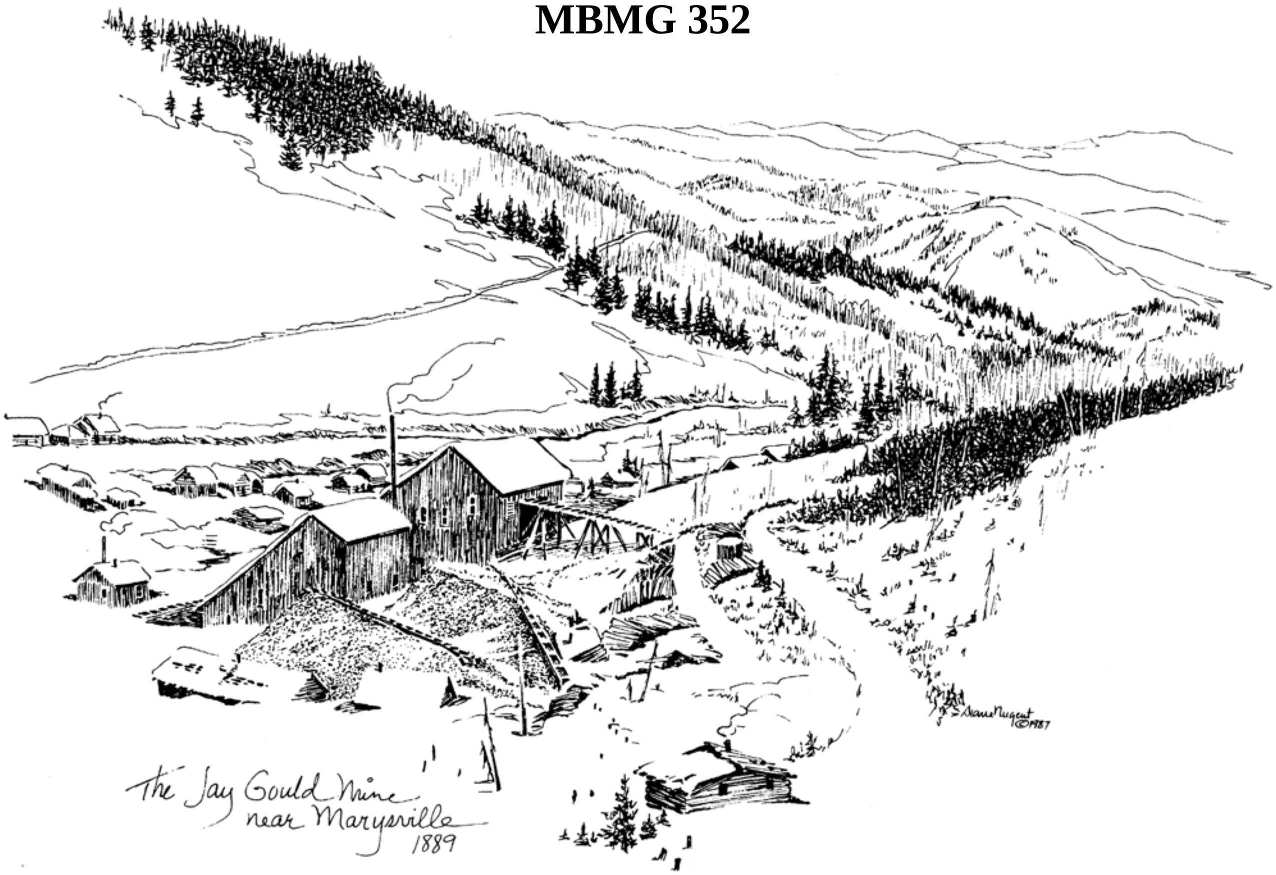
**Montana Bureau of Mines and Geology**
**Abandoned-Inactive Mines**
**Helena National Forest**

# Volume I
# Upper Missouri River Drainage

## MBMG 352




**John Metesh**
**Jeff Lonn**
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**Phyllis Hargrave**
**James Madison**

**Prepared for the U.S. Department of Agriculture**
**Forest Service -Region 1**

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(Cover art, Jay Gould Mine, by Diane Nugent)

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# Introduction

To fulfill its obligations under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Northern Region of the U.S. Forest Service (USFS) desires to identify and characterize the abandoned and inactive mines with environmental, health, and/or safety problems that are on or affecting National Forest System lands. The Northern Region administers National Forest System lands in Montana and parts of Idaho and North Dakota. Meanwhile, the Montana Bureau of Mines and Geology (MBMG) collects and distributes information about the geology, mineral resources, and ground water of Montana. Consequently, the USFS and the MBMG determined that an inventory and preliminary characterization of abandoned and inactive mines in Montana would be beneficial to both agencies and have entered into participating agreements to accomplish this work. The first forest inventoried was the Deerlodge National Forest. The results of this inventory are presented in five volumes: Volume I - Basin Creek, Volume II - Cataract Creek, Volume III - Flint Creek and Rock Creek, Volume IV - Upper Clark Fork River, and Volume V - Jefferson River. The second forest inventoried was the Helena National Forest. The results of this inventory are presented in Volume I - Upper Missouri River (this report) and Volume II - Blackfoot / Little Blackfoot River.

## 1.1 Project Objectives

In 1992, the USFS and MBMG entered into the first of these agreements to identify and characterize abandoned and inactive mines on or affecting National Forest System lands in Montana. The objectives of this discovery process, as defined by the USFS, are 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 National Forest System 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 National Forest System lands, and can therefore be eliminated from further consideration.

4. Cooperate with other state and federal agencies and integrate the Northern Region program with their programs.

5. Develop and maintain a data file of site information that will allow the region to pro-actively respond to governmental and public interest group concerns.

In addition to the USFS 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 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, in turn, increases metal solubility. 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, and
6) mine characteristics, which affect the other five elements.

To this list, most geochemists would add mineral availability, *e.g.*, calcite, which can neutralize the acidity. These six 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.

AMD 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 ($SO_4^=$), 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 ($[CuFe]_{12}Sb_4S_{13}$), and sphalerite ([Zn,Fe]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 controlled by the solubility of that metal.

### 1.3.2 Solubility of Selected Metals

At a pH above 2.2, ferric hydroxide ($Fe[OH]_3$) precipitates to produce a brown-orange color in surface waters and forms a similar colored coating on rocks in affected streams. Other metals, such as copper, lead, cadmium, zinc, and aluminum, if present in the source rock, may co-precipitate or adsorb onto the ferric hydroxide (Stumm and Morgan 1981). Alunite ($KAl_3[SO_4]_2[OH]_6$) and jarosite ($KFe_3[SO_4]_2[OH]_6$) will precipitate at pH less than 4, depending on $SO_4^=$ and $K^+$ activities (Lindsay 1979). Once the acid conditions are present, the solubility of the metal governs its fate and transport:

**Manganese** solubility is strongly controlled by the redox state of the water and is limited by several minerals such as pyrolusite and manganite; under reduced conditions, pyrolusite ($MnO_2$) is dissolved and manganite (MnO[OH]) is precipitated. Manganese is found in mineralized environments as rhodochrosite ($MnCO_3$) and weathering products of rhodochrosite.

**Aluminum** solubility is most often controlled by alunite ($KAl_3[SO_4]_2[OH]_6$) or by gibbsite ($Al[OH]_3$), depending on pH. Aluminum is one of the most common elements in rock-forming minerals such as feldspars, micas, and clays.

**Silver** solubility is strongly affected by the activities of halides such as $Cl^-$, $F^-$, $Br^-$, and $I^-$. Redox and pH also affect the solubility of silver, but to a lesser degree. Silver substitutes for other cations in common ore minerals, such as tetrahedrite and galena, and is found in the less common hydrothermal minerals pyrargyrite ($Ag_3SbS_2$) and proustite ($Ag_3AsS_3$).

**Arsenic** 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 $H_2AsO_4$. Arsenic is abundant in metallic mineral deposits as arsenopyrite (FeAsS), enargite ($Cu_3AsS_4$), and tennantite ($Cu_{12}As_4S_{13}$), to name a few.

**Cadmium** solubility data are limited. In soils, the solubility of cadmium is controlled by the carbonate species octavite ($CdCO_3$) at soil pHs above 7.5 and by strengite ($Cd_3[PO_4]_2$) at soil pHs below 6. In soils, octavite is the dominant control on solubility of cadmium. In water, at low partial pressures of $H_2S$, $CdCO_3$ is easily reduced to CDS.

**Copper** solubility in natural waters is controlled primarily by the carbonate content; malachite ($Cu_2[OH]_2CO_3$) and azurite ($Cu_3[OH]_2[CO_3]_2$) control solubility when $CO_3$ is available in sufficient concentrations. In soil, copper complexes readily with soil-iron to form cupric ferrite. Other compounds such as sulfate and phosphates in soil may also control copper solubility in soils. Copper is present in many ore minerals, including chalcopyrite ($CuFeS_2$), bornite ($Cu_5FeS_4$), chalcocite ($Cu_2S$), and tetrahedrite ($Cu_{12}Sb_4S_{13}$).

**Mercury** readily vaporizes under atmospheric conditions and thus, is most often found in concentrations well below the 25 µg/L equilibrium concentration. The most stable form of mercury in soil is its elemental form. Mercury is found in low-temperature hydrothermal ores as cinnabar (HgS), in epithermal (hot springs) deposits as native mercury, and as native mercury in human-made deposits where mercury was used in the processing of gold ores.

**Lead** concentrations in natural waters are controlled by lead carbonate which has an equilibrium concentration of 50 µg/L at pHs between 7.5 and 8.5. As with other metals, concentrations in solution increase with decreasing pH. In sulfate soils with a pH less than 6, anglesite controls solubility while cerussite, a lead carbonate, controls solubility in buffered soils. Lead occurs in the common ore mineral galena (PbS).

**Zinc** solubility is controlled by the formation of zinc hydroxide and zinc carbonate in natural waters. At pHs greater than 8, the equilibrium concentration of zinc in waters with a high bicarbonate content is less than 100 µg/L. Franklinite may control solubility at pH less than 5 in water and soils, and is strongly affected by sulfate concentrations. Thus, production of sulfate from AMD may ultimately control solubility of zinc in water affected by mining. Sphalerite (ZnS) is common in mineralized systems.

(References: Lindsay 1979, Stumm and Morgan 1981, Hem 1985, Maest and Metesh 1993)

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 strongly depends 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. Furthermore, 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 value.

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, cations, and anions.

## 1.4 Methodology

1.4.1 Data Sources

The MBMG began this inventory effort by completing a literature search for all known mines in Montana. The MBMG plotted the published location(s) of the mines on USFS maps. From the maps, the MBMG developed an inventory of all known mines that are located on or could affect National Forest System lands in Montana. The following data sources were used:

1) the MILS data base (U.S. Bureau of Mines),
2) the MRDS data base (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, and
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 those sites with the potential to release hazardous substances and sites that did not have enough information to make that determination without a field visit. For problems to exist, a site must have a source of hazardous substances and a method 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 USFS developed screening criteria (table 1), which 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 were “yes” or unknown, the site was visited. Personal knowledge of a site and published information were used to answer the questions. USFS mineral administrators used these criteria to "screen out" several sites using their knowledge of an area.

Table 1. 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 (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, high walls, or hazardous structures/debris |

**If the answers to questions 1–6 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 data base along with the data source(s) that was consulted (See appendix II). Often these sites were viewed from a distance while visiting another site. In this way, the accuracy of the consulted information was often checked.

Placer mines were not studied as part of this project. Although mercury was used in amalgamation, the complex nature of placer deposits makes mercury detection difficult and is beyond the scope of this inventory. Due to their oxidized nature, placer deposits are not likely to contain other anomalous concentrations of heavy metals. Limestone and building stone quarries, gravel pits, and phosphate mines were considered to be free of anomalous concentrations of hazardous substances and 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 historic structures, and land ownership. Some site locations were refined using conventional field methods or by USFS global positioning system (GPS) crews. Each site is located by latitude/longitude and by township-range-section-tract (figure 1).

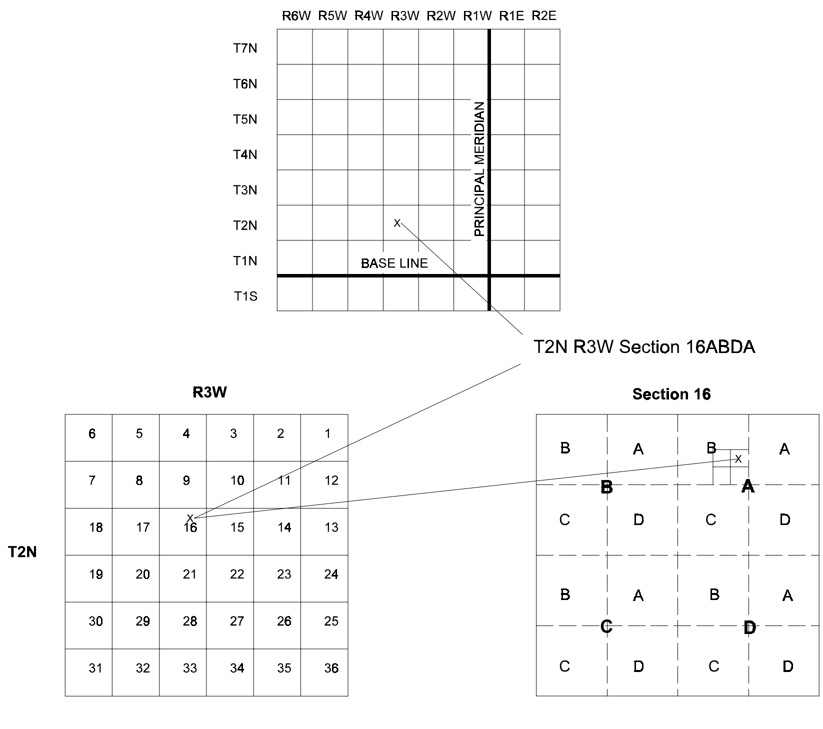



Figure 1. The township, range, and tract of a site location is obtained from a topographic map. The tract is read counterclockwise.

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.

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

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). 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.

#### 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;

3) leach samples: duplicates of selected composite samples for testing leachable metals (EPA Method 1312).

All three types of samples were used, respectively, to characterize the economic geology of the deposit, to examine the value and metal content of dumps and tailings, and to verify the availability of metals for leaching when exposed to water. Assay samples were 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 all of the sites the geologist determined had the potential for environmental problems. A hydrogeologist also visited the sites 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 because mine disturbances may have high total metal concentrations yet may be releasing few metals into the surface water, ground water, or soil. Conversely, another disturbance could have lower total metal content, but 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, Eh, etc.) and observations (e.g., erosion and staining of soils/stream beds ). 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, sample sites were located to assess conditions on National Forest System lands; therefore, samples sites were located on National Forest System 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 hydrogeologist wrote a site sampling and analysis plan (SAP) for each mine site or development area that was then approved by the USFS project manager. Each sample location was plotted on the site map or topographic map and described in the SAP; each sample site was given a unique seven-character identifier based on its location, sample type, interval, and relative concentration of dissolved constituents. The characters were defined as follows:

<u>D</u> <u>DA</u> <u>T</u> <u>L</u> <u>I</u> <u>C</u>

D: Drainage area - determined from topographic map
DA: Development area (dominant mine)
T: Sample type: <u>T</u> - Tailings, <u>W</u> - Waste Rock, <u>D</u> - Soil, <u>A</u> - Alluvium, <u>L</u> - Slag <u>S</u> - Surface Water, <u>G</u> - Ground Water
L: Sample location (1-9)
I: Sample interval (default is 0)
C: Sample concentration (<u>H</u>igh, <u>M</u>edium, <u>L</u>ow) 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.*, stream flow) in accordance with the following:

**Sampling and Analysis Plan (SAP)** - These plans are site specific and they list 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 sample analyzes, 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 not qualified nor validated under this project. The quality-assurance managers and project hydrogeologist determined the usability of such data.

1.4.5 Analytical Methods

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

Contract Laboratory Statement of Work, Inorganic Analyzes, Multi-media, Multi-concentration. March 1990, SOW 3/90, Document Number ILM02.0, 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 - EPA

Method 200.7 Determination of Trace Metals in Water and Waste by Inductively Coupled Plasma and Mass Spectrometry - 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, EPA, Washington D.C.

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

All analyzes 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 that were measured into some perspective, they were compared to these developed standards. However, it is understood that metal concentrations in mineralized areas may naturally exceed these 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 desired (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 (ALS). The primary and secondary MCLs along with the acute and chronic Aquatic Life Standards for selected metals are listed in table 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 metals concentrations.

Table 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 | |

Table 2. continued.

| | | | | |
|---|---|---|---|---|
| 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 | | |
| Fluoride | 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.

### 1.4.6.2 Soil Standards

There are no federal standards for concentrations of metals and other constituents in soils; acceptable limits for such 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 Health and Environmental Sciences for sites within the Clark Fork River basin in Montana. The proposed upper limit 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 3.

Table 3. Clark Fork Superfund background levels (mg/kg) for soils.

| 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 |

### 1.4.7 Analytical Results

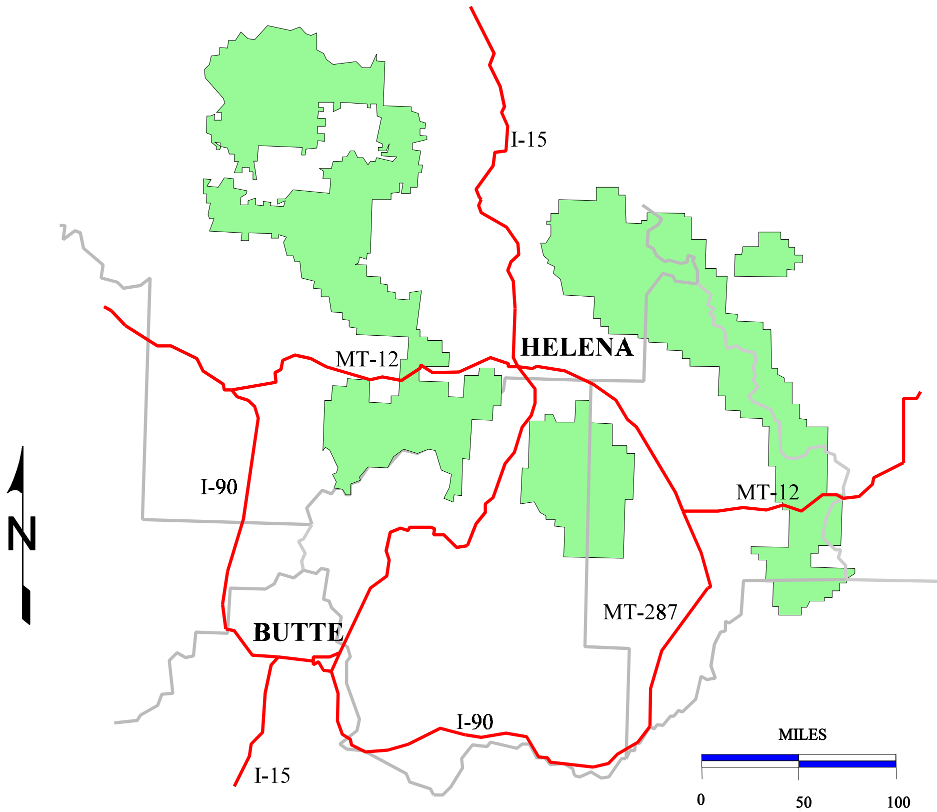
The results of the sample analyzes were used to estimate the nature and extent of potential impact to the environment and human health. Selected results for each site are presented in the discussion; a complete listing of water-quality, soil chemistry are presented in appendix IV.

All of the data for this project were collated with existing data and were incorporated into a new MBMG abandoned-inactive mines data base. The data base 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 current data base are presented in appendix V and are compatible with the MBMG geographic information system (GIS) package.

## 1.5 Helena National Forest

The nearly 1.3-million acres administered by the U.S. Forest Service, Helena National Forest (HNF) straddle the Continental Divide in southwestern Montana (figure 2) and include 83,000 acres in the Scapegoat Wilderness, 28,600 in the Gates of the Mountains Wilderness, and 160,000 in the Elkhorn Wildlife Management Unit. The regional office is located in Missoula with the supervisor's office in Helena and district offices located in Helena, Townsend, and Lincoln. The east half of the Butte 1° x 2° and the west half of the White Sulphur Springs 1° x 2° quadrangles cover the area. The HNF lies within portions of Broadwater, Jefferson, Meagher, Powell, and Lewis and Clark counties.

The topography is typical of southwestern Montana's basin and range province, grading from semiarid grass/sagebrush vegetated valleys to coniferous forests and alpine peaks above timberline. Typical elevations found in the HNF range from Elkhorn Peak at 9,381 feet in the Elkhorn Mountains, Mount Edith at 9,480 feet in the Big Belts, and Greenhorn Mountain, north of Helena, at 7,400 feet. Valley elevations are from 3,500 to 4,500 feet.



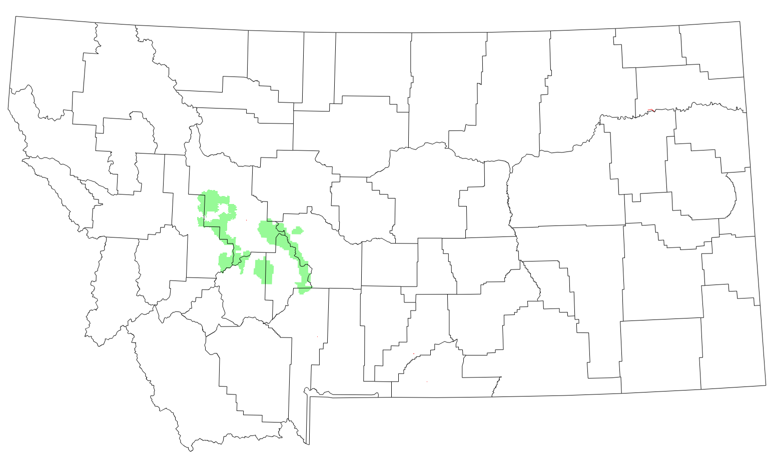



Figure 2. The Helena National Forest and associated wilderness areas cover nearly 1.3 million acres in west-central Montana.

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 the area. Gold was first discovered in the area in Last Chance Gulch in 1864 (Lyden 1948) at the present site of Helena. Associated lode deposits were located soon thereafter; a few of the earliest being the Whitlatch-Union (1864), the Gregory (1864), Legal Tender (1866), East Pacific (1867), and the Drumlummon (1876). According to Sahinen (1959), the majority of the lode mines were in their heyday prior to the turn of the century and have been worked sporadically since then.

The Helena National Forest includes all or part of more than 26 mining districts as defined by Elliot *et al.* (1992), Sahinen (1935), and Pardee and Schrader (1933). These districts include Clancy, Rimini, Elliston, Helena, Scratchgravel Hills/Grass valley, Austin, Ophir, Marysville, Wickes-Corbin, Elkhorn, Buffalo, Nevada Creek, Finn, Heddleston, Stemple-Gould, McClellan Gulch, Lincoln, Big Blackfoot as well as seven loosely defined “areas” on the Butte 1° x 2° sheets. The White Sulphur Springs 1° x 2° sheet contains additional districts of Winston, Park, Radersburg, York, Spokane Hills, Confederate Gulch, Hellgate, and Magpie gulches. The Helena National Forest reports have been organized by drainage basins to include those mines that are not located in traditional mining districts.

Placers in the area include Tenmile Creek and its tributaries, worked since the 1860s, which provided only $80,000 in gold from 1864 to 1920. Confederate Gulch was the largest placer gold producer in Broadwater County yielding an estimated $12 million by 1933 with gold at $35.00 per ounce (Lyden 1948). Other placers in Broadwater County were found in Beaver Creek, Indian Creek, and Crow Creek as well as smaller placers associated with lode mines (Lyden 1948). Lesser amounts of gold came from Skelly, Davis, and Greenhorn gulches, Scratchgravel Hills, and the Marysville placers on Silver Creek. Tributaries to the Blackfoot River such as Stonewall, Sauerkraut, and Liverpool creeks have placers. Sapphires, along with gold, are found in the placers of El Dorado Bar, Gruell’s, French and American bars on the Missouri River.

