent to the creek but is less than 90 cubic yards (Pioneer Technical Services 1994); it appears weakly mineralized and entirely oxidized (figure 6.4).

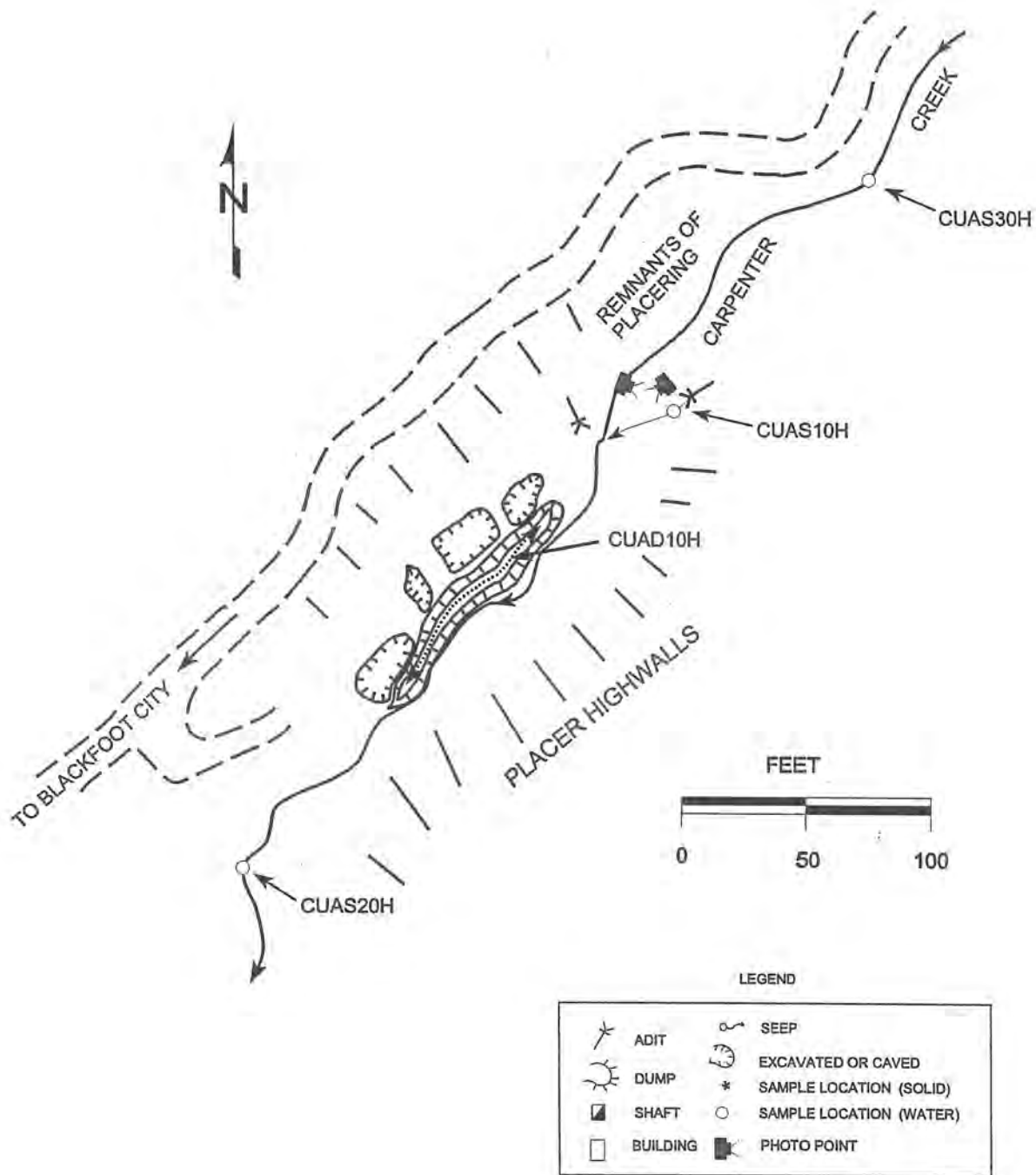


Figure 6.2 Site map of the Section 32 - Unnamed Adits mine, August 1995.



Figure 6.3 Adit "A01" trending N20°W with four small "ponds" to capture any discharge.



Figure 6.4 Adit "A02" trends N60°E and has a small discharge barely discernable in the lower center of photo.

6.5.3.1 Site Features - Sample Locations

Three water samples were taken here on August 1, 1995; one approximately 75 feet upstream from the adits (CUAS30H), one approximately 325 feet downstream from the adits (CUAS20H), and one from the adit discharge (CUAS10H). The upstream sample is on a relatively undisturbed portion of the stream, above all mine disturbances and placer workings.

6.5.3.2 Soil

Soil sample CUAD10H was collected for this site as a 150' composite between the waste dump and the stream. There are minor exceedances in the soil sample for both arsenic and copper (table 6.3).

Table 6.3 Soil sampling results for Section 32 - Unnamed Adits mine.

Sample Location	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
Between edge of stream & waste dump (CUAD10H)	4.7 ¹	<4.3	40.9 ¹	6.3	33.1

(1) Exceeds one or more Clark Fork Superfund background levels (table 1.3)

(2) Exceeds phytotoxic levels (table 1.3)

6.5.3.3 Water

Water was flowing in Carpenter Creek at a rate of 0.7 cfs upstream and downstream of the site. Its condition was clear and cold. The creek here averages 2 to 3 feet wide. Pioneer Technical Services (1994) theorized that the water emerging from the adit is actually Carpenter Creek water because of similarities in field parameters. No exceedances were noted in the laboratory reports (table 6.4). Field pH and SC of the adit discharge were 7.5 and 323 μ mhos/cm @ 25°C, respectively; the creek had pH and SC readings in the range of 8.3-8.4 and 335-375 μ mhos/cm @ 25°C, respectively. Laboratory pH and SC results are comparable.

Table 6.4 Water-quality exceedances at the Section 32 - Unnamed Adits mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit discharge (CUAS10H)																			
Downstream Carpenter Creek (CUAS20H)																			
Upstream Carpenter Creek (CUAS30H)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in appendix X

6.5.3.4 Vegetation

Vegetation did not appear affected. Four small settling ponds (pseudo-wetlands?) were constructed below the site, and cattails were apparently planted in the lower side of two as an experiment.

6.5.3.5 Summary of Environmental Condition

This is a small site with a discharge of less than 1 gpm and <100 cubic yards of waste adjacent to the creek bed. The waste present is rather innocuous looking and has been bermed against erosion. The small settling ponds would catch whatever small discharge comes from the adit to the west. Some relic placer mining junk is in the creek bed.

6.5.4 Structures

No structures are present at this site.

6.5.5 Safety

The small overhang in the limited, open portion (5 to 10 feet) of the adits poses a very small risk to the public. Both openings are almost totally caved with only one timber set remaining. Loose, quartz monzonite boulders are in the back of the east adit but there is very little reason for someone to enter it. There are steep slopes at the head of this site which are associated with the placer mining in the area. The road is adjacent to the steep slope on west side of the site, and there is some danger that a vehicle could run off the road.

6.6 OPSATA MINE

6.6.1 Site location and Access

The Opsata mine (T11N R8W Sec 25 DBDA, Ophir Creek quadrangle) lies to the east of Ophir Creek and is represented by the shaft symbol on the topographic map at an elevation of 5,400 feet. It is reached via Highway 141, turning east 2.4 miles north of Avon and by following the forest service access road turning right at the junction before Blackfoot City. Immediately after crossing Ophir Creek, take the first left tire track going north. Most of the site is on BLM-administered land; it was an active, unpatented claim as recently as 1994.

6.6.2 Site History - Geologic Features

Pardee and Schrader (1933) describe the Opsata (named after Nels Opsata) as having produced \$600 worth of gold-silver ore at \$60 per ton (pre-1930s prices). According to Pardee and Schrader, the mine is at the contact between quartzite and quartz monzonite with the vein dipping northwest and opened to a depth of 90 feet by the shaft. Loen (1990) describes this mine as being entirely in Precambrian Bonner Formation quartzite with the dump material as brecciated and recemented quartzite, and euhedral quartz crystals with sulfides locally filling open spaces. Elliot *et al.* (1992) also summarize this information but show the mine in a slightly different location. A map of the site is shown in figure 6.5.

6.6.3 Environmental Condition

A small, waste dump is adjacent to a diversion ditch off of Ophir Creek (figure 6.6). Sulfides as well as quartzite, euhedral quartz and minor iron oxides are present on the dump. An upstream and downstream sample was collected. No water discharges from any of the workings (figure 6.7).

6.6.3.1 Site Features - Sample Locations

Two samples were taken from the small diversion ditch flowing through the waste. One sample was taken 50 feet upstream from the waste (OOPS20M) and one 50 feet downstream from the waste (OOPS10M). One composite assay sample was collected along the top of the dump (POOP-1). The sample ran 0.0015 opt Au, 7.2 ppm Ag, < 1 ppm Cu, 40 ppm Pb, and 8 ppm Zn.

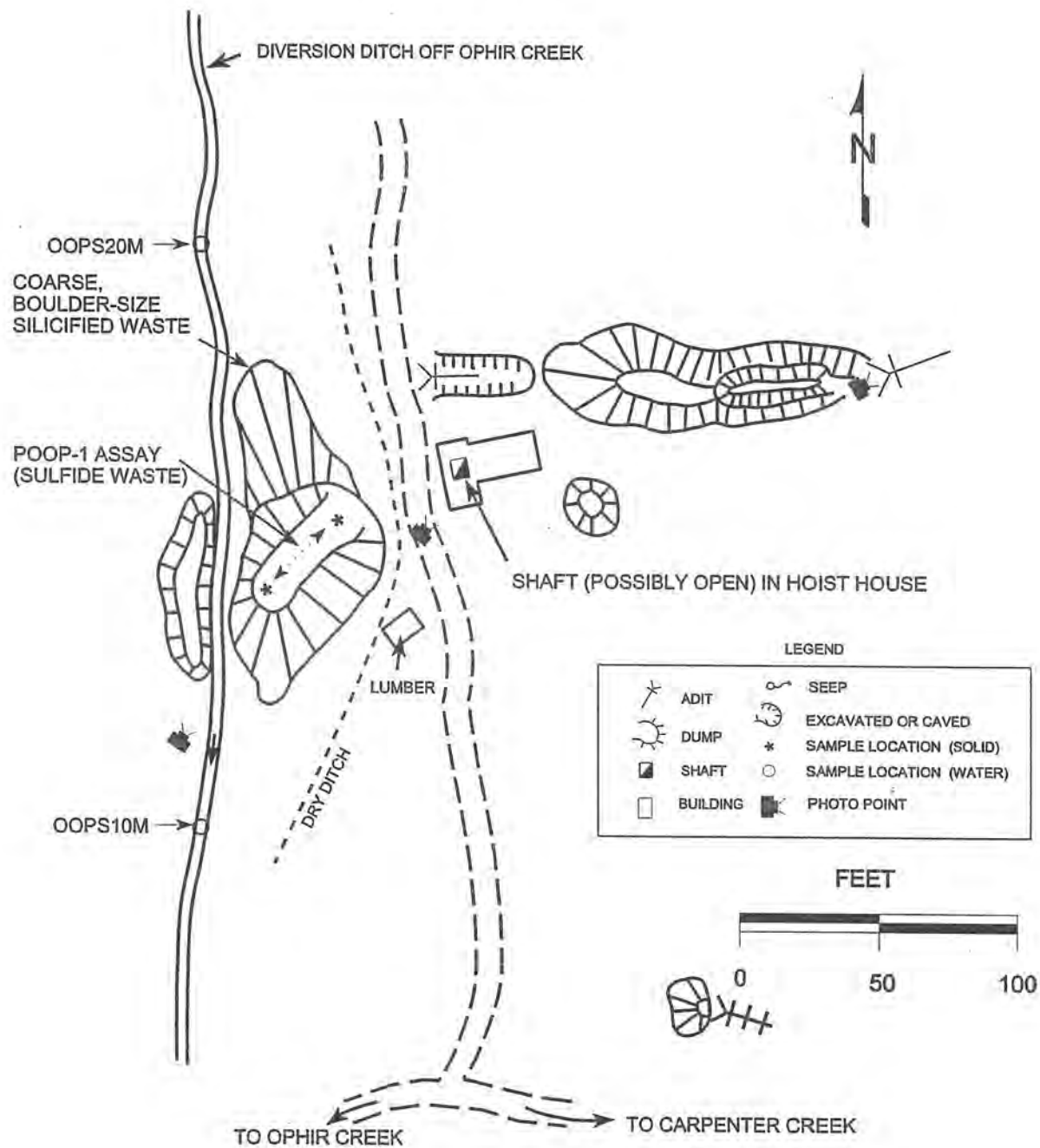


Figure 6.5 Site map of the Opsata mine, July 1995.



Figure 6.6 Waste dump, with adjacent diversion ditch (in the lower left of photo) off Ophir Creek.



Figure 6.7 Hoist house/mine shop may cover an open, 100' shaft.

6.6.3.2 Soil

No soil samples were collected at the site.

6.6.3.3 Water

Flow was calculated at 3.1 to 3.5 cfs. Field measurements above the site were pH = 8.90 and SC = 274 $\mu\text{mhos/cm}$ @ 25°C; below the site pH = 8.65 and SC = 248 $\mu\text{mhos/cm}$ @ 25°C. Lab pH was 8.3 upstream and 8.46 downstream and so is not considered to exceed MCLs even though the field parameters did. The water appeared clear and cold; no active erosion was occurring. No exceedances were noted in the lab reports (table 6.5).

Table 6.5 Water-quality exceedances at the Opsata mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Upstream - OOPS20M																			S*
Downstream- OOPS10M																			S*

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

*pH measured in laboratory was within acceptable MCL range of 6.5 to 8.5

Note: Analytical results are listed in appendix V.

6.6.3.4 Vegetation

The waste dump is sparsely vegetated probably because of lack of water, soil and nutrients more so than toxicity of metals. Grasses and weeds were abundant along the ditch where water was available.

6.6.3.5 Summary of Environmental Condition

Waste lines both sides of the diversion ditch for approximately 70 feet. No active erosion was taking place at the time of this visit. There is a very small

amount of rusting equipment, a few empty drums, and a pile of old lumber at the site.

6.6.4 Structures

A log and board hoist house/mine support building still stands at the site (figure 6.7). A sign that was present in 1994, but had been stolen by 1995, warned of an open 100-foot shaft. It was impossible to determine if an open shaft is still present beneath the pile of loose boards. The structure is unique and should at least be documented, if not preserved.

6.6.5 Safety

The wooden structure is partly collapsed, and it may obscure a 100-foot-deep shaft beneath loose boards. One open adit, trending N72°E, lies approximately 150' to the east of the hoist house but is only approximately 20 feet long at present; however, there are loose, untimbered, overhanging rocks in the workings. A second adit, 200 feet to the southeast of the hoist house, has caved in several places, and there is a slight chance of more caving. A third adit immediately to the north of the hoist house is totally collapsed, and prospect pits in the area are shallow.

6.7 LOWER LUKE MINE

Author's Note: The MBMG and BLM evaluated this site in 1993. In 1996 the site was partially reclaimed by the Cominco American Fertilizer Company.

6.7.1 Site Location and Access

The Lower Luke is on BLM-administered land along Gimlet Creek (T10N R9W Sec 15 BA). The site was visited and sampled at the request of the BLM, and although it was not inventoried in the same manner as other sites, it is included here for completeness. No site map was prepared.

6.7.2 Site History - Geologic Features

No site history was available for this mine. Also, no geological investigation was done on the site.

6.7.3 Environmental Condition

In 1993, the disturbed area consisted of a discharging, caved adit and associated waste-rock dump. The adit discharge and a small seep associated with the adit were the only waters found on or near the site which is situated on a steep hillside above a dry drainage.

6.7.3.1 Site Features - Sample Locations

The site was visited and sampled on June 24, 1993 by MBMG and BLM personnel. A sample was collected of the adit discharge that was flowing at about 5 gpm. The seep was flowing less than 1 gpm and was not sampled.

6.7.3.2 Soil

In 1993, most of the disturbed area was vegetated and appeared stable; there was no evidence of erosion or mass-wasting at the base of the dump. No soil samples were collected.

6.7.3.3 Water

None of the selected analytes had concentrations above their MCLs (table 6.6). The pH of the adit discharge was 7.45.

Table 6.6 Water-quality exceedances at the Warm Springs Phosphate mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
BLL010 (Adit discharge)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in appendix V.

6.7.3.4 Vegetation

In 1993, most of the disturbed area was sparsely to moderately vegetated; the areas of reduced vegetation appeared to be due to lack of soil rather than toxicity. The base of the dump and the areas around the adit and seep discharges were well vegetated. In 1995 and 1996, the dump was recontoured and revegetated to reduce erosion potential.

6.7.3.5 Summary of Environmental Condition

The adit discharge and small spring were the only water on the site. The waste-rock dump appeared stable and fairly well vegetated. There was no evidence of high erosion or mass wasting during run-off events and no deposition of waste material below the site. In 1995 and 1996, the site was partially reclaimed.

6.7.4 Structures

In 1993, remnants of unidentifiable buildings were observed on the site; no standing structures were observed. In 1996, the structure remnants were removed.

6.7.5 Safety

No safety concerns were identified at this site.

6.8 WARM SPRINGS PHOSPHATE MINE

6.8.1 Site Location and Access

The Warm Springs Phosphate mine is on private land near the head of Warm Springs Creek (T10N R10W Sec 25 and T10N R9W Sec 19). The site was visited and sampled at the request of the BLM and the Cominco American Mining Company. Although not inventoried in the same manner as other sites, it is included here for completeness. The site investigation was limited to the area below the mine where mine effluent flowed into a lagoon before discharging to the creek. No site map was prepared.

6.8.2 Site History - Geologic Features

The site history and geologic information are detailed in reports by Cominco American. No additional geologic information was gathered.

6.8.3 Environmental Condition

Because most of the site was on private land, no map was made. The site was still active and mining had only recently been suspended. As noted, the investigation was limited to the mine effluent.

6.8.3.1 Site Features - Sample Locations

The site was visited and sampled on June 24, 1993 by Montana Bureau of Mines and Geology and U.S. Bureau of Land Management personnel. Surface-water samples were collected from Warm Springs Creek upstream of the mine (CPS-010); from the influent stream to lagoon below the mine (CPS-020); from the lagoon effluent (CPS-030); and from Warm Springs Creek below the mine and lagoon (CPS-040). No stream-flow measurements were made.

6.8.3.2 Soil

Impacts to soils were not considered; no soil samples were collected.

6.8.3.3 Water

A comparison of selected analytes to water-quality standards is presented in table 6.7. The sample collected upstream of the mine had the highest sulfate concentration of the four samples and exceeded the sulfate MCL. The high concentration may be related to the geothermal origin of the creek, which had a temperature of 24°F. The only sample that did not exceed the sulfate MCL was that of the mine effluent to the lagoon (CPS-020).

The mine effluent sample (CPS-020) did, however, exceed standards for aluminum and fluoride. Both constituents were below standards at the effluent end of the lagoon (CPS-030). The concentration changes between the influent and effluent waters of the lagoon may reflect the influence of ground water on the water quality of the lagoon.

The downstream sample (CPS-040) indicated an exceedance of the secondary standard for sulfate and, like the upstream samples, may be related to the geothermal origin of the creek.

Mercury, a previously identified constituent of concern, was below the detection limit (0.1 µg/L) for all samples.

Table 6.7 Water-quality exceedances at the Warm Springs Phosphate mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
CPS010 (Upstream - Warm Spr. Creek)																	S		
CPS020 (Mine effluent - lagoon influent)	S														S				
CPS030 (Lagoon effluent)																	S		
CPS040 (Downstream - Warm Spr. Creek)																	S		

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in appendix V.

6.8.3.4 Vegetation

Observations of vegetation were limited to the sampling sites. No stress related to poor water quality was observed.

6.8.3.5 Summary of Environmental Condition

The exceedances of water quality criteria appear to be related to the geothermal origin of the water; a more detailed sampling effort would be required to confirm this supposition. Mercury, which had been identified as a potential concern, was not found above the detection limit.

6.8.4 Structures

As noted, the mine had only recently been suspended and was still occupied by mine personnel. The condition of the many structures on the site was not evaluated.

6.8.5 Safety

Safety concerns were not evaluated.

6.9 LONDONDERRY MINE AND MILL

Author's Note: In 1996, the Londonderry mine and mill were reclaimed. Many of the features discussed below are no longer present.

6.9.1 Site Location and Access

The Londonderry mine and mill (T8N R13W Sec 4 CCAB) are located on the west bank of Flint Creek, approximately a half mile northwest of the town of Maxville, Montana. Portions of the site are on land administered by the BLM. Access to the site is via a poorly defined foot trail that begins near the U.S. Geological Survey gaging station in Maxville.

6.9.2 Site History - Geologic Features

At the Londonderry, two parallel N40°W 70°SW lodes of iron-stained and silicified red sandstone of the Missoula Group were mined (Emmons and Calkins 1913). These zones were about one foot wide and yielded \$6.50 in gold and 50 ounces in silver per ton.

The Londonderry appears to investigate these structures through about 2,000-3,000 feet of underground workings. Waste-rock dumps at the site are composed of altered quartzite that contains sericite, kaolinite, pyrite, and quartz veinlets. A composite sample contained surprisingly high metal values: 0.0175 oz/ton gold, 94.8 ppm silver, 14 ppm copper, 1,025 ppm lead, 298 ppm zinc, and 1,200 ppm arsenic. A mill building is present, but no tailings were observed.

6.9.3 Environmental Condition

At the Londonderry, a 10-15 gpm adit discharge flows from a partially collapsed adit directly into Flint Creek (see figure 6.8). Near the adit portal, there is a broad area that is stained with iron-oxyhydroxide precipitates. Another environmental concern at the site is a large waste-rock dump which is being actively eroded by Flint Creek. The dump and the adit discharge are located on private land.

6.9.3.1 Site Features - Sample Locations

Water-quality samples were collected from Flint Creek upstream (FMXS20M) and downstream (FMXS10M) of the Maxville on October 14, 1994. The flow rate of the creek was approximately 67 cfs.

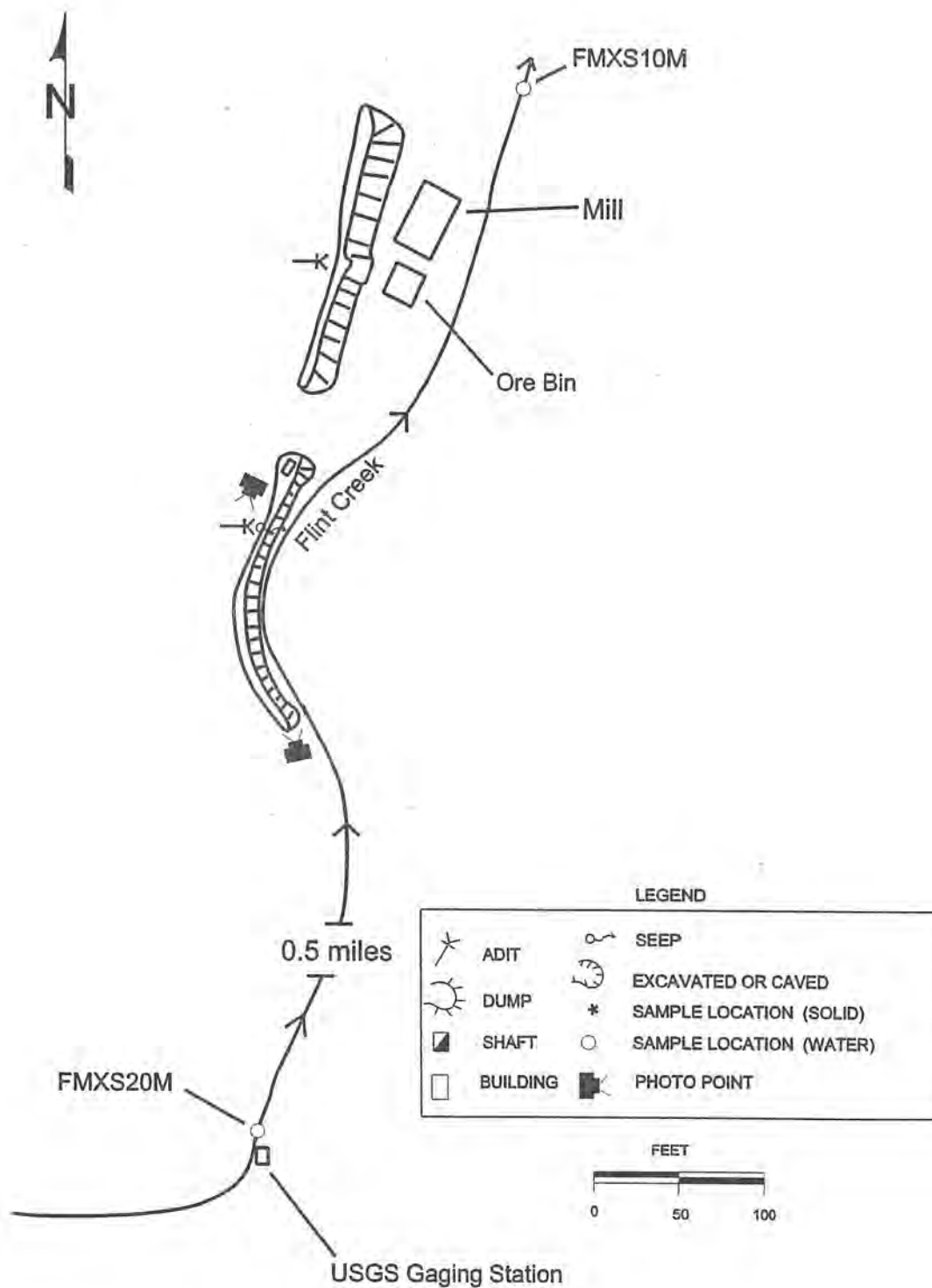


Figure 6.8 Sketch map of the Londonderry mine and mill, October 1994.



Figure 6.9 Ferric-oxyhydroxide precipitates stain the ground near the partially collapsed adit at the Londonderry mine and mill.



Figure 6.10 Flint Creek is actively eroding the streamside waste-rock dump at the Londonderry mine and mill.

6.9.3.2 Soil

No waste rock or tailings were observed on the BLM-administered land immediately downstream of the site. Therefore, no soil samples were collected.

6.9.3.3 Water

The concentration of manganese (0.069 mg/L) in Flint Creek downstream of the site was slightly above the secondary MCL of 50 mg/L. The field pH (8.52) at this location was also slightly outside the acceptable range (6.5-8.5).

Table 6.8 Water-quality exceedances at the Londonderry mine and mill.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Flint Creek - upstream of site (FMXS20M)																			
Flint Creek - downstream of site (FMXS10M)									S										S*

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

*pH measured in laboratory was within acceptable MCL range of 6.5 to 8.5

Note: Analytical results are listed in appendix V.

6.9.3.4 Vegetation

The waste-rock dumps at the site are barren to sparsely vegetated. Grass is growing in the area affected by the adit discharge.

6.9.3.5 Summary of Environmental Condition

The streamside waste-rock dump and adit discharge may be responsible for the elevated level of dissolved manganese in Flint Creek downstream of the site. In addition, the streamside dump may be a significant source of suspended solids, especially during storms and flooding events.

6.9.4 Structures

Structures at the site include a mine building, an ore chute, an ore bin, and the remnants of a mill.

6.9.5 Safety

The partially collapsed adit is a safety concern at the site. Also, the mill remnants and ore bin are potential concerns because they may be unstable.

6.10 GRANT AND HARTFORD MINE AND LEAD KING (MUSSIGBROD) MINE AND MILL

6.10.1 Site Location and Access

The Grant and Hartford mine (T12N R14W Sec 3 DACB) and the Lead King (Mussigbrod) mine and mill (T12N R14W Sec 3 DCBD) are located along First Chance Gulch, a short distance south of the Garnet ghost town. First Chance Gulch is a tributary to Bear Creek, which flows into the Clark Fork River. Most of the disturbances associated with these two sites are on patented claims. However, some of the Lead King workings extend onto BLM-administered lands. Access to both sites is via an improved dirt road that leads to Garnet.

6.10.2 Site History - Geologic Features

Workings at the Grant and Hartford consist of caved adits and dumps on both sides of the access road (and First Chance Gulch). Total surface disturbance is approximately four acres. Host rock is Precambrian Belt quartzite and schist; this is a vein deposit. Gangue mineralogy, based on dump rock, is vuggy quartz. Other minerals reported include barite, ankerite, calcite, and pyrite (Pardee 1918). Oxidized ore from stopes on the main adit level reportedly contained 1.5 to 5 ounces of gold and an equal amount of silver per ton; sulfide ore supposedly had similar values (Pardee 1918). This prospect was discovered in 1867 and most mining was done prior to 1910 (Pardee 1918). Estimated production was valued at \$30,000.00 (Pardee 1918). It is possible that some mining has taken place since that time. A claim map, which also shows underground workings, can be found in USGS Bulletin 660-F (Pardee 1918).

The Lead King (Mussigbrod) mine and mill are found a short distance downstream of the Grant and Hartford. Workings at the site consist of several caved adits, an open cut, the ruins of a mill building, and multiple waste rock piles. Included with the Crescent Claim, there were seven adit levels ranging from 600' to 1000' in length; these were distributed over a vertical distance of 300' (Pardee 1918). Host rock is Precambrian quartzite and schist. Dumps contain coarsely crystalline, white quartz that formed the gangue in this vein deposit. Mineralization visible on the dumps consists largely of limonite staining. Ore minerals reported from this mine include pyrite, chalcopyrite, tetrahedrite, and galena in the sulfide zone; in the oxidized zone, iron oxides and free gold were present (Pardee 1918). Ore from the oxidized zone (in adit 4) purportedly yielded \$35 per ton; places near the surface were even richer (Pardee 1918). A claim/underground map of the mine is found in USGS Bulletin 660-F (Pardee 1918).

6.10.3 Environmental Condition

A large dump at the Grant and Hartford is in contact with First Chance Gulch Creek. This dump is immediately adjacent to the road that leads to the Garnet ghost town.

At the Lead King (Mussigbrod) site, a small volume of water flows from a collapsed adit and into a small plastic-lined pond (PT1), which is a short distance upstream of the mill (see figure 6.11). Ferric-oxyhydroxide precipitate is present along the path of the adit discharge. Downstream of the mill, First Chance Gulch sinks into some waste-rock material and then resurfaces again as a large spring that flow into a couple of small impoundments (PT2 and PT3). The lowermost impoundment (PT3) is held back by a small tailings dam. Below the impoundments, First Chance Gulch descends through an area that has numerous spoil piles left from placering. The rock in this area does not appear to be mineralized.

6.10.3.1 Site Features - Sample Locations

Soil and water-quality samples were collected on BLM-administered land on June 27, 1995. Sample FLKS60H was collected from First Chance Gulch, upstream of both sites. The flow rate at this location was 120 gpm. Sample FLKS10M was collected from an unnamed tributary that crosses the road several hundred feet south of the Lead King mill. The flow rate of the tributary was 21 gpm. Samples FLKS30H and FLKS20H were collected along First Chance Gulch, near the small PT2 and PT3 impoundments, respectively. The flow rate at both of these locations was 187 gpm. Sample FLKS70H was collected from First Chance Gulch, below the last placer spoils. The flow rate of the gulch at this downstream location was 120 gpm.

Soil sample FLKD10M was collected from the tailings dam at PT3. No tailings were observed below this location.

6.10.3.2 Soil

The soil sample collected from the tailings dam at PT3 had concentrations of copper well above phytotoxic levels. The sample also had concentrations of arsenic, cadmium, lead, and zinc above the Clark Fork Superfund background levels for soils.

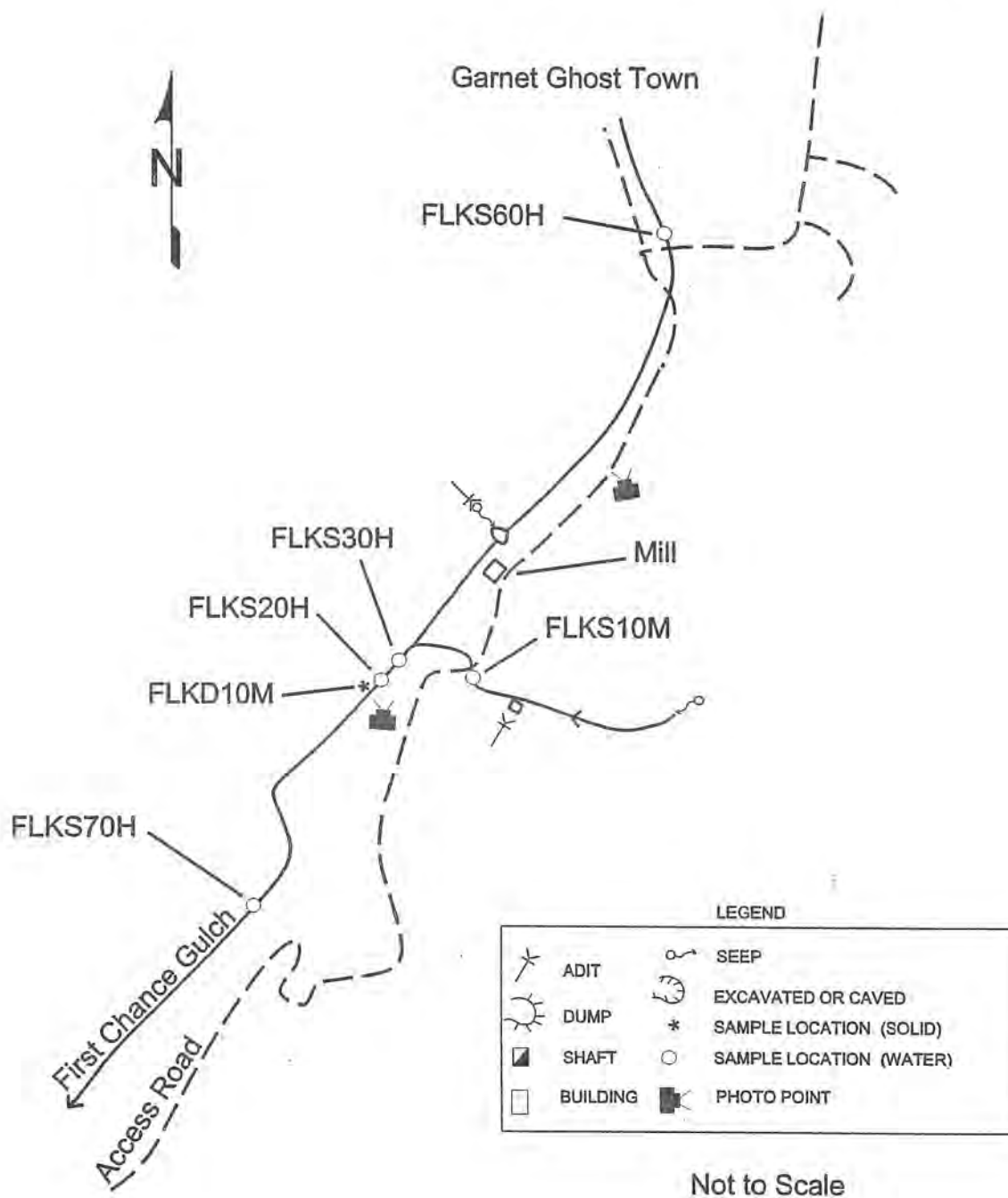


Figure 6.11 Sketch map of Grant and Hartford mine and Lead King (Mussigbrod) mine and mill area, June 1995.



Figure 6.12 At the Grant and Hartford, First Chance Gulch runs between a large waste-rock dump and the access road.



Figure 6.13 At sample location FLKS20H, technicians Frank Carr and Todd Werner measured the flow rate of the stream using a pipe dam, bucket, and stopwatch.

(1) Exceeds one or more Clark Fork Superfund background levels (table 1.3)
(2) Exceeds phytotoxic levels (table 1.3)

No water-quality criteria were exceeded at the upstream location on First Chance Gulch. However, the unnamed tributary that crosses the road south of the mill had a field pH of 5.97, which is outside the secondary MCL range of 6.5 to 8.5. At FLKS70H, downstream of all of the disturbances, the concentration of mercury was found to be 0.1 µg/L, which exceeds the chronic aquatic life standard.

Table 6.10 Water-quality exceedances at the Grant and Hartford mine and the Lead King (Mussigbrod) mine and mill.

[illegible]

Table 6.10 Water-quality exceedances at the Grant and Hartford mine and the Lead King (Mussigbrod) mine and mill (continued).

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
First Chance Gulch - downstream of all disturbances (FLKS70H)										C									

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

*pH measured in laboratory was within acceptable MCL range of 6.5 to 8.5

Note: Analytical results are listed in appendix V.

6.10.3.4 Vegetation

The waste-rock dumps at both sites are barren to sparsely vegetated. The top of the tailings dam at PT3 is densely vegetated with evergreens. The sides of the dam, however, are only sparsely vegetated with grass. The vegetation along the drainage below the sites appears healthy.

6.10.3.5 Summary of Environmental Condition

Most of the environmental impacts of the Grant and Hartford mine and the Lead King (Mussigbrod) mine and mill appear to be limited to the areas immediately surrounding the sites. Downstream of the sites, no sediment or erosion problems were observed, and vegetation appeared healthy. Water quality below the sites was good, except for a trace amount of mercury. The origin of the mercury is uncertain, but it could be associated with gold recovery from the placer mining along the creek.

6.10.4 Structures

At the Grant and Hartford, an ore bin is located adjacent to the road. At the Lead King (Mussigbrod), there is a mill building which is in fair condition. Both of these structures are on private land. Along the unnamed tributary, upstream of sample location FLKS10M, there are the remnants of a cabin. This structure is on BLM-administered land.

6.10.5 Safety

The highwalls and mill building at the Lead King (Mussigbrod) are obvious safety concerns, but they are located on private property. The most serious safety problem observed on nearby BLM land was an open adit south of the cabin remnants. The adit is at least 40 feet long.

6.11 FAIRVIEW MINE

6.11.1 Site Location and Access

The Fairview mine (T12N R14W Sec 11 BBDD) is a small group of workings near the head of Cave Gulch, a tributary to Bear Creek. Bear Creek is a tributary to the Clark Fork River. The site appears to be on private and BLM-administered lands. The site is a mile southeast of the Garnet ghost town and is easily accessible by road.

6.11.2 Site History - Geologic Features

The Fairview mine consists of one open (A2) and three caved adits (A1, A3, and A4), and several waste-rock dumps (see figure 6.14). Total surface disturbance is less than two acres. Host rock at this location is Precambrian micaceous schist and banded quartzite. Gangue mineralogy appears to be milky quartz; the only apparent sign of mineralization is relatively uniform limonite staining on the dump rock. Native gold, tellurides of gold and silver, and bismuth were reported from this location (Pardee 1918). Assays, late in the history of the mine, averaged 1.10 ounces of gold and 0.77 ounces of silver per ton (Pardee 1918). Records covering the period 1898 to 1907 show a production of over \$50,000.00 (Pardee 1918). It appears that this patented claim has been inactive for a considerable period of time.

6.11.3 Environmental Condition

The A1 and A3 adits have discharges that flow down the mountainside a short distance before infiltrating the ground. In the open A2 adit, shallow pools of standing water are present, but there is no evidence of water flowing from the adit portal.

6.11.3.1 Site Features - Sample Locations

The discharge from adit A3 (CFVS10L) was sampled on June 28, 1995. The flow rate of the discharge was 3.1 gpm. The discharge and standing water associated with adits A1 and A2, respectively, were not sampled because the adits are on private property.

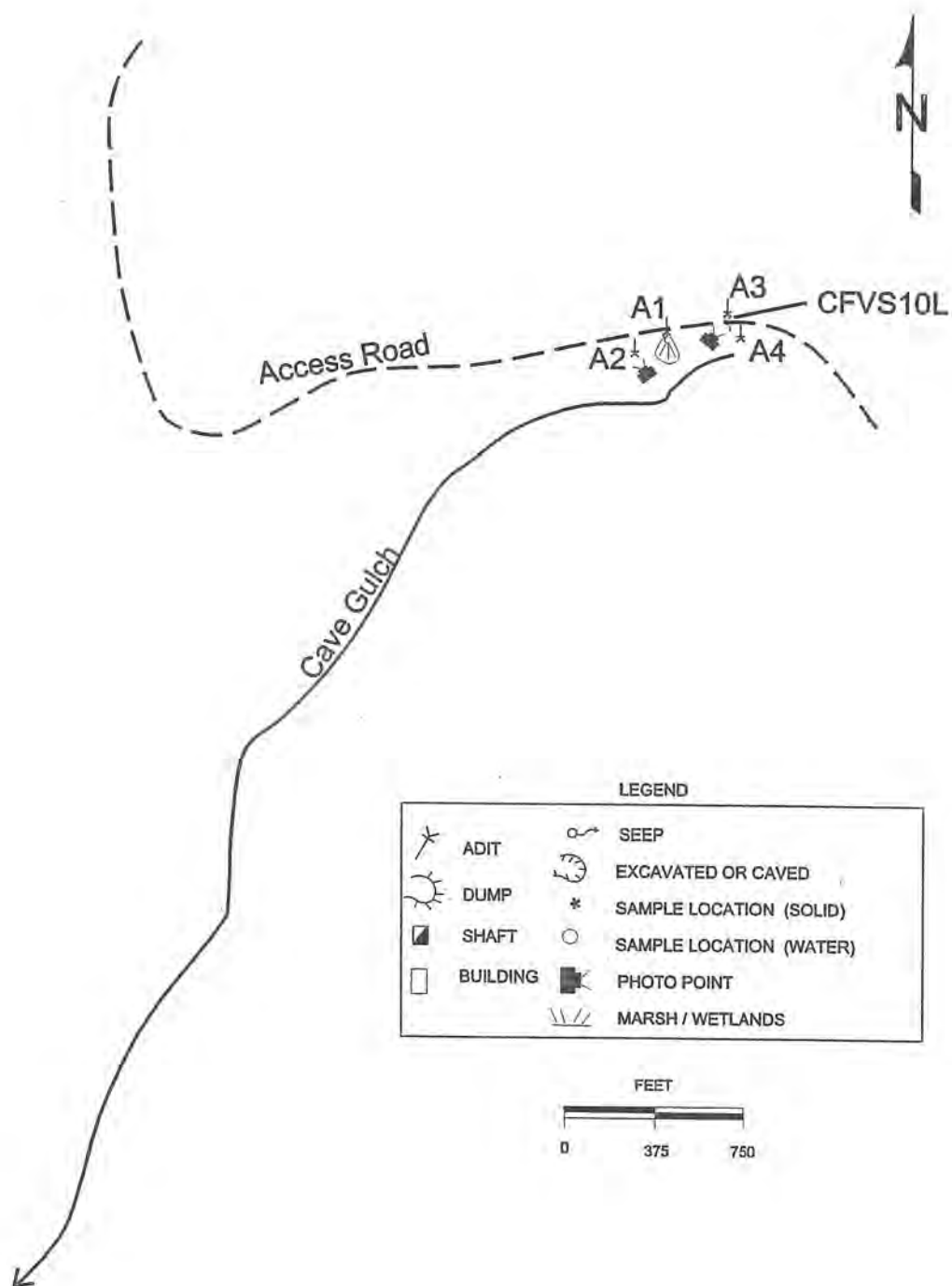


Figure 6.14 Site map of the Fairview mine, June 1995. Sample CFVS10L was collected from the adit A3 discharge.



Figure 6.15 At the Fairview mine, shallow pools of water are present in the open A2 adit.



Figure 6.16 The discharge from the A3 adit flows down the embankment next to the road. No vegetation is growing within the discharge channel.

6.11.3.2 Soil

Impacts to soil were limited to the waste-rock dumps; therefore, no soil samples were collected.

6.11.3.3 Water

The discharge from the A3 adit contained concentrations of manganese (0.109 mg/L) and mercury (0.1 µg/L) above water-quality standards. The field pH (6.17) of the sample was also outside the acceptable secondary MCL range (6.5-8.5).

Table 6.11 Water-quality exceedances at the Fairview mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit A3 discharge (CFVS10L)									S	C									S*

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

* pH measured in laboratory was within the acceptable secondary MCL range of 6.5 to 8.5

Note: Analytical results are listed in appendix V.

6.11.3.4 Vegetation

The waste-rock dumps at the site are barren to sparsely vegetated with grasses. No vegetation is growing in the path of the discharge from the A3 adit.

6.11.3.5 Summary of Environmental Condition

The discharge from the A3 adit appears to have impacted a small area immediately downhill of the mine portal; no vegetation has been affected farther downhill. The other adit discharge at the site is on private land and does not appear to affect vegetation.

6.11.4 Structures

No structures were observed on private or federal lands near the site.

6.11.5 Safety

The open A2 adit is a safety concern; however, it is on private land.

6.12 ARMADA MINE

6.12.1 Site Location and Access

The Armada mine (T12N R14W Sec 11 ADBC) is a patented claim located approximately 1.4 miles southeast of the Garnet ghost town, on a small drainage that joins Cayuse Gulch. Cayuse Gulch is a tributary to Deep Creek, which in turn, flows into Bear Creek. The mine property is completely surrounded by BLM-administered land. Access to the site is via a four-wheel drive road that turns west off a well-maintained road along a ridge southeast of Anderson Hill. A site map was not prepared because the mine is on private land.

6.12.2 Site History - Geologic Features

The Armada consists of a large open cut with waste rock piles. Estimated total surface disturbance is three acres. Host rock is granodiorite in contact with Precambrian or Cambrian sedimentary rocks. The contact is highly mineralized with a large pyrite vein exposed and visible from some distance. This is either a replacement or vein deposit, or a combination of the two. Minerals found at this location include abundant limonite and pyrite with lesser quartz. An assay sample contained less than 2 ppm lead, 72 ppm zinc, 10,000 + ppm copper, 25.4 ppm silver, 0.0250 ounces of gold, and 24 ppm arsenic.

The Armada property was developing and producing in 1974 (Lawson 1974). However, judging from the condition of the workings today, there has been no mining for several years.

6.12.3 Environmental Condition

An iron-stained seep emerges near the base of the headwall at the northwest end of the site. As the seep descends along the open cut, it flows over waste rock and vein material containing abundant pyrite. At the south end of the cut, the water from the seep collects in a small pond. Overflow from the pond flows a short distance down a haul road before infiltrating the ground. Water does not surface again until reaching a spring several hundred feet down the drainage. This spring is the headwater of Cayuse Creek.



Figure 6.17 The Armada mine is a large open-cut near the headwaters of Cayuse Creek.



Figure 6.18 White salts can be seen on a mineralized outcrop at the Armada mine.

6.12.3.1 Site Features - Sample Locations

A water-quality sample was collected from the spring below the mine on June 28, 1995. The flow rate of the spring was less than 5 gpm.

6.12.3.2 Soil

Soils on the BLM land below the site did not appear impacted; therefore, no soil samples were collected.

6.12.3.3 Water

The sample collected from the spring below the site had no water-quality exceedances.

Table 6.12 Water-quality exceedances at the Armada mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Spring on BLM land below site (CARS10H)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

6.12.3.4 Vegetation

Along the path of the seep, the ground is barren to sparsely vegetated. Much of the disturbed land elsewhere around the site appears to be naturally re-vegetating with grasses and evergreens. The drainage below the site is densely vegetated and does not appear impacted by the mine.

6.12.3.5 Summary of Environmental Condition

Environmental problems at Armada appear to be restricted to the disturbed area. The water quality of the spring on BLM-administered land below the site is good and vegetation appears healthy.

6.12.4 Structures

No structures were observed at the site.

6.12.5 Safety

The highwall of the open-cut poses a hazard, but it is on private property.

6.13 UNNAMED 12N14W11DABB MINE

6.13.1 Site Location and Access

The Unnamed 12N14W11DABB mine (T12N R14W Sec 11 DABB) is located on BLM land along Cayuse Gulch, approximately 1.5 miles southeast of the Garnet ghost town. Cayuse Gulch is a tributary to Deep Creek, which flows into Bear Creek. The site is accessible by foot from a trail that begins on the haul road below the Armada mine (see previous section).

6.13.2 Site History - Geologic Features

The site consists of an open adit, a collapsed adit, and a moderately large, unmineralized waste-rock dump (see figure 6.19). No production records or historical information were found for the mine.

6.13.3 Environmental Condition

The waste-rock dump at this site is adjacent to an old haul road that now serves as a channel for water running down Cayuse Gulch. There is some potential for erosion of the waste, especially during storms and other high runoff events. Another environmental concern at the site is a discharge that flows from the open adit. This discharge sinks into the dump material before reaching Cayuse Gulch.

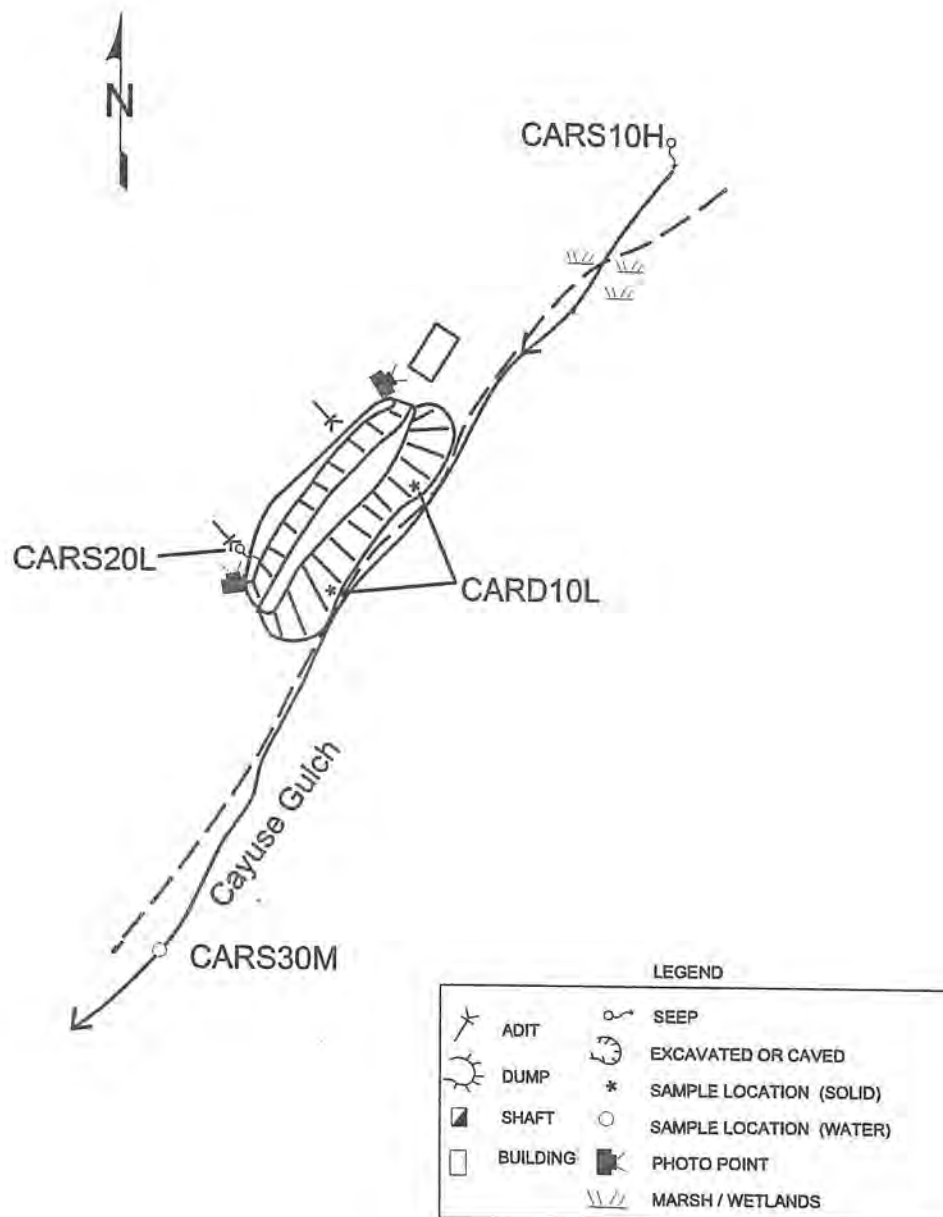
6.13.3.1 Site Features - Sample Locations

Soil and water-quality samples were collected at the site on June 28, 1995. Sample CARS20L was collected from the adit discharge, which had a flow rate of 4.3 gpm. Samples were also collected from Cayuse Gulch, upstream (CARS10H) and downstream (CARS30M) of the site. The flow rate at the upstream location was 11 gpm; at the downstream location, the flow rate was 14 gpm.

Soil sample CARD10L was collected from the edge of the waste-rock dump adjacent to Cayuse Gulch.

6.13.3.2 Soil

The soil sample collected from the streamside dump had a copper concentration an order of magnitude greater than the phytotoxic limit. The sample also had



Not to Scale

Figure 6.19 Sketch map of the Unnamed 12N14W11DABB mine, June 1995.



Figure 6.20 The open adit at the Unnamed 12N14W11DABB mine has a small discharge that flows across the top of the waste-rock dump.



Figure 6.21 The remnants of a cabin/mine building are scattered across the top of the waste-rock dump.

concentrations of arsenic, cadmium, lead, and zinc above Clark Fork Superfund background levels for soil.

Table 6.13 Soil sampling results for the Unnamed 12N14W11DABB mine.

Sample Location	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
Soil at the base of waste-rock dump, adjacent to Cayuse Gulch (CARD10L)	85.5 ¹	10.4 ¹	1825 ^{1,2}	470 ¹	363 ¹

(1) Exceeds one or more Clark Fork Superfund background levels (table 1.3)

(2) Exceeds phytotoxic levels (table 1.3)

6.13.3.3 Water

The field pH of the adit discharge was 6.25, which falls outside the acceptable secondary MCL range of 6.5 to 8.5. However, the laboratory pH of the sample was 7.82. The other samples collected at the site had no water-quality exceedances.

Table 6.14 Water-quality exceedances at the Unnamed 12N14W11DABB mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Cayuse Gulch - upstream of site (CARS10H)																			
Adit discharge (CARS20L)																			S*
Cayuse Gulch - downstream of site (CARS30M)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

*pH measured in laboratory was within acceptable secondary MCL range of 6.5 to 8.5

Note: Analytical results are listed in appendix V.

6.13.3.4 Vegetation

The waste-rock dump at the site is vegetated with grasses and small brush.

6.13.3.5 Summary of Environmental Condition

The water quality of Cayuse Creek does not appear to be significantly impacted by the streamside dump or the adit discharge under baseflow conditions. However, during storms and flooding events, sediment eroded from the dump may release metals, especially copper, to the creek.

6.13.4 Structures

The remnants of a cabin or mine building are present at the north end of the waste-rock dump.

6.13.5 Safety

Hazards identified at the site include the open adit and the building remnants. Both of these features are on BLM-administered land.

6.14 BLACKTAIL (LINTON) MINE AND MILL

6.14.1 Site Location and Access

The Blacktail (Linton) mine and mill (T12N R15W Sec 30 CBBC) are located on Cramer Creek, approximately 3.5 miles north of Interstate-90 and the Clark Fork River. Most of the site is on BLM-administered land. The site is easily accessible on the Cramer Creek Road, which begins near the Beavertail exit of I-90.

6.14.2 Site History - Geologic Features

The Blacktail (Linton) mine workings consist of a large open cut, a caved adit, an open stope, the remains of a 500 ton mill, and several waste-rock dumps. Total surface disturbance is approximately seven acres. Host rock is light to medium-gray dolomite (Cambrian Hasmark Formation?); signs of mineralization include abundant iron oxides. High-grade ore composed of galena with cerrusite and malachite was reported from this replacement deposit. The ore purportedly carried one ounce of silver for 1% lead, with a trace of gold (Sahinen 1957).

The mine was opened in 1947, and the mill was constructed in 1949. The mine operated from 1947 to 1953 (Sahinen 1957). Production data for the mine are incomplete, but judging from the size of the waste-rock dumps, the production was substantial.

6.14.3 Environmental Condition

At this site, a relatively large tailings and waste-rock dump is situated on the banks of Cramer Creek (see figure 6.22). Waste material appear to have been washed downstream a considerable distance, thus impacting private lands.

6.14.3.1 Site Features - Sample Locations

A soil sample (CBTD10M) was collected along the base of the tailings and waste-rock dump, where it comes into contact with the creek. Water-quality samples were collected from Cramer Creek upstream (CBTS10H) and downstream (CBTS20H) of the site. The flow rate of the creek at the upstream location was 630 gpm; at the downstream location, it was 1,000 gpm. All of the samples were collected on August 8, 1995.

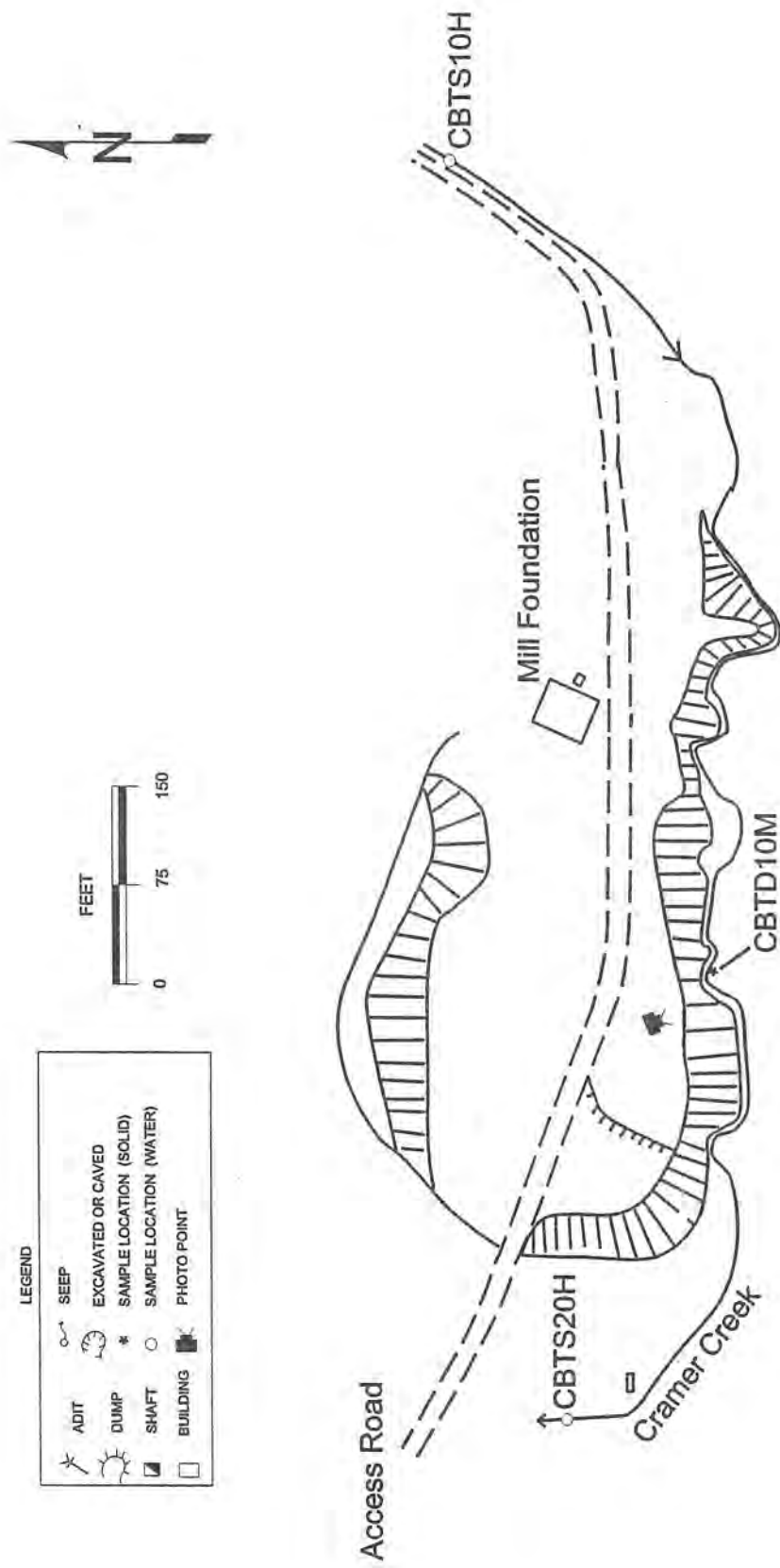


Figure 6.22 Site map of the Blacktail (Linton) mill and streamside dump, August 1995. The open slope is on the mountainside north of the mill.



Figure 6.23 At the Blacktail (Linton) mine, tailings are mixed with waste rock in a large dump adjacent to Cramer Creek.



Figure 6.24 A large open stope is located on the mountainside above the Blacktail (Linton)'s mill foundation and streamside dumps.

6.14.3.2 Soil

The concentrations of arsenic, copper, and lead in the waste material adjacent to the creek exceed phytotoxic limits.

Table 6.15 Soil sampling results for the Blacktail (Linton) mine and mill.

Sample Location	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
Soil at the base of waste-rock dump, adjacent to Cramer Creek (CBTD10M)	256 ^{1,2}	1.1 ¹	110 ^{1,2}	1,050 ^{1,2}	76.2 ¹

(1) Exceeds one or more Clark Fork Superfund background levels (table 1.3)

(2) Exceeds phytotoxic levels (table 1.3)

6.14.3.3 Water

The field pH of Cramer Creek was above the secondary MCL upper limit of 8.5 at the upstream and downstream sample locations. No other water-quality standard were exceeded.

Table 6.16 Water-quality exceedances at the Blacktail (Linton) mine and mill.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Cramer Creek - upstream of site (CBTS10H)																			S
Cramer Creek - downstream of site (CBTS20H)																			S

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

6.14.3.4 Vegetation

The waste-rock and tailings at the site are barren to sparsely vegetated with grasses, brush, and small trees. Vegetation along the flood plain below the site also appears to be impacted.

6.14.3.5 Summary of Environmental Condition

Based on the sampling results of this preliminary site assessment, the water quality of Cramer Creek below the Blacktail (Linton) is good under base-flow conditions; the pH of the water is high, so dissolved metals are not a serious problem. However, during runoff events, the suspended sediment load of the creek probably contains high concentrations of metals from tailings and waste-rock that are eroded from the streamside dumps. Past flooding events have deposited streamside tailings more than a quarter mile below the site.

6.14.4 Structures

A concrete foundation is the only remnant of the mill that once stood at the site.

6.14.5 Safety

The large open stope on the mountainside above the mill foundation is a safety concern. Warning signs and fences have been placed around the stope, but it is still easily accessible. This feature appears to be on BLM-administered land.

6.15 ALADDIN, CAPE NOME, AND HIDDEN TREASURE MINES

6.15.1 Site Location and Access

The Aladdin (T12N R16W Sec 18 DDCB) and Cape Nome (T12N R16W Sec 18 DDCB) mines are patented claims along an unnamed tributary to Wallace Creek, which is a tributary to the Clark Fork River. The Hidden Treasure mine (T12N R16W Sec 19 CABB) is a patented claim at the east end of the Wallace Creek reservoir. Blocks of BLM-administered lands are located upstream and downstream of these sites. All three sites are accessible via the Wallace Creek Road. No site maps were prepared because the mines are on private land.

6.15.2 Site Histories - Geologic Features

The Aladdin workings consist of a small waste-rock dump below a collapsed adit. Total surface disturbance is less than an eighth of an acre. Host rock, based on dump samples, was granodiorite and Precambrian quartzite. Mineralization apparent on the dump rock includes iron oxide, secondary copper minerals, and chalcopyrite (or pyrite).

Workings at the Cape Nome include a shaft and adit, both of which are collapsed. There are also several small waste-rock dumps near the shaft and adit. No production records were found for the site.

The Hidden Treasure mine consists of an open adit and a large waste-rock dump. Total surface disturbance is approximately three acres. Host rock is Precambrian Garnet Range Formation; lithology is light- to medium-colored quartzite. Evidence of mineralization includes iron-oxide staining over most of the site. The literature indicates that the site was developed by two adits; only one was observed in 1994. Maps of adit levels can be found in Hintzman (1964); a plan and section-underground workings map can be found in Piquette (1940).

6.15.3 Environmental Condition

At the Aladdin and Cape Nome, small waste-rock dumps are located adjacent to the unnamed tributary to Wallace Creek. At the Hidden Treasure, there is an adit discharge that flows across the top of the waste-rock dump a short distance before infiltrating the ground. Along the side and base of the dump, there are several seeps that also sink into the ground within a short distance.



Figure 6.25 The top of the streamside waste-rock dump at the Aladdin is barren.



Figure 6.26 A gate across the adit entrance at the Hidden Treasure mine has been vandalized so that it is now possible to crawl into the mine workings.

6.15.3.2 Soil

6.15.3.3 Water

Table 6.17 Water-quality exceedances at the Aladdin, Cape Nome, and Hidden Treasure mines.

[illegible]

Table 6.17 Water-quality exceedances at the Aladdin, Cape Nome, and Hidden Treasure mines (continued).

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Seep in road - near base of Hidden Treasure dump (WHTS10H)																			
Wallace Creek - downstream of all sites and reservoir (WHTS30M)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

* Laboratory pH was within the acceptable secondary MCL range.

6.15.3.4 Vegetation

The top of the waste-rock dump at the Aladdin mine is barren to sparsely vegetated; however, the ground around the base of the dump, close to the unnamed tributary, is densely vegetated. The streamside dump at the Cape Nome is moderately vegetated. The dump at the Hidden Treasure is also moderately vegetated. The vegetation on the BLM land below the sites appears healthy and unaffected by the mining.

6.15.3.5 Summary of Environmental Condition

Although the streamside waste-rock dumps at the Aladdin and Cape Nome may release metal-laden sediments to the unnamed creek, the environmental impacts on BLM land along the drainage below are evidently minor. Likewise, the impacts from the discharges at the Hidden Treasure are minor and probably do not extend much beyond the site itself.

6.15.4 Structures

No structures are present at the Aladdin. At the Cape Nome, there is a large, unstable ore bin. At the Hidden Treasure, there is an ore bin next to the access road and a mine building to the east of the adit.

6.15.5 Safety

At both the Cape Nome and Hidden Treasure, the ore bins pose a safety concern because the structures are unstable. At the Hidden Treasure, the open adit has been sealed with a gate; however, several steel bars have been removed, so it is possible to crawl inside. No hazards were identified on BLM-administered lands near the sites.

6.16 SUMMARY OF MINING IMPACTS ON BLM LAND - UPPER CLARK FORK RIVER DRAINAGE

Of the 14 sites with potential environmental impacts, the Blacktail (Linton), the Londonderry, the Lead King (Mussingbrod) and the Grant and Hartford appear to have the most serious problems. At the Blacktail (Linton), a large waste-rock and tailings dump is situated along the edge of Cramer Creek. Soil adjacent to the creek contains elevated concentrations of arsenic, copper, and lead. During storm and runoff events, soil and waste probably wash into the creek, causing sedimentation and metal-loading problems. At the Londonderry, a similar situation exists. A large, sparsely vegetated waste-rock dump is located on the edge of Flint Creek and is highly susceptible to erosion. Another problem at the Londonderry is an adit discharge which flows directly into the creek. The Lead King and the Grant and Hartford, both located along First Chance Gulch near the ghost town of Garnet, also have streamside wastes with potential erosion problems. A soil sample collected from a small tailings impoundment below the two sites contained elevated concentrations of copper. Impacts from the two sites, however, do not appear to extend far downstream.

Sites with lesser environmental problems include the Fairview and Unnamed 12N14W11DABB mines. At the Fairview, a discharge from a collapsed adit contains concentrations of manganese and mercury that slightly exceed water-quality standards. The discharge infiltrates the ground a short distance from the portal. At the Unnamed 12N14W11 DABB, there is a metal-laden waste-rock dump close to a small stream. However, the erosion potential of the waste material is less severe than at the sites noted above.

The eight remaining sites with potential environmental problems were found to have little, if any, impact on BLM-administered lands. The Section 32 - Unnamed Adits, Lower Luke, Opsata, and Hidden Treasure sites have small discharges that appear to have no serious water-quality problems. The Armada has a seep that appears to be of poor quality, but it infiltrates the ground before reaching BLM-administered land. Streamside waste-rock dumps at the Aladdin and Cape Nome mines may impact water quality locally but do not affect BLM lands which are located several miles downstream. Water discharging from the Warm Springs Phosphate mine has elevated concentrations of aluminum, fluoride, and sulfate; however, these water-quality problems may be because of geothermal activity in the area, rather than mining.

Twenty-four of the 135 inventoried sites were found to have one or more safety concerns. Nineteen of the sites had hazardous mine openings, six sites had unstable structures, and three sites had steep highwalls. Fourteen of the sites with safety hazards are on or adjacent to BLM-administered land (see table 6.2).

JEFFERSON RIVER DRAINAGE

7.1 GEOLOGY

BLM mine sites in the Jefferson River drainage occur in widely varying types of geologic environments. Mines in the Pipestone district occur primarily in quartz monzonite of the Boulder batholith. However, other granitic intrusives are present as well as volcanic rocks. At least one mine in the area is located in basalt country rock. Mines of the Silver Star district are primarily found in an area of Archean gneiss and schist. Many of the mine sites are skarn deposits located along the contact of Cretaceous quartz monzonite and Cambrian limestone in close proximity to Archean country rocks. A few mines in this district are located entirely in the quartz monzonite of the Hell's Canyon Pluton of the Boulder batholith. Mines of the Gold Hill District typically occur in belt sedimentary rocks. Many are found in Cambrian limestones and others are associated with Cretaceous intrusive rocks.

7.2 ECONOMIC GEOLOGY

The majority of mines and prospects in the Jefferson River drainage explore veins of quartz, with the exception of the skarn deposits in the Silver Star district. The veins are typically narrow and steeply dipping; most strike east-west.

Veins in the Pipestone district are typical of Boulder batholith quartz veins. Mines in this area were developed primarily for the silver content of the lead-zinc sulfide ore that was present in the quartz. Most veins are oxidized near the surface and contain jasperoid, characteristic of the veins near the perimeter of the Boulder batholith. Production from all mines is low, much having been done during the 1930s. Total production from area mines likely amounts to no more than \$20,000 dollars from all metals. Future prospects of mine development in this area appear unlikely. One exception is the active open pit mine along the railroad right-of-way just north of the Pipestone freeway interchange. The mine reportedly produces railroad ballast and has been in continuous operation for several years. The deposit's location literally on the railroad spur is quite fortuitous.

The veins of the Gold Hill, or Renova, district were valued primarily for the gold content of the quartz ore material. The veins contain significant amounts of sulfides, primarily pyrite, arsenopyrite, and to a lesser degree, copper sulfides. Though found in Belt sediment, the mineralization is very likely to have been influenced by the Cretaceous intrusive rocks found in the area. Mines in Meagher Limestone and Jefferson dolomite may be either fissure veins or bedded sedimentary deposits, most containing high percentages of iron or manganese oxides. Estimates

of production for this district are in excess of \$1.5 million. However, included in this figure is production for the Mayflower mine, which is not within the BLM inventory study area. If production from this mine could be determined and deducted, production from the district would prove to be much less significant. Most historical production has been in oxidized and enriched areas of the veins. The sulfide ores at depth are of lower grades and obviously more difficult to process. Future mining development in this district would appear unlikely.