Placers reached their maximum production before 1872, when the richest ones began to play out; production was primarily by “hydrauliking” and sluicing. By 1870, production from gold and silver lode deposits had become important. Most lode mines had been discovered by the late 1880s, with 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, which contains free gold, enjoyed greater longevity. Some of these gold producers were worked until 1942, when the federal government placed restrictions on gold mining as a result of World War II. During World War II, 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 influenced the mining economics. Additional properties were brought on line as the Defense Logistics Agency went through a period of creating stock piles of critical strategic minerals.

#### 1.5.1.1 Production

The total value of minerals produced from all mines within the Helena National Forest boundaries was probably in the range of $190 million with $50 million from placers and approximately $140 million from lode mines (Sahinen 1935). The estimated values reflect the price of commodities at the time of production and not current prices. A more current estimate would total in the range of $294 million (Elliot *et al.* 1992) but again this is a “ballpark” figure.

#### 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 mines, 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, or 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 USFS-administered land). Gold was often removed from free-milling ores by mercury amalgamation. Cyanidation arrived 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 widely used 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 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 Helena National Forest Investigation

A total of 468 sites were identified in or near the Helena National Forest (HNF) by using the U.S. Bureau of Mines MILS data base as a reference and other sources of information, including Pardee and Schrader (1933), Elliot *et al.* (1992), and McClernan (1983). Table 4 summarizes the process by which the final results were achieved in the Helena National Forest inventory. These numbers are accurate to the extent that the data base is updated and will change reflecting current progress in data base entry.

Table 4. Summary of Helena National Forest investigation.

Total Number of Abandoned/Inactive Mines Sites that were:

| | |
|---|---|
| PART A - Field Form | |
| Located in the general area from MILS | 468 |
| PART B - Field Form (Screening Criteria) | |
| Screened out by HNF minerals administrator or by description in literature | 140 |
| Location inaccurate | 27 |
| Visited by MBMG geologist | 301 |
| Screened out by geologist | 219 |
| Visited by hydrogeologist | 82 |
| Screened out by hydrogeologist | 15 |
| PART C - Field Form | |
| Sampled (Water and Soil) | 67 |

An individual discussion of each of the 67 sites referred to the hydrogeologists and sampled is included in the appropriate volume of the Helena National Forest report. All 468 sites inventoried as possibly affecting HNF are listed in appendix II of each volume.

**1.7 Mining Districts and Drainage Basins**

The Helena National Forest encompasses more than 26 mining districts as described by several different authors. These boundaries are subject to interpretation, change, and often the same district is known by several names. Some mines are not located in traditional districts, so for the purposes of this study, all the mines studied have been organized by drainage basin, which separates the national forests into manageable areas for discussions of geology and hydrogeology. Perhaps more important, however, it is an aid to the assessment of cumulative environmental impacts on the drainage.

# Upper Missouri River Drainage

The upper Missouri River drainage is in the eastern portion of the Helena National Forest, east of the Continental Divide. Major tributaries within the forest include Prickly Pear Creek, Tenmile Creek, Sevenmile Creek, Canyon Creek, Trout Creek, and Indian Creek.

The terrain ranges from broad flat valleys in the Helena valley to rugged mountain ranges and encompasses an area of about 17,150 square miles above Holter Dam (Shields *et al.* 1996). The city of Helena, with a population of about 40,000 people, represents the major population center in the drainage, but there are several small towns (population less than 10,000), including Clancy, Rimini, East Helena, and Townsend.

## 2.1 Geology

The Missouri River basin of Helena National Forest contains all or part of three mining districts: Clancy, Helena, and Wickes. However, these can be grouped by geology and drainage basin into just two areas described below. Figure 3 represents the mines and mills within the Helena National Forest in the Upper Missouri River.

### Boulder Mountains Area

The Boulder Mountains area includes many mining districts and areas defined by the USGS (Loen and Pearson 1989, Elliott *et al.* 1992), including the Big Foot, Oro Fino, Pipestone, Homestake, and Little Pipestone districts, and the North Boulder and South Boulder Mountains areas. Geology across these areas is similar. The entire Boulder Mountains area is underlain by igneous rocks, mostly monzogranite, granodiorite, and aplite of the Cretaceous Boulder batholith, but also including some Cretaceous Elkhorn Mountains volcanics and Tertiary Lowland Creek volcanics. Numerous high-angle normal (?) northwest-northeast-, and north-trending faults cut the area. Geologic mapping in the area was done by Becraft and Pinckney (1961), Pinckney and Becraft (1961), Ruppel (1963), Ruppel *et al.* (1993), Smedes (1967, 1968), Smedes *et al.*(1962), and Wallace (1987).

The area within the Helena National Forest includes parts of the Clancy, Helena, and Wickes mining districts. The geology of these areas is uniform and well described by Becraft *et al.* (1963), who mapped the Jefferson City 15-min. quadrangle and examined mines and prospects, and Roby *et al.* (1960), who described mines and prospects in Jefferson County.

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.

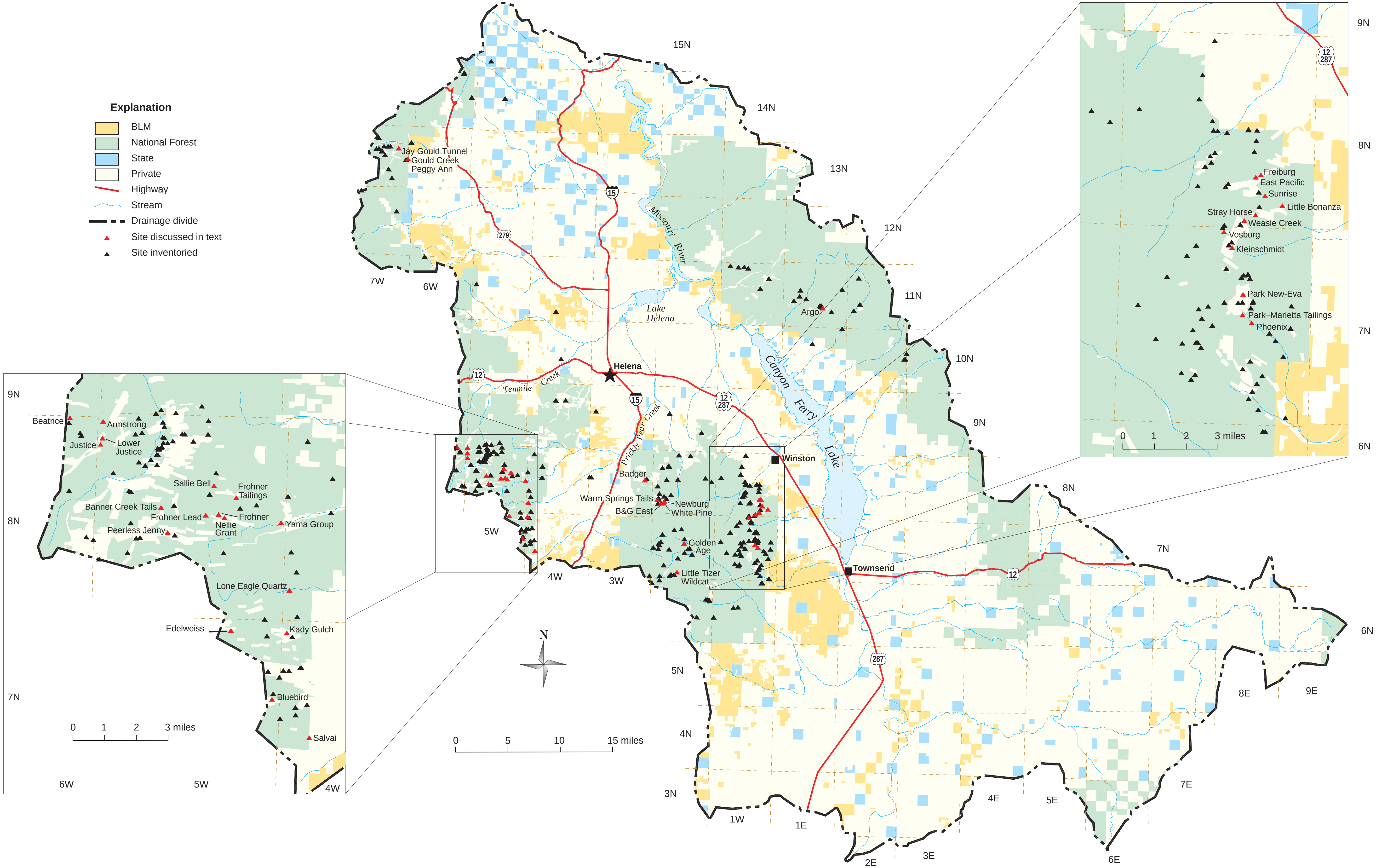



Figure 3. The abandoned-inactive mines in the Upper Missouri River drainage are generally found at higher elevations in the Big Belt and Elkhorn Mountains as well as the Continental Divide.

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 long, 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. The Helena, Clancy, and Wickes mining districts were important producers, but most production came from outside forest boundaries.

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.

## Elkhorn Mountains

Weed and Barrell (1901) and Stone (1911) gave preliminary descriptions of the geology and ore deposits. Pardee and Schrader (1933), Klepper *et al.* (1957), Smedes (1966), and Klepper *et al.* (1971) mapped the area in more detail and provided the definitive work on the geology of the district.

In the Elkhorn district, Paleozoic and Mesozoic sedimentary rocks were deformed by Cretaceous compression into north-trending folds and faults. At the same time, the sediment was covered by extrusive rocks of the andesitic Elkhorn Mountains volcanics and intruded by dikes and sills. Following compression, the Boulder Batholith of granitic composition and satellite bodies of diorite and gabbro were emplaced, accompanied by extensive contact metamorphism of the country rocks. Most mineralization in the district is probably related to the intrusion of the Boulder Batholith and its satellite stocks.

Most mineral deposits are probably related to the Cretaceous intrusive activity. And most have been described by Stone (1911), Knopf (1913), Pardee and Schrader (1933), Reed (1951), Klepper *et al.* (1957), Roby *et al.* (1960), Klepper *et al.* (1971), or the U.S. Bureau of Mines/U.S. Geological Survey (1978). The USBM/USGS study is particularly detailed, and MBMG could not hope to improve on their information. Therefore, we have only included descriptions of those mines studied by USBM/USGS when they posed potential environmental problems.

The Elkhorn Mountains/Prickly Pear drainage includes the Elkhorn, Tizer-Wilson, and Warm Springs districts. Some of these have been very large, important metals producers, especially the Elkhorn district, which lies mostly in Deerlodge National Forest. Production information is only available for some districts, so it is not compiled here.

## 2.2 Economic Geology

The economic geology of the Boulder Mountains has not been comprehensively described. Pardee and Schrader (1933), Roby *et al.* (1960), Ruppel (1963), and U.S. Bureau of Mines (1988) gathered information on some of the larger mines. Loen and Pearson (1989) and Elliott *et al.* (1992) compiled existing information on all known mines on the Dillon and Butte $1^o$ x $2^o$ quadrangles.

Virtually all mines are developed in plutonic rocks or adjacent volcanic country rocks. Most examine veins that are short and discontinuous but often rich. The veins usually occupy east-west structures, contain abundant base-metal sulfides, and have high silver-to-gold ratios. A few disseminated molybdenite occurrences are present in plutonic rocks near Butte.

The Boulder Mountains area has been a small producer of metals; the total value, at the time of production, has been estimated at only $638,600 (Loen and Pearson 1989, Elliott *et al.* 1992). This value was derived from at least 4,332 oz of gold, 76,999 oz of silver, 21,933 lbs of copper, 433,344 lbs of lead, and 152,611 lbs of zinc.

Mines in the Elkhorn mining district were studied by Weed and Barrell (1901), Pardee and Schrader (1933), Klepper *et al.* (1957), Roby *et al.* (1960), and finally by the USGS/USBM (1978). This final comprehensive report on the Elkhorn Wilderness study area covered most of the mines investigated in this study. In the short allotted time, there was no opportunity to improve on the excellent geologic information provided by the wilderness area report.

Three basic types of orebodies occur in the Elkhorn district (Klepper *et al.* 1957), and all three are related to intrusions of Boulder Batholith age. Most mines worked oxidized replacement zones in carbonate rocks. Silver-bearing galena, pyrite, and sphalerite are primary ore minerals common to deposits of this type. Most were mined for their silver content and the productive Elkhorn mine is an example. The second type is skarn deposits like those found at the Elkhorn Iron mine and the Golden Curry mine. A third type of deposit is represented only by the Skyline, a mineralized breccia pipe in andesitic Elkhorn Mountains volcanics.

The district produced a total of 70,015 oz Au; 14,982,751 oz Ag; 383 tons Cu; 8,304 tons Pb; and 3,081 tons Zn (Klepper *et al.* 1957).

## 2.3 Hydrology and Hydrogeology

The upper Missouri River, in west-central Montana, flows from its headwaters at the confluence of the Gallatin, Jefferson, and Madison rivers, northward to form the Upper Missouri River basin. The Helena National Forest covers the western tributaries, including Prickly Pear Creek, which drains the western Elkhorn Mountains; and Tenmile Creek, which drains the west side of the Boulder Mountains. Prickly Pear Creek flows into Tenmile Creek just downstream of the town of Helena, an area where extensive irrigation, municipal, and domestic water use are regulated by canals and reservoirs.

The Missouri River near Toston has a mean annual flow of 5,226 cubic feet/second (cfs) for water years 1890–1995 and a drainage area of 14,669 square miles (Shields *et al.* 1996). Near Clancy, Prickly Pear Creek has an annual mean discharge of 48.4 cfs for water years 1908–1995 (Shields *et al.* 1996). The drainage area above this station is 192 square miles. Downstream on Prickly Pear Creek at East Helena, the drainage area is 251 square miles, but no flow measurement records were available.

In general, the upper Missouri River basin in the Helena National Forest is bounded on the west and south by the Boulder Mountains and on the east by the Elkhorn Mountains. The mountain ranges are dissected by deep glaciated valleys, the lower elevations are filled with Tertiary and Quaternary alluvial and glacial deposits (Alden 1953). Mean annual temperatures range from 25–30$^{O}$F in the higher mountains to 40 to 45°F in the valleys. The average annual precipitation ranges from 40 in. in the mountains to 12 in. in the valleys (Montagne *et al.* 1978).

Water use in the upper Missouri River basins includes irrigation, stock, and domestic use of surface water and ground water. Canyon Ferry Lake is used for power generation, recreation, flood irrigation, and as a source for drinking water for Helena. The useable capacity of the lake is 2,043,000 acre-feet (Shields *et al.* 1996). The Tenmile Creek drainage near the town of Rimini also is used as a source of drinking water for the city of Helena. Hot springs have been developed near the Warm Springs Creek–Prickly Pear Creek confluence near the town of Alhambra.

## 2.4 Summary of the Upper River Drainage

There are 141 mine and mill sites on or near the Helena National Forest within the Prickly Pear–Tenmile Creek drainage. Of these, 22 were found to have a potential to have an adverse effect on soil or water quality on HNF-administered land. Of the 22 that have a potential effect on HNF-administered land, 17 sites have one or more discharges from workings or waste material and 3 sites exhibited signs of water or wind erosion.

There are 107 mine and mill sites on or near the Helena National Forest within the upper Missouri River drainage, outside the Prickly Pear–Tenmile Creek drainage. Of these, 17 were found to have a potential for adverse impacts to soil and water. All 17 had one or more discharges from workings or waste material.

The sites listed in **bold** in tables 5, 6, and 7 exhibited one or more environmental problems and are discussed in the following sections. Recently, there has been special concern for the impact of mining activities on the Prickly Pear–Tenmile Creek basin. The mines in these drainages are presented first, generally upstream to downstream. The mines in the rest of the upper Missouri River drainage follow, again, generally upstream to downstream.

All of the sites inventoried are presented in tables 5, 6, and 7. If mine openings or other dangerous features (unstable structures, highball, steep waste-rock dumps) were observed at a site on HNF-administered land, it is identified (Y) under the hazard heading in each table. In general, only those sites at which samples were collected were evaluated. Of the 248 sites inventoried, 9 sites on or partially on HNF-administered land were identified has having a potential safety problem.

Table 5. Summary of sites in the Prickly Pear–Tenmile drainage, Boulder Mountains (Clancy, Helena, and Wickes districts).

| **Name / ID[1]** | **Visit** | **Owner[2]** | **Sample[3]** | **Hazard[4]** | **Remarks** |
|---|---|---|---|---|---|
| Alice Lode LC003939 | N | MIX | N | NE | Location inaccurate |
| Alley LC001399 | N | PRV | N | NE | No effect on HNF |
| Aragon JF001739 | N | UNK | N | NE | Location inaccurate |
| Argonne JF002739 | N | UNK | N | NE | Location inaccurate |
| **Armstrong JF001237** | Y | NF | Y | Y | Adit discharge; open adit |
| **Banner Cr. Tails[5] JF008067** | Y | PRV | Y | NE | Waste in stream |
| **Beatrice JF001897** | Y | NF | Y | Y | Discharges, caved shaft |
| Betsy Ross LC007392 | N | MIX | N | NE | Location inaccurate |
| Big Jim JF006653 | N | PRV | N | NE | Location inaccurate |
| Blackbird JF002805 | N | PRV | N | NE | No effect on HNF |
| **Bluebird JF005171** | Y | PRV | Y | NE | Site discharges onto HNF |
| Bluestone JF005446 | Y | NF | N | NE | Dry |
| Bunker Hill LC001807 | Y | MIX | Y | NE | Tenmile Creek sampled downstream, see section 2.47 |
| Cappolis LC004589 | N | UNK | N | NE | Location inaccurate |
| Copper Dike LC001795 | N | MIX | N | NE | Location inaccurate |
| Corral Creek JF004906 | N | UNK | N | NE | Location inaccurate |
| Curtain Gulch Adits JF007474 | Y | NF | N | NE | Dry |
| Dan Kim JF008223 | Y | PRV | N | NE | Discharge did not reach HNF |
| Dewey Tunnels JF002817 | N | PRV | N | NE | No effect on HNF |

Table 5. continued.

| | | | | | |
|---|---|---|---|---|---|
| **Edelweiss-Argentine JF002481** | Y | MIX | Y | NE | Site discharges |
| Eureka LC001387 | Y | PRV | N | NE | No effect on HNF |
| Evergreen LC001765 | Y | MIX | N | NE | Dry, stressed vegetation; sampled Tenmile Creek, see Section 2.47 |
| Forest JF002913 | Y | NF | N | NE | Dry, some mill tailings |
| **Frohner JF005386** | Y | PRV | Y | NE | Discharges to HNF |
| **Frohner Lead JF007476** | Y | PRV | Y | NE | Discharges to HNF |
| **Frohner Basin Mill JF008068** | Y | PRV | Y | NE | Streamside tailings |
| General LC004439 | N | MIX | N | NE | Location inaccurate |
| Good Friday JF006129 | N | UNK | N | NE | Location inaccurate |
| Gould Placer LC007370 | N | UNK | N | NE | Pre-screened - placer only |
| Homestake JF002781 | N | PRV | N | NE | Dry, ridgetop |
| Horsefly JF001411 | Y | PRV | N | NE | Dry, no effect on HNF |
| Johnny LC007380 | N | MIX | N | NE | Location inaccurate |
| Jolly Roger LC003942 | Y | NF | Y | N | Dry no visible impact, leach sample only |
| **Justice JF007342** | Y | PRV | Y | NE | Discharges to HNF |
| **Kady Gulch JF007471** | Y | PRV | Y | NE | Discharge to HNF |
| Kady Pond JF007258 | Y | NF | N | NE | Dry |
| Lee Mountain LC001975 | Y | PRV | N | NE | Sampled Tenmile Creek, see Section 2.47 |
| Lexington LC001813 | Y | MIX | N | NE | Sampled Tenmile Creek, see Section 2.47 |
| Little Lily LC001381 | Y | PRV | N | NE | Dry, no visible impacts to HNF |
| Loeber LC002091 | N | NF | N | NE | Dry, ridgetop location |
| **Lone Eagle Quartz JF004801** | Y | NF | Y | NE | Adit discharge |

Table 5. continued.

| | | | | | |
|---|---|---|---|---|---|
| **Lower Justice JF008046** | Y | PRV | Y | NE | Discharge to HNF |
| Lucky Joe LC004209 | N | UNK | N | NE | Location inaccurate |
| Lucky Linda LC000997 | Y | NF | N | N | Dry, no visible impacts |
| May and Manganese JF006301 | Y | PRV | N | NE | Dry, no effect on HNF |
| May Lily LC004966 | Y | PRV | N | NE | No visible impacts to HNF |
| McAwber LC007430 | Y | PRV | N | NE | No visible impacts to HNF |
| Morgan Gulch JF007456 | Y | NF | N | NE | Dry |
| Mount Washington JF005534 | N | UNK | N | NE | Location inaccurate |
| Mountain Queen JF002577 | N | UNK | N | NE | Location inaccurate |
| **Nellie Grant JF002583** | Y | PRV | Y | NE | Discharges to HNF |
| Quartz Creek JF007455 | Y | NF | N | NE | Dry |
| Panama JF002967 | Y | MIX | N | NE | Dry, no effect on HNF |
| **Peerless Jenny JF001369** | Y | PRV | Y | Y | Adit discharge on private; caved shaft (?) on HNF |
| Ray Jensen LC001117 | Y | PRV | N | NE | No visible impacts to HNF |
| Red Mtn Tunnel LC001753 | Y | PRV | N | NE | No visible impact to HNF |
| Rhoades JF002865 | N | UNK | N | NE | Location inaccurate |
| Russel LC007324 | N | MIX | N | NE | Location inaccurate |
| **Sallie Bell (Red Mtn) LC007475** | Y | PRV | Y | NE | Discharges to HNF |
| **Salvai JF002775** | Y | NF | Y | NE | Streamside dumps |
| Silver King JF004946 | Y | NF | N | NE | Dry |
| Teal Lake LC007268 | Y | MIX | N | NE | Adit on private; sampled Tenmile Creek, see Section 2.37 |
| Transit LC001447 | Y | PRV | N | NE | No visible impact to HNF |

Table 5. continued.

| | | | | | |
|---|---|---|---|---|---|
| Umatilla JF004846 | N | UNK | N | NE | Location inaccurate |
| Unnamed Uranium LC001273 | Y | PRV | N | NE | Dry adit, past discharge |
| Upper Quartz Creek JF007454 | Y | NF | N | NE | Dry |
| Valley Forge | Y | PRV | N | NE | Dry, no visible impacts to HNF |
| Woodrow Wilson JF001535 | Y | PRV | N | NE | Discharge did not reach HNF |
| **Yama Group JF005441** | Y | PRV | Y | NE | Streamside dumps |

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
   NF: HNF-administered land
   PRV: Private
   MIX: Mixed (HNF-administered land and private)
   UNK: Owner unknown

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

4) Y: Physical and/or chemical safety hazards exist at the site.
   NE: Physical and chemical safety hazards were not evaluated.

5) Mill site present.

Table 6. Summary of sites in the Prickly Pear–Tenmile drainage, Elkhorn Mountains-east side (Clancy, Helena, and Wickes districts).

| Name / ID[1] | Visit | Owner[2] | Sample[3] | Hazard[4] | Remarks |
|---|---|---|---|---|---|
| Anderson Gulch JF001043 | N | NF | N | NE | Screened; prospect only |
| **Armstrong JF001237** | Y | NF | Y | Y | Adit discharge; open adit |
| Ann Kizer JF005530 | N | UNK | N | NE | Location inaccurate |
| **B&G JF005526** | Y | PRV | Y | NE | Flooded shaft |
| **Badger JF002025** | Y | PRV | Y | NE | Discharges to HNF |
| Ballard JF007470 | Y | PRV | N | NE | Dry, no effect on HNF |
| Bell JF006629 | N | UNK | N | NE | Location inaccurate |
| Bell, Best JF002469 | Y | PRV | N | NE | Dry |
| Big Tizer Wildcat JF001583 | Y | NF | N | NE | Dry |
| Blackjack JF009415 | Y | PRV | N | NE | Dry |
| Bosphorus JF005211 | N | PRV | N | NE | Screened; prospect only |
| Calahan JF001595 | Y | NF | N | NE | Dry |
| Carbonate Chief JF006681 | N | UNK | N | NE | Location inaccurate |
| Casey Meadows JF001391 | Y | NF | N | NE | Dry |
| Center Reef JF002295 | Y | PRV | N | NE | Dry |
| Chicago JF005226 | Y | PRV | N | NE | Dry |
| Christmas Gift JF006205 | N | UNK | N | NE | Location inaccurate |
| Eagles Nest JF006221 | N | UNK | N | NE | Location inaccurate |
| Euclid JF006245 | N | UNK | N | NE | Location inaccurate |
| Gold Series - Big Mary JF001253 | N | NF | N | NE | Screened; prospect only |
| Golden Gate JF006125 | N | UNK | N | NE | Location inaccurate |
| Greenleaf JF001175 | N | UNK | N | NE | Location inaccurate |

Table 6. continued.

| | | | | | |
|---|---|---|---|---|---|
| High Ridge JF001403 | N | NF | N | NE | Screened in office |
| Invay Group JF006189 | N | NF | N | NE | Screened; prospect only |
| Ironside JF005216 | N | NF | N | NE | Screened; prospect only |
| JC Copper JF001073 | N | NF | N | NE | Screened; prospect only |
| Lava Mountain JF001409 | Y | NF | N | NE | Dry |
| Lone Tree JF006425 | N | UNK | N | NE | Location inaccurate |
| Midnight #2 JF001061 | N | UNK | N | NE | Location inaccurate |
| Mastadon JF006293 | Y | PRV | N | NE | Dry, no effect on HNF |
| Maverick JF001415 | N | NF | N | NE | Screened in office |
| McNary & Cline JF005091 | N | UNK | N | NE | Location inaccurate |
| Moonlight JF001079 | N | NF | N | NE | Screened; prospect only |
| **Newburg JF005191** | Y | PRV | Y | NE | Discharges to HNF |
| Ohio LC001085 | N | NF | N | NE | Screened in office |
| Pataloma JF001589 | Y | NF | N | NE | Dry |
| Pilot JF001817 | N | UNK | N | NE | Location inaccurate |
| Rachel JF001661 | Y | PRV | N | NE | Discharge did not reach HNF |
| Road Junction JF001091 | Y | NF | N | NE | Dry prospect |
| RD Potee JF004891 | N | UNK | N | NE | Location inaccurate |
| Skookum JF006241 | N | UNK | N | NE | Location inaccurate |
| St. Joseph JF001097 | N | NF | N | NE | Screened; prospect only |
| Upper Tizer Lake JF001109 | N | NF | N | NE | Screened; prospect only |
| Upper Wilson Creek JF001727 | N | NF | N | NE | Screened; placer only |
| **Warm Springs Tailings JF001505** | Y | NF | Y | NE | Streamside tailings |

Table 6. continued.

| | | | | | |
|---|---|---|---|---|---|
| West Ridge JF001367 | N | NF | N | NE | Screened; prospect only |
| Weston JF001523 | N | UNK | N | NE | Location inaccurate |
| **White Pine JF005478** | Y | PRV | Y | NE | Discharge to HNF |
| Willard Group JF001529 | Y | NF | N | NE | Dry |
| Zalinski Prospect JF001379 | N | NF | N | NE | Screened; prospect only |

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
NF: HNF-administered land
PRV: Private
MIX: Mixed (HNF-administered land and private)
UNK: Owner unknown
3) Solid and/or water samples (including leach samples)
4) Y: Physical and/or chemical safety hazards exist at the site.
NE: Physical and chemical safety hazards were not evaluated.

Table 7. Summary of sites in the upper Missouri River drainage, Elkhorn Mountains (Clancy, Helena, and Wickes districts).

| **Name/ID**[1] | **VISIT** | **OWNER**[2] | **SAMPLE**[3] | **HAZARD**[4] | **REMARK** |
|---|---|---|---|---|---|
| Alberta BW000579 | Y | NF | N | NE | Dry, no effect on HNF |
| Alice Lode BW000585 | Y | UNK | N | NE | Dry, no effect on HNF |
| Alpha LC001333 | N | UNK | N | NE | Screened in office |
| **Argo / Eclipse BW006615** | Y | MIX | N | Y | Streamside tailings |
| August Rust BW004331 | Y | NF | N | NE | Dry, no effect on HNF |
| Bachelor Gold Mining Company LC004584 | N | PRV | N | NE | Screened in office |
| Badger LC001357 | Y | MIX | N | NE | No effect on HNF |
| Big Chief BW006251 | Y | NF | N | NE | Dry, no effect on HNF |
| Big Copper Lode LC007363 | Y | NF | N | NE | No effect on HNF |
| Big Hat Lode MR003157 | N | PRV | N | NE | Screened in office |
| Bigler MR008161 | Y | NF | N | NE | Dry, no effect on HNF |
| Blue Jay Placer LC003904 | N | UNK | N | NE | Screened in office |
| Bonanza BW006211 | Y | NF | N | NE | Dry, no effect on HNF |
| Buckeye BW006275 | Y | NF | N | Y | Dry; open adit |
| Buena Vista BW004256 | N | UNK | N | NE | Location inaccurate |
| Bullion King BW006207 | Y | PRV | N | NE | Dry, no effect on HNF |
| Calahan JF001595 | Y | NF | N | NE | Dry, no effect on HNF |
| Carbon BW004451 | N | UNK | N | NE | Location inaccurate |
| Carlson Crosscut BW008074 | Y | PRV | Y | NE | Discharge |
| Central Group / Control Group BW004606 | N | PRV | N | NE | No effect on HNF |
| Conshohocken BW006195 | Y | NF | N | NE | Dry, no effect on HNF |
| Crosscut BW003976 | N | NF | N | NE | Location Inaccurate |

Table 7. continued.

| | | | | | |
|---|---|---|---|---|---|
| Denver BW004336 | Y | PRV | N | Y | Dry, open shaft |
| Diamond hill BW008248 | N | NF | N | NE | Dry ridgetop |
| **East Pacific BW006751** | Y | MIX | Y | NE | Discharge from waste; tailings |
| Eil H. BW003991 | Y | PRV | N | NE | Dry, no effect on HNF |
| Etta BW004011 | Y | NF | N | NE | Dry, no effect on HNF |
| Eureka Creek Divide BW000669 | Y | NF | N | NE | Dry, no effect on HNF |
| Eureka Creek, Lower BW000711 | N | UNK | N | NE | Location inaccurate |
| Eureka Creek BW003951 | N | UNK | N | NE | Location inaccurate |
| **Freiburg BW006679** | Y | PRV | Y | NE | Adit discharge |
| Golconda LC007348 | N | PRV | N | NE | Screened in office |
| Gold Bug BW006239 | Y | MIX | N | NE | Dry, no effect on HNF |
| Gold Dust BW006311 | Y | PRV | N | NE | Part of the Marietta Group |
| **Golden Age Mill JF002241** | Y | NF | Y | NE | Streamside tailings |
| Golden Charm LC007336 | Y | NF | N | NE | No effect on HNF |
| Golden Glow BW008261 | Y | MIX | N | NE | Dry, no effect on HNF |
| **Gould Creek /Peggy Ann LC007415** | Y | MIX | N | NE | Possible effect on HNF |
| Granite Butte Prospects LC008140 | Y | NF | N | NE | Dry, no effect on HNF |
| Hawkeye BW000555 | N | UNK | N | NE | Location inaccurate |
| Hellgate Placer BW006427 | N | UNK | N | NE | Screened in office |
| Irish Sydicate BW003806 | Y | PRV | N | NE | Dry, no effect on HNF |
| **January BW006759** | Y | PRV | Y | NE | Adit discharge and streamside dump |
| Jawbone BW006323 | Y | PRV | N | NE | Part of the Marietta Group |

Table 7. continued.

| | | | | | |
|---|---|---|---|---|---|
| **Jay Gould Tunnel LC007439** | Y | NF | Y | Y | Adit discharge |
| **Kleinschmidt / Lttle Olga BW006387** | Y | MIX | Y | NE | Stream side tailings |
| Last Hour BW006115 | N | UNK | N | NE | Location inaccurate |
| Little Annie BW006327 | Y | PRV | N | NE | Dry, no effect on HNF |
| **Little Bonanza BW006123** | Y | PRV | Y | NE | Adit Discharge |
| Little Giant # 5805 BW004596 | Y | NF | N | NE | Dry, no effect on HNF |
| Little Jim No.1-5 Claims BW000627 | N | UNK | N | NE | Location Inaccurate |
| Little Joe BW008246 | Y | PRV | N | NE | Dry, no effect on HNF |
| Little Olga BW006127 | Y | PRV | N | NE | Dry, no effect on HNF |
| **Little Tizer Wildcat JF001601** | Y | PRV | Y | NE | Adit discharge |
| Lonesome Pine BW003836 | Y | NF | N | NE | Dry, no effect on HNF |
| Longfellow Creek BW000693 | N | NF | N | NE | Screened, prospect |
| Longhorn BW000699 | N | UNK | N | NE | Location inaccurate |
| Loomis BW006627 | Y | NF | N | NE | Dry, no effect on HNF |
| Lower Sunshine BW008082 | Y | NF | N | Y | Dry; open adit |
| Maine and Sullivan BW006131 | N | PRV | N | NE | Dry, no effect on HNF |
| **Park - Marietta Tailings BW008282** | Y | NF | Y | NE | Breeched impoundment, streamside tailings |
| Marietta BW006335 | Y | PRV | N | Y | Part of the Marietta Group; adit discharges, streamside waste on private |
| McFadden-Nave BW003796 | N | NF | N | NE | Screened in office, ridgetop |
| McNary and Cline JF005091 | N | UNK | N | NE | Location inaccurate |
| Mighty Monarch BW006139 | Y | NF | N | NE | Dry, no effect on HNF |

Table 7. continued.

| | | | | | |
|---|---|---|---|---|---|
| Miller BW006143 | Y | PRV | N | NE | No effect on HNF |
| Monte Christo BW000495 | Y | PRV | N | NE | Dry, no effect on HNF |
| Native Silver BW006135 | Y | NF | N | NE | Dry, no effect on HNF |
| New Hope BW006339 | Y | NF | N | NE | Dry, no effect on HNF |
| Noon and Edna BW004086 | N | UNK | N | NE | Location inaccurate |
| North Phoenix BW008145 | Y | NF | N | NE | Dry, no effect on HNF |
| Old Bachelor LC001093 | N | UNK | N | NE | Screened in office |
| Old Faithful JF001055 | N | NF | N | NE | Screened in office, ridgetop |
| **Park-New Era BW006343** | Y | PRV | N | Y | Part of the Marietta Group; adit discharges, streamside waste on private |
| Peggy Ann LC001015 | Y | MIX | N | Y | No effect on HNF |
| Peter the Great BW003881 | N | NF | N | NE | Location inaccurate |
| **Phoenix BW004486** | Y | NF | Y | Y | Seepage around dump, streamside tailings |
| Pioneer BW006299 | N | UNK | N | NE | Location inaccurate |
| Quartette BW003886 | Y | PRV | N | NE | Dry, no effect on HNF |
| Roadside Prospect BW000729 | N | UNK | N | NE | Location inaccurate |
| Sadie BW006179 | Y | NF | N | NE | Dry, no effect on HNF |
| Salt Lick Prospect BW000735 | Y | NF | N | NE | Dry, no effect on HNF |
| Shabert / Schabert BW006183 | Y | NF | N | NE | No effect on HNF |
| Silver Reef BW004506 | N | UNK | N | NE | Location inaccurate |
| Silverine and Wasp BW000741 | Y | PRV | N | NE | Dry, no effect on HNF |
| Snowshoe BW000687 | N | UNK | N | NE | Location inaccurate |
| Spring Hill / Hrdmore BW004516 | Y | NF | N | NE | Dry, no effect on HNF |
| Stray Horse North BW006187 | Y | NF | N | NE | Dry, no effect on HNF |

Table 7. continued.

| | | | | | |
|---|---|---|---|---|---|
| **Stray Horse BW008079** | Y | PRV | Y | NE | Adit discharge |
| Summit JF002391 | Y | NF | N | NE | Dry, no effect on HNF |
| **Sunrise BW006283** | Y | PRV | Y | NE | Adit discharge, streamside dump |
| Sunshine BW006279 | N | NF | N | NE | Dry, no effect on HNF |
| Susie S. BW004511 | N | UNK | N | NE | Location inaccurate |
| Toronto BW004196 | N | UNK | N | NE | Location inaccurate |
| Unnamed 7N1W10DDDC BW008281 | Y | PRV | N | NE | Part of the Marietta Group |
| Unnamed Barite BW000513 | N | UNK | N | NE | Location inaccurate |
| Unnamed Locality BW008249 | Y | NF | N | NE | Dry, no effect on HNF |
| Unnamed Location BW008226 | N | UNK | N | NE | Screened in office |
| Unnamed Prospect BW003921 | N | UNK | N | NE | Screened in office |
| Victory LC007278 | Y | MIX | N | NE | No effect on HNF |
| Vinyard Copper BW004116 | N | NF | N | NE | No effect on HNF |
| Viola BW006655 | N | NF | N | NE | Dry, no effect on HNF |
| **Vosburg BW006315** | Y | MIX | Y | Y | Adit discharge and tailings |
| Vulture BW006727 | Y | PRV | N | NE | Dry, no effect on HNF |
| Warner Creek BW000561 | Y | NF | N | Y | Dry; open adit |
| **Weasel Creek BW004321** | Y | PRV | Y | NE | Discharge |
| Yellowjacket JF002463 | Y | MIX | N | Y | Dry, no effect on HNF |

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
NF: HNF-administered land
PRV: Private
MIX: Mixed (HNF-administered land and private)
UNK: Owner unknown

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

4) Y: Physical and/or chemical safety hazards exist at the site.
NE: Physical and chemical safety hazards were not evaluated.

## 2.5 Peerless Jenny Mine

### 2.5.1 Site Location and Access

The Peerless Jenny mine (T8N R5W section 21BDBB) is a private holding located within the Helena National Forest, approximately 18 miles southwest of Helena. Access to the site is via an improved dirt road along Tenmile Creek above the town of Rimini.

### 2.5.2 Site History - Geologic Features

The Peerless Jenny produced very high-grade lead-silver ore (Knopf 1913) with values reportedly up to 900 oz per ton silver, and with 200 tons averaging 500 oz per ton. The vein was approximately 6 ft wide; it was composed of quartz with pyrite, galena, sphalerite and cerussite (Knopf 1913). The mine was worked as early as 1874; it was again worked in 1925 and 1926, according to Pardee and Schrader (1933). McClernan (1983) reports production figures from 1901 to 1948 with 1,316 tons producing 338 oz gold, 38,438 oz silver, 4,552 lbs copper, 38,229 lbs lead and 622 lbs zinc. The mine exploited a fault controlled, east-west trending, steeply north-dipping quartz vein with pyrite, sphalerite, and galena.

### 2.5.3 Environmental Condition

The workings at the site include two collapsed adits, a shaft (?), and several large waste-rock dumps on private land. In addition, there are three or four cabins in poor-to-fair condition. As noted previously, all of the site features are located on private land. The aerial extent of the site is approximately four acres; the average elevation of the site is 7,320 feet.

The waste-rock dumps are immediately adjacent to a tributary of Banner Creek that flows onto HNF-administered land. Surface runoff from the site flows to the north into Banner Creek. Surface-water discharges from the mine workings include two seeps that originate from the upper adits and a third colorful seep that emerges from the toe of the lower waste-rock dump. The ground to the southeast and northeast of the lower dump is marshy. Downhill (northeast) of the dumps, all of the mine discharges join together into a single stream that enters Banner Creek approximately 300 ft below. There is also apparently to be a collapsed shaft on HNF-administered land below the main development area. No discharge was evident, and the waste-rock dump, if present, was small and covered by vegetation.

#### 2.5.3.1 Site Features –Sample Locations

A sample (BPJS10M) was collected from Banner Creek, downstream of the site, to evaluate the impact of the mine discharges on HNF-administered land (figure 4). The field SC was 108 μmhos/cm; the pH was 7.0; The stream was flowing approximately 200 gpm when the site was sampled on 9/28/93. The private holdings extended well upstream of the site on Banner

Creek and the small tributary drainage in which the workings were contained. The waste-rock dumps were well inside the private land boundary; there was no indication of impacts to soils on HNF-administered land, so no soil samples were collected. Site features and sample locations are shown in figure 4; site photographs are shown in figures 4a and 4b.

### 2.5.3.2 Soil

Because the waste-rock dumps and the area below the disturbed area was on private land, no samples were collected. The streambed did not contain evidence of waste material.

### 2.5.3.3 Water

The concentration of zinc exceeded the aquatic life acute and chronic standards (table 8). The concentrations of the other metals with which standards were compared were well below MCLs and ALSs, and in some cases, below the detection limit. Without a sample collected from private land above the development area, it could not be determined if the concentration of zinc found reflects background conditions.

Table 8. Water-quality exceedences, Peerless Jenny Mine.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | **pH** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Banner Cr. - downstream(BPJS10M) | | | | | | | | | | | | | A,C | | | | | | |

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

Note: The analytical results are listed in appendix IV.

### 2.5.3.4 Vegetation

Local undisturbed vegetation at the site consists of weeds, grasses, brush, and conifers. In the waste-rock dump areas, the ground is barren to sparsely vegetated. The marshy area around the lower waste-rock dump is well vegetated with grasses. The area below the site on HNF-administered land showed no indication of impact. The area around the caved shaft on HNF-administered land was well vegetated.

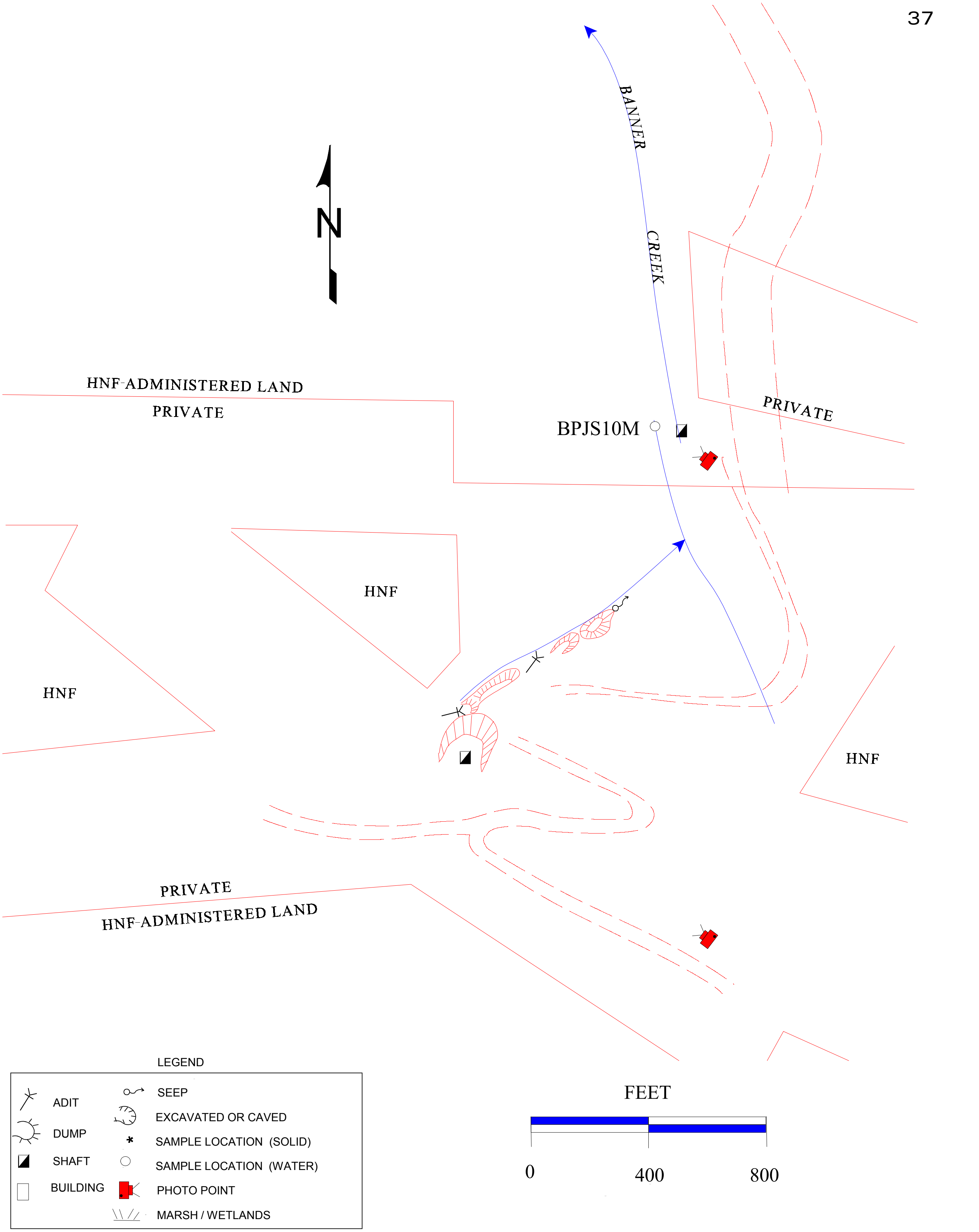



Figure 4. The Peerless Jenny mine (9/22/93) is on private land in Banner Creek. An unnamed tributary flows past the waste material and into Banner Creek below the mine

Figure 4a. The Peerless Jenny mine is in a small tributary of Banner Creek. The waste-rock dump can be seen from the access road.


Figure 4b. The opening on the side of the hill is inconspicuous; it was uncertain if it is related to mining.

2.5.3.5 Summary of Environmental Condition

With the possible exception of zinc, there were no indications of impact by the mine on private land on HNF-administered land. Although storm events and snowmelt runoff may cause waste material to be eroded, there was no evidence of waste material on HNF-administered land below the site.

2.5.4 Structures

There were several cabin-like structures on private land; no structures were observed on HNF-administered land.

2.5.5 Safety

Safety concerns on the private land were not evaluated. The caved shaft (?) on HNF-administered land does pose a concern. Although not large, the hole is inconspicuous and may pose a safety threat.

## 2.6 Sallie Bell (Red Mountain) Mine

2.6.1 Site Location and Access

The Sallie Bell (Red Mountain) mine (T8N R5W section 10DCAD) is a private holding located within the Helena National Forest, approximately three miles southeast of the town of Rimini. Access to the site is best from the Prickly Pear drainage from the east. The site is about one mile above the road through Frohner basin on a primitive road behind a locked gate.

2.6.2 Site History-Geologic Features

The large operation appears to have mined the locally common east-west striking Boulder Batholith vein of quartz, pyrite, galena, sphalerite, and chalcocite. A select sample contained 0.166 oz/ton gold, 12.8 oz/ton silver, 0.086% copper, 5.31% lead, 3.88% zinc, and 1.58% arsenic. It is difficult to tell the extent of the old workings because they have been covered by more recent surface work.

2.6.3 Environmental Condition

The site consisted of at least one adit, a shaft, and associated waste-rock dumps on private land and an adit on HNF-administered land. An unnamed stream originated near the upper adit on HNF-administered land and flowed past the main workings of the mine. A discharge from the lower adit on private land reached the stream as did numerous seeps that emerged from the waste-rock dumps. At the north end of the site, the stream flowed directly across the top of the mineralized lower dump.