The Silver Star district is one of the two most productive districts in the Jefferson River drainage. The mines were valued primarily for the gold content. Many were high-grade deposits that produced ore that could be shipped directly to smelters. The lower grade ores were also amenable to straight forward processing methods. The narrow veins were exploited to depths of several hundred feet from surface and appeared to be highly oxidized to these depths. Skarn deposits in the district also proved to be economic, containing high grade gold and some base metals. Economic reserves would seem to have been exhausted, at least under current market conditions because several exploration projects in the past decade did not lead to a producing mine. Industrial minerals in the district, however, seem to be a different matter. An active, open-pit chlorite mine has had several years of production.

The second important district in the Jefferson drainage is the Pony, or Mineral Hill, mining district. Most mines in the district were developed on quartz veins in Archean rocks or Cretaceous quartz monzonite. The veins contained economic quantities of gold as well as base metals. Gold was the primary economic constituent of most ores. Tungsten is present in some areas of the district but has not appeared to be present to a sufficient degree to allow economic exploitation. Most known veins in existing mines have been explored and mined to considerable depths. Recent exploration efforts have not resulted in any new mining activity, and the economic potential of the district appears to be low. Historically the district is estimated to have produced between 180,000 and 300,000 ounces of gold -- the majority of which was mined from the Boss Tweed and Clipper mines.

7.3 HYDROLOGY AND HYDROGEOLOGY

The Jefferson River drainage, in southwest Montana, flows from its origin at the confluence of the Beaverhead, Big Hole, and Ruby Rivers to its confluence with the Gallatin and Madison Rivers to form the Missouri River. The Boulder River is a tributary of the Jefferson. Other large tributaries include Willow Creek, South Boulder Creek, and Whitetail Creek. Average stream discharges for current measurement stations are presented in table 7.1.

Table 7.1 Stream-gaging data for the Jefferson River drainage. Seasonal records only.

Gage Location	Period of Record	Drainage Area (mi ²)	Annual Mean Flow (cfs)
Jefferson R. near Twin Bridges	1940-1994*	7,632	2,014
Willow Cr. near Harrison	1923-1994**	83.8	40.7
Jefferson R. near Three Forks	1978-1994	9,532	1,931

* August 1940 to September 1943, October 1957 to September 1972, May to present.

** April 1938 to September 1982, October 1982 to present seasonal only.

Source: Shields *et al.* 1995

In general, the Jefferson River drainage is bounded on the east and south by the Tobacco Root Mountains and on the west by the Highland Mountains and the Continental Divide. The higher elevations of the Highland Mountains and the Tobacco Root Mountains were glaciated. Quaternary terminal moraine is found in the upper reach of South Boulder Creek; smaller moraines are found in tributaries in the Highland Mountains. With few exceptions, near-stream deposits are Quaternary alluvium along the entire drainage. The surficial deposits on the valley margins of the upper reaches are generally Quaternary terraces and alluvial fans or Tertiary lake bed sediment (Alden 1953).

The average annual precipitation ranges from 12 inches in the valley to 40 inches in the higher elevations of the Tobacco Root Mountains (Montagne *et al.* 1982). Average annual temperatures range from 40-45°F in the valley to 25-30°F in the mountains (Bergantino 1978).

Much of the water demand in the Jefferson River drainage is for irrigation. There are about 310,000 acres irrigated upstream of Twin Bridges and 390,000 acres irrigated above Three Forks; about 12,500 acres are irrigated above the Willow Creek Reservoir. The river is controlled to some degree by the Lima, Ruby, Clark Canyon, and Willow Creek Reservoirs. A summary of reservoir capacities and extremes (water-year 1994) for reservoirs affecting the Jefferson River is presented in table 7.2.

Table 7.2 Reservoir statistics for the Jefferson River drainage.

Reservoir	Useable Capacity*	WY 1994 Extremes*
Lima (Red Rock River)	84,050	80,820 to 8,560
Ruby River	39,740	39,500 to 0
Clark Canyon	255,600	170,000 to 76,000
Willow Creek	17,730	18,000 to 2,270

*acre-feet

Source: Shields *et al.* 1995

Ground water in the drainage is commonly used for domestic water supply. The town of Three Forks is the largest municipal user of ground water. Most wells in the drainage tap the shallow alluvial aquifer system.

7.4 SUMMARY OF THE JEFFERSON RIVER DRAINAGE

For the abandoned/inactive mine inventory for the BLM, the MBMG investigated 70 mine and/or mill sites within the Jefferson River drainage (see figure 7.1 and table 7.3). Of these sites, 61 were found to have no impact on BLM-administered land, six may pose environmental problems, and two could not be located. The six sites with potential environmental impacts were the Garnet Gold mine, Iron Rod (Golden Rod) mine, Green Campbell mine and mill, Lone Wolf mine, Pauper's Dream mine, and Strawberry/Keystone mine and mill (listed in **bold** in table 7.3). These sites were investigated in detail and are discussed in the following sections.

If mine openings or other dangerous features (unstable structures, steep waste-rock dumps, high walls) were observed at a site, then the site was designated unsafe, or hazardous, in table 7.3. Of the 70 sites inventoried, 23 were found to have safety concerns. It should be noted that only sites where soil and/or water quality samples were collected were screened carefully for safety problems. Hazards may exist at many of the other sites, but they may not have been noted or observed during the inventory.

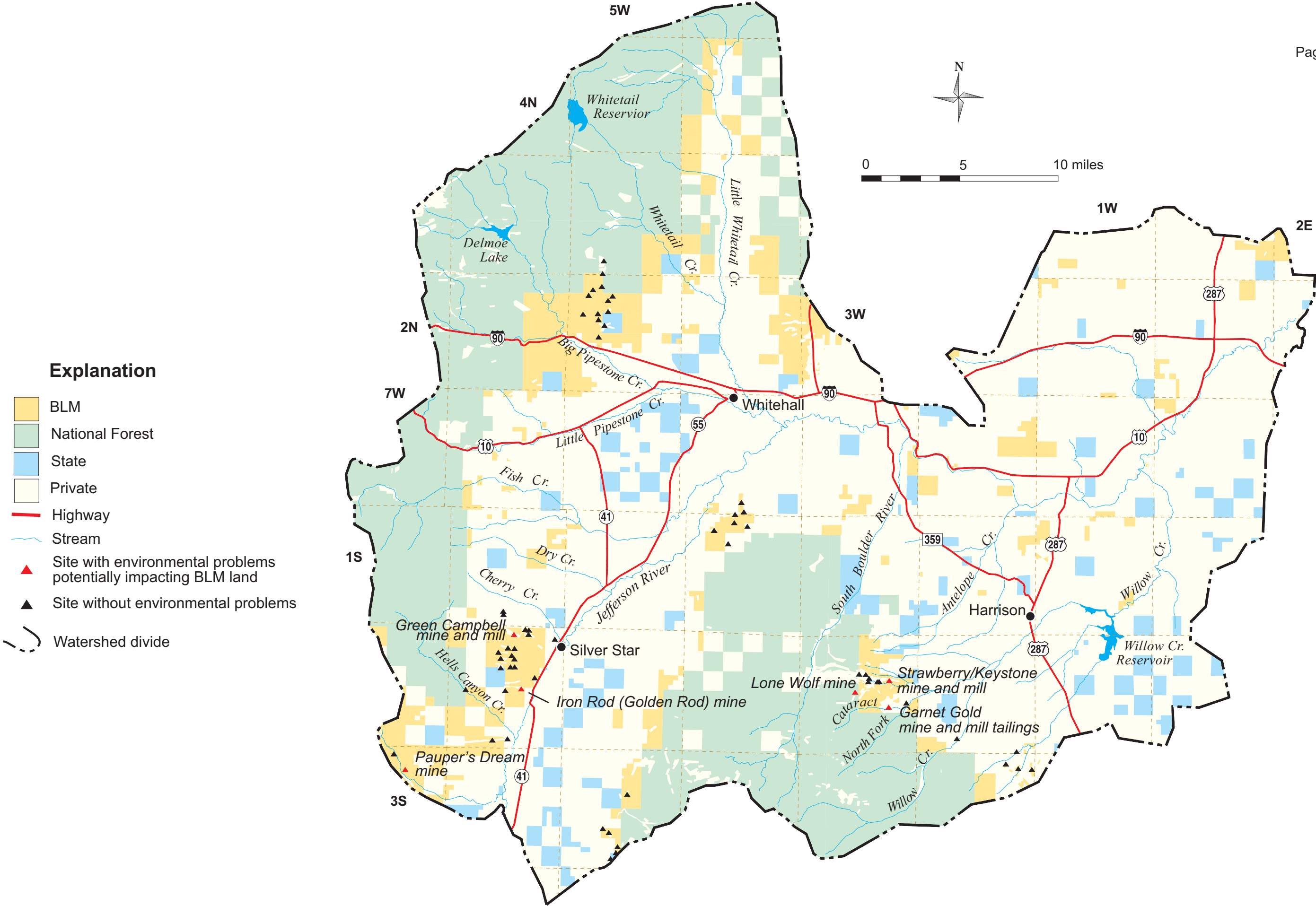


Figure 7.1. Abandoned/inactive mines inventoried in the Jefferson River drainage.

Table 7.3 Summary of sites inventoried in the Jefferson River drainage. Site name in **bold** indicates potential environmental problems. "Y" in hazard column indicates a safety hazard is present at site.

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
American Pit	PRV	Y	N	NE	Part of Broadway/Victoria site.
Antler	PRV	N	N	NE	Active, open-pit chlorite mine.
Aurora	PRV	Y	N	N	Caved shaft. Dry.
Bedford	BLM	Y	N	N	No impact.
Bi-Metallic	PRV	N	N	NE	Screened out in office.
Blue Rock/May Basket	PRV	N	N	NE	No impact on BLM.
Blue Grouse	BLM	Y	N	N	Small prospects. Dry.
Bonanza Fraction	PRV	Y	N	N	Small prospects. Dry.
Boss Tweed	PRV	Y	N	Y	Mill, tailings, and extensive workings.
Bowler's Blind	PRV	Y	N	N	No impact on BLM.
Bozeman	PRV	Y	N	N	Dry.
Broadway	MIX	Y	N	N	Open cut and dry tailings dams.
Bryzant	MIX	Y	N	N	Caved workings. Dry.
Caldwell Ranch	BLM	Y	N	Y	Shallow shafts and prospects. Dry.
Clancy	PRV	Y	N	N	Caved shaft. Dry.
Clifford	PRV	Y	N	N	Caved workings. Dry.
Clipper	PRV	Y	N	Y	Open stopes. Dry.
Contact	PRV	N	N	NE	Screened out in office.
Cricket	PRV	Y	N	Y	Open stopes. Dry.
Dividend Lode	PRV	Y	N	N	Dry.
Dry Creek	BLM	Y	N	Y	Open shafts, caved stopes. Dry.

Table 7.3 Summary of sites inventoried in the Jefferson River drainage (continued).

SITE¹	OWNER²	VISIT	SAMPLE³	HAZARD⁴	REMARKS
Easter Lily	PRV	Y	N	N	Caved adit. Dry.
Frida Marie	MIX	Y	N	N	Prospects. Dry.
Galena	BLM	Y	N	N	Prospects. Dry.
Garnet Gold⁵	PRV	Y	Y	Y	Streamside tailings and gated adit with discharge. Petro-chemical spill.
Gold Hill	PRV	Y	N	NE	No impact on BLM.
Golden Link	PRV	N	N	NE	No impact on BLM.
Golden Rod	PRV	Y	Y	Y	Same as Iron Rod.
Golden Sunlight	PRV	N	N	NE	Screened out. Active in 1995.
Golden Valley/ Minnie Wilson	BLM	Y	N	Y	Shallow open shaft. Dry.
Green Campbell⁵	PRV	Y	Y	Y	Open adit, shafts, mill, and bulldozer cuts. Adit discharge.
Hell's Canyon Placer	BLM	Y	N	N	Nondescript sandbars along stream.
Iron King	PRV	N	N	NE	Caved adit. Dry.
Iron Rod (Golden Rod)	PRV	Y	Y	Y	Gated adit with small seep.
Keystone	MIX	Y	N	Y	Open shaft and caved adits. Dry.
King Shaft	PRV	Y	N	Y	Caved shaft backfilled with wooden debris. Waste-rock dump in ephemeral drainage.
Lead Queen	PRV	Y	N	N	Two caved adits. Dry.
Lone Wolf	NF	Y	Y	N	Adit discharge originates on NF land. Discharge runs onto BLM land.

Table 7.3 Summary of sites inventoried in the Jefferson River drainage (continued).

SITE¹	OWNER²	VISIT	SAMPLE³	HAZARD⁴	REMARKS
Mammoth Adit	PRV	Y	N	N	Intermittent adit discharge. No effect on BLM.
Mammoth & Stella	BLM	Y	N	N	Caved shaft and adit. Dry.
Minnie Wilson	BLM	Y	N	Y	Open shaft. Dry.
Mohawk	BLM	Y	N	N	Caved workings. Dry.
Mountain Cliff	MIX	Y	N	Y	Open adits. Dry.
Ned	PRV	Y	N	Y	Open adit. Dry.
North Willow Tungsten	PRV	Y	N	N	Small prospects. Dry.
Norwegian	PRV	Y	N	Y	Open adits. Dry.
Norwegian Creek	PRV	N	N	NE	Screened out in office.
Norwegian Placer	PRV	Y	N	N	Placer workings.
Now Property	MIX	N	N	NE	No impact on BLM.
Pauper's Dream	BLM	Y	Y	N	Adit discharge and waste-rock dump seep.
Pegmatite Deposit	PRV	Y	N	N	Shallow prospect. Dry.
Pipestone Quarry	PRV	Y	N	NE	Active site. Dry.
Plainview	BLM	Y	N	Y	Open adit. Dry.
Ringing Rocks	BLM	Y	N	Y	Open shaft and stopes. Dry.
Section 16	STA	Y	N	Y	Open shaft. Dry.
Section 17 Shaft	BLM	Y	N	Y	Open shaft. Dry.
Shamrock	PRV	Y	N	N	Caved shaft. Dry.
South Easter Lily	BLM	Y	N	N	Caved adit. Dry.
Strawberry/ Keystone⁵	MIX	Y	Y	Y	Streamside tailings and open, flooded adit with discharge. Mill remnants.
Surprise	MIX	Y	N	N	Prospects and caved shafts. Dry.

Table 7.3 Summary of sites inventoried in the Jefferson River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Tidal Wave	MIX	Y	N	N	Prospect pits, trenches, and caved adits. Dry.
Unnamed 01S04W03CBDB	PRV	Y	N	Y	Caved and open shafts and stopes. Dry.
Unnamed 02S06W09	BLM	N	N	NE	Screened out.
Unnamed 03S05W33 (1)	UNK	N	N	NE	Unable to locate.
Unnamed 03S05W33 (2)	UNK	N	N	NE	Unable to locate.
Unnamed Section 8	BLM	Y	N	N	Dry.
Unnamed Section 17	BLM	Y	N	N	Caved workings. Dry.
Victoria	MIX	Y	N	Y	Open cut, mill, and tailings. Dry.
West Dry Creek	BLM	Y	N	Y	Open shafts and stopes. Dry.
Willow Creek	PRV	Y	N	N	Dry.

1) Mines in **bold** may pose environmental problems and are discussed in the text; others are included only in appendix II (all mines) and appendix III (sites visited).

2) Administration/Ownership Designation

BLM: Bureau of Land Management

PRV: Private

MIX: Mixed (BLM and private)

STA: State of Montana

UNK: Owner unknown

3) Solid and/or water samples (including leach samples)

4) Y: Physical safety hazards exist at the site.

NE: Physical safety hazards were not evaluated.

5) Mill site present

7.5 PAUPER'S DREAM MINE

7.5.1 Site Location and Access

The Pauper's Dream mine (T3S R7W Sec 12 ABAC) is located seven miles northwest of Twin Bridges, along an unnamed gulch that drains toward the Jefferson River. The site is accessible by a four-wheel drive road that turns off the Rochester Creek road approximately four miles west of Twin Bridges. The site is on BLM land, but all of the surrounding lands are private.

7.5.2 Site History - Geologic Features

Pits and shafts are aligned on an east-striking fault (O'Neill 1995) in Precambrian metamorphic rocks with cherty quartz and iron staining. A partially collapsed, 200-foot-long adit discharges water. A composite sample from a nearby dump contained 0.0395 oz/ton gold, 2.2 ppm silver, 433 ppm copper, 1410 ppm lead, 294 ppm zinc, and 162 ppm arsenic. A sample of the "ore" was similar: 0.0845 oz/ton gold, 3.8 ppm silver, 210 ppm copper, 900 ppm lead, 232 ppm zinc, and 732 ppm arsenic.

7.5.3 Environmental Condition

At the north end of the site, a discharge flows from a partially collapsed adit which is located at the bottom of a southeastward-trending gulch (figure 7.2). After passing between two small waste-rock dumps on the banks of the gulch, the discharge runs several hundred feet before encountering a third dump that blocks the natural drainage. The discharge flows around the west side of this dump and then sinks into the ground. Water resurfaces at the toe of the dump and runs several hundred feet farther down the gulch before infiltrating completely.

7.5.3.1 Site Features - Sample Locations

Three water-quality samples were collected at the site on September 1, 1994. One sample (BPDS10H) was collected from the discharge flowing from the mouth of the adit. A second sample (BPDS40H) was collected where the discharge sinks into the ground on the west side of the dump that blocks the gulch. A third sample (BPDS20H) was collected from the seep at the base of this dump. The flow rates at these locations were 5.5, 7.1, and 5.8 gpm, respectively.

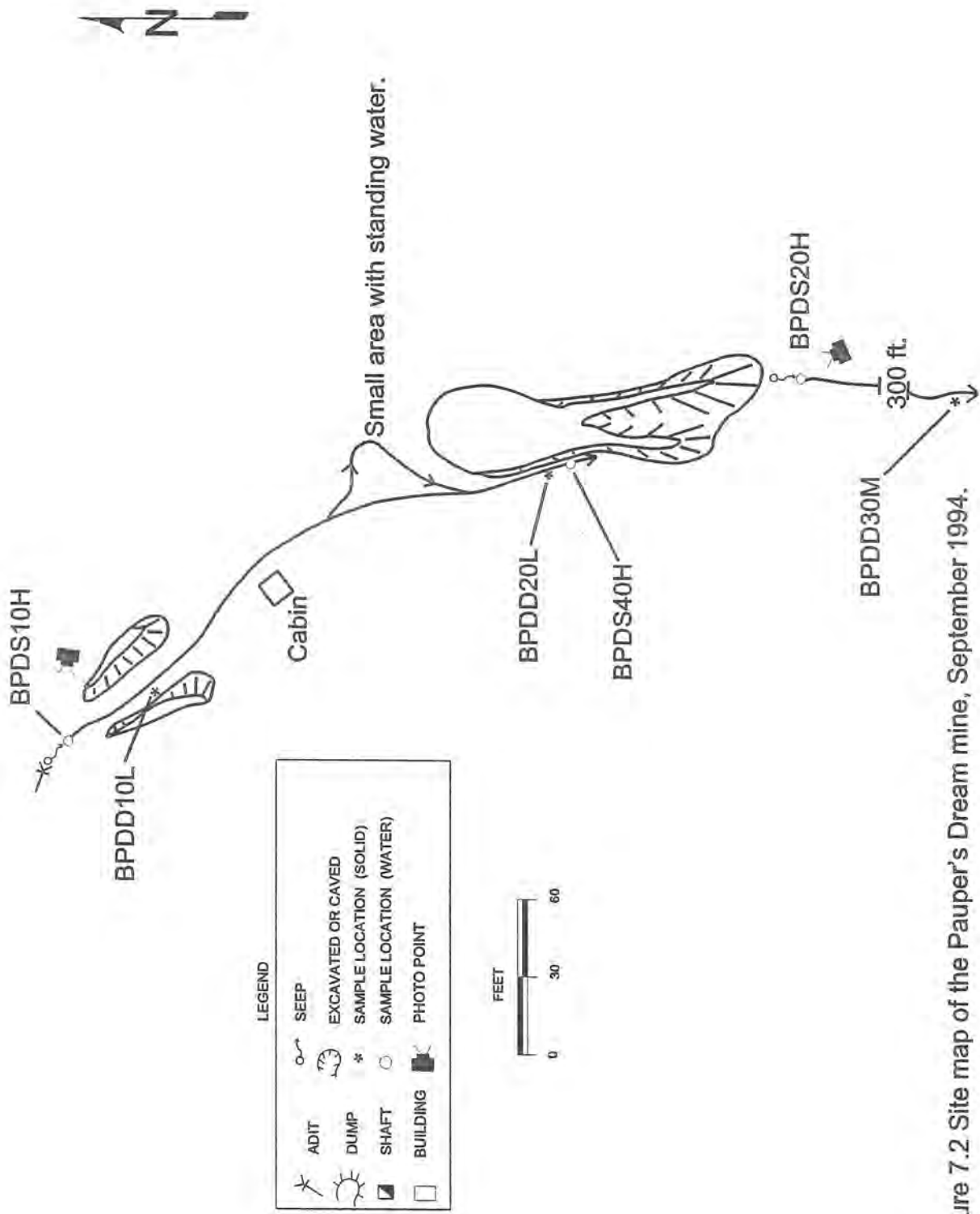


Figure 7.2 Site map of the Pauper's Dream mine, September 1994.



Figure 7.3 Sample BPDS10H was collected from the discharge flowing from the adit on the north end of the site.



Figure 7.4 A seep is located at the base of the waste-rock dump that blocks the natural drainage. Sample BPDS20H was collected here.

Soil samples were collected from three locations at the site. Sample BPDD10L was collected at the toes of the waste-rock dumps near the adit. Sample BPDD20L was collected on the west edge of the waste-rock dump where the adit discharge sank into the ground. The third sample (BPDD30M) was collected along the drainage several hundred feet below the mine. At this location, the soil was dark black and had a hydrogen-sulfide odor.

7.5.3.2 Soil

The copper concentration in sample BPDD20L was slightly above the phytotoxic level (100 mg/Kg). Copper concentrations at the other sample locations were well below this level but still exceeded one or more of the Clark Fork Superfund background levels. The analytical results are summarized in table 7.4.

Table 7.4 Soil sampling results for the Pauper's Dream mine.

Sample Location	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
Soil at toes of waste-rock dumps near adit (BPDD10L)	24.8 ¹	4.27 ¹	33.9 ¹	315 ¹	47.3 ¹
Soil on west side of dump blocking drainage (BPDD20L)	11.8 ¹	4.12 ¹	108 ^{1,2}	119 ¹	63.6 ¹
Soil along drainage below mine (BPDD30M)	14.0 ¹	5.46 ¹	17.3 ¹	26.0 ¹	43.1

(1) Exceeds one or more Clark Fork Superfund background levels (table 1.3)

(2) Exceeds phytotoxic levels (table 1.3)

7.5.3.3 Water

Mercury was the only analyte that exceeded water-quality standards at the site. The concentration of mercury ranged from 0.12 $\mu\text{g/L}$ at locations BPDS10H and BPDS40H to 0.16 at location BPDS20H.

Table 7.5 Water-quality exceedances at the Pauper's Dream mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit discharge - at adit mouth (BPDS10H)										C									
Adit discharge - west side of dump that blocks drainage (BPDS40H)										C									
Seep at toe of dump that blocks drainage (BPDS20H)										C									

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in appendix V.

7.5.3.4 Vegetation

The waste-rock dumps in the area are vegetated with grasses, sage brush, and small trees. Grasses and willows are growing along the course of the adit discharge and the waste-rock dump seep; all of the vegetation appear healthy.

7.5.3.5 Summary of Environmental Condition

Although mercury concentrations in the water at the site exceed chronic aquatic life standards, vegetation in the area appears healthy. The soil along the edge of the dump that blocks the natural drainage has a slightly elevated copper concentration, but erosion in this area is not a problem. Based on the location of the site and the analytical results, it is unlikely that the Pauper's Dream has a detrimental impact on the Jefferson River drainage.

7.5.4 Structures

The only structure at the site is a cabin in fair condition.

7.5.5 Safety

No safety problems were observed near the site.

7.6 IRON ROD (GOLDEN ROD) MINE

7.6.1 Site Location and Access

The Iron Rod (Golden Rod) mine (T2S R6W Sec 22 AABD) is situated along an unnamed gulch, approximately three miles southwest of Silver Star, Montana. The gulch drains eastward to the Jefferson River. According to the BLM's Butte South 1:100,000 land-management map, the mine is on federal land; however, there are signs posted which state that the property belongs to the Golden Rod Mining Company. Access to the site is via a four-wheel drive road that turns off MT State Highway 41 about three miles south of Silver Star.

7.6.2 Site History - Geologic Features

One of the more productive mines in the Silver Star district, the Iron Rod (Golden Rod) developed oxidized, narrow, east-west trending veins in Archean gneiss. A northwest striking adit was reportedly driven around 1000 feet to intersect the ore-yielding zone. A large waste-rock dump at the site probably contains a large volume of material from drifting on the veins once they were encountered. A gated adit along the drainage above the existing mine yard may be the original working at the site.

7.6.3 Environmental Condition

A clear discharge flows from the main adit (collapsed) and collects in a shallow pool near the adit mouth. The water then flows into one of the nearby mine buildings and sinks into the ground. A second discharge is present at the base of the mine's large waste-rock dump. This discharge runs down the natural drainage for a short distance before disappearing.

Although the large waste-rock dump blocks the path of the unnamed gulch, erosion of the waste material is not a significant problem because the drainage is dry most of the year. Also, the waste rock is not highly mineralized.

7.6.3.1 Site Features - Sample Locations

Water-quality samples were collected from the adit discharge (JGRS10H) and from the seep at the base of the waste-rock dump (JGRS20H). On the day that the samples were collected (October 5, 1994), the flow rate of the adit discharge was

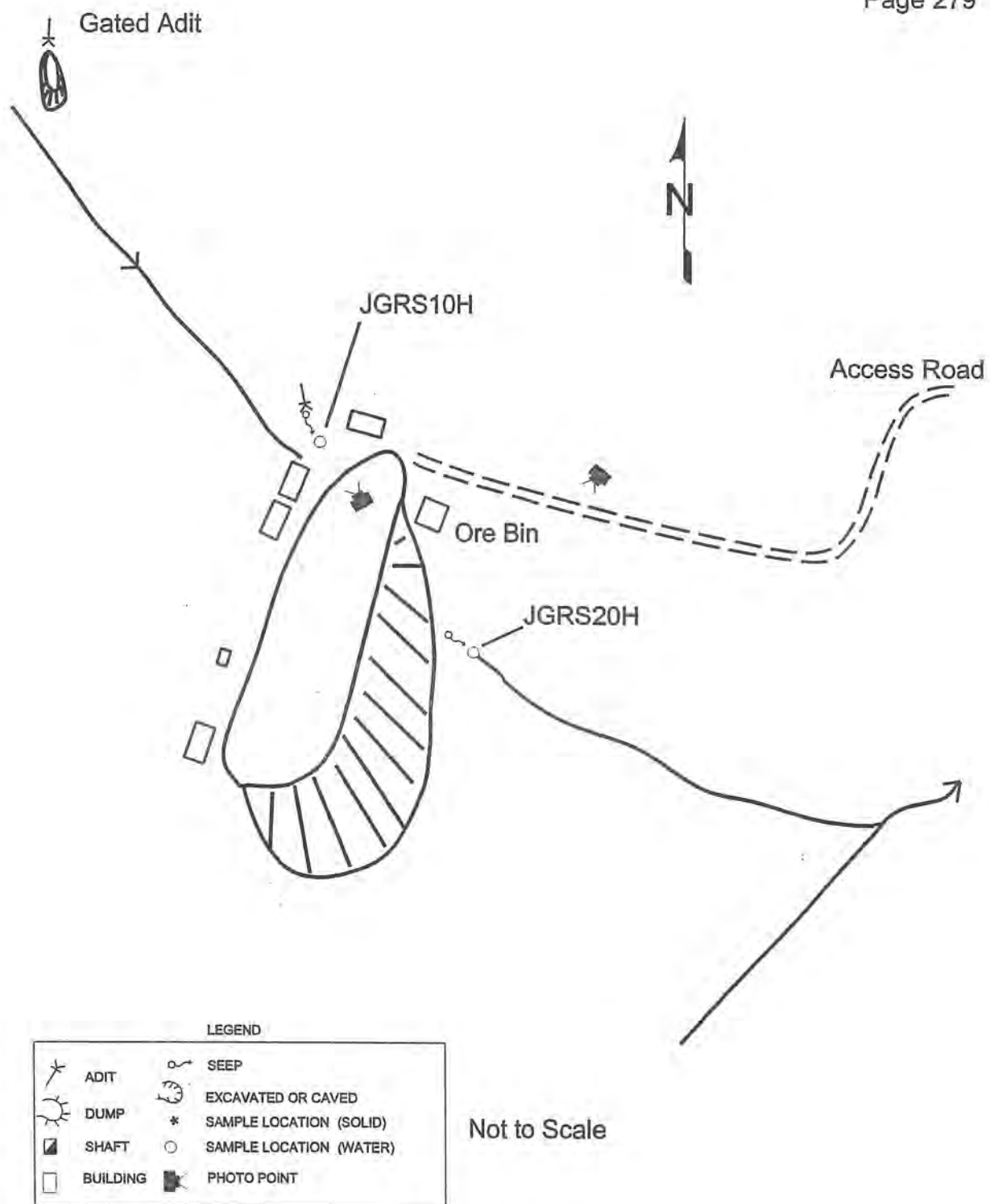


Figure 7.5 Sketch map of the Iron Rod (Golden Rod) mine, October 1994.



Figure 7.6 At the Iron Rod (Golden Rod) mine, a discharge flows from a collapsed adit and collects in a shallow pool. Sample JGRS10H was collected here.



Figure 7.7 The Iron Rod's waste-rock dump blocks the path of the unnamed gulch.

1.7 gpm; the flow rate of the waste-rock dump seep was 1.2 gpm. No water was found along drainage above the mine.

7.6.3.2 Soil

No evidence of soil contamination was observed at the site; therefore, no soil samples were collected.

7.6.3.3 Water

No water-quality criteria were exceeded at the site.

Table 7.6 Water-quality exceedances at the Iron Rod (Golden Rod) mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit discharge (JGRS10H)																			
Waste-rock dump seep (JGRS20H)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

7.6.3.4 Vegetation

Healthy vegetation is growing along the paths of the adit discharge and waste-rock dump seep; aquatic insects are also present. The top of the waste-rock dump is sparsely to moderately vegetated; the slopes of the dump are generally barren because the slopes are steep, and the waste material is so coarse.

7.6.3.5 Summary of Environmental Condition

The water quality of the adit discharge and waste-dump seep at the Iron Rod mine is good. Also, no serious soil or waste-rock erosion problems exist. The overall environmental impact of this site is small.

7.6.4 Structures

Four mine buildings, an outhouse, and an ore bin are present at the site. All of the structures are in fair condition.

7.6.5 Safety

The waste-rock dump has very steep slopes and poor footing.

7.7 GREEN CAMPBELL

7.7.1 Site Location and Access

The Green Campbell mine and mill (T2S R6W Sec 3 BDAA) are located along an unnamed gulch approximately two miles west of Silver Star, Montana. The gulch drains eastward to the Jefferson River. The mill and all of the mine workings are on private land; however, BLM property is located along the gulch above and below the site. Accessed to the site is via a dirt road that turns off MT State Highway 41 at Silver Star.

7.7.2 Site History - Geologic Features

The Green Campbell mine explores an east-west trending quartz vein in Archean gneiss. Features at the site include a main shaft, an open adit, several prospects and smaller workings, a tailings impoundment, a mill and numerous support buildings. A sketch map of the site is presented in figure 7.8.

7.7.3 Environmental Condition

The open adit east of the mill and shaft has a clear discharge that flows into the unnamed gulch. Several hundred feet down the gulch, the water disappears and then resurfaces just above several small ponds on BLM-administered land.

Upgradient of the mine and mill, there is a small spring on BLM land that is used for watering livestock. A eutrophic pool below the spring is choked with yellow-green algae. Water flows a short distance from the pool down the gulch before infiltrating the ground.

Several small waste-rock dumps are located on private land along the gulch; however, they do not contain high-sulfide materials and have not been eroded significantly.

7.7.3.1 Site Features - Sample Locations

Water-quality samples were collected from the spring upgradient of the site (JGCS10H) and from the ponds along the drainage below the site (JGCS20H). On the day that the samples were collected (October 6, 1994), the flow rate at the spring was 0.95 gpm; the flow rate between the ponds was 1.8 gpm.

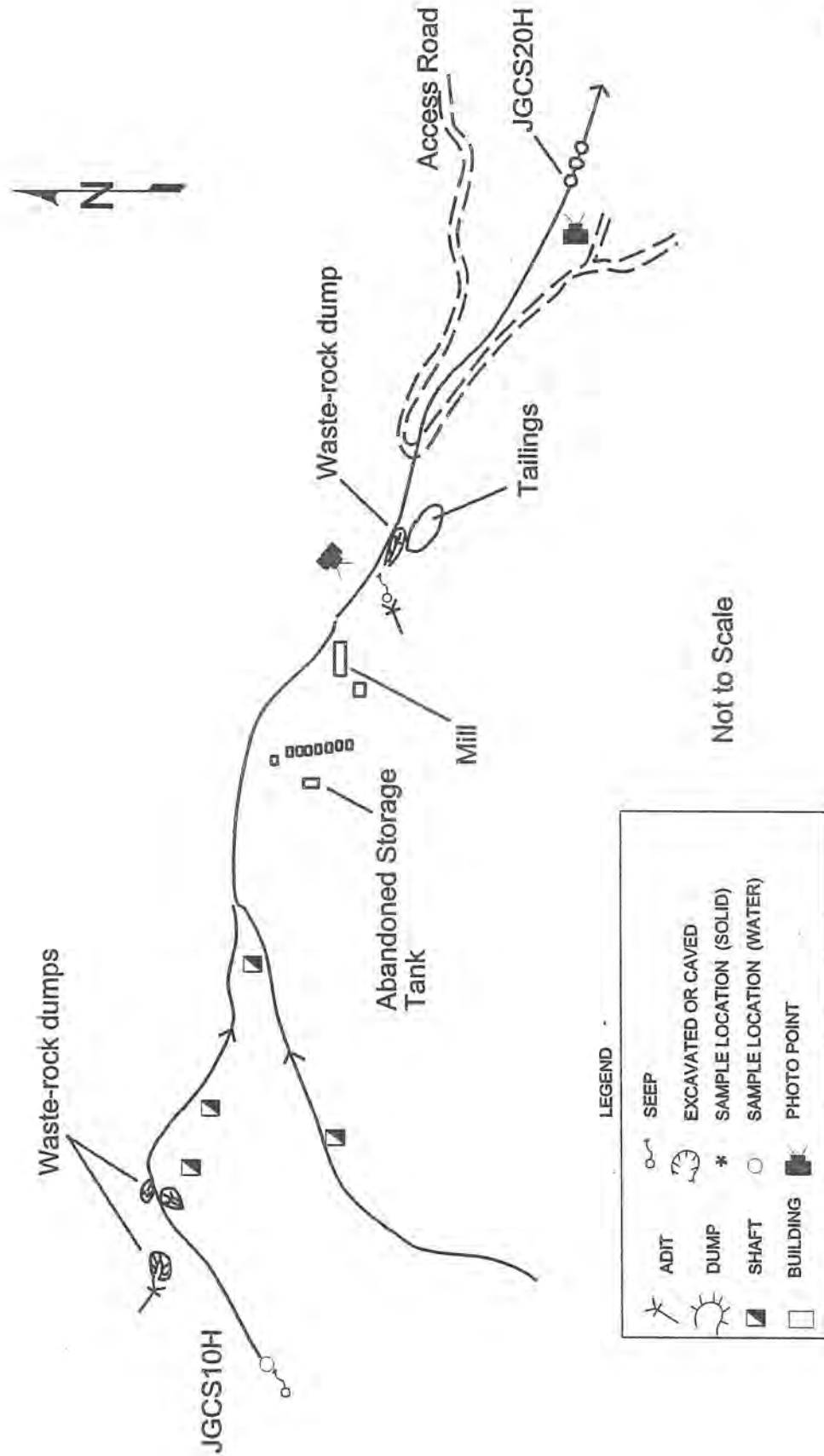


Figure 7.8 Sketch map of the Green Campbell mine and mill, October 1994.



Figure 7.9 A clear discharge flows from an open adit along the drainage east of the mill.



Figure 7.10 Several small ponds are located on BLM land east of the mill and discharging adit. Sample JGCS20H was collected here.

7.7.3.2 Soil

No tailings or waste rock were observed on BLM lands; therefore, no soil samples were collected at the site.

7.7.3.3 Water

No water-quality criteria were exceeded at the site.

Table 7.7 Water-quality exceedances at the Green Cambell mine and mill.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Spring upgradient of site (JGCS10H)																			
Pond water below site (JGCS20H)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

7.7.3.4 Vegetation

Vegetation around the spring upgradient of the site and the ponds below the site appears healthy. Grasses, cattails, willows, and small cottonwoods and aspen are present. Along the dry portions of the drainage, grasses and sage brush are growing. The tailings impoundment has naturally re-vegetated with sage brush.

7.7.3.5 Summary of Environmental Condition

The adit discharge could not be sampled directly because it is on private land; however, it does not appear to degrade water quality on BLM property below the site. Vegetation on the private and public lands around the site is healthy, and no erosion problems were observed. Overall, the environmental impact of this site appears minimal.

7.7.4 Structures

The mill building at this site is impressive. Most of the structure and its interior workings appear to be intact. In addition to the mill, there are several mine buildings and cabins at the site. All of the buildings are in fair condition and are located on private land.

7.7.5 Safety

All of the mine openings and structures observed at the site are on private land. No safety concerns were noted on the BLM lands above and below the site.

7.8 LONE WOLF

7.8.1 Site Location and Access

The Lone Wolf mine (T2S R3W Sec 16 DDCC) is situated on a steep mountain drainage approximately four miles west of Pony, Montana. Cataract Creek, one mile south of the site, is the closest named drainage. The site is on Beaverhead National Forest land; however, an adit discharge from the site runs onto BLM property. The site can be accessed by taking the road from Pony that follows the North Fork of Willow Creek and then Cataract Creek.

7.8.2 Site History - Geologic Features

Features at the Lone Wolf mine include a short, caved adit and a small waste-rock dump. The dump does not contain any material that would be classified as ore. Many small prospects are scattered across the mountainside near the site. A sketch map of the area is presented as figure 7.11.

7.8.3 Environmental Condition

A clear discharge flows from the collapsed adit on National Forest land. A half mile below the site, the discharge crosses onto BLM land and then flows into Cataract Creek.

7.8.3.1 Site Features - Sample Locations

Three water-quality samples were collected on BLM land near the site on October 18, 1994. Sample CLWS10M was collected from the adit discharge at the point where it crosses onto BLM land. The flow rate of the discharge was 24 gpm. Samples CLWS20L and CGTS20L were collected from Cataract Creek upstream and downstream of the confluence with the adit discharge. The flow rates were 857 and 1090 gpm, respectively.

7.8.3.2 Soil

No mine waste was observed along the course of the adit discharge; therefore, no soil samples were collected.

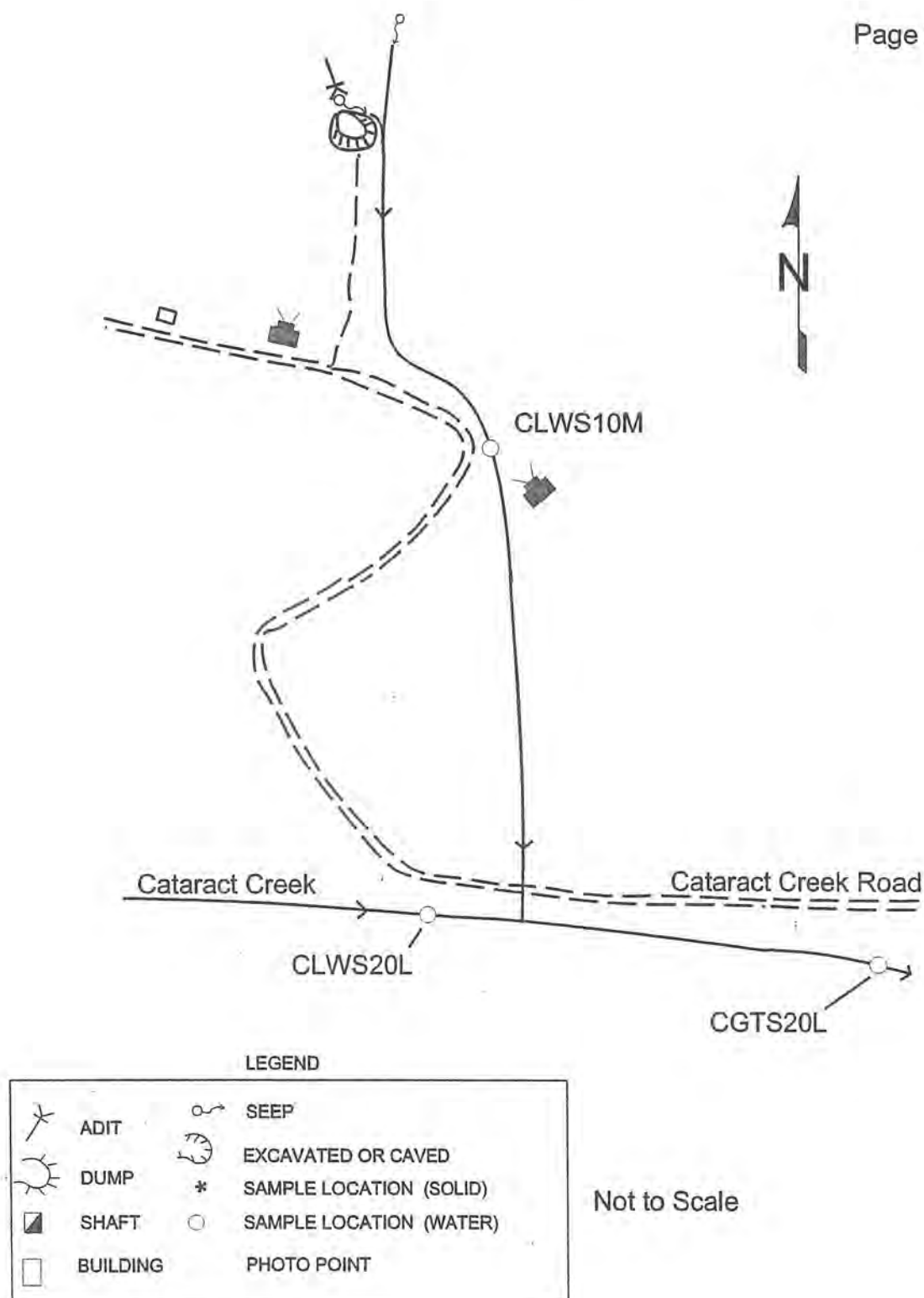


Figure 7.11 Sketch map of the Lone Wolf mine, October 1994.



Figure 7.12 The Lone Wolf mine, near the center of the photograph, has a small waste-rock dump and a collapsed adit with a discharge.



Figure 7.13 Water-quality sample CLWS10M was collected where the Lone Wolf adit discharge crosses onto BLM land.

7.8.3.3 Water

The mercury concentration in all three water samples was $0.12 \mu\text{g/L}$, which exceeds the chronic aquatic life standard of $0.012 \mu\text{g/L}$. The water sample collected from Cataract Creek downstream of the confluence with the adit discharge also slightly exceeded the chronic aquatic life standard for cadmium. No other water-quality problems were found.

Table 7.8 Water-quality exceedances at the Lone Wolf mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit discharge (CLWS10M)										C									
Cataract Creek - upstream of confluence with adit discharge (JGCS20H)										C									
Cataract Creek - downstream of confluence with adit discharge (CGTS20L)				C						C									

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

7.8.3.4 Vegetation

Vegetation in the area does not appear to be impacted by the discharge from the mine. The path of the discharge is densely vegetated with healthy grasses, and along Cataract Creek, thick willow groves are growing.

7.8.3.5 Summary of Environmental Condition

The Lone Wolf's adit discharge contains mercury above the chronic aquatic life standard, but it does not contribute significantly to the degradation of water quality in Cataract Creek. The creek already contains a similar concentration of

mercury upstream of the confluence with the discharge and the concentration does not increase downstream. The source of the mercury in the area is uncertain but could be natural or related to small-scale placer mines that used mercury amalgamation to extract gold.

Although cadmium exceeds the chronic aquatic life standard at the downstream location on Cataract Creek, the mine discharge is not the source; its cadmium concentration was below the detection limit. Additional sampling of Cataract Creek will be necessary to verify and/or characterize the cadmium occurrence.

Vegetation around the site appears healthy and there are no indications of soil contamination. Overall, it appears that the Lone Wolf does not have a serious environmental impact on BLM lands.

7.8.4 Structures

Several old mine buildings are located on the mountainside below the mine; however, none of the structures are on BLM land.

7.8.5 Safety

No safety concerns were identified at this site.

7.9 GARNET GOLD MINE AND MILL TAILINGS

7.9.1 Site Location and Access

The Garnet Gold mine (T2S R3W Sec 23 DBCC) is located near Cataract Lake, approximately two miles southwest of Pony, Montana. The site is on private property; the closest BLM lands are about a mile above and below the site. The site can be accessed by taking the road from Pony that follows the North Fork of Willow Creek and then Cataract Creek.

7.9.2 Site History - Geologic Features

The Garnet Gold developed a quartz vein that contained base metal sulfides and precious metals. The mine is located in quartz monzonite host rock. Features at the site include a gated adit, a waste-rock dump, and an old school bus (see figure 7.14).

A mill site was formerly located on the flood plain of Cataract Creek below the mine. Today, all that remains are some streamside tailings.

7.9.3 Environmental Condition

A 10 to 20 gpm discharge flows from the mouth of the adit, down the face of the waste-rock dump, across the access road, and into Cataract Creek. Near the mouth of the adit, the discharge channel has been stained grey-green.

Below the mine, Cataract Creek flows through a breached tailings impoundment. During high runoff events, tailings are probably washed into the creek. However, no tailings deposits were observed on BLM land downstream of the site.

Liquid chemical spills are another environmental concern at the site. Near the adit, a large patch of ground has been stained with waste oil(?) that has leaked from a 55-gallon drum. A second drum that contains a clear organic liquid, perhaps paint thinner, has been overturned on the waste-rock dump. The bungs have been removed, and at least half of the drum's contents have spilled on the ground. The BLM Butte District Office was notified of this situation in August 1994.

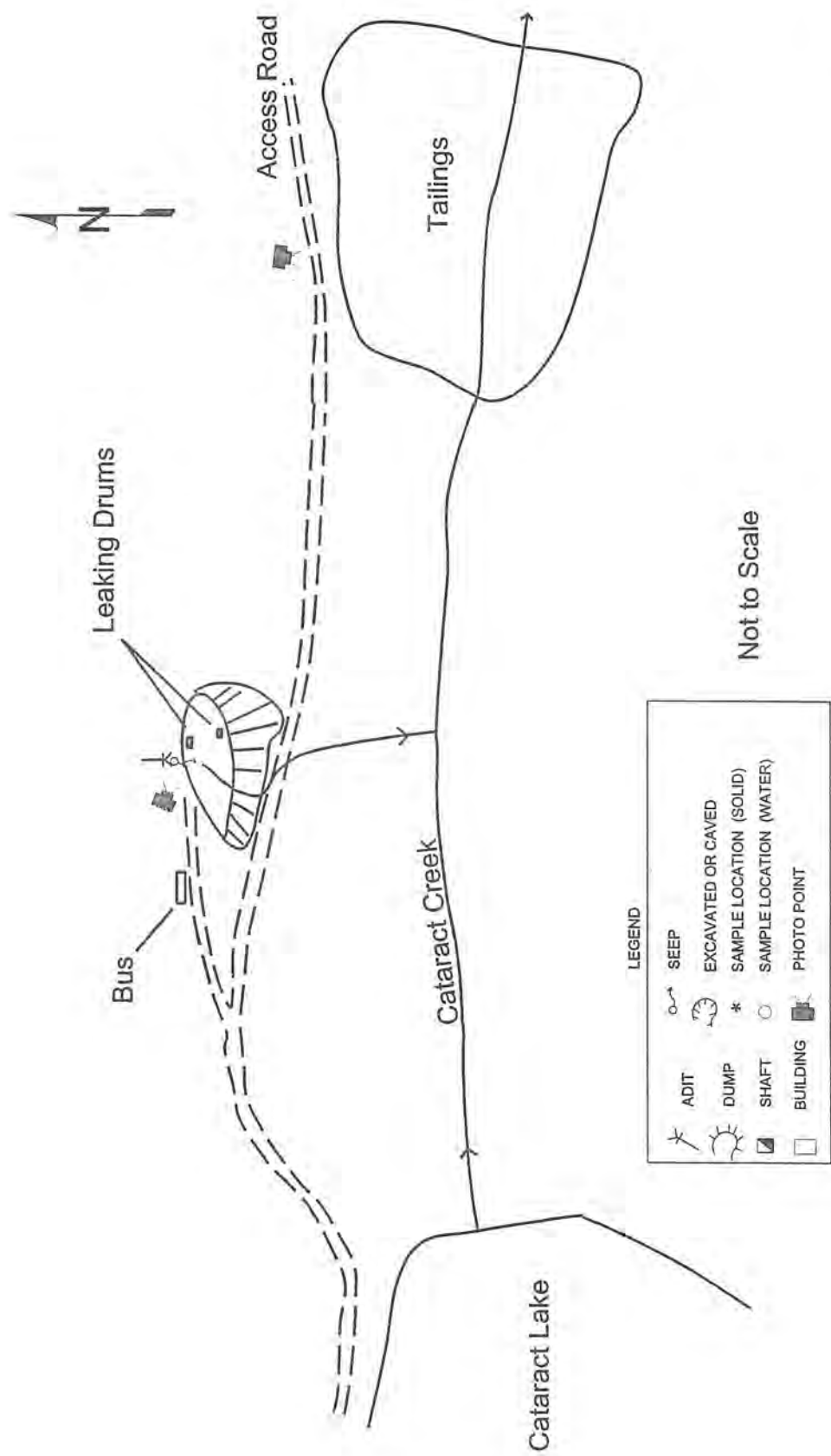


Figure 7.14 Sketch map of Garnet Gold mine and mill tailings, August 1994.



Figure 7.15 At the Garnet Gold mine, waste-oil(?) leaking from a 55-gallon drum has stained the soil near the adit.



Figure 7.16 Streamside tailings can be seen from the public road that passes through the Garnet Gold mine site.

7.9.3.1 Site Features - Sample Locations

Water-quality samples were collected upstream and downstream of the site on October 18, 1994. The upstream sample (CGTS20L) was collected from Cataract Creek which had a flow rate of 1,090 gpm. The downstream sample (CGTS10L) was collected from the North Fork of Willow Creek below the confluence with Cataract Creek. The flow rate at this location was 1,740 gpm.

7.9.3.2 Soil

No soil samples were collected because streamside tailings were not observed on the BLM land downstream of the site.

7.9.3.3 Water

Upstream of the site, mercury ($0.12 \mu\text{g/L}$) and cadmium ($2.5 \mu\text{g/L}$) slightly exceeded their chronic aquatic life standards. Downstream of the site, only mercury exceeded chronic aquatic life standards; cadmium was below the laboratory detection limit.

Table 7.9 Water-quality exceedances at the Garnet Gold mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Cataract Creek - upstream of site (CGTS20L)				C						C									
North Willow Creek - downstream of site and confluence with Cataract Creek (CGTS10L)										C									

Exceedance codes:

- P - Primary MCL
- S - Secondary MCL
- A - Aquatic Life Acute
- C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

7.9.3.4 Vegetation

The waste-rock dump at the site is sparsely vegetated with grasses. The streamside tailings are moderately vegetated with grasses, willows, and trees, but some of the vegetation appears stressed. Vegetation on the BLM lands above and below the site appears healthy.

7.9.3.5 Summary of Environmental Condition

The adit discharge and streamside tailings could not be sampled directly because they are on private land. Water samples collected on BLM land upstream of the site had slight cadmium and mercury exceedances; downstream of the site, only mercury was above standards. These water-quality results suggest that metals potentially being released from the site have little, if any, impact on BLM land.

The organic chemical spills at the site are of greater concern. Depending upon what the organic liquids are, huge volumes of surface water and ground water could be contaminated. Although the problem is currently confined to private land, action should be taken to remove these hazardous wastes.

7.9.4 Structures

No buildings are present at the site.

7.9.5 Safety

The two drums of organic liquids and the contaminated soil at the site are a health concern and should be removed. No safety concerns were noted on BLM lands upstream and downstream of the site.

7.10 STRAWBERRY-KEYSTONE MINES AND MILL

7.10.1 Site Location and Access

The Strawberry-Keystone mines and mill (T2S R3W Sec 14 BDDD) are on Pony Creek, approximately two miles west of Pony, Montana. According to the BLM's Bozeman Resource Map (1:100,000), the site is on private property; however, BLM land is located a short distance upstream and downstream of the site. Access to the site is via the Pony Creek Road from Pony.

7.10.2 Site History - Geologic Features

The mines in this area exploited two parallel, east-west trending quartz veins that contained base metal sulfides and precious metals. Zones with notable tungsten mineralization were also encountered. The veins occur in Archean metamorphic host rock. Features in the area include numerous crosscut adits (both open and caved), open stopes, and many surface prospects. There is also a collapsed mill present within the flood plain of Pony Creek. Tailings are spread along the south bank of the stream for several hundred feet. An assay sample of the tailings contained 0.031 opt gold.

7.10.3 Environmental Condition

A 30 gpm discharge (estimate) flows from the mouth of a partially flooded adit on the north bank of Pony Creek (see figure 7.17). The discharge runs down the side of a large waste-rock dump and into the stream. Near the mouth of the adit, the discharge channel is stained bright orange with ferric-oxyhydroxide precipitate. Grasses grow along the path of the discharge, but no aquatic insects are present.

At the toe of the large dump, there is a small seep that joins the adit discharge. Some of the vegetation in this area is stressed.

The tailings below the mill are dry and do not come into direct contact with the creek. Surface runoff from rainfall and snowmelt has cut a gully through the easternmost tailings pile. A small trail of tailings runs from the pile down to the creek.

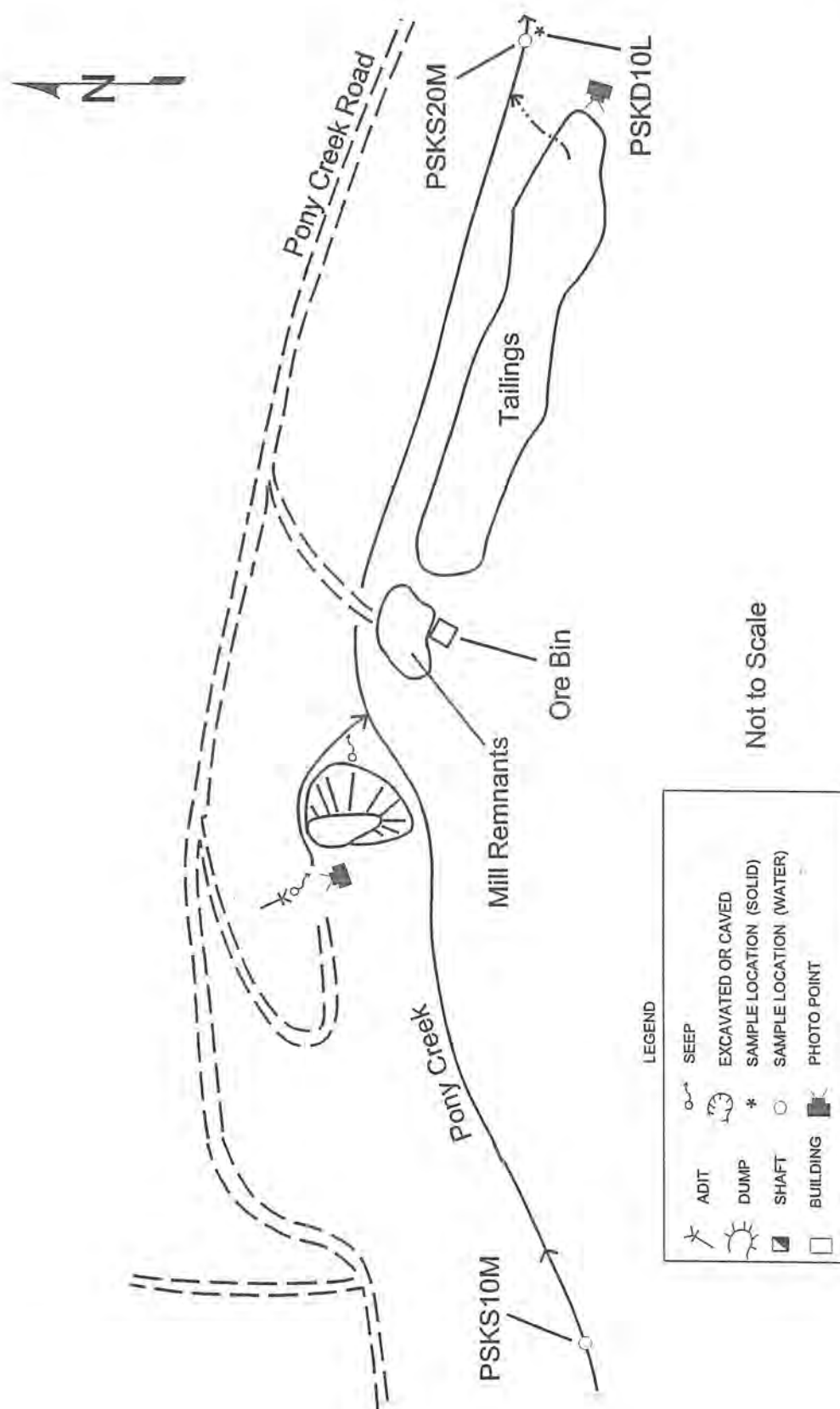


Figure 7.17 Sketch map of the Strawberry-Keystone mine and mill area, October 1994.



Figure 7.18 A ferric-oxyhydroxide stained discharge flows from a partially flooded adit on the north bank of Pony Creek.



Figure 7.19 The top of the easternmost tailings pile is barren to sparsely vegetated. Runoff has carried tailings from this area down to the creek.

7.10.3.2 Soil

Table 7.10 Soil sampling results for the Strawberry-Keystone mines and mill.

(1) Exceeds one or more Clark Fork Superfund background levels (table 1.3)
(2) Exceeds phytotoxic levels (table 1.3)

7.10.3.3 Water

The upstream and downstream samples from Pony Creek did not exceed any water-quality standards.

Table 7.11 Water-quality exceedances at the Strawberry-Keystone mines and mill.

[illegible]

Table 7.11 Water-quality exceedances at the Strawberry-Keystone mines and mill (continued).

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Pony Creek - downstream of site (PSKS20M)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

7.10.3.4 Vegetation

As noted previously, grasses are growing along the course of the adit discharge. Vegetation on the slopes of the waste-rock dump below the adit is generally healthy except near the small seep at the base of the dump. The tailings piles below the mill are barren to moderately vegetated. Healthy willows and grasses are growing on the BLM land downstream of the site.

7.10.3.5 Summary of Environmental Condition

The water quality of Pony Creek is not significantly impaired by the discharges from the site. Soils downstream of the site have elevated levels of metals, especially copper, but support abundant, healthy vegetation. The source of the metals may be tailings that have washed downstream; however, there is no obvious visual evidence of streamside tailings.

7.10.4 Structures

Piles of lumber and an ore bin are the only remnants of the mill that once stood at the site. No structures were observed on the nearby BLM lands.

7.10.5 Safety

Near the site, there are several open adits which are a safety concern. Also, the piles of lumber left from the mill could pose a slip-trip-fall hazard.

7.11 SUMMARY OF MINING IMPACTS ON BLM LAND - JEFFERSON RIVER DRAINAGE

Of the six sites with potential environmental problems in the Jefferson drainage, only the Pauper's Dream and Iron Rod (Golden Rod) mines are on BLM-administered land. At the Pauper's Dream, an adit discharge and a waste-rock seep flow down a small gulch that drains toward the Jefferson River. Water sampled from the two discharges contained slightly elevated concentrations of mercury; however, the environmental impact of the discharges is probably minimal because the flow from the site is small and the water infiltrates the ground several miles before reaching the nearest perennial drainage. At the Iron Rod (Golden Rod), there are also an adit discharge and a waste-rock seep. Samples collected from the discharges had no water-quality exceedances.

The Lone Wolf mine and the Garnet Gold mine, which are on National Forest and private land respectively, are additional sites investigated in the Jefferson drainage. Water-quality samples collected on BLM-administered lands near these sites had slightly elevated concentrations of mercury, but it was unclear whether the mercury was linked to mining activity. Further sampling may be necessary if mercury is deemed to be a serious problem. Another concern at the Garnet Gold mine was two 55-gallon drums possibly containing paint thinner and waste oil. One of the drums had been overturned and the other had been punctured by bullets. The drums and contaminated soils should be removed from the site to avoid surface and ground-water contamination problems.

The final two sites that were investigated in detail were the Green Campbell mine and the Strawberry-Keystone mines and mill. At the Strawberry-Keystone, there are streamside tailings, an iron-stained adit discharge, and a waste-rock seep. The water quality of the creek flowing past the site does not appear to be adversely impacted by the tailings or the discharges; however, soil downstream of the Strawberry/Keystone contains elevated copper concentrations. At the Green Campbell mine, an adit discharge flows into a perennial drainage near the town of Silver Star. A sample collected from a small pond below the site had no water-quality exceedances; therefore, the impact of the site on BLM land was considered minimal.

Twenty-three of the 70 inventoried sites were found to have one or more safety concerns. Twenty-one of the sites had hazardous mine openings, four had unsafe structures, and one (the Garnet Gold) had a petrochemical hazard. Twelve of the sites with safety hazards are on or immediately adjacent to BLM-administered land (see table 7.3).

MADISON RIVER DRAINAGE

8.1 GEOLOGY

The geology of the Bozeman 1° x 2° quadrangle, which covers the Madison River drainage, has not yet been published. The following list describes theses completed in the general drainage. Millholland (1976) described the geology of the Gravelly Range Precambrian metamorphic rocks. Beck (1959) described the geology of the Sphinx Mountain area. Bubb (1961) mapped a part of the Greenhorn Range. Erslev (1981) studied the petrology and structure of the Madison Range. Kleinschmidt (1981) mapped the bedrock geology of Horse Creek and Wall Creek drainages, in the Gravelly Range. Le Van and McClean (1951) mapped an area in Gallatin County called Red Canyon. Manske (1961) described the geology of the Baldy Mountain area in the Gravelly Range. Fairbank (1984) conducted a heavy-metal survey within this drainage and Brooks (1984) did a geochemical survey on the west side of the Gravellys. Holmes (1986) mapped a portion of the Hebgen Lake quadrangle, immediately north of Hebgen Lake.

8.2 ECONOMIC GEOLOGY

The upper Madison River drainage contains widely scattered prospects and mines, usually small phosphate, iron or gypsum occurrences. The Madison River drains an area that includes the talc occurrences along Johnny Gulch and Cherry Gulch, which also has iron, manganese, mica, kyanite, and feldspar associated with them, according to USBM-MILS. Other industrial minerals have been explored for around Ennis such as quartz crystals, talc, gravel, iron (magnetite), mica, and barite. Phosphate has also been sparsely explored for along the west flank of the Madison Range. Farther to the north, along the east flank of the Tobacco Root Mountains, gold and silver mineralization takes precedence; placers downstream are associated with these occurrences. Other minerals listed as associated with this area along the general area of Meadow and South Meadow Creek (the Washington district) are uranium/thorium?, chromite, copper, and lead. The area around Norris and Hot Springs Creek also is host to gold and silver mineralization as well as corundum, copper, manganese, zinc, and lead.

Mines east of the Tobacco Roots are usually located in quartz/gold veins in Archean gneisses. Mines around Norris include those in the Maltbys Mound and Warm Springs area.

Placers occur along the eastward flowing tributaries of the Madison from the Gravelly Mountains, but these tend to be small and according to Lyden (1948), are derived from glacial gravels and from small veins in the area.

8.3 HYDROLOGY AND HYDROGEOLOGY

The Madison River drainage, in southwest Montana, has its origins in Yellowstone Park, Wyoming. From the Montana border the river flows west and then north to its confluence with the Jefferson and Gallatin Rivers to form the Missouri River at Three Forks. Major tributaries include the Firehole River, the Gibbon River, West Fork of the Madison, Standard Creek, Horse Creek, and Meadow Creek. Annual mean streamflows for selected sites in the Madison River drainage are presented in table 8.1.

Table 8.1 Stream-gaging data for the Madison River drainage.

Gage Location	Period of Record	Drainage Area (sq. miles)	Annual Mean Flow (cfs)
Firehole R. near W. Yellowstone	1983-1994	282	309
Gibbon R. near W. Yellowstone	1913-1994	118	116
Madison R. near W. Yellowstone	1913-1994*	420	489
Madison R. near McAllister	1939-1994	2,186	1,748

*Intermittent data

Source: Shields *et al.* 1995

The drainage is bounded by the Continental Divide on the south, by the Madison Range on the east, and by the Gravelly and Tobacco Root ranges on the west. The higher elevations of the Gravelly and Tobacco Root mountains were glaciated; the west flank of the Madison Range was extensively glaciated. Terminal moraines are common in the tributary drainages as are periglacial terraces and fans on the east valley margins. The west valley margins in the upper drainage consist primarily of Tertiary lake bed sediment; near-stream deposits are typically Quaternary alluvium (Alden 1953).

The average annual precipitation ranges from 12 inches in the valley to 60 to 100 inches in the south end of the Madison Range (Montagne *et al.* 1982).

Average annual temperatures range from 45-55°F in the lower valley to 40-45°F in the higher valley to 25-30°F in the mountains (Bergantino 1978).

The Madison River is a renowned blue-ribbon trout fishery and its recreational use is high; Hebgen and Ennis lakes are also quite popular for recreation. Hebgen Lake has a useable capacity of 378,800 acre-feet and ranged from 370,100 to 252,700 acre-feet in water-year 1994. Ennis Lake has a useable capacity of 41,020 acre-feet and ranged from 37,690 to 27,450 in water-year 1994 (Shields *et al.* 1995). Water use for irrigation is common throughout the valley, particularly in lower reaches. Ground water is used for domestic, public, and municipal water-supply in West Yellowstone, and is used for domestic and public water supply in Ennis. Hot springs are common in the area north of West Yellowstone; downstream at Ennis, hot springs and wells have been developed for commercial use.

8.4 SUMMARY OF THE MADISON RIVER DRAINAGE

For the abandoned/inactive mine inventory for the BLM, the MBMG investigated 29 mine and/or mill sites within the Madison River drainage (see figure 8.1 and table 8.2). Of these sites, 28 were found to have no impact on BLM-administered land and one, the Florence mine, may pose environmental problems. The Florence was investigated in detail and is discussed in the following section.

If mine openings or other dangerous features (unstable structures, mine openings, high walls) were observed at a site, then the site was designated unsafe or hazardous in table 8.2. Of the 29 sites inventoried, two were found to have safety concerns. It should be noted that the only sites that were screened for safety hazards in detail were those where soil and/or water samples were collected. Hazards may exist at many of the other sites, but they were not inventoried as part of this project.

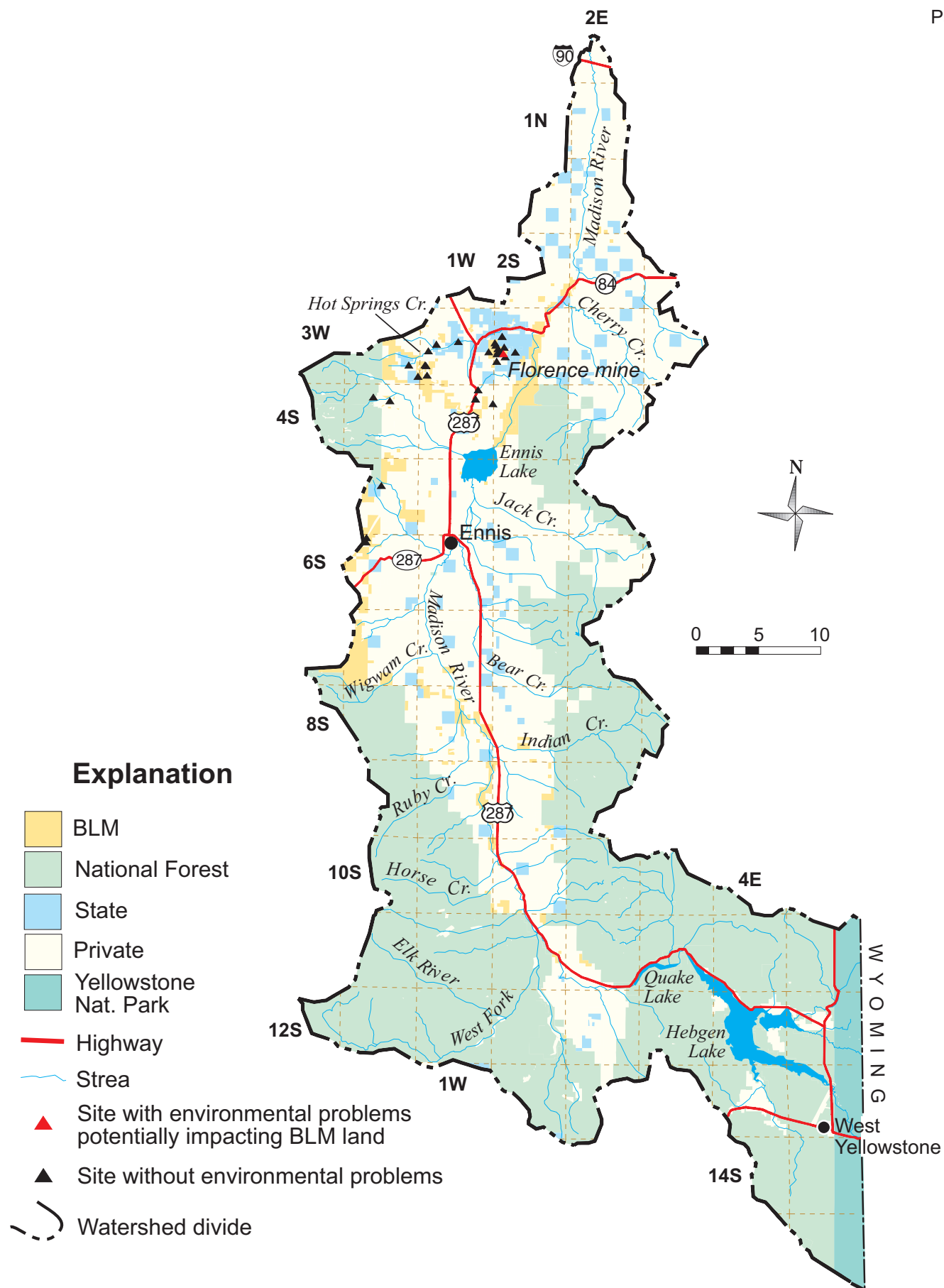


Figure 8.1. Abandoned/inactive mines inventoried in the Madison River drainage.