Approximately 800 feet downstream from the lower adit, the stream crossed back onto HNF-administered land, and another mile beyond the property line, the unnamed stream flowed into Beaver Creek.

2.6.3.1 Site Features-Sample Locations

Samples were collected from the site on 10/26/93 and 10/27/93. Surface-water samples were collected from the unnamed stream above the site (BRMS20L), where the stream was flowing about 4 gpm, the SC was about 69 μmhos/cm, and the pH was 8.81; and downstream of the site (BRMS10L), where the stream was flowing about 38 gpm, the SC was about 78 μmhos/cm, and the pH was 8.9.

Additional surface-water samples were collected near the confluence of the unnamed stream and Beaver Creek, about one mile downstream. The unnamed stream was flowing at about 177 gpm and had an SC of 53 μmhos/cm and a pH of 6.2 (BRMS50L); Beaver Creek was flowing about 192 gpm, the field SC was 87 μmhos/cm and pH was 7.0 (BRMS40L) above the confluence; and Beaver Creek below the confluence was flowing about 380 gpm with an SC of 76 μmhos/cm and a pH of 5.8 (BRMS30L). Soils near the upper adit on HNF-administered land were well vegetated, and there was no indication of impact or erosion; no soil samples were collected. Site features and sample locations are shown in figure 5; site photographs are shown in figures 5a and 5b.

2.6.3.2 Soil

The soils near the caved upper shaft did not appear adversely impacted; soils below the waste-rock dumps on private land are probably susceptible to erosion but were not sampled.

2.6.3.3 Water

The sample collected above the site exceeded the secondary MCL for pH (too high); the metals concentration was generally at or below the detection limits. The increase in metals concentration downstream (BRMS10L) is dramatic even 1,000 ft downstream; the concentrations of several metals exceed MCLs and ALSs (table 9). The zinc concentration is apparently persistent in Beaver Creek below its confluence with the stream from the site. The low pH in the sample collected from the unnamed stream above its confluence with Beaver Creek and from Beaver Creek above the confluence suggests other wastes may be present.

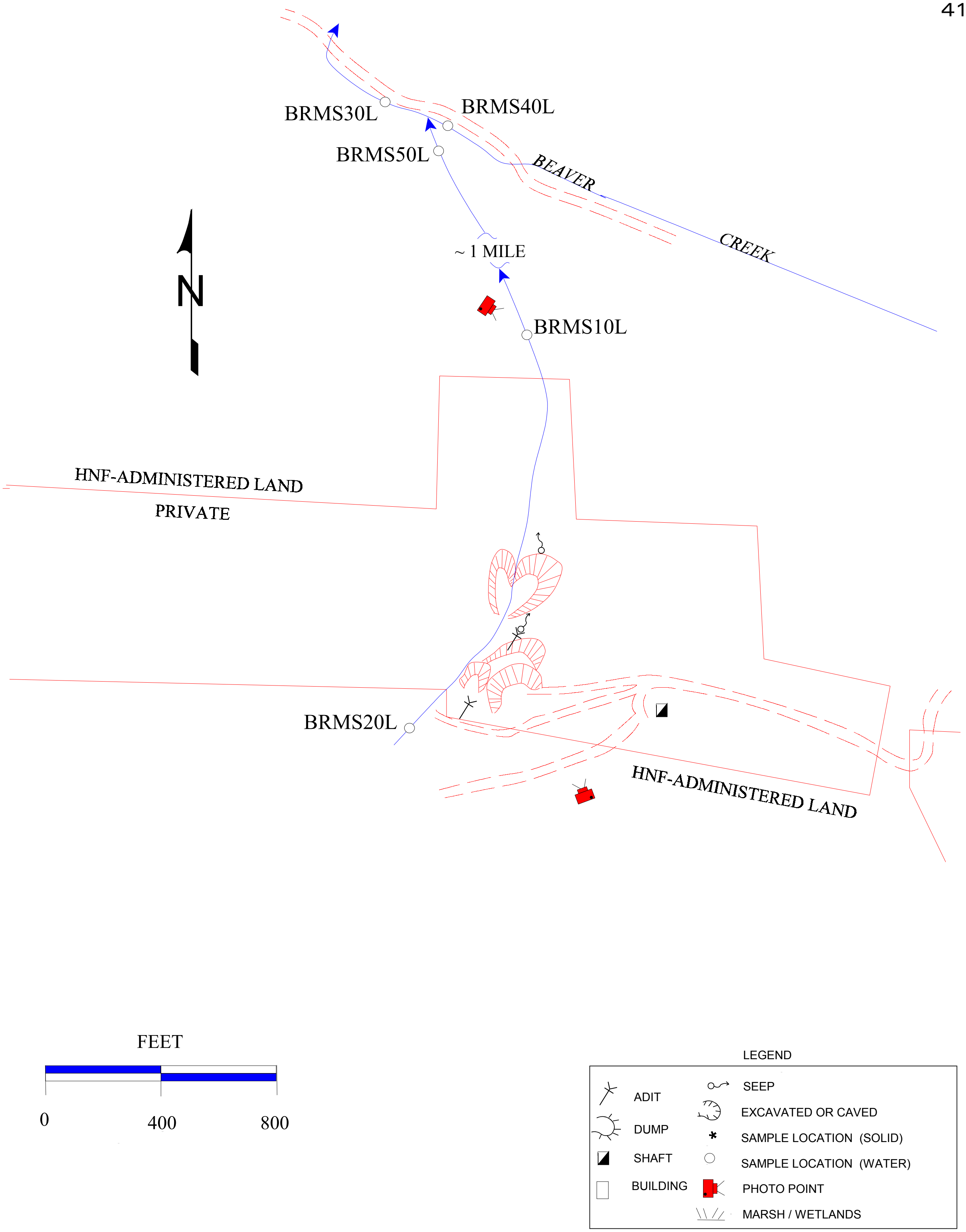



Figure 5. The Sallie Bell (Red Mountain) mine (7/21/93) is on private land in Beaver Creek. The unnamed tributary flowing past the waste-rock dumps into Beaver Creek.

Figure 5a. The Sallie Bell (Red Mountain) mine has several waste-rock dumps on either side of the small stream.

Figure 5b. Surface-water sample locations were on HNF-administered land upstream and downstream (shown) of the mine.

Table 9. Water-quality exceedences, Sallie Belle (Red Mountain) mine.

| Sample Site | Al | As | Ba | Cd | Cr | Cu | Fe | Pb | Mn | Hg | Ni | Ag | Zn | Cl | F | $NO_3$ | $SO_4$ | Si | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unnamed stream above site (BRMS20L) | | | | | | | | | | | | | | | | | | | S |
| Unnamed stream below site (BRMS10L) | | | | S,A C | | A,C | | C | S | | | | A,C | | | | | | S |
| Unnamed stream above confluence (BRMS50L) | | | | | | | | | | C | | | A,C | | | | | | S |
| Beaver Cr. above confluence (BRMS40L) | | | | | | | | | | C | | | | | | | | | |
| Beaver Cr. below confluence (BRMS30L) | | | | | | | | | | C | | | A,C | | | | | | |

Exceedence codes:

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

Note: The analytical results are listed in appendix IV.

### 2.6.3.4 Vegetation

Local undisturbed vegetation at the Sallie Belle (Red Mountain) mine consists of weeds, grasses, and coniferous trees. In the waste-rock dump areas, the ground is barren to sparsely vegetated. At the toe of the lower waste-rock dump, much of the vegetation is dead or stressed.

### 2.6.3.5 Summary of Environmental Condition

The Sallie Belle (Red Mountain) mine and associated waste-material are on private ground upstream of HNF-administered land. The dissolution of metals by the stream that flows through the property is apparent at least 1,000 ft downstream on HNF-administered land. Although waste material was not observed in the stream bed, the barren areas near the base of the waste-rock dumps are susceptible to erosion and likely contribute metals-laden sediment to the stream.

## 2.6.4 Structures

There were several structures observed from a distance on private land; no structures were found on HNF-administered land.

### 2.6.5 Safety

The adits, trenches, and associated waste-rock dumps, as well as all structures were on private land. An evaluation of safety concerns was not conducted.

## 2.7 Banner Creek Tailings

### 2.7.1 Site Location and Access

The Banner Creek tailings (T8N R5W section 16BCD) are within private holdings within HNF-administered land, approximately 18 miles southwest of Helena. Access to the site is via an improved road along Tenmile Creek through the town of Rimini. Banner Creek is a tributary of Tenmile Creek.

### 2.7.2 Site History - Geologic Features

The Banner Creek tailings' origin is unknown; no mill or remains of a mill were located nearby during this investigation. The tailings appear to be deposited along Banner Creek in a low area (possibly by flooding) and may not be in their original location. They lie below the Peerless Jennie and other patented claims at the head of Banner Creek in Lewis and Clark County, in the Rimini mining district. Also, the Gould diggings/Banner Creek placer (Pardee and Schrader 1933, McClernan 1983) lie topographically above these tailings. Pardee and Schrader theorized the gold in the placer originated at the Porphyry Dike mine; there may be some connection between the tailings with either the Porphyry Dike mine or the Banner Creek placer.

### 2.7.3 Environmental Condition

The site consists of a large marsh that has been partially covered with mill tailings. The tailings appear to be concentrated on the south side of the marsh, along the banks of Banner Creek; however, the exact aerial extent is difficult to discern because of vegetation. The tailings may have originated at the Peerless Jenny mine, but other mines also may have contributed. No mill site has been identified. As noted previously, the site is located on private land. The aerial extent of the exposed tailings is approximately two acres.

The marsh in which the tailings are located is fed by the east and west branches of Banner Creek. The two branches join together at the far south end of the marsh. Below the confluence, Banner Creek meanders its way through several hundred feet of exposed streamside tailings. This stretch of the creek is also impacted by several seeps. At the north end of the marsh, the creek flows along what appears to be a human-made channel, perhaps related to placer mining. Beavers have constructed several dams across the channel here, so the water is quite deep. Approximately 1,000 feet downstream from the north end of the marsh, Banner Creek crosses back onto HNF-administered land.

2.7.3.1  Site Features - Sample Locations

The site was on private land; sample collection was restricted to HNF-administered land. The site was sampled on 10/25/93. A surface-water sample was collected upstream of the site on the west branch of Banner Creek (BBCS10L) where the stream was flowing about 320 gpm, the SC was about 53 µmhos/cm and the pH was 7.51; a second upstream sample was collected from the east branch of Banner Creek where the stream was flowing about 145 gpm, the SC was about 72 µmhos/cm, and the pH was 8.06. A surface water sample was collected downstream of the site on Banner Creek where the stream was flowing about 435 gpm, the SC was about 51 µmhos/cm, and the pH was 8.47. Any exposed tailings and impacted soils were on private land and were not sampled. Site features and sample locations are shown in figure 6; photographs are shown in figures 6a and 6b.

2.7.3.2  Soil

No samples were collected of the exposed tailings and impacted soils that were on private land. No impacted soils or tailings were observed on HNF-administered land.

2.7.3.3  Water

The concentration of mercury in the sample collected downstream of the site exceeded aquatic life criteria (ALS). No other MCLs or ALSs were exceeded in any of the samples collected (table 10). However, the concentrations of iron and manganese were notably higher downstream of the tailings. The concentrations of metals in the east branch of Banner Creek were similar to those found downstream of the site suggesting that additional waste material may be found further upstream in this branch of Banner Creek.

Table 10. Water-quality exceedences, Banner Creek tailings.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | **pH** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West branch Banner Cr. Upstream (BBCS10L) | | | | | | | | | | | | | | | | | | | |
| East branch Banner Cr. Upstream (BBCS30L) | | | | | | | | | | | | | | | | | | | |
| Banner Cr. Downstream (BBCS20L) | | | | | | | | | | C | | | | | | | | | |

Exceedence codes:

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

Note:  The analytical results are listed in appendix IV.

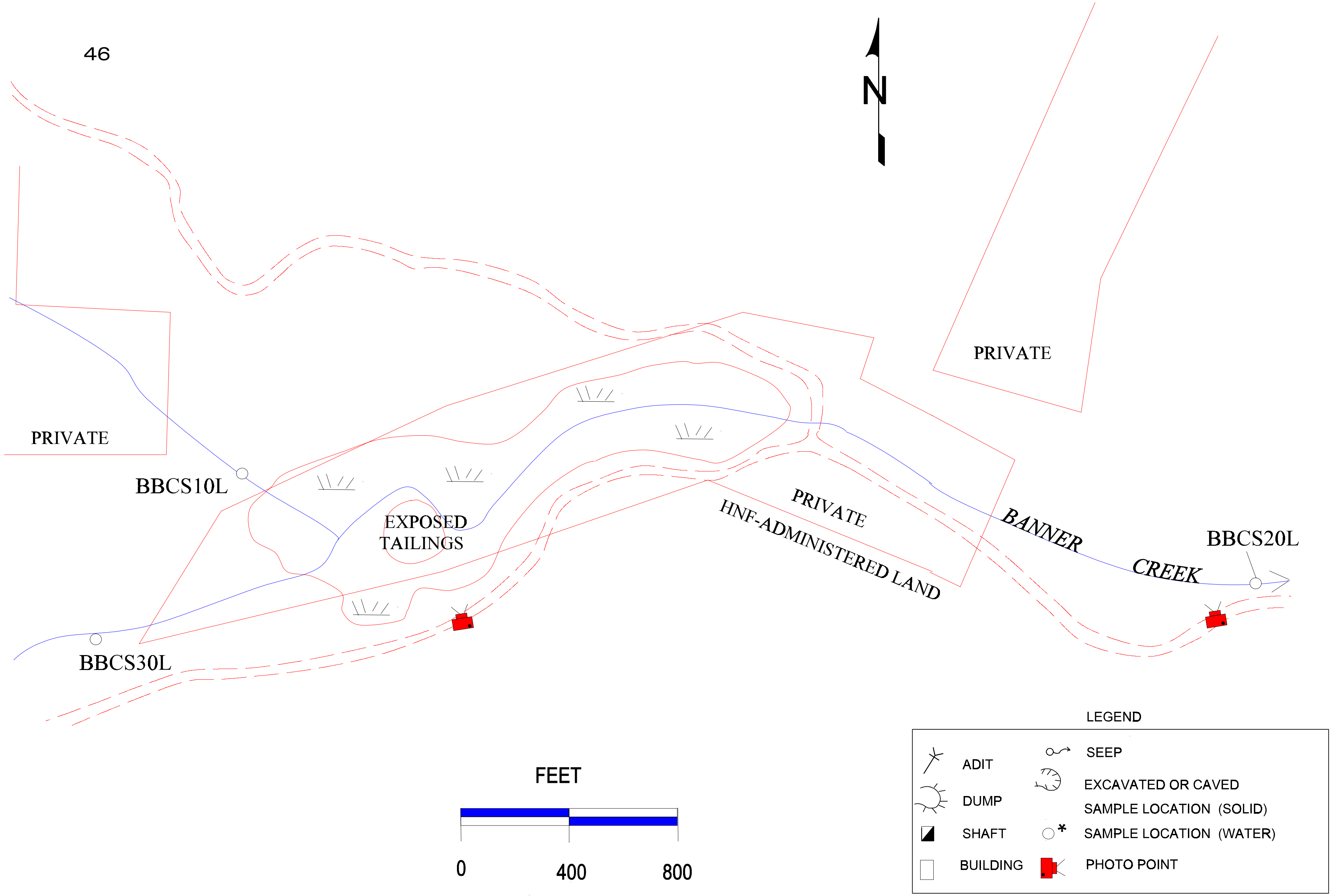



Figure 6. The Banner Creek tailings (8/25/93) are in the flood plain of Banner Creek. Most of the tailings are on private land.


Figure 6a. Barren ground where tailings are exposed indicate the phytotoxicity of the soils associated with the Banner Creek tailings.

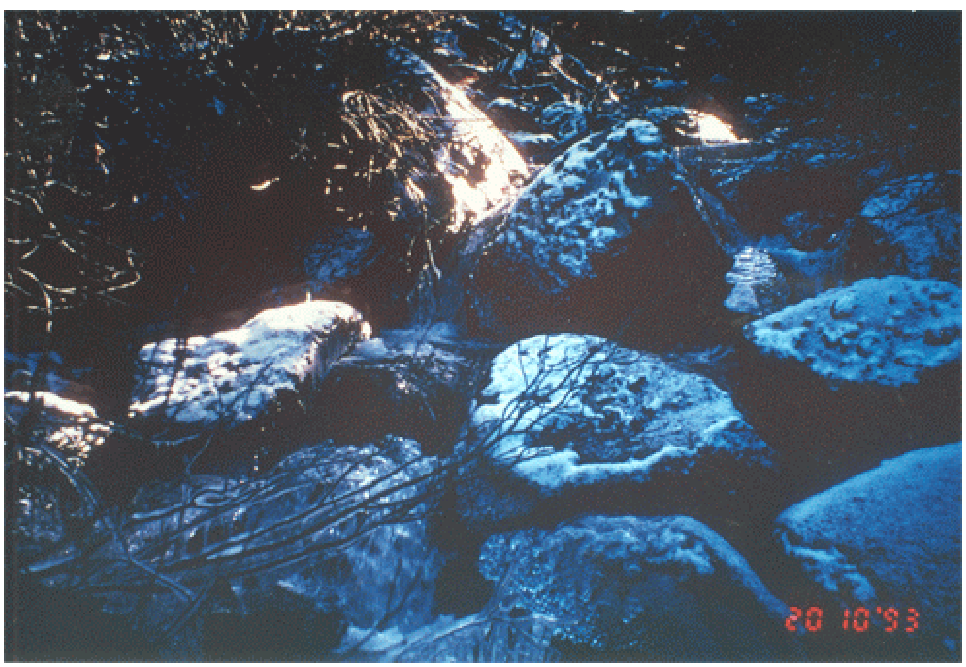



Figure 6b. Banner Creek below the tailings had higher concentrations of iron and mercury.

2.7.3.4 Vegetation

Local undisturbed vegetation at the site consisted of weeds, grasses, willows, and coniferous trees. At the south end of the marsh where the tailings were present, there were several large patches of barren ground.

2.7.3.5 Summary of Environmental Condition

The Banner Creek tailings did not appear to have a strong adverse impact on water quality in Banner Creek. While the concentration of some metals increased downstream of the site, they were well below the MCLs and ALSs considered. With the exception of areas of exposed tailings, the site appeared to be well vegetated and resistant to erosion.

2.7.4 Structures

No structures were observed on HNF-administered land or on private land near the tailings.

2.7.5 Safety

No safety concerns were identified on HNF-administered land.

## 2.8 Justice and Lower Justice Mines

2.8.1 Site Location and Access

The Justice and Lower Justice mines (T8N R5W section 6CCAC) are on land of mixed owner ship within HNF-administered land, approximately 12 miles southwest of Helena. The mines are in a tributary drainage of the lower portion of Tenmile Creek and are accessed via improved road from the town of Rimini.

2.8.2 Site History - Geologic Features

The Justice and Lower Justice are located in the Rimini mining district and according to Ruppel (1963) the only known production was in 1900 and in the 1940s. During the earlier date, approximately 200 tons were mined. The mines are not mentioned in either Knopf (1913) or in Pardee and Schrader (1933); they probably were not major producers in the district. The term “Lower Justice” was coined in this study to distinguish the two localities. The mine is also known as the Clementh(a).

One adit and one shaft were noted as the extent of the workings (McClernan 1983, Elliot *et al.* 1992) estimated 1,600 feet of workings. The mineralization is similar to that of most of the Rimini district in that a predominantly quartz vein with lesser amounts of pyrite, galena, arsenopyrite, chalcopyrite, tetrahedrite and tourmaline was mined. The mine is located in quartz monzonite of the Boulder batholith, but tuff also was noted on the waste dump by an MBMG geologist.

### 2.8.3 Environmental Condition

The Justice mine consisted of a collapsed adit and two reclaimed waste-rock dumps. The USGS topographic map shows a shaft near the lower dump; however, it had been backfilled or sealed and could not be found. According to the land ownership map, the adit and the associated waste-rock dump are on HNF-administered land, and the upper waste-rock dump is on private land.

A small but apparently potent discharge flows from the adit. On the day of the hydrogeologist's visit (6/9/94), several hundred dead earthworms lay along its path. After flowing through a culvert under the main road, the discharge quickly soaked into the ground. However, a well-defined path of dead vegetation suggested that during rainfall and winter runoff events, the discharge probably flows all the way to Minnehaha Creek, several hundred feet to the west.

East of the site, there was a large spring that emerged from the mountainside. The water from the spring formed a small unnamed creek that flowed past the foot of the reclaimed upper waste-rock dump and eventually into Minnehaha Creek. Although there were no obvious seeps or eroding waste-rock materials along the unnamed creek, the sediment near the mine had a light orange coloring. As part of the reclamation work, the creek bed had been lined with black nylon netting, suggesting that erosion of the waste-rock materials may have been a problem in the past. Downhill from the mine, there were several small seeps near Minnehaha Creek. The seeps did not look bad, but they did have relatively high conductivities (624 µmhos/cm), and no grasses were growing along their paths. The aerial extent of the mine is approximately one acre. The average elevation of the site is 6,200 feet.

The Lower Justice mine consisted of a collapsed adit and an associated waste-rock dump on private land. The adit had a small, clear discharge that flowed through a culvert under the main road and then into a marshy area west of the waste-rock dump. Within the marsh, there were numerous seeps, several of which were stained orange-red with ferric hydroxides. The marsh drained to the north and west, into Minnehaha Creek. The aerial extent of the site was less than a quarter acre. The average elevation of the site is 6,120 feet.

### 2.8.3.1 Site Features-Sample Locations

Samples were collected at the site on 6/29/94. Surface-water samples were collected from Minnehaha Creek upstream of the Justice mine (TJUS60L) where the stream was flowing about 43 gpm, the SC was 35 µmhos/cm, and the pH was 6.58. Another surface water sample was collected from an unnamed stream where it crossed onto HNF-administered land near the mine (TJUS20L); the spring was flowing about 92 gpm, the SC was 23 µmhos/cm, and the pH was 5.69. Another unnamed stream flows into Minnehaha Creek near the mine; a surface-water sample was collected just above the confluence (TJUS50L); the stream was flowing about 115 gpm, the SC was about 38 µmhos/cm, and the pH was 6.25. A sample was also collected from the adit discharge which was flowing about 1 gpm, with an SC of about 1650 µmhos/cm, and a pH of 2.89 and from the seeps below the waste-rock dump which flowed at about 0.6 gpm, with an SC of about 607 µmhos/cm, and a pH of 3.53.

A surface-water sample was collected from Minnehaha Creek below the Justice mine and above the Lower Justice mine (TJUS30L); the stream was flowing about 326 gpm, the SC was about 42 µmhos/cm, and the pH was 6.86. A small spring emerges from the wetlands area below the Lower Justice mine and flowed onto HNF-administered land; a sample (TLJS10L) was collected from this stream, which was flowing about 5 gpm, had an SC of about 72 µmhos/cm, and a pH of 6.89. A surface-water sample (TAMS10L) was collected from Minnehaha downstream of the Lower Justice and upstream of the Armstrong mine (next section); here the stream was flowing at about 307 gpm, the SC was about 36 µmhos/cm, and the pH was 6.48.

There were no indications of impacts to soils near the base of the dumps on HNF-administered land; no soil samples were collected. Site features and sample locations are shown in figure 7; photographs are shown in figures 7a and 7b.

### 2.8.3.2 Soil

The area below the base of the waste-rock dump on HNF-administered land was generally well vegetated, and there was no indication of adverse impact to soils.

### 2.8.3.3 Water

The concentrations of dissolved metals in the upper adit discharge and the seeps along Minnehaha Creek are quite high; several MCLs and ALSs were exceeded (table 11). With the exception of aluminum, the persistence of the metals dissolved in the stream was limited to a few hundred feet; the concentrations of all dissolved metals in TJUS30L were significantly lower. The concentrations of dissolved metals apparently decreased with distance downstream as indicated by the results of TAMS10L.

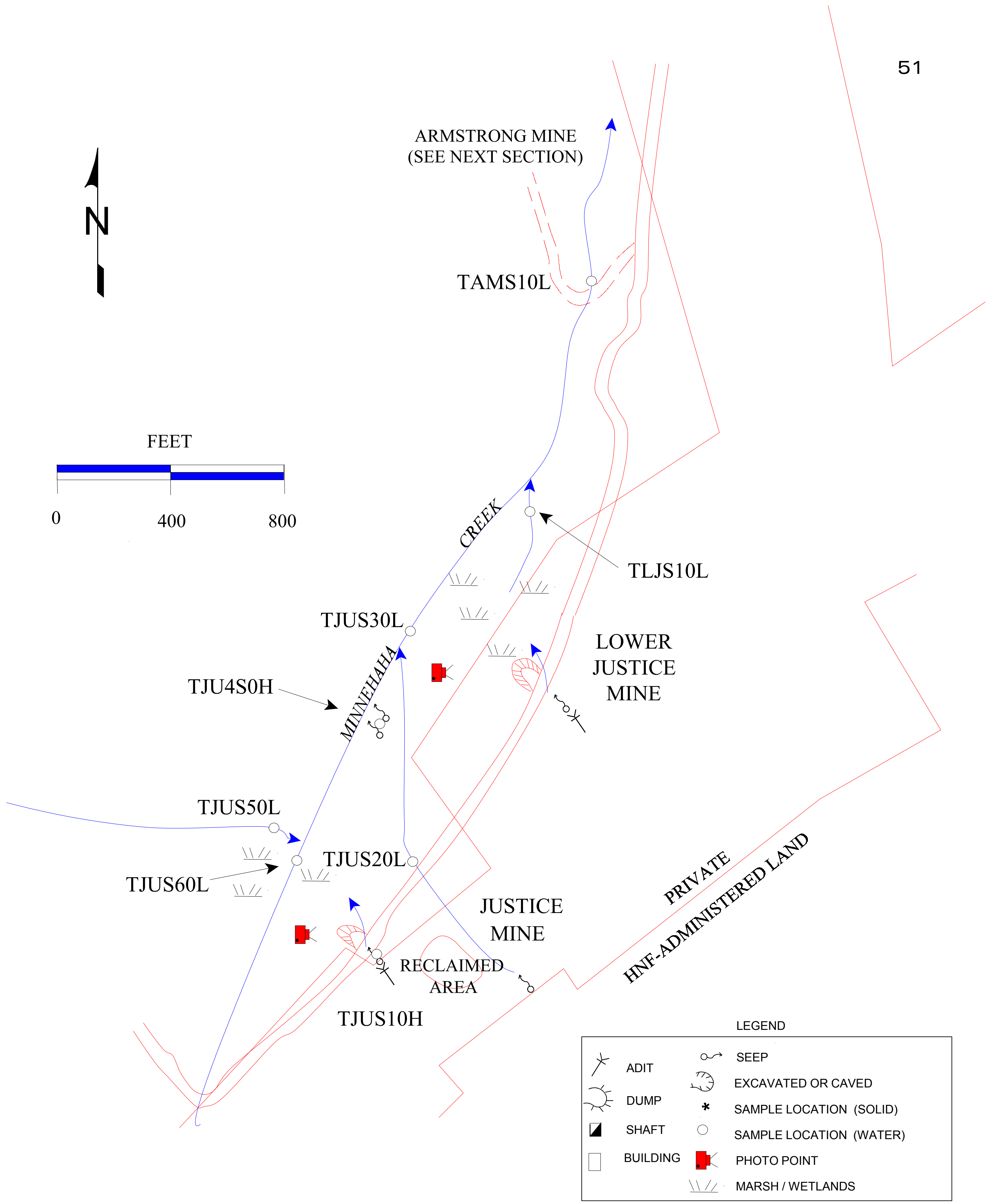



Figure 7. The Justice and lower Justice mines (6/9/94) are on private lands adjacent to Minnehaha Creek. Several site discharges flow into the creek, which is on HNF- administered land.

Figure 7a. The main waste-rock dump of the Justice mine has been reclaimed. The adit still discharges to Minnehaha Creek.

Figure 7b. The waste rock dump of the Lower Justice mine is on private land. The collapsed adit discharges toward the creek.

Table 11. Water-quality exceedences, Justice and Lower Justice mines.

| Sample Site | Al | As | Ba | Cd | Cr | Cu | Fe | Pb | Mn | Hg | Ni | Ag | Zn | Cl | F | $NO_3$ | $SO_4$ | Si | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Minnehaha Cr - Upstream (TJUS60L) | | | | | | | | | | | | | | | | | | | |
| Unnamed Cr. Upstream (TJUS50L) | | | | | | | | | | | | | | | | | | | S |
| Unnamed Cr. Upstream (TJUS20L) | | | | | | | | A,C | | | | | | | | | | | S |
| Adit discharge (TJUS10H) | S,A C | P,A C | | P,A C | | A,C | S,A | P,A C | S | C | | C | S,A C | | | | S | | S |
| Seeps below dump (TJUS40H) | S,A C | | | S,A C | | A,C | S | S,C | S | | | | A,C | | | | S | | S |
| Minnehaha Cr. Downstream (TJUS30L) | S,C | | | | | | C | | | | | | | | | | | | |
| Unnamed Cr. Downstream of L. Justice (TLJS10L) | | | | | | | | | | | | | | | | | | | |
| Minnehaha Cr. - downstream (TAMS10L) | S,C | | | | | | | | | | | | | | | | | | S |

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

Note: The analytical results are listed in appendix IV.

### 2.8.3.4 Vegetation

Local undisturbed vegetation at both sites consists of grasses and coniferous trees. The waste-rock dumps at the Justice mine are densely vegetated with grasses. At the Lower Justice mine, the waste-rock dump is partially vegetated with conifers and grasses. Along Minnehaha Creek, there are willows and riparian grasses. No vegetation is growing along several of the seeps that drain into the creek downhill from the Justice mine.

### 2.8.3.5 Summary of Environmental Condition

The upper adit of the Justice mine was producing a small adit discharge; the presence of low-pH, high-dissolved metals in seeps along the creek suggest that ground water is adversely impacted. Reclamation efforts were apparently focused on sediment control; water and soils near the acidic discharges continue to be adversely impacted.

2.8.4 Structures

No structures were observed on HNF-administered land.

2.8.5 Safety

No safety concerns were identified on HNF-administered land.

## 2.9 Armstrong Mine

2.9.1 Site Location and Access

The Armstrong mine (T8N R5W section 6BCAB) is on HNF-administered land with private land holdings immediately below the mine. The site is approximately 12 miles southwest of Helena. Access to the site is by way of an improved road along Tenmile Creek then Minnehaha Creek, which is a tributary.

2.9.2 Site History - Geologic Features

The Armstrong mine is described in Knopf (1913) who classified it as a tourmaline silver-lead deposit; with the principal ore mineral being galena with lesser sphalerite and pyrite. Pardee and Schrader (1933) reiterate what Knopf stated in a brief paragraph. McClernan (1983) also quotes Ruppel (1963) stating the vein here trends east-west, dipping 80°- 85°N and averages 1–4 ft thick, with the thickness locally greater than 12 feet. The vein appears related to a fault zone, similar to many other veins mined in the area.

The workings according to Ruppel (1963) totaled approximately 1,500 feet and explored the vein, vertically, for 280 feet. Originally, the mine was worked by four (Elliot *et al.* 1992) or five (Ruppel 1963) adits. A 1 in.= 40 ft-scale mine map of three of the adits can be found in the files at the Montana Bureau of Mines and Geology. Total production of ore was estimated at 10,000 to 15,000 tons (Ruppel 1963).

2.9.3 Environmental Condition

The Armstrong mine is on a steep mountainside just west of Minnehaha Creek. The site consists of at least six adits and as many coalescing high-sulfide waste-rock dumps. The uppermost adit at the top of the slope is open and extends for at least 50 feet; all of the other adits are collapsed. No seeps or discharges were observed around the mine workings. However, at the mouth of the lower adit, there was a red-stained channel that indicates this feature has an intermittent discharge. During previous visits, water was observed dripping from the lower ore-bin, but at the time of sampling, no water was present.

Northeast of the mine, there was an extensive area that is devoid of vegetation. This area had apparently been contaminated by surface runoff (rainfall and snowmelt) from the waste-rock dump. The runoff channel extended onto private land and down a steep embankment to Minnehaha Creek.

Along Minnehaha Creek, there was a small but nasty-looking spring approximately 100 feet upstream of where the runoff channel enters the creek. No vegetation is growing around this feature. It was not sampled because it was on private land.

The aerial extent of the mine is approximately one acre. The average elevation of the site is 6,000 feet.

#### 2.9.3.1 Site Features - Sample Locations

The site was sampled on 6/29/94. A surface-water sample was collected from Minnehaha Creek upstream of the site on HNF-administered land. At this location the stream had a flow of about 307 gpm, an SC of 34 µmhos/cm, and a pH of 6.48. A second sample was collected from Minnehaha Creek about one mile below the site on HNF-administered land. At this location, the stream flow nearly tripled to about 980 gpm; the field SC was about 63 µmhos/cm and the pH was 6.81. Site features and sample locations are shown in figure 8; photographs are shown in figures 8a and 8b.

#### 2.9.3.2 Soil

No soil samples were collected; however, a sample of the waste material was collected. Assay results indicated high concentrations of lead and zinc.

#### 2.9.3.3 Water

Dissolved-metal concentrations generally increased downstream of the site. The concentrations of cadmium and zinc exceeded one or more aquatic life standard downstream, but not upstream of the mine (table 12). The concentrations of other constituents, such as aluminum and arsenic decreased downstream of the site, however. As noted in the previous section, the Justice and Lower Justice mines were contributing metals to Minnehaha Creek upstream of the Armstrong mine.

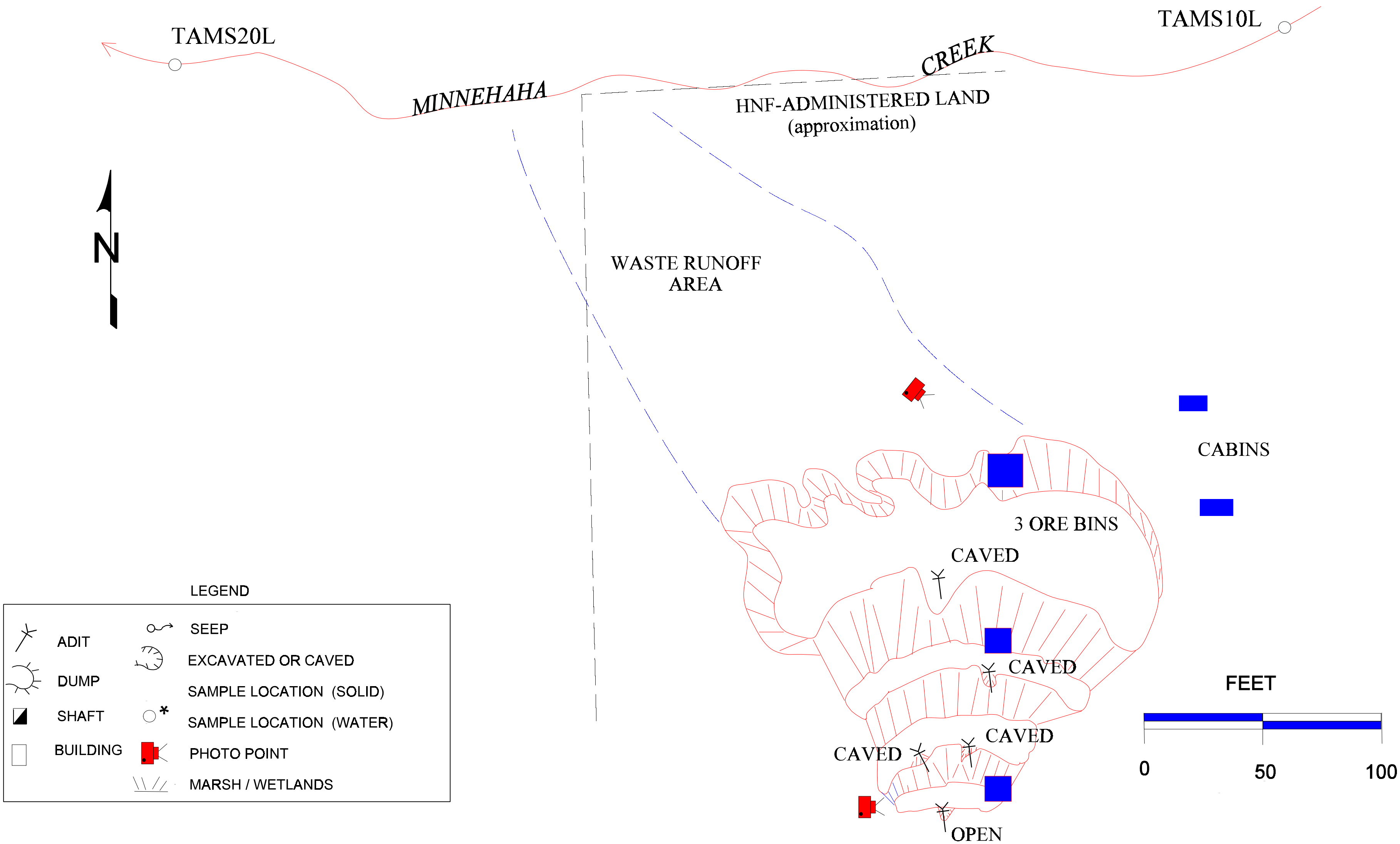



Figure 8.The Armstrong mine (8/19/93) is on HNF- administered land above Minnehaha Creek. Although dry, waste material from the dumps had been washed down toward the creek.

Figure 8a. The upper adit of the Armstrong mine was open at the time of the visit. There was no evidence of discharge.

Figure 8b. The lower waste-rock dump of the Armstrong mine was barren. The area below the dump also was barren of vegetation.

Table 12. Water-quality exceedences, Armstrong mine.

| Sample Site | Al | As | Ba | Cd | Cr | Cu | Fe | Pb | Mn | Hg | Ni | Ag | Zn | Cl | F | $NO_3$ | $SO_4$ | Si | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Minnehaha Cr Upstream (TAMS10L) | S | | | | | | | | | | | | | | | | | | S |
| Minnehaha Cr Downstream (TAMS20L) | S | | | C | | | | | | | | | A,C | | | | | | |

Exceedence codes:

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

Note: The analytical results are listed in appendix IV.

2.9.3.4 Vegetation

Local undisturbed vegetation at the site consists of grasses and coniferous trees. The waste-rock dump is barren. As noted previously, there is an extensive area northeast of the mine that also is barren.

2.9.3.5 Summary of Environmental Condition

Water-quality samples from Minnehaha Creek indicate at least some adverse impacts attributable to the Armstrong mine. Soils and vegetation have obviously been severely impacted in the area downhill from the mine to the creek. As noted, at the time of the visit, there were no discharges on the site; however, the presence of seeps on private land nearby and the evidence of past discharge suggests a greater adverse impact during other times of the year.

2.9.4 Structures

There were two cabins, one in good condition on HNF-administered land. In addition, there were three ore bins on the waste-rock dumps.

2.9.5 Safety

Although the open, uppermost adit was difficult to access (there is no well-defined path up the steep mountain side) it is a safety concern. The Armstrong mine is clearly visible from the main road, and there was evidence of recent visitors.

## 2.10 Beatrice Mine

### 2.10.1 Site Location and Access

The Beatrice mine (T8N R5W section 1BBCB) is located on HNF-administered land, approximately thirteen miles southwest of Helena, Montana. The site is about three miles from Bullion Park on the Tenmile Creek–Telegraph Creek drainage divide. The road was in poor condition.

### 2.10.2 Site History - Geologic Features

The Beatrice is referenced in McClernan (1983) and Ruppel (1963). No mention of the mine could be found in Knopf (1903) or in Pardee and Schrader (1933). The Armstrong and Beatrice have very similar minerals, with a roughly east-west striking, steeply dipping, four-foot thick vein of quartz, pyrite, galena, sphalerite, and with the Beatrice also containing chalcopyrite.

Ruppel (1963) describes the workings as including a 450-foot long adit, a 600-foot crosscut, a 300-foot drift and a 400-foot inclined shaft. Ruppel also states the mine was worked in 1901–1903. The workings have all been caved, at least since the 1960s (McClernan 1983). An MBMG geologist estimated the workings here totaled ½ to 1 mile long.

### 2.10.3 Environmental Condition

The Beatrice mine was visited on two occasions after it was inventoried by the geologist. On the first occasion, in early summer, there were numerous surface water discharges. On the second occasion, later in the summer when the site was sampled, most water courses were dry.

Most of the workings are within an unnamed tributary to Minnehaha Creek. Three of the four waste-rock dumps were being actively eroded by the tributary stream. Fine-grained waste-rock sediment had been deposited at least several hundred feet downstream of the mine, and probably farther. The uppermost waste-rock dump was blocking a small tributary drainage, but the erosion was less of a problem due to the small volume of water.

At the time of the first visit, there were several active seeps and adit discharges that visibly impacted the water-quality of the unnamed tributary. The middle adit had a large discharge that increased the specific conductance (SC) of the tributary by a factor of five (upstream: 47 µmhos/cm; downstream: 243 µmhos/cm). The lower adit had a small discharge that did not appear to be as bad—green algal slime and moss were abundant at the mouth of the adit. At the upper adit, there was an iron-oxide stained path indicating an intermittent discharge. At the toes of waste-rock dumps, there were active seeps, two of which discharged into the wetlands below. The seep below the upper waste-rock dump looked particularly bad with bright red iron-oxide staining and had an SC of 540 µmhos/cm. The mine had an aerial extent of approximately two acres and an average elevation of 6,800 feet.

On the second visit to the site, most of the upper area was dry; there was some standing water in small excavations but no flowing water. The only flowing surface water in the area was an unnamed stream to the south and a spring emerging from wetlands below the workings.

### 2.10.3.1 Site Features - Sample Locations

Most of the site was dry on 8/3/95, so only two surface water samples were collected. A sample (MBES10L) was collected from the small stream south of the site, above any ground-water influence from the mine. At this location the stream was flowing about 4.5 gpm, the SC was about 28 µmhos/cm, and the pH was 6.88. A second sample (MBES20L) was collected at the point where the wetlands began flowing below the disturbed area. At this location the stream was flowing about 3 gpm, the SC was about 28 µmhos/cm, and the pH was 6.14. A composite soil-sample (MBED10L) was collected from the soil-wash area below the largest waste-rock dump. Site features and sample locations are shown in figure 9; photographs are shown in figures 9a and 9b.

### 2.10.3.2 Soil

The concentrations of metals in the soils below the lowermost waste-rock dump were well below phytotoxic limits (table 13). The concentrations of arsenic, cadmium, copper, and lead exceeded one or more background levels, but only slightly.

Table 13. Soil sampling results, Beatrice mine (mg/kg).

| **Sample Location** | **As** | **Cd** | **Cu** | **Pb** | **Zn** |
|---|---|---|---|---|---|
| Below lower dump (MBED10L) | 9.1[1] | 0.79[1] | 16.4[1] | 17.4[1] | 25.2 |

(1) Exceeds one or more Clark Fork Superfund background levels (table 3)
(2) Exceeds phytotoxic levels (table 3)

### 2.10.3.3 Water

The concentration of aluminum exceeded the secondary MCL upstream and downstream of the site (table 14); however, the concentration nearly doubled in the downstream sample. The downstream sample also had elevated concentrations of iron and copper. The pH was notably lower in the downstream sample, suggesting a significant ground-water contribution.

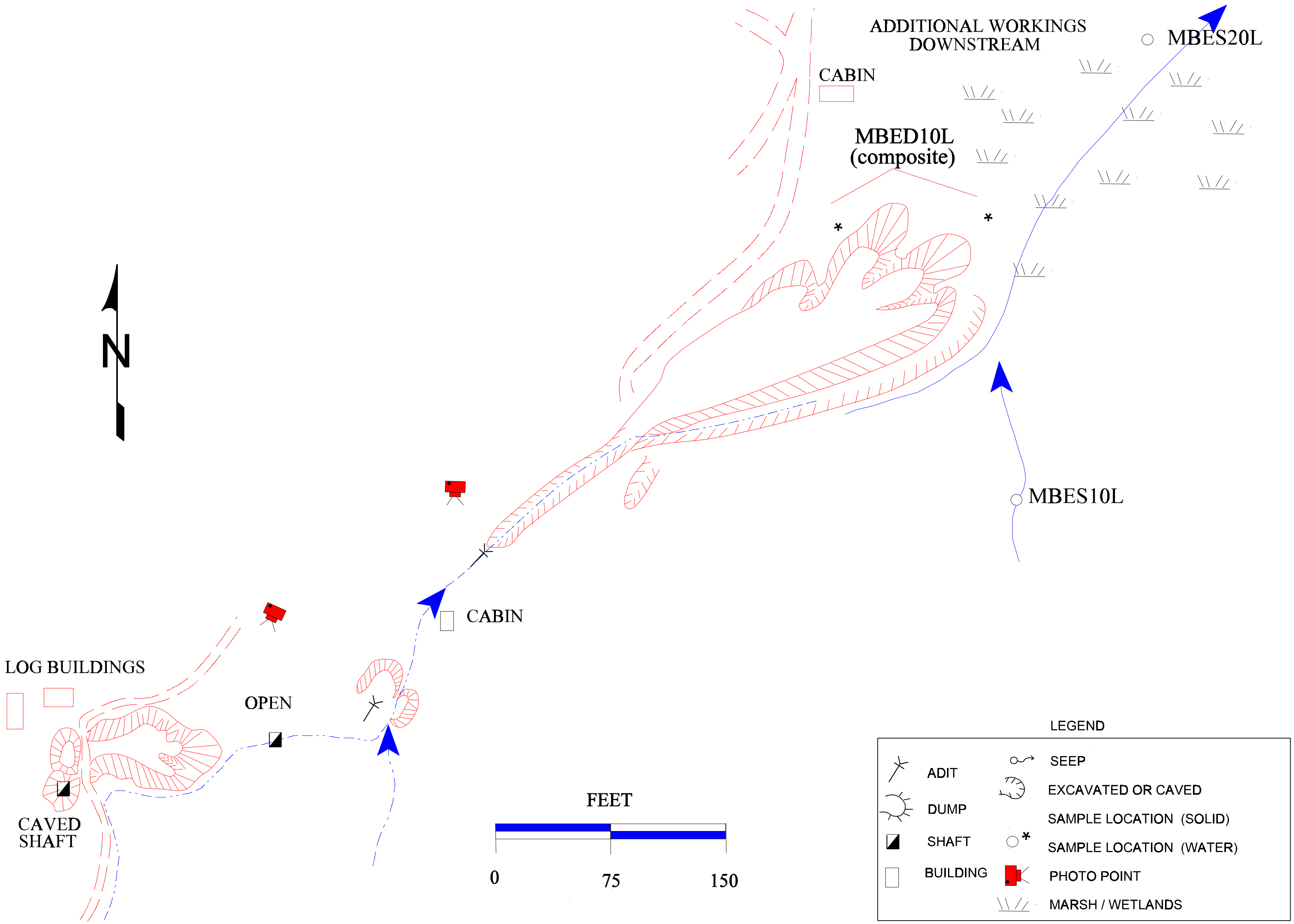



Figure 9. The Beatrice mine (8/19/93) has several large waste-rock dumps. Surface-water flowing on and near the site varies quite dramatically with the season.


Figure 9a. The upper waste-rock dump of the Beatrice mine is large and provides sediment to the intermittent stream.