Table 8.2 Summary of sites inventoried in the Madison River drainage. Site name in **bold** indicates potential environmental problems. "Y" in hazard column indicates physical safety concern.

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Badger Nos. 1 & 2	MIX	Y	N	N	Dry. No impact.
Bertha	PRV	Y	N	N	Dry. No impact.
Betty Mae	PRV	Y	N	N	Dry. No impact.
Billy	PRV	Y	N	N	No impact.
Birdia ⁵	PRV	Y	N	N	Dry tailings.
Boaz ⁵	PRV	Y	N	N	Dry tailings.
Bull Moose	MIX	Y	N	N	Dry, caved workings.
Bull Moose 2	MIX	Y	N	N	Dry, caved workings.
Emperor	STA	Y	N	N	Dry prospect.
Florence	MIX	Y	Y	N	Adit discharge.
Galena	PRV	Y	N	NE	Dry. No impact.
Grubstake ⁵	PRV	Y	N	Y	Shaft with headframe. Dry tailings.
Helene	BLM	Y	N	N	Dry, caved workings.
Hot Springs Placer	STA	Y	N	N	No impact.
Josephine	MIX	Y	N	N	Dry. No impact.
Kennet	PRV	Y	N	N	Dry, caved shaft.
Mohican	PRV	Y	N	N	Caved prospects.
Montana Boy ⁵	MIX	Y	N	Y	Dry shaft and mill site. Active?
Red Rose	STA	N	N	NE	Screened out in office.
Revenue/North Shaft ⁵	MIX	Y	N	N	Dry, caved workings. Tailings.
Tobacco Root	BLM	Y	N	N	Dry, caved adit.
Unnamed 03S01E18CACC	MIX	Y	N	N	Dry, caved workings.
Unnamed 03S01E18CCDB	BLM	Y	N	N	Dry, caved workings.

Table 8.2 Summary of sites inventoried in the Madison River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Unnamed 04S01W12ADDB	MIX	N	N	NE	Screened out in office.
Unnamed 05S02W15BBBD	PRV	N	N	NE	Screened out in office.
Unnamed 04S02W09BDAD	PRV	N	N	NE	Screened out in office.
Unnamed Sec 30	PRV	Y	N	N	Dry, caved workings.
Washington Bar Placer	MIX	Y	N	N	No impact.
Waterlode	PRV	Y	N	N	Dry, caved workings.

1) Mines in **bold** may pose environmental problems and are discussed in the text; others are included only in appendix II (all mines) and appendix III (sites visited).

2) Administration/Ownership Designation
BLM: Bureau of Land Management

PRV: Private

MIX: Mixed (BLM and private)

STA: State of Montana

UNK: Owner unknown

3) Solid and/or water samples (including leach samples)

4) Y: Physical safety hazards exist at the site.

NE: Physical safety hazards were not evaluated.

5) Mill site present

8.5 FLORENCE MINE

8.5.1 Site Location and Access

The Florence mine (T3S R1E Sec 19 DBAD) is located along an unnamed gulch that drains into Hot Springs Creek, a tributary to the Madison River. Access to the site is via a dirt road that turns off State Highway 84 about 2.5 miles east of Norris. The BLM's Bozeman Resource Map (1:100,000) shows that the mine is on private land; however, BLM-administered lands are located a short distance above and below the site.

8.5.2 Site History - Geologic Features

Southeast-striking adits and prospects possibly explore a quartz vein in Archean country rock. No production records are available for this site.

8.5.3 Environmental Condition

Water discharges from the lowest adit (collapsed) and collects in a pond constructed of waste rock (see figure 8.2). Based on the animal tracks observed on the ground in the area, the pond appears to be an important watering hole for wildlife. At the north end of the pond, water drains into a small gully that crosses the dirt access road. The water then flows a short distance down the natural drainage before sinking into the ground.

A 4-inch-diameter well is located on BLM land along the dry drainage above the site. The well is at least 20 feet deep and contains no water.

8.5.3.1 Site Features - Sample Locations

Water-quality sample HFLS10H was collected from the pond discharge where it flows onto BLM land. The flow rate of the discharge was 7 gpm. The sample was collected on October 7, 1994.

8.5.3.2 Soil

No evidence of soil contamination was observed on BLM land below the site; therefore, no soil samples were collected.

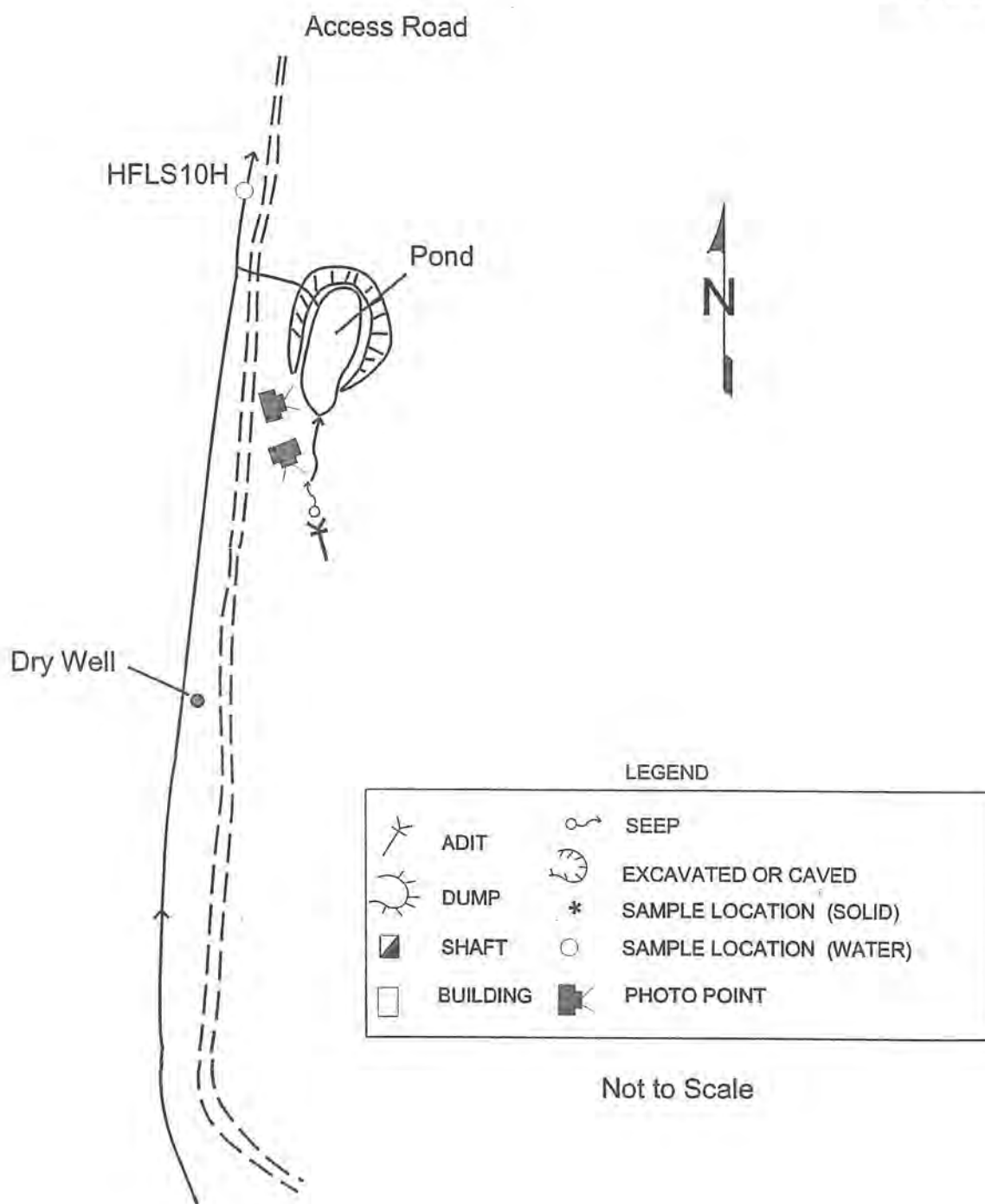


Figure 8.2 Sketch map of the Florence mine, October 1994.



Figure 8.3 A small discharge flows from a collapsed adit at the Florence mine.



Figure 8.4 The adit discharge flows into a pond constructed of waste rock. The pond appears to be an important watering hole for wildlife.

8.5.3.3 Water

The pH of the discharge from the pond was 8.56, slightly above the secondary MCL upper limit of 8.5. No other analytes exceeded water-quality standards.

Table 8.3 Water-quality exceedances at the Florence mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Discharge from pond (HFLS10H)																			S*

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

*pH measured in laboratory was within acceptable secondary MCL range.

8.5.3.4 Vegetation

Abundant, healthy vegetation is growing along the path of the adit discharge and around the pond. Vegetation along the drainage below the site is also healthy.

8.5.3.5 Summary of Environmental Condition

The water quality of the discharge leaving the site appears to be good. The only parameter that may slightly exceed standards is pH. No serious soil or waste-rock erosion problems exist. The overall environmental impact of this site is small.

8.5.4 Structures

No structures are present at the site.

8.5.5 Safety

No safety concerns were identified at the site.

8.6 SUMMARY OF MINING IMPACTS ON BLM LAND - MADISON RIVER DRAINAGE

Only one site, the Florence mine, was found to have a potential environmental impact on BLM-administered land in the Madison River drainage. At the Florence, an adit discharge flows into a small pond constructed of waste rock. A small flow spills from the pond into an ephemeral drainage and then infiltrates the ground a short distance below the site. The only problem noted at the site was that the pH of the water was slightly above the secondary MCL upper limit of 8.5. The overall environmental impact of the site is small.

Two of the 29 inventoried sites were found to have one or more safety concerns (see table 8.2). The Grubstake, located on private land, has a shaft with a headframe. The Montana Boy, located on private and BLM-administered land, has a shaft and a mill building.

UPPER MISSOURI RIVER DRAINAGE

9.1 GEOLOGY

The upper Missouri River drains an area that includes the west side of the Big Belt Mountains, the Elkhorn Mountains, and much of the Boulder batholith area. Smedes (1966) composed the definitive work on the geology and igneous petrology of the northern Elkhorn Mountains as well as the mineral deposits. Mertie *et al.* (1951) mapped the geology of the Canyon Ferry quadrangle; Freeman *et al.* (1958) mapped the geology of the Townsend valley; Klepper *et al.* (1957) mapped the geology of the southern Elkhorn Mountains.

Important geologic formations in the mountains surrounding the watershed include the intrusive Boulder batholith, the Elkhorn Mountains volcanics, and folded and faulted Paleozoic and Mesozoic sedimentary rocks. Unconsolidated sediment fills the broad basin valley. The Elkhorn Mountains volcanics have been intruded by quartz monzonite stocks (Reed 1951), and mineralization is often located where these stocks are intersected by faults. The Lombard thrust is the dominant structural feature of the Townsend valley, with northwest-trending normal faults secondary (Reed 1951).

9.2 ECONOMIC GEOLOGY

The Missouri drains the mining districts of Rimini, Scratchgravel Hills, Wickes-Corbin, Marysville, the east side of the Stemple Pass area, Wolf Creek, York-Confederate Gulch, Winston, Park (Indian Creek), and Radersburg (Pardee and Schrader 1933).

Knopf (1913) first described the mines and deposits around Helena. Billingsley and Grimes (1918) wrote a description of the deposits of the Boulder batholith. Reed (1951) described the mines and mineral deposits of Broadwater County, which the Missouri drains to a large extent. All of the following summaries were taken from Pardee and Schrader (1933) with occasional reference to other works and are very general at best.

Confederate Gulch: The Confederate Gulch area consists of several small "pocket-y", gold lodes associated with small granodiorite stocks. Veins in this area are mainly quartz and iron oxides with native gold and with galena correlating with the gold mineralization (Pardee and Schrader 1933). The gulch was probably more well known for its placer deposits, which Pardee

and Schrader (1933) estimated at approximately \$12,000,000. The placers were a result of several stages of erosion in the Pleistocene that formed terraces along the present drainage. The authors attribute the gold to the quartz/gold deposits of Miller Mountain.

Marysville District: Much of the land here is patented, but the remainder is mostly BLM, with USFS to the west. Weed (1903) as well as Knopf (1913) and Pardee and Schrader (1933) described this area in great detail. Barrell (1907) wrote a detailed study of just the Marysville district. The Marysville district centers around a granite diorite stock intruded into Precambrian Belt rocks. The veins were described as steeply dipping fissure veins (occurring in shoots) in the intrusive and the surrounding metamorphosed Belt rocks. The gold is associated with tetrahedrite and chalcopyrite, and pyrite, sphalerite, and galena. Gangue includes platy quartz and calcite locally with some iron and manganese.

Park (Indian Creek): The gold ore is pyrite with arsenopyrite and galena, or quartz with arsenopyrite and pyrite, or quartz with iron oxides and galena, or pyrite and galena, all of which are associated with two granite intrusions (Pardee and Schrader 1933). There is a placer associated with the district (Lyden 1948).

Radersburg: The deposits of the Radersburg district occur in veins in post-Cretaceous intrusives; the veins are predominantly gold-bearing pyrite with very little quartz or other gangue. The richest deposits are fissure veins with lesser ore found along the contacts of the intrusive and sedimentary rocks. The host rocks for the various individual mines in the district listed by Pardee and Schrader (1933) include andesite, quartzite, slates, and shales. There is a small placer associated with this site.

Scratchgravel Hills: This area just northwest of Helena was mined for lead-silver, gold, and iron, with ubiquitous copper mineralization. The area is characterized by a large granite (quartz monzonite) intrusive injected into Belt Series rocks, mostly shales, sandstones, and limestones. Deposit types here include contact metamorphic and either lead-silver or gold-quartz-iron oxide-manganese veins. The unoxidized portions of the gold veins sometimes include galena and sphalerite. Silver-lead ore minerals include argentite, cerargyrite, cerusite, and a "vanadate of lead, zinc, copper and arsenic (cuprodescloizite)."

Wickes-Corbin: Wickes-Corbin deposits are in metamorphosed "andesites" that were intruded by a large quartz monzonite stock, which in turn was intruded by late-stage aplites. The ore is found in quartz, fissure veins or

shears, and Pardee and Schrader (1933) list the ore minerals as "primary galena, sphalerite, pyrite, chalcopyrite, tetrahedrite, and arsenopyrite, and secondary, cerusite, anglesite, bournonite, and covellite" and gangue included quartz, calcite, rhodochrosite and tourmaline. Placers have been located in Comet Creek, Clancy Creek, as well as Prickley Pear Creek into which Comet and Clancy creeks drain.

Winston District: The Winston district is associated with Cretaceous intrusives (granodiorite stocks) that have been injected into overlying volcanics and sediments (Elkhorn Mountains volcanics). The area has been mined for its gold and silver content as well as, to a lesser degree, its base metals. Earll (1964) described the two differing sets of veins; one, flat-lying, generally northeast-trending, predominantly gold/silver and the other, steeply dipping, east-west, predominantly lead-zinc veins. Knopf (1913), Billingsley and Grimes (1918) and Pardee and Schrader (1933) included this district in their reports on the metalliferous deposits. Earll (1964) published a description of the individual mines and geology of the area.

9.3 HYDROLOGY AND HYDROGEOLOGY

The upper Missouri River, in west-central Montana, flows from its headwaters at Three Forks northward to its confluence with the Dearborn River below Wolf Creek. Some of the larger tributaries include Crow Creek, Sixteen Mile Creek, Ten Mile Creek, and Prickly Pear Creek. A summary of stream discharges for the basin is presented in table 9.1.

Table 9.1 Stream-gaging data for the upper Missouri River drainage.

Gage Location	Period of Record	Drainage Area (mi ²)	Annual Mean Flow (cfs)
Missouri R. at Toston	1891-1994*	14,669	5,212
Prickly Pear Cr. near Clancy	1908-1994*	192	48.3
Tenmile Cr. near Rimini	1915-1994*	32.7	17.3
Missouri R. near Wolf Creek	1946-1994	17,149	5,461

*intermittent data

Source: Shields *et al.* 1995

The upper Missouri River drainage is bounded on the east by the Big Belt Mountains and on the west by the Elkhorn Mountains and the Continental Divide. Only the highest elevations of the Elkhorn and Big Belt mountains were glaciated. The surficial deposits in the upper drainage (above Toston) are Tertiary-lake bed sediment while the surficial deposits in the lower drainage are generally Quaternary-age terraces and alluvial fan deposits (Alden 1953). In-stream and near-stream deposits are generally Quaternary alluvium along the length of the drainage.

Average annual precipitation ranges from 12 inches in the valley to 20 inches in the higher elevations (Montagne *et al.* 1982). Average annual temperatures range from 45-55°F in the lower valley, 40-45°F in the higher valley, 30-35°F in the Big Belt Mountains, and 25-30°F in the Elkhorn Mountains (Bergantino 1978).

Surface water is used for various needs in the upper Missouri basin; most uses involve reservoirs. Canyon Ferry Lake has a useable capacity of 2,043,000 acre-feet and is used for irrigation, flood control, power production, recreation, and as a water-supply for Helena. The stored volume ranged from 1,876,000 to 1,467,000 acre-feet in water-year 1994 (Shields *et al.* 1995). The Helena Valley reservoir is used for irrigation and municipal water supply for Helena. Lake Helena is used for wildlife, recreation, and power production through Hauser dam. Hauser and Holter lakes are used for recreation and power production. Storage capacities and extremes for water-year 1994 are presented in table 9.2:

Table 9.2 Reservoir statistics for the Upper Missouri River drainage.

Reservoir	Useable Capacity*	WY 1994 Extremes*
Helena Valley	5,900	8,950 to 2,040
Lake Helena	12,710	11,360 to 10,040
Hauser Lake	55,110	52,890 to 50,680
Holter Lake	81,920	82,300 to 72,870

*acre-feet

Source: Shields *et al.* 1995

Ground-water use is also quite extensive and varied in the basin; high-production wells are used for irrigation near Toston and for municipal water supply in Helena. Domestic and public supply wells are numerous throughout the valley.

9.4 SUMMARY OF THE UPPER MISSOURI RIVER DRAINAGE

For the abandoned/inactive mine inventory for the BLM, the MBMG investigated 195 mine and/or mill sites within the upper Missouri River drainage (see figure 9.1 and table 9.3). Of these sites, 168 were found to have no impact on BLM-administered land, 10 may pose environmental problems, and 17 could not be located. The names of the ten sites with potential environmental impacts are listed in **bold** in table 9.3. These sites were investigated in detail and are discussed in the following sections.

If mine openings or other dangerous features (unstable structures, mine openings, highwalls) were observed at a site, then the site was designated unsafe, or hazardous, in table 9.3. Of the 195 sites inventoried, 15 were found to have safety concerns. It should be noted that only sites where soil and/or water samples were collected were screened for safety hazards in detail. Hazards may exist at many of the other sites, but they may not have been inventoried as part of this project.

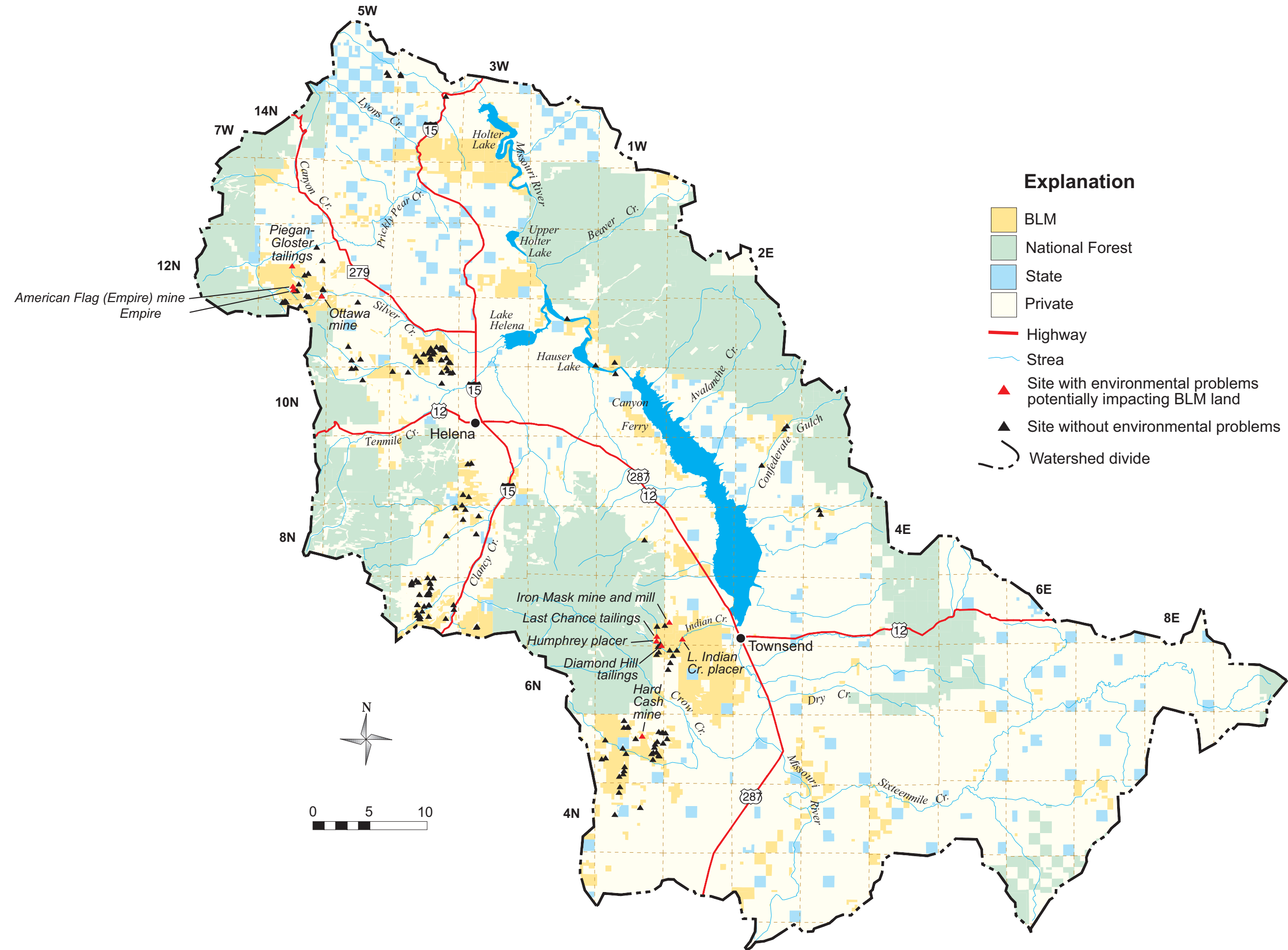


Figure 9.1. Abandoned/inactive mines inventoried in the upper Missouri River drainage.

Table 9.3 Summary of sites inventoried in the Upper Missouri River drainage. Site name in **bold** indicates potential environmental problems. "Y" in hazard column indicates physical safety concern.

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Adams	PRV	N	N	NE	Screened out in office.
Ajax	UNK	N	N	NE	Unable to locate.
Alice	UNK	N	N	NE	Unable to locate.
Alta	PRV	Y	N	NE	Large disturbance. Active site.
American Flag (Empire)	MIX	Y	Y	Y	Two open adits with discharges. Open stopes.
Ariadene Claim	MIX	Y	N	N	Dry. No impact.
Ariadne	PRV	Y	N	N	Dry workings on hillside.
Atlas	PRV	Y	N	N	No impact.
Bald Mountain	PRV	Y	N	NE	No impact.
Baldy Smith	MIX	Y	N	NE	Dry. No impact.
Banner	BLM	Y	N	N	Dry, cave adit.
Bell Boy	MIX	Y	N	Y	Mine openings. Dry. No impact.
Belmont	PRV	Y	N	NE	No impact.
Bertha	PRV	Y	N	N	Reclaimed.
Big Chief	PRV	N	N	NE	Screened out in office.
Big Indian	PRV	Y	N	N	Dry, open cut.
Big Indian Mill ⁵	PRV	Y	N	N	Revegetated tailings.
Big Ox	PRV	Y	N	NE	No impact.
Big Timber	UNK	N	N	NE	Unable to locate.
Bissonette (Liberty)	PRV	N	N	NE	Screened out in office.
Black Friday	MIX	Y	N	N	Dry. No impact.
Black Jack	UNK	N	N	NE	Unable to locate.
Blacksmith	MIX	Y	N	N	Dry. No impact.

Table 9.3 Summary of sites inventoried in the Upper Missouri River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Blue Jay	PRV	N	N	NE	No impact.
Bluebird (1)	MIX	Y	N	N	Dry. No impact.
Bluebird (2)	MIX	Y	N	N	Dry. No impact.
Bluebird Copper and Silver	MIX	Y	N	N	Dry prospects.
Bluebird Group	MIX	Y	N	N	Dry. No impact.
Bonanza	UNK	N	N	NE	Unable to locate.
Boulder Creek Placer	MIX	Y	N	N	No impact.
Boulder	UNK	N	N	NE	Unable to locate.
Buckeye	PRV	Y	N	NE	Observed from a distance. No impact.
Buckhorn	BLM	Y	N	N	Dry. No impact.
Bunker Hill	PRV	Y	N	NE	No impact.
Calumet	PRV	Y	N	NE	Small, dry prospects.
Charles D. Greenfield Property	PRV	Y	N	N	Dry. No impact.
Come Again and Crown Group	MIX	Y	N	N	Dry, open cut.
Confederate Gulch	PRV	Y	N	N	No impact.
Congress	MIX	Y	N	N	Dry. No impact.
Copper Gulch	MIX	Y	N	N	No significant disturbance.
Copper Hill	MIX	Y	N	N	Dry. No impact.
Copper Queen	UNK	N	N	NE	Unable to locate.
Cruse	PRV	Y	N	NE	Dry. No impact.
Cyclone	BLM	Y	N	N	Dry. No impact.
Dailey Copper	PRV	Y	N	N	Dry. No impact.
David Copperfield	PRV	Y	N	N	No impact.
Dewdrop Group	MIX	Y	N	N	Dry. No impact.

Table 9.3 Summary of sites inventoried in the Upper Missouri River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Diamond Hill ⁵	PRV	Y	Y	NE	Streamside tailings.
Donald Dee	MIX	Y	N	N	Dry. No impact.
Drumheller	PRV	Y	N	N	Dry. No impact.
Drumlummon ⁵	PRV	Y	N	N	Mine waste in flood plain. No impact on BLM.
East Mint	UNK	N	N	NE	Unable to locate.
Economy	PRV	N	N	NE	Screened out in office.
Eldorado Bar	PRV	N	N	NE	Screened out.
Elizabeth	BLM	Y	N	N	Dry. No impact.
Ella	BLM	Y	N	Y	Dry. Open adit.
Emma May	UNK	N	N	NE	Unable to locate.
Empire Mill ⁵	MIX	Y	Y	Y	Streamside tailings. Mill foundation highwalls.
Erickson = 1,2,3	MIX	Y	N	N	Small prospect. Dry.
Francis Claim	PRV	Y	N	NE	Associated with Alta. No impact on BLM.
Franklin and Sam Gaty	PRV	N	N	NE	Screened out in office.
Free Coinage	PRV	Y	N	N	Dry.
Freiburg	PRV	Y	N	N	No impact.
French Bar Placer	PRV	N	N	NE	Screened out.
G. Washington	PRV	N	N	NE	Dry ridge.
General Harrison	PRV	Y	N	N	No impact.
Golconda (Golden Assets)	MIX	Y	N	NE	Observed from a distance. Dry.
Golconda Creek (1)	PRV	Y	N	Y	Mine opening.
Golconda Creek (2)	MIX	N	N	NE	Screened out in office.
Gold Bug & Mary Rose	PRV	Y	N	N	Small prospect. Dry.
Golden Crown	BLM	Y	N	N	Dry. No impact.

Table 9.3 Summary of sites inventoried in the Upper Missouri River drainage (continued).

SITE¹	OWNER²	VISIT	SAMPLE³	HAZARD⁴	REMARKS
Good Hope Prospect	PRV	Y	N	N	No impact.
Gopher	MIX	Y	N	N	Small prospects. Dry.
Grandfather	PRV	Y	N	N	No impact.
Granite Creek	BLM	Y	N	N	Small, dry prospects.
Gravel Bar/ Metropolitan Bar	PRV	N	N	NE	Screened out.
Gregory	PRV	Y	N	N	Adit discharge. No impact on BLM.
Gregory Mill Tailings	PRV	Y	N	N	Streamside tailings. No impact on BLM.
Hard Cash	MIX	Y	Y	Y	Two open adits and a shaft. Seasonal discharge.
Helena-Jefferson	MIX	N	N	NE	Dry ridge. Screened out in office.
Hematite Iron	UNK	N	N	NE	Unable to locate.
Herb W	PRV	Y	N	N	Dry, open cut.
Herwood	PRV	N	N	NE	Screened out in office.
Hopeful	BLM	Y	N	N	Dry. No impact.
Horseshoe Claim	PRV	Y	N	N	Dry dumps. No impact.
Hudson	MIX	N	N	NE	Screened out in office.
Humphrey Placer	BLM	Y	Y	N	Placer spoils.
Independent	PRV	Y	N	N	Hillside dumps. Dry.
Indian Creek	PRV	Y	N	Y	Placer spoils. Highwalls.
Iron (1)	PRV	Y	N	Y	Open adit. Dry.
Iron (2)	MIX	Y	N	N	Dry. No impact.
Iron (3)	PRV	Y	N	NE	No impact.
Iron Age	MIX	Y	N	N	Caved workings. Dry.
Iron Cross	PRV	Y	N	N	Dry. No impact.

Table 9.3 Summary of sites inventoried in the Upper Missouri River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Iron Mask ⁵	PRV	Y	Y	Y	Open adit with discharge. Tailings.
Jebro	PRV	Y	N	N	Dry. No impact.
Jo Dandy	PRV	Y	N	N	Dry. No impact.
Jo Jo	PRV	Y	N	N	Dry. No impact.
Jumbo	PRV	Y	N	N	Dry. No impact.
Kanoka	MIX	Y	N	N	Dry. No impact.
Keating	PRV	Y	N	N	Dry. No impact.
King Solomon	BLM	Y	N	N	Dry. No impact.
Last Chance (1)	PRV	N	N	NE	Screened out in office.
Last Chance (2) Prospect	PRV	Y	N	Y	Open adit. Dry.
Last Chance Tailings	MIX	Y	Y	N	Streamside tailings.
Lexington	BLM	Y	N	N	Dry prospects.
Lion	PRV	Y	N	N	Dry, open cut.
Little Alta	PRV	Y	N	NE	Associated with Alta. No impact on BLM.
Little Fannie	BLM	Y	N	N	Dry. No impact.
Little Giant ⁵	MIX	Y	N	N	Dry. No impact.
Little Nell	MIX	Y	N	N	Dry.
Little Ox	UNK	N	N	NE	Unable to locate.
Lookout	BLM	Y	N	N	Dry.
Lost Horse Creek	MIX	Y	N	N	Small, dry prospects.
Lower Indian Creek	PRV	Y	Y	N	Placered streambed.
M and L	MIX	Y	N	N	Dry, caved workings.
Magpie Group	UNK	N	N	NE	Screened out in office.
Maine-Sullivan	PRV	Y	N	NE	Observed from a distance. Dry.

Table 9.3 Summary of sites inventoried in the Upper Missouri River drainage (continued).

SITE¹	OWNER²	VISIT	SAMPLE³	HAZARD⁴	REMARKS
Mary Tait	UNK	N	N	NE	Unable to locate.
Matson Group	PRV	Y	N	N	No impact.
Midway	PRV	Y	N	N	Dry dumps on hillside.
Mineral Hill	MIX	Y	N	N	No impact.
Minnesota	PRV	Y	N	N	Dry dumps on hillside.
Montana Tunnels	MIX	N	N	NE	Active in 1995.
Monte Christo	PRV	Y	N	N	Caved adits. Dry.
Moonlight	UNK	N	N	NE	Unable to locate.
Morning Star	PRV	Y	N	N	Dry. No impact.
Mount Shasta	UNK	N	N	NE	Unable to locate.
Mullin Claim	BLM	Y	N	N	Dry. No impact.
Muskeegan	MIX	Y	N	N	Partially reclaimed.
Nada	BLM	Y	N	N	Dry. No impact.
New Albany	PRV	Y	N	N	No impact.
New Era/Rosenfield	PRV	N	N	NE	Screened out in office.
Nile	MIX	Y	N	Y	Mine openings. Dry. No impact.
North Alta	PRV	Y	N	NE	Associated with Alta. No impact on BLM.
North Home	MIX	Y	N	N	Dry. No impact.
North Star	BLM	Y	N	N	Dry. No impact.
North Star Claim	UNK	N	N	NE	Unable to locate.
Northern Pacific	PRV	Y	N	NE	Active site.
Old Silver	PRV	N	N	NE	Screened out in office.
Osage Chief	PRV	Y	N	N	Dry. No impact.
Ottawa	PRV	Y	Y	N	Adit with discharge.
Palmer Engh Placer	PRV	Y	N	N	Placer workings.

Table 9.3 Summary of sites inventoried in the Upper Missouri River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Parker Group	MIX	Y	N	N	Dry. No impact.
Pie Ore	PRV	Y	N	N	No impact.
Piegan Gloster Mill Tailings ⁵	MIX	Y	Y	N	Streamside tailings.
Piegan Gloster Mine and Mill	PRV	Y	N	N	Mill and tailings. See Piegan Gloster Mill Tailings.
Piegan Gulch	PRV	Y	N	N	Placer workings.
Poe Lead	PRV	Y	N	N	Dry. No impact.
Portal	PRV	Y	N	N	Dry. No impact.
Prentice Property	PRV	N	N	NE	Screened out in office.
Queen of the Valley	PRV	Y	N	N	Dry, open cut.
Rarus	MIX	Y	N	NE	Observed from a distance. Dry hillside.
Regina Claim	BLM	Y	N	N	No impact.
Rena	BLM	Y	N	N	Caved shaft. Dry.
Retriever	PRV	Y	N	NE	Associated with Alta. No impact on BLM.
Roosevelt	BLM	Y	N	Y	Open stopes. Dry.
Rosetta	PRV	N	N	NE	Screened out in office.
Rothfuss Copper	PRV	N	N	NE	Screened out in office.
Rothfuss Iron	BLM	N	N	NE	Screened out in office.
Ruby Silver	BLM	Y	N	N	Dry waste rock.
Santa Anita	PRV	Y	N	N	Dry waste rock.
Satellite	MIX	Y	N	N	No impact.
Scratchgravel Hills	BLM	Y	N	N	Dry. No impact.
Shakopee and Earthquake	PRV	Y	N	Y	Mine openings. Adit discharge. No impact on BLM.

Table 9.3 Summary of sites inventoried in the Upper Missouri River drainage (continued).

SITE¹	OWNER²	VISIT	SAMPLE³	HAZARD⁴	REMARKS
Shannon	PRV	Y	N	N	Dry. No impact.
Sheep Creek Copper-Silver	PRV	N	N	NE	Screened out in office.
Silver Age	BLM	Y	N	N	Dry. No impact.
Silver Bar	MIX	Y	N	N	Dry. No impact.
Silver Cross	BLM	Y	N	N	Dry. No impact.
Silver-Copper Mining Co.	MIX	Y	N	N	Dry. No impact.
Simpson	MIX	Y	N	N	Dry. No impact.
Staple	PRV	Y	N	N	Small, dry prospects
Summit	MIX	Y	N	N	Dry. No impact.
Tom Lode	PRV	N	N	NE	Screened out.
Towsley	PRV	Y	N	Y	Mine openings. Dry. No impact.
Trinity	PRV	Y	N	N	No impact.
Umatilla	PRV	Y	N	NE	Dry. No impact.
Unnamed 04N01W15AADA	MIX	Y	N	N	No impact.
Unnamed 08N03E05BAAB	BLM	N	N	NE	Screened out in office.
Unnamed 08N03E05ACCB	PRV	N	N	NE	Screened out in office.
Unnamed 08N03W05DBAA Shafts	PRV	Y	N	N	Dry. No impact.
Unnamed 09N03W17BCBD	BLM	Y	N	Y	Open shaft. Dry.
Unnamed 10N04W34ACBC	BLM	Y	N	N	Dry.
Unnamed 11N04W34ACBC	BLM	Y	N	N	Dry. No impact.

Table 9.3 Summary of sites inventoried in the Upper Missouri River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Unnamed 11N06W10CADD Adit	BLM	Y	N	N	Dry.
Unnamed Sec 10	BLM	Y	N	N	Dry.
Unnamed Silica	PRV	N	N	NE	Screened out in office.
War Eagle	PRV	Y	N	NE	Dry. No impact.
Wayside	BLM	Y	N	N	Dry. No impact.
Wickes Corbin	UNK	N	N	NE	Unable to locate.
Wickes Manganese	BLM	Y	N	N	Dry. No impact.
Windy Ridge Property	MIX	N	N	NE	Dry. No impact.
Wolf Creek	PRV	N	N	NE	Screened out in office.
Yellowstone Claim	UNK	N	N	NE	Unable to locate.

1) Mines in **bold** may pose environmental problems and are discussed in the text; others are included only in appendix II (all mines) and appendix III (sites visited).

2) Administration/Ownership Designation

BLM: Bureau of Land Management

PRV: Private

MIX: Mixed (BLM and private)

STA: State of Montana

UNK: Owner unknown

3) Solid and/or water samples

4) Y: Physical safety hazards exist at the site.

NE: Physical safety hazards were not evaluated.

5) Mill site present

9.5 HARD CASH MINE

9.5.1 Site Location and Access

The Hard Cash mine (T5N R1W Sec 11 CCBF) is located on an ephemeral tributary to Keating Gulch about four miles west of Radersburg, Montana. The mine appears to be on private land but a portion may be on BLM-administered land. The site is accessible via the Keating Gulch Road.

9.5.2 Site History - Geologic Features

Reed (1951) called this gold-silver mine "substantial" (among others) in the area. The heyday of the mine was from 1880-1900 and then on a smaller scale from 1931 to 1941. In Reed's report, total short tons of ore from this mine, from 1901 to 1948, equaled 1,007 tons yielding 1,032 ounces of gold, 466 ounces of silver, 1,082 pounds of copper, and 53 pounds of lead. It lies in andesitic rocks of the Elkhorn Mountains volcanics.

According to Reed (1951), the Hard Cash originally consisted of three adits and a shallow shaft, with workings greater than 5,000 feet. Several adits and shafts explore a northwest-striking quartz vein containing sulfides. Winchell (1914) stated that the vein had been worked along 500 feet of its length, with an ore shoot of 250 feet and with the vein terminated by a fault 600 feet from the portal.

Workings observed at the site in 1996 include two open adits and a small, partially collapsed shaft. Waste-rock dumps are associated with each of the openings. Minerals found here include auriferous pyrite, a little sphalerite, bornite, chalcopyrite, native copper, and quartz gangue (Winchell 1914). Because most of the site appears to be on private land, no site map was prepared.

9.5.3 Environmental Condition

A portion of the ephemeral drainage along which the site is located has been filled in with a waste-rock dump. No water is present along the drainage above the dump, but below it, there is a small seep with milky colored water. On the day of the site visit (6/5/96), water from the seep flowed down the drainage a short distance before infiltrating the ground. Iron stains on rocks below the point of infiltration indicate that during at least part of the year, water from the drainage flows into Keating Gulch.



Figure 9.2 An open adit is located next to a mine building at the Hard Cash mine.



Figure 9.3 A small, milky seep surfaces along the ephemeral drainage just below the lowermost waste-rock dump.

The adit associated with the waste-rock dump may have a seasonal discharge. No water was observed flowing from the portal, but there was evidence of a small flow that occurred earlier in the spring.

9.5.3.1 Site Features - Sample Locations

The seep below the dump appears to be on private land, so it was not sampled. Instead, water-quality samples were collected from Keating Gulch upstream (KHCS10H) and downstream (KHCS20H) of the confluence with the ephemeral drainage. The flow rate of Keating Gulch was about 11 gpm at both locations.

9.5.3.2 Soil

BLM-administered land along Keating Gulch did not appear to have any soil contamination problems. Therefore, no soil samples were collected.

9.5.3.3 Water

Keating Gulch had no water-quality exceedances upstream and downstream of the site. The concentration of zinc increased from 2.8 to 8.1 $\mu\text{g/L}$ but was well below the aquatic and drinking water limits.

Table 9.4 Water-quality exceedances at the Hard Cash mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Keating Gulch - upstream of confluence with ephemeral drainage (KHCS10H)																			
Keating Gulch - downstream of confluence with ephemeral drainage (KHCS20H)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

9.5.3.4 Vegetation

The portion of the ephemeral drainage that was impacted by the seep was barren to sparsely vegetated. Along Keating Gulch, upstream and downstream of the confluence with the ephemeral drainage, vegetation was dense and healthy.

All of the waste-rock dumps at the site are barren to sparsely vegetated with grasses and weeds.

9.5.3.5 Summary of Environmental Condition

Under baseflow conditions, the small seep at the base of the lowermost waste-rock dump does not appear to impact the water-quality of Keating Gulch. Also, no soil contamination problems were noted on BLM-administered land below the site. Overall, the environmental impact of the site on BLM land appears minimal.

9.5.4 Structures

No structures were observed on BLM-administered land. However, a small mine building in fair condition is located on private land adjacent to one of the adits.

9.5.5 Safety

Hazards at the site include two open adits and a partially collapsed shaft. All three openings appear to be on private land. No safety concerns were observed on BLM-administered land along Keating Gulch.

9.6 LAST CHANCE TAILINGS AND HUMPHREY PLACER

9.6.1 Site Location and Access

Indian Creek, a tributary to the Missouri River near Townsend, Montana, has been heavily impacted by past mining, milling, and placer activities. The Humphrey placer (T7N R1W Sec 36 DCAD) and Last Chance tailings (T7N R1W Sec 36 DCDB) are located along a two-mile section of the creek that is above the confluence with the West Fork of Indian Creek. Most of the land along this section of the creek is administered by the BLM. The sites are accessible via Indian Creek Road.

9.6.2 Site History - Geologic Features

The Last Chance tailings refer to thin tailings deposits located along Indian Creek near a site called the Last Chance prospect. The tailings originated at the Park-New Era mine and mill, several miles farther up the drainage. The tailings probably came from ore extracted from Elkhorn Mountains volcanics (andesite) that contained sulfides, including pyrite, galena, sphalerite, and chalcopyrite.

At the Humphrey placer, workings are in the streambed of Indian Creek and in the alluvium on benches above the streambed. Hand-stacked rock piles indicate a small production. Reed (1951) wrote that Indian Creek, in general, was placered in the 1870s and again in the 1940s. Evidently, the original work failed to recover the placer gold down to bedrock and on the channel margins. They were subsequently reworked using hydraulics at the later date. Lyden (1948) fails to mention this placer by name but does describe the overall Indian Creek placer. He theorized that the gold in the placers was derived from the veins in the Hassel (Park) mining district.

9.6.3 Environmental Condition

The Last Chance tailings are streamside tailings deposits spread intermittently along the two-mile reach of Indian Creek previously described (figure 9.4). The tailings apparently originate from the mill and tailings impoundment associated with the Park mines, which are several miles farther up the drainage, within the Helena National Forest. Because the tailings are within the flood plain of the creek, they are susceptible to erosion during high-flow events and are a potential source of leachable metals.

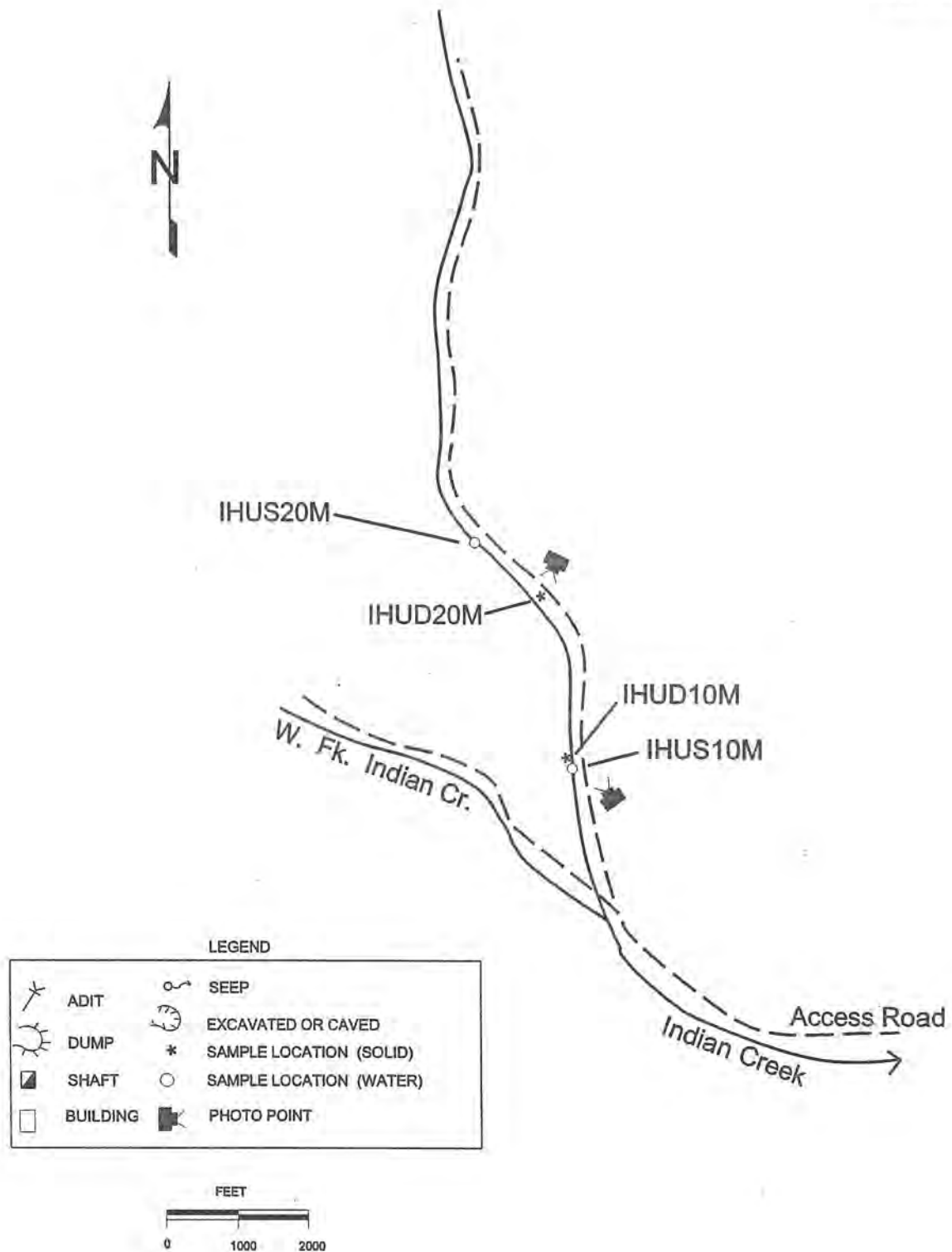


Figure 9.4 Location map of the Last Chance tailings and Humphrey placer area, August 1995f



Figure 9.5 Spoils from the Humphrey placer are located along the flood plain of Indian Creek.



Figure 9.6 Soil sample IHUD20H was collected from streamside tailings deposits along the banks of Indian Creek.

The Humphrey placer consists of extensive spoil piles of unmineralized sand, gravel, and cobbles located along the same reach of the creek as the Last Chance tailings. The spoils do not appear to pose a serious environmental problem, but were investigated because they are on BLM land.

9.6.3.1 Site Features - Sample Locations

Soil and water-quality samples were collected at the sites on August 10, 1995. Water-quality samples were collected from Indian Creek upstream (IHUS20M) and downstream (IHUS10M) of the majority of the tailings deposits that are on BLM lands. The flow rate of the creek at the upstream location was 0.9 cfs; at the downstream location, the flow rate was 1 cfs. Soil samples IHUD10M and IHUD20H were collected at two locations where tailings had obviously affected vegetation.

9.6.3.2 Soil

Both soil samples collected along Indian Creek had arsenic concentrations well above phytotoxic levels. Sample IHUD20H also had very high concentrations of lead.

Table 9.5 Soil sampling results for the Last Chance tailings

Sample Location	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
Streamside tailings - approx. 0.35 miles upstream of confluence with W. Fk. Indian Cr. (IHUD10M)	1180 ^{1,2}	2.7 ¹	35.6 ¹	641 ¹	310 ¹
Streamside tailings - approx. 0.95 miles upstream of confluence with W. Fk. Indian Cr. (IHUD20H)	1630 ^{1,2}	1.1 ¹	23.1 ¹	3610 ^{1,2}	127 ¹

(1) Exceeds one or more Clark Fork Superfund background levels (table 1.3)

(2) Exceeds phytotoxic levels (table 1.3)

9.6.3.3 Water

The concentration of arsenic in Indian Creek at the downstream location (51.1 $\mu\text{g/L}$) was slightly above the primary MCL of 50 $\mu\text{g/L}$. At the upstream location, the concentration of arsenic (49.2 $\mu\text{g/L}$) was just below the primary MCL. No other analytes exceeded water-quality criteria.

Table 9.6 Water-quality exceedances at the Last Chance tailings.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Indian Creek - upstream of tailings on BLM land (IHUS20M)																			
Indian Creek - downstream of tailings on BLM land (IHUS10M)		P																	

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

9.6.3.4 Vegetation

Along the sections of the creek that have been severely impacted by streamside tailings, the ground is barren to sparsely vegetated. In placered areas, natural revegetation is gradually occurring.

9.6.3.5 Summary of Environmental Condition

The streamside tailings along the upper portion of Indian Creek have clearly impacted the soils, vegetation, and water along the drainage. Because the tailing originate on private and National Forest lands upstream of the BLM land, a joint effort by the BLM, the National Forest Service, and the State will probably be necessary to address this problem.

Although placer spoils are found along this same portion of Indian Creek, they do not appear to contribute much to the environmental problems. They are not highly mineralized, and they are naturally revegetating.

9.6.4 Structures

No structures were observed on BLM land.

9.6.5 Safety

No safety concerns were observed on BLM land near the creek.

9.7 DIAMOND HILL TAILINGS AND LOWER INDIAN CREEK PLACER

9.7.1 Site Location and Access

The Diamond Hill tailings (T7N R1W Sec 36 CACC) are located along the West Fork of Indian Creek, near the Diamond Hill and Bluebird mines. The Lower Indian Creek placer (T7N R1E Sec 32 DBBB) begins a short distance below the tailings and extends several miles down the Indian Creek drainage. Both the tailings and the placer workings are located on a long strip of private property that is surrounded by BLM-administered land. The sites can be accessed by following the Indian Creek Road, which begins near Townsend.

9.7.2 Site History - Geologic Features

The Diamond Hill mine and mill are found in the Indian Creek region and are discussed in the Reed (1951) summary on mining in Broadwater County. The Diamond Hill property once had two amalgamating mills: a 40 and 120 stamp that operated in the 1890s (Reed 1951). A 10-stamp mill operated in the 1940s. The Diamond Hill was one of the earliest mines in the area. The property has been sporadically mined by means of glory-holing and open-cutting since the mid-1940s. Reed (1951) reported that \$500,000 worth of metals were produced from the mine. At present, Pegasus Gold hopes to make it an underground mine and is actively pursuing exploration and permitting.

Reed (1951) termed the deposit a fracture-filling and replacement lode associated with aplites and quartz monzonite intruded into andesite. It has an intense alteration halo around the intrusion. This mine is one of several associated with the Indian Creek fault, a large northwest-trending break. The mining followed chimney-like, erratic ore shoots. Ore minerals include pyrite, limonite, scheelite, native gold and occasionally tetradymite (bismuth telluride) (Reed 1951).

The Lower Indian Creek placer refers to the portion of the West Fork and Indian Creek drainage below the Diamond Hill mine. For several miles down the drainage, all land is private and has been extensively worked. BLM land crosses the drainage a short distance upstream of an active limestone quarry.

9.7.3 Environmental Condition

The Diamond Hill tailings are a small streamside tailings deposit along the West Fork of Indian Creek (figure 9.7). Because they lie within the flood plain of the creek, they are a potential source of sediment and leachable metals.

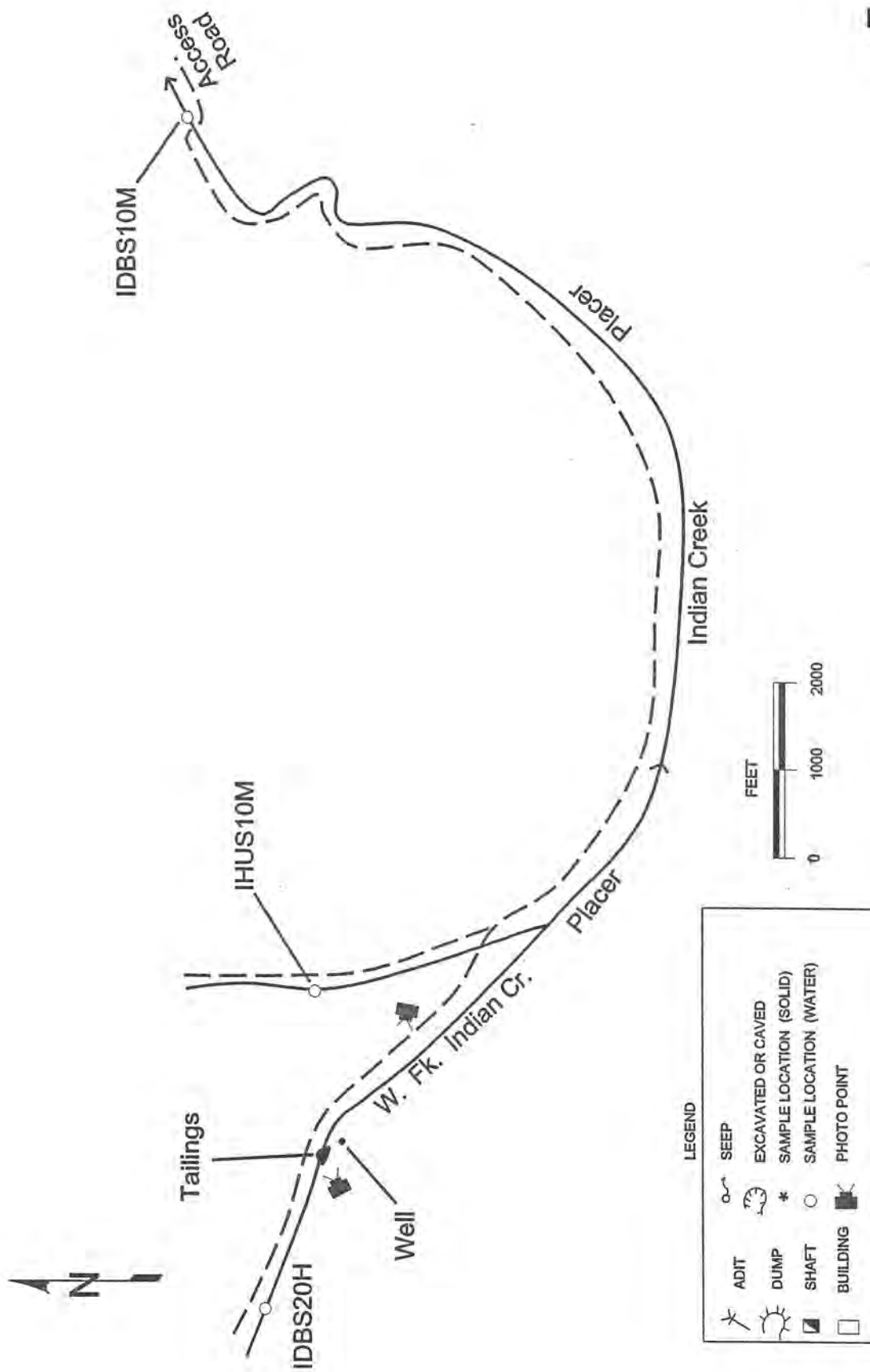


Figure 9.7 Sketch map for the Diamond Hill tailings and Lower Indian Creek placer area, August 1995.



Figure 9.8 The Diamond Hill tailings are located along the banks of the West Fork of Indian Creek.



Figure 9.9 Placer mining has lowered the base level of Indian Creek 30 to 50 feet in some locations.

The Lower Indian Creek placer consists of extensive spoils within the flood plain of the West Fork of Indian Creek and the mainstem of Indian Creek. In some locations, the base level of the creek is 30 to 50 feet below the level prior to placering. The site was investigated because of possible sedimentation and mercury-leaching problems.

9.7.3.1 Site Features - Sample Locations

Water-quality samples were collected on BLM land upstream and downstream of the sites on August 11, 1995. Sample IDBS10M was collected from the West Fork of Indian Creek, upstream of the streamside tailings (figure 9.7). The flow rate at this location was 130 gpm. Sample IHUS10M (discussed in previous section on Last Chance tailings) was collected from the mainstem of Indian Creek, upstream of the Lower Indian Creek placer. Sample IDBS20H was collected from Indian Creek downstream of the Lower Indian Creek placer. The flowrates at these upstream and downstream locations on Indian Creek were 448 and 329 gpm, respectively.

9.7.3.2 Soil

No spoils or tailings were observed on BLM land downstream of the two sites; therefore, no soil samples were collected.

9.7.3.3 Water

No water-quality criteria were exceeded at the upstream location on the West Fork of Indian Creek. At the upstream location on the mainstem of Indian Creek, the arsenic concentration exceeded the primary MCL (see section 9.6). At the downstream location on Indian Creek, no standards were exceeded, but the arsenic concentration (44.6 $\mu\text{g/L}$) was close to the primary MCL (50 $\mu\text{g/L}$).

Table 9.7 Water-quality exceedances at the Diamond Hill tailings and Lower Indian Creek placer.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
West Fork of Indian Creek - upstream of Diamond Hill tailings (IDBS10M)																			
Indian Creek - upstream of confluence with W. Fk. Indian Cr. (IHUS10M)		P																	
Indian Creek - downstream of disturbances (IDBS20H)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

9.7.3.4 Vegetation

Near the Diamond Hill tailings, the ground is barren to sparsely vegetated. Along the placered sections of the West Fork and mainstem of Indian Creek, the ground is sparsely to moderately vegetated. The BLM downstream of the mining disturbances is densely vegetated.

9.7.3.5 Summary of Environmental Condition

Although the Diamond Hill tailings and Lower Indian Creek placer have impacted the soil and vegetation on private lands along the West Fork and mainstem of Indian Creek, the BLM land downstream of these disturbances does not appear to be affected. The arsenic concentration in Indian Creek is an environmental concern, but the Lower Indian Creek placer and Diamond Hill tailings do not appear to be the primary sources. Instead, most of the arsenic load is probably from the Park mines and mill tailings and the Last Chance tailings (see section 9.6), which are located farther up the Indian Creek drainage.

9.7.4 Structures

No buildings were observed on the BLM lands upstream and downstream of the Lower Indian Creek placer and Diamond Hill tailings. However, several trailers and other temporary structures are located on private land along the placer.

9.7.5 Safety

The highwalls left from the placer mining of the West Fork and mainstem of Indian Creek are a safety concern, but they are located on private property. No safety hazards were observed on BLM land.

9.8 IRON MASK MINE AND MILL

9.8.1 Site Location and Access

The Iron Mask mine (T7N R1E Sec 30 BBAA) is a private holding at the head of Whipcracker Gulch, a tributary drainage to Canyon Ferry Lake. Whipcracker Gulch crosses onto BLM-administered land approximately a half mile below the site. The site can be accessed by following a four-wheel drive road that turns north off the Indian Creek Road.

9.8.2 Site History - Geologic Features

This lead-zinc mine had a 75-ton flotation mill in the mid-1940s and was worked from 1904 to 1949 (Reed 1951). The workings were driven on a northwest-striking, northeast-dipping, fissure-filling vein in Elkhorn Mountains andesite. Workings include a 2,300-foot cross-cut adit that has raises and stopes along 600 feet of its length and a 100-foot winze. Winchell (1914) stated that the Iron Mask mine found in the Park (Hassel) district was composed of a shaft, 200 feet deep and contained quartz with iron oxides and galena. Minerals found in this mine include galena, sphalerite, limonite, and quartz (Reed 1951). Presently, there is an open, flowing adit and open shafts on the quartz vein.

9.8.3 Environmental Condition

At the Iron Mask, a 20 to 30 gpm discharge flows from the portal of a partially collapsed adit. The adit discharge is the headwaters of Whipcracker Gulch. A short distance from the adit portal, the discharge runs down the north side of a large waste-rock dump and then flows into the natural Whipcracker Gulch channel.

To the south of the waste-rock dump are the remnants of a mill and a small volume of tailings. On the day the site was visited (August 10, 1995), some of the tailings were covered with a white coating of salts. No tailings or waste material were observed in contact with the waters of Whipcracker Gulch.

9.8.3.1 Site Features - Sample Locations

A water-quality sample (WIMS10H) was collected on BLM land downstream of the site on August 10, 1995. The flow rate of Whipcracker Gulch at this location was 15 gpm.



Figure 9.10 A large discharge flows from the partially collapsed adit at the Iron Mask mine and mill.



Figure 9.11 Tailings are spread down the hillside below the Iron Mask mill. Vegetation near the tailings has obviously suffered.

9.8.3.2 Soil

Because no tailings or waste rock were observed on the BLM land downstream of the site, no soil samples were collected.

9.8.3.3 Water

Whipcracker Gulch had no water-quality exceedances below the site.

Table 9.8 Water-quality exceedances at the Iron Mask mine and mill.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Whipcracker Gulch - downstream of site (WIMS10H)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

9.8.3.4 Vegetation

The waste-rock dump at the site is sparsely vegetated with grasses. The tailings below the mill are barren to sparsely vegetated. Vegetation on the BLM land below the site appears healthy.

9.8.3.5 Summary of Environmental Condition

The water-quality data from Whipcracker Gulch suggest that any environmental impacts from the adit discharge, the streamside waste-rock dump, and mill tailings are limited to the private land immediately around the site. No tailings or waste materials were observed on federal land, and vegetation along the drainage below the site appears healthy.

9.8.4 Structures

A mine building and the remnants of a mill are located near the adit and waste-rock dump. A cabin is located along the drainage below the mine. All three of these structures are on private land. No buildings are present on federal land.

9.8.5 Safety

The open adit portal is a safety concern at the site. No safety concerns were noted on BLM lands below the site.

9.9 OTTAWA MINE

9.9.1 Site Location and Access

The Ottawa mine (T11N R6W Sec 2 CBAD) is a private holding along Ottawa Gulch, about 1.5 miles southwest of Marysville, Montana. BLM-administered land is located a short distance upstream and downstream of the site. Access to the site is via an improved dirt road that begins in Marysville.

9.9.2 Site History - Geologic Features

Both Walker (1963) and McClernan (1983) describe this tungsten mine, which is also known as the Prentice. The host rock is a hornfels of Helena limestone on the eastern edge of the associated Marysville quartz diorite stock. Tungsten is found in scheelite with small amounts of pyrite and chalcopyrite, and with garnet, epidote, quartz and actinolite gangue.

Walker (1963) includes plan view underground maps of two adits as well as cross sections and assay results from 20 samples. Workings totaled 1,260 feet from the adits with an additional 180 feet of raises and surface trenches. Samples assayed from trace to 3.05% WO_3 .

9.9.3 Environmental Condition

A 5-10 gpm discharge flows from a collapsed adit portal, down an embankment, and into Ottawa Gulch. The discharge is clear and vegetation is present along its entire course.

9.9.3.1 Site Features - Sample Locations

On June 4, 1996, water-quality samples OOTS10M and OOTS20M were collected from Ottawa Gulch upstream and downstream of the site, respectively. The flow rate of the gulch upstream of the site was 5 cfs; downstream of the site, the rate was 9 cfs.



Figure 9.12 A discharge flows from the collapsed adit at the Ottawa mine.



Figure 9.13 An ore bin is located at the edge of the waste-rock dump at the Ottawa mine.

9.9.3.2 Soil

No erosion problems were observed at the site and no evidence of soil contamination was noted on BLM-administered land; therefore, no soil samples were collected.

9.9.3.3 Water

Ottawa Gulch had no water-quality exceedances upstream or downstream of the site.

Table 9.9 Water-quality exceedances at the Ottawa mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Ottawa Gulch - upstream of site (OOTS10M)																			
Ottawa Gulch - downstream of site (OOTS20M)																			

Exceedance codes:

- P - Primary MCL
- S - Secondary MCL
- A - Aquatic Life Acute
- C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

9.9.3.4 Vegetation

The waste-rock dump at the site is partially vegetated with grasses and willows. The BLM-administered land upstream and downstream of the site is densely vegetated with healthy grasses, willows, and conifers.

9.9.3.5 Summary of Environmental Condition

The water-quality data from Ottawa Gulch indicate that the adit discharge has little, if any, environmental impact on BLM-administered land.

9.9.4 Structures

An ore bin is located on private land at the edge of the site's waste-rock dump. No buildings are present on federal land.

9.9.5 Safety

No safety concerns were noted on private or BLM-administered land.

9.10 AMERICAN FLAG (EMPIRE) MINE AND EMPIRE MILL

9.10.1 Site Location and Access

The American Flag (Empire) mine (T12N R6W Sec 33 AABC) and Empire mill (T12N R6W Sec 33 BABB) are on a mix of private and BLM-administered land near the head of Empire Creek, about three miles west of Marysville, Montana. The sites can be accessed by following an improved dirt road that turns off the Little Prickly Pear Creek road.

9.10.2 Site History - Geologic Features

Pardee and Schrader (1933) described the ore at the American Flag and Empire mines as devoid or low in sulfides, similar to the Belmont. According to their map, these mines are located in the contact zone surrounding the quartz diorite, Marysville batholith. Walker (1992), however, reported some high-grade galena in the Empire. The Empire mined from 6,500-foot level to 5,700-foot level (Walker 1992). According to McClernan (1983), the Empire produced 5,683.57 ounces Au, 19,666 ounces Ag, 85,839 pounds Cu, 1,248,168 pounds Pb, and 36,462 pounds Zn from 36,087 tons of ore during the years of 1901 to 1948. The Empire produced \$2,500,000 in gold (Walker 1992). The vein at the Empire averaged 6-feet wide, and ranged from 1 foot to 20 feet wide. Minerals mined consisted of quartz, crushed shale, iron oxides, malachite, chrysocolla, and cerusite (a replacement of galena).

The American Flag mined a 2-foot quartz/gold/silver vein, parallel to the Empire vein (Pardee and Schrader 1933). Another mine in the area is the M. and L., which is the eastward continuation of the Empire vein that strikes N 80°W, dipping 70°S. in Belt Empire shale. Workings at the M. and L. include a 250-foot shaft and drifts 150 feet and 400 feet long.

Workings observed at the mines include several adits and shafts, some of which are open; there are also open stopes as well as numerous prospects.

Much of the ore from Empire and American Flag mines was sent to the Empire mill farther down the gulch on Empire Creek. The mill possibly processed ore from the Bell Boy (in 1926) and associated mines farther to the east as well (Pardee and Schrader 1933). Walker (1992) reported that the mill had 60 stamps and a cyanide plant, much like the Piegan-Gloster. The large, elegant mill building contained no equipment at the time of the MBMG geologist's visit in 1995; the

building has since burned. Extensive tailings deposits from the mill are found in breached impoundments on private and BLM-administered lands along Empire Gulch.

9.10.3 Environmental Condition

At the American Flag (Empire) mine, discharges flow from the portals of two open adits that are located along a small sub-drainage of Empire Creek. Both discharges flow across mineralized waste-rock dumps before sinking into the ground. At the lowermost workings, water re-emerges at the base of the waste-rock dump and continues down the drainage to join Empire Creek.

At the Empire mill, breached tailings impoundments are strung along Empire Creek for about a half mile. At least one of the impoundments is on BLM-administered land.

9.10.3.1 Site Features - Sample Locations

The sites were visited and sampled on June 5, 1996. A water-quality sample (EEMS20M) was collected from the discharge below the lowermost waste-rock dump at the American Flag (Empire) mine. At the Empire mill, water samples were collected from Empire Creek, upstream (EEMS10M) and downstream (EEMS30M) of the mill site. The flow rate of the creek at the upstream location was 2.3 cfs; at the downstream location, the flow rate was 4.5 cfs. Also, a soil sample (EEMD10M) was collected from the streamside tailings on BLM-administered land.

9.10.3.2 Soil

Concentrations of metals and arsenic in the tailings adjacent to Empire Creek are extremely high. The copper concentration is more than 50 times greater than the phytotoxic limit of 100 mg/Kg; the zinc concentration is more than 35 times greater than the 500 mg/Kg phytotoxic limit.

Table 9.10 Soil sampling results for the Empire mill tailings.

Sample Location	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
Streamside tailings on BLM-administered land (EEMD10M)	289 ^{1,2}	58 ¹	5,180 ^{1,2}	8,126 ^{1,2}	18,570 ^{1,2}

(1) Exceeds one or more Clark Fork Superfund background levels (table 1.3)

(2) Exceeds phytotoxic levels (table 1.3)



Figure 9.14 At the American Flag (Empire) mine, there are two open adits with discharges.



Figure 9.15 The Empire mill tailings are being actively eroded by Empire Creek.

9.10.3.3 Water

The lead concentration in the discharge below the American Flag (Empire) mine was $4.9 \mu\text{g/L}$, slightly above the chronic aquatic life limit ($3.2 \mu\text{g/L}$). Empire Creek upstream of the Empire tailings had no water-quality exceedances. Downstream of the tailings, the field pH of the creek was high (8.7) and the concentration of mercury ($0.16 \mu\text{g/L}$) exceeded the chronic aquatic life standard.

Table 9.11 Water-quality exceedances at the American Flag (Empire) mine and Empire mill.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
American Flag (Empire) mine - discharge at base of lowermost dump (EEMS20M)								C											
Empire Creek - upstream of Empire tailings (EEMS10M)																			
Empire Creek - downstream of Empire mill (EEMS30M)										C									S*

Exceedance codes:

- P - Primary MCL
- S - Secondary MCL
- A - Aquatic Life Acute
- C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

* pH measured in laboratory was within acceptable MCL range of 6.5-8.5.

9.10.3.4 Vegetation

The waste-rock dumps at the American Flag (Empire) mine are barren to sparsely vegetated. At the Empire mill site, vegetation is stressed or absent in numerous locations; however, much of the site, has naturally revegetated with grasses and willows.

9.10.3.5 Summary of Environmental Condition

The tailings adjacent to Empire Creek contain very high concentrations of metals and arsenic, and vegetation is obviously impacted. Under low flow conditions, the tailings do not appear to significantly affect the water quality of Empire Creek; however, during runoff and high flow events, tailings that erode into the creek probably contribute a substantial metal load. Based on the volume of tailings observed and their proximity to the stream, it seems likely that substantial streamside tailings deposits exist downstream of the site.

The lead concentration in the seep below the American Flag (Empire) mine is above the chronic aquatic life standard. Additional site characterization on private land would be necessary to access if the source of the lead is the adit discharges or the waste-rock dumps that the discharges infiltrate or both.

9.10.4 Structures

Three mine buildings in fair condition were observed near the American Flag (Empire) mine. An adit portal is located inside one of the buildings. All of these structures appear to be on private land.

At the Empire mill site, only the rock mill foundation remains. The rest of the structure burned down within the past two years. No buildings were observed on BLM-administered land.

9.10.5 Safety

At the American Flag (Empire) mine, the two discharging adits are open and easily accessible. The upper adit has a gate, but vandals have broken the lock. On the hillside above the upper adit, there is an open stope which is bisected by a dirt road. A fence and warning signs have been placed around part of the stope, but the opening still remains a hazard.

At the Empire mill, the foundation of the mill is a potential hazard due to the high rock walls.

The safety concerns noted above appear to be on private land. No hazards were observed on BLM-administered land.

9.11 PIEGAN GLOSTER MILL TAILINGS

9.11.1 Site Location and Access

The Piegan Gloster mill tailings (T12N R6W Sec 21 AACB) are on a mix of private and BLM-administered land along Piegan Creek, a tributary to Little Prickly Pear Creek. The site can be accessed by following a dirt road that begins where Prickly Pear Road crosses Piegan Creek.

9.11.2 Site History - Geologic Features

McClernan (1983) described the Piegan Gloster lode as consisting of two adits, one of which was 1,200 feet long. Walker (1992) reported that the Gloster (originally spelled Gloucester?) was worked to a depth of 1,300 feet and workings also consisted of 750 foot winze below the lower tunnel. He also summarized the development work as totaling 12,000 to 14,000 feet. The quartz/calcite, minor pyrite, 3- to 12-foot-wide vein is hosted by quartz diorite. Walker (1992) characterized these mines as epigenetic and epithermal and stated that the gold in the Gloster may be associated with pyrite as well as free. Production from 1901 to 1948 totaled 156,981 ounces Au, 320,822 ounces Ag, and 1,883 pounds Cu from 317,641 short tons of ore. The mine produced \$3,500,000 worth of gold (Walker 1992). The Gloster tailings yielded \$250,000 in gold (Walker 1992). Walker (1992) also stated that the Gloster mill operated in the 1920s (and possibly at other times) and processed a quartz-calcite ore from the Shannon mine. Ore was processed by a 60-stamp mill with amalgamation during early years (1870s to 1890s) with a cyanide plant in the Barnes-King (1916 to 1923) era.

Today, extensive tailings deposits are spread along the course of Piegan Creek below the Piegan Gloster mill. The estimated volume of tailings is 336,000 cubic yard (AMRB 1994).

9.11.3 Environmental Condition

Two small portions of BLM-administered land are present along Piegan Creek below the mill. Both pieces of land are impacted by streamside tailings. A large tailings impoundment is located on private land between the BLM lands. Piegan Creek is diverted into a pipe in an attempt to by-pass this impoundment. However, on the day of the site visit (6/5/96), the creek water below the impoundment was turbid, presumably due to suspended tailings.



Figure 9.16 A large tailings impoundment is located between two small segments of BLM land that cross the Piegan Creek drainage.



Figure 9.17 A composite soil sample (PPCD10M) was collected along the banks of Piegan Creek where streamside tailings have been deposited.

9.11.3.1 Site Features - Sample Locations

A water-quality sample (PPCS10H) was collected on BLM-administered land downstream of the tailings impoundment. The flow rate of the the creek was 2.6 cfs. Also, a composite soil sample (PPCD10M) was collected to document impacts related to the streamside tailings.

9.11.3.2 Soil

The streamside tailings on BLM-administered land contain concentrations of copper and zinc that are above their respective phytotoxic limits of 100 and 500 mg/Kg. The concentration of lead is slightly below the phytotoxic limit of 1,000 mg/Kg.

Table 9.12 Soil sampling results for the Piegan Gloster mill tailings.

Sample Location	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
Streamside tailings on BLM-administered land (PPCD10M)	48 ¹	5 ¹	149 ^{1,2}	947 ¹	1,085 ^{1,2}

(1) Exceeds one or more Clark Fork Superfund background levels (table 1.3)

(2) Exceeds phytotoxic levels (table 1.3)

9.11.3.3 Water

The mercury concentration in Piegan Creek downstream of the tailings impoundment was 0.12 µg/L, which is above the chronic aquatic life standard. Also, the field pH of the creek (8.8) was outside the acceptable MCL range of 6.5-8.5.

Table 9.13 Water-quality exceedances at the Piegan Gloster mill tailings.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Piegan Creek - downstream of tailings impoundment (PPCS10H)										C									S*

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

* pH measured in laboratory was within acceptable MCL range of 6.5-8.5.

9.11.3.4 Vegetation

Vegetation is stressed by sedimentation along much of the Piegan Creek drainage. In some locations, such as the tailings impoundment between the two segments of BLM land, natural revegetation is occurring, but there are still erosion problems.

9.11.3.5 Summary of Environmental Condition

The impact of the Piegan Gloster mill tailings is visually apparent on the small segments of BLM land that cross Piegan Creek. Thin streamside tailings deposits are spread along the creek banks throughout these areas. Concentrations of copper, lead, and zinc in these tailings are close to or above phytotoxic levels. With the exception of mercury and pH, water quality downstream of the site does not appear to be a problem under low flow conditions. During high flow and runoff events, it is likely that tailings erode into the creek and contribute a significant metal load.

9.11.4 Structures

No structures were observed on BLM-administered land.

9.11.5 Safety

No safety concerns were noted on BLM-administered land.

9.12 SUMMARY OF MINING IMPACTS ON BLM LAND - UPPER MISSOURI RIVER DRAINAGE

Of the 10 sites with potential environmental problems in the upper Missouri drainage, the Last Chance tailings, the Empire mill, and the Piegan Gloster mill tailings are the three with the greatest adverse environmental impact on BLM-administered lands. The Last Chance tailings on Indian Creek originate from the Park-New Era mill several miles up the drainage. The tailings contain elevated concentrations of arsenic and lead and are the likely source of the dissolved arsenic in the creek. At the Empire mill and Piegan Gloster mill tailings sites, extensive streamside tailings deposits are present on BLM lands. At both sites, the tailings contain elevated concentrations of several metals. Erosion of the tailings during storm and runoff events probably contribute substantially to the metal loads of the creeks at these two sites.

The remaining seven sites with potential environmental problems (American Flag (Empire), Diamond Hill tailings, Hard Cash, Humphrey placer, Iron Mask, Lower Indian Creek placer, and Ottawa) appear to have little, if any, adverse impact on BLM-administered lands.

Fourteen of the 195 inventoried sites were found to have one or more safety concerns. Thirteen sites had hazardous mine openings and two sites (the Indian Creek placer and the Empire mill) had unsafe highwalls. Eight of the sites with safety hazards are on or immediately adjacent to BLM-administered land (see table 9.3).

RUBY RIVER DRAINAGE

10.1 GEOLOGY

The Ruby River drainage includes the east slope of the Ruby Range and the Greenhorn Range areas; the Virginia City, Sheridan, and south half of the Tidal Wave mining districts (Loen and Pearson 1989). The drainage falls on parts of four 1° x 2° sheets: Dillon, Bozeman, Ashton, and Dubois.

Ruppel *et al.* (1993) mapped the Dillon 1° x 2° quadrangle at 1:250,000. Their map shows the valleys of the upper Ruby River filled with Tertiary Bozeman Group valley-fill deposits, while the Ruby, after it joins Alder Creek, has Quaternary fan deposits covering the Bozeman Group sediments.

The east flank of the Ruby Range is dominated by Archean quartzofeldspathic gneiss cut by numerous northwest-trending normal faults. Also present are Archean marble and gneisses, Cambrian (undivided), and Mississippian/Devonian undivided (Three Forks Shale and Jefferson Dolomite). The Ruby Mountain range itself is defined by northeast-trending, range-front faults and includes small slivers of thrust faults. The Bozeman sediment of the upper Ruby valley is primarily affected by north-south-trending faults.

The Greenhorn Range also has Archean quartzofeldspathic gneiss as a primary rock type with Archean amphibolite and marble (Berg 1979). Small remnants of the Snowcrest and Greenhorn thrust faults cut through the area. The southern Tobacco Roots are also dominated by Archean quartzofeldspathic gneiss, but also with interlayered amphibolite.

Authors who mapped this general area are Klepper (1950), general geology of parts of Madison and Beaverhead counties; Karasevich (1980), and Tysdal (1976) northern Ruby Range; Garihan (1979), central Ruby Range; Dorr and Wheeler (1948), upper Ruby River basin; Mann (1954), Gravelly Range; and Berg (1979), Greenhorn Range.

10.2 ECONOMIC GEOLOGY

The area is dominated by the Virginia City area with its lode mines south of Virginia City in the Browns Gulch mining district as well as the extensive placers west of town along Alder Gulch. Lorain (1937) described the lode mines of the Tobacco Root Mountains (primarily hosted by Archean rocks) including those

around Virginia City, Alder, and Sheridan. Mines include the Marietta, U.S. Grant, Kearsarge, and Easton-Pacific among many others.

Numerous talc prospects have been explored in the Ruby Mountains and the Greenhorn and Gravelly ranges. These occurrences are usually associated with marble (Berg 1979), which is a result of amphibolite-facies metamorphism. Other industrial minerals prospected for in this area include vermiculite, iron, pumice, corundum, uranium, strontium, garnet, building stone, and phosphate.

The southern Tobacco Roots have been explored for gold, silver, zinc, molybdenum, lead, bismuth, some talc, iron, copper, thorium, chromium, feldspar, sand/gravel, mica, tungsten, and kyanite. The mines here are hosted by the Cherry Creek Series gneisses (Lorain 1937). Some of the mines associated with this area include the Broad Gauge-Tamarack, Red Pine, Leiter, and Gray Eagle.

Placers include Alder Gulch, Barton Gulch, Greenhorn Creek, Idaho Creek, Ruby River, Nevada City, as well as very small placers on the majority of westward flowing tributaries to the upper Ruby River (Lyden 1948). Placers associated with the southern Tobacco Root Mountains are located on California Creek, Bivens Creek, Sparrow, Ramshorn Creek, Mill Creek, Wisconsin Creek, and Harris Creek.

10.3 HYDROLOGY AND HYDROGEOLOGY

The Ruby River drainage is a relatively small drainage in southwest Montana near the Continental Divide. The drainage flows from the Gravelly-Snow Crest Mountains northward to its confluence with the Beaverhead River near Twin Bridges. Most of the tributary drainages are of nearly equal size, the two largest being Sweetwater Creek in the upper reaches of the drainage and Alder Creek in the lower reaches of the drainage. Stream discharge records for the Ruby River above and below the reservoir near Alder are presented in table 10.1.

Table 10.1 Stream-gaging data for the Ruby River drainage.

Gage Location	Period of Record	Drainage Area (mi ²)	Annual Mean Flow (cfs)
Ruby R. above reservoir	1938-1994	538	178
Ruby R. below reservoir	1962-1994	596	209

Source: Shields *et al.* 1995

The drainage is bounded on the south, east, and west by the Gravelly-Snow Crest Ranges. The Tobacco Root Mountains are northeast of the main drainage. The higher elevations of the Snow Crest and the Tobacco Root Mountains were glaciated; minor terminal moraines are found in the higher reaches of some tributaries. Lake bed sediment deposits on the valley margin are common in the drainage above Alder, but are not found downstream (Alden 1953). Near-stream and in-stream sediment are generally Quaternary alluvium.

Annual precipitation averages 40 inches in the higher elevations of Tobacco Root Mountains to 12 inches or less in the lower valley (Montagne *et al.* 1982). Annual temperatures average 25 to 30°F in the higher elevations to 40 to 45° F in the valley (Bergantino 1978).

With no large settlements in the drainage, ground-water development is generally limited to domestic use and irrigation; there are only a few wells in the upper drainage. Approximately 3500 acres are irrigated above Ruby dam; most of the irrigation demand is met with water supplied by the river and its tributaries. The reservoir, which has a useable capacity of 39,740 acre-ft, is used for irrigation and recreation. In water-year 1994, the storage volume ranged from 39,500 to 0 acre-ft (Shields *et al.* 1995).

10.4 SUMMARY OF THE RUBY RIVER DRAINAGE

For the abandoned/inactive mine inventory for the BLM, the MBMG investigated 82 mine and/or mill sites within the Ruby River drainage (figure 10.1 and table 10.2). Of these sites, 70 were found to have no impact on BLM-administered land, three may pose environmental problems, and nine could not be located. The names of the three sites with potential environmental impacts are listed in **bold** in table 10.2. These sites were investigated in detail and are discussed in the following sections.

If mine openings or other dangerous features (unstable structures, steep waste-rock dumps, high walls) were observed at a site, then the site was designated unsafe, or hazardous, in table 10.2. Of the 82 sites inventoried, 10 were found to have safety concerns. It should be noted that only sites where soil and/or water samples were collected were screened for safety hazards in detail. Hazards may exist at many of the other sites, but they may not have been inventoried as part of this project.

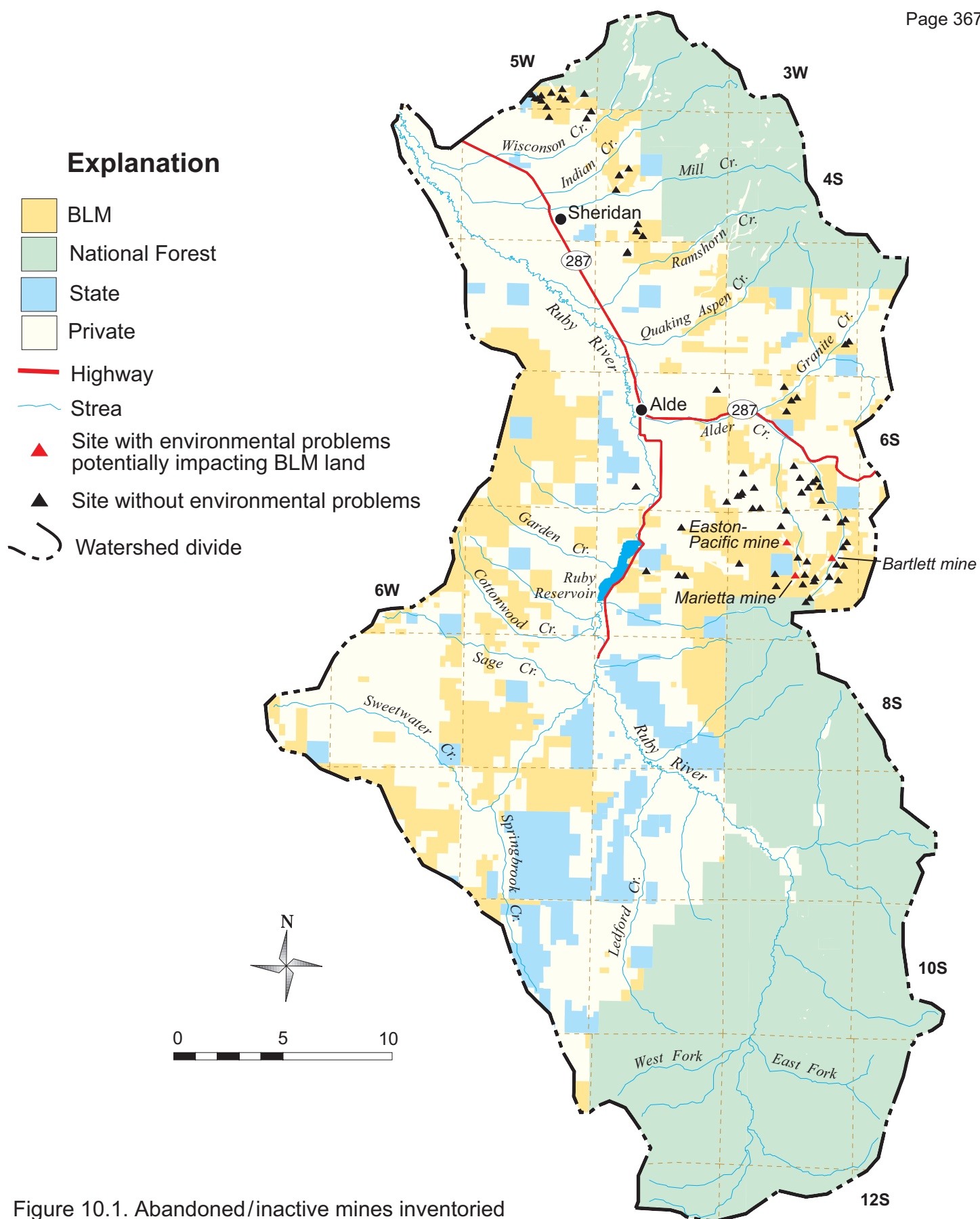


Figure 10.1. Abandoned/inactive mines inventoried in the Ruby River Drainage.

Table 10.2 Summary of sites inventoried in the Ruby River drainage. Site name in **bold** indicates potential environmental problems. "Y" in hazard column indicates safety concern at site.

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Agitator Concentrator	PRV	Y	N	Y	Hazardous structure.
Alameda and Bamboo Chief	PRV	Y	N	NE	No impact.
Bartlett	MIX	Y	Y	N	Adit discharge.
Barton Gulch East Placers	BLM	Y	N	N	Placer workings in stream.
Barton Gulch West Placers	MIX	Y	N	N	Placer workings in stream.
Batten Brothers/Bell	MIX	Y	N	N	Dry. No impact.
Bivens Creek Placer	MIX	Y	N	N	No impact.
Bivens Creek Prospect	BLM	Y	N	N	No impact.
Black Ace	BLM	Y	N	Y	Mine openings. Dry.
Black Eagle	UNK	N	N	NE	Unable to locate.
Broadgauge-Tamarack	PRV	Y	N	NE	Active site with crusher, mill, and tailings pond.
Buckeye	PRV	Y	N	Y	Open shaft. No impact on BLM.
California Creek Placer	MIX	Y	N	N	No impact.
Chromium Occurrence	UNK	N	N	NE	Unable to locate.
Cook	PRV	Y	N	N	Dry. No impact.
Cornucopia and Cabin Lode	PRV	Y	N	N	Dry. No impact.
Cost Manganese Lode	PRV	N	N	NE	Screened out in office.
Diamond Hitch Adit 1	PRV	Y	N	N	Dry. No impact.
Dullea Adit 1	PRV	Y	N	N	Dry. No impact.
Easton-Pacific	PRV	Y	Y	Y	Adit discharges, streamside waste. Partially open adits.

Table 10.2 Summary of sites inventoried in the Ruby River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Edward Scheitlin Gold Mill ⁵	PRV	Y	N	NE	Active site. Viewed from a distance.
El Fleeda	PRV	Y	N	NE	Dry. No impact.
Falcon Prospect ⁵	BLM	Y	N	Y	Open adit. Dry.
Fork Prospect	STA	Y	N	Y	Open adit. Waste in contact with a spring, but no impact on BLM.
Forks	PRV	Y	N	N	No impact. Secured adit.
Garrison Placer	MIX	Y	N	N	Placer waste in stream. Active site.
General Shafter	PRV	N	N	NE	Active?
Grandview Prospect	PRV	Y	N	Y	Hazardous mine opening.
Granite Creek	BLM	Y	N	NE	Dry hillside. Observed from a distance.
Granite Creek Prospect	BLM	Y	N	N	Dry.
Hansen	UNK	N	N	NE	Unable to locate.
Harris Creek Placer	MIX	Y	N	N	No impact.
Harris Creek Prospect	PRV	Y	N	N	No impact.
Heller Prospect Adit 1	BLM	Y	N	N	Dry. No impact.
Hill Top	PRV	Y	N	N	Dry. No impact.
Homestake and Blackrock	PRV	Y	N	NE	Dry. No impact.
Iron Occurrence	UNK	N	N	NE	Unable to locate.
Kearsarge	PRV	Y	N	NE	Active site.
Keynote	UNK	N	N	NE	Unable to locate.
Latest Out	PRV	Y	N	N	Small prospect pit.
Lawyer	PRV	Y	N	N	No impact.
Lucas	PRV	Y	N	NE	Observed from a distance. No impact.

Table 10.2 Summary of sites inventoried in the Ruby River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Mapleton	MIX	Y	N	N	Dry, caved workings.
Marietta ⁵	PRV	Y	Y	N	Adit discharge.
Mountain Chief	PRV	Y	N	N	Dry. No impact.
Nash Group	BLM	Y	N	N	Adit secured with locked gate.
Native Silver	UNK	N	N	NE	Unable to locate.
Nellie Bly	PRV	Y	N	NE	Observed from a distance. No impact.
Old Toledo	PRV	Y	N	Y	3 open shafts and extensive dumps. Collapsed adit with discharge on private land.
Ore Cache	MIX	Y	N	N	Dry, caved workings.
Pacific	PRV	Y	Y	Y	See Easton-Pacific.
Pearl Group	PRV	Y	N	N	Dry. Small prospects.
Pearson Prospect	BLM	Y	N	Y	Partially caved shaft. Dry.
Prospect	PRV	Y	N	NE	No impact.
Riddel	BLM	Y	N	N	Dry. Small prospects.
Rosebud	BLM	Y	N	N	Dry, secured adit. No impact.
Ruby Silver	UNK	N	N	NE	Unable to locate.
Silver Bell	PRV	Y	N	NE	Dry, reclaimed site.
St. John Group	PRV	Y	N	NE	No impact.
St. Lawrence Consolidated	PRV	Y	N	N	Reclaimed. No impact.
U S Grant	PRV	N	N	NE	Active site.
Union	BLM	Y	N	N	Two gated adits and a grated shaft. Dry.
Unnamed 03S05W34 Deposit	UNK	N	N	NE	Unable to locate.

Table 10.2 Summary of sites inventoried in the Ruby River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Unnamed 04S04W33	BLM	Y	N	N	Same as Nash Group. Adit secured with locking gate.
Unnamed 04S05W01ABAD	PRV	Y	N	N	No impact.
Unnamed 04S05W01ACCB	PRV	Y	N	N	No impact.
Unnamed 06S03W30ACDA	PRV	Y	N	N	No impact.
Unnamed 06S04W32AABD	PRV	N	N	NE	Screened out in office.
Unnamed 06S03W31ACAA	PRV	N	N	NE	Screened out in office.
Unnamed 06S03W31ACCC	PRV	Y	N	N	Dry. No impact.
Unnamed 06S03W32CCDD	PRV	Y	N	N	Dry. No impact.
Unnamed 07S03W15ACAD	PRV	Y	N	N	Dry. No impact.
Unnamed 07S03W13CBAA	BLM	N	N	NE	Screened out in office.
Unnamed 07S03W13CABA	PRV	Y	N	N	Dry. No impact.
Unnamed 07S03W15DCCB	BLM	Y	N	N	Dry. No impact.
Unnamed Feldspar	UNK	Y	N	NE	Visited MILS location, but unable to locate.
Unnamed Gold Deposit	PRV	Y	N	N	Collapsed adit and numerous prospect pits.
Unnamed Sec 16	STA	Y	N	N	Dry. No impact.
Virginia City Talc Occurrence	PRV	N	N	NE	Active site?
Walker	MIX	Y	N	Y	Two gated adits and other mine openings. Dry.

Table 10.2 Summary of sites inventoried in the Ruby River drainage (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
White Talc	PRV	Y	N	N	Dry. No impact.
Winnetka Trust	PRV	Y	N	NE	No impact.

1) Mines in **bold** may pose environmental problems and are discussed in the text; others are included only in appendix II (all mines) and appendix III (sites visited).

2) Administration/Ownership Designation

BLM: Bureau of Land Management

PRV: Private

MIX: Mixed (BLM and private)

STA: State of Montana

UNK: Owner unknown

3) Solid and/or water samples

4) Y: Physical safety hazards exist at the site.

NE: Physical safety hazards were not evaluated.

5) Mill site present

10.5 BARTLETT MINE

10.5.1 Site Location and Access

The Bartlett mine is on private property but surrounded by BLM-administered land (T7S R3W Sec 14 ABDB). The site is accessible via an unimproved road that turns off of the Alder Gulch Road and follows Greybacke Gulch.

10.5.2 Site History - Geologic Features

About 2,200 feet of drifts, crosscuts, raises, and winzes follow gold-silver mineralization in Archean metamorphic rocks. Two adits--an upper and lower--strike northwest. Quartz and minor pyrite with some secondary copper minerals in waste-dump material. A dilapidated building and an ore bin are still standing at the lower adit.

10.5.3 Environmental Condition

Both adits at the the Bartlett mine have caved; water discharges from the lower adit. Although the two waste-rock dumps are mostly unvegetated, they are not visibly impacting BLM-administered land. Because the adits and waste-rock dumps are on private property, a map was not prepared.

10.5.3.1 Site Features - Sample Locations

A water sample was collected from the adit discharge (GBLS10L). Water samples from Greybacke Gulch upstream (GBLS20L) and downstream (GBLS30L) from its confluence with the adit discharge were also collected. The flow rate of the adit discharge was about 15 gpm, and downstream from its confluence with the adit discharge, Greybacke Gulch was flowing at about 45 gpm (flow measurements made on August 15, 1995).

10.5.3.2 Soil

Soil samples were not collected because soils that may be impacted from stormwater runoff from the waste-rock dumps are on private property. BLM-administered land is not being impacted by the stormwater runoff.



Figure 10.2 The discharge from the lower caved adit at the Bartlett mine flows into a grassy boggy area.



Figure 10.3 An ore bin at the Bartlett mine next to a waste-rock dump. Note the vegetation growing on top and at the bottom edge of the dump.

10.5.3.3 Water

None of the water samples collected exceeded any of the water-quality standards.

Table 10.3 Water-quality exceedances at the Bartlett mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Greybacke Gulch - upstream of site (GBLS20L)																			
Adit discharge (GBLS10L)																			
Greybacke Gulch - downstream of site (GBLS30L)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

10.5.3.4 Vegetation

The vegetation outside the disturbed area is unstressed. The discharge from the adit has created a wetlands that supports a lush growth of grass.

10.5.3.5 Summary of Environmental Condition

Water quality in Greybacke Gulch is not adversely affected by the discharge from the site. Vegetation outside of the disturbed area is unimpacted from mining activities.

10.5.4 Structures

The remains of a dilapidated building and a structurally sound ore bin are located near the lower adit. These two features are visible from BLM-administered land.

10.5.5 Safety

Because all of the mining impacts are on private property, the safety of this site was not evaluated.

10.6 EASTON-PACIFIC MINE

10.6.1 Site Location and Access

The Easton-Pacific mine complex is located about five miles southwest of Virginia City, Montana at the head of Browns Gulch (T7S R3W Sec 9, 10, and 15). The privately owned mining complex is bordered by BLM-administered land.

10.6.2 Site History - Geologic Features

Very extensive workings are located at the top of the Browns Gulch drainage and an unnamed tributary to Browns Gulch. Many small workings are concealed in the timber and are easy to miss. Over twenty adits are located around the site. A few are partially open. Four adits in the bottom of Browns Gulch had discharges. There are several areas of large surface workings, apparently from open-pit mining. Numerous exploration/mining roads have been cut. The mine develops a quartz vein in Archean rocks. Some authors feel that the mine is on the contact between Cretaceous intrusive rocks and Archean rocks. Others feel that there are no intrusive rocks present, although there is evidence of material that closely resembles Butte quartz monzonite in the area. There also may be a migmatite in this location. A sample collected from the site (MAEAS-1) assayed 0.021 opt Au and 73.6 ppm Ag.

10.6.3 Environmental Condition

Discharges from numerous adits on the mining property flow into Browns Gulch. Waste-rock dumps are associated with the adits, shafts, and open pits, and are mostly unvegetated. Because the site is on private property, a site map was not constructed.

10.6.3.1 Site Features - Sample Locations

A water sample from Browns Gulch was collected downstream of the mining complex on BLM-administered land (BEPS10L). Soil samples were not collected because soils on BLM-administered land were not visibly impacted.

10.6.3.2 Soil

Because material from the waste-rock dumps did not appear to be impacting BLM-administered land, soil samples were not collected.



Figure 10.4 Pacific Pit near the head of Browns Gulch.

10.6.3.3 Water

Water-quality standards in Browns Gulch were not exceeded.

Table 10.4 Water-quality exceedances at the Easton-Pacific mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Browns Gulch - downstream of site (BEPS10L)																			

Exceedance codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

10.6.3.4 Vegetation

Vegetation on BLM-administered land is not adversely impacted by the mining complex.

10.6.3.5 Summary of Environmental Condition

Water flowing onto BLM-administered land does not exceed any water-quality standards. Waste material from the mining complex is not washing onto or adversely impacting soils on BLM-administered land.

10.6.4 Structures

The mining complex is on private property; therefore, structures were not inventoried.

10.6.5 Safety

The mining complex is on private property; therefore, the safety of the site was not determined.

10.7 MARIETTA MINE

10.7.1 Site Location and Access

The Marietta mine is located about ten miles east of the Ruby Reservoir and about six miles south of Virginia City (T7S R3W Sec 10 CCAA). The site is accessible via a well-maintained road. The privately owned site is bordered by BLM-administered land.

10.7.2 Site History - Geologic Features

Small underground mine reported to explore a continuation of the mineralization found in the Easton-Pacific mine to the north. The mine has a large mill building with no equipment. The mill looks out of proportion to the small apparent production from this site. Pyrite and galena can be found in the quartz vein material left in the ore bins at the mill. Several small caved adits at the site are collared in Archean rocks. Some dump material looks like intrusive granitic rock. Two assay samples were collected from this site. One sample was collected from a small dump south of the main dump and had the following values: 0.090 opt Au and 48.2 ppm Ag. The second sample was taken from material in the ore bin of the mill and contained these values: 0.089 opt Au, 71.6 opt Ag, 2,140 ppm Pb, and 4,460 ppm Zn.

10.7.3 Environmental Condition

A caved adit, waste-rock dump, and mill are present at the site. Water from the caved adit flows into Barton Gulch. Mill tailings were not observed at the site nor along the stream side of Barton Gulch.

10.7.3.1 Site Features - Sample Locations

Water samples were collected from Barton Gulch upstream (BMAS10L) and downstream (BSAS20L) from the site at the BLM/private property borders. A sample of the adit discharge was not collected because it only flows on private property. Soil on BLM-administered land was not observed to be impacted by waste from the mine and was therefore not sampled.



Figure 10.5 Delapidated mine buildings and a waste-rock dump at the Marrietta mine.

10.7.3.2 Soil

Soil on BLM-administered land was not observed to be impacted by waste from the mine.

10.7.3.3 Water

Water-quality standards in Barton Gulch upstream and downstream of the site were not exceeded.

Table 10.5 Water-quality exceedances at the Marietta mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Barton Gulch - upstream of site (BMAS10L)																			
Barton Gulch - downstream of site (BSAS20L)																			

Exceedance codes:

- P - Primary MCL
- S - Secondary MCL
- A - Aquatic Life Acute
- C - Aquatic Life Chronic

Note: Analytical results are listed in appendix V.

10.7.3.4 Vegetation

Vegetation on BLM-administered land is not adversely impacted by the mining.

10.7.3.5 Summary of Environmental Condition

Water flowing onto BLM-administered land does not exceed any water quality standards. Waste material from the mining complex are not washing onto or adversely impacting soils on BLM-administered land.

10.7.4 Structures

The mine site is on private property; therefore, structures were not inventoried.

10.7.5 Safety

The mine is on private property; therefore, safety of the site was not determined.

10.8 SUMMARY OF MINING IMPACTS ON BLM LAND - RUBY RIVER DRAINAGE

The Bartlett, Easton-Pacific, and Marietta are the only sites identified in the Ruby drainage that have potential environmental impacts on BLM-administered land. Water-quality samples collected upstream and downstream of the sites indicated no adverse impacts.

Ten of the 82 inventoried sites were found to have one or more safety concerns. Nine sites had one or more hazardous mine openings; one site, the Agitator Concentrator had a hazardous structure. Four of the sites with safety hazards are on or immediately adjacent to BLM-administered land (table 10.2).

OTHER MINE AND MILL SITES INVENTORIED IN MONTANA

11.1 SUMMARY OF OTHER SITES

In addition to the mines and mills inventoried in southwestern Montana, the MBMG investigated 108 sites in the central and eastern portion of the state (see table 11.1). Of these sites, nine could not be located and the remainder were found to have no adverse environmental impacts on BLM-administered land.

Six of the 106 sites were found to have hazardous mine openings. Of these six sites, five are on or immediately adjacent to BLM-administered land. It should be noted that hazards may exist at many of the other sites, but they may not have been observed during the brief site visits.

Table 11.1 Summary of sites inventoried in central and eastern Montana. Site name in **bold** indicates potential environmental problems. "Y" in hazard column indicates physical safety concern.

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Abby	PRV	N	N	NE	Screened out in office.
Accident	PRV	Y	N	NE	Dry. No impact.
Alabama	PRV	N	N	NE	Active mine.
Alder	BLM	Y	N	NE	Dry. No impact.
Allen Silver Claims	BLM	N	N	NE	Screened out in office.
Alpine Gulch Placer	BLM	N	N	NE	Screened out in office.
Antone Peak	PRV	N	N	NE	Active mine.
Armells Creek Placer	PRV	N	N	NE	No impact.
Armells Producer Claim	PRV	Y	N	NE	Dry. No impact.
August	PRV	N	N	NE	Active mine.
Badger King	PRV	N	N	NE	Active mine.
Barnes-King	PRV	N	N	NE	Active mine.
Beaver	BLM	Y	N	NE	Adit discharge. Under active permit.
Big Chicago	MIX	Y	N	NE	Observed from a distance. No impact.
Big Grassy Group	PRV	Y	N	NE	Dry. No impact.
Black Diamond	BLM	Y	N	NE	Dry prospect.
Black Hawk	BLM	Y	N	NE	Dry. No impact.
Blue Butte	UNK	N	N	NE	No access through private land.
Blue Goose	PRV	Y	N	N	Dry, caved workings.
Blue Rock Placer	BLM	Y	N	NE	No impact.
Butcher Knife	BLM	Y	N	NE	Dry. No impact.
Cape Nome	PRV	Y	N	NE	Adit discharge. Impact on BLM unlikely.
Cave	BLM	Y	N	NE	Dry. No impact.

Table 11.1 Summary of sites inventoried in central and eastern Montana (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Clara May and Ella	PRV	N	N	NE	Screened out in office.
Clarks Fork Placer	UNK	N	N	NE	Unable to locate using MILS coordinates.
Collar	MIX	Y	N	NE	Dry, open cut. Caved workings.
C.R. Kendall	PRV	N	N	NE	Active mine.
Cumberland	PRV	Y	N	Y	Open stope. Dry. No impact.
Dandy (The)	BLM	Y	N	Y	Three open adits. Dry.
Depression	BLM	Y	N	NE	Dry. No impact.
East Pryor	BLM	Y	N	N	Partially reclaimed. Dry.
Florence	BLM	Y	N	NE	Dry, caved workings.
Gies	PRV	Y	N	N	Secured adit. Dry.
Gilt Edge	PRV	Y	N	NE	Active mine.
Globe	PRV	Y	N	NE	Dry. No impact.
Gold Bug	PRV	N	N	NE	Active mine.
Golden and Dawes Lode Claims	PRV	N	N	NE	Screened out in office.
Golden Armells and Armells Bonanza	PRV	N	N	NE	No potential for impact on BLM land.
Golden and Dawes Lode Claims	PRV	N	N	NE	Screened out in office.
Golden Discovery	PRV	N	N	NE	Active permit.
Golden Jack	MIX	Y	N	Y	Open adits. Dry. No impact.
Goodwin	BLM	Y	N	NE	Dry. No impact.
Great Falls and Judith Property	MIX	Y	N	NE	Dry. No impact.
H & H	PRV	N	N	NE	Active permit.

Table 11.1 Summary of sites inventoried in central and eastern Montana (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Hamilton Copper Prospect	BLM	Y	N	NE	Dry. No impact.
Hamilton Copper Queen Group	BLM	Y	N	NE	Dry. No impact.
Hardscramble	MIX	Y	N	NE	Dry. No impact.
Hawkeye	MIX	N	N	NE	Active permit.
Horseshoe and Muleshoe	PRV	N	N	NE	Active permit.
Independent	BLM	N	N	NE	Active mine.
Iron Chancellor	MIX	Y	N	NE	Dry. No impact.
Jack Deuce	PRV	N	N	NE	Active mine.
Justice	PRV	N	N	NE	No potential for impact on BLM land.
Kendall Deposit	PRV	N	N	NE	Active permit.
Landusky Operation	PRV	N	N	NE	Active mine.
Last Chance	PRV	Y	N	NE	Dry, caved adits.
Lead Chief and Lead Chief No. 2	PRV	N	N	NE	Screened out in office.
Linda Kay	PRV	N	N	NE	Active mine.
Linster	PRV	Y	N	NE	Viewed from a distance. No potential impact on BLM.
Little Ben	PRV	N	N	NE	Active mine.
Little Rockies Mining Co.	PRV	N	N	NE	Active mine.
Lucky Strike	PRV	Y	N	NE	Viewed from a distance. No potential impact.
Maginnis	PRV	Y	N	NE	Active mine.
Maiden Creek Placer	BLM	Y	N	NE	No impact.
Mammoth	PRV	N	N	NE	No potential for impact.

Table 11.1 Summary of sites inventoried in central and eastern Montana (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Marie	BLM	Y	N	Y	Open adit. Dry.
Matthews	PRV	N	N	NE	No impact.
Montago	MIX	Y	N	NE	Same as Collar. No impact.
Mount Clair	MIX	Y	N	Y	Open adits. Possible seasonal adit discharge.
Mydranda Claim	BLM	Y	N	NE	Dry. No impact.
New Year	PRV	N	N	NE	Screened out.
North Moccasin	PRV	N	N	NE	Screened out.
North Moccasin Project	PRV	N	N	NE	Screened out.
Northern Pacific	PRV	Y	N	NE	Dry. No impact.
P.K. Mine	PRV	Y	N	NE	Same as Globe. No impact.
Peerless Claim	MIX	Y	N	NE	Dry. No impact.
Pilgrim Prospect	BLM	Y	N	NE	Dry. No impact.
Pinkeye	PRV	N	N	NE	Active mine.
Ruby Creek Placer	PRV	N	N	NE	Active mine.
Ruby Gulch	PRV	N	N	NE	Active mine.
S & P Mining	MIX	Y	N	NE	Dry. No impact.
Santiago	PRV	N	N	NE	Active permit.
She	PRV	Y	N	NE	No impact.
Sheep Mountain	PRV	Y	N	NE	Dry. No impact.
Silver Bullion	PRV	Y	N	NE	Active mine.
Slag Dump	PRV	Y	N	NE	No potential for impact.
Spotted Horse	PRV	Y	N	NE	Active mine.
Sunset Claims	UNK	N	N	NE	Unable to locate using MILS coordinates.

Table 11.1 Summary of sites inventoried in central and eastern Montana (continued).

SITE ¹	OWNER ²	VISIT	SAMPLE ³	HAZARD ⁴	REMARKS
Surprise	PRV	N	N	NE	Active mine.
Sutter	BLM	Y	N	NE	Dry. No impact.
Swamp Frog	BLM	Y	N	Y	At least 2 open adits.
Tail Holt	BLM	Y	N	NE	Adit discharge. Active site at time of visit.
Thomas Claims	PRV	Y	N	NE	Reclaimed.
Unnamed Gold	UNK	N	N	NE	Unable to locate using MILS coordinates.
Unnamed 09S28E07CBBC	BLM	Y	N	N	Fenced open shaft (10' deep). Dry.
Unnamed Uranium (1)	UNK	N	N	NE	Unable to locate using MILS coordinates.
Unnamed Uranium (2)	UNK	N	N	NE	Unable to locate using MILS coordinates.
Unnamed Uranium (3)	UNK	N	N	NE	Unable to locate using MILS coordinates.
Unnamed Uranium (4)	UNK	N	N	NE	Unable to locate using MILS coordinates.
Unnamed Vanadium	UNK	N	N	NE	Unable to locate using MILS coordinates.
Voltaire	PRV	Y	N	NE	Dry. Reclaimed site.
War Eagle	PRV	N	N	NE	Active mine.
West Armell's Creek	MIX	Y	N	NE	Dry. No impact.
Western Mines Corp.	BLM	N	N	NE	Screened out in office.
White & Gilpatrick Claims	PRV	Y	N	NE	Dry. No impact.
White Elephant	PRV	Y	N	NE	No impact.

Table 11.1 Summary of sites inventoried in central and eastern Montana (continued).

SITE¹	OWNER²	VISIT	SAMPLE³	HAZARD⁴	REMARKS
Windmill No. 3	UNK	N	N	NE	Unable to locate using MILS coordinates.
Wocasek	BLM	N	N	NE	Screened out in office.

1) Mines in **bold** may pose environmental problems and are discussed in the text; others are included only in appendix II (all mines) and appendix III (sites visited).

2) Administration/Ownership Designation

BLM: Bureau of Land Management

PRV: Private

MIX: Mixed (BLM and private)

STA: State of Montana

UNK: Owner unknown

3) Solid and/or water samples

4) Y: Physical safety hazards exist at the site.

NE: Physical safety hazards were not evaluated.

5) Mill site present

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APPENDIX I

ABANDONED/INACTIVE MINES PROGRAM
FIELD FORM

PART A

(to be completed for all identified sites)

LOCATION AND IDENTIFICATION

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ID# _____ Site Name(s) _____
District _____ Resource Area _____
Location based on: GPS _____ Field Map _____ Existing Info _____ Other _____
Lat _____ Long _____ xutm _____ yutm _____ zutm _____
Quad Name _____ Principal Meridian _____
Township _____ Range _____ Section _____ 1/4 _____ 1/4 _____ 1/4 _____
State _____ County _____ Mining District _____

Ownership of all disturbances:

- _____ BLM
_____ Mixed private and BLM, or unknown
_____ Private

If private only, impacts on BLM land from the site are:

_____ Visually apparent _____ Likely to be significant _____ Unlikely or minimal

If all disturbances are private and impacts to BLM Resources are unlikely or minimal, STOP HERE.

PART B

(To be completed for all sites on or likely affecting BLM lands)

SCREENING CRITERIA

- | Yes | No | |
|-------|-------|--|
| _____ | _____ | 1. Mill site or tailings present |
| _____ | _____ | 2. Adits with discharge or evidence of a discharge |
| _____ | _____ | 3. Evidence of or strong likelihood for metal leaching or AMD (iron stains, stressed or lack of vegetation, waste below water table, etc.) |
| _____ | _____ | 4. Mine waste in floodplain or shows signs of water erosion |
| _____ | _____ | 5. Residences, high public use area, or environmentally sensitive area (as listed in HRS) within 200 feet of site. |
| _____ | _____ | 6. Hazardous wastes/materials (chemical containers, explosives, etc) |
| _____ | _____ | 7. Open adits/shafts, highwalls, or hazardous structures/debris |
| _____ | _____ | 8. Site visit |
- If yes, provide name of visitor and date of visit:
_____ Date _____
- If no, list sources of information:

If the answers to questions 1 through 6 are all NO, STOP HERE



BUREAU OF LAND MANAGEMENT

ABANDONED/INACTIVE MINE LAND INVENTORY FIELD CHECKLIST

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A. SITE IDENTIFICATION

ID Number: _____

Site/Mine Name: _____ Primary Commodity: _____

B. LOCATION DATA

USGS Quad: _____ LAT: _____ LONG: _____ OR

UTM Coord: _____ N _____ E Zone _____ AND

Township: _____ Range: _____ Section: _____ Subdivision: _____

Meridian: _____ County: _____

Surface: BLM _____ / Non-BLM _____ Mineral Estate: BLM _____ / Non-BLM _____

C. ACCESS

Visible from: Nearest road _____ / Trail _____ / Population center _____

Access by: 2wd _____ / 4wd _____ / Hike _____ / Other _____

Access disturbance in need of reclamation: Length _____ / Width _____ / Acres _____

Road Log: _____

Recent human use: _____ Describe: _____

D. SITE DESCRIPTION

Acreage: _____ Elevation: _____

General slope (degrees): 0-10 _____ / 11-35 _____ / >35 _____

Floodplain: Disturbance in _____ / Adjacent to _____ / NA _____

Recent mineral activity _____ Describe: _____

E. MINING/EXPLORATION FEATURES (Provide numbers of features)

Open adits _____ / Closed adits _____ / Open inclines _____ / Closed inclines _____

Open shafts _____ / Closed shafts _____ / Stopes _____

Other openings _____ Type _____

Trenches _____ Length _____ / Prospects _____ / Open drill holes _____

Pits >30 ft. deep _____ / Pits <30 ft. deep _____ / Pit highwall length _____

Waste dumps: <0.1 ac _____ / 0.1 - 5 ac _____ / >5 ac _____

Tailings: <0.1 ac _____ / 0.1 - 5 ac _____ / >5 ac _____

Heaps _____ / Dredge _____

Ponds _____ / Dams _____

Mills _____ Type _____

Explosives _____ Describe: _____

Equipment/Machinery _____ / Headframes _____ / Trestles/tramways _____

Powerlines _____

Structures _____ Type _____

Condition: Good _____ / Fair _____ / Poor _____ / Number Locked _____

Homesites _____

Other: _____

(03/95)

F. ENVIRONMENTAL FEATURES

VEGETATION

Vegetation: Healthy _____ / Stressed _____ / Dead _____ / Nonexistent _____

Evidence of natural revegetation: _____ / Describe: _____

ANIMALS

Evidence: _____ / Presence: _____ / Describe: _____

GEOLOGY

Staining of soils _____ Describe: _____

Sulfide minerals _____ Type(s): _____

Tailings: Confined _____ / Unconfined _____ / Unknown _____

HYDROLOGY

	pH	Conductivity	Flow (GPM)	Sketch #
Water flowing from workings: _____	_____	_____	_____	_____
Standing water in workings: _____	_____	_____	_____	_____
Water through/over tailings: _____	_____	_____	_____	_____
waste rock: _____	_____	_____	_____	_____
ore: _____	_____	_____	_____	_____

Adjacent water sources:	Type	pH	Conductivity	Flow (GPM)	Distance
Ground water: _____	_____	_____	_____	_____	_____
Surface water: _____	_____	_____	_____	_____	_____
Surface H2O above site: _____	_____	_____	_____	_____	_____
Surface H2O below site: _____	_____	_____	_____	_____	_____

Evidence of aquatic life: _____ Location: _____ Describe: _____

Water bed color: White _____ / Yellow _____ / Yellow-Orange _____ / Orange _____
Brown _____ / Green _____ / Grey-Black _____ / Other _____

Samples collected: _____ Sketch #(s): _____

G. POTENTIAL HAZARDOUS MATERIALS (Provide numbers of features)

Chemical piles or spills _____ / Acid or Chemical odor _____ / Asbestos _____
Petrochemical Products _____ / Dump sites _____
Power Substations _____ / Transformers _____Barrels, Tanks, Containers _____ Leaking: _____ Contents: _____
Evidence of Underground Storage Tanks: _____ Describe: _____Other: _____

(03/95)

H. RECLAMATION

SITE CONDITIONS

Erosion : Rills _____ / Gullies _____ / Sheetwash _____
 Unstable Rock _____ / Slope instability _____ / Wind erosion _____

MITIGATION STATUS

None _____ / Fencing _____ / Signs _____ / Safety hazards mitigated _____
 Other: _____

Mitigation condition: Good _____ / Fair _____ / Poor _____

Site ID tags : _____ / Locations: _____

OPTIONAL: Identify the critical reclamation measures needed :

_____ Cable nets, grates	_____ Topsoil, soil amendments
_____ Permanent seal	_____ Revegetation
_____ Gates	_____ Stabilize/destroy structures
_____ Backfill openings, pit	_____ Drainage control
_____ Recontour	_____ Water treatment
_____ Fences	_____ Wildlife closure
_____ Warning signs	_____ No action
_____ Plug open drill holes	_____ Trash / clean up
_____ Other: _____	

I. SITE SKETCH

Show orientation, approximate scale, access route, adjacent drainages, and locations of features on attached sketch map. Use the feature symbols provided in the map legend on page 6.

J. GLOBAL POSITIONING SYSTEM DATA _____

K. PHOTOGRAPHS

Number of photographs taken: _____

L. ACTION

Site requires immediate investigation _____ by: Law Enforcement _____ / BLM _____
 HAZMAT _____ / Other _____

Reason: _____

BLM AML INVENTORY FIELD CHECKLIST

ID Number: _____

M. FEATURES - PROVIDE DIMENSIONS IN FEET.

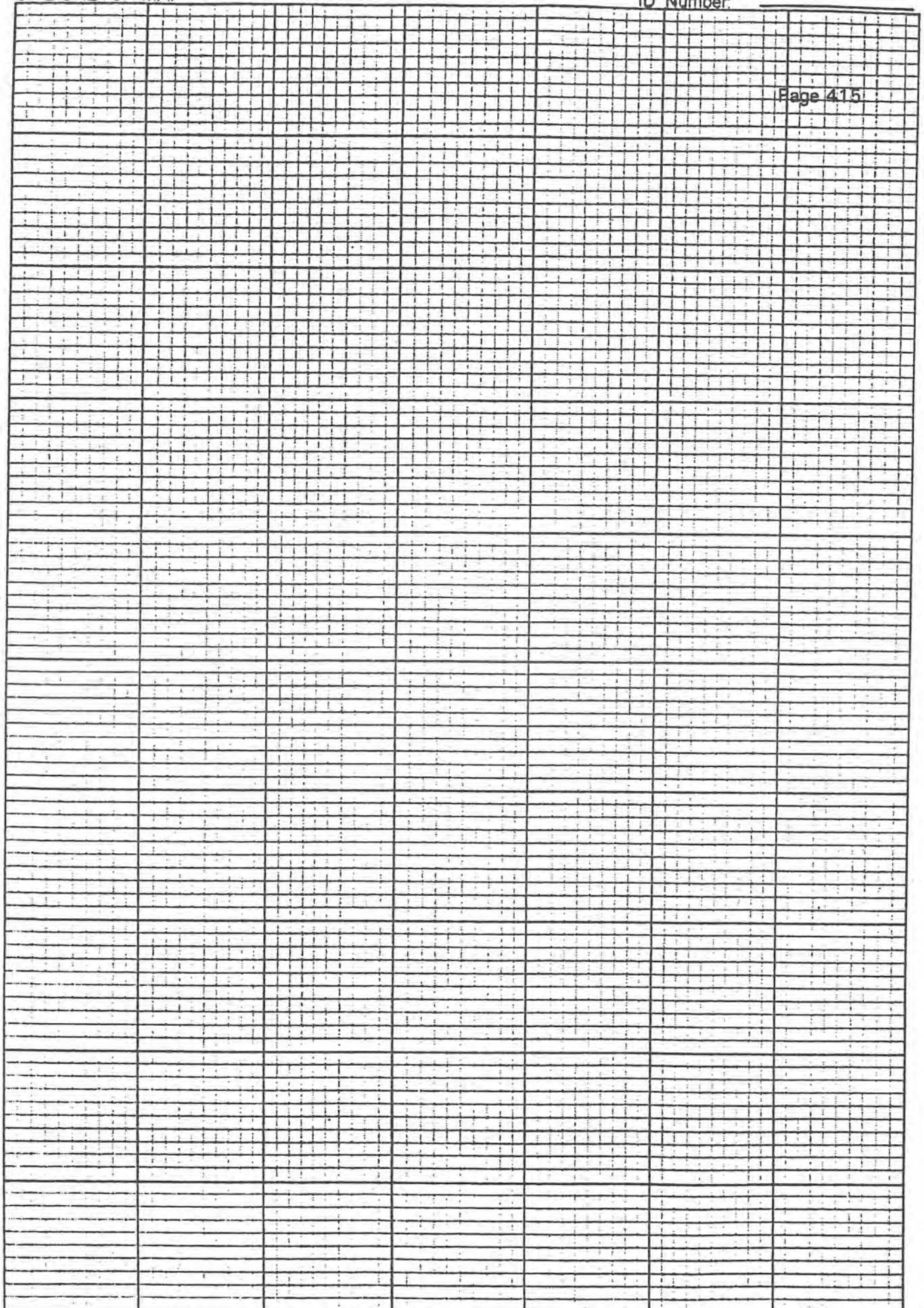
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Feature	Length	Width	Height or Depth	Mitigation

Field Notes:

INSPECTED BY: _____ TITLE: _____ DATE: _____
 INSPECTED BY: _____ TITLE: _____ DATE: _____

(03/95)



ID Number: _____

Fill out the following for each photo:

[illegible]

APPENDIX II

ABANDONED/INACTIVE MINE SITES
INVENTORIED FOR THE
MBMG-BLM AIM PROGRAM

ID	Site Name	Drainage	Quadrangle	ID	Site Name	Drainage	Quadrangle
SB006532	300930170 UNNAMED LOCATION	BIG HOLE	WICKIUP CREEK	FE007116	BLACK DIAMOND	OTHER	JUDITH PEAK
FE001053	ABBY MINE	OTHER	KENDALL	MA003155	BLACK EAGLE	RUBY	RUBY DAM
FE001413	ACCIDENT	OTHER	JUDITH PEAK	BW006247	BLACK FRIDAY	MISSOURI	RADERSBURG
MI005747	ADALINE	BLACKFOOT	MINERAL RIDGE	FE001041	BLACK HAWK	OTHER	NEW YEAR
LC001315	ADAMS MINE	MISSOURI	WOLF CREEK	JF006857	BLACK JACK MINE	MISSOURI	JEFFERSON CITY
MA003120	AGITATOR CONCENTRATOR	RUBY	COPPER MOUNTAIN	BE000402	BLACK ROCK NO 1	BEAVERHEAD	LEMHI PASS
BE000139	AGNES LODGE	BEAVERHEAD	POLARIS	BW004238	BLACKSMITH	MISSOURI	GIANT HILL
LC001321	AJAX MINE	BIG HOLE	SCRATCHGRAVEL HILL	MI005595	BLACKTAIL (LINTON)	CLARK FORK	MINERAL RIDGE
MA003832	AJAX MINE	MISSOURI	NEZ PERCE HOLLOW	MA005980	BLOWOUT MINE	BIG HOLE	WICKIUP CREEK
PH002989	ALABAMA	OTHER	ZORTMAN	PO005180	BLUE BIRD	BLACKFOOT	WILD HORSE PARKS
GR000848	ALABAMA MINE	BLACKFOOT	ELEVATION MOUNTAIN	WB001340	BLUE BUTTE	OTHER	PARSON CREEK
MI005499	ALADDIN	CLARK FORK	CLINTON	BE004270	BLUE DOT MINE	BEAVERHEAD	BANNACK
MA007247	ALAMEDA AND BAMBOO CHIEF	RUBY	VIRGINIA CITY	FE001047	BLUE GOOSE	OTHER	LEWIS PEAK
PH002824	ALDER MINE	OTHER	ZORTMAN	MA005994	BLUE GROUSE MINE	JEFFERSON	WHITEHALL
JF006753	ALICE MINE	MISSOURI	WICKES	LC004289	BLUE JAY MINE	MISSOURI	AUSTIN
FE001455	ALLEN SILVER CLAIMS	OTHER	NEW YEAR	MI005671	BLUE LODGE	CLARK FORK	CLINTON
FE007227	ALPINE GULCH PLACER	OTHER	NEW YEAR	GR003561	BLUE MOON MINE	CLARK FORK	ELEVATION MOUNTAIN
JF005482	ALTA MINE	MISSOURI	WICKES	MA003892	BLUE ROCK AND MAY BASKET	JEFFERSON	MALTBYS MOUND
BE000328	AMARANTH MINE	BEAVERHEAD	ARGENTA	PH002884	BLUE ROCK PLACER	OTHER	ZORTMAN
JF006808	AMAZON PROSPECT	BOULDER	MOUNT THOMPSON	BE004090	BLUE WING	BEAVERHEAD	BANNACK
MA000835	AMERICAN CHEMET MINE	BEAVERHEAD	CHRISTENSEN RAHCH	BE000209	BLUE WING DISTRICT PLACER	BEAVERHEAD	BANNACK
LC001339	AMERICAN FLAG MINE (EMPIRE MINE)	MISSOURI	CANYON CREEK	BW006098	BLUEBIRD (1)	MISSOURI	RADERSBURG
MA003448	AMERICAN PIT	JEFFERSON	SILVER STAR	BW004126	BLUEBIRD (2) MINE	MISSOURI	GIANT HILL
BE000749	ANACONDA MINE	BEAVERHEAD	ARGENTA	LC007292	BLUEBIRD COPPER AND SILVER	MISSOURI	SCRATCHGRAVEL HILL
PO002486	ANDERSON MINE / BROCK / WARM SPRINGS	CLARK FORK	WINDY ROCK	BW006619	BLUEBIRD GROUP	MISSOURI	GIANT HILL
BE004245	ANITA MINE	BEAVERHEAD	ARGENTA	MA003750	BOAZ MINE	MADISON	NORRIS
MA000973	ANTLER MINE	JEFFERSON	SILVER STAR	BE004280	BOAZ MINE	BEAVERHEAD	ARGENTA
PH002886	ANTONE PEAK	OTHER	ZORTMAN	JF005458	BOB INGERSOLL	BOULDER	WICKES
SB006380	ANTONIOLI'S QUARRY	BIG HOLE	TUCKER CREEK	GR000182	BOHRER MINE	CLARK FORK	LESTON RIDGE
MA007241	ANYTHING MINE	BIG HOLE	TWIN BRIDGES SW	BE004285	BON MINE	BEAVERHEAD	BANNACK
SB006440	APEX NO. 2 CLAIM	BIG HOLE	WICKIUP CREEK	LC007394	BONANZA CLAIM	MISSOURI	SCRATCHGRAVEL HILL
MA008199	APRIL CLAIMS	BIG HOLE	TWIN BRIDGES SW	MA003408	BONANZA FRACTION / IRON BLOSSOM	JEFFERSON	WHITEHALL
LC001351	ARIADENE CLAIM	MISSOURI	SCRATCHGRAVEL HILL	MI006003	BONITA	CLARK FORK	RAVENNA
JF005450	ARIADNE	MISSOURI	JEFFERSON CITY	BE004300	BONNIE GROUP	BEAVERHEAD	BANNACK
GR000746	ARKANSAS MINE	BLACKFOOT	ELEVATION MOUNTAIN	MA006914	BOSS TWEED AND CLIPPER	JEFFERSON	PONY
GR003484	ARMADA MINE	CLARK FORK	ELEVATION MOUNTAIN	PO004810	BOSTON MINE	BLACKFOOT	ELEVATION MOUNTAIN
FE007206	ARMELLS CREEK PLACER	OTHER	JUDITH PEAK	BW004611	BOULDER CREEK PLACER	MISSOURI	DIAMOND CITY
FE007131	ARMELLS PRODUCER CLAIM	OTHER	JUDITH PEAK	JF001961	BOULDER IRON	BOULDER	TACOMA PARK
BE000792	ARMSTEAD AREA DEPOSIT	BEAVERHEAD	GARFIELD CANYON	JF006673	BOULDER MINE	MISSOURI	WICKES
BE000521	ARTIC CLAIM	BEAVERHEAD	BANNACK	MA008073	BOWLER'S BLIND	JEFFERSON	WHITEHALL
JF006761	ATLAS MINE	MISSOURI	WICKES	MA003795	BOZEMAN MINE	JEFFERSON	PONY
PH002746	AUGUST MINE	OTHER	ZORTMAN	BE004305	BRENNER PLACER MINE / BRANNER	BEAVERHEAD	JEFF DAVIS PEAK
MA007238	AURORA	JEFFERSON	SILVER STAR	MA007037	BROADGAUGE-TAMARACK	RUBY	SHERIDAN
JF002049	AUSTRALIAN MINE	BOULDER	JEFFERSON CITY	MA007223	BROADWAY	JEFFERSON	SILVER STAR
JF008103	AUSTRALIAN WEST	BOULDER	MOUNT THOMPSON	PO002750	BROCK CREEK AREA	CLARK FORK	WINDY ROCK
PH002572	BADGER KING	BEAVERHEAD	ZORTMAN	PO002440	BROCK MINE (ANDERSON)	CLARK FORK	WINDY ROCK
BE000480	BADGER MINE	OTHER	ERMONT	BE000408	BROWN BEAR & FRYING PAN	BEAVERHEAD	LEMHI PASS
MA007088	BADGER NOS. 1&2	MADISON	NORRIS	SB001738	BROWN PROSPECT	BIG HOLE	MELROSE
GR003034	BAKER & SULLIVAN	CLARK FORK	ELEVATION MOUNTAIN	BE000389	BROWNELL MINE	BEAVERHEAD	ARGENTA
LC007361	BALD BUTTE MINE	CLARK FORK	GREENHORN MOUNTAIN	MA006845	BRYZANT MINE	JEFFERSON	OLD BALDY MOUNTAIN
LC004264	BALD MOUNTAIN MINE	MISSOURI	GREENHORN MOUNTAIN	JF005161	BUCKEYE	MISSOURI	WICKES
LC007367	BALDY SMITH MINE	MISSOURI	AUSTIN	MA003822	BUCKEYE	RUBY	SHERIDAN
BE000420	BALTC	BEAVERHEAD	EVERSON CREEK	BW003961	BUCKHORN MINE	MISSOURI	RADERSBURG SW
JF002181	BALTIMORE MINE	BOULDER	MOUNT THOMPSON	MA007220	BUFFALO	BIG HOLE	TWIN BRIDGES SW
BE000552	BANNACK MINES	BEAVERHEAD	BANNACK	PO004820	BUFFALO GULCH	BLACKFOOT	NEVADA LAKE
JF006729	BANNER MINE	MISSOURI	JEFFERSON CITY	MA006004	BULL MOOSE 2 MINE	MADISON	MALTBYS MOUND
BE000185	BANNOCK PLACER	BEAVERHEAD	ELI SPRING	MA003610	BULL MOOSE MINE	MADISON	MALTBYS MOUND
FE007128	BARNES-KING	OTHER	KENDALL	JF001127	BUNKER HILL	MISSOURI	WICKES
MA003483	BARTLETT MINES	RUBY	CIRQUE LAKE	FE007020	BUTCHER KNIFE MINE	OTHER	NEW YEAR
MA003390	BARTON GULCH EAST PLACERS	RUBY	CIRQUE LAKE	PO002870	BUTTERFLY	CLARK FORK	OPHIR CREEK
MA003435	BARTON GULCH WEST PLACERS	RUBY	RUBY DAM	BE000853	CABLE MINE AND MILL	BEAVERHEAD	POLARIS
MA005860	BATTEN BROTHERS MINE / BELL	RUBY	VIRGINIA CITY	JF008091	CADWELL RANCH	JEFFERSON	DRY MOUNTAIN
BE000737	BEA ANN CLAIM	BEAVERHEAD	BANNACK	MA000283	CALIFORNIA CREEK PLACER	RUBY	COPPER MOUNTAIN
MA007235	BEACON LIGHT	BIG HOLE	NEZ PERCE HOLLOW	LC007397	CALUMET MINE	MISSOURI	CANYON CREEK
GR003169	BEAR CREEK (1)	CLARK FORK	ELEVATION MOUNTAIN	MA003637	CALVIN MINE	BIG HOLE	WICKIUP CREEK
GR000152	BEAR CREEK (2)	CLARK FORK	BEARMOUTH	MA008062	CALVIN SOUTH MINE	BIG HOLE	WICKIUP CREEK
GR000146	BEARMOUTH PLACER MINE	CLARK FORK	BEARMOUTH	SB005540	CAMP CREEK MINE AND MILL	BIG HOLE	WICKIUP CREEK
PH002878	BEAVER MINE	OTHER	ZORTMAN	SB008058	CAMP CREEK PLACER	BIG HOLE	WICKIUP CREEK
MA004452	BEAVERHEAD MINE / SIERRA STRIP MINE	BEAVERHEAD	MINE GULCH	BE000520	CAMP FRIGID	BEAVERHEAD	UPPER RED ROCK LAKE
MA008299	BEDFORD	JEFFERSON	SILVER STAR	BE000990	CANYON CREEK PHOSPHATE MINE	BIG HOLE	CATTLE GULCH
LC007390	BELL BOY MINE	MISSOURI	GREENHORN MOUNTAIN	MI005467	CAPE NOME MINE	OTHER	CLINTON
BE004280	BELL RANCH CLAY PROSPECT	BEAVERHEAD	ARGENTA	JB005052	CAPE NOME MINE	CLARK FORK	BARKER
BE000137	BELLA MINE	BEAVERHEAD	ARGENTA	BE000695	CAPITOL CLAIM	BEAVERHEAD	POLARIS
MI006011	BELLVIEW	CLARK FORK	CLINTON	BE000174	CARBONATE MINE	BEAVERHEAD	ARGENTA
LC007391	BELMONT MINE	MISSOURI	GREENHORN MOUNTAIN	MA007217	CARPENTER	BIG HOLE	TWIN BRIDGES SW
MA000823	BENNETT OWEN CLAIM	BEAVERHEAD	MINE GULCH	GR003074	CASCADE MINE	CLARK FORK	ELEVATION MOUNTAIN
BE000983	BERLIN MINE	BIG HOLE	MELROSE	MI005483	CATO	BLACKFOOT	UNION PEAK
GR003591	BERT CREEK	CLARK FORK	LESTON RIDGE	FE001359	CAVE	OTHER	JUDITH PEAK
JF004758	BERTHA	MISSOURI	JEFFERSON CITY	BE004535	CEDAR CREEK	BEAVERHEAD	ELI SPRING
MA003613	BERTHA MINE	MADISON	EIGHTMILE CREEK	BE000822	CEDAR CREEK SYNCLINE	BEAVERHEAD	GARFIELD CANYON
MA003630	BETTY MAE	MADISON	NORRIS	BE000568	CENTENNIAL MOUNTAINS DISTRICT	BEAVERHEAD	UPPER RED ROCK LAKE
MA000499	BI-METALLIC / BIMETALLIC / BIMETALIC	JEFFERSON	MALTBYS MOUND	MA007214	CHAMPION	BLACKFOOT	MINERAL RIDGE
FE007122	BIG CHICAGO	OTHER	JUDITH PEAK	MI005579	CHARCOAL MINE	MISSOURI	SCRATCHGRAVEL HILL
JF005366	BIG CHIEF	MISSOURI	WICKES	LC001963	CHARLES D. GREENFIELD PROPERTY	BEAVERHEAD	BANNACK
FE007137	BIG GRASSY GROUP	OTHER	JUDITH PEAK	BE000527	CHARTER OAK MINE	BEAVERHEAD	SUNFLOWER MOUNTAIN
GR003096	BIG HORN CALCIUM QUARRY	CLARK FORK	ELEVATION MOUNTAIN	MI005591	CHESTER	CLARK FORK	MINERAL RIDGE
JF005155	BIG INDIAN	MISSOURI	HELENA	MI005495	CHLORIDE	BIG HOLE	WICKIUP CREEK
LC008162	BIG INDIAN MILL	MISSOURI	HELENA	SB008101	CHLORITE GULCH	BIG HOLE	MELROSE
JF006853	BIG JIM MINE	BOULDER	MOUNT THOMPSON	SB001426	CHRISTIANSEN GROUP	BIG HOLE	COPPER MOUNTAIN
JF006177	BIG LIMBER	BOULDER	MOUNT THOMPSON	MA006040	CHROMIUM OCCURRENCE	RUBY	SILVER STAR
LC004244	BIG OX	MISSOURI	CANYON CREEK	MA006971	CLANCY MINE	OTHER	JUDITH PEAK
LC004594	BIG SKY READY MIX SAND	CLARK FORK	GRIFFIN CREEK	FE001353	CLARA MAY AND ELLA	CLARK FORK	BEARMOUTH
JF004861	BIG TIMBER MINE	MISSOURI	WICKES	GR003651	CLARK FORK	CLARK FORK	MEDICINE TREE HILL
PO005105	BIG VIEW MINE	CLARK FORK	OPHIR CREEK	GR003164	CLARK FORK OF THE COLUMBIA RIVER	OTHER	HATCHER PASS
PO004790	BILK AND WEASEL GULCH	BLACKFOOT	ELEVATION MOUNTAIN	CB000093	CLARKS FORK PLACER	BLACKFOOT	UNION PEAK
BE008211	BILLINGS CREEK PLACER	BEAVERHEAD	POLARIS	MI005479	CLEMANTHA	BOULDER	MOUNT THOMPSON
MA003803	BILLY MINE	MADISON	MALTBYS MOUND	JF002187	CLEVELAND	JEFFERSON	SILVER STAR
MA003015	BIRDIA	MADISON	NORRIS	MA003453	CLIFFORD MINE	CLARK FORK	BONNER
JF008102	BISHOP CREEK	BOULDER	MOUNT THOMPSON	MI005599	CLINTON PIT	JEFFERSON	WICKIUP CREEK
JF002217	BISMARCK	BOULDER	MOUNT THOMPSON	SB001744	CLIPPER MINE	JEFFERSON	SILVER STAR
LC001075	BISSONETTE MINE (LIBERTY)	MISSOURI	SHEEP CREEK	MA006012	CLIPPER MINE	BIG HOLE	SILVER STAR
MA003510	BIVENS CREEK PLACER	RUBY	COPPER MOUNTAIN	FE001347	COLLAR	OTHER	JUDITH PEAK
MA003548	BIVENS CREEK PROSPECT	RUBY	COPPER MOUNTAIN	MI005707	COLOMA SARITE VEIN	BLACKFOOT	UNION PEAK
MA007253	BLACK ACE	RUBY	OLD BALDY MOUNTAIN	MI005723	COLOMA PLACER	BLACKFOOT	UNION PEAK