Figure 9b. Waste material below the upper dumps has washed down the drainage during runoff events.

Table 14. Water-quality exceedences, Beatrice mine.

| Sample Site | Al | As | Ba | Cd | Cr | Cu | Fe | Pb | Mn | Hg | Ni | Ag | Zn | Cl | F | $NO_3$ | $SO_4$ | Si | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unnamed Cr. Upstream (MBES10L) | S | | | | | | | | | | | | | | | | | | |
| Unnamed Cr. Downstream (MBES20L) | S,C | | | | | | S | | | | | | | | | | | | S |

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

Note: The analytical results are listed in appendix IV.

#### 2.10.3.4 Vegetation

Local undisturbed vegetation at the site consisted of grasses and coniferous trees. The waste-rock dumps were generally barren. Along the drainage between the upper and lower dumps, there was a large area of dead vegetation. Some of the vegetation below the lowermost dump was stressed or dead.

#### 2.10.3.5 Summary of Environmental Condition

The adverse impact to water quality from runoff from the site was evident during the first visit to the site. The samples collected indicate at least some impact to water quality during dry periods. Erosion of the waste-rock dumps was active during the first visit and visually apparent during the second visit.

### 2.10.4 Structures

There were several dilapidated structures near the caved shaft. Small cabins in poor repair were found next to the drainage between waste-rock dumps and north, away from the site.

### 2.10.5 Safety

The primary safety concern at the Beatrice mine is a small open shaft in the drainage below the upper waste-rock dump. In addition there was the caved shaft, very near the access road. There were also at least two flooded excavations, depth unknown, along a road west of the main workings.

## 2.11 Bluebird Mine

### 2.11.1 Site Location and Access

The Bluebird mine (T7N R5W section 13ACDD) is on private land within HNF-administered land, approximately nine miles southwest of Jefferson City. Access to the site is by way of improved road and primitive road from Jefferson City.

### 2.11.2 Site History - Geologic Features

The Bluebird has a long-lived history of production. The following information was compiled from Winchell and Winchell (1912), Knopf (1913), Roby *et al.* (1960), and Becraft *et al.* (1963). The mine was discovered about 1887 and worked on an intermittent basis until 1946. A steeply south-dipping, N80°W vein of quartz, tourmaline, pyrite, and tetrahedrite, with some sphalerite, galena, arsenopyrite, chalcopyrite, and rhodochrosite was mined from andesitic tuff of the Elkhorn Mountains volcanics. The vein lies along a contact between the tuff and a granitic dike. Workings (all now caved) consisted of a 1,000-foot vertical shaft and three adits with a combined length of more than 5,000 feet. Production records 1902–1946 show that 17,989 tons of ore were mined, with an average grade of 0.19 oz/ton gold, 18.65 oz/ton silver, 2.69% copper, and 0.57% lead.

### 2.11.3 Environmental Condition

The Bluebird mine consisted of four collapsed adits with associated waste-rock dumps. The upper, main portal had a large volume acid discharge that visibly affected Curtain Creek until its waters sank below ground near the Salvai mine (Section 2.12). All of the mine workings are located on private land.

Curtain Gulch emerged as a spring on the hillside to the northwest of the mine. At the upper end of the site, this stream was joined by a large, red discharge from the upper adit. The stream then flowed down the face of the highly mineralized, upper waste-rock dump. Several hundred feet downhill, the stream flowed past the lower waste-rock dump and was further impacted by discharges from the lower two adits and numerous nearby seeps. After passing around the north edge of the lower dump, additional seeps from the toe of the dump and a discharge from the lowest adit complete the demise of the stream. Approximately 400 feet downstream from the lowest dump, Curtain Gulch flowed back onto HNF-administered land and about 3/4 miles downstream, flowed into Wood Chute Gulch just above the Salvai mine.

The aerial extent of the site is approximately three acres. The average elevation of the mine is 7,000 feet.

2.11.3.1  Site Features - Sample Locations

The Bluebird mine site was sampled on 10/18/93. Because all of the workings were on private land, sampling was restricted to an upstream location (CBBS10M) where the stream was flowing about 30 gpm, the SC was about 143 µmhos/cm, and the pH was 8.21, and a downstream location (CBBS20H) where the stream was flowing about 400 gpm, the SC was about 317 µmhos/cm, and the pH was 7.43. A third sample (PSAS20H) was collected from the stream about 2 miles below the site. At this location the stream was flowing about 30 gpm, the SC was about 276 µmhos/cm, and the pH was 7.9. All three sample locations were on HNF-administered land. Site features and sample locations are shown in figure 10; photographs are shown in figures 10a and 10b.

2.11.3.2  Soil

Although the waste-rock dumps appeared to have eroded and affected soils downslope, there were no apparent adverse impacts on HNF-administered land. Likewise, the vegetation along the creek appeared healthy and no streamside waste material was observed.

2.11.3.3  Water

The concentration of cadmium exceeded the primary drinking water MCL just below the Bluebird mine (table 15) and remained elevated as far downstream as the Salvai mine (next section). The concentration of other metals such as mercury and zinc also increased significantly. The likelihood of waste material being deposited in the stream bed and along the stream bank downstream of the Bluebird is high and may account for the persistence of some, and the appearance of other metals in Curtain Gulch and Wood Chute Gulch above the Salvai mine. No mines were found above the Salvai mine on Wood Chute Gulch.

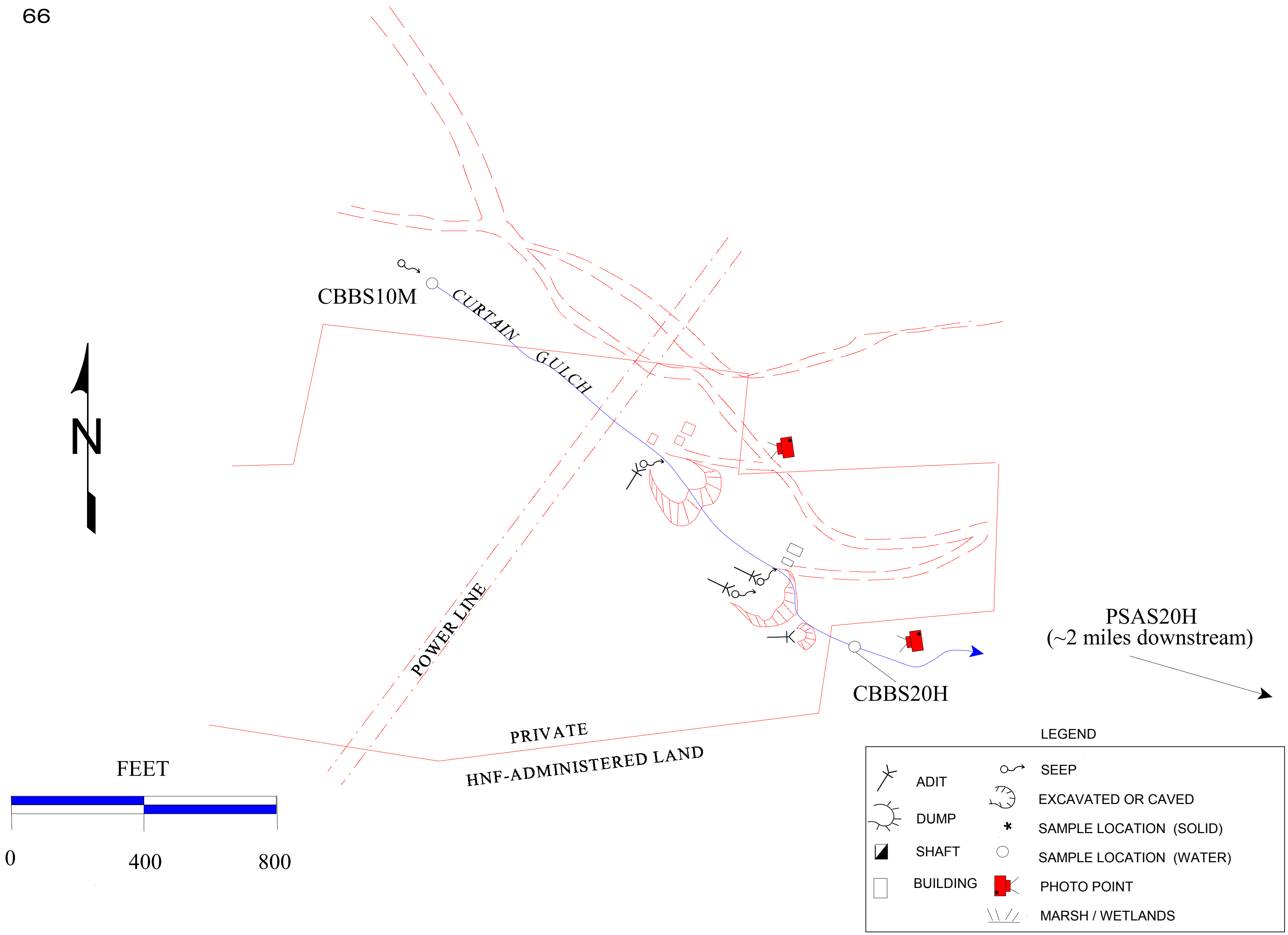



Figure 10. The Bluebird mine (10/13/93) is on private land in Curtain Gulch. Several of the adits had active discharges that flowed into the creek. Samples were collected upstream and down stream of the mine.

Figure 10a. Curtain Gulch flowing through the Bluebird mine was visibly impacted by the dissolution of metals from the waste material.


Figure 10b. Curtain Gulch below the Bluebird mine on HNF-administered land was still visibly impacted.

Table 15. Water-quality exceedences, Bluebird mine.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | **pH** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Curtain Gulch - Upstream (CBBS10M) | | | | | | | | | | | | | | | | | | | |
| Curtain Gulch - Downstream (CBBS20H) | | | | P,A C | | | | | | C | | | A,C | | | | | | |
| Wood Chute Gulch - Downstream (PSAS20H) | | | | C | | | | | S | | | | A,C | | | | | | |

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

Note: The analytical results are listed in appendix IV.

### 2.11.3.4 Vegetation

Local undisturbed vegetation at the Bluebird mine consisted of weeds, grasses, and coniferous trees. In the waste-rock dump areas, the ground was generally barren. Many of the trees immediately downstream of the site were dead or stressed.

### 2.11.3.5 Summary of Environmental Condition

The Bluebird mine was visibly impacting surface water and soils on private land. Surface-water, and likely, ground-water quality have been adversely impacted on HNF-administered land as well. As vegetation continues to die off, sediment loads, including metals-laden waste, will likely increase.

## 2.11.4 Structures

An ore bin and two mine buildings were observed on private land; no structures associated with the Bluebird mine were observed on HNF-administered land.

## 2.11.5 Safety

No safety concerns were identified on HNF-administered land.

## 2.12 Salvai Mine

### 2.12.1 Site Location and Access

The Salvai mine (T7N R5W section 19AAAA) is on HNF-administered land, approximately seven miles southwest of Jefferson City in the Boulder Mountains. The site is accessible from Jefferson City via improved road and primitive road.

### 2.12.2 Site History - Geologic Features

The Wood Chute Gulch stream flows across a mineralized dump of Elkhorn Mountains volcanics containing 1–5% disseminated pyrite and quartz veinlets. A composite dump sample assayed 0.016 oz/ton gold, 1.5 oz/ton silver, 0.068% copper, 0.59% lead, 0.092% zinc, and 0.60% arsenic.

The mine was discovered in 1903 (Pardee and Schrader 1933). Mineralization consists of two east-striking veins that dip steeply north and contain chalcocite, chalcopyrite, galena, arsenopyrite, ruby silver, and bournonite (Pardee and Schrader 1933). One vein is five feet wide, the other is a 64-foot-wide low-grade shear zone (Pardee and Schrader 1933). The mine was mostly worked in the late 1920s (Becraft *et al.* 1963). Production 1928–1929 was 459 tons of ore from which 163 oz of gold, 9283 oz of silver, and 21,820 pounds of copper were recovered (Roby *et al.* 1960).

### 2.12.3 Environmental Condition

The Salvai mine included a gated adit, a collapsed adit, and associated waste-rock dumps. Based on the location of barbed-wire fences, the upper, locked adit and waste-rock dump were assumed to be on private property and were not mapped. The lower, caved adit and waste-rock dump were on HNF-administered land, and, again, based on barbed-wire fences, the associated waste-rock dump was assumed to be on HNF-administered land with private land immediately downstream.

Surface runoff from the mine drained into Wood Chute Gulch. As the stream crossed the site, it passed within 50 feet of the lower adit and then flowed over the face of the lower waste-rock dump. There were no surface-water discharges from any of the mine features.

The aerial extent of the mine is approximately one acre. The average elevation of the mine is 5,840 feet.

#### 2.12.3.1 Site Features - Sample Locations

Samples were collected at the site on 10/18/93. Surface-water samples were collected from Wood Chute Gulch upstream (PSAS20H) of the disturbed area. At this location, which is downstream of the Bluebird mine, the flow was about 25 gpm, the SC was about 276 µmhos/cm, and the pH was 7.9. A second surface-water sample (PSAS10H) was collected downstream of the mine. At this location the stream was flowing about 15 gpm, the SC was about 282 µmhos/cm, and the pH was 7.75. There was visual evidence of soils and waste material mixing and being eroded from the lower waste-rock dump. A composite soil sample (PSAD10M) was collected in this area. Site features and sample locations are shown in figure 11; photographs are shown in figures 11a and 11b.

#### 2.12.3.2 Soil

The concentrations of metals in the soils between the waste-rock dump and Wood Chute Gulch were quite high. In particular, the concentrations of arsenic, copper, and lead exceeded phytotoxic limits (table 16). The concentration of mercury (0.16 mg/kg) is one of the higher values found in mines in the area. As noted, this material is readily available for transport to Wood Chute Gulch during runoff events.

Table 16. Soil sampling results, Salvai mine (mg/kg).

| **Sample Location** | **As** | **Cd** | **Cu** | **Pb** | **Zn** |
|---|---|---|---|---|---|
| Soils below dump (PSAD10M) | 2160[1,2] | 4.4[1] | 500[1,2] | 2440[1,2] | 395[1] |

(1) Exceeds one or more Clark Fork Superfund background levels (table 3)
(2) Exceeds phytotoxic levels (table 3)

#### 2.12.3.3 Water

Although the water quality of Wood Chute Gulch downstream of the Salvai mine is somewhat poor, the quality of water above the mine is only slightly better (table 17). The Bluebird mine, about two miles upstream, probably contributes to the total metals loading in the stream. In general, the concentrations of metals near the Salvai mine are relatively low. However, during spring runoff and storm events, there is likely to be a large amount of metals dissolved from the waste-rock dump.

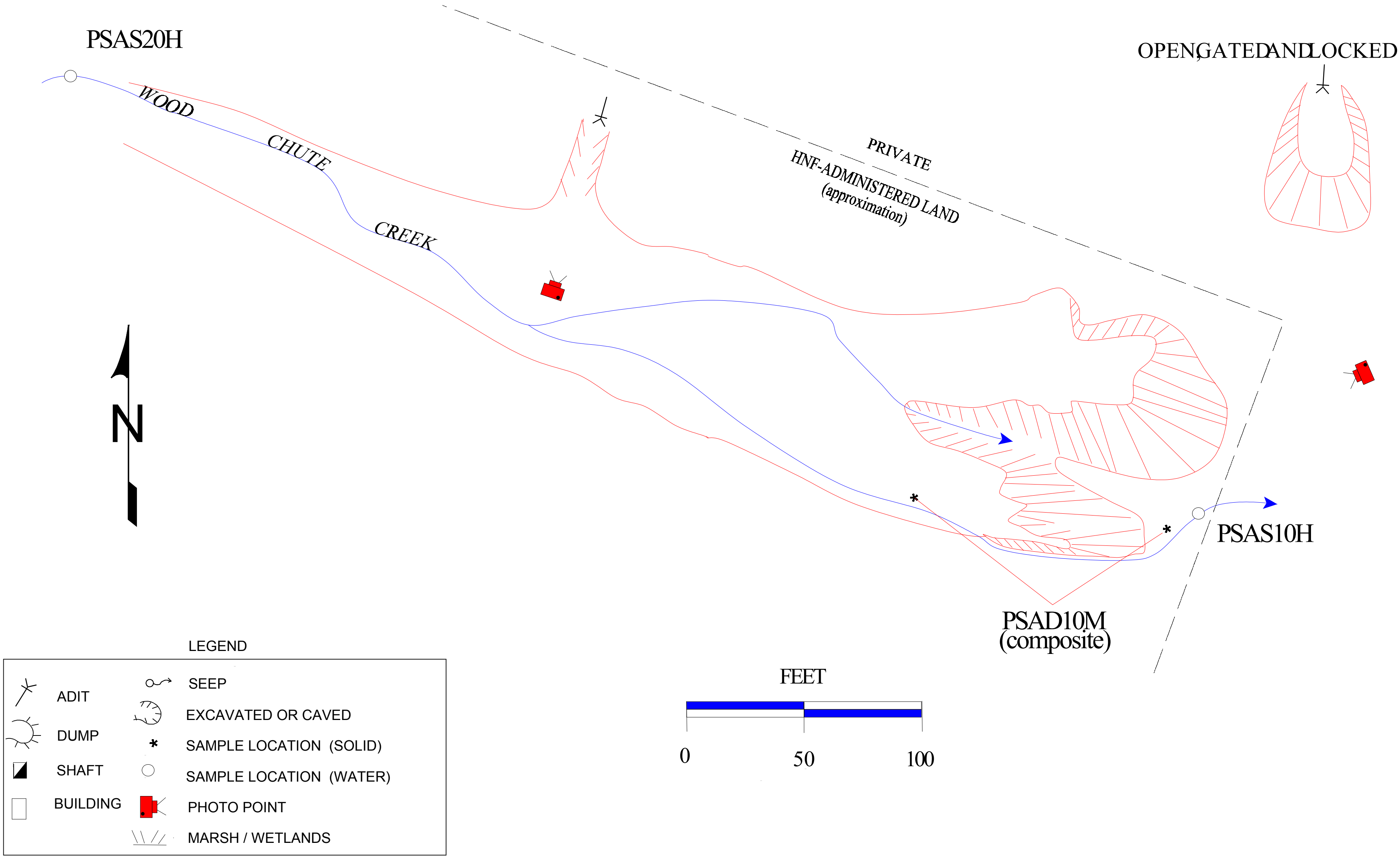



Figure 11. The disturbed area of the Salvai mine (5/24/93) is on private and HNF-administered land. Wood Chute Creek flows through the main development area.


Figure 11a. The main adit of the Salvai mine was collapsed and dry. There was no evidence of past discharge.


Figure 11b. Wood Chute Creek below the Salvai mine was impacted by the Salvai mine (shown) and the Bluebird mine upstream.

Table 17. Water-quality exceedences, Salvai mine.

| Sample Site | Al | As | Ba | Cd | Cr | Cu | Fe | Pb | Mn | Hg | Ni | Ag | Zn | Cl | F | $NO_3$ | $SO_4$ | Si | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wood Chute Gulch Upstream (PSAS20H) | | | | C | | | | | S | | | | A,C | | | | | | |
| Wood Chute Gulch Downstream (PSAS10H) | | | | C | | | | | S | | | | A,C | | | | | | |

Exceedence codes:

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

Note: The analytical results are listed in appendix IV.

#### 2.12.3.4 Vegetation

Local undisturbed vegetation at the Salvai mine consists of weeds, grasses, brush, and coniferous and deciduous trees. On the waste-rock dump and downslope areas, the ground is barren to sparsely vegetated.

#### 2.12.3.5 Summary of Environmental Condition

Wood Chute Gulch was flowing over part of the mineralized waste-rock dump of the Salvai mine. Although metals loading to the stream was low at the time of sampling, the soil sampling results suggest that arsenic, copper, and other metals are readily available for dissolution and transport to the stream during runoff events. The area immediately downstream was private land and was not inspected; however, the possibility of a significant metals loading to ground water exists as well.

### 2.12.4 Structures

No structures were observed on HNF-administered land.

### 2.12.5 Safety

No safety concerns were identified on HNF-administered land.

## 2.13 Kady Gulch Mine

### 2.13.1 Site Location and Access

The Kady Gulch mine (T7N R4W section 6BCBB) is on private land within HNF-administered land, approximately nine miles southwest of the town of Clancy. The site is accessible by way of a primitive road about two miles above the Clancy Creek road.

### 2.13.2 Site History - Geologic Features

A caved N74°W adit discharges water and has an associated streamside dump of mostly clays. The adit must be a few hundred feet long. Vein mineralogy is quartz, chalcedony, pyrite, galena, and sphalerite, and a select sample of this material contained 0.010 oz/ton gold, 3.5 oz/ton silver, 0.287% copper, 1.5% lead, 0.941% zinc, and 0.21% arsenic. Two more very short caved adits head southwest just uphill.

### 2.13.3 Environmental Condition

The Kady Gulch mine included two collapsed adits with mineralized waste-rock dumps. All of the mine workings were on private land; however, HNF-administered land was a short distance both uphill and downhill from the mine. The unnamed tributary to Kady Gulch originated on the mountainside to the northwest of the mine. As it flowed past the upper workings of the mine, it came into contact with the north side of the upper waste-rock dump. Several hundred feet further downhill, the tributary was visibly impacted by a discharge from the lower adit. It also comes into contact with the lower dump.

On the day of the initial visit (10/27/93), the tributary continued down the hill another 600 feet, infiltrated the ground, and disappeared. A dry streambed continued from the point of infiltration to Kady Gulch, 450 feet away. This suggests that during major runoff events, water from the unnamed tributary flows directly into the gulch. The aerial extent of the site is approximately one acre. The average elevation of the mine is 6,300 feet.

#### 2.13.3.1 Site Features - Sample Locations

The site was sampled on 6/22/94. Because the workings are contained within private land, surface-water sampling was restricted to the unnamed tributary upstream and downstream on HNF-administered land (figure 12). The tributary at the upstream sample location (KKGS10L) was flowing about 192 gpm, the SC was about 86 µmhos/cm, and the pH was 6.88. At the downstream sample location (KKGS20L), the stream was flowing about 78 gpm, the SC was about 89 µmhos/cm, and the pH was 7.31. No soil samples were collected.