ID	Site Name	Drainage	Quadrangle	ID	Site Name	Drainage	Quadrangle
SB007598	COLUMBIA	BIG HOLE	WICKIUP CREEK	BE000695	FIREHOLE	BEAVERHEAD	POLARIS
LC001069	COME AGAIN AND CROWN GROUP	MISSOURI	SCRATCHGRAVEL HILL	BE0004595	FISHER MINE	BEAVERHEAD	ARGENTA
JF001475	COMET MINE	BOULDER	MOUNT THOMPSON	BE000659	FLEMING'S "HALLOYSITE" PROSPECT	BEAVERHEAD	ERMONT
JF005401	COMSTOCK	BOULDER	MOUNT THOMPSON	FE001443	FLORENCE	OTHER	JUDITH PEAK
BE0004045	COMSTOCK MINE	BEAVERHEAD	ERMONT	MA008988	FLORENCE MINE	MADISON	NORRIS
BW006415	CONFEDERATE GULCH	MISSOURI	DIAMOND CITY	BE004605	FLORIDA CLAIM	BEAVERHEAD	ARGENTA
BW006199	CONGRESS	MISSOURI	RADERSBURG	MA003794	FORK PROSPECT	RUBY	OLD BALDY MOUNTAIN
JF008087	CONTACT	JEFFERSON	DELMOE LAKE	MA007121	FORKS MINE	RUBY	VIRGINIA CITY
MA008166	COOK MINE	RUBY	ALDER	BE000492	FRACTION CLAIM	BEAVERHEAD	ARGENTA
MI002676	COOK PROSPECT	CLARK FORK	RAVENNA	JF006289	FRANCIS CLAIM	MISSOURI	WICKES
BE000114	COOLIDGE MINE	BEAVERHEAD	ARGENTA	BE008023	FRANCIS H.	BEAVERHEAD	BANNACK
PO002876	COONS TUNGSTEN	CLARK FORK	OPHIR CREEK	LC001057	FRANKLIN AND SAM GATY	MISSOURI	SCRATCHGRAVEL HILL
MA007211	COOPER	BIG HOLE	NEZ PERCE HOLLOW	JF004751	FREE COINAGE	MISSOURI	JEFFERSON CITY
BE000438	COPPER BELL	BEAVERHEAD	ARGENTA	JF004741	FREE ENTERPRISE MINE	BOULDER	MOUNT THOMPSON
MI005503	COPPER BELL	CLARK FORK	CLINTON	JF006233	FREEBURG MINE	BOULDER	MOUNT THOMPSON
MI006015	COPPER CLIFF MINE	BLACKFOOT	UNION PEAK	LC000991	FRENCH BAR PLACER	MISSOURI	WICKES
JF002133	COPPER GULCH	MISSOURI	WICKES	BE0004015	FRENCH LODGE MINE	MISSOURI	HAUSER LAKE
LC001933	COPPER HILL	MISSOURI	AUSTIN	MA007124	FRIDA MARIE CLAIM	BEAVERHEAD	BANNACK
SB001834	COPPER HILL (1)	BIG HOLE	MELROSE	MI002616	FROSTBITE DEPOSIT	JEFFERSON	SILVER STAR
SB006712	COPPER HILL (2)	BIG HOLE	WICKIUP CREEK	BE000191	FRYING PAN BASIN PLACER	BLACKFOOT	UNION PEAK
MI005583	COPPER KING	BLACKFOOT	POTOMAC	BE000810	FRYING PAN COMPLEX AREA	BEAVERHEAD	BOND
JF006209	COPPER KING PROSPECT	BOULDER	MOUNT THOMPSON	BE000310	G + G, G & G, G & G.	BEAVERHEAD	ARGENTA
BW004121	COPPER QUEEN MINE	MISSOURI	RADERSBURG	JF002763	G. WASHINGTON	BEAVERHEAD	LEMHI PASS
GR003824	COPPER STATE MINE	CLARK FORK	BLACK PINE RIDGE	BE000276	GALENA	MISSOURI	JEFFERSON CITY
MA007151	CORNUCOPIA AND CABIN LODGE	RUBY	VIRGINIA CITY	MA003650	GALENA	BEAVERHEAD	ARGENTA
MA008198	COST MANGANESE LODGE	RUBY	RUBY DAM	MA005552	GALENA MINE	JEFFERSON	MALTBYS MOUND
BE004555	COTTONTAIL GROUP	BEAVERHEAD	ELI SPRING	GR003838	GARNET	MADISON	SILVER STAR
FE001263	CR KENDALL	OTHER	KENDALL	MA006911	GARNET GOLD MINE	CLARK FORK	ELEVATION MOUNTAIN
MA006778	CRICKET MINE	JEFFERSON	SILVER STAR	MA005584	GARRISON PLACER	JEFFERSON	PONY
LC007403	CRUSE MINE	MISSOURI	GREENHORN MOUNTAIN	MA000805	GEM CLAIM	RUBY	CIRQUE LAKE
MI005451	CRYSTAL SPRINGS MINE	BLACKFOOT	UNION PEAK	LC007378	GENERAL HARRISON MINE	BEAVERHEAD	BEAVERHEAD ROCK SE
FE001341	CUMBERLAND	OTHER	JUDITH PEAK	MA003778	GENERAL SHAFTER MINE	MISSOURI	SCRATCHGRAVEL HILL
BW006603	CYCLONE	MISSOURI	RADERSBURG	MA005568	GERMANIA	RUBY	CIRQUE LAKE
JF005206	DAILEY COPPER MINE	MISSOURI	WICKES	FE001179	GIES MINE	BIG HOLE	TWIN BRIDGES SW
MI005751	DAISY	BLACKFOOT	MINERAL RIDGE	FE001005	GILT EDGE	OTHER	JUDITH PEAK
GR003679	DANDY MINE	BLACKFOOT	ELEVATION MOUNTAIN	PO005380	GIMLET MINE	OTHER	JUDITH PEAK
JF002121	DAVID COPPERFIELD	MISSOURI	WICKES	FE001113	GLOBE	CLARK FORK	GRAVELY MOUNTAIN
BE0004030	DAVIS SYNDICATE / BON ACCORD	BEAVERHEAD	BANNACK	JF005178	GOLCONDA	OTHER	JUDITH PEAK
BE000533	DEL MONTE MINE	BEAVERHEAD	BANNACK	JF008108	GOLCONDA CREEK (1)	MISSOURI	WICKES
PO004645	DENVER MINE	CLARK FORK	OPHIR CREEK	JF005152	GOLCONDA CREEK (2)	MISSOURI	WICKES
FE001335	DEPRESSION	OTHER	JUDITH PEAK	JF008081	GOLCONDA/RELIANCE MINE	BOULDER	ELKHORN
BW003981	DEWDROP GROUP	MISSOURI	RADERSBURG	PH008212	GOLD BUG	OTHER	MOUNT THOMPSON
GR003069	DEWEY MINE	CLARK FORK	ELEVATION MOUNTAIN	BE000589	GOLD BUG & BLUE GRASS CLAIMS	BEAVERHEAD	ZORTMAN
BE000318	DEXTER MINE	BEAVERHEAD	ARGENTA	BW006379	GOLD BUG & MARY ROSE MINE	BEAVERHEAD	BANNACK
BW006387	DIAMOND HILL	MISSOURI	GIANT HILL	BE004290	GOLD DAY	MISSOURI	GIANT HILL
MA008016	DIAMOND HILL ADIT 1	RUBY	OLD BALDY MOUNTAIN	MA008072	GOLD HILL MINES	JEFFERSON	ARGENTA
MA003398	DICK AND BILLY JANE	BIG HOLE	NEZ PERCE HOLLOW	MA003403	GOLD KING (1)	BEAVERHEAD	WHITEHALL
BE000671	DILLON MINE	BEAVERHEAD	POLARIS	SB006652	GOLD KING (2)	BIG HOLE	NEZ PERCE HOLLOW
BE000085	DIVIDE NOS. 1 & 2 CLAIMS	BEAVERHEAD	GARFIELD CANYON	GR003054	GOLD LEAF MINE	BIG HOLE	ELEVATION MOUNTAIN
MA007079	DIVIDEND LODGE MINE	JEFFERSON	PONY	MA007229	GOLD NUGGET MINE	BIG HOLE	TWIN BRIDGES SW
MI005447	DIXIE	BLACKFOOT	UNION PEAK	MA000943	GOLD SEAL CLAIMS	BIG HOLE	TWIN BRIDGES SW
BW004076	DONALD DEE	MISSOURI	RADERSBURG	FE007107	GOLDEN AND DAWES LODGE CLAIMS	OTHER	SPRING CREEK JCT
PO005420	DOUGLAS CREEK BASIN BENTONITE	BLACKFOOT	CHIMNEY LAKES	PO004705	GOLDEN ANGEL MINE	BLACKFOOT	ELEVATION MOUNTAIN
LC007400	DRUMHELLER MINE	MISSOURI	SCRATCHGRAVEL HILL	FE007104	GOLDEN ARMELLS AND ARMELLS BONANZA	OTHER	JUDITH PEAK
LC001969	DRUMMUMMON MINE	MISSOURI	GREENHORN MOUNTAIN	LC007389	GOLDEN CROWN	MISSOURI	SCRATCHGRAVEL HILL
GR003686	DRUMMOND QUARRY	CLARK FORK	DRUMMOND	FE007101	GOLDEN DISCOVERY	OTHER	KENDALL
GR003596	DRY & WET MULKEY GULCHES	CLARK FORK	BEARMOUTH	BE004430	GOLDEN GATE MINING CO	BEAVERHEAD	ERMONT
JF008135	DRY CREEK	JEFFERSON	DRY MOUNTAIN	FE001017	GOLDEN JACK	OTHER	LEWIS PEAK
MA008875	DULLEA ADIT 1	RUBY	OLD BALDY MOUNTAIN	BE000563	GOLDEN LEAF MINE/SLEEPING PRINCESS	BEAVERHEAD	BANNACK
GR007839	DURAND	CLARK FORK	MAXVILLE	MA005578	GOLDEN LINK	JEFFERSON	MALTBYS MOUND
BE000677	DURHAM BULL	BEAVERHEAD	POLARIS	MA005578	GOLDEN ROD	JEFFERSON	SILVER STAR
BE000203	DYER CREEK PLACER	BEAVERHEAD	POLARIS	JF005148	GOLDEN SUNLIGHT	JEFFERSON	BLACK BUTTE
MA008136	EAL'S MINE	BIG HOLE	EARLS GULCH	JF001781	GOLDEN VALLEY / MINNIE WILSON	JEFFERSON	DELMOE LAKE
JF008225	EAST MINT MINE	MISSOURI	WICKES	BE000204	GOLDSMITH MINE	BEAVERHEAD	ARGENTA
CB000147	EAST PRYOR MINES	OTHER	MYSTERY CAVE	JF005510	GOOD HOPE PROSPECT	MISSOURI	WICKES
SB006148	EAST SOAP GULCH IRON DEPOSIT	BIG HOLE	WICKIUP CREEK	BE000210	GOODVIEW MINE	BEAVERHEAD	ERMONT
JF008229	EASTER LILY / EASTER LILLY	JEFFERSON	DRY MOUNTAIN	FE007098	GOODWIN	OTHER	JUDITH PEAK
MA007115	EASTON-PACIFIC MINE	RUBY	CIRQUE LAKE	BW006227	GOPHER	MISSOURI	RADERSBURG
JF005221	ECONOMY	MISSOURI	EAST HELENA	BE000641	GOWRIE	BEAVERHEAD	ARGENTA
MA003987	EDWARD SCHEITLIN GOLD MILL	RUBY	VIRGINIA CITY	MI005739	GRANDFATHER	BLACKFOOT	CLINTON
GR003681	EDWARDS GULCH	CLARK FORK	DRUMMOND	MA003153	GRANDVIEW PROSPECT	MISSOURI	WICKES
LC007428	EL DORADO BAR / ELDORADO BAR	RUBY	HAUSER LAKE	LC008138	GRANITE CREEK	RUBY	COPPER MOUNTAIN
MA008977	EL FLEEDA MINE	MISSOURI	VIRGINIA CITY	MA000787	GRANITE CREEK MINE / LAWYER	MISSOURI	AUSTIN
MA005540	ELGIN MINE	BIG HOLE	TWIN BRIDGES SW	MA000961	GRANITE CREEK PROSPECT (S)	RUBY	VIRGINIA CITY
LC007406	ELIZABETH MINE	MISSOURI	SCRATCHGRAVEL HILL	GR003064	GRANT AND HARTFORD	RUBY	VIRGINIA CITY
GR000242	ELK CREEK AND TRIBUTARIES (1)	BLACKFOOT	ELEVATION MOUNTAIN	BE000218	GRASS HOPPER CLAIMS NO. 1	CLARK FORK	ELEVATION MOUNTAIN
PO004660	ELK CREEK AND TRIBUTARIES (2)	BLACKFOOT	ELEVATION MOUNTAIN	MI005759	GRASS WIDOW	BEAVERHEAD	BANNACK
MI005535	ELK CREEK BARITE DEPOSIT	BLACKFOOT	GREENOUGH	BE000980	GRASSHOPPER CREEK OCCURRENCE	BEAVERHEAD	DALYS
MI005727	ELK CREEK PLACER	BLACKFOOT	GREENOUGH	BE000078	GRASSHOPPER PLACER	BEAVERHEAD	BANNACK
LC007407	ELLA MINE	MISSOURI	SCRATCHGRAVEL HILL	BE004310	GRASSHOPPER PLACER, NO. 1 AND NO. 2	BEAVERHEAD	BANNACK
GR000188	ELMO PLACER	CLARK FORK	ELEVATION MOUNTAIN	LC007429	GRASSHOPPER PROSPECT	MISSOURI	HAUSER LAKE
BE008019	ELSIE	BEAVERHEAD	POLARIS	PO005115	GRAVEL BAR / METROPOLITAN BAR	CLARK FORK	GRAVELY MOUNTAIN
MA003827	EMMA	BIG HOLE	NEZ PERCE HOLLOW	JF005041	GRAY EAGLE	BOULDER	MOUNT THOMPSON
JF006237	EMMA MAY MINE	MISSOURI	WICKES	BE000017	GRAY GOOSE CLAIMS	BEAVERHEAD	DEER CANYON
SB001414	EMMA NEVADA	BIG HOLE	MELROSE	BE000300	GRAYBIRD	BEAVERHEAD	ARGENTA
SB008104	EMMA NEVADA II	BIG HOLE	MELROSE	FE001385	GREAT FALLS AND JUDITH PROPERTY	OTHER	JUDITH PEAK
MA003620	EMPEROR	MADISON	MALTBYS MOUND	MA004002	GREEN CAMPBELL MINE AND MILL	JEFFERSON	SILVER STAR
LC001081	EMPIRE MILL	MISSOURI	CANYON CREEK	MI005703	GREENOUGH MINE / ELK CREEK BARITE	BLACKFOOT	BATA MOUNTAIN
BW004296	ERICKSON-1, 2, 3 MINE	MISSOURI	GIANT HILL	JF005421	GREGORY	MISSOURI	JEFFERSON CITY
BE000264	ERMONT GROUP	BEAVERHEAD	ERMONT	JF008139	GREGORY MILL TAILINGS	MISSOURI	JEFFERSON CITY
BE0008053	ERMONT MILL TAILINGS	BEAVERHEAD	ERMONT	SB008160	GREY LOCK	BIG HOLE	MELROSE
BE004590	ERMONT NO. 19 MINE	BEAVERHEAD	ERMONT	SB008107	GREY LOCK WEST	BIG HOLE	MELROSE
BE004585	ERMONT NO. 2 MINE	BEAVERHEAD	ERMONT	BE000701	GRIZZLY BEAR	BEAVERHEAD	POLARIS
MA008105	EUREKA	BIG HOLE	WICKIUP CREEK	BE000222	GROUND HOG MINE	BEAVERHEAD	ERMONT
PO004930	EUREKA GULCH PLACER MINES	CLARK FORK	OPHIR CREEK	MA002995	GRUBSTAKE	MADISON	NORRIS
MI005675	EUREKA MINING CO.	CLARK FORK	CLINTON	BE004315	GULCH PLACER	BEAVERHEAD	BANNACK
BE000743	EXCELSIOR MINE	BEAVERHEAD	BANNACK	FE007085	H & H	OTHER	KENDALL
GR003019	FAIRVIEW (1) MINE	BOULDER	ELEVATION MOUNTAIN	BE000912	H & S MINE, HOFFMAN & STEELE	BEAVERHEAD	JEFF DAVIS PEAK
PO005090	FAIRVIEW (2) MINE	CLARK FORK	OPHIR CREEK	PO004680	HALF-WAY SIXMILE CREEK BENTONITE	CLARK FORK	GRAVELY MOUNTAIN
JF002547	FAIRVIEW MINE	CLARK FORK	MOUNT THOMPSON	FE001215	HAMILTON COPPER PROSPECT	OTHER	JUDITH PEAK
BE008017	FAITHFUL	BEAVERHEAD	POLARIS	FE001227	HAMILTON COPPER QUEEN GROUP	OTHER	JUDITH PEAK
MA006800	FALCON PROSPECT	RUBY	OLD BALDY MOUNTAIN				
BE000676	FARLIN CREEK	BEAVERHEAD	POLARIS				
BE000198	FERDINAND MINE	BEAVERHEAD	ARGENTA				

ID	Site Name	Drainage	Quadrangle	ID	Site Name	Drainage	Quadrangle
BE000306	HAND (MAULDIN) MINE	BEAVERHEAD	ARGENTA	JF004781	KING SOLOMON	MISSOURI	JEFFERSON CITY
MA003043	HANSEN	RUBY	ALDER	BE000812	KISSICK CREEK PROPERTY	BEAVERHEAD	GARFIELD CANYON
GR003029	HAPARANDA	BLACKFOOT	ELEVATION MOUNTAIN	MI005543	KLONDIKE	CLARK FORK	CLINTON
BW005223	HARD CASH	MISSOURI	RADERSBURG	PH002812	LANDUSKY OPERATION	OTHER	ZORTMAN
FE007092	HARDSCRAMBLE	OTHER	JUDITH PEAK	GR000098	LANNEN PLACER	CLARK FORK	BEARMOUTH
MA003500	HARRIS CREEK PLACER	RUBY	COPPER MOUNTAIN	FE001275	LAST CHANCE	OTHER	JUDITH PEAK
MA003823	HARRIS CREEK PROSPECT	RUBY	COPPER MOUNTAIN	JF008408	LAST CHANCE (1)	MISSOURI	LOUISVILLE
PO004710	HARTFORD MINE	BLACKFOOT	ELEVATION MOUNTAIN	BW004558	LAST CHANCE (2) PROSPECT	MISSOURI	GIANT HILL
PH002530	HAWKEYE	OTHER	ZORTMAN	MA005880	LAST CHANCE TAILINGS	MISSOURI	GIANT HILL
SB007875	HELEHAN PROSPECT	BIG HOLE	DEWEY	MA005880	LATEST OUT MINE	RUBY	COPPER MOUNTAIN
JF002145	HELENA-JEFFERSON	MISSOURI	WICKES	BE004415	LAURILENE NO. 1 CLAIM	BEAVERHEAD	BANNACK
MA003838	HELENE MINE	MADISON	NORRIS	MA005458	LAWYER / GRANITE CREEK	RUBY	VIRGINIA CITY
MA001810	HELL'S CANYON PLACER	JEFFERSON	SILVER STAR	FE001419	LEAD CHIEF AND LEAD CHIEF NO. 2	OTHER	SPRING CREEK JCT
MA009880	HELLER PROSPECT ADIT 1	RUBY	OLD BALDY MOUNTAIN	GR003059	LEAD KING (1) MINE AND MILL	CLARK FORK	ELEVATION MOUNTAIN
LC007313	HEMATITE IRON MINE	MISSOURI	SCRATCHGRAVEL HILL	MI002682	LEAD KING (2) MINE	BLACKFOOT	MINERAL RIDGE
BE000509	HENDRICKS / GRAETER / APEX	BEAVERHEAD	BANNACK	MA003115	LEAD QUEEN	JEFFERSON	OLD BALDY MOUNTAIN
BE000874	HENNEBERRY RIDGE SYNCLINE	BEAVERHEAD	ELI SPRING	BE004485	LEAH MAY MINE	BEAVERHEAD	ARGENTA
LC004479	HERB W	MISSOURI	SCRATCHGRAVEL HILL	GR000104	LEHSOU MINE	CLARK FORK	ELEVATION MOUNTAIN
LC007314	HERWOOD	MISSOURI	ROBERTS MOUNTAIN	GR003411	LENORE & MYRNA CLAIMS	CLARK FORK	WILD HORSE PARKS
GR000038	HERZER AND GREEN PROPERTY	BLACKFOOT	ELEVATION MOUNTAIN	MI005559	LEONARD	BLACKFOOT	UNION PEAK
JF002703	HIAWATHA	BOULDER	MOUNT THOMPSON	BE004490	LEONIE TUNNEL PROSPECT	BEAVERHEAD	BANNACK
SB008057	HIDDEN MINE	BIG HOLE	WICKIUP CREEK	PO005410	LEPRECHAUN PLACER	CLARK FORK	OPHIR CREEK
BE004445	HIDDEN PASTURE CREEK	BEAVERHEAD	DIXON MOUNTAIN	LC001177	LEXINGTON MINE	MISSOURI	SCRATCHGRAVEL HILL
MI005547	HIDDEN TREASURE MINE	CLARK FORK	CLINTON	GR000782	LIMESTONE OCCURRENCE (1)	CLARK FORK	DRUMMOND
MA007127	HIDDEN TREASURE MINE	BIG HOLE	NEZ PERCE HOLLOW	GR000850	LIMESTONE OCCURRENCE (2)	CLARK FORK	LIMESTONE RIDGE
GR005737	HIDDEN TUNNEL MINE	CLARK FORK	MEDICINE TREE HILL	GR003659	LIMESTONE QUARRY	CLARK FORK	LIMESTONE RIDGE
BE000840	HIGH LINE	BEAVERHEAD	JEFF DAVIS PEAK	PH002710	LINDA KAY MINE	OTHER	ZORTMAN
JF002709	HIGH ORE	BOULDER	MOUNT THOMPSON	FE001011	LINSTER	OTHER	LEWIS PEAK
MA007130	HILL TOP MINE	RUBY	CIRQUE LAKE	LC007348	LION MINE	MISSOURI	SCRATCHGRAVEL HILL
BE004060	HILLSIDE PLACER MINE/THOMPSON MINE	BEAVERHEAD	BANNACK	PH002548	LITTLE BEN	OTHER	ZORTMAN
GR003681	HITCHCOCK QUARRY	CLARK FORK	DRUMMOND	JF005186	LITTLE ALTA	MISSOURI	WICKES
MI005507	HOB0	CLARK FORK	CLINTON	SB001000	LITTLE BUTTE ORE MINE	BIG HOLE	WICKIUP CREEK
MA003875	HOMESTAKE AND BLACKROCK	RUBY	VIRGINIA CITY	BW004481	LITTLE FANNIE MINE	MISSOURI	GIANT HILL
PO002968	HOOPER CREEK	CLARK FORK	BAILEY MOUNTAIN	BW000789	LITTLE GIANT MINE & MILL	MISSOURI	RADERSBURG
JF003276	HOPE AND BULLION MINE	BOULDER	MOUNT THOMPSON	BE008020	LITTLE HAWK MILL	BEAVERHEAD	POLARIS
BE004450	HOPE PLACER	BEAVERHEAD	BANNACK	BE000756	LITTLE HAWK MINE	BEAVERHEAD	POLARIS
LC007375	HOPEFUL MINE	MISSOURI	SCRATCHGRAVEL HILL	JF001307	LITTLE NELL	MISSOURI	JEFFERSON CITY
SB006672	HORN SILVER MINE	BEAVERHEAD	WICKIUP CREEK	LC001453	LITTLE OX	MISSOURI	CANYON CREEK
BE000126	HORN SILVER MINE	BIG HOLE	ARGENTA	PH002788	LITTLE ROCKIES MINING CO	OTHER	ZORTMAN
FE007083	HORSESHOE AND MULESHOE	MISSOURI	NEW YEAR	BE000514	LITTLE WATER CANYON	BEAVERHEAD	DIXON MOUNTAIN
JF002355	HORSESHOE CLAIM	OTHER	JEFFERSON CITY	BE004185	LIVELY	BEAVERHEAD	JEFF DAVIS PEAK
MA003415	HOT SPRINGS PLACER	MADISON	NORRIS	BE004500	LOGAN MINE	BEAVERHEAD	BANNACK
LC007377	HUTTON MINE	MISSOURI	SHEEP CREEK	PO004980	LOIS MINE	CLARK FORK	GRIFFIN CREEK
BW004021	HUMPHREY PLACER	MISSOURI	GIANT HILL	GR003348	LONDONDIERRY	CLARK FORK	MAXVILLE
BE000132	HURON	BEAVERHEAD	BANNACK	MA003790	LONE WOLF	JEFFERSON	PONY
JF002715	IDA	BOULDER	WILLOW SPRINGS	BE004505	LONE WOLF MINE	BEAVERHEAD	ERMONT
GR000058	IDAHO MINE	BLACKFOOT	ELEVATION MOUNTAIN	MA007208	LONGFELLOW MINE	BIG HOLE	NEZ PERCE HOLLOW
JF006181	INDEPENDENCE MINE	BOULDER	MOUNT THOMPSON	BW004428	LOOKOUT	BEAVERHEAD	GIANT HILL
GR000002	INDEPENDENCE PROSPECT	CLARK FORK	ELEVATION MOUNTAIN	BE004515	LOOKOUT MINE	MISSOURI	BANNACK
BW004546	INDEPENDENT	MISSOURI	GIANT HILL	BE000023	LOOKOUT NO. 3 CLAIM	BEAVERHEAD	GARFIELD CANYON
PH002908	INDEPENDENT	OTHER	ZORTMAN	BE004510	LOOKOUT NO. 1 CLAIM	BEAVERHEAD	GARFIELD CANYON
MA007087	INDEX MINE	BIG HOLE	NEZ PERCE HOLLOW	BE008209	LOST CLOUD (DISTRICT)	BEAVERHEAD	POLARIS
BW004536	INDIAN CREEK	MISSOURI	GIANT HILL	LC007411	LOST HORSE CREEK	MISSOURI	CANYON CREEK
BE000234	INGERSOL GROUP	BEAVERHEAD	ERMONT	BE004520	LOUMONT CLAIMS	BEAVERHEAD	ARGENTA
BE000545	INGERSOL MINE	BANNACK	BANNACK	BW008242	LOWER INDIAN CREEK	MISSOURI	GIANT HILL
GR000086	INTERNATIONAL	CLARK FORK	ELEVATION MOUNTAIN	PO005365	LOWER LUKE MINE	CLARK FORK	LUKE MOUNTAIN
BE000809	IOLA PROSPECT	BEAVERHEAD	CABOOSE CANYON	SB001408	LOWER PANDORA MINE	BIG HOLE	WICKIUP CREEK
LC007353	IRON (1)	MISSOURI	SCRATCHGRAVEL HILL	SB008110	LOWER SOAP GULCH PLACER	BIG HOLE	MELROSE
BW003811	IRON (2) MINE	MISSOURI	DEVILS FENCE	GR003284	LOWERY MINE	CLARK FORK	ELEVATION MOUNTAIN
JF006357	IRON (3) MINE	MISSOURI	DEVILS FENCE	MA003290	LUCAS	RUBY	CIRQUE LAKE
BW006255	IRON AGE	MISSOURI	RADERSBURG	GR000116	LUCKY BOY PROSPECT	CLARK FORK	MEDICINE TREE HILL
BE004040	IRON AGE CLAIM	BEAVERHEAD	BANNACK	FE001449	LUCKY STRIKE	BIG HOLE	LEWIS PEAK
FE001389	IRON CHANCELLOR MINE	OTHER	JUDITH PEAK	SB008424	LUCKY STRIKE MINE	OTHER	WICKIUP CREEK
BW008755	IRON CROSS MINE	MISSOURI	RADERSBURG	GR002974	LYNX MINE	CLARK FORK	ELEVATION MOUNTAIN
MA004497	IRON KING	JEFFERSON	WHITEHALL	LC007356	M AND L MINE	MISSOURI	CANYON CREEK
BW004541	IRON MASK	MISSOURI	GIANT HILL	FE001023	MAGINNIS MINE	OTHER	JUDITH PEAK
BE000551	IRON MASK MINE	BEAVERHEAD	BANNACK	GR003048	MAGNIE & ANDERSON MINE	CLARK FORK	ELEVATION MOUNTAIN
BE000251	IRON MOUNTAIN MINE	BEAVERHEAD	ARGENTA	LC004248	MAGPIE GROUP	MISSOURI	SCRATCHGRAVEL HILL
MA005808	IRON OCCURRENCE	RUBY	OLD BALDY MOUNTAIN	SB008113	MAHOGANY	BIG HOLE	MELROSE
MA007084	IRON ROD MINE	JEFFERSON	SILVER STAR	BE000221	MAIDEN CREEK PLACER	BEAVERHEAD	DEADMAN PASS
JF002373	J & F #1	BOULDER	WILLOW SPRINGS	FE007224	MAIDEN CREEK PLACER	OTHER	JUDITH PEAK
PH002482	JACK DEUCE	OTHER	ZORTMAN	SB001174	MAIDEN ROCK MINE	BIG HOLE	MELROSE
MI005763	JACK POT	CLARK FORK	CLINTON	BE008816	MAIDEN ROCK SILICA	BIG HOLE	MELROSE
BE000312	JACK RABBIT MINE	BEAVERHEAD	ARGENTA	BW006131	MAINE-SULLIVAN	MISSOURI	WINSTON
GR000074	JACKIE MARIE MINE	CLARK FORK	ELEVATION MOUNTAIN	FE001281	MAMMOTH	OTHER	JUDITH PEAK
MA003842	JACKRABBIT MINE	BIG HOLE	WICKIUP CREEK	MA008058	MAMMOTH ADIT	JEFFERSON	TWIN BRIDGES
BE000539	JEANETTE CLAIM	BEAVERHEAD	BANNACK	MA003972	MAMMOTH AND STELLA MINES	JEFFERSON	SILVER STAR
BW006283	JEBRO	MISSOURI	RADERSBURG	MI005475	MAMMOTH MINE	BLACKFOOT	UNION PEAK
BE000215	JEFF DAVIS GULCH	BEAVERHEAD	JEFF DAVIS PEAK	JF004961	MANTLE	BOULDER	MOUNT THOMPSON
MI006023	JENLO MINES	BLACKFOOT	MINERAL RIDGE	MA003165	MAPLETON MINE	RUBY	VIRGINIA CITY
PO002738	JENS AREA	CLARK FORK	LIMESTONE RIDGE	PO004980	MARCUM HILL MINES / MILLER MINE	BLACKFOOT	MARCUM MOUNTAIN
BW008763	JO DANDY MINE	MISSOURI	RADERSBURG	CB000021	MARIE MINE	OTHER	RED PRYOR MOUNTAIN
BW006287	JO JO	MISSOURI	RADERSBURG	MA008144	MARIETTA	RUBY	CIRQUE LAKE
BE004470	JOKER MINE	BEAVERHEAD	ARGENTA	JF002751	MARY TAIT	MISSOURI	JEFFERSON CITY
MA003825	JOSEPHINE	MADISON	NORRIS	GR000392	MASCULINE MINE	BLACKFOOT	ELEVATION MOUNTAIN
MI002562	JOYCE NUMBER TWO	BLACKFOOT	GREENOUGH	JF006297	MATSON GROUP	MISSOURI	WICKES
BE000588	JUDY QUARTZ	BEAVERHEAD	GRAPHITE MOUNTAIN	FE001029	MATTHEWS	OTHER	JUDITH PEAK
BW004586	JUMBO	MISSOURI	RADERSBURG	BE000883	MAYFLOWER	BEAVERHEAD	POLARIS
BE008284	JUNCTION	BEAVERHEAD	BANNACK	MA003565	MCCARTNEY CREEK PLACER	BIG HOLE	NEZ PERCE HOLLOW
BE000428	JUNG FRAU	BEAVERHEAD	COYOTE CREEK	MI005699	MCQUARRIE QUARRY	CLARK FORK	BONNER
FE001269	JUSTICE	OTHER	JUDITH PEAK	BE000018	MIDNIGHT MINE	BEAVERHEAD	ERMONT
BW006231	KANOKA	MISSOURI	RADERSBURG	JF004881	MIDWAY	MISSOURI	JEFFERSON CITY
SB008080	KASERMAN PLACER	BIG HOLE	WICKIUP CREEK	PO008312	MINERAL HILL	BLACKFOOT	MARCUM MOUNTAIN
PO008029	KATIE ALLEN	CLARK FORK	OPHIR CREEK	JF002769	MINERAL HILL	MISSOURI	JEFFERSON CITY
MA007232	KEARSARGE MINE	RUBY	CIRQUE LAKE	JF002489	MINNEAPOLIS MINE	BOULDER	MOUNT THOMPSON
BW006147	KEATING	MISSOURI	RADERSBURG	JF008048	MINNEAPOLIS PLACER & PROSPECT	BOULDER	MOUNT THOMPSON
FE007161	KENDALL DEPOSIT	OTHER	KENDALL	JF005431	MINNESOTA	MISSOURI	JEFFERSON CITY
MI002502	KENNEBECK	CLARK FORK	CLINTON	JF001769	MINNIE WILSON	JEFFERSON	DRY MOUNTAIN
MA003355	KENNET	MADISON	VIRGINIA CITY	BE000707	MISS GRUNDY / GRUNDY	BEAVERHEAD	POLARIS
BE000672	KENT MINE	BEAVERHEAD	BANNACK	MI002526	MISSOULA LIMESTONE	BLACKFOOT	UNION PEAK
MA003330	KEYNOTE	RUBY	OLD BALDY MOUNTAIN	BE003945	MISSOURI PROSPECT/ BOX X	BEAVERHEAD	BANNACK
MA008944	KEYSTONE	JEFFERSON	SILVER STAR	GR005757	MITCHELL COPPER MINE	CLARK FORK	MEDICINE TREE HILL
JF002667	KING COLE	BOULDER	MOUNT THOMPSON	PO005010	MITCHELL PROSPECT	CLARK FORK	OPHIR CREEK
MA005572	KING SHAFT	JEFFERSON	TWIN BRIDGES	MA005516	MOHAWK MINE	JEFFERSON	SILVER STAR

ID	Site Name	Drainage	Quadrangle	ID	Site Name	Drainage	Quadrangle
MA003010	MOHICAN	MADISON	NORRIS	BE000011	PEGMATITE ON MONTANA STATE LAND	BEAVERHEAD	GARFIELD CANYON
JF005126	MOLLY MCGREGOR MINE AND MILL	BOULDER	MOUNT THOMPSON	LC004354	PENOBSCOT MINE	CLARK FORK	GREENHORN MOUNTAIN
MI005463	MONGAR MINE	BLACKFOOT	MINERAL RIDGE	BE000016	PETERSON FLAT SYNCLINE	BEAVERHEAD	ELI SPRING
BE004355	MONIDA CLAIMS	BEAVERHEAD	EVERSON CREEK	MA005740	PICARD	BIG HOLE	TABLE MOUNTAIN
BE000227	MONIDA PLACER	BOULDER	MONIDA	JF001637	PIE ORE	MISSOURI	WICKES
JF002813	MONO	OTHER	WICKES	LC007420	PIEGAN GULCH	MISSOURI	CANYON CREEK
FE007110	MONTAGO MINE	BLACKFOOT	JUDITH PEAK	LC008167	PIEGAN-GLOSTER MINE AND MILL	MISSOURI	CANYON CREEK
MI002706	MONTANA BARITE	MADISON	GREENOUGH	LC008307	PIEGAN-GLOSTER TAILINGS	MISSOURI	CANYON CREEK
MA003635	MONTANA BOY	JEFFERSON	NORRIS	FE001437	PILGRIM PROSPECT	OTHER	JUDITH PEAK
JF002799	MONTANA TUNNELS MINE	MISSOURI	MOUNT THOMPSON	JF004928	PILOT	BOULDER	WICKES
JF002727	MONTE CHRISTO	BIG HOLE	JEFFERSON CITY	PH002860	PINKEYE	OTHER	ZORTMAN
MA005528	MONTE CLARK MINE	BEAVERHEAD	NEZ PERCE HOLLOW	BE003995	PIONEER MINE	BEAVERHEAD	BANNACK
BE000432	MONUMENT	MISSOURI	COYOTE CREEK	JF005096	PIPESTONE QUARRY	JEFFERSON	DRY MOUNTAIN
LC007434	MOONLIGHT MINE	MISSOURI	SCRATCHGRAVEL HILL	MA005824	PLAINVIEW	JEFFERSON	OLD BALDY MOUNTAIN
LC007436	MORNING STAR MINE	MISSOURI	SCRATCHGRAVEL HILL	BW000549	POE LEAD MINE	MISSOURI	RADERSBURG
GR003676	MORRIS CREEK	CLARK FORK	LIMESTONE RIDGE	BE004000	POLAR BEAR MINE	BEAVERHEAD	ARGENTA
MI005471	MORSE & KENNEDY MINE	BLACKFOOT	BATA MOUNTAIN	BE000684	POLARIS MINE	BEAVERHEAD	POLARIS
FE001221	MOUNT CLAIR	OTHER	LEWIS PEAK	MA003393	POLLY JANE GROUP	BIG HOLE	EARLS GULCH
BW003861	MOUNT SHASTA	MISSOURI	RADERSBURG	BE000557	POMEROY MINE	BEAVERHEAD	BANNACK
MA003618	MOUNTAIN CHIEF	RUBY	VIRGINIA CITY	JF001843	PORTAL MINE	MISSOURI	WICKES
MA003060	MOUNTAIN CLIFF	JEFFERSON	PONY	GR000476	POWERS PLACER MINE	BLACKFOOT	ELEVATION MOUNTAIN
GR003731	MOUNTAIN GROUP	CLARK FORK	ELEVATION MOUNTAIN	LC004359	PRENTICE PROPERTY	MISSOURI	AUSTIN
PO002236	MOUNTAIN MINE	CLARK FORK	ELEVATION MOUNTAIN	BE003955	PRISCILLA MINE	BEAVERHEAD	BANNACK
GR000704	MOUNTAIN RAM MINE	CLARK FORK	POTATO LAKES	MA003660	PROSPECT MINE	RUBY	VIRGINIA CITY
GR003569	MOUNTAIN VIEW MINE AND MILL	BLACKFOOT	ELEVATION MOUNTAIN	MI005587	QUEEN MARY	CLARK FORK	CLINTON
JF002625	MT. THOMPSON	BOULDER	MOUNT THOMPSON	JF001655	QUEEN OF THE HILLS	BOULDER	MOUNT THOMPSON
MA007046	MUELLER MINE	BIG HOLE	NEZ PERCE HOLLOW	LC007316	QUEEN OF THE VALLEY	MISSOURI	SCRATCHGRAVEL HILL
SB008114	MULLENS	BIG HOLE	WICKIUP CREEK	MI002478	RANBLER MINE	BLACKFOOT	UNION PEAK
LC007437	MULLIN CLAIM	MISSOURI	SCRATCHGRAVEL HILL	BE000503	RANDALL MINE	BEAVERHEAD	BANNACK
JF002757	MUSKEGAN	JEFFERSON CITY	JEFFERSON CITY	JF002229	RARUS	MISSOURI	JEFFERSON CITY
GR000428	MUSSINGBROD CLAIMS / LEAD KING	CLARK FORK	ELEVATION MOUNTAIN	BE000131	RATTLESNACK CREEK PLACER	BEAVERHEAD	ARGENTA
MA000949	MUTCH	BIG HOLE	TWIN BRIDGES SW	GR003044	RED CLOUD MINE	CLARK FORK	ELEVATION MOUNTAIN
FE001425	MYDRANDA CLAIM	OTHER	JUDITH PEAK	MA003662	RED HORSE MINE	BIG HOLE	NEZ PERCE HOLLOW
BW004276	NADA MINE	MISSOURI	RADERSBURG	GR003294	RED ROCK MINE	CLARK FORK	ELEVATION MOUNTAIN
GR003649	NANCY HANKS MINE / MINNIE PALMER	CLARK FORK	ELEVATION MOUNTAIN	MA002985	RED ROSE	MADISON	MALTBYS MOUND
MA003095	NASH GROUP	RUBY	COPPER MOUNTAIN	JF004841	REDWING MINE	BOULDER	MOUNT THOMPSON
MA003150	NATIVE SILVER	RUBY DAM	RUBY DAM	LC007320	REGINA CLAIM	MISSOURI	SCRATCHGRAVEL HILL
MA003055	NED	JEFFERSON	PONY	PO002162	RELYEA MILL	CLARK FORK	WINDY ROCK
LC004224	NEENAN MINE	CLARK FORK	GREENHORN MOUNTAIN	PO002434	RELYEA MINE	CLARK FORK	WINDY ROCK
MI005755	NELLIE	BLACKFOOT	MINERAL RIDGE	BW006167	RENA	MISSOURI	RADERSBURG
MA004457	NELLIE BLY	RUBY	CIRQUE LAKE	BE000030	RENA MINE	BEAVERHEAD	ERMONT
PO005060	NELSON AND DAN 1 AND 2 MINES	BLACKFOOT	ELEVATION MOUNTAIN	PO005370	RESERVOIR AND OPHIR PATENTS	CLARK FORK	OPHIR CREEK
BE0003950	NELSON PROSPECT	BEAVERHEAD	BANNACK	MA008148	RESERVOIR SPRING	BIG HOLE	NEZ PERCE HOLLOW
BE0000576	NEVADA GROUP	BEAVERHEAD	PRICE CREEK	JF001799	RETRIEVER	MISSOURI	WICKES
JF006345	NEW ALBANY MINE	MISSOURI	WICKES	MA006893	REVENUE MINE NORTH SHAFT	MADISON	MALTBYS MOUND
BE0000024	NEW DEPARTURE MINE	BEAVERHEAD	BANNACK	MA003665	RIDDEL	RUBY	CIRQUE LAKE
LC001507	NEW ERA / ROSENFELD	MISSOURI	ROBERTS MOUNTAIN	JF008093	RINGING ROCKS	JEFFERSON	DRY MOUNTAIN
MA007202	NEW MINE	BIG HOLE	NEZ PERCE HOLLOW	JF002643	ROBERT EMMET	BOULDER	WICKES
GR003744	NEW SEATTLE	CLARK FORK	MAXVILLE	MA008051	ROCHESTER MILL TAILINGS	BIG HOLE	TWIN BRIDGES SW
FE001035	NEW YEAR	OTHER	NEW YEAR	MI002712	ROCK CREEK QUARRY	CLARK FORK	CLINTON
MA008115	NEZ PERCE	BIG HOLE	TWIN BRIDGES SW	JF002745	ROOSEVELT	MISSOURI	JEFFERSON CITY
MA008116	NEZ PERCE NORTH	BIG HOLE	TWIN BRIDGES SW	MA005640	ROSEBUD MINE	RUBY	VIRGINIA CITY
MA008117	NEZ PERCE SOUTH	BIG HOLE	TWIN BRIDGES SW	PO005145	ROSELLE	BLACKFOOT	HELMVILLE
BE000713	NICK PREEN MINES	BEAVERHEAD	POLARIS	LC004371	ROSETTA MINE	MISSOURI	ROBERTS MOUNTAIN
LC007294	NILE MINE	MISSOURI	GREENHORN MOUNTAIN	BW006171	ROTHFUSS COPPER	MISSOURI	RADERSBURG
JF001937	NORTH ALTA	MISSOURI	JEFFERSON CITY	BW006175	ROTHFUSS IRON MINE	MISSOURI	DEVILS FENCE
BE004190	NORTH CENTRAL MINE	BIG HOLE	CATTLE GULCH	BE000384	ROYAL	BEAVERHEAD	EVERSON CREEK
BW003155	NORTH HOME	MISSOURI	RADERSBURG	PO004755	ROYAL MINE	BLACKFOOT	MARCUM MOUNTAIN
FE001071	NORTH MOCCASIN MINE	OTHER	KENDALL	PH002488	RUBY CREEK PLACER	OTHER	ZORTMAN
FE006867	NORTH MOCCASIN PROJECT	OTHER	SPRING CREEK JCT	MA005652	RUBY GULCH MINE	OTHER	ZORTMAN
BW004031	NORTH STAR	MISSOURI	RADERSBURG	BW006943	RUBY SILVER MINE	RUBY	RUBY DAM
LC007441	NORTH STAR CLAIM	MISSOURI	SCRATCHGRAVEL HILL	MA007001	RUBY SILVER MINE	MISSOURI	RADERSBURG
JF008010	NORTH WALDY MINE	BOULDER	MOUNT THOMPSON	MA007001	RUBY VIEW MINE	BEAVERHEAD	MINE GULCH
MA004007	NORTH WILLOW CREEK TUNGSTEN DEPOSIT	JEFFERSON	PONY	SB001816	RUTH & COPPER BOTTOM	BIG HOLE	WICKIUP CREEK
JF002367	NORTHERN PACIFIC	MISSOURI	WICKES	BE000882	RUTH MINE	BEAVERHEAD	BANNACK
FE001407	NORTHERN PACIFIC	OTHER	JUDITH PEAK	FE006846	S & P MINING	OTHER	JUDITH PEAK
MA003395	NORWEGIAN CREEK	JEFFERSON	MALTBYS MOUND	BE000155	S.S. & R. MINE	BEAVERHEAD	TEPEE MOUNTAIN
MA008146	NORWEGIAN CREEK PLACER	JEFFERSON	MALTBYS MOUND	GR003324	SALLIE MELLER CLAIM	CLARK FORK	HENDERSON MOUNTAIN
MA003645	NORWEGIAN MINE	JEFFERSON	MALTBYS MOUND	BE003810	SALT MOUNTAIN MINE	BEAVERHEAD	POLARIS
MA004052	NOW PROPERTY	JEFFERSON	MALTBYS MOUND	BW006607	SANTA ANITA MINE/ SAN ANITA	MISSOURI	RADERSBURG
MA005728	NYHART-COX	BIG HOLE	GLEN	FE007212	SANTIAGO	OTHER	KENDALL
JF004831	OBELISK	BOULDER	MOUNT THOMPSON	BE008206	SASSMAN'S PROSPECT	BEAVERHEAD	POLARIS
GR000452	OHIO AND BUCKEYE MINE	BLACKFOOT	ELEVATION MOUNTAIN	BW004591	SATELLITE	MISSOURI	DIAMOND CITY
BE000629	OLD FAVORITE MINE	BEAVERHEAD	POLARIS	SB008119	SBME-1	BIG HOLE	MELROSE
SB005232	OLD GLORY (NORTH) IRON DEPOSIT	BIG HOLE	MELROSE	LC007447	SCRATCHGRAVEL HILLS	MISSOURI	SCRATCHGRAVEL HILL
SB001420	OLD GLORY MINE	BIG HOLE	MELROSE	JF008094	SECTION 16	JEFFERSON	DRY MOUNTAIN
LC007443	OLD SILVER MINE	MISSOURI	ROBERTS MOUNTAIN	JF008095	SECTION 17 SHAFT	JEFFERSON	DRY MOUNTAIN
MA003887	OLD TOLEDO MINE	RUBY	COPPER MOUNTAIN	PO008013	SECTION 32 UNNAMED ADITS	CLARK FORK	OPHIR CREEK
MI005683	OLYMPIAD MINE	BLACKFOOT	UNION PEAK	SB008120	SECTION 8	BIG HOLE	WICKIUP CREEK
PO002858	OPHIR (1)	CLARK FORK	OPHIR CREEK	MI005767	SENATE	CLARK FORK	CLINTON
PO004845	OPHIR (2) MINE	CLARK FORK	OPHIR CREEK	BE008285	SENATOR / ARCAT	BEAVERHEAD	BANNACK
PO004840	OPHIR CREEK (1)	CLARK FORK	OPHIR CREEK	BE004455	SHAFER-RENZ MINE	BEAVERHEAD	ARGENTA
PO004885	OPHIR CREEK (2)	CLARK FORK	OPHIR CREEK	LC001819	SHAKOPEE AND EARTHQUAKE	MISSOURI	GREENHORN MOUNTAIN
PO004850	OPSATA MINE	CLARK FORK	OPHIR CREEK	GR000254	SHAMROCK MINE	CLARK FORK	ELEVATION MOUNTAIN
MA003690	ORE CACHE	RUBY	CIRQUE LAKE	MA005660	SHAMROCK MINE	JEFFERSON	SILVER STAR
SB006180	ORPHAN BOY	BIG HOLE	MELROSE	LC004219	SHANNON MINE	MISSOURI	GREENHORN MOUNTAIN
LC001939	OSAGE CHIEF	MISSOURI	AUSTIN	FE001299	SHE	OTHER	JUDITH PEAK
BE000719	OSTERLY	BEAVERHEAD	POLARIS	BE004220	SHEAR ZONE	BEAVERHEAD	LEMMI PASS
LC004254	OTTAWA	MISSOURI	GREENHORN MOUNTAIN	LC003634	SHEEP CREEK COPPER-SILVER MINE	MISSOURI	SHEEP CREEK
MA000847	OWEN-MCGOVERN PROSPECT (TALC)	BEAVERHEAD	ELK GULCH	FE001251	SHEEP MOUNTAIN MINE	OTHER	JUDITH PEAK
BE003970	P & R MINE	BEAVERHEAD	POLARIS	MA007076	SHOEMAKER	BIG HOLE	NEZ PERCE HOLLOW
FE007047	P. K. MINE	OTHER	JUDITH PEAK	MA008011	SHORT SHIFT MILL	BIG HOLE	WICKIUP CREEK
MA004462	PACIFIC MINE(S)	RUBY	CIRQUE LAKE	MA007028	SHORT SHIFT MINE	BIG HOLE	WICKIUP CREEK
BV006359	PALMER ENGH PLACER	MISSOURI	GIANT HILL	MA008054	SHORT SHIFT PLACER	BIG HOLE	WICKIUP CREEK
BV003876	PARKER GROUP	MISSOURI	DEVILS FENCE	MA003180	SHORT SHIFT WEST	BIG HOLE	WICKIUP CREEK
BE003980	PAUL PROPERTY	BEAVERHEAD	MONIDA	MA005712	SHORTFELLOW MINE	BIG HOLE	NEZ PERCE HOLLOW
MA008050	PAUPER'S DREAM MINE	JEFFERSON	TWIN BRIDGES SW	BE000574	SIDEROCK-GREEN HORN AREA	BEAVERHEAD	LIMA DAM
SB006892	PEABODY MINE	BIG HOLE	WICKIUP CREEK	GR003466	SIERRA MINE	CLARK FORK	ELEVATION MOUNTAIN
MA003238	PEARL GROUP	RUBY	VIRGINIA CITY	MA003298	SIERRA STRIP MINE / BEAVERHEAD MINE	BEAVERHEAD	MINE GULCH
PO004885	PEARL MINE	BLACKFOOT	ELEVATION MOUNTAIN	JF005356	SILMONT CLAIMS	BOULDER	MOUNT THOMPSON
MA006767	PEARSON PROSPECT	RUBY	OLD BALDY MOUNTAIN	LC001831	SILVER AGE MINE	MISSOURI	SCRATCHGRAVEL HILL
FE001287	PEERLESS CLAIM	OTHER	JUDITH PEAK	LC007300	SILVER BAR MINE	MISSOURI	SCRATCHGRAVEL HILL
GR003741	PEGGY ANN	CLARK FORK	ELEVATION MOUNTAIN	MA003670	SILVER BELL	RUBY	ALDER
JF008090	PEGMATITE DEPOSIT	JEFFERSON	DRY MOUNTAIN	BE000390	SILVER BELLE GROUP	BEAVERHEAD	BANNACK

ID	Site Name	Drainage	Quadrangle	ID	Site Name	Drainage	Quadrangle
BE003855	SILVER BUCKLE GROUP	BEAVERHEAD	BANNACK	MA005832	UNNAMED 03S05W33 (1) DEPOSIT	JEFFERSON	OLD BALDY MOUNTAIN
FE001467	SILVER BULLION	OTHER	JUDITH PEAK	MA006788	UNNAMED 03S05W33 (2) PROSPECT	JEFFERSON	OLD BALDY MOUNTAIN
LC004394	SILVER CROSS MINE	MISSOURI	SCRATCHGRAVEL HILL	MA005796	UNNAMED 03S05W34 DEPOSIT	RUBY	OLD BALDY MOUNTAIN
BE0008210	SILVER FISSURE / POLARIS	BEAVERHEAD	POLARIS	MA003218	UNNAMED 03S07W08B8AA	BIG HOLE	NEZ PERCE HOLLOW
JF005416	SILVER HILL MINE	BOULDER	MOUNT THOMPSON	MA005848	UNNAMED 03S07W08B8AD	BIG HOLE	NEZ PERCE HOLLOW
MA005864	SILVER KING	BEAVERHEAD	NEZ PERCE HOLLOW	MA005736	UNNAMED 03S07W08D8CA MINE	BIG HOLE	NEZ PERCE HOLLOW
BE000623	SILVER KING MINE	BIG HOLE	POLARIS	MA005754	UNNAMED 03S07W08D8CD MINE	BIG HOLE	NEZ PERCE HOLLOW
GR003759	SILVER KING MINE	CLARK FORK	CORNISH GULCH	MA005716	UNNAMED 03S07W08D8CA MINE	BIG HOLE	NEZ PERCE HOLLOW
BE003840	SILVER MINE	BIG HOLE	EARLS GULCH	MA005748	UNNAMED 03S07W08D8CB MINE	BIG HOLE	NEZ PERCE HOLLOW
MA008200	SILVER NOTE	BIG HOLE	TWIN BRIDGES SW	MA005500	UNNAMED 03S07W08D8AB MINES	BIG HOLE	NEZ PERCE HOLLOW
BE000830	SILVER QUEEN	BEAVERHEAD	PRICE CREEK	MA005478	UNNAMED 03S07W08DDDA MINE	BIG HOLE	NEZ PERCE HOLLOW
PO005085	SILVER REEF MINE	CLARK FORK	WINDY ROCK	MA005488	UNNAMED 03S07W08DDDD SHAFT CLUSTER	BIG HOLE	NEZ PERCE HOLLOW
BE0003800	SILVER ROSE MINE	BEAVERHEAD	BANNACK	MA006020	UNNAMED 03S07W08B8CB1 MINE	BIG HOLE	NEZ PERCE HOLLOW
BE000589	SILVER STAR (LONE STAR) MINE	BEAVERHEAD	BANNACK	MA006024	UNNAMED 03S07W08B8CB2 MINE	BIG HOLE	NEZ PERCE HOLLOW
BE003845	SILVER WATER MINE	BEAVERHEAD	ARGENTA	MA003175	UNNAMED 03S07W08B8DC CLUSTER	BIG HOLE	NEZ PERCE HOLLOW
LC007282	SILVER-COPPER MINING CO	MISSOURI	SCRATCHGRAVEL HILL	MA003110	UNNAMED 03S07W08C8CB MINES	BIG HOLE	NEZ PERCE HOLLOW
BW004041	SIMPSON	MISSOURI	RADERSBURG	MA003105	UNNAMED 03S07W18AABA MINE	BIG HOLE	NEZ PERCE HOLLOW
BE000534	SIR WALTER SCOTT	BEAVERHEAD	ARGENTA	BW008155	UNNAMED 04N01W15AADA	MISSOURI	RADERSBURG SW
FE008849	SLAG DUMP	OTHER	JUDITH PEAK	MA003683	UNNAMED 04S01W12ADDD MINE	MADISON	NORRIS
BE003880	SLEEPING PRINCESS GROUP/GOLDEN LEAF	BEAVERHEAD	BANNACK	MA003648	UNNAMED 04S02W08B8AD MINES	MADISON	MALTBYS MOUND
MA007007	SNOW WHITE TALC MINE	BEAVERHEAD	MINE GULCH	MA003018	UNNAMED 04S04W33 MINE	RUBY	COPPER MOUNTAIN
SB008122	SOAP GULCH BARITE OCCURRENCE	BIG HOLE	MELROSE	MA003163	UNNAMED 04S05W01A8AD MINE	RUBY	OLD BALDY MOUNTAIN
SB001138	SOAP GULCH IRON	BIG HOLE	WICKIUP CREEK	MA003158	UNNAMED 04S05W01ACCB MINE	RUBY	OLD BALDY MOUNTAIN
SB008298	SOAP GULCH PLACER	BIG HOLE	MELROSE	MA003189	UNNAMED 04S08W07B8DA	BIG HOLE	EARLS GULCH
JF008089	SOUTH EASTER LILY	JEFFERSON	DRY MOUNTAIN	MA003368	UNNAMED 04S08W07BCCA	BIG HOLE	EARLS GULCH
PO002756	SOUTH END OF GARRISON ANTICLINE	CLARK FORK	LUKE MOUNTAIN	MA003048	UNNAMED 05S02W15B8BD MINE	MADISON	LEONARD CREEK
PO002510	SOUTH LUKE MINE	CLARK FORK	GARRISON	MA003063	UNNAMED 06S03W30ACDA MINE	RUBY	ALDER
BE0008309	SOUTH OF DEWEY SHAFT	BIG HOLE	DEWEY	MA003068	UNNAMED 06S03W31ACCA MINE	RUBY	ALDER
GR003751	SPOKANE	CLARK FORK	ELEVATION MOUNTAIN	MA003058	UNNAMED 06S03W31ACCC MINE	RUBY	ALDER
FE001119	SPOTTED HORSE MINE	OTHER	JUDITH PEAK	MA003058	UNNAMED 06S03W32CCDD MINE	RUBY	ALDER
GR003871	SPRING GULCH (1)	CLARK FORK	DRUMMOND	MA003053	UNNAMED 06S04W32AABD MINE	RUBY	ALDER
GR000308	SPRING GULCH (2) MINE	CLARK FORK	DRUMMOND	MA003743	UNNAMED 07S03W13CABA MINE	RUBY	CIRQUE LAKE
GR003864	SPRING GULCH QUARRY	CLARK FORK	LIMESTONE RIDGE	MA003703	UNNAMED 07S03W13CBAA MINE	RUBY	CIRQUE LAKE
BE0003870	SPRING PROSPECT	BEAVERHEAD	ARGENTA	MA003753	UNNAMED 07S03W15ACAD MINE	RUBY	CIRQUE LAKE
MA007019	ST. JOHN GROUP	RUBY	VIRGINIA CITY	MA003738	UNNAMED 07S03W15DCCB MINE	RUBY	CIRQUE LAKE
MA007022	ST. LAWRENCE CONSOLIDATED	RUBY	ALDER	BW008087	UNNAMED 08N03E05AACB	MISSOURI	GURNETT CREEK WEST
LC007266	STAPLE MINE	MISSOURI	CANYON CREEK	JF008099	UNNAMED 08N03E05BAA8	MISSOURI	GURNETT CREEK WEST
BE003875	STAPLETON MINE	BEAVERHEAD	ARGENTA	PO005245	UNNAMED 09N03W17BCBD	MISSOURI	JEFFERSON CITY
BE000444	STARLIGHT (1)	BEAVERHEAD	EVERSON CREEK	BE008290	UNNAMED 09S07W12CCAB PROSPECT	MISSOURI	HELENA
BE003885	STARLIGHT (2) MINE	BEAVERHEAD	ARGENTA	C8000435	UNNAMED 09S28E07C8BC	CLARK FORK	GARRISON
PO002812	STATE PRISON BRICK PLANT	CLARK FORK	LUKE MOUNTAIN	LC008153	UNNAMED 10N04W34ACBC	BEAVERHEAD	ELK GULCH
MA008123	STATELAND	BIG HOLE	WICKIUP CREEK	PO004750	UNNAMED 10N10W12	OTHER	BEAR CANYON
BE003890	STEVENSON MINE	BEAVERHEAD	BANNACK	LC008152	UNNAMED 11N08W10CADD ADIT	MISSOURI	SCRATCHGRAVEL HILL
MI002718	STINKWATERS PIT	BLACKFOOT	GREENOUGH	GR008274	UNNAMED 12N14W11DAB8	CLARK FORK	WINDY ROCK
GR00290	STONE PLACER MINE	CLARK FORK	ELEVATION MOUNTAIN	MI008283	UNNAMED 13N14W18ACDD	MISSOURI	GREENHORN MOUNTAIN
MA004047	STRAWBERRY-KEYSTONE MINE AND MILL	JEFFERSON	PONY	BE008018	UNNAMED ADIT	CLARK FORK	ELEVATION MOUNTAIN
BE003900	STRINGER MINE	BEAVERHEAD	ARGENTA	BE000083	UNNAMED ALUMINUM	BEAVERHEAD	BATA MOUNTAIN
MA007073	SUGAR BOWL	BIG HOLE	TABLE MOUNTAIN	MI005687	UNNAMED BARITE (1)	BEAVERHEAD	POLARIS
BW008355	SUMMIT	MISSOURI	RADERSBURG SW	MI002532	UNNAMED BARITE (2)	BEAVERHEAD	UNION PEAK
MI005743	SUMPTER	BLACKFOOT	CLINTON	MI005639	UNNAMED BARITE (3)	CLARK FORK	CLINTON
BE000572	SUNRISE (1)	BEAVERHEAD	ERMONT	PO008014	UNNAMED CARPENTER CREEK ADIT	BLACKFOOT	UNION PEAK
BE000725	SUNRISE (2)	BEAVERHEAD	POLARIS	BE009125	UNNAMED COPPER PROSPECT	CLARK FORK	OPHIR CREEK
MA003498	SUNRISE SHAFT	BIG HOLE	TWIN BRIDGES SW	MA006064	UNNAMED FELDSPAR	BEAVERHEAD	ELK GULCH
CB000428	SUNSET CLAIMS	OTHER	MYSTERY CAVE	CB000447	UNNAMED GOLD	RUBY	COPPER MOUNTAIN
BE000450	SUNSHINE	BEAVERHEAD	COYOTE CREEK	MI005847	UNNAMED GOLD	OTHER	BEAR CANYON
PH002776	SURPRISE MINE	JEFFERSON	ZORTMAN	MA005804	UNNAMED GOLD DEPOSIT	BLACKFOOT	GREENOUGH
MA003130	SURPRISE MINE	OTHER	WHITEHALL	BE000419	UNNAMED GOLD, BISMUTH	RUBY	COPPER MOUNTAIN
FE001101	SUTTER MINE	OTHER	JUDITH PEAK	BE000496	UNNAMED KAOLIN	BEAVERHEAD	BANNACK
CB000747	SWAMP FROG MINE	OTHER	RED PRYOR MOUNTAIN	JF002199	UNNAMED LEAD	BEAVERHEAD	ERMONT
BE004110	SWEENEY MINE	BEAVERHEAD	MILLPOINT	GR003039	UNNAMED LEAD SILVER PROSPECT	BOULDER	WICKES
GR005633	T & H EXTENSION CLAIM	CLARK FORK	ELEVATION MOUNTAIN	MA003768	UNNAMED MINE SEC 16	CLARK FORK	UNION PEAK
BE000702	T.D.-8	BEAVERHEAD	BANNACK	BE004350	UNNAMED NICKEL	RUBY	CIRQUE LAKE
FE001059	TAIL HOLT MINE	OTHER	JUDITH PEAK	SB008588	UNNAMED NITROGEN	BEAVERHEAD	PRICE CREEK
MA000163	TALC OCCURRENCE	BEAVERHEAD	MINE GULCH	BE000041	UNNAMED PB-AG	BIG HOLE	WICKIUP CREEK
BE004120	TAYLOR MINE	BEAVERHEAD	BANNACK	GR003891	UNNAMED PHOSPHATE	BEAVERHEAD	TEPEE MOUNTAIN
GR000278	TEN MILE PLACER	CLARK FORK	ELEVATION MOUNTAIN	PO002818	UNNAMED PLACER MINE	CLARK FORK	DRUMMOND
CB000015	THE DANDY MINE / PRYOR MOUNTAIN	OTHER	RED PRYOR MOUNTAIN	MA000829	UNNAMED PROSPECT 07S06W11DCCA	CLARK FORK	OPHIR CREEK
FE001085	THOMAS CLAIMS	OTHER	JUDITH PEAK	BE004105	UNNAMED PYROPHYLLITE OCCURRENCE	BEAVERHEAD	MINE GULCH
BE004125	THOMPSON MINE/HILLSIDE PLACER	BEAVERHEAD	BANNACK	BE000281	UNNAMED QUARTZ, FELDSPAR	BEAVERHEAD	ARGENTA
MA007181	TIDAL WAVE	JEFFERSON	OLD BALDY MOUNTAIN	JF008157	UNNAMED SEC 10	BEAVERHEAD	GARFIELD CANYON
GR003686	TIE GULCH	CLARK FORK	BEARMOUTH	JF008159	UNNAMED SEC 17	MISSOURI	JEFFERSON CITY
GR000260	TIGER MINE	CLARK FORK	ELEVATION MOUNTAIN	MA008160	UNNAMED SEC 17	JEFFERSON	DRY MOUNTAIN
MA003523	TOBACCO ROOT MINE	MADISON	NORRIS	JF008158	UNNAMED SEC 8	MADISON	NORRIS
LC007270	TOM LODE	MISSOURI	HAUSER LAKE	LC003919	UNNAMED SILICA	JEFFERSON	DELMOE LAKE
LC007272	TOWSLEY MINE	MISSOURI	GREENHORN MOUNTAIN	MA005828	UNNAMED SILVER DEPOSIT	MISSOURI	AUSTIN
MA000295	TREASURE CHEST MINE / TREASURE	BEAVERHEAD	MINE GULCH	LC008100	UNNAMED T11N04W34ACBC	BIG HOLE	NEZ PERCE HOLLOW
MA003293	TRI STATE STRIP MINE / TRI-STATE	BEAVERHEAD	MINE GULCH	MA008297	UNNAMED TALC 07S08W02CDBD	MISSOURI	SCRATCHGRAVEL HILL
MI005583	TRIANGLE	CLARK FORK	CLINTON	MA008298	UNNAMED TALC 07S08W03DDDD	BEAVERHEAD	MINE GULCH
JF004778	TRINITY MINE	MISSOURI	WICKES	CB000027	UNNAMED URANIUM (1)	BEAVERHEAD	MINE GULCH
BE000635	TUSCARORA MINE	BEAVERHEAD	ARGENTA	CB000381	UNNAMED URANIUM (2)	OTHER	MYSTERY CAVE
GR003234	TWIN BUTTES	CLARK FORK	MAXVILLE	CB000411	UNNAMED URANIUM (3)	OTHER	RED PRYOR MOUNTAIN
MA004477	U S GRANT MINE	RUBY	VIRGINIA CITY	CB000441	UNNAMED URANIUM (4)	OTHER	BEAR CANYON
LC004499	UMATILLA	MISSOURI	AUSTIN	CB000017	UNNAMED VANADIUM	OTHER	RED PRYOR MOUNTAIN
MA008125	UNION	RUBY	WICKIUP CREEK	GR000314	UPPER DEEP CREEK	CLARK FORK	ELEVATION MOUNTAIN
MA003253	UNION MINE	BIG HOLE	OLD BALDY MOUNTAIN	SB008124	UPPER PANDORA	BIG HOLE	WICKIUP CREEK
MA003083	UNNAMED 01S04W03C8DB MINE	JEFFERSON	WHITEHALL	MA005920	UPPER ROCHESTER PLACER	BIG HOLE	WICKIUP CREEK
SB006558	UNNAMED 01S09W35ADCC LOCATION	BIG HOLE	MELROSE	MI002840	URANIUM CLAIM	BIG HOLE	NEZ PERCE HOLLOW
MA006797	UNNAMED 02S06W09 PROSPECTS	JEFFERSON	SILVER STAR	JF002189	VALLEY MINE	BLACKFOOT	UNION PEAK
MA006908	UNNAMED 02S07W29CCDD PROSPECTS	BIG HOLE	WICKIUP CREEK	BE003935	VAN ARMIN	BEAVERHEAD	MOUNT THOMPSON
MA006926	UNNAMED 02S07W30DABD PROSPECTS	BIG HOLE	WICKIUP CREEK	BE004570	VANADINITE	BEAVERHEAD	POLARIS
MA003223	UNNAMED 02S07W31DAAD SHAFT CLUSTER	BIG HOLE	NEZ PERCE HOLLOW	MA005724	VICTORIA MINE	BIG HOLE	NEZ PERCE HOLLOW
MA003208	UNNAMED 02S07W31DCCA	BIG HOLE	NEZ PERCE HOLLOW	MA007058	VIRGINIA CITY TALC OCCURRENCE	JEFFERSON	SILVER STAR
MA003213	UNNAMED 02S07W31DCDB MINES	BIG HOLE	NEZ PERCE HOLLOW	MA000745	VIRGINIA MINE	RUBY	CIRQUE LAKE
MA006889	UNNAMED 02S07W32B8AC MINE	BIG HOLE	WICKIUP CREEK	FE000999	VOLTAIRE MINE	BOULDER	MOUNT THOMPSON
MA003503	UNNAMED 02S07W32B8BC MINE	BIG HOLE	NEZ PERCE HOLLOW	JF001553	WADAMS	OTHER	JUDITH PEAK
MA003528	UNNAMED 02S07W32B8CB MINE	BIG HOLE	NEZ PERCE HOLLOW	BE004235	WALKER MINE	BEAVERHEAD	BANNACK
MA003568	UNNAMED 02S07W32B8CC MINE	BIG HOLE	NEZ PERCE HOLLOW	JF002157	WALLACE CREEK MILL	BOULDER	MOUNT THOMPSON
MA003733	UNNAMED 02S07W32B8CD SHAFT CLUSTER	BIG HOLE	NEZ PERCE HOLLOW	MA008827	WALLACE LODGE MINE	RUBY	OLD BALDY MOUNTAIN
MA003228	UNNAMED 02S07W32C8BB SHAFT CLUSTER	BIG HOLE	NEZ PERCE HOLLOW	MI002760	WAR EAGLE	CLARK FORK	CLINTON
MA006941	UNNAMED 02S08W13AADD PROSPECTS	BIG HOLE	WICKIUP CREEK	BE004115		BEAVERHEAD	BANNACK
MA006935	UNNAMED 02S08W29DABD PROSPECTS	BIG HOLE	WICKIUP CREEK	PH002920		OTHER	ZORTMAN
MA003333	UNNAMED 0300S70780	BIG HOLE	WICKIUP CREEK				
MA003628	UNNAMED 03S01E18CACC MINE	MADISON	NORRIS				
MA003833	UNNAMED 03S01E18CCDB MINE	MADISON	NORRIS				

ID	Site Name	Drainage	Quadrangle	ID	Site Name	Drainage	Quadrangle
LC001867	WAR EAGLE MINE	MISSOURI	AUSTIN				
PO002296	WARM SPRINGS CREEK	CLARK FORK	GARRISON				
PO002648	WARM SPRINGS CREEK QUARRY	CLARK FORK	WINDY RIDGE				
PO002666	WARM SPRINGS PHOSPHATE MINE	CLARK FORK	GARRISON				
SB001198	WARREN PROSPECT	BIG HOLE	TUCKER CREEK				
MA003405	WASHINGTON BAR PLACER	MADISON	MALTBYS MOUND				
BE004055	WASHINGTON MINE	BEAVERHEAD	BANNACK				
MA008128	WATER TANK	BIG HOLE	TWIN BRIDGES SW				
MA002990	WATERLODE	MADISON	NORRIS				
MA007016	WATSECA MINE AND MILL	BIG HOLE	NEZ PERCE HOLLOW				
LC007280	WAYSIDE	MISSOURI	SCRATCHGRAVEL HILL				
FE001085	WEST ARMELL'S CREEK	OTHER	JUDITH PEAK				
JF006088	WEST DRY CREEK	JEFFERSON	DELMOE LAKE				
BE000006	WEST ERMONT MINE	BEAVERHEAD	ERMONT				
FE001481	WESTERN MINES CORP.	OTHER	NEW YEAR				
BE000575	WHEAL ROSE MINE	BEAVERHEAD	BANNACK				
FE001395	WHITE & GILPATRICK CLAIMS	OTHER	JUDITH PEAK				
FE001323	WHITE ELEPHANT	OTHER	JUDITH PEAK				
BE000102	WHITE LIME MINE	BEAVERHEAD	ARGENTA				
MA003578	WHITE MINE	BIG HOLE	NEZ PERCE HOLLOW				
MA004057	WHITE TALC MINE	RUBY	VIRGINIA CITY				
MA000751	WHITNEY CLAIMS	BEAVERHEAD	MINE GULCH				
JF005331	WICKES CORBIN	MISSOURI	WICKES				
JF005271	WICKES MANGANESE	MISSOURI	WICKES				
SB003055	WICKIUP CREEK MINE	BIG HOLE	WICKIUP CREEK				
JF002223	WILBER SILVER	BOULDER	MOUNT THOMPSON				
BE000731	WILD BAT	BEAVERHEAD	POLARIS				
MA003050	WILLOW CREEK CLAIM	JEFFERSON	PONY				
CB000489	WINDMILL NO. 3	OTHER	BEAR CANYON				
LC001147	WINDY RIDGE PROPERTY	MISSOURI	CANYON CREEK				
MA007049	WINNETKA TRUST GROUP	RUBY	VIRGINIA CITY				
FE001329	WOCASEK	OTHER	NEW YEAR				
LC003909	WOLF CREEK	MISSOURI	ROBERTS MOUNTAIN				
BE000647	WOOLEY	BEAVERHEAD	ARGENTA				
BE004240	YELLOW BIRD	BEAVERHEAD	ERMONT				
LC007286	YELLOWSTONE CLAIM	MISSOURI	SCRATCHGRAVEL HILL				
PO005415	YOUR NAME PLACER	BLACKFOOT	CHAMBERLAIN MOUNTAIN				

APPENDIX III

DESCRIPTIONS OF SELECTED MINE AND MILL SITES
WITH NO POTENTIAL ADVERSE ENVIRONMENTAL IMPACT
ON BLM-ADMINISTERED LAND

1. BEAVERHEAD RIVER DRAINAGE

Agnes Lode

BE000138

This is an open adit trending S80°E, dry driven due east on the slope opposite the Little Hawk. It is probably less than 50 feet in length. Limestone hosts the mine with strong iron staining locally.