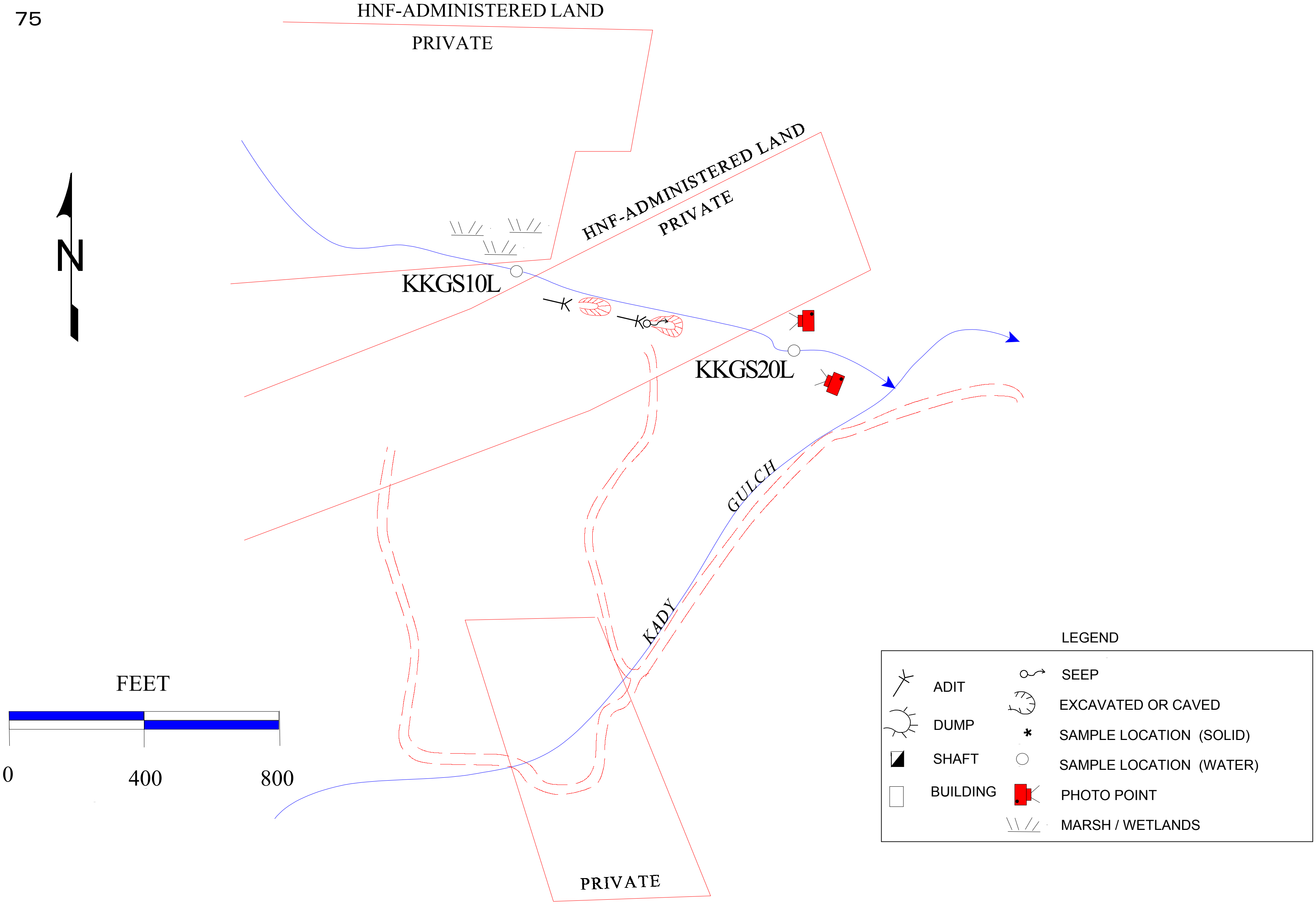



Figure 12. The Kady Gulch mine (10/27/93) is on private land on an unnamed tributary of Kady Gulch. The stream flows past the waste-rock dumps of the mine. Samples were collected upstream and downstream on HNF-administered land.

Figure 12a. The lower adit of the Kady Gulch mine was discharging to an unnamed tributary of Kady Gulch. The adits and dumps were on private land.

Figure 12b. Surface-water sample locations were on HNF-administered land upstream and downstream (shown) of the mine.

2.13.3.2 Soil

The entire disturbed area was on private land; there was no visible indication of adverse impacts to soils on HNF-administered land below the site.

2.13.3.3 Water

The concentrations of dissolved metals in the stream were generally higher above the mine than below (table 18). There is the possibility of additional workings or waste upstream of KKGS10L that were not found. Another consideration is the fact that the stream was losing water to ground water in the area of the mine; the chemistry of the two samples suggests two different waters.

Table 18. Water-quality exceedences, Kady Gulch mine.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | **pH** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tributary - Upstream (KKGS10L) | S,A | | | C | | | | | S | | | | A,C | | | | | | |
| Tributary -Downstream (KKGS20L) | | | | | | | | | | | | | A,C | | | | | | |

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

Note: The analytical results are listed in appendix IV.

2.13.3.4 Vegetation

Local undisturbed vegetation at the Kady Gulch mine consisted of weeds, grasses, and coniferous trees. In the waste-rock dump areas on private land, the ground was generally barren.

2.13.3.5 Summary of Environmental Condition

The adverse impacts, if any, of the Kady Gulch mine on HNF-administered land are difficult to assess with limited data. The relatively large quantity of water lost to ground water near the workings indicates a complex flow system as does the intermittent nature of the stream.

2.13.4 Structures

No structures were observed on HNF-administered land.

## 2.13.5 Safety

No safety concerns on HNF-administered land were identified for the Kady Gulch mine.

# 2.14 Edelweiss-Argentine Mine

## 2.14.1 Site Location and Access

The Edelweiss-Argentine mine (T7N R4W section 2BDBD) is on private land, approximately 12 miles southwest of Jefferson City. The site is accessible via primitive road from Cataract Creek, either from the Occidental Plateau or along Branch Creek.

## 2.14.2 Site History - Geologic Features

It appears that a typical east-west Boulder batholith vein at least four feet thick of quartz, pyrite, sphalerite and clays was investigated at the Edelweiss-Argentine mine. Apparently, the deposit was not discovered until 1946 or 1947 (Roby *et al.* 1960), and no production has been recorded (Elliott *et al.* 1992).

## 2.14.3 Environmental Condition

The Edelweiss-Argentine mine included two collapsed adits, a large bulldozer-cut, and several mineralized waste-rock dumps. With the exception of the lowest waste-rock dump, all of the mine features were on private land. The lower dump extends toward a triangle of HNF-administered land that was surrounded by the private holding.

There are at least two surface-water discharges from the mine that impact the South Fork Quartz Creek watershed. One discharge originated from the large bulldozer-cut and the other issued from the flooded, lower adit. Both discharges flowed several hundred feet over mineralized waste-rock dumps before draining into the creek. The upper adit also has an intermittent discharge, but on the day of the site visit (10/27/93), the red-stained drainage below the adit was dry. The aerial extent of the site is approximately twenty acres. The average elevation of the mine is 7,400 feet.

### 2.14.3.1 Site Features - Sample Locations

The site was sampled on 6/21/94; because the workings and mine discharges were on private land, sampling of the South Fork Quartz Creek was restricted to upstream and downstream on HNF-administered land. At the upstream sample location (PAAS20L), the creek was flowing about 7 gpm, the SC was about 73 µmhos/cm, and the pH was 7.16. At the downstream location, the creek was flowing about 80 gpm, the SC was about 142 µmhos/cm, and the pH was 6.92. No soil samples were collected. Site features and sample locations are shown in figure 13; photographs are shown in figures 13a and 13b.

### 2.14.3.2 Soil

The base of the lower waste-rock dump that was on or near HNF-administered land appeared stable and well vegetated. There was no visible adverse impacts on soils in this area.

### 2.14.3.3 Water

Concentrations of manganese, silver, and zinc exceed MCLs and ALSs downstream of the mine but not upstream (table 19). The concentrations of most of the constituents for which analyses were conducted increase downstream. As noted, it was visibly apparent that metals-laden discharges reach the stream at other times of the year.

Table 19. Water-quality exceedences, Edelweiss-Argentine mine.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | **pH** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S.F. Quartz Cr - Upstream (PAAS20L) | | | | | | | | | | | | | | | | | | | |
| S.F. Quartz Cr - Downstream (PAAS10L) | | | | | | | | | S | | | A,C | A,C | | | | | | |

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

Note: The analytical results are listed in appendix IV.

### 2.14.3.4 Vegetation

Local undisturbed vegetation at the Edelweiss-Argentine mine consisted of weeds, grasses, and coniferous trees. In the waste-rock dump areas, the ground was generally barren. Many of the trees along the mine-discharge drainages were dead or stressed.

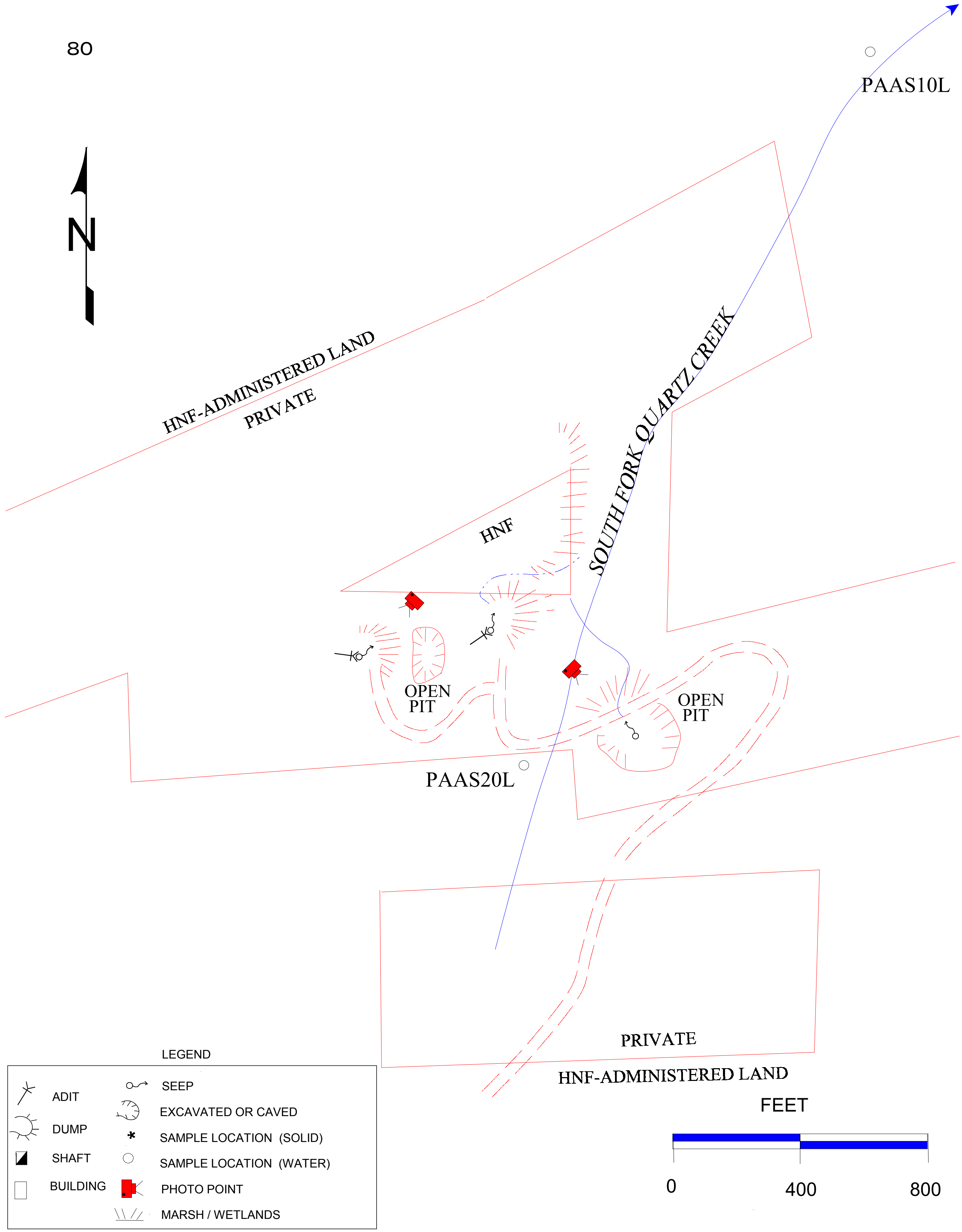



Figure 13. The Edelweiss-Argentine mine (10/27/93) is on either side of South Fork Quartz Creek on private land. Samples were collected upstream and downstream of the mine.


Figure 13a. The Edelweiss-Argentine pit was discharging toward South Fork Quartz Creek on HNF-administered land.

Figure 13b. The Edelweiss-Argentine adit was discharging water toward South Fork Quartz Creek.

2.14.3.5 Summary of Environmental Condition

Although the impact on surface-water quality below the Edelweiss-Argentine mine was minimal at the time of sampling, it was apparent that during other times of the year, probably during spring runoff, the impact can be much greater. Visible evidence of metals-laden discharge into the creek and stressed or dead vegetation indicates a significant adverse impact.

### 2.14.4 Structures

There was at least one structure on private land, but no structures were observed on HNF-administered land.

### 2.14.5 Safety

There is an open adit on private land; no safety concerns on HNF-administered land were identified.

## 2.15 Lone Eagle Quartz Mine

### 2.15.1 Site Location and Access

The Lone Eagle Quartz mine (T7N R4W section 31BABB) is on HNF-administered land about nine miles southwest of the town of Clancy. The site is accessible by primitive road along the South Fork of Quartz Creek about three miles above the main Clancy Creek road.

### 2.15.2 Site History - Geologic Features

The Lone Eagle is an old metal mine that was reopened in 1952 to explore for uranium (Becraft 1956, Becraft *et al.* 1963). Sixty-five tons of uranium ore with 0.24-0.28% $U_3O_8$ were shipped between 1952 and 1955 (Roby *et al.* 1960). The vein consists of quartz, pitchblende, pyrite, sphalerite and galena, and is 1–5 feet wide and 230 feet long (Roby *et al.* 1960). Maps by Becraft *et al.* (1963) show a 275-foot crosscut and a 360-foot drift along the N45°E 50°–75°SE vein. They also show a parallel 10-foot-thick quartz-pyrite vein that was untested. A select sample of vein material from the dump ran 0.008 oz/ton gold, 5.96 oz/ton silver, 1.20% copper, 0.17% lead, 0.829% zinc, and 0.49% arsenic.

In 1993, the caved adit discharged water across the dump; a dump composite sample contained 0.006 oz/ton gold, 0.4 oz/ton silver, 0.007% copper, 0.26% lead, 0.079% zinc, and 0.08% arsenic.

## 2.15.3 Environmental Condition

The Lone Eagle Quartz mine included two collapsed adits and associated mineralized waste-rock dump. All of the mine features were on HNF-administered land. Surface runoff from the mine flowed into a large wetland adjacent to the site. The wetland was fed and drained by the South Fork of Quartz Creek (for sampling information upstream of Lone Eagle Quartz mine, see Edelweiss-Argentine, previous section).

The only surface-water discharge from the mine originated from the lower adit. This discharge ran down the east edge of the lower waste-rock dump and infiltrated into the ground a short distance from the wetlands. The drainage path of the discharge was stained bright red. Although the discharge did not flow directly into the South Fork of Quartz Creek, it probably degrades the quality of the ground water that discharges from the wetlands into the creek. The aerial extent of the site is less than one acre. The average elevation of the mine is 5,950 feet.

### 2.15.3.1 Site Features - Sample Locations

The site was sampled on 6/22/94; samples were collected from the adit discharge and from the South Fork of Quartz Creek, upstream and downstream of the mine. At the upstream sample location (PLES20M), the creek was flowing about 965 gpm, the SC was about 156 µmhos/cm, and the pH was 8.0. The adit (PLES10H) was discharging about 2.5 gpm, the SC was about 534 µmhos/cm, and the pH was 7.38. At the downstream sample location (PLES30M), the South Fork of Quartz Creek was flowing about 956 gpm, the SC was about 130 µmhos/cm, and the pH was 6.97. No soil samples were collected. Site features and sample locations are shown in figure 14; photographs are shown in figures 14a and 14b.

### 2.15.3.2 Soil

The base of the dumps appeared stable and generally well vegetated. There was no visible impact to soils below the dumps.

### 2.15.3.3 Water

Neither the upstream sample nor the downstream sample had concentrations above the MCLs or ALSs considered (table 20). In general, there was little change in concentration of constituents from above and below the site. All of the metals concentrations were significantly less than those found in the sample below the Edelweiss-Argentine mine upstream (previous section). The concentrations of cadmium, mercury, and zinc in the adit discharge exceeded the ALSs and concentration of manganese exceeded the secondary MCL (table 20).

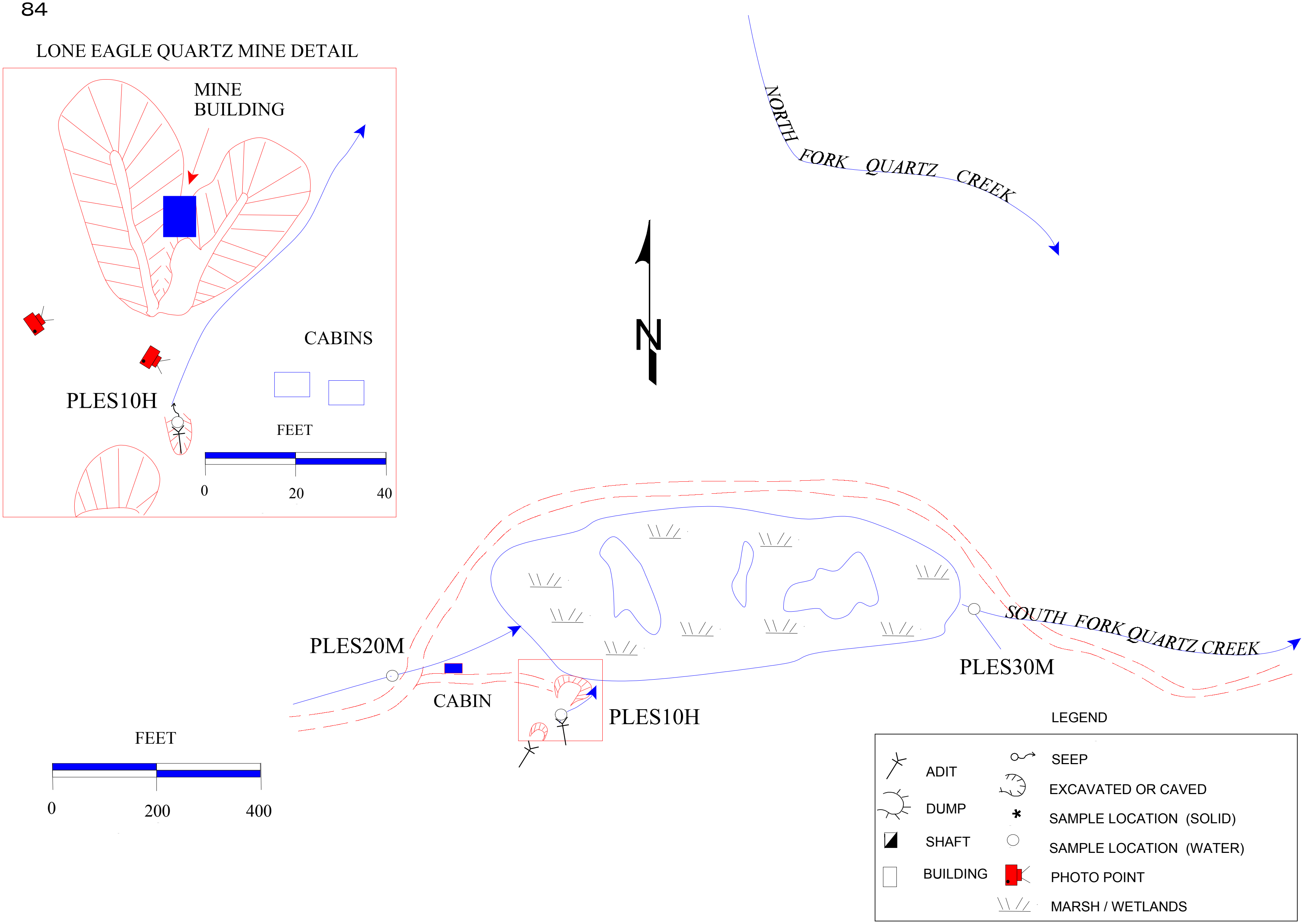



Figure 14. The Lone Eagle Quartz mine (7-8/93) is on HNF-administered land in the South Fork Quartz creek drainage. A collapsed adit was discharging water into a wetlands area below the mine.

Figure 14a. The Lone Eagle Quartz lower adit was discharging water into a wetlands below the mine.

Figure 14b. The lower waste-rock dump of the Lone Eagle Quartz mine was barren, but the area below the dump was generally well vegetated.

Table 20. Water-quality exceedences, Lone Eagle Quartz mine.

| Sample Site | Al | As | Ba | Cd | Cr | Cu | Fe | Pb | Mn | Hg | Ni | Ag | Zn | Cl | F | $NO_3$ | $SO_4$ | Si | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S.F. Quartz Cr - Upstream (PLES20M) | | | | | | | | | | | | | | | | | | | |
| Lone Eagle Quartz adit discharge (PLES10H) | | | | C | | | | | S | C | | | A,C | | | | | | |
| S.F. Quartz Cr - Downstream (PLES30M) | | | | | | | | | | | | | | | | | | | |

Exceedence codes:

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

Note: The analytical results are listed in appendix IV.

#### 2.15.3.4 Vegetation

Local undisturbed vegetation at the Lone Eagle Quartz mine consisted of weeds, grasses, brush (willows) and coniferous trees. In the wetlands area, grasses and willows predominated. The lower waste-rock dump was barren to sparsely vegetated. Many of the trees along the adit discharge drainage were dead or stressed.

#### 2.15.3.5 Summary of Environmental Condition

The base of the waste-rock dumps were generally well vegetated and appeared stable. The adit discharge contained elevated concentrations of several dissolved metals, but had little impact to the South Fork of Quartz Creek at the time of sampling. The wetlands below the site may be receiving ground waters from the underground workings; the loss of surface water flow through the area indicates a significant ground-water flow through the wetlands.

### 2.15.4 Structures

There were two cabins in poor condition and a mine building in fair condition that housed an old compressor. A third cabin, located along the north side of the access road, was in good condition and is probably used as a campsite.

### 2.15.5 Safety

The poor conditions of the cabins, scattered debris and machinery may be a safety concern at this site.

## 2.16 Frohner Lead Mine

### 2.16.1 Site Location and Access

The Frohner Lead mine (T8N R5W section 15CADA) is on private and HNF-administered land, approximately 15 miles west of the town of Clancy. The site is at the upper end of Lump Gulch and is accessible by improved road and primitive road through Frohner Basin from Clancy.

### 2.16.2 Site History - Geologic Features

The northwestern extension of the Frohner–Nellie Grant vein was mined through several shafts (presently caved or covered) and adits. Total length of workings must be 1,000–2,000 feet. Vein material on the dump contains chalcedony, quartz, pyrite, galena, and tetrahedrite, and a select sample of this assayed at 0.104 oz/ton gold, 1.64 oz/ton silver, 0.099% copper, 0.45% lead, 0.081% zinc, and 1.49% arsenic.

### 2.16.3 Environmental Condition

The Frohner Lead mine included three collapsed adits and associated waste-rock dumps along with at least three caved shafts. Most of the mine features are located on HNF-administered land. Both the lower two adits have red discharges that infiltrate their respective waste-rock dumps and disappear. At the toe of the lower waste-rock dump, there is a large seepage area. The water from this area forms the headwaters of an unnamed tributary to Lump Gulch. The aerial extent of the mine is approximately one acre. The average elevation of the mine is 7,400 feet.

#### 2.16.3.1 Site Features - Sample Locations

The site was sampled on 10/20/93. Surface-water samples were collected from the two discharging adits, the seeps below the lower waste-rock dump, and from the unnamed stream below the mine. The middle adit (PFLS10M) was discharging about 0.4 gpm, the SC was about 167 µmhos/cm, and the pH was 4.17. The lower adit (PFLS20M) was discharging about 2 gpm, the SC was about 121 µmhos/cm, and the pH was 5.68. The seeps below the lower waste-rock dump (PFLS40M) were flowing about 0.25 gpm, the SC was about 107 µmhos/cm, and the pH was 4.69. At the sample location (PFLS30L), the unnamed tributary was flowing about 3.5 gpm, the SC was about 71 µmhos/cm, and the pH was 7.2. No soil samples were collected. Site features and sample locations are shown in figure 15; photographs are shown in figures 15a and 15b.