Location: T6S R12W Sec 14 BABB

Artic Claim

BE000521

One patented claim has been explored by two shafts, one open and originally at least 160 feet deep (Geach 1972), secured by a DSL-AMRB grate and the other caved at about 35-40 feet depth, but with a gradual slope on one side. A dump grab sample (PGAC-1) assayed 0.011 opt Au, 3.03 opt Ag, 0.006% Cu, 0.125% Pb, and 0.105% Zn. The upper dump has a skeletal boxwork and abundant yellowish to reddish orange iron oxide. This mine is located on a high, dry ridge.

Location: T07S R11W Sec 20 DADA

Bannack Mines

BE000552

There is a patent for a Bannack mine but no information was found in the literature, other than as a general topic for the area. The patented claim plat shows no location for Bannack mine.

The only recorded production was in 1960 and 1961 when 5,042 tons of ore were produced from the Bannack mine (Crowley 1961). This mine may be confused with the Bannack-Apex (Hendricks-Graeter) or as a general name for mines in the Bannack area.

Location: T08S R11W Sec 08 BBCC

Bannock Placer

BE000185

These workings are located on the Eli Spring quadrangle in the same place as the Grasshopper Strip mine (DSL-AMRB 1990). At that time, the DSL-AMRB had plans to recontour and backfill any openings. Historically, the Bannack placers worked two levels: the creek alluvial gravels and terrace gravels (Lyden 1948). Patented placer claims are located along the creek bottom but BLM land is adjacent to the private land.

Location: T08S R11W Sec 23

Bea Ann Claim
BE000737

An unpatented, reclaimed mine on BLM land which once had two adits, at least one shaft and several prospect pits located at the north end an unnamed gulch. One open shaft above the reclaimed adits remains, possibly inadvertently, and contains an old hand winch approximately 10' down. The mine was located in Mississippian Madison limestone, and was supposedly associated with the Cretaceous granodiorite. It was described by Geach (1972) as a 20 foot wide chimney, dipping 52°NW, filled with rubble of earthy iron oxides. Other minerals associated with the mine include banded nodules of calcite and black psilomelane-type manganese oxides, and fragments of quartz and jasper. The reclaimed dumps contain "earthy" dark brown limonite, trace secondary copper minerals, limestone breccia, calcite crystals and psilomelane. There is no record of production; the commodity listed is manganese. One physical hazard, no environmental hazards.

Location: T08S R11W Sec 05 DCBA

Blue Dot Mine
BE004270

This adit is a part of the New Departure mine and is currently listed as active on the Bannack topographic map and so was not visited. Geach (1972) reported the adit was originally 700 feet long and was later extended after 1958. An article in the November 24, 1963 Montana Standard reported 2,500 feet of new tunnel (the Blue Dot) was driven as a crosscut to the extensions of the previous workings to get to the sulfide. Ore from the 208 orebody, which this adit accessed, yielded 23,645 tons of ore, yielding 69,300 lbs Pb, 13,600 lbs Cu, 90,500 lbs Zn, 162,642 ounces Ag, and 34 ounces Au.

Location: T07S R11W Sec 26 BDBD

Blue Wing
BE004090

Winchell (1914) listed this as a separate mine from the Kent but Sassman (1941) stated that the Blue Wing, along with other lodes, became known as the Kent group. Geach (1972) does not discuss it as a separate mine.

Location: T07S R11W Sec 33 AACB

Blue Wing District Placer
BE000209

This patented claim is located on Cold Spring Creek in the E½ section 3, T8S, R11W. Upon examination of the property in the field, no evidence of its existence could be found. Lyden (1948) reported 2.26 ounces of gold recovered in 1934 from this placer, and indicated that no dredging was likely.

A reference in the MBMG mineral property files listed total production from 1902-1965 as 708 ounces. Loen and Pearson (1989) also refer to it as the Cold Spring Creek placer.

Location: T08S R11W Sec 03 AACD

Boaz

BE004280

A caved shaft, three small waste rock dumps, and a trench may be the Boaz claim; total surface disturbance is quite small. The 10' x 10' shaft (now caved) apparently explored a mineralized zone in the Devonian Jefferson dolomite. There is scant limonite staining on the dump rock; no other signs of mineralization are apparent. Gold ore was purportedly produced here in 1961 (Crowley 1961). These workings are situated on a dry NW-SE trending ridge; there is no water component. The site is located on BLM land.

Location: T06S R10W Sec 19 DACD

Bon Mine

BE004285

This property consists of five unpatented claims and Gilbert (1935) reported 800 feet of adits and shafts. Presently all workings are caved and recent dozer work has obscured where the workings were. Dump grab sample (PGBN-1) assayed 0.002 opt Au, 4.89 opt Ag, 0.01 % Cu, 0.05 % Pb, and 0.10 % Zn. Manganese values exceeded 10,000 ppm.

Location: T07S R11W Sec 32 ACBA

Bonnie Group

BE004300

Two collapsed adits, driven northeastward into Pennsylvanian Quadrant sandstone, located in SW ¼ section 15, T7S, R11W are assumed to be the Bonnie group. There is no apparent ore on the barren dumps, and sample PGBO-1 assayed <0.0005 opt Au, 0.05 opt Ag, 0.001 % Cu, 0.007 % Pb, and 0.006 % Zn. Trauerman (1940) in MBMG's Memoir 20 is the only reference to this group of six unpatented claims (listed under Logan Properties).

Location: T07S R11W Sec 15 CCCB

Capitol Claim

BE000665

The Capitol lies to the south of the Old Faithful claim but the major workings lie to the south on private land. Geach (1972) has a geologic sketch map of the numerous pits and adits here. He describes the deposit as a lens of jasperoid approximately 200 feet

long and five to 20 feet wide at the contact of Jefferson limestone and an overlying basalt.

Results of the select sample PGCP-1 were 0.004 opt Au, 0.15 opt Ag, 0.11 % Cu, 4.15% Pb and 0.10% Zn. This sample consisted of yellow-brown microcrystalline quartz (jasperoid ?), with some siliceous breccia.

Location: T06S R12W Sec 24 CDBC

Carbonate

BE000174

The Carbonate mine workings consist of three caved shafts and one open shaft (gated and locked); total surface disturbance is less than one acre. This mine site explores a steeply inclined, north-trending vein in the Cambrian Flathead sandstone. An andesite sill or dike follows the hanging wall of the ore body (Geach 1972). The primary ore mineral was galena in a gangue of brecciated quartzite, recemented by yellow jasper (Geach 1972). Limonite staining is found on most dump rock; heavy iron mineralization in veins is found around the open shaft. An AIM grab sample assayed greater than 10,000 ppm lead, 278 ppm zinc, 41 ppm copper, 28 ppm silver, 0.240 ounces of gold, and 616 ppm arsenic.

This property was located in the 1890's; in addition to earlier shipments, ore was shipped in 1942, 1949, and 1953. Total reported production was 64 tons of ore yielding 10 ounces of gold, 592 ounces of silver, 10,773 pounds of lead, and 611 pounds of zinc (Geach 1972). This site is located at the top of a dry NW-SE trending ridge; there is no water component. This site is located on BLM land.

Location: T06S R10W Sec 18 CBAB

Cedar Creek

BE004535

No production and no development is listed for this site, except for a bulldozer trench by the USGS (Swanson 1970). The average P_2O_5 content is 7½ % in the Retort Member of the Permian Phosphoria Formation (Swanson 1970). Grades range from 26.3% in the basal 3', 14.3% in the next 16'; the top 32' are low grade shales (Swanson 1970). The topography consists of high dry ridges, vegetated with sparse trees, and is associated with a series of synclines and anticlines (Popoff and Service 1965; Cressman and Swanson 1964; Ruppel, O'Neill, and Lopez 1993).

LOCATION: T09S R11W Sec 26 CABB

Charter Oak

BE000527

Workings at the Charter Oak consist of one unpatented claim with one main adit with ore bin and an upper inclined shaft; both are still open but have been locked. Shenon, 1906 stated that the ore was oxidized silver and lead minerals in a quartz/calcite gangue. According to Geach, 1972 ore was in small replacement bodies localized

along a north-trending fault dipping 61° to the west. Geach (1972) reported that 506 tons of ore yielded 76,923 lbs Pb, 15,700 lbs Zn, 3,409 lbs Cu, 14,845 ounces Ag, and 20 ounces Au. Total workings are between 500 and 600 feet in length (Geach 1972; Gilbert 1935; Trauerman 1940). Although located in 1860's, the main dates of operation were from 1938-1964. Sample PGCO-1, from the upper dump, ran 0.014 opt Au, 12.2 opt Ag, 0.41% Cu, 3.18% Pb, and 1.72% Zn. There is relatively high (1,395 ppm) arsenic, and 1,305 ppm antimony.

Location: T08S R11W Sec 04 BDAD

Coolidge

BE000114

The Coolidge mine workings consist of three inclined shafts and several prospect pits. Host rock is Devonian Jefferson dolomite (basal beds near the contact with underlying Cambrian Flathead sandstone). The beds in this area strike northeast and dip 27°SE to 44°SE (Geach 1972). A northeast-striking sill or dike of andesite is associated with the deposit. The ore occurred on the footwall side of the andesite dike (Geach 1972). Ore deposits at this site were located in the 1870's. Ore was shipped from this property in 1898, 1935, 1936, 1940, 1948, 1960, 1961, and 1964 (Geach 1972). Total recorded production was 279 tons of ore yielding 17,713 pounds of lead, 882 pounds zinc, 170 pounds copper, 3114 ounces silver, and 23 ounces gold (Geach 1972). This patented claim is located on a dry ridge.

Location: T06S R10W Sec 18 DBDB

Cottontail Group

BE004555

This prospect/mine is located on a large, bare to sparsely forested flat area. Trauerman and Waldron (1940) state that there is a 700' long tunnel located on a Cottontail group property in Beaverhead County, but no evidence for this was found in the field. The commodity listed for this location is gold, silver, zinc and manganese and ore minerals are black manganese and pink manganese (rhodochrosite/rhodonite). Either there is another "Cottontail group" or it was missed in this inspection. One small prospect was located on a high dry ridge, with brecciated limestone a ¾-inch quartz vein and no sulfides.

Location: T09S R11W Sec 22

Del Monte

BE000533

This is one of the few mines in this area hosted in granodiorite, although also associated with the Mississippian Madison Group (Geach 1972; Shenon 1931). Veins strike N80°E, and dip steeply south (Shenon 1931). The property consists of six patented claims including the Del Monte, Francis H., Bare Hill, Isabella, Maltby, and the Bonaparte (Sassman 1941). Veins in the granodiorite have high silver content (up to 500 opt) while veins in the limestone have low silver but high antimony (Geach 1972). Winchell (1914) reported that sulfide ore began at 80 feet depth with silver content

declining at 60 feet. Ore minerals included iron and manganese oxides, sphalerite, galena, chalcopryite, pyrite, polybasite, tetrahedrite, pyargyrite among others (Shenon 1931; Geach 1972). The mine is also associated with north and northeasterly trending faults. Workings consisted of a 253 foot shaft and a 600 foot long tunnel (Geach, 1972; MBMG mineral properties files). All workings have been fenced by DSL-AMRB. The mine operated from 1871 to 1941, primarily from 1935-1941. Recorded production consists of 394 tons of ore, yielding 206 lbs Pb, 228 lbs Cu, 7,397 ounces Ag and 20 ounces Au (Geach 1972). A grab sample (PGFH-1) taken from the Francis H. shaft's dump assayed 0.41 opt Au, 1.28 opt Ag, 0.01% Cu, 0.37% Pb, and 0.08% Zn.

Location: T07S R11W Sec 28 CABA

Dexter

BE000318

The Dexter workings consist of several shafts connected by a 260' adit, crosscuts, and stopes; all underground workings except one shaft (grated and locked) are inaccessible. The total surface disturbance is about 1 ½ acres. This mine site explores a vein consisting of garnetized limestone in the Devonian Three Forks Shale (Shenon 1931). The vein is associated with a granodiorite stock. Fracturing and alteration were noted in the wall rock of the adit. Primary ore minerals were partly oxidized galena, pyrite, and tetrahedrite (Geach 1972). An AIM grab sample assayed 658 ppm lead, 826 ppm zinc, 22 ppm copper, 2.4 ppm silver, trace gold, and 50 ppm arsenic. This mine was purportedly worked in the 1880's and well into this century. No published production figures were found. Judging from the size of the dumps, production must have been fairly substantial. This dry site is located on BLM land; there is no water component.

Location: T06S R10W Sec 17 BBCE

Dillon

BE000671

The Dillon mine is a fairly extensive group of adits and shafts located on a ridge in the central part of the district. An open daylighted adit/shaft(?) at the extreme south end of the property was found obscured by timber slash making it all the more dangerous. The depth is unknown. All other workings are completely caved with some slight daylighting to the surface possibly a hazard. One patented claim covers all workings here. There are no AMD's. Several of the openings were secured by DSL-AMRB with locked grates and culverts.

The mineralization is confined to a bedding-plane vein striking north and dipping 30° west in Cambrian Hasmark Formation (Geach 1972). The vein has been worked over a length of 800 feet and is as wide as three feet (Geach 1972). Secondary copper minerals were found on the dumps along with abundant iron oxides. Records show the

property was worked in 1935 (Geach 1972) but it appears to have had recent exploration also. Total production, again according to Geach, was 201 tons.

Location: T06S R12W Sec 23 BDAB

Divide Nos. 1 and 2 Claims

BE000065

The Divide 1 and 2 claims are located on the top of a dry mountain near the head of Kissick Canyon. The workings consist of dozer trenches and accompanying waste rock piles. Host rock appears to be granite gneiss; amphibolite and a highly siliceous gneiss(?) are also present. The only apparent sign of mineralization is limonite staining; the MILS database lists the commodity mined here as thorium. A white quartz vein trending NW-SE cuts through the southwest side of the workings and may be related to the mineralization. The primary disturbance at this location appears to be on private land; there appears to be no adverse impact on adjacent BLM land.

Location: T11S R11W Sec 09 ACCC

Durham Bull

BE000677

This mine was not located in the MBMG's 1994 survey although, as recently as 1972, Geach visited it and described the workings in MBMG's Bulletin 85 (1972). It was described as being in SE¼ of section 25; the entire ridge east of the Pinkerton Homestead was walked but no sign of any adits were found. The sketch in Geach (1972) shows the adit driven to the south/southwest and so presumably it should be on the northeast side of the ridge, but none could be found. The general topography here is dry and remote and so no hazards would be expected.

Schutz (1986) shows the claim in the SW¼ section 23, T6N, R12W which is probably the correct location. Workings would be either on private or BLM land. Historically the mine consisted of two adits; one of which was 150' long. There is no record of production; a selected sample by Geach (1972) ran 0.38 opt Au, 1.55 opt Ag, 2.28% Cu and 0.30% Zn.

Location: T06S R12W Sec 23 DBDA

Dyer (Dias/Dyce/Dies) Creek Placer

BE000203

This placer falls both on the Mill Point and Polaris 7 ½' quadrangles, on both private and BLM land. Geach (1972) theorized that the source of the gold were the contact deposits in the Baldy Mountain district; similarly, Lyden (1948) thought the gold came from the veins of the Faithful and Garrett claims. Production records are limited to 1908 when 100 fine ounces were taken out of Dyer and May creeks (Lyden 1948), but the placer was worked as early as 1868 to 1886 (Geach 1972). Old placer workings are evident on both private and BLM land to the west of BLM road 1878, and above the junction of east and west forks of Dyer Creek. One old water wheel remains at the junction of the east and west forks. An active (?) placer operation is located just

below the junction of East Fork Dyer Creek and West Fork Dyer Creek on BLM land. It was reclaimed during the summer of 1994 during the time of this study.

Location: T07S R12W Sec 02 DDCC

Elsie (Else) Claim

BE008019

This prospect has a fairly large open cut with a steep highwall but is also on a patented claim. Other prospects are smaller and seemly follow a shear or contact. There are no AMD's, access is by four wheel drive only and so the only hazard is remote.

Location: T06S R 12W Sec 15 ACDC

Excelsior

BE000743

One vertical shaft (capped) and one adit at the main mine, with several short adits associated with the property, comprised of three patented claims (Excelcior Extension, Excelcior Placer, and Excelsior Mill Site). Cretaceous granodiorite and a quartz porphyry dike intruded Mississippian Madison limestone as shown on a mine map (Geach 1972). A 2' wide vein which was mined trends S37°E and minerals associated with the Excelsior include garnet, calcite, specularite, chlorite, tetradymite, native gold, quartz, siderite, manganese oxide, and auriferous pyrite. Production from the Excelsior spanned from 1872 when it was patented and was last worked in 1963 (no ore); the mine was most active between the years of 1902, 1911-14, and 1917-19. Historical production records show that ore averaged of 0.788 opt Au, 2.16 opt Ag, 2.09% Cu; a select chip sample assayed 0.001 opt Au, 0.05 Ag, 0.03% Cu, and no lead or zinc (Geach 1972). Other references include Shenon (1931), Lowell (1965), and Sassman (1941). The area has been secured by DSL-AMRB with an expanded metal grate over the shaft and a cable mesh on the adit. Other openings have been backfilled and recontoured. One wooden headframe remains at the site.

Location: T08S R11W Sec 08 CADB

Faithful

BE008017

See write-up for Old Favorite site.

Location: T06S R12W Sec 24 CABC

Firehole

BE000695

Geach (1972) reported 300 feet of workings driven S20°W in dolomite. He also states there is no record of production and no ore minerals. It was screened out. It is on private land.

Location: T06S R12W Sec 08 A

French Lode

BE004015

The French Lode is a patented claim located on a dry hillside in section 8, and has been entirely secured and reclaimed by DSL-AMRB. Originally it had four adits and three shafts, all of which have been backfilled or culverted (DSL-AMRB 1990). It is also associated with Mississippian Madison limestone and Cretaceous granodiorite.

Location: T08S R11W Sec 08 CCBA

Galena

BE000276

The Galena mine, approximately ¾-mile east of the Dexter, consists of two caved shafts(/), a caved adit(?), and several small dumps. Total surface disturbance is less than one acre. The workings explore a vein deposit in the Mississippian Madison limestone; the vein strikes S20°E and dips 70°S (Shenon 1931). Ore minerals included galena, pyrite, and some tetrahedrite (Shenon 1931). Present-day evidence of mineralization includes only limonite staining on the dump rock. An AIM sample assayed 1,210 ppm lead, 1,530 ppm zinc, 99 ppm copper, 3.6 ppm silver, trace gold, and 256 ppm arsenic. No operational dates or production figures were found for this mine. This BLM site is located on the south side of a dry gulch; there is no water component.

Location: T06S R10W Sec 17 BDDB

Gold Bug & Bluegrass Claims

BE000689

Originally the Dakota group of claims, this now consists of two patented claims with some disturbances on adjacent BLM land. Workings included a 310' shaft, 345' tunnel, with a 135' winze below tunnel (Geach 1972). Production occurred largely between 1922-1941, and estimates ranged from \$60,000 to \$550,000 (Sassman 1941). Additionally, a mine map shows over 700' of workings in the Gold Bug and 1770' of workings total. Historical records show 2,353 tons of ore yielded 2,181 oz Au, 4,830 oz Ag, 32,073 lbs Cu, and 7,437 lbs Pb (Geach 1972). Minerals include disseminated pyrite, quartz, oxidized, massive brown iron oxide, local copper staining, specularite, epidote, coarse garnet, and calcite (Geach 1972). Replacement veins commonly 2'-3', up to 15' maximum, occur along a dike/limestone contact trending N80°W according to Geach (1972), but according to Shenon (1931), the deposit trends N50°W and rakes north 25°. This area has been extensively reclaimed by DSL-AMRB in the early 1990's. The few remaining adits extend 10-15' into the slope and pose no real hazards, in fact they may provide wildlife habitat.

Location: T08S R11W Sec 05 DCCC

Golden Leaf

BE000563

This is a very large, complex of mines and three successive mills, largely reclaimed by DSL-AMRB. Grasshopper Creek has been rip-rapped along the entire length of tailings

except for the short length in front of the Priscilla mill. The 1,100' x 300' reddish tails have not been capped, although well revegetated by sagebrush and wildflowers, so some wind erosion occurs. Northern Testing (1982) determined that there were 19,200 cubic yards of tailings from 1.5 feet to 15 feet thick, but Pioneer Technical Services (1994) estimated total tailings in two separate impoundments as 89,000 cubic yards. All the adits have been secured, and most of the dumps recontoured.

There was at least three adit levels, totaling between 10,000' (Geach 1972) and 18,000' (Heinrich 1949) of workings for the entire group. Mill-types includes a 250-ton mill, a 100-ton cyanidation mill, and a 125-ton continuous decantation cyanide plant with a zinc-dust precipitation unit (Geach 1972). The deposits occur along the western margin of the Bannack Stock (Kgd) and its apophyses in Mississippian Madison limestone. The ore occurs outside garnetized zones adjacent to the stock (Geach 1972). Minerals listed for this site include: tetrahedrite, chalcopyrite, quartz, calcite, garnet, iron oxides, cerussite, anglesite, galena, smithsonite, and pyrite (Geach 1972) and additionally, according to Shenon (1931), native gold, malachite, azurite, chrysocolla, tenorite, sphalerite, native sulfur, specularite, magnetite, limonite, epidote, siderite, vesuvianite, and manganese oxide.

Dates of operation include: 1909-14, 1925-26, 1937 and 1955 (Geach 1972). In this period, the Wadams and Golden Leaf produced 2,921 tons ore, yielding 10,472 oz Au, 29,455 oz Ag, 7,001 lbs Cu, 100,781 lbs Pb and 300 lbs Zn.

Location: T08S R11W Sec 08 BCBA

Goodview BE000210

The Goodview mine consists of two adits, an inclined drift, and several dumps; all underground entrances were caved in 1994. The site covers approximately one acre. The mine explored a replacement body in thinly bedded shaley limestone (Cambrian Wolsey shale). The limestone strikes N20°E and dips 35°SE; the deposit is at the intersection of this limestone and a fissure striking N5°E and dipping 85°SE (Geach 1972). The ore shoot was apparently 40' long and 10' wide; it was composed of earthy, oxidized lead minerals. Below the limestone was an altered zone containing quartz grains and impregnated with iron oxide (Geach 1972). An AIM sample assayed 7,760 ppm lead, 3,660 ppm zinc, 228 ppm copper, 26.8 ppm silver, trace gold, and 2,740 ppm arsenic.

Total recorded production for this mine was 1,080 tons yielding 163,934 pounds lead, 2,204 pounds zinc, 742 pounds copper, 7,403 ounces silver, and 179 ounces gold. Production was recorded in 1941-1942, 1948, 1950, and 1954. This dry site is located on BLM land. Geach (1972) contains a geologic sketch (plan) map.

Location: T06S R10W Sec 18 CCAC

Grasshopper Claims No.1

BE000216

These unpatented claims are located in section 9, T8S, R11W; in open, unforested dry country on BLM land. Four or five prospect pits are located in the saddle where the dirt road forks either to Bannack or to the Bon Accord. The prospects are located in a Tertiary/Cretaceous breccia (Ruppel *et al.* 1993). PVC claim posts trend N-S along this ridge and another line trends N-S along the valley to the east. No physical or environmental problems are foreseen.

Location: T08S R11W Sec 09 BDBA

Grasshopper Creek Occurrence

BE000960

This occurrence, located on the Dalys 7 ½'-quadrangle, is supposedly a volcanic ash occurrence. The only reference (which was not located) is the USBM files (Anonymous MBMG mineral property files. Room 213, Main Hall, Montana Tech, Butte).

Location: T08S R10W Sec 26 DBBB

Grasshopper Placer

BE000078

The exact location of this placer is unclear, but is probably presently considered as a part of the Bon Accord placer. The location as plotted on the topographic map is now a cow pasture with old machinery dotting it (trucks, excavator, dozer).

Location: T08S R11W Sec 15 CBDA

Grasshopper Placer, No.1 & No.2

BE004310

Once again, this may be a case of a general name applied to placers located along Grasshopper Creek. Patented placer claims line the creek bed and adjacent land but surrounding land is largely BLM. According to Gilbert (1935) and MBMG Memoir 20 (1940), 150 cubic yards of gravel was moved in 1934 at six unpatented claims and \$4,000 total production came from the Grasshopper placers as of 1939.

Location: T08S R10W Sec 29 CAAA

Grasshopper Prospect

BE008022

This prospect was the subject of a master's thesis by Meyer (1980). The mineralization occurs in a Cretaceous dacite porphyry in a two mile diameter alteration system.

Location: T08S R11W Sec 11 BACA

Graybird Group

BE000300

The Graybird group consists of six unpatented claims; principal work has been on the Graybird No. 1 claim along a 70' surface cuts. The cut has been made along an

intensely kaolinized and sericitized granodiorite(?) dike and thin-bedded, partly marmorized and chloritized limestone in the Amsden Formation (Geach 1972). The contact strikes N20°W and dips 67°NE; the vein material exposed consists of reddish-brown jasper with galena and cerrusite (Geach 1972). The only present-day indication of mineralization is iron oxide staining of dump and wall rocks. An AIM sample assayed in excess of 10,000 ppm for both lead and zinc, 80 ppm copper, 7.6 ppm silver, trace gold, and 374 ppm arsenic. Production was recorded in 1961 and 1965 but actual figures are confidential. Judging from the size of the dumps, production was modest. This dry site is located on BLM land.

Location: T06S R10W Sec 29 ACDA

Gray Goose

BE000017

The Gray Goose claims are located on a dry ridgeline in sections 15 & 22 (T 11S; R 11W; Beaverhead County, Montana). Workings consist of bulldozer trenches and accompanying waste rock piles. Host rock is coarse-grained granite gneiss cut by thin, white quartz veins. The MILS database lists uranium as the principal commodity here; the only apparent sign of mineralization is limonite staining. These workings are located on BLM land; all workings are dry and pose no apparent environmental threats.

Location: T11S R11W Sec 22 BBAD

Grizzly Bear

BE000701

DSL-AMRB has already secured one vertical shaft here and accessibility is difficult and remote. A shaft has been grated but the adits are partially open to an unknown length. No AMD's or open adits are present although some slight danger exists from steep highwalls and partially open adits that someone could squeeze through. A northeast-trending adit has a glory hole or cave to the surface. An upper adit has four partially open branches. The workings are located on one patented, private claim.

Loen and Pearson (1989) describe this as being located in Devonian Jefferson Dolomite and Geach (1972) describe the mineralization as quartz and a copper-stained sulfide (tetrahedrite ?). The dump contains orange, iron-stained dolomite and some fault breccia. The upper dump has drusy quartz crystals, gray cherty material, boxwork, and very fine grained limonitic material with recemented dolomitic clasts.

Location: T06S R12W Sec 22 ACBB

Ground Hog

BE000222

The Ground Hog mine consists of five shafts, one 200' tunnel, 300' of drifting, and several small to moderately sized dumps. This is an active mine employing a cyanide leaching operation. This mine explores a shear zone in the Cambrian Flathead sandstone; the zone trends N30°W and dips 80°NE (Geach 1972).

Gangue mineralogy was brecciated and recemented quartzite; ore minerals included gold, silver, lead, and zinc (Geach 1972). Gangue mineralogy is brecciated and recemented quartzite; ore minerals include gold, silver, lead, and zinc (Geach 1972). An assay map of the underground workings show a range for gold values from a few cents to \$25.00/ton (Geach 1972). The site was located in 1895 and has probably been intermittently operated since that time; production records are not available (Geach 1972). This mine consists of one patented claim and six unpatented claims (Geach 1972); it is adjacent to BLM land. Geach includes a longitudinal section of this mine and several underground maps in his 1972 publication; additional surface sketch (plan) maps exist in the MBMG files.

Location: T06S R10W Sec 18 CACD

Gulch Placer

BE004315

There is no patent number for this placer but the topographic map shows it as private. It also is presently considered to be part of the Bon Accord placer. It is an active (?) operation, or at least in the process of being permitted. The location accuracy is +/- five kilometers, and Gilbert (1935) lists it as located four miles southeast of Bannack. Records show 1,000' worked in 1934, producing \$759.68 (Gilbert 1935). In 1939, the miners handled five cu yds per day (Trauerman and Waldron 1940). The MBMG's mineral property files show the placer was worked in 1933-35, 1939, 1942, 1946 (Anonymous no date).

Location: T08S R11W Sec 22 ACAB

Hendricks

BE000509

Most of the Hendricks mine is within Bannack State Park, on the south side of Grasshopper Creek, it is owned by a combination of the Bannack State Park (Montana FWP), private and BLM. It has been extensively studied by Northern Testing (1982), DSL-AMRB (1990), Pioneer Technical Services (1995) (as the Apex millsite), and Department of Fish, Wildlife and Parks. The mine is hosted in Mississippian Madison limestone (close to the Amsden contact) and probably not associated with any intrusive (Geach 1972; Shenon 1931). Workings include a lower tunnel called the Graeter Tunnel, Gibson Tunnel, and Stallings Raise; estimates of workings length range from 600' (Gilbert 1935) to 1,550' (Shenon 1931) to 2,700' (Geach 1972).

Mineralogy includes yellow, red and brown iron oxides (gold bearing), garnet, and fault gouge (Geach 1972). Ore occurs in bedding planes (one at least 8' thick) in six different shoots (Geach 1972; Shenon 1931). Production was 1918 to 1961, mainly from 1919-21 and 1933-41 (Anonymous no date); total recorded production was 23,594 tons ore yielding 5,299 oz Au, 4,979 oz Ag, 296 lbs Cu, and 251 lbs Pb.

Mills at the site progressed from a 5-stamp mill in 1918, to a ball mill, classifier and two cyanide tanks added in 1919 to a 10-stamp mill in 1920 (ball mill, classifier, two

agitators, four thickeners, and six cyanide tanks) to a 50-ton ball mill in 1934. Tailings total 60,800 cubic yards (or 79,800 cubic yards according to Pioneer Technical Services (1995), ranging from 3' on the edges to 15' thick in the center (Northern Testing 1982). The state DSL-AMRB has rehabilitated the mill, fenced, posted and gated all structures and openings, and has more plans for future work (Dale Herbort, personal communication, 1994).

Location: T08S R11W Sec 07 ABCC

Henneberry Ridge Syncline

BE000874

No field visit was conducted because this is another phosphate occurrence and there is no record of production, although ownership is BLM. The horizon of interest is the Retort Phosphatic Shale Member. Swanson (1970) notes the phosphate is found in oolitic to pelletal sedimentary apatite and the average grade is 8% P_2O_5 .

Location: T09S R11W Sec 02 DABA

Hidden Pasture Creek

BE004445

The Hidden Pasture Creek (uranium) prospect site consists of several trenches and minor accompanying waste rock. The prospect is located about 1.5 miles up Hidden Pasture Creek drainage (access is by non-mechanized trail). Total surface disturbance is approximately one acre. This prospect appears to be a phosphate deposit (Phosphoria Formation); minor uranium values were probably reported. Most of the area has been revegetated and there is no water component at this site; no apparent environmental problems exist.

Location: T13S R10W Sec 26 CADB

Hillside Placer/Thompson Mine

BE004060

This patented claim group covers 90 acres (DSL-AMRB, 1990) and is located in the center of several of the other lode claims (Anon, MPF, Rm. 213). The other mines are described individually. All of the placer workings along Grasshopper Creek have been recontoured and reseeded (with the exception of the Excelsior placer).

Location: T08S R11W Sec 08 CBBA

Hope Placer

BE004450

One patented placer claim located immediately north of the town of Bannack. No environmental problems and no physical hazards.

Location: T08S R11W Sec 06 CADB

Huron (Cottontail)

BE000132

This group of unpatented claims has an amazing amount of openings, both adits and shafts and is located north of the Kent mine in SE¼ section 28, T8S, R11W. At least nine shafts and eight tunnels were accounted for in a Dillon Tribune article found in the MBMG mineral property files (1967). All have been grated, fenced, cabled or culverted by DSL-AMRB. Two major fissure veins trend N80°E and N65°E, about 80 feet apart, and dip steeply south (Geach 1972). There are five veins in all (MBMG mineral property files, Dillon Tribune article).

Ore and gangue mineralogy includes iron and copper stained quartz, jasper, calcite, minor galena and brown-black manganese oxides (Geach 1972) and additionally cerargyrite and sulfides (Shenon 1931). Sample PGHC-1 assayed 0.078 opt Au, 9.2 opt Ag, 0.20% Cu, 0.47% Pb, and 0.25% Zn. Production yielded 129 tons of ore, with 1730 lbs Pb, 200 lbs Zn, 1869 lbs Cu, 7334 ounces Ag and 7 ounces Au (Geach 1972). Production spanned from 1864 to 1953; with the only consecutive years being 1872-73, 1882-1885, 1918-1919 and 1936-1937 (Geach 1972).

Location: T07S R11W Sec 28 DBCD

Ingersol Group

BE000545

This is a repeat of the Ingersol mine, probably including the Colonel Ingersol, Bob Ingersol, Contact and Silver Rose patented claims located in NE¼ sec 4, T8S, R11W. Location: T08S R11W Sec 04 ABBA

Ingersol Mine

BE000545

This is composed of several adits and shafts all secured by the DSL-AMRB in NE¼ section 4, T8S, R11W. Mississippian Madison limestone is in thrust contact with Tertiary andesite (Shenon 1931, Geach 1972), with ore as replacement veins in the limestone (Leon and Pearson 1989). A select sample by Geach (1972) assayed 7.75% Pb, 5.60% Zn, 0.30% Cu, 8.7 opt Ag and 0.02 opt Au. Ore and gangue minerals include brown, iron stained quartz, pyrite, sphalerite, and chalcopryrite (Geach 1972) in addition to quartz/calcite, cerussite, cerargyrite, bromyrite (?) and malachite (Shenon 1931). The area was discovered in the 1860's, with most work done between 1918 and 1941 (specifically 1934-41, MBMG-MPF, room 213) yielding 511 tons of ore: 20,300 lbs Pb, 2,000 lbs Zn, 3,185 lbs Cu, 10,922 ounces Ag, and 13 ounces Au (Geach 1972). The property consists of several adits caved at the portals and, upslope, two vertical shafts. Geach (1972) and Shenon (1931) refer to a 200 foot deep winze and a 150 foot tunnel connecting the winze to the surface, with a total of 1,500 feet of workings.

Location: Location: T08S R11W Sec 04 ABBA

Iron Age Claim

BE004040

This claim was screened out due to the fact that it was associated with the active New Departure mine, the host rock is Mississippian Madison Limestone, the ore is magnetite and workings were described as a shallow pit (MBMG mineral property file). The only ore produced was probably used as flux.

Location: T07S R11W Sec 26 BABA

Iron Mask Mine

BE000551

This mine is similar to the Del Monte in that the ore is hosted in veins in Cretaceous granodiorite (Geach 1972). Ore and gangue minerals include quartz, pyrite, manganese oxide, calcite, iron oxides, with sulfides in the lower workings (Shenon 1931). Assay sample PGIM-1 resulted in 0.038 opt Au, 10.3 opt Ag, 0.03% Cu, 0.43% Pb and 0.67% Zn. Workings include one shaft, originally 200' deep, presently caved at the collar, with other adits in the area all caved. There are abundant sulfides on the dump but the area is so dry they are not perceived as a problem.

Location: T07S R11W Sec 28 DDDD

Iron Mountain Area

BE000749/BE000869/BE000438/BE000204/BE000306/BE000251/BE000312

The Anaconda, Brownell, Copper Bell, Goldsmith, Hand (Maudline), Iron Mountain, and Jack Rabbit mines are located on or near Iron Mountain, near Argenta. These workings consist of numerous trenches, pits, shafts, adits, and dumps. Total surface disturbance is in excess of 100 acres. The mines are located at or near the contact of the Madison limestone with the Argenta quartz monzonite stock. The deposits are in a strongly mineralized area measuring approximately 1200' east-west and more than 1200' in length north from the contact (Geach 1972). The ore bodies are irregular fissure veins cutting the limestone country rock or replacement deposits at or near the quartz monzonite contact (Geach 1972). The principal ore minerals include massive brown cerussite, limonite, and patches of dark-gray anglesite (Geach 1972). Dump and wall rock throughout this area is heavily iron-stained. Production from this group of mines has been substantial and includes lead, zinc, copper, silver, and gold.

The Iron Mountain mine sites are dry; no mention of ground water in mine shafts was made in the literature. These mines are situated on patented ground adjacent to BLM land. Geach includes an underground map of the Goldsmith mine and two longitudinal section maps of the Hand mine in his 1972 publication.

Location: T06S R10W Sec 29 BBBB, T06S R10W Sec 30 AAAD, T06S R10W Sec 29 BCDD, T06S R10W Sec 30 ABDB, T06S R10W Sec 29 BBCC, T06S R10W Sec 30 ADAD, T06S R10W Sec 29 BCBA, respectively.

Jeanette
BE000539

This unpatented claim has no record of production and no mill site. Geach's (1972) description of the Jeanette resembles more closely the Randall mine in location and physical aspects. The chip sample taken by Geach ran 7.35% Pb, 0.40% Zn, 0.07% Cu, 5.2 ounces Ag, and 0.001 ounces Au taken in dark brown jasper, quartz, and manganiferous limestone. Field reconnaissance found several prospects in limestone and a lower adit (caved) in granodiorite on BLM land where an unpatented claim might be located.

Location: T07S R11W Sec 33 ACAD

Kent
BE000672

The Kent mine produced approximately \$750,000 with production spanning from its discovery in 1864 to 1935, with most production in 1907-10, 1917-19, 1928, and 1935 (Geach 1972). It appears that it has been worked more recently (1950's through 1980's ?). It may have been mined at one time by Carl Brown Mining, the same outfit that presently mines the New Departure. There are extensive workings to the west of the main mine, largely secured by DSL-AMRB, but with one open shaft remaining. Most of the workings are on private patented claims but the workings probably extend on BLM land. Shenon (1931) reported an 850 foot tunnel and maps show two west-trending tunnels, the Blue Wing Tunnel and the Whopper Tunnel, with a drift to the north.

The host rock is Mississippian Madison limestone with ore in close proximity to Cretaceous granodiorite (Geach 1972). The ore was found associated with limestone altered to a chocolate brown color. Ore was found in fissures and in pipe-like bodies (Geach 1972). Ore and gangue minerals include quartz, calcite, galena, tetrahedrite, jamesonite, sphalerite, covellite, pyrite, jalpaite (?), cerargyrite, bindheimite, linarite, caledonite, cerussite, anglesite, malachite, azurite, chrysocolla, smithsonite, calamine, limonite, and manganese oxide (Shenon 1931; Geach 1972).

Location: T07S R11W Sec 33 AACB

Laurilene No.1 Claim
BE004415

An unpatented, supposedly manganese, claim located in an unnamed gulch in section 5, T8S, R11W. The host rock is altered Madison Limestone with narrow iron-stained quartz and jasper veins (Geach 1972). There is no record of production (Geach 1972). Workings include three adits: 100' upper adit, 200' middle adit, and 150' lower adit (Geach 1972). All openings have been backfilled by the DSL-AMRB.

Location: T08S R11W Sec 05 CDAB

Leonie Tunnel Prospect

BE004490

This prospect consists of an almost completely caved adit estimated at 100' to 200' in length driven westward in Cretaceous granodiorite. The dump is composed of iron-stained granodiorite, with minor small calcite veins with trace sulfide (pyrite?). A dump grab sample, PGLT-1, assayed 0.002 opt Au, 0.01 opt Ag, 0.002% Cu, 0.03% Pb and 0.01% Zn. Lowell (1965) shows the geologic setting of the Leonie Tunnel prospect.

Location: T07S R11W Sec 28 DDBA

Little Hawk and Little Hawk Mill

BE000756, BE008020

The Little Hawk consists of a large ridge-top open cut with one or two minor underground exploration tunnels. There is an open inclined shaft to the southeast.

Below the ridge is a gravity mill in poor condition and tailings impounded in good condition. No runoff was observed and the only possible erosion would be from wind on the dry, unconsolidated, silt-sand sized tailings. The area is reasonably revegetated with sagebrush and grasses. Analysis of the tailings both by the MBMG and Pioneer Technical Services removed this site as a possible environmental problem. Assays from a composite sample from the Little Hawk tailings (PGLH-1) assayed 0.006 opt Au, 0.02 opt Ag, 0.05% Cu, 0.001% Pb, and 0.003% Zn.

Location: T06S R12W Sec 15 AACB/T06S R12W Sec 14 BCBA

Logan

BE004500

Probably the same as Lone Star/Silver Star/Skeets mine (Loen and Pearson 1989). Trauerman and Waldron (1940) also mention Logan Properties, which may or may not be the same mine. Lowell (1965) shows the geologic setting of the Logan mine.

Location: T07S R11W Sec 33

Lookout

BE004515

The location for the Lookout mine in section 5, T8S, R11W is not accurate enough to identify the workings. There are several unidentified mines that may be the Lookout but all have been reclaimed by DSL-AMRB, and so, are not a concern. Winchell (1914) reported the Lookout had gold telluride ores and auriferous pyrite; the pyrite is associated with garnet, calcite, specular hematite, epidote and bornite. Production is noted in 1939 of 13 tons of ore yielding 11 oz Au, 158 oz Ag, 7 lb Cu and 1442 oz Pb (Geach 1972). The mine is unpatented and located on BLM land. Loen and Pearson (1989) list the Lookout as being in Mississippian Madison Group in contact with Cretaceous granodiorite.

Location: T08S R11W Sec 5 CDDD

Mayflower
BE000683

The Mayflower was visited but the workings (two prospects/shafts?) were not located where the patented claim plotted on the map. The workings that were found had no AMD's or physical hazards. The larger one is completely caved and the smaller one still has stulls visible down it. Access is very difficult (by 4wd only); the site is remote, and there is not a direct access.

Location: T06S R12W Sec 22 DCBD

Miss Grundy
BE000707

Miss Grundy is a private, patented claim hosted by Devonian Jefferson dolomite (Loen and Pearson 1989) while Geach (1972) places it in quartzite. Geach also lists it as having no record of production, all oxide, and the adits caved. The site was screened out for the reasons listed.

Location: T06S R12W Sec16 ACDA

Missouri Prospect/ Box X
BE003945

This mine is also known as the Box X unpatented claim (from the location notice by Bill Hand (1986) at the portal). According to Lowell (1965), this prospect is located in a Tertiary tuff but at the portal the rocks appear to be a limestone breccia, with possible volcanics above on the hillside. The dump here and above in the hillside have both been reclaimed by DSL-AMRB and the adit (N75 °W) is collapsed. Dump material appears to have been limestone breccia, a volcanic clast breccia in addition to secondary copper minerals, calcite veinlets, and reddish-brown to dark brown limonite. Dump material on one of the NW-trending upper prospects, possibly a backfilled shaft, was sampled (PGBX-1) and assayed 0.003 opt Au, 1.0 ppm Ag, 1,230 ppm Cu, 342 ppm Pb, and 908 ppm Zn. The only other anomalous elements were vanadium at 408 ppm and arsenic at 3,590 ppm. The sample consisted of dark brown, limonitic stained rock with minor carbonate and quartz veins, with trace secondary copper stains and yellowish, very fine grained void fillings between the dark brown stringers, with no sulfides.

Location: 08S 11W Sec 09 CDAC

Nelson Prospect
BE003950

This prospect is located on private land, and is referenced by Sahinen (1934) and by Geach (1972) who quotes Sahinen. A 15-foot adit and several prospect pits are the only noted workings. The prospect is located on the fault contact between Cretaceous rhyolite and andesite. The property was screened out because of these reasons. The general area was viewed from the highway and no disturbances were noted.

Location: T07S R11W Sec 12

New Departure Mine

BE000024

The New Departure is currently being mined by Carl Brown under an active mining permit. It is the largest single producer in the area, with total production estimates of \$1.5 to \$3.0 million dollars from a group of seven patented claims covering 119 acres. Workings exceeded one mile in length of adits, drifts and raises in 1935 (Gilbert 1935; Lowell 1965). It was located in 1871 and was principally operated in the 1880's, in 1905, 1918, from 1923-28, 1928-41, 1948, 1952, and 1958-65, and presently. According to a November 24, 1963, Montana Standard article, the New Departure consisted of a group of seven claims and the ore consisted of a mixture of silver and lead sulfides (argentiferous galena).

Oxide ore minerals include cerargyrite, cerussite, bindheimite, smithsonite, anglesite, malachite, azurite, gypsum and iron and manganese oxides. Sulfide minerals include sphalerite, galena, argentiferous tetrahedrite, argentite and wulfenite (Geach 1972; Shenon 1931). Other authors also listed chalcopyrite, pyrite, and polybasite as being present (Pearson and Childs 1989). The Stapleton Tunnel also has high grade manganese ore (pyrolusite and psilomelane) (Shenon 1931). Sheldon (1919) reported water in workings, which was one of the reasons the Blue Dot Tunnel was driven. The ore is located in veins from 1" to 10' in width in Mississippian Madison limestone -in a limestone breccia- in fault contact (thrust) with Tertiary andesite (Geach 1972). Within the veins, ore occurs in shoots (Winchell 1914).

Location: T07S R11W Sec 26 BCAD

Nick Preen

BE000713

No hazards or AMD's are associated with this group of mines. One cabin in poor condition remains standing. All adits are caved except for one which is almost totally caved. Eight- to ten-inch Douglas fir trees are growing on the waste rock dumps. Two adits are located to the east of East Fork of Dyce Creek; they may have been worked at a later date. The site is on BLM land.

Location: T06S R12W Sec 14 ADCC

Old Favorite

BE000629

The Faithful was probably the largest producer in the district. Production totaled 1,037 tons of ore yielding 69,512 pounds Pb, 6,700 pounds Zn, 2,582 pounds Cu, 1,576 ounces Ag, and 268 ounces Au. Sassman (1941) states that in 1894 a Burlington mill was constructed by the Old Faithful Mining Company. Sassman (1941) also states that little mining had occurred in this district since the late 1800's. Tailings were dumped in the dry drainage; a flake of free gold was found in a piece of siliceous breccia on the tailings pile. The vein here is composed of red-brown jasper, goethite, limonite, manganese oxide, with blebs of pyrite and galena (Geach 1972). Workings explored the north-south vein for 1,200

feet; the vein averages three to five feet wide. Host rock reported includes Mississippian Madison Limestone or Pennsylvanian Quadrant Sandstone (Winchell 1914) or Cambrian Hasmark Formation (Loen and Pearson 1989). Workings include a 250 foot deep shaft (presently caved) with 300 feet of workings driven off it.

Assays from a composite sample taken across the face of the dry tailings (PGOF-1) ran 0.071 opt Au, 0.09 opt Ag, 0.62% Cu, 0.02% Pb and 0.03% Zn.

Locations: T06S R12W Sec 24 BCDD

Osterly Prospect

BE000719

This is another mine which was never positively located, although Geach (1972) associated it with the Nick Preen mine. The Wild Bat is also described as being 1,000 feet southwest of the Osterly. Located in the NE ¼ section 14 near a small knob on the ridge above the East Fork Dyce Creek, only small caved workings remain. No problems were associated with any of the mine workings. The site is on BLM land.

Location: T06S R12W Sec 14 ACCB

P & R

BE003970

Accuracy here was +/- five kilometers; the workings consisted of 150 feet of tunnel and a 25 foot winze according to a mineral property file in the MBMG and Trauerman and Reynier (1950). The mineral property file also quotes the grades associated with this site as 175 to 1,125 opt Ag and 11% to 60% Pb, which leads to some doubt as to the credibility of the information. The site was screened out because of inaccurate location.

Location: T06S R12W Sec 22

Peterson Creek Syncline

BE000616

Located in the Permian Phosphoria Formation, this occurrence is west of the Cedar Creek syncline. The area is covered to the west by Tertiary deposits and to the north by Madison Group thrust over the Phosphoria and Tertiary deposits. Swanson (1970) describes the ore as oolitic to pelletal sedimentary apatite. The average grade from literature is 7.5% P₂O₅ (Swanson 1970). Several prospects are in the area, dug on a few local quartz veins.

Location: T09S R11W Sec 27 CAAC

Pioneer

BE003995

According to Geach (1972), this patented mine in Mississippian Madison limestone operated in the 1930's, with total production figures of 432 tons of ore yielding 384 oz Au, 103 oz Ag, 1,800 lb Cu and no Pb or Zn. It is located west of the road leading up to the Gold Bug and Bluegrass claims as shown by Lowell (1965). The mine was

intended to drift to a downward extension of the Gold Bug and Bluegrass ore bodies (Geach 1972). The shaft is open but fenced and the adit secured by a culvert and grate installed by DSL-AMRB. No environmental hazards and no physical hazards present.

Location: T08S R11W Sec 08 BAAC

Pomeroy
BE000557

The Pomeroy mine is also known as the Brick Pomeroy, the Silver Buckle and the Silver Belt (two patented claims on which the mine is located). It was operated in the 1860's and 1870's, 1880's, 1908-09 and 1966-67 (Geach 1972). Workings are described as from anywhere from three to ten shafts, all of which have been secured by DSL-AMRB by fencing or expanded metal grates. They ranged in depth from 20-80 feet (MBMG mineral property files). The main working consisted of an inclined shaft with an open stope to the surface (Shenon 1931). A chip sample across two feet of gouge by Geach (1972) assayed 0.20% Pb, 0.40% Zn, 1.25 opt Ag, and 0.003 opt Au. The main vein trends northeast-southwest and dips 60-75°NW (Geach 1972; Shenon 1931). A dump grab sample (PGPO-1) assayed 0.009 opt Au, 3.24 opt Ag, 0.02% Cu, 0.08% Pb and 0.04% Zn.

Location: T07S R11W Sec 28 BBCC

Priscilla
BE003955

The Priscilla mine is along the south side of Grasshopper Creek, in the NW ¼ section 8, T8S, R11W. It operated from 1938 to 1941, producing 1,244 tons of ore yielding 399 oz Au, 1,959 oz Ag, with no Cu, Pb, or Zn from garnetized limestone (Mm in contact with Kgd)(Geach 1972). A 15' vein was noted by Shenon (1931). Minerals found on the dumps include pyrite with chalcopyrite, quartz, calcite, garnet, secondary copper minerals, specular hematite, epidote, and iron oxides. There is a timbered portal with an open door, the ruins of a mill (concrete foundations with a few burned timbers) and approximately 50' of streamside tailings. Abandoned core and cuttings are exposed to the weather and five 55-gallon drums were left on a cart near the top of the hill. Pioneer Technical Services (1995) lumped this site with the Gold Leaf and estimated total tailings as 89,000 cubic yards.

Location: T08S R11W Sec 08 BBDB

Randall
BE000503

The Randall mine is a patented claim, found in the 1860's and operated intermittently until 1939 (Shenon 1931; Geach 1972). Total production was 26 tons of ore producing 322 ounces of silver and one ounce of gold (Geach 1972). A line of prospects extends ENE-WSW approximately N80°E. Geach (1972) describes this property as the Jeanette claim, but according to the land ownership lines on the topographic map, the prospects along the road and those to the west are the Randall.

The deposit is considered to be replacement along east-striking fissures in Mississippian Madison limestone (Shenon 1931; Geach 1972). A granodiorite intrusive is assumed to be close by as inferred by Shenon's geologic map. The ore mineral here is argentiferous galena (Shenon 1931). There are no hazards and no water present.
Location: T07S R11W Sec 33 ACBC

Ruth
BE000882

The location of the Ruth mine was determined to be a group of six unpatented claims on BLM land with the only production in 1934 (Anon, MBMG mineral property files). The general area where the mine was supposedly located was visited and some evidence of a mining operation was found along BLM road 1847 in SW ¼ section 33 but no hazards were noted. There is a possibility that the Ruth and the Logan (therefore the Lone Star also) are the same mine. Gilbert (1935) states that the owner of the Ruth is W. Logan. He also states that the ore is in limestone.
Location: 07S 11W Sec 33

Salt Mountain
BE003810

The Salt Mountain mine location has an accuracy of +/- 5 kilometers and no other information listed and so was screened out.
Location: T06S R12W Sec 22

Silver Belle (Belt) Group
BE000390

The Silver Belt is a patented claim group which, according to a MBMG mineral property file claim map is approximately where the Pomeroy mine is located. There is another Silver Belt mine in the Bryant district (Geach 1972). There is evidence of recent exploration work here (drill roads and pads) and all openings have been secured by DSL-AMRB either by expanded metal grates or barbed wire fencing.
Location: T07S R11W Sec 28 BBCC

Silver Buckle Group
BE003855

This is the patented claim immediately to the west/southwest of the Silver Belt claim according to the patented claim map in the MBMG mineral property files. It is part of the Pomeroy mine workings but has only several prospect pits and shallow shafts on it. There is no water and no real hazards.
Location: T07S R11W Sec 29 ADBA

Silver Rose

BE003800

Lowell (1965) shows this mine to the southwest of the (Col.) Ingersol mine and to the northwest of the Charter Oak mine. Five unpatented claims comprise the group (Gilbert 1935). It was worked as early as 1885 according to Sassman (1941). Mississippian Madison Limestone hosts the vein which was mined here (Gilbert 1935). Field investigation found an open adit with a winze and an open shaft (only 10'-15' deep, but steep sides).

Location: T08S R11W Sec 04 ABCB

Silver Star (Lone Star)

BE000569

This patented claim is located in SE¼ section 33 and is located by Shenon (1931) but not on the patented claim map in the MBMG mineral property files. It is hosted in Mississippian Madison limestone in fault contact with Tertiary andesite (Geach 1972). Ore occurs as replacement veins in the limestone (MBMG mineral property files). According to Geach (1972), the ore and gangue minerals are quartz, manganese oxides, calcite and according to Shenon (1931) minerals include reddish-brown iron oxide and secondary copper-silver minerals.

One adit here is secured by a culvert and expanded metal grate while the other adit is caved. A lower adit is also caved.

A chip sample taken by Geach (1972) ran 0.02% Pb, 0% Zn, 0.55 opt Ag, 0.005 opt Au, and a second chip sample ran 0.80% Pb, 1.0% Zn, 0.15% Cu, 4.85 opt Ag, 0.005 opt Au. A select sample (PGLS-1) from the lower dump below the road ran 0.004 opt Au, 9.9 opt Ag, 1.12% Cu, 6.06% Pb, 9.12% Zn, and >100 ppm cadmium. Minerals noted in this sample were pyrite, sphalerite(?), secondary copper minerals, calcite, quartz, iron oxide and manganese oxide.

Location: T07S R11W Sec 33 DDBB

Sleeping Princess Group/Golden Leaf

BE003860

The Golden Leaf, including the mill and properties, became the Sleeping Princess group in 1931 after being purchased by the I.B. Haviland Company (Sassman 1941). Geach (1972) reported that between 1931 and 1939 the Sleeping Princess Group produced 87,092 tons of ore yielding 18,256 oz Au, 57,328 oz Ag, 3,516 lbs Cu, 2,043 lbs Pb and no zinc.

Location: T08S R11W Sec 08 BCBA

Stevenson

BE003890

Shenon (1931) shows this mine's location in the E½ section 27 on his geologic map and field identification was based on this. The mine found in Shenon's approximate

location has three adits, two collapsed and one still open with a shallow shaft just inside the portal. The open adit trends N70°W back into the hillside and the upper two adits are completely caved. The occurrence is hosted in Mississippian Madison Limestone and it is unknown if it associated with the granodiorite intrusion located less than ½-mile to the southeast of the mine. This mine is located to the slightly to the northeast of the Wheal Rose mine. There is no road to this mine.

Assays for a random dump sample (PGST-1) ran 0.003 opt Au, 4.11 opt Ag, 0.04% Cu, 0.27% Pb, and 0.53% Zn. The sample consisted of dark brown stained limestone, manganese oxide, trace secondary copper stained minerals, trace quartz disseminated pyrite vein, and blue limestone.

Location: T07S R11W Sec 27 ADCB

Sunrise (1)

BE000372

The Sunrise workings consist of a caved adit, a 100 yard bulldozer cut, and several small dumps. Numerous other trenches (cuts) are found in the same general area and may be part of this claim. Total surface disturbance is approximately 2½ acres. Host rock appears to be Devonian Jefferson limey dolomite. The presence of quartzite cobbles on the dumps and in the trenches suggests that this site is near the contact with the Cambrian Flathead Sandstone. Most of the dump rock and rock exposed in the trenches exhibits some degree of limonite staining; there is no other evidence of mineralization. The workings purportedly explored a 1' yellowish gouge vein deposit containing flinty gray quartz fragments and manganese oxide staining (Geach 1972). Ore minerals included copper, lead, zinc, silver, and gold (Geach 1972).

This property was located in 1957; it has no record of production. Judging from the volume of dump rock, production was minor. The Sunrise workings are located on a dry north-facing hillside; there is no water component. All workings are on BLM land.
Location: T06S R11W Sec 24 BADC

Sunrise (2)

BE000725

There are two Sunrise mines in the MILS database, presumably both the same. Geach (1972) reports two adits, one trending N60°W and the other trending N25°E. Loen and Pearson (1989) place the geologic setting as Paleozoic undifferentiated intruded by a northeast-trending Cretaceous diorite dike. The field visit did not identify any hazards at this site. The Sunrise is a patented claim. There is no record of production though Geach (1972) reports 0.57 opt Au, 0.50 opt Ag, and 0.17% Cu.

Location: T06S R12W Sec 24 BCBD

Sweeney

BE004110

The location of this mine is +/- 5 kilometers; it is plotted on the Holland Ranch south

of Highway 278 but, when contacted by phone, they had not heard of any mine by this name. An ore chute is located on the north side of Highway 278, but it is associated with bentonite (or some kind of volcanic ash). The mine may be located on Mill Point (Robin McCulloch, personal communication, 1994) or possibly a Sweeney mine in the Medicine Lodge - Cabin Creek district (T13S R12W Sec 1,) as described by Geach (1972).

Location: R07S T12W Sec 22

T.D.-6

BE000702

The U.S. Bureau of Mines published a study of this mine (Pattee 1960) including a map at 1" = 75', with an excellent one-page description. It is located on the west side of the ridge ½-mile west of Taylor Creek. There is reportedly no production for tungsten, but a few truckloads of manganese ore were mined.

A grab sample from a 2.5-ton pile of oxides ran 5.38% manganese, 0.12% WO₃, 0.14% Cu, 84% silica, and no P₂O₅ (Pattee 1960). Assays for the T.D.-6 (PGTD-1) showed 0.0005 opt Au, <0.006 opt Ag, 0.01% Cu, 0.002 Pb, and 0.01% Zn, with anomalous manganese (5,090 ppm) and 160 ppm tungsten.

Location: T07S R11W Sec 07 ABAC

Taylor Mine

BE004120

One adit bearing due north overlooking Taylor Creek is completely collapsed. The total length of the working is probably less than 50 feet.

Assays for rather barren-looking, very fine grained chert (PGTM-1) were <0.0005 opt Au, 0.22 opt Ag, 0.002% Cu, 0.008% Pb, and 0.019% Zn. Slightly anomalous values for chromium ran 201 ppm. This assay reflects a chip sample across the outcrop.

Location: T07S R11W Sec 07 DDAD

Thompson

BE004125

This mine is considered a part of the patented Hillside Placer mine; it is not itself patented as the Thompson mine but is on patented land. It is located in Mississippian Madison Limestone associated with the Cretaceous granodiorite stock (Loen and Pearson 1989). Lowell (1965) shows the regional geologic location of this mine. There is one high sulfide lobe on the east side of the ore dump (already sampled by DSL-AMRB); however, the dump is at least a half mile from Grasshopper Creek, and there is no significant erosion or runoff.

Location: T08S R11W Sec 08 CBBA

Tuscarora Group

BE000635

The Tuscarora group of patented claims include the Governor Tilden, Florida, Wooley, Fraction, Fraction Placer, Reform, Burleigh, and Spring (Geach 1972). Multiple dumps are found in the area. Surface disturbance covers several acres. Host rock for the deposits of the Tuscarora group is Devonian Jefferson Dolomite; the beds here strike N20°E and dip approximately 25°SE (Geach 1972). Much of the ore mineralization occurred in pipes localized at the intersections of fractures parallel to the Tuscarora fault (Geach 1972). Ore consisted primarily of a "sand carbonate" which assayed as much as 60% lead and 60 ounces per ton of silver. Patchy galena was also found locally; it was associated with reddish-brown jasper remnants on the walls of some pipes (Geach 1972). Evidence of mineralization on the dump rock includes limonite and hematite with quartz; some areas, such as the Florida claim, appear to have extensive iron mineralization. An AIM sample from this claim assayed 672 ppm lead, 1,030 ppm zinc, greater than 15% iron, 253 ppm copper, 21.8 ppm silver, trace gold, and 2,330 ppm arsenic. The earliest discoveries in this area took place in 1865. Production was recorded intermittently up to 1959 (Geach 1972). Records from 1916 to 1959 indicate cumulative production of 1994 tons yielding 433,468 pounds lead, 10,323 pounds zinc, 10,681 pounds copper, 17,890 ounces silver, and 393 ounces gold (Geach 1972). Some of the Tuscarora group workings are located in the drainage below Argenta Spring; most of these workings are revegetated. The drainage below these sites is dry. Workings of the Tuscarora group are located on patented claims adjacent to BLM land. Geach (1972) includes plan view and cross-section maps of the Tuscarora and Governor Tilden mines and a plan view of the Wooley mine.

Location: T06S R10W Sec 18 ACDC

Unnamed Adit

BE008018

This may be the Vanadinite but it could not be stated with certainty. There is a stuccoed pole cabin in good condition west of Dyce Creek with stone chimneys. Workings consisted of a caved adit trending N10°E with 95% granodiorite and 5% skarn minerals (calcite, epidote, chlorite/pyroxene?).

Location: T06S R12W Sec 14 DDBB

Unnamed Aluminum

BE000083

This site was screened out because of the poor accuracy of the MILS location (+/- 1 km) and the commodity listed.

Location: T06S R12W Sec 35

Unnamed Gold, Bismuth

BE000419

This unpatented occurrence consists of four or more open, untimbered adits and two lower, partially collapsed adits, individually probably not more than 25'-100'. Property

boundaries according to the BLM map show BLM ownership, but the topographic map shows possible Bannack State Park ownership. Pennsylvanian Quadrant quartzite (with a small sliver of Amsden Formation) has been thrust over Mississippian Madison limestone (upper Mission Canyon Member) (Lowell 1965). Dumps are located in the drainage but no water was present at the time of the visit and no sulfides were noted on the dumps. Minerals present include quartz (both boxwork veinlets and drusy crystals) and iron oxides. There is no record of production for this prospect.

Location: T08S R11W Sec 07 BDDD

Unnamed Lead, Zinc, Silver

BE000041

An unnamed prospect with workings consisting of a partially open adit and small waste rock dump is found approximately one mile from Medicine Lodge Creek road. Total surface disturbance is less than one acre. This is purportedly (MILS) a lead-zinc prospect. Host rock at this location appears to be Jefferson Formation (brecciated and mineralized possibly along a shear zone?). Signs of mineralization at this location include limonite and hematite staining as well as traces of galena. All workings are dry; there appears to be no environmental threats at this location.

Location: T13S R12W Sec 02 DDCC

Davis Syndicate Placer

BE004030

The location of this unnamed placer coincides with the patented Bon Accord placer or Davis Syndicate placer. Sassman (1941) reported this was worked by placering and also by tunneling to bedrock at approximately 35'. A shaft was dug in 1895 in an attempt to reach bedrock followed by a 3000' drain tunnel and then a second shaft (Sassman 1941). The claims include 90 acres of patented ground (Sassman 1941) and probably encompass the Gulch placer and the Grasshopper placer. Operation dates span from 1885-97, 1932-38, 1939-40, 1939-75 and to 1988, as well as a short portion (Gulch placer) being actively permitted to be mined.

Location: T08S R11W Sec 16 BCAB

Unnamed Tungsten

BE000071

Several prospects are located near here but information on this site is limited. The accuracy is +/- one kilometer and the commodity is tungsten. The site was screened out because of these factors.

Location: T06S R12W Sec 15

Vanadinite

BE003935

The Vanadinite was never positively located (accuracy is +/-5 kilometers in the MILS database), but from Geach's description the location would fit the unnamed adit and

cabin on the west side of the East Fork of Dyce Creek. Geach (1972) reports three shafts, two adits and one drift (a total of 440 feet of workings). The adit (if this is the Vanadinite) trends N10°E and the dump is 95 % granodiorite and perhaps 5 % skarn minerals (epidote, garnet, calcite, and chlorite).

Location: T06S R12W Sec 23

Wadams

BE004235

A patented claim located topographically highest on the dry hillside above the Bannack lode mines; this is grouped with the Golden Leaf (Geach 1972). DSL-AMRB has backfilled and fenced the adit. The dumps remain; minerals include chalcopryite, cuprite, malachite, azurite, chrysocolla, plus galena, cerusite, garnet and epidote (Winchell 1914). Fissures and mineralized fractures in Madison limestone at the apex of a granodiorite apophysis make up the deposit (Shenon 1931). The downward extension was apparently cut off by a fault (Geach 1972). Dates of operation span from 1909 to 1955 and operations, combined with the Golden Leaf, produced 2,921 tons of ore yielding 10,472 oz Au, 29,455 oz Ag, 7,001 lbs Cu, 100,781 lbs Pb, and 300 lbs Zn (Geach, 1972).

Location: T08S R11W Sec 07 DAAB

Wallace Lode

BE004115

Another patented lode mine, very similar to the Wadams (and located topographically below it) in that its downward extension was also found to be cut off by a large fault and with the same geological host (Madison Limestone associated with a Kgd apophysis)(Geach 1972). This is also grouped with the Golden Leaf; it was the uppermost adit level. Geach (1972) also noted production only in one year, 1939, with 32 tons of ore producing 24 oz Au and 28 oz Ag. DSL-AMRB has backfilled and/or secured the adit with a culvert and has sampled the dumps of the Wallace. Location: T08S R11W Sec 07 ADDA

Washington

BE004055

This mine is located on private, patented ground to the east of the road leading up to the Gold Bug/Bluegrass claims. It consists of one shaft (capped with concrete slabs and fenced by DSL-AMRB) and one adit (culvert and locked). No record of production was found for this mine. The placer workings next to Grasshopper Creek have been recontoured and reseeded.

Location: T08S R11W Sec 08 BADA

Wheal Rose

BE000575

This patented claim in section 27, T.7S.,R.11W. supposedly contains a short adit trending S57°E, but the only working located in this study trended almost due east

and was secured by a culvert and expanded metal grate (DSL-AMRB). It is located on the west side of the ridge near the south end and is associated with a shaft directly above it from which a sample was taken. There is no record of production from this mine.

Assays for the Wheal Rose (PGWR-1) taken from the upper shaft ran 0.010 opt Au, 11.4 opt Ag, 0.065% Cu, 0.556% Pb, and 1.78% Zn. Other elements of interest included 372 ppm antimony > 10,000 ppm manganese and > 100 ppm cadmium. Geach's (1972) select sample ran 0.55% Pb, 1.30% Zn, 0.04% Cu, 2.35 opt Ag, and 0.010 opt Au.

Location: T07S R11W Sec 27 CAAA

White Lime

BE000102

The White Lime is a limestone claim consisting of bulldozer trenches with dumps. Total surface disturbance is approximately one acre. Host rock is Mississippian Madison Limestone which has been altered to light-gray to white marble. The marble formed when a granodiorite stock intruded the country rock. The marble is coarsely crystalline in part and contains calcite crystals. There is no other obvious mineralization. No production figures and/or operational data was found in the literature. This is a dry site located on a small hill; there is no water component. All workings are on BLM land.

Location: T06S R10W Sec 17 ACDA

Wild Bat

BE000731

The Wild Bat consists of a 50' long dozer trench and two shallow shafts/ or prospect pits. These are located on a barren dry ridge with poor accessibility. Host rock here is Mississippian Madison limestone and associated Cretaceous granodiorite (skarn). Limestone, granodiorite, iron oxide, quartz, secondary copper minerals, epidote, garnet, and calcite are found on the dump.

LOCATION:T06S R12W Sec 14 CADA

2. BIG HOLE RIVER DRAINAGE

Calvin

MA003837

Silver-rich galena was mined from this mine mostly after 1927 (Sahinen 1939). The top of the Meagher Formation hosts this deposit, which consists of a 40°, S50°W pipe-shaped body of jasperoid breccia parallel to bedding. McClernan (1977) felt that this deposit, along with other similar ones in the area, resembled Mississippi Valley-type orebodies.

In 1994, four open adits with a combined length of several thousand feet were present, all driven on the same stratigraphic horizon.

Location: T02S R08W Sec 28 ACAC

Calvin South

MA008062

One open adit with over 1000 feet of workings investigates a sheared, gougy zone parallel to bedding (N18°W 35°SW) in Cambrian Meagher Formation. Ore appears to be similar to that of other nearby mines: breccia of siliceous dolomite cemented by quartz and iron oxides. A select sample contained 0.0250 oz/ton gold, 94.6 ppm silver, 1,850 ppm copper, more than 10,000 ppm lead, more than 10,000 ppm zinc, and 1,555 ppm arsenic.

Location: T02S R08W Sec 28 DBBC

Camp Creek Mine and Mill

SB006540

An open adit, less than 100 feet long, and a series of pits follow a generally east-striking, gently south-dipping structure for 300 feet along strike in iron-stained muscovite schist and augen gneiss. This mine is just south of the east-west Camp Creek Fault and also lies along the Northeast Rochester Fault. A sample of the iron-stained gneiss contained only 0.0135 oz/ton gold, 0.4 ppm silver, 114 ppm copper, 48 ppm lead, 104 ppm zinc, and 58 ppm arsenic. Some mill ruins are also present here, but no tailings are visible.

Location: Location: T02S R08W Sec 11 BADA

Chlorite Gulch

SB008101

A series of trenches and pits, one open adit, and one open incline expose some jasperoid along bedding in the Cambrian Meagher formation. About 100 feet of workings are probably present. A high-angle, northeast-striking, down-to-the-south fault cuts the prospected area. The area also lies just above a thrust that puts Meagher Formation over Precambrian schist (Dresser 1995). A select sample assayed 0.1145

oz/ton gold, 45.6 ppm silver, 1,835 ppm copper, 7,820 ppm lead, 418 ppm zinc, and 3,100 ppm arsenic.

Location: T02S R08W Sec 17 ADBC

Christiansen Group

SB001426

One caved reclaimed adit about 200 feet long and numerous trenches are present along a N3°E trend in Proterozoic Lahood Formation. Quartz, quartz breccia, iron oxide, and secondary copper minerals characterize the zone. A sample contained 0.0020 oz/ton gold, 10 ppm silver, more than 10,000 ppm copper, 60 ppm lead, 196 ppm zinc, and 550 ppm arsenic. It seems copper was the commodity, and in fact Sahinen (1939) reported that 30 tons of ore were produced and averaged 20.4% copper and 9 oz/ton silver.

Location: T02S R09W Sec 01 ADDD

Columbia

SB007598

Four caved shafts and a caved stope are aligned along a N52°W 41°NE vein (Sahinen 1950). Vein material on the dumps consists of beautiful pieces of quartz-cemented black shale breccia, with pyrite and arsenopyrite blebs and secondary copper minerals in the matrix. All is dry.

Location: T01S R08W Sec 26 CBAD

Copper Hill (2)

SB001834

More than 20 short adits, shafts, and pits (with a combined length of 1,000-2,000 feet) investigated iron and copper stained coarse-grained quartz. Host rocks are Precambrian metamorphic rocks just south of the Camp Creek Fault near its intersection with the Northeast Rochester Fault. A select vein sample ran 0.0025 oz/ton gold, 12.2 ppm silver, more than 10,000 ppm copper, 70 ppm lead, 136 ppm zinc, and 124 ppm arsenic, so copper was probably the commodity sought.

Location: T01S R09W Sec 26 DAAB

Emma Nevada

SB001414

One caved adit, and numerous pits and trenches mined \$46,000 worth of silver from shallow workings (Sahinen 1939) in the Proterozoic LaHood Formation just north of the Camp Creek Fault. Apparently the ore body was cut off at shallow depth by a talc-like fault selvage (Sahinen 1939). A sample of quartz-iron oxide breccia contained only 0.0090 oz/ton gold, 3.0 ppm silver, 31 ppm copper, 392 ppm lead, 296 ppm zinc, and 420 ppm arsenic.

Location: T02S R08W Sec 06 BBCA

Eureka

MA008105

An open shaft with about 1,000 feet of workings investigated a bedding-parallel zone that is probably on the same stratigraphic horizon in the Cambrian Meagher Formation as the nearby Calvin. A sample of brecciated material contained 0.0605 oz/ton gold, more than 200 ppm silver, 1,705 ppm copper, more than 10,000 ppm lead, more than 10,000 ppm zinc, 1,100 ppm arsenic, so the ore appears to be "silver-lead-zinc" ore like that in the surrounding mines (see McClernan 1977).

Location: T02S R08W Sec 21 DAAA

Gold King (Emma Nevada II)

SB008104

At the Gold King, quartz containing pyrite, galena, and free gold (Sahinen 1950) was mined from Precambrian schist and Cambrian Meagher Formation along some complex fault systems (Dresser 1995). According to Sahinen (1939), a nearly vertical chimney-shaped mass from 6 inches to 10 feet wide was mined, and production 1909-1911 amounted to 252 tons of ore averaging 2.63 oz/ton gold, 1.43 oz/ton silver, and 0.69% copper. An MBMG sample of quartz breccia cemented by iron-oxide and calcite also had high metal values: 0.2930 oz/ton gold, 90.4 ppm silver, 5,180 ppm copper, 2,430 ppm lead, 242 ppm zinc, and 934 ppm arsenic.

Location: T02S R09W Sec 01 DADB

Gold King (2)

SB006652

Many small prospects, including an open adit, explore silicified LaHood breccia containing iron-oxide and sericite along the Camp Creek Fault. Sahinen (1939) reported that 200 tons of silver ore worth \$13,000 was produced.

Location: T02S R09W Sec 01 DADB

Grey Lock

SB006160

A N62°W 63°NE structure near the Camp Creek Fault in altered LaHood Formation is explored by one open adit and one open incline with only about 100 feet of total workings. Ore appears to be an iron-stained quartz breccia; a sample contained 0.1915 oz/ton gold, 17 ppm silver, 357 ppm copper, 1,350 ppm lead, 146 ppm zinc, and 1,220 ppm arsenic.

Location: T02S R08W Sec 06 DDAB

Grey Lock West

SB008107

A series of pits on a N10°E trend in iron-stained LaHood is investigated here.

Location: T02W R08W Sec 06 DBDD

Horn Silver

SB006672

Two open shafts are located in sheared, iron-stained Lahood Formation, Proterozoic diabase, and high-grade metamorphic rocks along the Camp Creek Fault. Structures exposed have a N72°E 74°NW orientation.

Location: T02S R08W Sec 05 DCBD

Jackrabbit

MA003842

One caved and one open incline, and some flotation cells but no tailings, remain at the Jackrabbit. McClernan (1977) studied this mine in detail. Mineralization is controlled by a bedding-parallel carbonate breccia near the top of the Meagher Formation. A pipe-shaped body, two to ten feet wide and 760 feet long, was mined; it had a 15-20 degree, S10°W plunge. It contained jasperoid, galena, pyrite, sphalerite, and tetrahedrite. McClernan (1977) modeled this and other nearby similar deposits after the Mississippi Valley-types of the midwest.

Location: T02S R08W Sec 21 CACA

Soap Gulch Iron

SB001138

At this site, there are numerous prospects in gossanous black shales of the Belt Supergroup. The shale may have been prospected for its iron content.

Location: 02S R08W Sec 29 DAAC

Little Butte Ore

SB001000

Three caved adits with a few hundred feet of associated workings are present just south of the Camp Creek Fault in unmineralized Precambrian metamorphic rocks.

Location: T02S R08W Sec 11 AAAB

Lower Soap Placer

SB008110

Placer workings are present on the dry terrace just north of Soap Gulch. This site was active in 1994.

Location: T02S R09W Sec 12 BDCD

Lucky Strike

SB006424

A caved shaft with a few hundred feet of workings is present on a 2-foot wide N12°W vertical vein of quartz, iron oxide, and secondary copper minerals. Host rocks are Precambrian metamorphics just south of the Camp Creek Fault, and possibly also along the Northeast Rochester Fault.

Location: T02S R08W Sec 03 DDDD

Mahogany
SB008113

Three adits, two of which are open, and some prospect pits investigate fault zones in complexly thrust Pilgrim and Red Lion formations (Dresser 1995). Prospects extend across both sides of Soap Gulch.

Location: T02S R09W Sec 12 ACAB

Mullens
SB008114

A series of workings follow a bedding parallel N36°E 22°NW structure in Wolsey (?) shale below a porphyritic sill on both sides of Camp Creek. The zone is cut by high-angle faults of small displacement (Dresser 1995). At least three open adits and one open stope are present, with about 500 feet of total workings estimated. Quartz vein containing pyrite and galena was sampled and contained 0.1440 oz/ton gold, 67 ppm silver, 363 ppm copper, more than 10,000 ppm lead, 4,220 ppm zinc, and more than 10,000 ppm arsenic.

Location: T02S R08W Sec 17 DCDA

Nez Perce
MA008115

One open incline and three caved shafts (probably 500 to 1,000 feet of workings) examine a N31°W 56°NE structure containing quartz, iron oxides, secondary copper minerals, and chlorite, and hosted by biotite-rich schist. A select sample contained 0.0040 oz/ton gold, 5.2 ppm silver, more than 10,000 ppm copper, 148 ppm lead, 66 ppm zinc, and 122 ppm arsenic.

Location: T03S R07W Sec 28 CCAC

Nez Perce North
MA008116

A quartz-pyrite-sericite rich zone of Precambrian metamorphic rocks parallel to foliation (N12°E 67°NW) is examined by three short, open inclined shafts. Granite and aplite dikes on east trends abound, as do east-trending structures. A sample of the altered material contained 0.0170 oz/ton gold, 2.0 ppm silver, 300 ppm copper, 148 ppm lead, 224 ppm zinc, and 202 ppm arsenic.

Location: T03S R07W Sec20 AADA

Nez Perce South
MA008117

Light brown earthy gossan containing calcite veinlets is present here on an east-striking structure approximately parallel to foliation in the Precambrian metamorphic rocks. A sample ran 0.0145 oz/ton gold, less than 0.2 ppm silver, 69 ppm copper, 20 ppm lead, 50 ppm zinc, and 76 ppm arsenic. Three covered shafts with 500-1,000 feet of total workings investigate this zone.

Location: T03S R07W Sec 33 CBDD

Orphan Boy-Little Group

SB006180

A short caved N10°E adit and a nearly caved shallow shaft were dug in sheared and silicified Precambrian metamorphic rocks near some complex thrust faults (Dresser 1995). Ore apparently consists of sugary quartz, sericite, and iron oxide. Sahinen (1939) stated that a 40-foot thick irregular mass of copper-stained rock was mined. Location: T02S R08W Sec 06 CDAB

Pandora, Upper

SB008124

A short, caved adit mined gossanous material from black shales of the Belt Supergroup.

Location: T01S R08W Sec 33 BBBB

Peabody

SB006692

One open shaft and two open adits, all less than 50 feet long, examine iron-stained Jefferson dolomite.

Location: T02S R08W Sec 20 BAAD

SBME-1

SB008119

More than 10 adits (3 open) are lined up on the same stratigraphic horizon in the Cambrian Meagher Formation. More than 1000 feet of workings are probably present. Ore consists of quartz veins, jasperoid, and gossanous material, and a sample ran 0.0145 oz/ton gold, 152 ppm silver, 1920 ppm copper, more than 10,000 ppm lead, 1015 ppm zinc, and 5230 ppm arsenic. It appears that "silver-lead" ore similar to that of other mines hosted by the Meagher Formation was mined. Ruins of a tramway to transport ore to the valley floor are present.

Location: T02S R08S Sec 07 ACBB

Section 8

SB008120

A series of pits and 2 short shafts (1 open) trace a vertical N20°W shear zone one foot wide with coarse-grained quartz and secondary copper stain in muscovite schist and amphibolite.

Location: T02S R08W Sec 08 ACAD

Short Shift

MA007028

An open shaft with workings of unknown extent explores a quartz-iron oxide-rich area of Precambrian metamorphic rocks that is possibly related to a pyrite-bearing hornblende porphyry found on the dump. A select sample assayed 0.603 oz/ton gold,

2 ppm silver, 52 ppm copper, 294 ppm lead, 24 ppm zinc, and 346 ppm arsenic.
Location: T02S R07W Sec 6 DDDDB

Short Shift West

MA003180

A caved adit heads due west for 200-300 feet in Precambrian metamorphic rocks just south of the Camp Creek Fault. There are also dry placer workings below.

Location: T02S R07W Sec 07 BBDA

Soap Gulch Placer

SB008298

There is little, if any, evidence of placering here.

Location: T01S R08W Sec 32 ACCC

Stateland

MA008123

Here are two caved adits less than 50 feet long in Precambrian metamorphic rocks, just south of the Camp Creek Fault.

Location: T02S R08W Sec 16 AACA

Union

MA008125

An open adit about 200 feet long in Flathead quartzite examines a breccia zone of quartzite clasts cemented by iron oxide and a trace of galena. A select sample ran 0.2010 oz/ton gold, 62.6 ppm silver, 231 ppm copper, more than 10,000 ppm lead, 4,670 ppm zinc, and 110 ppm arsenic.

Location: T02S R08W Sec 28 AAAA

Unnamed 02S08W29DABD

MA006935

Bedding-parallel shears, N25°W 22°NE, in weakly silicified tan siltstone were the targets of three short adits.

Location: T02S R08W Sec 29 DABD

Unnamed 300930170

LaHood Formation with much sericite or chlorite makes up most of the dump at this site. Some gray clays and quartz fragments were sampled; they ran 0.0135 oz/ton gold, 0.4 ppm silver, 114 ppm copper, 48 ppm lead, 104 ppm zinc, and 58 ppm arsenic.

Location: T02S R08W Sec 01 BADA

Unnamed Nitrogen

SB006588

Two adits less than 50 feet long have been driven in Jefferson Dolomite.
Location: T02S R08W Sec 20 BADA

Upper Rochester Lode

MA003570

One caved shaft 100-200 feet long, a caved adit less than 50 feet long, and numerous prospects trace a N55°W 75°NE fault zone (the Northeast Rochester Fault) in Precambrian augen gneiss. A sample contained 0.1145 oz/ton gold, 6.8 ppm silver, 204 ppm copper, 1,540 ppm lead, 304 ppm zinc, and 554 ppm arsenic. This appears to be the source of the Upper Rochester Placer.
Location: T02S R07W Sec 18 CBAA

Water Tank

MA008126

One 15-foot shaft was constructed on a N80°E 75°NW hematite and limonite-stained shear about 15 feet wide. A natural seep nearby precipitated iron hydroxides. A sample contained less than 0.0005 oz/ton gold, less than 0.2 ppm silver, 114 ppm copper, 6 ppm lead, 44 ppm zinc, and 132 ppm arsenic.
Location: T03S R07W Sec 27 CACC

3. BLACKFOOT RIVER DRAINAGE

Bilk and Weasel Gulches

PO004790

Placer workings are found in Bilk and Weasel gulches almost to the top of the drainage divide. Workings consist of trenches, pits, and waste rock piles. Host rock is Quaternary gravels (with cobbles) composed principally of granodiorite, marble, and brown garnet rock. These placer deposits have been worked since the 1860's. A pumping plant was in operation at one time and provided water (from Weasel Creek) for placer mining operations in Bilk Gulch. Details on production from this area were not found. Most of the workings lie on patented claims. Both of these gulches were dry when visited in 1994. It does not appear that placer mining has adversely affected water or other resources in this area.

Location: T12N R13W Sec 04

Boston

PO004810

The Boston workings consist of several small to moderately sized dumps. Evidence of underground mining (other than the dumps) has been obscured by time and revegetation. The mine purportedly had several open pits and a shaft (Pardee, 1918). This site is situated on a dry N-S trending ridge; surface disturbance is less than one acre. The mine is located on a crescent-shaped body about 3,000' feet long and no more than 500' wide (Pardee 1918). Host rock is a brown garnet-epidote-magnetite rock formed by contact metamorphism. Ore minerals include chrysocolla (altered to malachite in part) and gold (occurring primarily in flinty quartz veinlets). Sparse chrysocolla and malachite were noted on the dump rock; these minerals formed crusts or fracture fillings on the dark brown garnet rock. There was also limonite stained quartz present on the dumps. An AIM sample assayed 6 ppm lead, 102 ppm zinc, 10,000+ ppm copper, 10.6 ppm silver, 0.0150 ounces of gold, and less than 2 ppm arsenic. The Boston was active in the last half of the 19th century; the mine was inactive in 1916 (Pardee 1918). Production figures could not be found for this mine; dump size indicates a moderate amount of ore was produced. This patented claim poses no environmental hazards.

Location: T12N R13W Sec 05 DBAB

Cato

MI005483

Workings in a dry gulch a short distance south of the Mammoth mine may be the Cato. Workings consist of trenches, pits, and small waste rock dumps. Total surface disturbance is probably less than one acre. Host rock is granodiorite; white, coarsely-crystalline quartz appears to be the gangue for this vein deposit. The only apparent sign of mineralization is minor limonite staining. This site lies on a patented claim and is dry; there are no apparent environmental problems associated with this site.

Location: T13N R14W Sec 33 BDCB

Clemantha

MI005479

The Clemantha claim, located a short distance northwest of the Coloma ghost town, is mostly reclaimed (recontoured and seeded). Total surface area is approximately two acres. This site was apparently developed by an incline shaft 360' deep (Sahinen 1957); all underground workings have been obscured by time and reclamation work. Host rock is granodiorite (near the limestone contact); the gangue in this deposit is quartz. The only sign of mineralization on this claim is scattered rocks exhibiting limonite staining. This mine produced high-grade, oxidized silver and gold ore. This patented site is located on a dry hillside and poses no apparent environmental threats. Location: T13N R14W Sec 33 BBAA

Copper Cliff

MI006015

The Copper Cliff site, as described here, consists of three patented claims. These are the Copper Cliff, Crescent, and Tiger. Workings on these claims consist of open cuts, adits (mostly caved), at least one partially open shaft, and numerous dumps. Surface disturbance is roughly estimated at 15 acres. Host rock is Precambrian Belt quartzite (Garnet Range Formation) and Paleozoic limestone. Signs of mineralization include limonite staining on dump rock and secondary copper mineral staining on open cuts. Heavily cemented quartzite breccia with disseminated breccia was reported by Pardee (Pardee, 1918). These deposits are classified as mineralized breccia pipes forming in heavily faulted strata (Ellsworth 1993). Different ore shipments contained from 9.5% to 22% copper, from 0.5 to 1 ounce silver, and 25 cents to \$2.50 per ton gold (Sahinen 1957). The deposit was discovered in 1891; mining history can be described as sporadic up to the present day. Production from this site has been substantial; 310 tons (yielding 77,000 pounds of copper with minor gold and silver) were shipped in from 1905-1910 (Sahinen 1957). All workings observed on the patented claims at Copper Cliff in 1994 were dry; no apparent environmental threat was posed by the mining operations at this location. Maps of the Copper Cliff area can be found in several publications, namely Pardee (1918), Sahinen (1957), and Ellsworth (1993). Location: T12N R15W Sec 11

Crystal Springs-Rambler-Valley

MI005451/MI002478/MI002640

The Crystal Springs, Rambler, and Valley claims are located adjacent to the Clemantha. Total surface disturbance for these sites is no more than several acres. Little information is available regarding the type and number of underground workings at these sites. In any event, all underground workings are caved. These include a number of adits and shafts. There are also several waste rock dumps on these claims. Host rock is granodiorite (near the limestone contact); the gangue mineralogy is quartz. As with the Clemantha, these were gold-silver prospects. Judging from surface disturbance and dumps, production from these mines was small to modest. The Crystal Springs and Valley sites are on patented claims; the Rambler lies on BLM land.

These sites are located on a dry hillside and pose no apparent environmental threats.
Location: T13N R14W Sec 32 BBBD/T13N R14W Sec28 BBAA/T13N R14W Sec 32 BADB

Daisy
MIO05751

The Daisy workings are found a short distance west of, and above, the Charcoal mine/mill site. Workings consist of an open pit or quarry with a 50 foot highwall. Waste rock has been dumped downslope of the open pit. Total surface disturbance is approximately three acres. Host rock is a light gray to tan quartzite (Precambrian Garnet Range Formation?) cut by white to gray quartz veins. The only apparent sign of mineralization is limonite staining which is present on almost all rock exposed. A mining shack (in relatively good condition) and an open shed are found at the site. A small freshwater spring is found between these buildings. Water flows a short distance and sinks underground. There does not appear to be environmental degradation at this location. The site is located on federal land administered by the BLM.
Location: T12N R16W Sec10 ABDB

Elk Creek and Tributaries/Powers Placer
PO004660/GR000476

Numerous placer workings are found in the drainage of Elk Creek and it's principal tributaries. Total surface disturbance is probably in excess of several hundred acres but an actual figure is difficult to determine. The placer gold is found in quaternary gravels derived primarily from granodiorite and Precambrian Belt rocks. Gold is found in these deposits as fine, flat particles resting on granite bedrock (Pardee 1918). The general average for the placers in the Garnet area was \$50.00 per foot (Pardee 1918). Placer mining started in the Elk Creek drainage in 1866. Most placer mining activity in this area had ceased by 1916; there has been intermittent activity since that time. Production of placer gold from this area must have been significant based on workings; no reliable production figures are available. Most of the placer work has been done on federal (BLM) land. No apparent water quality problems resulting from placer operations were noted in 1994.

Location:T12N R13W Sec 06 CCBA/T12N R14W Sec 01 BADD

Elk Creek
GR000242

The Elk Creek workings consist of at least two, possibly three, collapsed adits, two moderate-sized dumps, and several prospect pits. Workings are located on a dry northeast facing hillside. A cabin in fair condition is located near the workings. Total surface disturbance is approximately two acres. Host rock is Precambrian Belt quartzite (Garnet Range Formation?). Gangue mineralogy appears to be quartz; it occurs in narrow veins. The only apparent sign of mineralization on the dump rock and wall rock is limonite staining. The USBM reported that this was a gold prospect (USBM database). There is no water component at this BLM site.
Location: T12N R14W Sec 02 DBAD

Gold Leaf
GR003054

The Gold Leaf workings consist of a caved shaft, several prospect pits, and several small to moderately sized dumps (possibly lying below completely caved adits). Total surface disturbance is approximately one acre. This deposit is at the contact between limestone and granodiorite; the limestone has been altered to a light-gray to white marble. A garnet-epidote-magnetite rock similar to that at the Boston mine is also present on the dump rock. The granodiorite has minor quartz veins probably acting as a gangue. There is slight to moderate limonite staining on the dump rock and traces of malachite and chrysocolla. Pardee (1918) reported granodiorite with quartz veins as the host rock. Irregular masses of limonite with free gold, some pyrite and minor chalcopyrite were reported (Pardee 1918). Ore purportedly extended from the surface down to approximately 40' (Pardee 1918). A 3' channel sample (including 6" of vein material) assayed 0.44 ounces of gold and 0.15 ounces of silver; the same vein was nearly barren at the end of the adit (Kauffman 1963). Little information regarding history and production of this mine was found in the literature. It seems likely that most of the mining activity at this location was before the turn of the century. Dump size indicates a moderate amount of ore was produced. This patented claim poses no environmental hazards; there is no water component.

Location: T12N R13W Sec 05 DCAA

Golden Angel
P0004705

An area ¼-mile south-southwest of the Boston mine site with trenches, pits, and small dumps may be the Golden Angel. Host rock is similar to the Boston (garnet-epidote-magnetite rock); limestone altered to marble is also present on the dumps. Ore mineralogy is similar to that reported for the Boston; both sites lie on the same crescent-shaped contact metamorphic body. Green hornblende (actinolite) was also reported (Pardee 1918); none was visible on the dumps in 1994. This mine was active in the latter part of the 19th century; it was inactive by 1916 (Pardee 1918). There is no water component on this patented claim; no environmental problems are apparent.

Location: T12N R13W Sec 05 DBBD

Leonard
MI005559

The Leonard or Blue Bell workings are found a short distance south of and several hundred feet higher than Copper Cliff. Workings consist of a partially caved adit, open cuts, and a relatively large dump. Older underground workings are caved (Sahinen 1957). Total surface disturbance is approximately two acres. Host rock is medium to light gray, limey dolomite. Evidence of mineralization includes limonite staining and minor secondary copper mineral (malachite) staining. This mine explores a silicified breccia with earthy material similar to that found at Copper Cliff. Production prior to

1916 assayed 7% to 10% copper (Pardee 1918). This BLM site is on a dry north facing hillside; this site poses no apparent environmental problems.

Location: T12N R15W Sec 04 CCAD

Mammoth

MI005475

The Mammoth workings consist of at least two caved shafts, several prospect pits, and a substantial dump area. Total surface disturbance is approximately two acres. Host rock is granodiorite. There is also minor white to pinkish marble (or limestone) on the dumps reflecting the proximity to the limestone-granodiorite contact. This was a vein deposit with white quartz forming the gangue; the only apparent sign of mineralization in 1994 was limonite staining. In the upper levels, the ore in both principal veins was oxidized and reportedly rich; the sulfide ore contained pyrite and tetrahedrite (Sahinen 1957). An AIM sample assayed 534 ppm lead, 136 ppm zinc, 259 ppm copper, 44 ppm silver, 0.919 ounces gold, and 36 ppm arsenic. This mine was developed in the late 1800's with mining continuing well into the 1900's (Sahinen 1957). Small yearly outputs were recorded up to 1950; the underground workings were caved by 1957 (Sahinen 1957). Total production was approximately \$200,000 worth of gold-silver ore. More efficient milling practices could have increased this value (Sahinen 1957). All workings at this site are dry and pose no threats to surface water. Location: T13N R14W Sec 33 BCAA

Nellie

MI005755

The Nellie workings are believed to be located a short distance southwest of a dilapidated cabin. Workings consist of at least three collapsed adits, one collapsed shaft, and several small- to moderately sized waste rock dumps. Total surface disturbance is approximately two acres. Host rock is medium-gray, limy, dolomite with minor calcite. The only apparent sign of mineralization is iron oxide stain in part. The dolomite has dark-gray to black beds and laminae in part; this could possibly be organic material. This BLM site is located near the top of a ridge; all workings are dry. Location: T12N R16W Sec 10 CAAC

Olympiad (Comet)

MI005683

The Olympiad workings, including the Comet claim, are located a short distance north of Coloma at the head of Bivens Gulch. Workings consist of large dumps, prospect pits, and trenches, and caved underground workings. A partially caved adit is found directly above Bivens Gulch next to a cabin. Total surface disturbance is approximately five acres. Host rock, deposit type, and vein mineralogy are similar to other deposits in the area (i.e. granodiorite with enriched quartz veins). The only apparent sign of mineralization at this site is limonite staining on dump rock. The oxidized ore near the surface purportedly had good gold values; there were small shoots of sulfide ore below. Sulfide minerals from the shoots included tetrahedrite, pyrite, and chalcopyrite

(Pardee 1918). Specimens from the lower workings showed considerable muscovite mica and coarse quartz suggesting a pegmatite (Pardee 1918). Some of the oxidized ore from this site was purported to run as high as \$100.00 per ton gold. Only a few details regarding mine history and production are available. A 15-ton Huntington mill was installed at the site in 1905 but only a small production of gold was reported produced (Pardee 1918). Mining operations have probably continued on a sporadic basis up to the present-day. Accurate production figures were not found in the literature. This site is located on BLM land; all workings observed were dry and posed no apparent environmental threat.

Location:T13W R14W S 28 BCCD

4. BOULDER RIVER DRAINAGE

Australian West

JF008103

This small mine of one caved adit and one fenced shaft, each with less than 500 feet of associated workings, is probably on the same N75°W shear zone as the nearby Australian.

Location: T07N R04W Sec 31W DCAA

Bishop Creek

JF008102

A caved adit less than 100 feet long and with a N8°W orientation discharges a small volume of water onto a pyrite-chalcedony-rich dump.

Location: T06N R05W Sec 02 BBDB

Cleveland

JF002187

The Cleveland consists of a caved shaft with 500-1000 feet of associated workings and one open stope (non-hazardous). Apparently, veins up to five feet wide in a N84E 77SE (Becraft *et al.* 1963) shear zone were mined. Vein mineralogy is quartz, chalcedony, pyrite, and minor galena. Roby *et al.* (1960) state that recorded production was 7 ounces of gold, 2,176 ounces of silver, 2,347 pounds of copper, 36,629 pounds of lead, and 6,070 pounds of zinc from 204 tons of ore.

Location: T06N R04W Sec 05 DBCD

Comstock

JF005401

At the Comstock, a series of pits and adits, all locked or caved, follow an east-west shear zone. All dump material is oxidized. Roby *et al.* (1960) stated that lead-silver ore containing cerussite, fine-grained galena, quartz, chalcedony, copper carbonates, and minor pyrite was mined. Torbernite, a uranium-bearing mineral, was also identified on the dumps. Length of all workings was about 400 feet.

Location: T06N R05W Sec 14 DADC

Fairview

JF002547

A large open cut is present along a N72°W near vertical shear. The zone contains veins of quartz, chalcedony, and pyrite.

Location: T06N R04W Sec 05 BDAC

Gray Eagle

JF005041

The Gray Eagle is another large mine on the westward extension of the Comet vein. Four adits and a 250 foot shaft, with a combined length of at least 10,000 feet,

compose the mine (Roby *et al.* 1960). Two main veins were mined in a N75°W 20-50 foot wide altered zone in both Elkhorn Mountains Volcanics and quartz monzonite. One vein was up to 40 feet wide. The veins contain the typical Boulder Batholith assemblage of quartz, galena, sphalerite, pyrite, chalcopryite, and tetrahedrite. Uraninite has also been detected on the dumps, and there is some molybdenite in the surrounding country rocks (Becraft *et al.* 1963; Roby *et al.* 1960; Becraft 1956; Pardee and Schrader 1933). Production records were mostly combined with those of the Comet, but those that are separate show that 15,203 tons of ore yielded 1,297 ounces of gold, 339,529 ounces of silver, 85,966 pounds of copper, 1,035,407 pounds of lead, and 230,734 pounds of zinc (Roby *et al.* 1960). Total value of metals produced at the Gray Eagle is estimated at \$1 million (Becraft *et al.* 1963).

In 1993, all workings were caved and the dumps were partially vegetated.
Location: T07N R05W Sec 35 CBCA

Hiawatha
JF002703

The Hiawatha examines part of the one mile long, N75°E 75°NW Custer-Red Wing shear zone (Becraft *et al.* 1963). A vein 3-5 feet wide of quartz, pyrite, tetrahedrite, and native silver which cuts the Elkhorn Mountains Volcanics-Boulder Batholith contact was exploited. One 400-foot shaft and three adits with a combined length of 1,000 feet, all now caved, were present. 1902-1906 production was 4,222 tons of ore which yielded 577 ounces of gold and 90,713 ounces of silver.

Location: T06N R05W Sec 03 BCBA

Van Armin
JF002169

The Van Armin consists of one caved shaft (150 feet) and one caved 900 foot adit. According to Becraft *et al.* (1963), a N80°W 80°SW vein of galena, sphalerite, and chalcopryite up to eight feet wide was mined. The ore reportedly contained 50-75 oz/ton silver and 50-60% lead, and \$480,000 worth of metals were produced. The mine was last worked in 1896.

Location: T07N R04W Sec 32 CDDB

Wilbur Silver
JF002223

Two caved adits and a caved shaft follow a vertical N85°E vein 1-4 feet wide of galena, sphalerite, pyrite, and chalcopryite (Becraft *et al.* 1963). Production 1917-1940 was 339 tons from which 65 ounces of gold, 4,181 ounces of silver, 1,626 pounds of copper, and 80,905 ounces of lead were recovered (Roby *et al.* 1960). One dump is near a creek, but a buffer of vegetation exists and the dump is not being actively eroded by the creek.

Location: T07N R04W Sec 32 DBCD

5. UPPER CLARK FORK RIVER DRAINAGE (INCLUDING FLINT CREEK AND ROCK CREEK)

Bear Creek

GR003169

The Bear Creek placer workings consist of cuts, dumps, and minor workings in Bear Creek and Deep Creek drainages. Workings run from Top O'Deep and Garnet all the way to Bearmouth. Quaternary gravels (with cobbles) form the host rock. These gravels are principally composed of granodiorite, quartz monzonite, and limestone. Most of the gold taken from Bear Creek was in particles smaller than wheat grains; shape ranged from flakes to shot (Pardee 1918). Nuggets were fairly numerous and variable in weight; some were intergrown with quartz (Pardee 1918). The source for the placer gold was the lode deposits at Garnet, Top O'Deep, and other areas at the heads of drainages. The placer deposits of this area have been worked since the 1860's with most production prior to 1900 (Pardee 1918). Pardee estimated production to 1916 at \$7 million. Placer operations in the intervening years from 1916 to the present may have added another \$3 million (Kauffman 1963). Most of the workings lie on patented claims. The water in Bear Creek and Deep Creek drainages does not appear to have been adversely affected by placer mining operations.

Location: T12N R14W Sec 15 DABC

Bear Creek Placer-Ten Mile Placer

GR000152/GR000278

Bear Creek was the site of extensive placer operations in the past. Placers were mined from the junction with the Clark Fork River to the drainage divide west of Garnet. The lower two miles of the drainage were mined by dredging; evidence of this mining is apparent east of the principal access road. Host rock is quaternary gravels derived from the lode deposits at Garnet, Top O'Deep, and adjacent areas (Pardee 1918). The placers here were very rich. In some places the gravel yielded as much as \$1,000 per cubic yard; a general average, based on the meager data available, is \$30 per cubic yard (Pardee 1918). The bulk of the gold taken from Bear Creek was the size of wheat kernels, 0.90 fineness or purity (remainder chiefly alloy-silver), and deep yellow in color (Pardee 1918). Placer gold was first discovered in 1865. Deposits were worked heavily in the 19th century; some placer work continues to this day (Pardee 1918). Production to 1963 was estimated at no less than \$10 million for the placers in this general area (Kauffman 1963). The placer workings on Bear Creek do not appear to pose environmental hazards.

Location: T11N R14W Sec 11 CCAD/T12N R14W Sec 28 CCCD

Bellview

MI006011

The Bellview workings consist of an intact headframe above an open-shaft, an open-cut below the shaft, and mostly revegetated waste rock. Host rock is granodiorite; mineralization includes limonite staining and secondary copper mineral stains. An AIM

sample of dump rock assayed greater than 10,000 ppm lead, 502 ppm zinc, greater than 10,000 ppm copper, 174.5 ppm silver, 0.0100 ounces of gold, and 156 ppm arsenic. This appears to be a vein deposit. All workings at this site are dry. Large portions of the site have been revegetated. A small spring is located approximately 150 feet southwest of the shaft but does not appear to be in contact with waste rock. All workings are on BLM land.

Location: T12N R16W Sec17 BCDB

Big View
PO005165

There are no references to this occurrence except for a U.S.B.M. mineral property file (21.055); a search of the NW ¼ section 30, T11N, R7W found only two shallow prospect pits. The pits explored a skarn occurrence containing massive garnet, epidote and calcite (marble?) probably in contact with the Kqm mapped by Loen (1990).

Location: T11N R07W Sec 30 BDAA

Blue Moon
GR003561

The Blue Moon mine workings consist of at least two collapsed adits, one open adit, one large dump, several smaller dumps, and scattered trenches and pits. The site also has a dilapidated trailer house and other debris present. Total surface disturbance is approximately three acres. Host rock is Precambrian quartzite and schist (Precambrian Garnet Range Formation?). Vein mineralogy is light-colored quartz. The only other apparent signs of mineralization at this site is moderate to heavy limonite staining. An AIM sample assayed less than 2 ppm lead, 36 ppm zinc, 67 ppm copper, 0.2 ppm silver, trace gold, and less than 2 ppm arsenic. No information was found in the literature regarding mine history and/or production. Judging from the condition of the workings, there has been no mining at this site for several years. This dry site is located near the top of a dry ridge; all surface disturbances are on BLM land.

Location: T12N R14W Sec 02 CCCC

Butterfly Prospect
PO002870

This group of prospects and shafts is located in the SW ¼ section 30, T. 11N., R. 7W. and is private. It consists of two shafts of any significance-- one probably greater than 50 feet and the other 25 feet; both caved. The larger has a foundation for a hoist motor. Mining and Scientific Press, in 1903, describes a 225-foot tunnel on a 40-foot wide lead attributed to this property. McClernan (1976) quotes R.D. Geach's field notes. They stated that the mineralization was confined to several ¼-inch quartz veinlets in limestone, containing limonite, pyrite, malachite, chalcopyrite, and tetrahedrite(?). Loen (1990) also found garnet on the dumps and described the host rock as Madison limestone. His dissertation contains assays from this dump.

Location: T11N R07W Sec 30 CCCC

Coon's Tungsten

P0002876

This property consists of an open cut (approximately 150' by 100') with relatively steep highwalls, but with no hazards. It is a skarn with epidote, calcite, and trace secondary copper minerals. The contact of the Cambrian Meagher limestone and the intrusive (granodiorite or quartz monzonite) is well exposed. As shown on Loen's map (1990), this location is mapped as Precambrian McNamara Formation (Ymc). Commodities listed for this prospect include tungsten, copper, molybdenum and manganese. References include Walker (1963), McClernan (1976), Loen (1990), and Elliot *et al.* (1992). Sample PCCT-1 assayed <0.0005 opt Au, 0.01 opt Ag, 0.07% Cu, 0.005% Pb and 0.002% Zn.

Location: T11N R07W Sec 19 CCAA

Denver

P0004645

The Denver mine is located immediately to the east of the Fairview but is on BLM land. No open workings or environmental concerns were noted. One adit (trending N10°E), was at least 35' and possibly up to 100' or more long, is presently completely caved. Several shafts/ prospects are also caved and have 8"-10" Douglas fir trees growing in them. A second, lower adit, may have been driven to intersect the shaft but caving has obscured the relationship. Dumps are composed of quartzite, with lesser intrusive waste and vein material (quartz, pyrite, tarnished sulfides). Pardee and Schrader (1933) describe this as a four-foot vein in quartzite, with the vein of country-rock breccia cemented and silicified with pyritiferous quartz containing specks of tetrahedrite. Assays from a dump grab sample (PODN-1) ran 0.020 opt Au, 5.72 opt Ag, 0.004% Cu, 0.012% Pb, and 0.003% Zn.

Location: T11N R08W Sec 25 ACAB

Dewey

GR003069

The Dewey workings, located a short distance west of the ghost town, consist of two caved shafts, prospect pits, and multiple dumps. Surface disturbance covers several acres and is continuous with that on adjoining claims. Host rock is granodiorite; gangue mineralogy appears to be a white, vuggy quartz. Ore minerals reported in the oxidized zone included limonite, scant copper minerals, and trace manganese (Pardee 1918). In the sulfide zone, ore minerals included pyrite, chalcopyrite, and tetrahedrite (Pardee 1918). The only apparent sign of mineralization on the dumps in 1994 was limonite staining. Ore extracted from this claim averaged 3.5 ounces gold, 6.5 ounces silver, and 2% copper per ton (Pardee 1918). The Dewey was discovered and developed relatively early in the history of this mining district. In the period 1915-1916, this mine produced \$100,000.00 gross (Pardee 1918). The Dewey workings lie on a patented claim; there appears to be no water component at this location. Maps

showing longitudinal sections and underground workings can be found in USGS Bulletin 660-F (Pardee 1918).

Location: T12N R14W Sec 03 ACBD

Eureka Gulch Placer Mines

PO004930

Screened out because these mines are all on private land with no federal land downstream.

Location: T10N R08W Sec 01 AAD

Fairview (2) / Coulson

PO005090

Ownership of this mine is patented (M.S. 5166) and private. No visible impacts were noted on the surrounding BLM land. It was not visited for this reason. Some of the cabins appear inhabited. One large waste dump (appears to be sulfide-rich) is visible from the road and another is visible adjacent to one of the cabins partially obscured by Douglas fir trees.

Location: T11N R08W Sec 25 BADD

Independence

GR000002

A caved adit and small dump on the east side of Cayuse Gulch may be the Independence mine. Host rock is dark-gray, banded quartzite (Precambrian Garnet Range Formation?). Mineralization, other than limonite staining, is not apparent. This dry BLM site poses no apparent environmental problems.

Location: T12N R14W Sec 12 BCCB

International

GR000068

The International workings consist of prospect pits, probable caved adits, and multiple small waste rock dumps. Pardee (1918) indicated that this site was developed by a 100' shaft and levels. The workings are located a short distance north of the ghost town of Garnet; surface disturbance is approximately two acres. Host rock is granodiorite; gangue mineralogy is quartz. This vein deposit was a silver-gold prospect; flake or leaf gold was embedded in limonite in an ore specimen from this mine (Pardee 1918). Gold content ranged from 4 to 8 ounces per ton; silver ranged from 5 to 10 ounces per ton (Pardee 1918). Information regarding mine history and production are sketchy; smelter certificates of intermittent shipments from 1910-1914 amounted to approximately \$9,000 (Pardee 1918). All workings observed on this patented claim were dry; no apparent environmental problems exist.

Location: T12N R14W Sec 3 ACCA

Katie Allen

PO008029

Located in the SW ¼ section 30, T11N, R7W, in Tiger Gulch, workings here consist of a caved adit, a caved shaft and one partially open adit. Across the drainage, to the southeast, other workings include several caved shafts (all dry), caved adits (all dry) and some fairly recent trenches. The partially open adit is located in the drainage which trends north from Tiger Gulch. The road passes by and over the waste dump for the lower adit. The drainage also skirts the adit's waste pile but no water erosion was evident except for slight erosion by runoff down the road. There is a patented claim called the Katie Allen located to the southeast of these workings; along with patented claims Ophir #1, Ophir #2, Sunrise, and Spokane. Sample POKA-1 assayed 0.022 opt Au, 0.28 opt Ag, 0.0005% Cu, 0.003% Pb and 0.004% Zn.

Location: T11N R07W Sec 30 CBCD

Lehsou-Upper Deep Creek

GR000104/GR000314

The Lehsou or Hickey placer workings are located in the upper portion of Deep Creek Gulch. Workings consist of numerous pits and cuts with accompanying dumps; surface disturbance covers several acres. Host rock is Quaternary gravels (with cobbles); most of the gravels are composed of granodiorite, limestone, and quartz monzonite). The gravel purportedly contained appreciable amounts of placer gold, irregularly distributed (Pardee 1918). Land ownership in this area appears to be private as well as BLM. All workings are dry and in various stages of revegetation.

Location: T12N R13W Sec 05 CDCA/T12N R13W Sec 08 ACCC

Leprechaun Placer

PO005410

Very little information could be found on this placer; the general location as plotted from USBM MILS data was visited but no recent placering was noted. There were no hazards and no environmental problems.

Location: T11N R07W Sec 32 BACD

Lowery-Tiger

GR003284/GR000260

The Lowery and Tiger workings are found in Williams Gulch a short distance south of the Nancy Hanks mine. Workings consist of trenches, pits, and waste rock dumps. The literature indicates a 300' incline and 1,000' of drifts on four levels (Pardee 1918). All underground workings were caved in 1994. Host rock is Precambrian Belt limestone recrystallized to marble (and altered to garnet-epidote rock in places). On the Tiger, a vein striking N-NE and dipping at a low angle was mined; ore was said to be similar to the "red ore" zone of the Nancy Hanks mine (Pardee 1918). Signs of mineralization at these two sites include limonite staining on the dump rock and fragments of garnet-epidote rock (somewhat similar to that found at Top O'Deep only with a higher epidote fraction). One carload of ore from the Tiger averaged 22.5 ounces of gold and 25

ounces of silver; this was the richest single shipment from the Garnet mining district. Pardee estimated a total production for the Tiger of \$40,000 (Pardee 1918). Later production was reported to be three tons per day (of ¼" screenings from old gobs) (Trauerman and Waldron 1940). No production figures were found for the Lowery. The workings observed on these patented claims were dry and did not appear to pose environmental hazards.

Location: T12N R14W Sec 03 BDDC/T12N R14W Sec 03 BDCB

Lynx
GR002974

The Lynx workings are found on a dry slope above Cayuse Gulch Creek; they consist of a caved adit and a fairly large dump. Total surface disturbance is less than one acre. Host rock at this location is Precambrian Belt quartzite (Garnet Range Formation?). This was a vein deposit with gangue mineralogy consisting chiefly of white, partially vuggy quartz. The vein ranged in thickness from 1' to 3'. The strike of the vein was S80°W; it dipped 75°S. Evidence of mineralization on the dump rock includes limonite staining, minor pyrite, and minor malachite. A moderate quantity of ore stoped 80' from the portal (for 30') purportedly assayed about \$80 per ton (Pardee 1918). This dry site is located on a patented claim. A geologic-location map showing vein deposits at the head of Elk Creek can be found in USGS Bulletin 660-F (Pardee 1918).

Location: T12N R14W Sec 11 ADCB

Magone and Anderson
GR003049

The Magone and Anderson mine adjoins the Grant and Hartford claim on the southeast. Workings, as observed in 1994, consisted of one partially caved adit, several completely caved adits, and multiple dumps; the ruins of several cabins are found on this claim. Estimated surface disturbance is five acres. Host rock appears to be granodiorite, granodiorite gneiss, and schists. The workings explore a vein striking slightly north of due west and dipping 30N (Pardee 1918). Gangue mineralogy appears to be white to pinkish, partially vuggy quartz. Iron-oxide staining is the only apparent, present-day evidence of mineralization. Minerals reported in the literature include pyrite and tetrahedrite (Pardee 1918). Smelter receipts for ore sorted from dumps in 1914 indicated gold values ranging from 0.5 to 5.5 ounces of gold, 0.10 to 6.5 ounces of silver, and a trace of copper (Pardee 1918). Considerable work was done on this claim prior to 1910; the most productive period for this site was 1911-1914. Pardee (1918) estimated total production at or in excess of \$300,000. The Magone-Anderson patented claim is located on an apparently dry ridge; there appears to be no environmental concerns here.

Location: T12N R14W Sec 03 DADC

Mitchell Prospect
PO005010

The Mitchell prospect was determined to have no detrimental effects. The actual site

location was vague, but a general reconnaissance of the area found one prospect pit on the ridge and a group of prospects where a shaft symbol is plotted on the topographic map (T11N R7W Sec 30). No hazards were associated with this site; there is at least nine prospects and one caved inclined shaft, all in intrusive. There is a USBM mineral property file (21.008) on this prospect.

Location: T11N R07W Sec 30 BDAB

Mountain
PO002236

The Mountain mine consists of an open shaft, several moderately sized cuts, and several large waste rock dumps. Host rock is garnet with lesser magnetite and epidote. This deposit is a skarn approximately 10' wide and possibly several hundred feet long (Pardee 1918). The most abundant minerals were chalcopyrite and chrysocolla; there was some pyrite associated with the magnetite (Pardee 1918). Mineralization visible on the dump rock includes iron oxides, chrysocolla, and malachite. This mine was the only one active in 1916 when Pardee visited the district (Pardee 1918). Production figures and additional details on mining history were not found in the literature. This dry site is located on BLM land and poses no apparent problems.

Location: T12N R13W Sec 08 BBBB

Nancy Hanks
GR003649

The Nancy Hanks mine played a key role in the development of the Garnet mining district. The mine was developed by two shafts, stoping, drifting, and surface work. In 1994, workings consisted of a large open pit covering several acres. The Nancy Hanks deposit consists of flat, lens-like bodies (veins) in granodiorite. Gangue mineralogy is quartz (with lesser barite, calcite, and ankerite). Oxidized ore reportedly has abundant limonite, lesser azurite and malachite, and traces of antimony and manganese. The sulfide zone reportedly has pyrite, tetrahedrite, chalcopyrite, and galena (Pardee 1918). The best ore from this mine ran 8 ounces of gold, 4 to 28 ounces of silver, and a trace of copper to the ton. The oxidized ore contained about twice as much gold as the sulfide ore (Pardee 1918). This site was discovered in 1874 by following placer deposits up Williams Gulch. Development started in 1896; peak production was from 1897-1900. The mine yielded intermittently until 1907; activity since that time has been sporadic (Pardee 1918). Production to 1940 was purported to be over two million dollars. This patented claim has no water component. Plan maps and longitudinal sections can be found in USGS Bulletin 660-F (Pardee 1918).

Location: T12N R14W Sec 03 BDAC

Ophir Creek (2)
PO004885

This placer is correctly located but is totally on private land and was therefore not visited. There is an active placer operation being conducted in the area at the time of this study. Total production was over 100,000 ounces according to Loen, 1990. It

was mined by ground sluicing, underground drifting, hydraulic giant, dragline and washing plant (Loen 1990; Elliot *et al.* 1992). Other references are Pardee and Schrader (1933) and Lyden (1948).

Location: T11N R08W Sec 36 BCDA

Ophir Creek (1)

P0004840

Screened out because of lack of information; this is probably the same as the other Ophir Creek placers (it isn't even in the Ophir Creek drainage).

Location: T11N R08W Sec 12

Ophir (1)

P0002858

This mine is located on one of five patented claims. Pardee and Schrader (1933) states that this mine consisted of several shafts, one of which was 190 feet deep. The only dates of operation found were prior to 1911, 1918 and 1938. It was located along a 15-foot wide shear zone in quartzite (Loen 1990). McClernan (1976) also reiterates Pardee and Schrader (1933). It was screened out because of its location on private land with no federal land downstream. It was not located where shown on the topographic map according to the USBM MILS database.

Location: T11N R08W Sec 25 DDBB

Ophir (2)

P0004845

This mine was screened out for the following reasons: inaccurate location; no references; it may be the same as the other Ophir mine in section 25, T11N, R8W.

Location: T11N R07W Sec 31

Pearl

P0004865

The Pearl workings consist of a caved shaft and a moderately sized dump. Surface disturbance is less than one acre. Pardee (1918) indicated the mine was developed by a 300' vertical shaft with four levels. Host rock was reported as garnet-magnetite-epidote at the granodiorite-limestone contact (Pardee 1918). Ore minerals included chrysocolla and malachite with minor chalcopyrite; irregular bodies of flinty quartz with iron oxide were also present (Pardee 1918). The contact plane of this skarn deposit was irregular and dipped nearly vertically under the limestone; the "granite" encountered at 300' was reportedly barren (Pardee 1918). All dump rock observed in 1994 was granodiorite (with sparse limonite staining). Ore values were variable but the majority of production was gold; the mine is reported to have produced about \$20,000 worth of gold-copper ore (Pardee 1918). Pardee reported that the mine had been idle for several years prior to 1916 (Pardee 1918). It seems likely that this mine produced

a modest amount of ore from mining activity prior to the turn of the century. This dry site is located on private land; no apparent environmental problems exist.

Location: T12N R13W Sec 05 DBDD

Red Cloud

GR003044

The Red Cloud workings are located a short distance east-southeast of the Mussingbrod mill. Workings consist of caved adits, dumps, prospect trenches, and cuts. Host rock is Precambrian Belt quartzite and schist. Coarsely crystalline, white quartz forms the gangue at this vein deposit. Signs of mineralization at this site include heavy iron-oxide staining on dump and wall rocks. Ore minerals reported from the sulfide zone include pyrite, chalcopyrite, tetrahedrite, and galena; iron oxides with free gold were reported from the oxidized zone. After being worked by plates and concentrators, the ore averaged 90% silica, 4% iron (pyrite and limonite), 3% sulfur, small amounts of copper and lead, 1 ounce of gold, and 1.5 ounces of silver (Pardee 1918). This site was discovered about 1867. It reportedly operated until at least 1935 (Gilbert 1935). There may have been some minor mining activity since that time. All workings observed on this patented claim in 1994 were dry and posed no apparent environmental problems. A map of this mine can be found in USGS Bulletin 660-F (Pardee 1918).

Location: T12N R14W Sec 03 DCAC

Reservoir & Ophir Patents

PO005370

These two placer claims located in section 25, T11N, R8W, are shown in Loen (1990) Plate 3. Both are private with no federal land downstream.

Location: T11N R08W Sec 25 ACBD

Shamrock

GR000254

The Shamrock claim is located near Williams Gulch a short distance northwest of Garnet ghost town. Most of the area has been reclaimed (i.e. recountoured and reseeded). A moderately sized dump is present on this claim; it appears that the dump rock has been hauled here from an adjoining claim. At one time there was a 350' deep incline with levels aggregating more than 1200' (Pardee 1918). Host rock is granodiorite; this was a vein deposit with white quartz forming the gangue. The only present-day indication of mineralization is limonite staining on some waste rocks. This site was discovered in 1867; most of the mining activity took place in the 1800's and early 1900's. The mine was closed in 1916 and idle at least to 1918 (Pardee 1918). Some activity may have been undertaken since that time (prior to reclamation). Production of more than \$100,000 was reported to 1916 (Pardee 1918). This dry site appears to lie on both patented and BLM land. A cross-section (longitudinal map) can be found in USGS Bulletin 660-F (Pardee 1918).

Location: T12N R14W Sec 03 ACBD

Sierra
GR003466

The Sierra workings consist of numerous caved workings (including two adits and an incline), prospect pits, and small dumps. The workings are located northeast of Garnet in dense forest. Total surface disturbance is approximately 1.5 acres. Host rock is granodiorite; workings explore a vein which strikes north and dips 30 degrees west (Pardee 1918). Coarsely crystalline quartz forms the gangue; the only present-day evidence of mineralization is limonite staining. Ore minerals included pyrite and tetrahedrite in the sulfide zone and limonite with secondary copper minerals in the oxidized zone (Pardee 1918). This gold-copper prospect had a small production of medium-grade ore (Pardee 1918). This dry BLM site poses no apparent environmental threats.

Location: T12N R14W Sec 03 ADAD

Stone Placer
GR000290

The Stone placer workings are located on the divide between Cayuse and Day gulches. Workings consist of open cuts and trenches. The workings explore a paleo-placer deposit consisting of reddish clay with quartzite cobbles and gravel. Placer gold occurs as small particles in this deposit (Pardee 1918). Small scale placer mining was reported in 1918 (Pardee 1918); judging from the fresh appearance of the workings, activity has continued to present day. No information regarding production from this property was found in the literature. This site, which lies on BLM and patented land, is dry, and poses no apparent environmental concerns.

Location: T12N R14W Sec 12 BBDB

Unnamed Lead-Silver Deposit
GR003039

An unnamed site consisting of a caved adit, a moderately sized cut, and a small dump is located in T12N R14W Sec 20 D, Granite County, Montana. Total surface disturbance is less than one acre. Host rock is Cambrian Hasmark Formation; lithology is limey dolomite with boxwork and vugs filled with calcite or quartz. There is moderate to heavy limonite and hematite staining on these rocks in part. The United States Bureau of Mines database indicated that this was a lead-silver deposit. No information on mining history or production data was found in the literature. This BLM site is located on a dry hillside and has no water component.

Location: T12N R14W Sec 20 DCBA

Unnamed Placer Mine
PO002618

This unnamed placer mine in section 35, T11N, R8W is entirely on private land. It is adjacent to the road and no effects to federal land were noted.

Location: T11N R08W Sec 35 ABDA

6. JEFFERSON RIVER DRAINAGE

American Pit

MA003448

The location of this site is uncertain but may be associated with the active chlorite mine under the Antler mine site.

Location: R02S R06W Sec 22

Antler Mine

MA000973

Open pit chlorite mine active at the time of the area investigation. Produced chlorite that is reported to be used in many of the same applications for which talc is used.

Location: T02S R06W Sec14 CCAC

Aurora

MA007238

Caved shaft and adit with numerous prospects exploring a narrow east-west trending quartz vein in Archean gneiss. Small deposits of chromite containing material can also be found on the eastern end of the site.

Location: T02S R06W Sec 03 CCCD

Blue Grouse

MA005984

Small prospects on a quartz vein in quartz monzonite intrusive country rock.

Location: T01S R04W Sec 4 BDAD

Bonanza Fraction

MA003408

Small prospect on a quartz vein in Belt sediments. Vein material contains large amount of iron oxides.

Location: T01N R04W Sec 34 CADB

Boss Tweed

MA006914

Boss Tweed and associated Clipper property as well as workings of Mammoth mine are the largest historic producers in the Mineral Hill district, accounting for most of the production for the entire district. Site consists of extensive underground workings and surface exploration sites. A large unconfined tailings pile resides on steep hillside on lower end of property. An enormous stamp mill built near Pony never turned a wheel and was eventually dismantled. A small modern mill building is present on the site.

Location: T02S R03W Sec 15 CDDC

Bowler's Blind

MA008073

North striking adit in Meagher limestone. Iron oxide gossan with some silica. The ore deposit is small and irregular. A sample of the gossanous dump material revealed the following values: 0.180 opt Au, 7.6 ppm Ag, 1,130 ppm Pb, and 1,610 ppm Zn.

Location: T01S R04W Sec 09 CBAC

Broadway, Victoria

MA007223, MA007058

Large site with underground and substantial surface mining. Large mill facilities and dry tailings impoundments also present at the site. Ore body is skarn material. Open pit on the site has large pillar composed of mostly hedenbergite. Deposit is located on contact of quartz monzonite and Cambrian limestone. Copper oxides are visible in the deposit. Two large tailings impoundments are located at the site; both are dry and relatively stable. The mill facility is generally intact.

Location: T02S R06W Sec02 BCAA/T02N R06W Sec 02 BCCA

Caldwell Ranch

JF008091

Shallow caved shafts and connecting drifts on narrow steeply dipping quartz vein in quartz monzonite. Workings strike just south of west.

Location: T02N R05W Sec 05 AAAA

Clancy

MA006971

Small caved shaft and associated dump in skarn material located on contact of quartz monzonite and Cambrian limestone.

Location: T01S R06W Sec 33 AACD

Clifford

MA003453

Several shallow caved shafts/prospects exploring east-west trending quartz vein in Archean gneiss.

Location: T02S R06W Sec 09 DDCC

Clipper

MA006012

Several open stopes and prospects along an east-west trending quartz vein in Archean gneiss. Vein was probably mined in conjunction with the Golden Rod/Iron Rod mine workings paralleling the Clipper vein on the south.

Location: T02S R06W Sec15 CDDC

Cricket

MA006776

Open stopes on an east-west trending quartz vein in Archean gneiss. Small waste dump relative to the size of workings that are visible may indicate that most of the mined vein material was shipped offsite for processing.

Location: T02S R06W Sec 10 CDDA

Dry Creek

JF008135

Open shallow shaft and prospects on east west-striking quartz vein in quartz monzonite.

Location: T02N R05W Sec 05 DADA

Easter Lily

JF006229

East striking caved adit in granitic intrusive rocks. Small amount of material containing large proportion of iron oxides found on dump. More prospects on strike of adit are found further up the hill side to the east.

Location: T02N R05W Sec 09 CBCD

Frida Marie

MA007124

Several small, caved prospects/adits that may possibly explore the same quartz vein as the Stella/Mammoth mine further to the west. Country rock is Archean gneiss.

Location: T02S R06W Sec 10

Galena

MA005552

Small caved dumps with quartz vein material in Archean gneiss country rock.

Location: T02S R06W Sec 03 ADBB

Gold Hill

MA008072

An area that is actually recorded as several different mines all developing the same ore body. Vein strikes east-west and is explored by drifts, crosscuts, and shafts. Structure probably extends for close to a mile. Material on dump contains quartz and massive pyrite. Mine is developed in Belt-age sediments but an igneous intrusive is exposed less than a quarter of a mile from mine workings. An assay of vein material from the dump on the western end of the workings had the following values: 1.12 opt Au, 96.0 ppm Ag, 3,550 ppm As, and 1.03% Cu.

Location: T01S R04W Sec 04 BBCB

Hell's Canyon Placer

MA001810

Large sandbar at the mouth of a gulch that intersects Hell's Canyon Creek. There is no indication that significant placer mining has been carried out at the location.

Location: T02S R06W Sec 20 BBCB

Iron King

MA004497

Mine in Belt sediments. Dump indicates a short, caved adit with no serious production. Material on the dump contains a high percentage of iron oxides.

Location: T01S R04W Sec 5 CDDB

Keystone

MA006944

Two small shafts and several adits in Tom Benton gulch that probably explore the same skarn deposit mined at the Broadway further to the east. Country rock is mostly Cambrian limestone that looks to have been affected by the quartz monzonite intrusive to the south and west.

Location: T02S R06W Sec 03 BBBC

King Shaft

MA005572

Caved shaft and a secured adit are the major features of this site. The mining developments explore a narrow east west trending quartz vein in Archean gneiss. Slag found near the lowest adit indicates that some assaying or small scale ore smelting were attempted at the mine site. Two assay samples were taken at this site. The first sample was taken from material on the dumps around a collapsed shaft and the second sample was taken from the dumps at the lowest adit on the site. Assay sample 1 showed the following values: 0.183 opt Au, 21.4 ppm Ag, 1,095 ppm Cu, 3,520 ppm Pb, 890 ppm Zn, and 3,780 ppm As. Sample 2 had no significant metal values.

Location: T02S R06W Sec 33 CADB

Mammoth&Stella

MA003972

A caved shaft and adit and ruins of a few structures are about all that remain at this site. The workings explore an east west trending quartz vein in Archean gneiss. Quartz vein material is present on the dumps.

Location: T02S R06W Sec 09 DABB

Minnie Wilson(?)

JF001769

Shallow open shaft in quartz monzonite. Pieces of jasperoid and quartz vein material on small dump around shaft. An assay of vein material showed 20 ppb Au, 26.5 ppm Ag, 938 ppm Pb, and 1,940 ppm Zn.

Location: T02N R05W Sec 05 CDBD

Mohawk

MA005516

This site explores a small deposit of chromite containing material in Archean gneiss.

Location: T02S R06W Sec 10 BDBC

Mountain Cliff

MA003060

Numerous open and caved adits exploring quartz veins in Archean gneiss.

Location: T02S R03W Sec 15 BACA

Ned/Willow Creek

MA003055, MA003050

Group of caved prospects east of the Boss Tweed property. Majority of workings are covered with vegetation and plant litter.

Location: T02S R03W Sec 15 ABCC/T02S R03W Sec 15 ABCC

North Willow Tungsten

MA004007

Small prospects in Archean rocks.

Location: T02S R03W Sec 24 BDDD

Norwegian

MA003645

Caved shaft and dump associated with surface prospects.

Location: T03S R02W Sec 01 CDBA

Norwegian Placer

MA003395

Remnants of placer workings in streambed.

Location: T02S R02W Sec 36 CDBA

Pegmatite Deposit

JF008090

Large pieces of quartz and feldspar crystals in a shallow excavation most likely dug to obtain crystal specimens.

Location: T03N R05W Sec 33 BCBD

Pipestone Quarry

JF008096

Active open cut mining operation producing railroad ballast.

Location: T02N R05W Sec 20 AACD

Ringin Rocks

JF008093

Open shaft and open stopes located on north/south striking quartz vein in intrusive country rock. Dumps have gossanous material.

Location: T02N R05W Sec 09 BDCB

Section 16

JF008094

Open shaft in basalt. Caved adits to the east probably intersected shaft below surface.

Location: T02N R05W Sec 16 CBBD

Section 17 Shaft

JF008095

Jasperoid vein material on dumps around shallow shaft. Underground workings appear to be following a north south trending structure.

Location: T02N R05W Sec 17 ADBC

Shamrock

MA005660

This small dump around a caved shaft is almost due south of the Clancy mine and probably explores the same skarn mineralization on the contact of quartz monzonite and Cambrian limestone.

Location: T01S R06W Sec 33 ADAC

South Easter Lily

JF008089

Small dump associated with caved, east striking adit. Material containing fair amount of iron oxides on dump. Adit is collared in granitic intrusive country rock. An assay of dump material showed no significant levels of precious or base metals.

Location: T02N R05W Sec 09 CBCC

Surprise

MA003130

Caved shafts and prospects generally located on porphyry intrusive structure in Belt sediments. An assay of dump material indicated no noteable metal values.

Location: T01N R04W Sec 34 BCCD

Unnamed 01S04W03CBDB

MA003083

Series of caved and open shafts and shallow pits exploring north trending quartz veins near contact between Belt-age sediments and cretaceous intrusive dike/sill. Vein has minor sulfides and copper oxide minerals are visible. An open shaft at the north end of the site is generally on line with the east-west trend of the vein found in the Gold Hill group of mines to the west. Two assays of the site were taken. One assay sample of the exposed vein was taken and one assay from the intrusive country rock. The vein was found to contain 0.016 opt Au, and 1.84 % Cu. The country rock showed no significant metal values.

Location: T01S R04W Sec 03 CBDB

Unnamed Section 17

JF008159

Caved shaft and drifts following north south trending structure. Jasperoid vein material exposed in face of excavation.

Location: T02N R05W Sec 17 ADBC

West Dry Creek

JF008088

Open shaft and drift on east west trending quartz vein in quartz monzonite. A good deal of tourmaline is found at the western end of the site. A series of shallow trenches have been dug probably trying to locate the extension of the vein. Extreme eastern end of site has prospects dug along a north south striking remnant of Archean gneiss within the surrounding quartz monzonite. An assay of a vein exposed in a short prospect adit on the west end of the site showed the following assay values: 785 ppb Au, 1.9 ppm Ag, and 1,565 ppm As.

Location: T02N R05W Sec 17 BBBB

7. MADISON RIVER DRAINAGE

Badger#1 & 2

MA007088

Small collapsed adit/prospects in Archean country rock.
Location: T03S R01E Sec 19 DBBB

Bertha

MA003613

Caved shaft in Archean rocks.
Location: T06S R02W Sec 05 ADBB

Betty Mae

MA003630

No significant workings were found associated with this location, although an inclined shaft was reported in the literature.
Location: T04S R01W Sec 11 BDAC

Boaz/Birdia

MA003750

Shafts, adits and prospects exploring quartz veins in Archean country rock. Sizeable, dry tailings in wash to the east of mine site. Fairly modern mill building and heap leach impoundment on spur between mine and historic tailings impoundment.
Location: T03S R01E Sec 19 CBCA

Bull Moose

MA003610

Caved shafts exploring quartz veins in quartz monzonite. Site is reported to be associated with the workings of the Revenue mine further to the south and east.
Location: T03S R01W Sec 30 CAAB

Emperor

MA003620

Very small prospect, even as prospects go, located in quartz monzonite in a State section. This may not be the accurate location of the Emperor.
Location: T03S R02W Sec 36 ACAD

Grubstake

MA002995

Shaft with headframe and recent metal sided mill building. Sizeable dumps and dry tailings impoundment in gulch below headframe. Mine appears to develop quartz vein in Archean rock.
Location: T03S R01E Sec 19 DDBD

Helene

MA003638

Open and collapsed adits/shafts(?) and many prospects exploring west-striking quartz vein in Archean rocks.

Location: T03S R01E Sec 19 BACC

Hot Springs Placer

MA003415

Barely distinguishable placer workings in streambed on State land.

Location: T03N R01W Sec 16 DADA

Josephine

MA003625

Small caved prospects on quartz vein in Archean rocks.

Location: T03S R01E Sec 19 BCAD

Kenner

MA003355

Caved shaft exploring quartz vein in Archean rocks. Probably explores the same vein as the Bertha mine.

Location: T06S R02W Sec 05 DBAC

Mohican

MA003010

Caved prospects on quartz vein in Archean rocks.

Location: T03S R01E Sec 18 ABCC

Montana Boy

MA003635

Shaft and newer mill building.

Location: T04S R01W Sec 02 ACDA

Revenue

MA006893

Large dumps and surface cuts. Several caved shafts. Dry tailings impoundment. All workings located in quartz monzonite. Mine develops precious metals containing quartz veins in Cretaceous intrusive. A new impoundment is being constructed on the site, possibly to carry out gold leaching operations.

Location: T03S R01W Sec 31 ACCB

Tobacco Root

MA003523

Small prospects exploring quartz veins in Archean country rocks.

Location: T03S R01W Sec 24 ACCC

Unnamed 03S01E18CACC

MA003628

Caved/open prospects on quartz vein in Archean rocks.

Location: T03S R01E Sec 18 CACC

Unnamed 03S01E18CCDB

MA003633

Caved prospects in Archean country rocks.

Location: T03S R01E Sec 18 CCDB

Unnamed Sec 30

MA008160

Small caved adits and associated dumps exploring quartz vein in Archean country rocks.

Location: T03S R01E Sec 30 BBDB

8. UPPER MISSOURI RIVER DRAINAGE

Ariadene LC001351

Caved shaft and prospects on quartz vein in intrusive granitic rock. Mine reportedly contained lead ore minerals.

Location: T11N R04W Sec 36 CBDB

Bald Mountain, Cruse Mine LC004264, LC007403

No detailed investigation done at this site. Walker (1992) provides a brief description of this mine.

Location: T12N R06W Src 35 CABC/T12N R06W Sec 03 CBAD

Baldy Smith LC007367

This site was examined from a distance for environmental problems only. Pardee and Schrader (1933) provide a description of the geology here.

Location: T11N R05W Sec 34 BDDA

Bell Boy, Nile, Towsley, Shakopee, Earthquake LC007390, LC007294, LC007272, LC001819

Caved and open adits and shafts, as well as several surface prospects near a contact of intrusive granitic rocks and altered Belt sediments. Quartz veins all on the same structure developed in the mine/ mines contain gold, silver and lead mineralization. McClernan (1983), Walker (1992), Pardee and Schrader (1933) provide more detailed geology.

Location: T11N R06W Sec 04 BADC/T11N R06W Sec 04 CACD/T11N R06W Sec 04 BCAA/T11N R06W Sec 04 ADAA

Belmont LC007391

This mine is associated with the Bald Mountain mine. No detailed investigation was done here. Knopf (1913) and McClernan (1983) discuss the geology of the mine.

T12N R06W Sec 35 CDB

Big Ox LC004244

This site was given only a cursory inspection for environmental problems. McClernan (1983) describes workings at this site.

Location: T12N R06W Sec 13 CAAD

Blue Bird Copper & Silver

LC007292

Caved shaft and prospects exploring a quartz vein in granitic country rock. Pardee and Schrader (1933) note that lead/silver ore was produced and they noted some copper mineralization from their investigation.

Location: T10N R04W Sec 01 CDCD

Blue Jay

LC004289

No detailed examination was done at this site. A brief look for environmental problems was carried out. Pardee and Schrader (1933) provide a description of site geology.

Location: T11N R05W Sec 28 DCDB

Bonanza

LC007394

Workings of this mine are closely associated with the workings of the Ariadne mine to the south. Pardee and Schrader (1933) provide a description of the workings and geology and McClernan (1983) provides a map location of this site.

Location: T11N R04W Sec 35 ACCB

Calumet

LC007397

No geologic examination of this site was conducted. Pardee and Schrader (1933) describe the geology and mine workings for this site.

Location: T12N R06W Sec 36 DADA

Golden Crown, Come Again & Crown, Queen of The Valley,

Iron, Herb W., Lion, North Star

LC007369, LC001069, LC007318,
LC004479, LC007441

All of these sites are in the same location according to the Mills database and descriptions given by Pardee and Schrader (1933). Only the Crown group and Queen of the Valley are described in the literature. Pardee and Schrader (1933) describe inclined shafts and glory hole mine workings developing quartz veins in intrusive granitic rocks. Mined ore was also reported to have been sent to a mill near the mine. Remnants of the surface exposure of the glory hole are present and some bulldozer work appears to have been carried out in the open cut.

Location: T11N R04W Sec 26 BBCB, T11N R04W Sec 26 ACCB, T11N R04W Sec 26 BDDA, T11N R04W Sec 26 Bddb, T11N R04W Sec 26 CAAA, respectively

Copper Hill

LC001933

The mine is developed by caved adits and is cut by the right of way of Montana Rail Link, which would likely hinder any serious future development of the site by any party

but the railroad. Workings are in limestone near an exposure of intrusive rock. Pardee and Schrader (1933) provide more detail.

Location: 10N R05W Sec 04 AABC

Drumheller

LC007404

Caved shaft in Belt sediments near an exposure of intrusive granitic rocks. Pardee and Schrader (1933) were able to conduct a more in-depth investigation because the mine was open for study during their visit.

Location: T11N R04W Sec 33 CAAB

Drumlummon

LC001969

The major historic producer in the Marysville district and one of the more productive gold mines in the greater Helena T12N R06W Sec 36 CADD mining region. Pardee and Schrader (1933) and Walker (1992) describe the geology, mine workings, and history of the site in detail.

Location: 12N R06W Sec 36 CADD

Elizabeth

LC007406

Caved shafts and prospects explore a quartz vein in intrusive country rock. Pardee and Schrader (1933) offer a more in-depth description of the property.

Location: T11N R04W Sec 26 DABA

Ella

LC007407

Open adit with gate that has been forced open. Adit is collared in granitic intrusive rock near the top of the west side of Scratchgravel Hill. Pardee and Schrader (1933) reported that this is a crosscut adit that developed a quartz vein containing iron and manganese oxides and gold in chalcedonic quartz. Some of this material can be found on the dump.

Location: T11N R04W Sec 27 DADB

General Harrison

LC007378

Quartz vein in granitic country rock exposed by surface cuts and prospects.

Location: T11N R04W Sec 27 CADA

Gloster

LC008167

Small overgrown dumps in metamorphic contact rock.

Location: T12N R06W Sec 27 CADD

Granite Creek

LC008138

No detailed investigation was done at this site. Area consists of small dry prospects and placer workings.

Location: T10N R04W Sec 06 BDCB

Charles Greenfield

LC00001963

Small prospect in Belt sediments.

Location: T11N R04W Sec 28 DDDB

Hopeful/Moonlight

LC007375

Several short, collapsed adits and shafts with numerous surface prospects. Pardee and Schrader (1933) give a description of the underground workings which were open at the time of their visit.

Location: T11N R04W Sec 35 AADC

Lost Horse Creek

LC007411

Several open stopes and prospects probably associated with the workings of the Empire and M&L mines.

Location: T12N R06W Sec 34 BDBB

Magpie Group

LC004249

No visit was made to this site. Pardee and Schrader (1933) report that the mine is located in the valley south of the Scratchgravel Hills and to the northeast of the Franklin mine. They also relate information about the geology and mine workings at the site.

Location: T10N R04W Sec 02 ACCC

Morning Star

LC007436

Numerous surface prospects and shallow excavations in the area of quartz float material in granitic intrusive rock.

Location: T10N R04W Sec 01 CBAC

Mullin Claim

LC007437

Caved adit on the north end of the Scratchgravel hills in granitic country rocks. Description of the underground workings is given by Pardee and Schrader (1933).

Location: T11N R04W Sec 26 BDBB

Osage Chief

LC001939

Shallow surface deposit related to the Copper Hill prospect to the west of the railroad. Mine was worked from the surface (Pardee and Schrader 1933).

Location: T10N R05W Sec 04 AAAC

Ottawa

LC004254

Small overgrown dump and framed adit with water flowing.

Location: T11N R06W Sec 02 CBAD

Piegan Gulch

LC007420

Extensive placer workings along the course of Piegan Creek.

Location: T12N R06W Sec 27 BCDA

Scratchgravel Hills

LC007447

Several small prospects in Belt sediments around this site.

Location: T11N R04W Sec 33 BAAD

Shannon Mine

LC004219

Caved workings in Belt sediments. Details of geology and workings are found in Walker (1992).

Location: T11N R06W Sec 03 DBBB

Silver Age

LC001831

Caved shafts and prospects in Belt sediments.

Location: T11N R04W Sec 33 DBDA

Silver Bar

LC007300

Small prospects exploring quartz veins in granitic country rock.

Location: T10N R04W Sec 02 AADA

Silver-Copper

LC007282

Small caved shaft with dump containing oxidized vein material (Pardee and Schrader 1933).

Location: T11N R04W Sec 36 CDBA

Staple

LC007266

This site with a caved adit is described by Pardee and Schrader (1933).

Location: T12N R06W Sec 22 DDDA

Unnamed 11N04W34ACBC

LC008100

The prospects at this location may be associated with the Nettie, Bluebird or Wayside mines as described by Pardee and Schrader (1933).

Location: T11N R04W Sec 34 ACBC

War Eagle

LC001867

No geologic examination was done at this mine. Pardee and Schrader (1933) describe the geology and workings of this mine.

Location: T10N R05W Sec 10 ABCA

Wayside

LC007280

Caved shaft and shallow prospects in granitic country rock. Pardee and Schrader (1933) describe underground workings and geology of this and associated sites, which include the Blue Bird and Nettie.

Location: T11N R04W Sec 34 BDAA

9. RUBY RIVER DRAINAGE

Barton Gulch Placers

MA003390, MA003435

The entire creek in Barton gulch shows evidence of placer work. The placering starts at the Marietta mine near the top of the drainage and continues to the mouth of the gulch at the Ruby river. Much of the work looks like small scale hand work. The western end of the site near the reservoir is actively being placered, reportedly for garnets and gold.

Location: T07S R03W Sec 21 CBAA/T07S R04W Sec 21 BAAB

Batton Brothers/Bell

MA005960

Two or more caved adits in Archean country rock. Quartz and altered material on small dumps. Lowest dump has remnants of drive-under, ore-loading platform. Possibly as much work was done at this site for building landscaping features and roads out of stone as was done in working the mine.

Location: T06S R03W Sec 35 BDDC

Broadgauge-Tamarack

MA007037

In 1996, the site was an active open pit operation with a crusher, mill, and tailings.

Location: T04S R04W Sec 17 CCCC

Buckeye

MA003822

This site is on private land and consists of an open shaft and some waste rock. Four building structures and some debris were also observed at the site. The site has no adverse impact on BLM-administered land.

Location: T04S R04W Sec 19 DADB

Cook Mine

MA008166

Caved shaft and adits with associated dumps; several areas of surface disturbance that may or may not be mining related. The mine is in the bottom of Williams Gulch, and the water table may be very near surface in the lowest workings at this site. The mine explored quartz vein containing iron oxides. Country rock is Archean gneiss.

Location: T06S R03W Sec 31 CBCC

Cost Manganese

MA008198

Small deposit of iron and manganese oxides in sedimentary rocks.

Location: T07S R04W SEC 03 DDDA

Scheitlin Mill

MA003987

Former gold mill associated with the U.S. Grant mine. Site was "active" at time of visit.

Location: T06S R03W SEC 26 BCDC

Forks

MA007121

North striking adit next to road. Adit is open but secured and has track and crude loadout facility. Mine is collared in Archean rock, but the dumps do not reveal any sign of possible ore being mined at this location.

Location: T07S R03W Sec 04 ABAC

Garrison Placer

MA005564

Active mine area at time of visit.

Location: T07S R03W Sec 27 AABB

General Schafter

MA003778

Mine location inaccessible due to active mining at Kearsarge site.

Location: T07S R03W Sec 22 BBDB

Granite Creek/Lawyer

MA000961, MA005456

Small prospect in Archean country rock.

Location: T06S R03W Sec 10 BBAB/T05S R03W Sec 25 ACCB

Hilltop

MA007130

Caved adit in Archean rocks.

Location: T07S R03W Sec 04 DDBB

Kearsarge

MA007232

Active mine site at time of field visit.

Location: T07S R03W Sec 23 ABBC

Latest Out

MA005680

A small prospect pit on private land with no hazards or environmental problems.

Location: T04S R04W Sec 32 AADD

Mapleton

MA003165

Narrow, northwest-striking quartz vein with iron oxides in Archean country rocks. Vein has been stoped to surface along a fairly long strike length. Adits at the site are all collapsed.

Location: T06S R03W Sec 09 DABB

Mountain Chief

MA003618

Bulldozer cuts and caved underground workings exploring quartz veins in Archean country rock.

Location: T06S R03W Sec 32 DCCC

Nash Group

MA003085

This site consists of an open adit on BLM-administered land. The adit has been secured with a three-foot-diameter culvert and a locking gate. No hazards or environmental problems were noted.

Location: T04S R04W Sec 33 CBDC

Old Toledo

MA003887

Features at this private site include a collapsed adit with a discharge, three open shafts, and extensive waste-rock dumps. The adit discharge runs into a man-made pond and then flows a short distance before infiltrating the ground. No adverse impacts to BLM-administered land were observed.

Location: T04S R04W 17 DBCB

Ore Cache

MA003690

Small northeast striking vein in Archean rocks.

Location: T07N R03W Sec 24 ABCC

Pearl Group

MA003238

Small prospects in Archean rocks.

Location: T07S R03W Sec 02 BDAA

Riddel

MA003665

Surface cuts and prospects exploring possible migmatite in Archean rocks.

Location: T07S R03W Sec 22 ACCB

Rosebud

MA005640

Maintained buildings and secured adit at this site. Mine may develop same mineralization as found in El Fleeda to the west.

Location: T06S R03W Sec 35 BBAB

Silver Bell

MA003670

Reclaimed mine site in Archean rocks.

Location: T06S R03W Sec 31 ACDB

St. Lawrence

MA007022

Headframe and structures at reclaimed mine shaft in Archean rocks. Quartz vein material in ore bin was assayed and found to have the following values: 0.340 opt Au, 22.1 opt Ag, 7,240 ppm Pb, and 1,385 ppm Zn.

Location: T06S R03W Sec 32 BABB

Unnamed 06S03W30ACDA

MA003048

Small development of a quartz vein in Archean rocks.

Location: T06S R03W Sec 30 ACDA

Unnamed 06S03W31ACAA

MA003063

Small dumps and cut in Archean rocks. May have explored same mineralization as Silver Bell mine.

Location: T06S R03W Sec 31 ACAA

Unnamed 06S03W31ACCC

MA003068

Reclaimed mine site in Archean rocks.

Location: T06S R03W Sec 31 ACCC

Unnamed 07S03W15ACAD

MA003753

Small dumps and caved adit in Archean rocks.

Location: T07S R02W Sec 15 ACAD

Unnamed 07S03W13CABA

MA003743

Small dumps and caved adits exploring southwest striking quartz vein in Archean rocks.

Location: T07S R03W Sec 13 CABA

Unnamed 07S03W15DCCB

MA003738

Small prospects with quartz float in Archean rocks.

Location: T07S R03W Sec 15 DCCB

Unnamed Gold

MA005804

A collapsed adit and numerous prospects. No effect on BLM-administered land.

Location: T04S R04W Sec 32 DAAB

Unnamed Sec 16

MA003768

Small overgrown caved adit and dump.

Location: T07S R03W Sec 16 CCDA

White Talc

MA004057

Small prospects in Archean rocks.

Location: T06S R03W Sec 04 BDCA

10. OTHER DRAINAGES AND MINING DISTRICTS

SITES IN THE SOUTHERN PRYOR MOUNTAINS

Dandy (Pryor Mountain)

CB000015

The Dandy or Pryor Mountain mine consists of open cuts, prospect pits and trenches, a number of adits (3 of which are open), and waste rock piles of varying size. Total surface disturbance is approximately 10 acres; this is a BLM site. Host rock is Permian Phosphoria formation (argillaceous, cherty, limy dolomite); the ore deposit is believed to be stratiform. Carnotite(?) coatings are present on some of the waste rock; carnotite was probably the principle ore mineral. Other mineralization includes iron-oxide staining (limonite and hematite). All workings at this site are dry; there is no water component. Location: T09S R27E Sec 08 AADD

East Pryor

CB000147

The East Pryor mine is located on the Pryor Mountains National Wild Horse Range (administered by the Bureau of Land Management). Most of the area has been recontoured and re-seeded; several prospect pits and small waste rock dumps are visible. Total surface disturbance at the site is approximately 5 acres (including the reclaimed area). Host rock is Permian Phosphoria dolomite; the dolomite at this location is highly brecciated and has abundant vugs in part indicating solution activity. This appears to have been a stratiform(?) deposit with carnotite(?) as the principle ore mineral. This site is located in a dry gulch and poses no apparent environmental problems; within a few more years, there will be no evidence of mining activity in this area.

Location: T09S R28E Sec 07 CAAA

Marie

CB000021

The Marie mine, located a short distance southwest of the Dandy, includes several prospect pits/trenches, a relatively large open adit, and several waste rock dumps, one of which is substantial. Total surface disturbance at the site is approximately 1 acre. Host rock is Permian Phosphoria dolomite; there is very little evidence of uranium mineralization on the waste rock found in the dumps. Sparse to moderate limonite/hematite staining was noted. As with other sites in the area, this was probably a stratiform(?) uranium deposit. This site is located at the head of a dry drainage; all workings are also dry. All disturbances are on BLM land.

Location: T09S R27E Sec 08 ACBD

Swamp Frog

CB000747

The Swamp Frog mine consists of surface and underground workings covering

approximately 15 acres. There are at least two open adits, multiple surface pits and cuts, and multiple waste rock dumps. Two dilapidated mining shacks are also found at this location. Host rock is Permian Phosphoria formation; most of the workings appear to explore the upper portion of the section. The lithology consists of argillaceous, limy, cherty dolomite with some phosphatic dolomite. There is scant evidence of uranium mineralization on the dump rock in the form of carnotite(?) films; other signs of mineralization include iron oxide staining. This probable stratiform(?) deposit appears to be the most substantial in the area based on the extent of the workings. Most of the workings are located in a dry strike-valley; prospect pits and trenches are found on the adjacent ridges. All workings are dry; all disturbances are located on BLM land.

Location: T09S R27E Sec 17 DACA

Unnamed Gold
CB000435

An unnamed paleo-placer gold mine(?) is found southwest of the mountain front on the Bear Canyon 7.5 map. This site consists of a 8' diameter shaft driven along a dry drainage. The shaft is open to a depth of approximately 10 feet but is fenced and poses no significant hazard. The host rock is Quaternary(?) gravels principally derived from the Phosphoria formation. The MILS inventory lists this mine as a placer gold deposit; in reality, it appears to be little more than an exploration shaft - there is no waste rock dump and operations seem to have been insubstantial. The shaft and adjacent drainage are dry; no environmental problems are posed by this site. This site is located on BLM land.

Location: T09S R28E Sec 07 CBBC

APPENDIX IV

ASSAY DATA

BUREAU OF LAND MANAGEMENT
ASSAY RESULTS

Site Name	Site ID	Assay ID	Sample Method, Material Type, Comments	Au oz/T	Ag ppm	Cu ppm	Pb ppm	Zn ppm
ARMADA MINE	GR003484	WCAR-1	COMPOSITE, WASTE ROCK	0.0250	25.4	13,900	<2	72
ARTIC CLAIM	BE000521	PGAC-1	GRAB, WASTE ROCK	0.0110	104.0	64	1,245	1,050
BALTIMORE	JF002181	JBBG-1	SELECT, VEIN, QTZ, CHALC,PY,GAL,TET	0.1900	1030	3,490	18,800	754
BELLVIEW	MI006011	WWBW-1	COMPOSITE, WASTE ROCK	0.0100	174.5	21,000	34,500	502
BLUE MOON MINE	GR003561	WFBM-1	COMPOSITE, WASTE ROCK	0.0010	0.2	67	<2	36
BON MINE	BE004285	PGBN-1	GRAB, WASTE ROCK, MNOX/RHODOCHROSITE/CALCITE/LS/FE0X.	0.0020	167.5	103	482	1,015
BONNIE GROUP	BE004300	PGBO-1	GRAB, WASTE ROCK, SANDSTONE WITH MINOR IRON OXIDE STAIN.	<0.0005	1.8	12	70	58
BOSTON MINE	PO004810	WDBN-1	COMPOSITE, WASTE ROCK	0.0150	10.6	19,900	6	102
CABLE MINE AND MILL	BE000653	PGCB-1	COMPOSITE, MILL TAILINGS, COMPOSITE OF TAILS IN CREEK.	0.0830	5.8	3,400	134	178
CALVIN SOUTH	MA008062	SBCS-1	SELECT, VEIN, BREC SI DOL W/QTZ FE-0X MATRIX	0.0250	94.6	1,850	45,000	52,100
CAMP CREEK MINE & MILL	SB006540	SBCC-1	SELECT, ORE, FE-ST GNEISS	0.0135	0.4	114	48	104
CAPITOL CLAIM	BE000665	PGCP-1	SELECT, WASTE ROCK, PRIMARILY CHALCEDONY AND FEOX STNED QTZ.	0.0035	5.2	1,085	41,500	986
CARBONATE MINE	BE000174	WRCE-1	COMPOSITE, WASTE ROCK	0.0240	28.0	41	15,500	278
CHARTER OAK MINE	BE000527	PGCO-1	SELECT, WASTE ROCK, SECONDARY CU MINERALS/YELLOW-GRN OX/MNOX/FEOX/QTZ	0.0135	381	4,120	31,800	17,200
CHLORITE GULCH	SB008101	SBCG-1	SELECT, ORE, JASPEROID	0.1145	45.6	1,835	7,820	418
CHRISTIANSSEN GROUP	SB001426	SBCG-2	SELECT, VEIN, QTZ BREC W/ FE-0X., MAL	0.0020	10.0	18,300	60	196
COONS TUNGSTEN	PO002876	PCCT-1	GRAB, WASTE ROCK, LS/GRANODIORITE, WITH MINOR CU-STAIN & SKARN MIN.	<0.0005	0.4	650	48	22
COPPER HILL	SB001834	SBCH-1	SELECT, VEIN, CS GR QTZ W/ FE & CU ST	0.0025	12.2	12,400	70	136
COPPER STATE	GR003624	GFCS-1	SELECT, VEIN, VUGGY QTZ,PY,CPY,CC	0.0020	85.6	7,480	2,740	2,000
DENVER MINE	PO004645	PODN-1	GRAB, WASTE ROCK, QUARTZITE/GRANODIORITE/TARNISHED SULFIDES	0.0195	196.0	38	120	32
DEXTER MINE	BE000318	WRDX-1	COMPOSITE, WASTE ROCK	0.0005	2.4	22	658	826
DIAMOND HITCH ADIT 1	MA006016	WNDH-1	COMPOSITE, WASTE ROCK	0.0685	5.0	252	3,310	4,770
DURAND-NEWSEATTLE	GR007639	GFNS-1	SELECT, ORE, FE-,CU-ST SHEAR ZONE IN QTZITE	0.0320	153.0	49,700	28	2,020
EMMA NEVADA	SB001414	SBEM-1	SELECT, ORE, QTZ-FE-0X BRECCIA	0.0090	3.0	31	392	296
EUREKA	MA008105	SBEV-1	SELECT, ORE, JASPEROID	0.0605	466	1,705	108,000	127,000
FLORIDA CLAIM	BE004605	WRFL-1	COMPOSITE, WASTE ROCK	0.0495	21.8	253	672	1,030
FRANCIS H.	BE008023	PGFH-1	GRAB, WASTE ROCK, MNOX/CALCITE & ???	0.410	44.0	132	3,690	834
GALENA	BE000276	WRGA-1	COMPOSITE, WASTE ROCK	0.0045	3.6	99	1,210	1,530
GOLCONDA/RELIANCE	JF008061	JHGR-1	COMPOSITE, WASTE ROCK, ALT GRANITE W/ PY, QTY, SER	0.0015	28.8	494	1,220	6,670
GOLD KING (EMMA NEVADA II)	SB008104	SBEM-2	SELECT, ORE, QTZ BRECCIA W/ FE-0X-CAL MATRIX	0.2930	90.4	5,180	2,430	242
GOODVIEW MINE	BE000210	WRGW-1	COMPOSITE, WASTE ROCK	0.0130	26.8	228	7,760	3,660
GRAYBIRD	BE000300	WRGB-1	COMPOSITE, WASTE ROCK	0.0005	7.6	928	15,100	17,700
GREY LOCK	SB006160	SBGL-1	SELECT, ORE, FE-ST QTZ BRECCIA	0.1915	17.0	357	1,350	146
HIDDEN	SB008057	SBHI-1	COMPOSITE, WASTE ROCK, FE-ST GNEISS	<0.0005	<0.2	89	18	66
HURON	BE000132	PGHC-1	GRAB, WASTE ROCK, LS/RHODOCHROSITE/YELLOW-GREEN OXIDE/MNOX/CU & PB	0.0775	290	1,990	4,740	2,480
IRON MASK MINE	BE000551	PGIM-1	GRAB, WASTE ROCK, PYRITE/MNOX/QTZ/POSSIBLY GRANODIORITE.	0.0375	322	256	4,250	6,730
KATIE ALLEN	PO008029	POKA-1	SELECT, WASTE ROCK, VISIBLE SULFIDES- SAMPLE TAKEN ALONG TOP OF DUMP.	0.0215	9.6	5	30	42
LEAD QUEEN	MA003115	WDLQ-1	COMPOSITE, WASTE ROCK	0.0120	697	8,070	2,570	1,545

ASSAY RESULTS (continued)

Site Name	Site ID	Assay ID	Sample Method, Material Type, Comments	Au oz/T	Ag ppm	Cu ppm	Pb ppm	Zn ppm
MULLENS	SB008114	SBMU-1	SELECT, VEIN, QTZ, PY, GAL	0.1440	67.0	363	45,500	4,220
NEZ PERCE	MA008115	MBNP-2	SELECT, VEIN, BIO SCHIST W/ QTZ, FE-OX, MAL, CHL	0.0040	5.2	36,400	12	66
NEZ PERCE NORTH	MA008116	MBNP-3	SELECT, ORE, GNEISS W/ QTZ, PY, SER	0.0145	<0.2	69	20	582
NEZ PERCE SOUTH	MA008117	MBNP-1	SELECT, ORE, EARTHY GOSSAN W CAL VNLETS	0.0170	2.0	300	148	224
OLD FAVORITE MINE	BE000629	PGOF-1	COMPOSITE, MILL TAILINGS, TOOK SAMPLE 1/3 WAY DOWN ON FACE OF TAILS.	0.0710	3.2	6,200	158	332
OPSATA MINE	PO004850	POOP-1	GRAB, WASTE ROCK, QTZ/PYRITE/QTZITE; SAMPLED ALONG TOP OF DUMP.	0.0015	7.2	<1	40	8
PANDORA, LOWER	MA008050	SBPA-1	COMPOSITE, WASTE ROCK, BK PYRITIC SHALE	<0.0005	1.0	51	34	66
PAUPER'S DREAM	MA008050	SBPD-1	COMPOSITE, WASTE ROCK, FE-ST GNEISS	0.0395	2.2	433	1,410	294
PAUPER'S DREAM	MA008050	SBPD-2	SELECT, VEIN, CHERTY QUARTZ	0.0845	3.8	201	900	232
POMEROY MINE	BE000557	PGPO-1	GRAB, WASTE ROCK, CALCITE/QTZ VNS/LIMESTONE/SECONDARY CU/+?DK GRY	0.0085	111.0	189	838	428
REDWING	JF004841	JCRW-1	COMPOSITE, WASTE ROCK, ALT GRANITE W/ PY, SER	0.0040	31.0	50	334	360
REDWING	JF004841	JCWY-2	SELECT, VEIN, QTZ, PY, GAL, SPH	0.462	131.5	373	41,800	26,000
SBME-1	MA008119	SBME-1	SELECT, ORE, QTZ, JAS, GOSSAN	0.0145	152.0	1,920	19,600	1,015
SHORT SHIFT	MA007028	MBSS-1	SELECT, ORE, GNEISS W/ QTZ, FE-OX	0.603	2.0	52	294	24
SILVER STAR (LONE STAR) MINE	BE000569	PGLS-1	SELECT, ORE, W/ 10% FINELY XLINE PYRITE & SECONDARY CU MINERALS	0.0040	310	11,200	60,600	91,200
STEVENSON MINE	BE003890	PGST-1	GRAB, WASTE ROCK, DK BRN STAINED LIMESTONE/ OX CU/ TR QTZ-DISS PY VN	0.0030	141.0	374	2,710	5,280
T.D.-6	BE000702	PGTD-1	GRAB, ORE	0.0005	<0.2	84	24	82
TAYLOR MINE	BE004120	PGTM-1	CHIP, ORE, MOSTLY CHALCEDONIC QTZ, MULTI-COLORED.	<0.0005	7.6	21	76	190
UNION	MA008125	SBVN-1	SELECT, ORE, QTZITE BREC W/ FE-OX, TR GAL	0.2010	62.6	231	21,600	4,670
UNION MINE	MA003253	WWUN-1	COMPOSITE, WASTE ROCK, FROM BELOW MAIN ADIT	0.0030	0.6	32	68	140
UNNAMED 04S05W01ABAD MINE	MA003163	VLUU-1	COMPOSITE, WASTE ROCK	<0.0005	1.4	64	500	1,200
UPPER ROCHESTER	MA003570	MBUR-1	SELECT, ORE, AUGEN GNEISS W QTZ VNLS	0.1145	6.8	204	1,540	304
WALDY	JF002157	JCWY-1	COMPOSITE, WASTE ROCK, ALT GRANITE	0.0105	9.8	63	2,580	982
WATER TANK	MA008126	MBNP-4	SELECT, ORE, SHEARED FE-ST GNEISS	<0.0005	<0.2	114	6	44
WHEAL ROSE MINE	BE000575	PGWR-1	GRAB, WASTE ROCK, REXLIZED LS/ QTZ/FeOX/MNOX/NO SULFIDES	0.0095	356	651	5,560	17,800
WICKIUP CREEK	SB008055	SBWC-1	SELECT, VEIN, QTZ, PY, GAL	0.0005	3.8	63	942	728

APPENDIX V

WATER-QUALITY AND SOIL CHEMISTRY DATA

BUREAU OF LAND MANAGEMENT
Water-Quality Results - Dissolved Concentrations

Mine/ Sample ID	Lab ID	Sample Location	Al (ug/l)	As (ug/l)	Ba (ug/l)	Cd (ug/l)	Cr (ug/l)	Cu (ug/l)	Fe (mg/l)	Pb (ug/l)	Mn (mg/l)	Hg (ug/l)	Ni (ug/l)	Ag (ug/l)	Zn (ug/l)	Cl (mg/l)	Fl (mg/l)	NO3 (mg/l)	SO4 (mg/l)	SI (mg/l)	Field pH (SU)	Lab pH (SU)	Field SC (umhos/cm)	Temp (C)
ALADDIN, CAPE NOME, AND HIDDEN TREASURE MINES																								
WALS10L	96Q0201	Unnamed tributary, 750 ft. upstream of Aladdin	<30.	<1.	150.7	<2.	<2.	<2.	0.042	<2.	0.003	<1.	<2.	<1.	11	<5	<1	0.05	5	1.5	7.38	7.59	61	8
WHTS10H	96Q0208	Seep in road, near Hidden Treasure dump.	<30.	11.9	164.2	<2.	<2.	8.9	0.013	<2.	0.01	<1.	<2.	<1.	24.9	1	0.3	<0.5	17.5	16.1	7.8	8.1	312	13
WHTS20M	96Q0197	Wallace Creek, 0.3 miles upstream of Hidden Treasure.	<30.	<1.	419.4	<2.	<2.	<2.	0.005	<2.	0.004	<1.	<2.	<1.	6	0.5	0.3	0.05	5	14.2	8.27	8.34	231	9.4
WHTS30M	96Q0200	Wallace Creek, downstream of all sites.	<30.	<1.	303.6	<2.	<2.	<2.	<0.003	<2.	<0.002	<1.	<2.	<1.	10.2	0.5	0.1	<0.5	5	20.7	7.26	7.13	245	8.8
AMERICAN FLAG (EMPIRE) MINE AND EMPIRE MILL																								
EEMS10M		Empire Creek upstream of Empire mill.	<30.	5	98.6	<2.	<2.	<2.	<0.003	<2.	<0.002	<0.1	<2.	<1.	7.8	0.7	<1.	<0.5	15	16.1	7.05	7.2	281	4.9
EEMS20M		Discharge below American Flag (Empire) dump.	<30.	8.3	27.2	<2.	21.6	3.3	0.006	4.9	0.003	<0.1	11.3	<1.	7.6	1	<1.	0.54	20	10.8	8.3	7.9	327	6.4
EEMS30M		Empire Creek downstream of Empire mill.	<30.	5.6	91.7	<2.	<2.	8.9	<0.003	<2.	0.021	0.16	<2.	<1.	25.4	0.8	<1.	<0.5	14.5	14.2	8.7	8	318	10.4
AMAZON PROSPECT, AUSTRALIAN MINE AND BISMARCK MINE																								
ABIS10H	94Q0695	Amazon Creek, below seep from prospect dump.	<30.	31	47	<2.	<2.	13.5	0.079	8	0.045	<0.1	<2.	<1.	297	1.8	0.178	0.076	30.9	19.3	7.73	7.63	381	13
ABIS20H	94Q0696	Amazon Creek, upstream of sites.	<30.	3.2	48.6	<2.	<2.	<2.	0.032	<2.	0.008	<0.1	<2.	<1.	14.4	0.3	0.12	0.055	10.9	21.1	7.9	7.81	244	10
ABIS30H	94Q0689	Amazon Creek, downstream of sites.	<30.	14.8	69	<2.	<2.	1.8	0.015	<2.	0.005	<0.1	<2.	<1.	43.2	2.3	0.182	0.064	59	20.3	8.35	8.18	415	16
ARMADA MINE																								
CARS10H	92Q0022	Spring on BLM land below site.	<30.	<1.	35.6	<2.	<2.	3.4	0.013	<2.	<0.002	<1.	<2.	<1.	5.7	<5	0.07	0.05	45	21.9	7.9	7.49	350.9	6.8
BARTLETT MINE																								
ABLS10L	96Q0235	Lower caved adit	<30.	<1.	48.1	<2.	<2.	<2.	0.013	<2.	0.008	<1.	<2.	<1.	12.2	1	0.3	0.05	55	8.3	7.57	7.7	292	10.3
ABLS20L	96Q0238	Alder Creek, upstream of mine.	<30.	<1.	40.2	<2.	<2.	<2.	0.005	<2.	0.003	<1.	2.6	<1.	6.3	1		0.05	10	9	7.61	7.81	239	8
ABLS30L	96Q0237	Alder Creek, downstream of mine.	<30.	<1.	39	<2.	<2.	<2.	<0.003	<2.	0.009	<1.	<2.	<1.	4.8	1		0.25	22.5	8.8	8.06	8.13	266	11
BLACKTAIL (LINTON) MINE AND MILL																								
CBTS10H	96Q0195	Cramer Creek, 500 ft. upstream of site.	<30.	4	47.9	<2.	<2.	<2.	0.01	<2.	0.005	<1.	<2.	<1.	<2.	0.5	<1	0.15	10	19.8	8.96	8.63	426	7.2
CBTS30H	96Q0198	Cramer Creek, downstream of waste-rock and tailings dump.	<30.	2.6	60.6	<2.	<2.	<2.	0.004	<2.	<0.002	<1.	<2.	<1.	<2.	0.5	0.1	0.15	10	19.1	8.54	8.49	429	6.6
CABLE MINE AND MILL																								
DCBS10L	95Q0231	Unnamed creek, upstream of tailings.	<30.	<1.	17.4	<2.	<2.	<2.	0.009	<2.	<0.002	<1.	<2.	<1.	2.2	2	0.134	0.25	<2.5	11	8.1	7.54	82	8.5
DCBS20L	95Q0224	Unnamed creek, downstream of tailings and placer spoils.	<30.	<1.	20.1	<2.	<2.	<2.	0.014	<2.	0.008	<1.	<2.	<1.	2.7	2	0.126	0.15	<2.5	12	8.5	7.81	69	8.8
COMET MINE AND MILL																								
HCOS10M	94Q0707	High Ore Cr., 0.9 miles upstream of site	<30.	2.1	20.6	<2.	<2.	2	0.1	<2.	0.018	<0.1	<2.	<1.	54	0.3	0.161	<0.5	8.3	17.9	7.8	7.4	105	11
HCOS20H	94Q0687	High Ore Cr., 0.3 miles downstream of site	<30.	32.1	26.3	6.5	<2.	3.8	0.198	<2.	3.14	<0.1	6.4	<1.	4145	1.9	0.121	0.055	141	18.4	7.1	6.98	454	10
HGCS10H	94Q0709	High Ore Cr., 2.5 miles downstream of site	<30.	18.2	28.7	3.9	<2.	5.9	0.103	2	0.87	<0.1	2.7	<1.	1201	2.1	0.12	<0.5	91.8	19.5	8.6	6.8	380	13.5
HGCS20H	94Q0705	Peters Gulch, at confluence w/High Ore Cr.	<30.	1.4	65.5	<2.	<2.	<2.	0.006	<2.	0.011	<0.1	<2.	<1.	63.9	3.06	0.22	<0.5	22.6	26.1	8.9	8.13	381	9.5
HGCS30H	94Q0693	High Ore Cr., 2.9 miles downstream of site	<30.	19.4	30.5	5	<2.	5.3	0.108	<2.	0.889	<0.1	3	<1.	1659	2.1	0.118	<0.5	82.2	19.6	8.1	7.3	388	10
HGCS40H	94Q0697	High Ore Cr., 3.2 miles downstream of site	<30.	18.9	30.4	4.8	<2.	4.4	0.097	<2.	0.86	<0.1	2.9	<1.	1776	2.15	0.136	<0.5	80.5	19.9	8	7.29	398	10
HGCS50H	94Q0703	High Ore Cr., 3.6 miles downstream of site	<30.	18.6	30.6	5.3	<2.	4.9	0.095	3.6	0.83	<0.1	3.1	<1.	2000	2.3	0.15	<0.5	91	20.3	7.7	7.52	410	8
HGCS60H	94Q0701	High Ore Cr., 3.8 miles downstream of site	<30.	18.9	32.1	5.6	<2.	5.1	0.107	<2.	0.814	<0.1	3.4	<1.	1970	2.4	0.15	0.055	90.7	20.3	8.86	7.27	402	7.5
HKCS10M	94Q0699	Unnamed tributary to High Ore Cr., downstream of site	<30.	<1.	26	<2.	<2.	5.3	0.024	<2.	0.013	<0.1	<2.	<1.	40	1.15	0.101	0.2	10.2	28	7.23	7.37	157	7.5
HKCS20H	94Q0691	High Ore Cr., 0.6 miles downstream of site	<30.	25.5	26.9	6.7	<2.	5.2	0.177	<2.	2.62	<0.1	5.5	<1.	3736	1.6	0.107	<0.5	115	19.8	6.53	6.59	443	8
CAMP CREEK PLACER																								
BWCS10M	95Q0210	Camp Creek, downstream of site.	<30.	4.1	7.2	<2.	<2.	2	0.442	<2.	0.02	<1.	<2.	<1.	3.8	2	0.262	0.05	15	22.5	8.24	7.72	189	11.1
BWCS30M	95Q0214	Wickiup Creek, upstream of site	<30.	1.2	5.7	<2.	<2.	3.7	0.061	<2.	0.01	<1.	<2.	<1.	<2.	2.5	0.26	0.05	22.5	19.3	8.33	7.97	255	11.8
BWCS40M	95Q0212	Camp Creek, upstream of site.	<30.	5.6	5.7	<2.	<2.	<2.	0.466	<2.	0.013	<1.	<2.	<1.	3.1	1.5	0.227	<0.5	12.5	23.4	8.26	7.8	159	10.7
CHARCOAL (SHAWBUT) MINE																								
ACHS10H	96Q0202	E. Fk. Ashby Creek, upstream of site.	<30.	<1.	78.6	<2.	<2.	<2.	0.005	<2.	<0.002	<1.	<2.	<1.	8.7	<5	<1	<0.5	5	12.6	8.82	8.55	453	9.7
ACHS20H	96Q0204	E. Fk. Ashby Creek, downstream of site.	<30.	<1.	79.5	<2.	<2.	<2.	0.004	<2.	0.004	<1.	<2.	<1.	11.2	0.5	<1	0.25	5	12.6	8.92	8.61	451	9.4
CLIPPER AND WICKIUP CREEK MINES																								
BWCS20M	95Q0229	Wickiup Creek, upstream of sites.	<30.	2.7	4.2	<2.	<2.	2.4	0.017	<2.	0.007	<1.	<2.	<1.	6.9	1.5	0.141	0.1	12.5	17.2	8.09	7.89	164	15.9
BWCS30M	95Q0214	Wickiup Creek, downstream of sites.	<30.	1.2	5.7	<2.	<2.	3.7	0.061	<2.	0.01	<1.	<2.	<1.	<2.	2.5	0.26	0.05	22.5	19.3	8.33	7.97	255	11.8
DIAMOND HILL TAILINGS AND LOWER INDIAN CREEK PLACER																								
IDBS10M	96Q0223	W. Fk. Indian Creek, upstream of Diamond Hill tailings.	<30.	3.8	31.2	<2.	<2.	<2.	0.006	<2.	<0.002	<1.	<2.	<1.	7	2	0.1	0.05	35	20.8	8.38	8.26	265	11.8
IDBS20H	96Q0227	Indian Creek, downstream of sites.	<30.	44.6	49.3	<2.	<2.	2.7	<0.003	<2.	<0.002	<1.	<2.	<1.	12.1	2	0.2	<0.5	55	16.3	8.12	8.49	329	19.4
IHS10M	96Q0229	Indian Creek, upstream of confluence with W. Fk. Indian Creek.	<30.	51.1	42.5	<2.	<2.	<2.	<0.003	<2.	<0.002	<1.	<2.	<1.	41.1	1	<1	<0.5	40	15.6	8.25	8.38	248	15.1
EASTON-PACIFIC MINE																								
BEPS10L	96Q0236	Downstream of BLM boundary.	<30.	<1.	62.9	<2.	<2.	<2.	0.033	2.7	0.026	<1.	<2.	<1.	5.2	0.5	0.3	0.1	22.5	10.8	8.47	8.42	300.2	10.2

BUREAU OF LAND MANAGEMENT
Water-Quality Results - Dissolved Concentrations

Mine/ Sample ID	Lab ID	Sample Location	Al (ug/l)	As (ug/l)	Ba (ug/l)	Cd (ug/l)	Cr (ug/l)	Cu (ug/l)	Fe (mg/l)	Pb (ug/l)	Mn (mg/l)	Hg (ug/l)	Ni (ug/l)	Ag (ug/l)	Zn (ug/l)	Cl (mg/l)	Fl (mg/l)	NO3 (mg/l)	SO4 (mg/l)	Si (mg/l)	Field pH (SU)	Lab pH (SU)	Field SC (umhos/cm)	Temp (C)
FAIRVIEW MINE CFVS10L	98Q0033	Discharge from adit A3.	<30.	<1.	36.6	<2.	<2.	<2.	0.138	<2.	0.109	0.1	3.4	<1.	3.3	0.5	0.118	0.05	32.5	25.1	6.17	6.72	116.4	6.8
FLORENCE MINE HFLS10H	95Q0266	FLORENCE MINE - BLM	<80.	<1.	66.2	<2.	10	2.5	<.003	<2.	<.002	<.1	2.1	<1.	<2.	2.5	0.171	0.45	27.5	12.6	8.56	8.14	381	11.5
GARNET GOLD MINE CGTS10L CGTS20L	95Q0291 95Q0293	North Willow Creek, downstream of confluence with Cataract Creek Cataract Creek, upstream of site.	<30. <30	<1. <1	11.4 7.1	<2. 2.5	<2. <2.	3.8 2.7	0.019 0.025	<2. <2.	<.002 <.002	0.12 0.12	<2. <2.	<1. <1.	13.4 10.8	0.5 <.5	<.05 0.054	0.1 0.1	2.5 2.5	17.4 11.9	7.75 8.31	7.45 7.32	68 89	5.6 3.3
GOLCONDA/RELIANCE MINE HGCS30H HGCS40H	94Q0693 94Q0697	High Ore Creek, upstream of site. High Ore Creek, downstream of site.	<30. <30.	19.4 18.9	30.5 30.4	5 4.8	<2. <2.	5.3 4.4	0.108 0.097	<2. <2.	0.889 0.88	<0.1 <0.1	3 2.9	<1. <1.	1659 1776	2.1 2.15	0.118 0.138	<.05 <.05	82.2 90.5	19.8 19.9	8.1 8	7.3 7.29	388 396	10 10
GRANT AND HARTFORD MINE, AND LEAD KING (MUSSINGBROD) MINE AND MILL FLKS10M FLKS20H FLKS30H FLKS60H FLKS70H	96Q0031 96Q0035 96Q0030 96Q0024 96Q0032	Unnamed tributary, upstream of Lead King. First Chance Gulch, at lower impoundment. First Chance Gulch, spring at upper impoundment. First Chance Gulch, upstream of sites. First Chance Gulch, downstream of sites.	<30. <30. <30. <30. <30.	<1. 31.6 33.2 33.8 31.6	25 2 2 2 31.6	<2. <2. <2. <2. <2.	<2. <2. <2. <2. <2.	5.6 2 2 2 2.2	0.029 0.019 0.021 0.066 0.007	<2. <2. <2. <2. <2.	0.007 0.005 0.005 0.015 <.002	<.1 <.1 <.1 <.1 <.1	<2. <2. <2. <2. <2.	<1. <1. <1. <1. <1.	22.1 2 4 4.6 3.2	<.5 <.5 <.5 <.5 <.5	0.126 0.093 0.098 0.069 0.067	<.05 0.05 0.05 0.05 0.05	100 65 55 25 60	19.1 19.6 19.9 20.9 19.5	5.97 7.91 8.01 7.6 8.16	6.65 8.04 8.1 7.8 8.1	310.7 336.4 343.9 333.4 343.6	7.1 8.8 8.1 8.7 8.8
GREEN CAMPBELL MINE AND MILL JGCS10H JGCS20H	95Q0268 95Q0269	Spring upgradient of site. Pond along drainage below site.	<80. <80.	<1. 1.5	15.4 44.8	<2. <2.	7.6 14.2	2 2.2	0.01 <.003	<2. <2.	<.002 0.004	<.1 <.1	<2. 3.3	<1. <1.	<2. 2.8	7.5 10	0.288 0.321	1.4 0.05	27.5 60	17.2 21.7	7.69 7.31	7.5 7.29	318 560	9 11.6
HARD CASH KHCS10H KHCS20H		Keating Gulch upstream of site. Keating Gulch downstream of site.	<30. <30.	1.5 1.8	32.2 32.9	<2. <2.	24 24.9	<2. <2.	0.011 <.003	<2. <2.	0.004 0.003	<0.1 <0.1	17.1 17.1	<1. <1.	2.8 8.1	6.7 6.5	<1. <1.	0.062 <.05	110 97.6	17.3 16.1	8.3 7.7	7.6 7.4	539 556	13.5 12.8
HIDDEN MINE BHNS10H BHNS20H BHNS30H	96Q0053 96Q0054 96Q0055	Discharge from east adit entrance. Discharge from west adit entrance. Spring on mountainside above mine.	<30. <30. <30.	1.5 1.2 1.2	73.4 72 89.6	<2. <2. <2.	<2. <2. <2.	<2. <2. <2.	<.003 <.003 0.085	<2. <2. <2.	0.003 <.002 0.016	0.1 0.1 <.1	<2. <2. <2.	<1. <1. <1.	5.3 3.6 4.7	105 105 32.5	0.192 0.138 0.121	2.5 4 5.25	100 125 27.5	10.6 8.9 15	7.86 7.69 8.06	8.23 8.33 8.04	1003.2 1078 596.1	19.8 17 14.3
HIDDEN TREASURE MINE RHTS10L RHTS20H RHTS30H	95Q0227 95Q0228 95Q0226	Pool of water in open slope. Reservoir Gulch, upstream of unnamed drainage. Reservoir Gulch, downstream of unnamed drainage.	200.2 <30. <30.	259.3 3.9 13.5	39 34.1 24.9	3.1 <2. <2.	<2. <2. <2.	103.1 <2. <2.	9.8 0.016 0.015	<2. <2. <2.	2 <.002 <.002	<.1 <.1 <.1	3.3 <2. 2	<1. <1. <1.	391 9 2.8	4.5 0.314 0.257	0.207 0.35 0.4	<.05 0.35 0.4	5 20 22.5	25.3 18.7 20.6	7.06 8.45 8.2	6.76 8.27 7.63	158 368 363	10 11.7 11.3
HOPE AND BULLION MINE BHBS10H BHBS20M	94Q0761 94Q0763	Boomerang Gulch, downstream of site Boomerang Gulch, upstream of site.	<30. <30.	7.4 4	87.8 39.2	<2. <2.	<2. <2.	4.7 3.3	0.01 0.023	<2. <2.	0.017 0.002	<0.1 <0.1	<2. <2.	<1. <1.	19 3.3	2.2 0.6	0.18 0.53	0.29 0.14	49.2 4.3	22.5 21.1	6.9 8	7.24 7.66	382 133.23	6 8
IRON MASK MINE AND MILL WIMS10H	96Q0231	Whipcracker Gulch, downstream of site.	<30.	7.5	25.3	<2.	<2.	<2.	<.003	<2.	<.002	<.1	<2.	<1.	35.9	3	0.2	0.15	70	14.2	8.26	8.16	432	11.2
IRON ROD (GOLDEN ROD) MINE JGRS10H JGRS20H	95Q0267 95Q0270	Adit discharge. Waste-rock dump seep.	<80. <80.	3.8 5.1	12.6 21.4	<2. <2.	11.1 10	5.3 3.4	0.022 <.003	<2. <2.	0.01 0.007	<.1 <.1	3 2.4	<1. <1.	6.4 16.7	17.5 17.5	0.517 0.545	<.05 0.15	32.5 32.5	17.7 19.4	8.38 7.82	8.11 7.62	546 523	16.2 10.7
KING COLE MINE HGCS10H HKCS20H	94Q0709 94Q0691	High Ore Creek, downstream of site. High Ore Creek, upstream of site.	<30. <30.	18.2 25.5	28.7 26.9	3.9 6.7	<2. <2.	5.9 5.2	0.103 0.177	2 <2.	0.87 2.62	<0.1 <0.1	2.7 5.5	<1. <1.	1201 3736	2.1 1.6	0.12 0.107	<.05 <.05	91.8 115	19.5 19.8	8.6 6.53	6.8 6.59	380 443	13.5 8
LAST CHANCE TAILINGS IHUS10M IHUS20M	96Q0229 96Q0221	Indian Creek, downstream of tailings on BLM administered land. Indian Creek, upstream of tailings on BLM administered land.	<30. <30.	51.1 49.2	42.5 38.8	<2. <2.	<2. <2.	<2. <2.	<.003 <.003	<2. <2.	<.002 <.002	<.1 <.1	<2. <2.	<1. <1.	41.1 62.4	1 <2.5	<.1 <.1	<.05 0.05	40 40	15.6 15.9	8.25 8.23	8.38 7.99	248 261	15.1 13.9
LONDONDERRY MINE AND MILL FMXS10M FMXS20M	95Q0284 95Q0286	Flint Creek, downstream of site. Flint Creek, upstream of site, near USGS gaging station.	<30. <30.	8.4 8.5	93.7 94.8	<2. <2.	2.2 2.5	2.9 11.1	0.03 0.037	<2. <2.	0.089 0.035	<.1 <.1	<2. <2.	<1. <1.	9.1 5.6	3.5 3	0.242 0.214	0.05 <.05	12.5 12	26.3 26.4	8.52 8.49	8.23 8.26	300 318	5.8 6.8

BUREAU OF LAND MANAGEMENT
Water-Quality Results - Dissolved Concentrations

Mine/ Sample ID	Lab ID	Sample Location	Al (ug/l)	As (ug/l)	Ba (ug/l)	Cd (ug/l)	Cr (ug/l)	Cu (ug/l)	Fe (mg/l)	Pb (ug/l)	Mn (mg/l)	Hg (ug/l)	Ni (ug/l)	Ag (ug/l)	Zn (ug/l)	Cl (mg/l)	Fl (mg/l)	NO3 (mg/l)	SO4 (mg/l)	Si (mg/l)	Field pH (SU)	Lab pH (SU)	Field SC (umhos/cm)	Temp (C)
LONE WOLF MINE																								
CGTS20L	95Q0293	Cataract Creek, downstream of confluence with adit discharge.	<30	<1	7.1	2.5	<2	2.7	0.025	<2	<0.002	0.12	<2	<1	10.8	<5	0.054	0.1	2.5	11.9	8.31	7.32	89	3.3
CLWS10M	95Q0289	Adit discharge on BLM administered land.	<30	1.2	19.9	<2	2.9	<2	0.024	<2	<0.002	0.12	<2	<1	4.9	<5	0.128	0.3	5	13.4	8.09	7.64	129	5.1
JGCS20H	95Q0289	Cataract Creek, upstream of confluence with adit discharge.	<80	1.5	44.8	<2	14.2	2.2	<0.003	<2	0.004	<1	3.3	<1	2.8	10	0.321	0.05	60	21.7	7.31	7.29	560	11.8
LUKE MINE																								
BLLO1	93Q0828	Adit discharge	<20	3.3	384	<2	<2	<2	0.006	<3	0.002		<2	<1	4.9	1.4	0.44	0.063	13	9.5	7.45	7.75	313	8.4
MANTLE MINE																								
CMAS10M	94Q0765	Cataract Creek, downstream of mine.	41	2.1	13	3.4	<2	39.5	0.124	<2	0.05	<0.1	<2	<1	277	0.8	0.094	0.2	12.5	13.5	8.2	7.23	90.58	4.9
CMAS20M	94Q0767	Cataract Creek, upstream of mine.	43	2.2	12.8	3.2	<2	44.9	0.121	<2	0.052	<0.1	<2	<1	278	0.7	0.054	0.29	12.5	13.2	7.9	7.19	112	5.1
MARIETTA MINE AND MILL																								
BMAS10L	96Q0234	Barton Gulch, 1000 ft. upstream of site.	<30	<1	25.3	<2	<2	2.6	0.004	<2	<0.002	<1	<2	<1	7.7	<5		0.1	2.5	11.3	7.61	7.55	104.5	4.5
BSAS20L	95Q0233	Barton Gulch, downstream of site.	<30	<1	46.2	<2	<2	<2	<0.003	<2	<0.002	<1	<2	<1	9.9	0.5	0.1	0.3	7.5	10.5	8.16	7.96	188	6.3
MINNEAPOLIS MINE AND PLACER																								
BMNS10H	94Q0753	Big Limber Gulch, downstream of confluence with tributary.	<30	1.8	87.1	<2	<2	<2	0.044	<2	0.031	<0.1	<2	<1	4.9	2.5	0.28	0.68	32.1	24.6	7.66	7.78	304.8	7
BMNS20H	94Q0781	Unnamed tributary, near confluence with Big Limber Gulch.	<30	<1	75.4	<2	<2	2.6	0.032	2.5	0.017	0.189	<2	<1	6.7	3.3	0.36	0.16	58.9	25.6	7.81	7.58	384.04	8.2
BMNS30H	94Q0755	Big Limber Gulch, upstream of confluence with tributary.	<30	2	61.7	<2	<2	3.2	0.048	3.4	0.022	<0.1	<2	<1	4.6	2.5	0.251	0.069	27.8	23	7.52	7.5	297.2	6
BMNS40H	94Q0757	Unnamed tributary, between mine and placer.	<30	1.2	49.8	<2	<2	<2	0.005	<2	0.003	<0.1	2	<1	4.7	3.5	0.342	0.086	187	27.5	7.79	8.02	668.78	8.7
BMNS50H	94Q0759	Unnamed tributary, at outlet of lower pond.	<30	1.5	35.5	<2	<2	<2	0.022	<2	0.015	<0.1	2.1	<1	3.6	3.7	0.39	0.121	160	19.1	7.84	7.78	612.32	7.4
MOLLY MCGREGOR MILL TAILINGS AND BALTIMORE MINE																								
BMBS10H	94Q0761	Boomerang Gulch, upstream of sites.	<30	7.4	87.8	<2	<2	4.7	0.01	<2	0.017	<0.1	<2	<1	19	2.2	0.18	0.29	49.2	22.5	6.9	7.24	382	6
BMBS10H	94Q0773	Boomerang Gulch, downstream of sites.	39	3.5	113	<2	<2	<2	0.016	<2	0.018	0.116	<2	<1	7.6	2.3	0.25	0.48	42.6	22.3	6.5	7.81	391.47	6
MOUNTAIN VIEW MINE AND MILL																								
MMVS10H	96Q0026	Discharge from adit A1.	<30	<1	9.5	<2	<2	<2	0.026	<2	<0.002	<1	<2	<1	<2	<5	0.089	<0.05	7.5	24.7	6.65	6.95	430.6	7.2
MMVS20H	96Q0034	Discharge from adit A3.	<30	<1	9.6	<2	<2	<2	0.021	<2	<0.002	<1	<2	<1	10	<5	0.052	0.05	2.5	17.2	5.01	6.02	379	3.9
MMVS30M	96Q0028	Seep from waste-rock dump near adit A3.	<30	<1	11.2	<2	<2	<2	0.031	<2	<0.002	<1	<2	<1	3.2	<5	0.051	<0.05	2.5	16.9	5.66	6.3	326.3	4.5
MMVS40M	96Q0029	Discharge from adit A1, below waste-rock dump.	<30	<1	13	<2	<2	<2	0.023	<2	0.003	<1	<2	<1	3.9	<5	0.089	<0.05	7.5	24.5	8.24	7.82	169.7	5
MMVS50L	96Q0020	McManus Gulch, below mill.	65.3	<1	13.7	<2	<2	<2	0.088	<2	0.003	<1	<2	<1	2.6	<5	0.036	<0.05	2.5	17.7	6.46	6.87	111.3	5.9
NORTH WALDY MINE																								
BRWS10M	94Q0779	Big Limber Gulch, below site.	<30	2.1	27.9	<2	<2	3.6	0.028	<2	0.007	<0.1	<2	<1	9.1	2	0.135	0.21	14.95	18.7	7.27	7.74	148.83	7.5
BRWS30M	94Q0751	Big Limber Gulch, above site.	<30	<1	44.4	<2	<2	<2	0.024	<2	0.002	<0.1	<2	<1	3.5	0.41	0.076	0.065	6.5	17.1	6.75	7.23	61.93	5.8
BVAS20M	94Q0775	Adit discharge.	<30	1.4	3.9	<2	<2	2.4	0.036	<2	0.02	<0.1	<2	<1	12.1	1.8	0.14	0.26	24.3	15.5	7.43	7.06	221.52	4.5
OPSATA MINE																								
OOPS10M	96Q0145	Ophir Creek, downstream of site.	<30	3.1	70.2	<2	<2	<2	<0.003	<2	<0.002	<1	<2	<1	3	<5	0.07	<0.05	5	9.5	8.65	8.46	246	10.3
OOPS20M	96Q0149	Ophir Creek, upstream of site.	<30	3.2	82.8	<2	<2	<2	0.007	<2	<0.002	<1	<2	<1	<2	0.5	0.064	0.05	5	9.5	8.9	8.3	274	9.8
OOPS30M	96Q0152	OPSATA MINE	<30	<1	<2	<2	<2	<2	<0.003	<2	<0.002	<1	<2	<1	<2					<1	7		180	9.8
OTTAWA MINE																								
OOTS10M		Ottawa Gulch upstream of site.	<30	3.5	77.3	<2	20.7	<2	0.009	<2	0.003	<0.1	10.6	<1	2.1	1.1	<1	0.06	8	8.6	8	7.1	277	12
OOTS20M		Ottawa Gulch downstream of site.	<30	2.5	91	<2	19.4	<2	0.004	<2	<0.002	<0.1	9.7	<1	3.6	0.7	<1	0.17	10.4	10.3	8.4	7.5	257	10.3
PANDORA MINE																								
BPAS10H	95Q0152	Soap Gulch, downstream of site.	<30	2.7	5.9	<2	<2	<2	0.01	<2	<0.002	<1	<2	<1	2.1	3	0.414	<0.05	60	17.7	8.22	8.18	320	11.1
BPAS20H	95Q0147	Soap Gulch, upstream of site.	<30	1.3	8.7	<2	<2	<2	0.01	<2	0.004	<1	<2	<1	2.1	3.5	0.446	<0.05	70	18.5	7.52	7.56	354	8.1
BPAS30H	95Q0149	Iron-stained seep upstream of site.	<30	4.2	3.7	<2	<2	<2	0.23	<2	0.091	<1	<2	<1	12.1				17.3		7.75	7.6	269	9.4
PIEGAN GLOSTER MILL TAILINGS																								
PPCS10H		Piegan Creek downstream of tailings impoundment	<30	4.8	51.4	<2	<2	5.1	<0.003	<2	0.035	0.12	9.4	<1	<2	1.6	<1	<0.05	22.3	17.5	8.8	7.3	380	13
PAUPER'S DREAM																								
BPDS10H	95Q0169	Adit discharge, at portal.	<30	3	13.8	<2	<2	<2	<0.003	<2	0.003	0.12	2.8	<1	<2	22.5	0.296	0.35	100	25.5	7.13	7.41	675	11.6
BPDS20H	95Q0171	Seep at toe of dump that blocks drainage.	<30	4.2	15	<2	<2	2.1	<0.003	<2	<0.002	0.12	2.6	<1	<2	25	0.328	0.25	110	26.4	8.24	8.17	695	13.9
BPDS40H	95Q0168	Adit discharge, west side of dump that blocks drainage.	<30	3.7	14.4	<2	<2	2.1	<0.003	<2	<0.002	0.16	2.6	<1	<2	22.5	0.341	0.3	100	25.4	8.35	8.19	735	11

BUREAU OF LAND MANAGEMENT
Water-Quality Results - Dissolved Concentrations

Mine/ Sample ID	Lab ID	Sample Location	Al (ug/l)	As (ug/l)	Ba (ug/l)	Cd (ug/l)	Cr (ug/l)	Cu (ug/l)	Fe (mg/l)	Pb (ug/l)	Mn (mg/l)	Hg (ug/l)	Ni (ug/l)	Ag (ug/l)	Zn (ug/l)	Cl (mg/l)	FI (mg/l)	NO3 (mg/l)	SO4 (mg/l)	Si (mg/l)	Field pH (SU)	Lab pH (SU)	Field SC (umhos/cm)	Temp (C)		
REDWING MINE																										
BRWS40H	94Q0743	Big Limber Gulch, upstream of site.	<30.	2.1	24.4	<2.	<2.	<2.	0.04	<2.	0.009	<0.1	<2.	<1.	4.8	1	0.084	0.22	24.8	18	7.64	7.44	232.8	7.7		
BRWS50H	94Q0777	Big Limber Gulch, 125 ft. downstream of site.	<30.	2	23.3	<2	<2.	3.2	0.033	<2.	0.066	<0.1	<2.	<1.	38.8	1	0.15	0.057	29.7	18.5	7.56	7.6	207.01	7.8		
BRWS60H	94Q0744	Adit discharge.	<30.	1.7	15.4	<2.	<2.	4.3	0.027	<2.	0.074	<0.1	<2.	<1.	11.5	2.8	0.125	0.073	48.6	16.2	7.74	7.6	457.84	7.2		
BRWS70H	94Q0747	Big Limber Gulch, 0.25 miles downstream of site.	<30.	2.2	24	<2.	<2.	8.7	0.061	<2.	0.014	<0.1	<2.	<1.	33.5	1	0.126	0.37	30.3	18.3	7.28	7.26	205.72	7.2		
ROCHESTER MILL TAILINGS																										
RROS10H	95Q0179	Rochester Creek, spring upstream of site.	<30.	13.6	32.1	<2.	<2.	6.2	<0.003	<2.	0.004	0.12	2.8	<1.	<2.	17.5	0.435	<0.05	90	23.3	7.38	7.53	657	13.4		
RROS20H	95Q0177	Rochester Creek, downstream of site.	<30.	2.9	31.4	<2.	<2.	<2.	0.007	<2.	<0.002	0.64	<2.	<1.	<2.	17.5	0.284	0.1	90	20.9	7.75	7.58	669	9.9		
SECTION 32 UNNAMED ADITS																										
CUAS10H	96Q0157	Adit discharge.	<30.	<1.	30.1	<2.	<2.	<2.	<0.003	<2.	<0.002	<1	<2.	<1.	2.6	<5	0.154	<0.05	12.5	24.7	7.46	8.07	323.7	8.5		
CUAS20H	96Q0158	Carpenter Creek, downstream of site.	<30.	<1	26.2	<2	<2.	<2.	<0.003	<2.	<0.002	<1	<2.	<1.	<2.	<5	0.13	<0.05	12.5	24.5	8.4	8.26	335.7	10.2		
CUAS30H	96Q0160	Carpenter Creek, upstream of site.	<30.	1	26.5	<2.	<2.	<2.	0.006	<2.	<0.002	<1	<2.	<1.	<2.	<5	0.152	<0.05	12.5	25.2	8.34	8.21	375.5	14.2		
SHORT SHIFT MILL																										
BSSS10H	95Q0217	Spring below mill	<30.	1.8	26.1	<2.	<2.	<2.	13	<2.	0.109	<1	<2.	<1.	<2.	5.5	0.272	<0.05	32.5	22.2	7.56	7.44	360	12.3		
STRAWBERRY-KEYSTONE MINES AND MILL																										
PSKS10M	95Q0271	Pony Creek, upstream of site.	<80.	<1.	13.4	<2.	3.4	2.5	0.007	<2.	<0.002	<1	<2.	<1.	<2.	0.5	0.141	0.3	32.5	14.4	7.96	7.83	117	8.5		
PSKS20M	95Q0273	Pony Creek, downstream of site.	<80.	<1.	18.4	<2.	3.6	<2.	0.01	<2.	0.005	<1	<2.	<1.	<2.	0.5	0.136	0.35	40	14.6	8.18	7.66	213	7.5		
UNNAMED 12N14W11DABB MINE																										
CARS10H	92Q0022	Spring upstream of site.	<30	<1.	35.6	<2.	<2.	3.4	0.013	<2.	<0.002	<1	<2.	<1.	5.7	<5	0.07	0.05	45	21.9	7.9	7.49	350.9	6.8		
CARS20L	96Q0023	Adit discharge.	<30	<1.	35	<2.	<2.	<2.	0.007	<2.	<0.002	<1	<2.	<1.	8.9	0.5	0.104	0.15	20	16.7	8.25	7.82	148.8	7		
CARS30M	96Q0021	Cayuse Gulch, downstream of site.	<30.	<1.	30	<2.	<2.	<2.	0.033	<2.	<0.002	<1	<2.	<1.	4.7	<5	0.07	<0.05	22.5	17.5	7.3	7.81	186.8	7		
UPPER ROCHESTER PLACER																										
RURS10H	95Q0173	Spring downstream of site.	<30.	2	21.1	<2	<2.	4.7	0.004	<2.	<0.002	<1	3	<1.	6.1	10	0.391	<0.05	47.5	17.1	7.29	7.34	431	9.1		
RURS20H	95Q0170	Spring in placer area.	<30	2.3	17.8	<2.	<2.	<2.	0.007	<2.	<0.002	<1	<2.	<1.	<2.	10	0.316	0.25	45	17.4	7.82	7.57	321	10.8		
RURS30H	95Q0175	Spring upstream of site.	<30	1.4	41.2	<2.	<2.	<2.	0.004	<2.	<0.002	<1	<2.	<1.	3	12.5	0.331	<0.05	42.5	21.1	7.13	7.1	441	13.7		
WALDY MINE																										
BRWS10M	94Q0779	Big Limber Gulch, upstream of site.	<30.	2.1	27.9	<2.	<2.	3.6	0.028	<2.	0.007	<0.1	<2.	<1.	9.1	2	0.135	0.21	14.95	18.7	7.27	7.74	148.83	7.5		
BRWS20H	94Q0741	Marshy area below waste-rock dump.	<30.	2	18.7	<2.	<2.	2.7	0.006	<2.	0.004	<0.1	<2.	<1.	20	1.2	0.129	0.26	50.4	19.2	7.29	7.05	309.8	6.8		
BRWS30H	94Q0742	Adit discharge.	<30.	2	10.3	<2.	<2.	<2.	0.029	<2.	0.011	0.65	<2.	1.1	16.4	2.15	0.131	0.12	41.1	15.1	7.93	8.21	334.16	6.5		
BRWS40H	94Q0743	Big Limber Gulch, downstream of site.	<30.	2.1	24.4	<2.	<2.	<2.	0.04	<2.	0.009	<0.1	<2.	<1.	4.8	1	0.084	0.22	24.8	18	7.64	7.44	232.8	7.7		
WARM SPRINGS CREEK PHOSPHATE																										
CPS010	93Q0824	Warm Springs Creek, upstream of site.	<30.	4.8	27.3	<2.	<2.	8.1	0.006	7.3	0.009		3.2	<1.	34.5	5.3	1.7	0.118	335	17.7	7.17	8.11	1009	24.1		
CPS020	93Q0829	Holding pond.	67	11.9	33	<2.	<2.	2.2	<0.003	<3.	0.035		26.8	<1.	28.9	2.7	2.21	2.94	165	12.1	7.97	7.79	504	12		
CPS030	93Q0831	Downstream of holding pond.	38.6	7.1	32.1	<2.	<2.		<0.003	<3.	0.015		12.3	<1.	12.6	4.8	1.97	1.247	268	15.41	7.85	8.11	754	17.2		
CPS040	93Q0826	Warm Springs Creek, downstream of site.	<30.	2.7	36.3	<2.	<2.	<2.	<0.003	<2.	0.002		2.8	<1.	3.8	5.1	1.5	<0.3	324	18.2	8.23	8.02	810	14.9		
WATSECA MINE AND MILL																										
RROS20H	95Q0177	Rochester Creek, spring approx. 1 mile below site.	<30.	2.9	31.4	<2.	<2.	<2.	0.007	<2.	<0.002	0.64	<2.	<1.	<2.	17.5	0.284	0.1	90	20.9	7.75	7.58	669	9.9		
RWAS10H	95Q0166	Location where spring water infiltrates ground.	<30.	3	52.9	<2.	<2.	12.4	0.021	<2.	0.003	<1	4.8	<10.	9.4	10	0.299	0.05	30	27.5	3.88	8.07	456	22		
RWAS20H	95Q0167	Iron-stained spring on BLM land.	<30.	3	51.4	<2.	<2.	<2.	0.043	<2.	0.014	0.12	<2.	<1.	7.3	10	0.248	<0.05	30	30	6.88	7.89	505	20.9		
RWAS30H	95Q0174	East Fork Rochester Creek, upstream of site.	<30.	3.8	54.7	<2.	<2.	<2.	0.081	<2.	0.089	<1	<2.	<1.	2.8	9.5	0.219	0.3	40	26.2	7.37	7.54	379	22.1		

BUREAU OF LAND MANAGEMENT																																
Soil Analyses (Qualified Data) (Concentrations in mg/kg)																																
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Soil Analyses (Qualified Data) (Concentrations in mg/kg)																																
Mine/ Sample ID	Lab ID	Sample Location	Ag	C	Q	As	C	Q	Ba	C	Q	Cd	C	Q	Cr	C	Q	Cu	C	Q	Hg	C	Q	Ni	C	Q	Pb	C	Q	Zn	C	Q
AMAZON PROSPECT																																
ABID10M	94S0068	Soil along Amazon Creek, below prospect dump.	1.91			223			67.9			4.82	B		3.38			77.2			0.07			6.75			374			661		
BLACKTAIL (LINTON) MINE AND MILL																																
CBTD10M	96S0026	Soil at base of waste-rock and tailings dump, adjacent to Cramer Creek.	0.91	B		256			17,400			1.1	B		1.8	B		110			1.86			16.0			1,050			78.2		
COMET MINE AND MILL																																
HCOD10H	94S0073	Streamside tailings, 0.3 miles below site.	20.1			4,590			91.6			34.1	*		1.95	B		482			0.53			3.00	B		2,520			3,650		*N
HCOD20H	94S0070	Streamside tailings, 0.4 miles below site.	11.3	U		1,290			132			8.54	*		8.98	U		188	U		0.20			4.27	U		1,470			885		
HGCD30M	94S0071	Streamside tailings, 3.6 miles below site.	7.55	B		1,250			66.8			15.0	*		3.39	B		144			0.22			3.89	B		695			2,080		*N
HGCD40M	94S0067	Streamside tailings, 3.8 miles below site.	12.5			2,610		*	55.5			6.77			3.46	B		239			0.30			3.58	B		1,470			923		
HKCD10M	94S0066	Streamside tailings, 2.5 miles below site.	24.4			2,840		*	141			41.2			3.45			380			0.49			7.48			2,170			7,330		
EMPIRE MILL																																
EEMD10M	96S0160	Streamside tailings on BLM administered land.	20			289		N	117		N	58			22		N	5180		N	10			13		N	8126		N	16570		N
ERMONT MILL TAILINGS																																
EERD10M	95S0008	Soil along runoff channel that breaches small tailings dam.	0.20	U		153			74.5			0.41	U		0.69	B		1.05	B		0.96			1.00	B		1.30			8.87		
EERD20L	95S0009	Soil along Ermont Gulch, approx. 0.5 miles below site.	0.20	U		16.6			16.7	B		0.41	U		1.00	B		0.84	B		0.08			1.44	B		1.65			7.85		
EERD30M	95S0010	Soil along Ermont Gulch, approx. 1 mile below site.	0.20	U		125			84.8			0.41	U		0.91	B		1.23	B		0.06			1.40	B		1.42			9.03		
EERD40M	95S0011	Soil in flat, grassy area, 700 ft. below main impoundment.	0.20	U		140			78.4			0.41	U		0.71	B		1.03	B		0.06			1.07	B		1.07			6.85		
GOLCONDA/RELIANCE MINE																																
HGCD10H	94S0069	Soil along streamside edge of dump W2.	20.8			2,520			80.6			21.1	*		1.74	B		364			0.33			3.89	B		1,460			3,130		
HGCD20H	94S0072	Soil along streamside edge of dump W1.	21.4			1,730			89.4			18.1	*		7.44			357			0.22			7.20			2,000			2,820		*N
LAST CHANCE TAILINGS																																
IHUD10M	96S0031	Streamside tailings, approx. 0.35 miles upstream of confluence with W. Fk. Indian Cr.	3.2			1,180			102			2.7	B		6.1			35.6			0.31			5.1	B		641			310		
IHUD20H	96S0036	Streamside tailings, approx. 0.95 miles upstream of confluence with W. Fk. Indian Cr.	25			1,630			54.7			1.1	B		1.1	B		23.1			0.16			0.92	B		3,610			127		
LEAD KING (MUSSINGBROD) MINE AND MILL																																
FLKD10M	96S0002	Tailings from lower impoundment along First Chance Gulch.	11.9	B	*	59.8			217			8.10	B		47.7			619	*		1.4			63.9	B		298			301		
PAUPER'S DREAM MINE																																
BPDD10L	95S0014	Soil at toes of waste-rock dumps near adit.	2.14	U		24.8			33.2	B		4.27	U		14.2	B		33.9	B		0.06	B		15.5	B		315			47.3		
BPDD20L	95S0015	Soil on west side of dump that block drainage.	2.06	U		11.8	B		74.9	B		4.12	U		38.0			108			0.12			34.6	B		119			63.6		
BPDD30M	95S0013	Soil along drainage below mine.	2.73	U		14.0	B		22.4	B		5.46	U		14.5	B		17.3	B		0.08	B		15.3	B		26.0			43.1	B	
PIEGAN GLOSTER MILL TAILINGS																																
PPCD10M	96S0179	Streamside tailings on BLM administered land.	B			48		N	181		N	5			B		N	149		N	37.6			B	B	N	947		N	1085		N
REDWING MINE																																
BRWD20H	94S0081	Barren patch of ground near path of adit discharge.	11.8			122			110			4.61	B	*	4.41			193			0.10	B		5.90	B		165			349		*N
BRWD30H	94S0083	Streamside waste-rock dump.	20.5			198			21.3			6.03	*		0.44	U		69.4			0.14			1.33			613			1,040		*N
STRAWBERRY-KEYSTONE MINES AND MILL																																
PSKD10L	95S0022	Soil along Pony Creek, approx. 700 ft. downstream of mill.	3.75	B		15.0	B	*	131	B		5.60	U		23.6	B		292	*		0.48			15.8	B		181			220		*N
UNNAMED 12N14W11DABB MINE																																
CARD10L	96S0001	Soil at base of waste-rock dump, adjacent to Cayuse Gulch.	7.25	B	*	85.5			404			10.4	B		175			1,820	*		2.1			146			470			363		
WALDY MINE																																
BRWD10M	94S0080	Waste-rock material adjacent to Big Limber Gulch.	32.8			277			149			3.54	*		2.19	B		36.7			0.09			8.30			377			389		*N

Notes:

- B - Detected but below method detection limit
- U - Analyzed for but below instrument detection limit
- N - Spike sample recovery not within control limits
- * - Duplicate analysis not within control limits