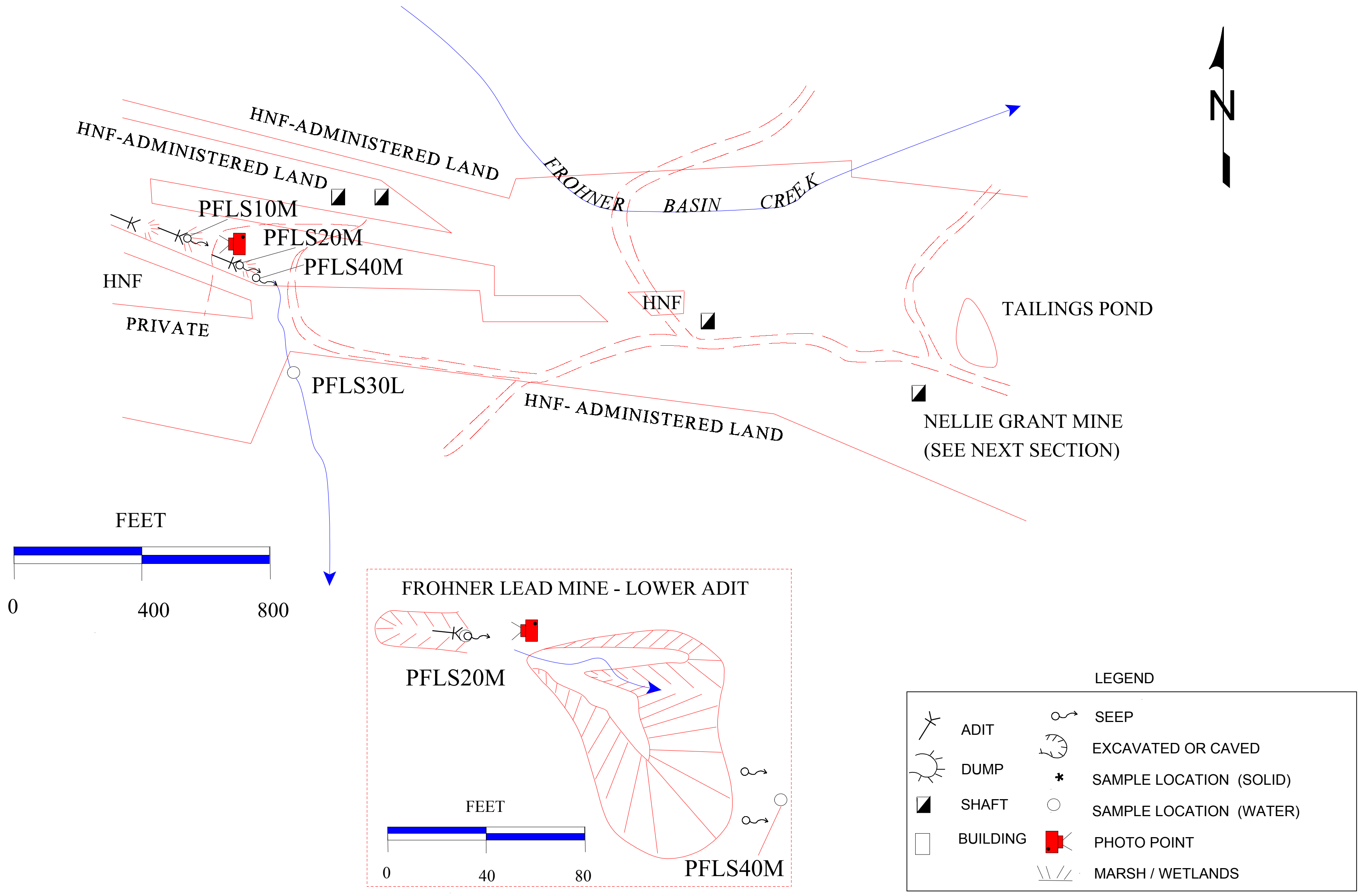



Figure 15. The Frohner Lead mine (6/29/93) is on HNF-administered land. Several adits were discharging water toward Lump Gulch.


Figure 15a. The middle adit of the Frohner Lead mine was discharging water toward the lowermost adit.

Figure 15b. The lowermost adit of the Frohner Lead mine was discharging water to an unnamed stream.

### 2.16.3.2 Soil

The bases of the waste-rock dumps appeared stable. There was no visible impact to soils downslope of the site on HNF-administered land.

### 2.16.3.3 Water

Despite the unavailability of a background sample, the adverse impact to water quality at the Frohner Lead mine is apparent (table 21). The small wetlands area below the lower dump is probably reducing and attenuating some metals such as iron and lead as indicated by the low sulfate concentration; but those metals that remain dissolved in higher pH ranges (such as cadmium and zinc) persist.

Table 21. Water-quality exceedences, Frohner Lead mine.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | **pH** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Middle adit discharge (PFLS10M) | S,A C | | | P,A C | | A,C | S | P | S | C | | | A,C | | | | | | S |
| Lower adit discharge (PFLS20M) | S,C | | | P,A C | | | | | S | | | | A,C | | | | | | S |
| Seeps below lower dump (PFLS40M) | S,C | | | P,A C | | | | | S | | | | A,C | | | | | | S |
| Unnamed stream below mine (PFLS30L) | S,C | | | A,C | | | S | | | | | | A,C | | | | | | |

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

Note: The analytical results are listed in appendix IV.

### 2.16.3.4 Vegetation

Local undisturbed vegetation at the Frohner Lead mine consisted of weeds, grasses, and coniferous trees. In the waste-rock dump areas, the ground was barren to sparsely vegetated. At the base of the waste-rock dumps and the seepage area below the lower waste-rock dump, the areas were well vegetated with marsh grasses and conifers.

2.16.3.5 Summary of Environmental Condition

Soils were not visibly impacted by eroded waste material; the bases of the waste-rock dumps were generally well vegetated. The acid mine discharges at the Frohner Lead mine contained elevated concentrations of several metals. The wetlands area below the mine was acting to attenuate some of the metals, but the concentration of other metals remained high in the small stream below the site.

2.16.4 Structures

There was a small mine building in bad condition and two ore bins on the lower dumps in poor condition.

2.16.5 Safety

The poor condition of the structures may pose a threat to safety; integrity of the shaft coverings is uncertain.

## 2.17 Frohner Mine & Mill and Nellie Grant Mine

2.17.1 Site Location and Access

The Frohner mine (T8N R5W section 15DACA) and mill (T8N R5W section 15DADA) are on private land surrounded by HNF-administered land, approximately 15 miles west of the town of Clancy. The Nellie Grant mine (T8N R5W section 14CCBD), about 1,000 feet west, is also a private holding located within HNF-administered land. A large wetlands called the Frohner Basin Meadows lies adjacent to the Frohner mine and mill and approximately 1,000 feet downhill from the Nellie Grant mine. A large portion of this wetlands has been impacted by tailings from the Frohner Mill site that have washed down Frohner Basin Creek. According to John Koerth of the Department of State Lands Abandoned Mines Reclamation Bureau (AMRB), some of the tailings also may have originated from the Nellie Grant mine. Most of the tailings are on HNF-administered land.

2.17.2 Site History - Geologic Features

The Frohner mine explored a section of the northwest-striking vein system that extends more than a mile from the Nellie Grant to the Frohner Lead (previous section). This zone dips 60°SW, is up to 40 feet wide and contains much arsenopyrite (Becraft *et al.* 1960), as well as pyrite, galena, and sphalerite. At least 2,000 feet of workings are present, and production 1928–1954 was 161 oz of gold, 7,329 oz of silver, 2,305 pounds of copper, 91,503 pounds of lead, and 26,000 pounds of zinc from 1,917 tons of ore (Roby *et al.* 1960). Water emerges from the caved adit and forms gray terraces before entering Frohner Creek.

Little is known about the history of the Frohner mill, except that an original gravity mill was replaced by a flotation mill built to retreat the gravity tailings (Roby *et al.* 1960). In 1993, there did appear to be two distinct types of tailings: an upper area of barren gray to red-brown clays, and a lower, sparsely vegetated area of coarse sand to gravel sized pieces of quartz-pyrite vein that may be untreated gravity tailings. Assay results support this theory: upper tailings results were less than 0.006 oz/ton gold, 0.10 oz/ton silver, 0.013% copper, 0.04% lead, 0.047% zinc, and less than 0.04% arsenic; lower tailings results were 0.110 oz/ton gold, 0.98 oz/ton silver, 0.041% copper, 0.26% lead, 0.821% zinc, and 0.53% arsenic. Drilling would be necessary to estimate volumes.

The Nellie Grant mine was a large disturbance that was "reclaimed" in 1993. Workings appeared to be extensive. Becraft *et al.* (1963) provided the following information. A N72°W 83°SW vein, probably the extension of the Frohner vein, was mined. The mineralization is typical of the Boulder Batholith: quartz, pyrite, sphalerite, chalcopyrite, and galena. Production 1948–1957 was 1,057 tons of ore yielding 293 oz of gold, 10,272 oz of silver, 3,481 pounds of copper, 216,242 pounds of lead, and 47,156 pounds of zinc.

### 2.17.3 Environmental Condition

The Frohner mine included a collapsed adit with a large waste-rock dump. The Frohner mill consisted of the remnants of a large mill building with a large volume of tailings that extended down the hillside into Frohner Basin Creek. The creek began on HNF-administered land northwest of the sites and, as it flowed past the Frohner mine, was impacted by a discharge from the adit as well as seeps that emerged from the waste-rock dump. The creek also came into contact with mineralized dump material along its banks.

At the Frohner Mill, just downstream, the creek flowed past several hundred feet of streamside tailings. During heavy rainfall and spring runoff events, the tailings are washed into the creek and eventually end up in the Frohner Meadows, approximately three-quarters of a mile downstream. Within this area, the creek came into contact with tailings that had washed down from the Frohner Mill. The tailings were distributed along the banks as well as over a large portion of the flood plain. Red seeps emerged from the tailings and drained into the creek.

The aerial extent of the mine was approximately one acre. The aerial extent of the mill was also approximately one acre. The average elevations of the mine and mill are 6,980 and 6,920 feet, respectively.

The Nellie Grant mine included a shaft, an adit, waste-rock dumps, several mine buildings, a mill, and a drained tailings pond. It should be noted that on the day of the initial visit (10/15/93), a contractor for the DSL's Abandoned Mines Reclamation Bureau was on site knocking down structures, and filling and sealing the shaft and adit; this description of the site is probably outdated. The aerial extent of the Nellie Grant mine is approximately seven acres. The average elevation of the mine is 6,880 feet. Just beyond the point where the creek crosses onto private land, it was joined by a discharge from the mine. This discharge originated from the remnants of the adit that had been plowed under by the AMRB contractor. The discharge descended over barren, muddy waste rock and tailings before plunging down the hillside into the basin. The contractor had placed bails of hay along the gully in an effort to control erosion; however, sediment was continuing to be washed downhill. Three monitoring wells had been installed on the private land at the foot of the hill, before the mine discharge reaches the wetlands.

A short distance downstream from its confluence with the Nellie Grant discharge, Frohner Basin Creek was joined by the East Branch of Frohner Basin Creek. The East Branch originated from a beaver pond on the northernmost end of the Frohner Basin Meadows. The pond was fed by two small unnamed streams. The western stream may or may not be impacted by seeps from the Frohner Mill tailings; the eastern stream appeared pristine.

The Frohner Basin Meadows are an extensive and complex wetlands area in the bottom of the drainage, east of the mines and mills. As noted previously, a large portion of the meadows has been covered with tailings from the Frohner Mill. Most of the tailings were obscured by swamp and beaver ponds, but there were several well exposed areas near the marsh's upper end. Most of the tailings were located on HNF-administered land. The tailings covered an area of approximately eight acres. The average elevation of the basin is 6,600 feet.

After exiting the northern meadow, Frohner Basin Creek flowed into the southern Frohner Basin Meadow. The southern meadow is drained by two small streams, one on the south end and the other on the east. The southern stream drained directly into Lump Gulch. The eastern stream joined Lump Gulch farther downstream in an area of wetlands, beaver ponds, and a human-made dam. Most of the water from the Lump Gulch pond was directed into a water diversion trench that probably leads to Park Lake, one mile to the northeast. The rest of the water continued down the original Lump Gulch drainage to the east.

#### 2.17.3.1 Site Features - Sample Locations

Several surface-water and soil samples were collected throughout Frohner Basin to assess the relative impact of the mines and mills. Samples were collected on 10/19/93. Surface-water samples were collected from Frohner Basin Creek upstream of the Frohner mine and mill (PFRS10L), downstream of the Frohner mine and mill and Nellie Grant mine upstream of the wetlands (PNGS10L), upstream of the wetlands on the east (PNGS20L) and west (PNGS30L) branch tributaries, a seep on the west side of the wetlands (PNGS40L), and from the east (PNGS50L) and west (PNGS60L) branch of the stream flowing through the wetlands. Additional surface-water samples were collected near the confluence of Frohner Basin Creek and Lump Gulch. A sample was collected above the confluence on Frohner Basin Creek (PNGS80M), above the confluence with Lump Gulch (PNGS70L), and below the confluence with Lump Gulch (PNGS90L).

A composite soil sample (PNGD10H) was collected from an area at the upper end of the wetlands where tailings and soil were in contact with the stream. A second composite sample (PNGD20H) was collected in the lower portion of the wetlands, again where tailings and soil were in contact with the stream. Site features and sample locations are shown in figure 16; photographs are shown in figures 16a ,16b, 16c, and 16c.

### 2.17.3.2 Soil

The concentrations of arsenic, copper, lead, and zinc far exceeded phytotoxic limits in both soil samples (table 22). Stressed and dead vegetation was evident in the areas where the samples were collected as well as several other areas. The extent and phytotoxicity of the tailings is probably widespread throughout Frohner Meadows.

Table 22. Soil sampling results, Frohner basin (mg/kg).

| **Sample Location** | **As** | **Cd** | **Cu** | **Pb** | **Zn** |
|---|---|---|---|---|---|
| Tailings / soil in upper wetlands (PNGD10H) | 6800[1,2] | 4.4[1] | 214[1,2] | 9020[1,2] | 538[1,2] |
| Tailings / soil in lower wetlands (PNGD20H) | 3100[1,2] | 12[1] | 333[1,2] | 2150[1,2] | 1290[1,2] |

(1) Exceeds one or more Clark Fork Superfund background levels (table 3)
(2) Exceeds phytotoxic levels (table 3)

### 2.17.3.3 Water

The high concentration of metals in the tailings/soils is well reflected in the water quality and exceedences of MCLs and ALSs throughout Frohner basin (table 23). Of particular note is the seep flowing into the wetlands (PNGS40L). This seep probably represents ground-water conditions in much of the wetlands. The field-Eh at this location was much lower than those measured at other sample sites and suggested reducing conditions. The reducing nature of the water from the seep is further evidence by a relatively low sulfate concentration. The poor quality of the water downstream of the wetlands indicates the limitations of the wetlands to ameliorate the metals loading to Frohner Basin Creek.

No additional waste material associated with mining was observed upstream on Lump Gulch, yet those waters exhibited elevated concentrations of several metals. Conversely, the east and west branch of the unnamed stream flowing into the wetlands exhibited low concentrations of metals, and probably represents background concentrations.

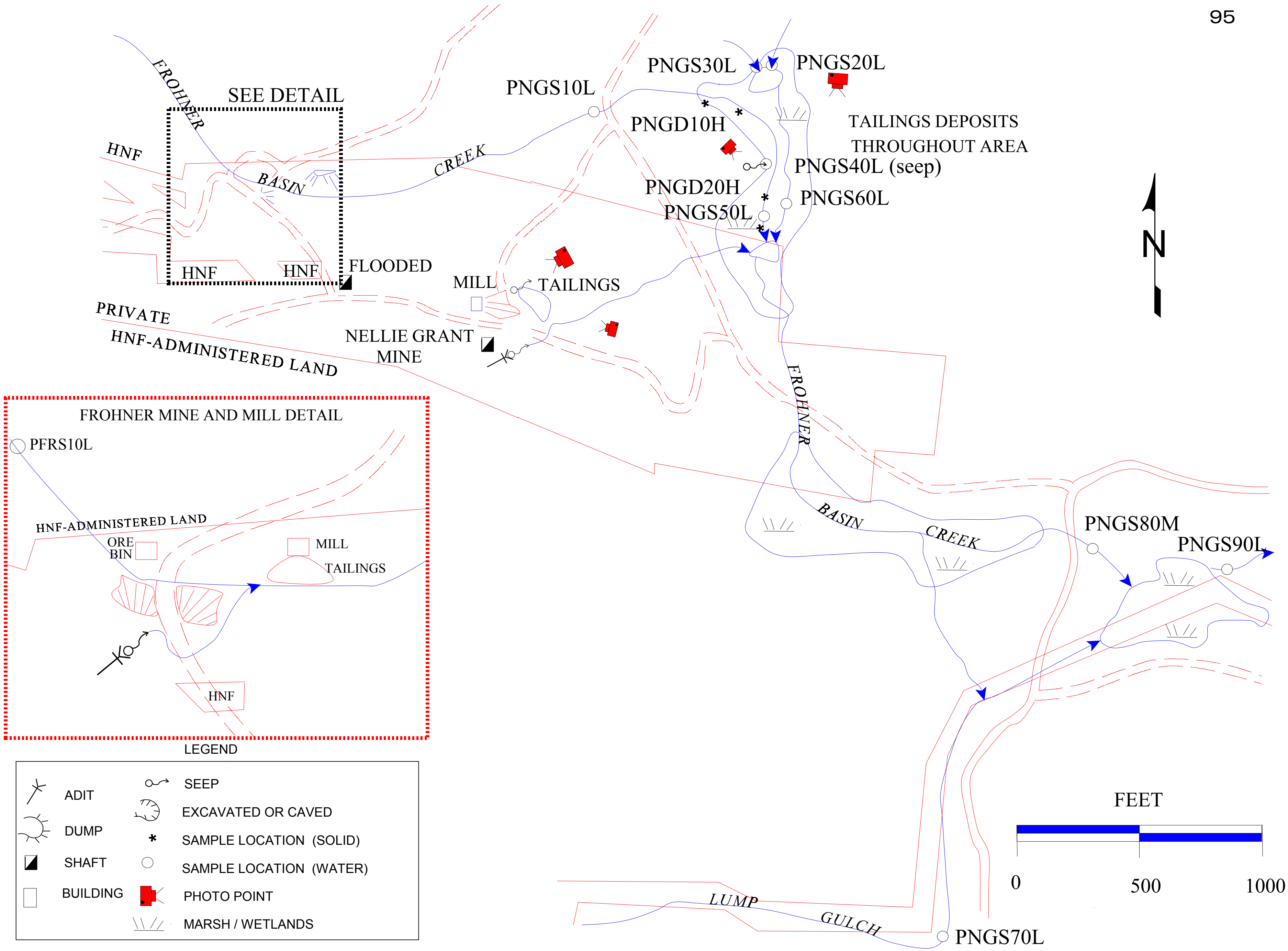



Figure16. The Frohner mine/mill and the Nellie Grant mine are on private land (10/15/93). Samples were collected on HNF-administered land.

Figure 16a. Reclamation of the Nellie Grant mine included sediment control and adit discharge control.

Figure 16b. The discharge from the base of Nellie Grant waste-rock dump flowed into the nearby stream.


Figure 16c. Frohner Basin Meadows has been visibly impacted by sediment and poor quality water from upstream mines (right).

Figure 16d. Metals-laden seeps in Frohner Basin Meadows were flowing into the creek.

Table 23. Water-quality exceedences, Frohner basin.

| Sample Site | Al | As | Ba | Cd | Cr | Cu | Fe | Pb | Mn | Hg | Ni | Ag | Zn | Cl | F | $NO_3$ | $SO_4$ | Si | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frohner Basin Cr - Upstream (PFRS10L) | | | | | | | | | | | | | | | | | | | |
| Frohner Basin Cr. - Upstream of wetlands (PNGS10L) | S,C | | | A,C | | | S | C | S | | | | A,C | | | | | | S |
| East branch - Upstream (PNGS20L) | S | | | | | | | | | | | | | | | | | | |
| West branch - Upstream (PNGS30L) | | | | | | | | | | | | | | | | | | | |
| Seep in wetlands - (PNGS40L) | S | P,C | | C | | A,C | S | P,A C | S | | | | A,C | | | | | | |
| East branch - Downstream (PNGS60L) | S | | | | | | | | | | | | | | | | | | |
| West branch - Downstream (PNGS50L) | S,C | | | P,A C | | | | C | S | | | | A,C | | | | | | |
| Frohner Basin Cr. - above confluence (PNGS80M) | S | | | P,A C | | | | | S | | | | A,C | | | | | | |
| Lump Gulch - above confluence (PNGS70L) | S | | | P,A C | | | | | | | | | A,C | | | | | | |
| Lump Gulch - below confluence (PNGS90L) | S | | | C | | | S | | S | | | | A,C | | | | | | |

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

Note: The analytical results are listed in appendix IV.

## 2.17.3.4 Vegetation

Prior to reclamation, local undisturbed vegetation at the Nellie Grant mine consisted of weeds, grasses, and coniferous trees. AMRB contractors and loggers had cleared the property, and most of the ground was barren. In the waste-rock dump and mill pond areas that had not been reclaimed, the ground was barren.

The Frohner Basin Meadows were vegetated with wetlands grasses, willows, and coniferous and deciduous trees. As noted, there are several large areas in the northern meadow that are barren and tailings were exposed.

#### 2.17.3.5 Summary of Environmental Condition

The adverse impact to surface water and soils from waste generated by the mines and mills in Frohner basin are significant and widespread. Although the data was collected during reclamation activities, the data probably reflect "normal" conditions for the basin. The attenuation capacity of the wetlands has been exceeded as evidenced by poor water quality in Lump Gulch below the site.

### 2.17.4 Structures

There were several structures observed at the Frohner mine and mill and at the Nellie Grant mine, all on private land. No structures were observed on HNF-administered land.

### 2.17.5 Safety

No safety concerns associated with mining or milling activities were identified on HNF-administered land.

## 2.18 Yama Group Mine

### 2.18.1 Site Location and Access

The Yama Group (T8N R5W section 13DDCA) is on private land within HNF-administered land,  approximately twelve miles west of the town of Clancy. The site is approximately one mile by trail below the Park Lake Campground and about one mile downstream of Frohner Basin (Frohner Lead, Frohner, and Nellie Grant mines). The site also is accessible by way of a very primitive road along the main Lump Gulch road from Clancy.

### 2.18.2 Site History - Geologic Features

Three adits from 90 to 500 feet long were used to investigate a N80°E 70–80°SE vein five to six feet wide of quartz, sphalerite, and galena (Roby *et al.* 1960). Ore reportedly averaged 8% lead and 8% zinc (Roby *et al.* 1960).

## 2.18.3 Environmental Condition

The Yama Group includes two collapsed adits and a waste-rock dump associated with the lower adit. All of the mine workings were on private land. The lower mine workings were about 200 feet away from the stream and there were no visible seeps or discharges. However, there was a small channel that ran from the toe of the lower waste-rock dump to Lump Gulch. During heavy rainfall and spring runoff events, water from the dump probably flows down this channel and into the stream. On the day of the site visit (10/14/93), the runoff channel was dry.

The aerial extent of the mine is approximately a half acre. The average elevation of the mine is 5,960 feet.

### 2.18.3.1 Site Features - Sample Locations

The site was sampled on 6/20/94; because the entire disturbed area, including the soil wash area, was on private land, sampling was restricted to Lump Gulch upstream and downstream on HNF-administered land. At the upstream sample location (LYAS20L), the stream was flowing about 570 gpm, the SC was about 72 µmhos/cm, and the pH was 6.41. At the downstream sample location, Lump Gulch was flowing about 1,100 gpm, the SC was about 78 µmhos/cm, and the pH was 7.48. As noted, the Yama Group is about one mile downstream of Frohner basin. No soil samples were collected. Site features and sample locations are shown in figure 17; photographs are shown in figures 17a and 17b.

### 2.18.3.2 Soil

Although it was visibly apparent that waste material had been washed into the stream just below the waste-rock dump, no waste material was found along the stream below the site on HNF-administered land. There was no evidence of adverse impact to stream side soils on HNF-administered land.

### 2.18.3.3 Water

In general, the concentration of dissolved metals were higher in the downstream sample. The concentration of aluminum exceeded the secondary MCL at both sample locations (table 24), but, again, was slightly higher in the downstream sample. It is interesting to note, however, that the pH was significantly lower in the upstream sample. This was also the case during the initial visit on 10/14/93.

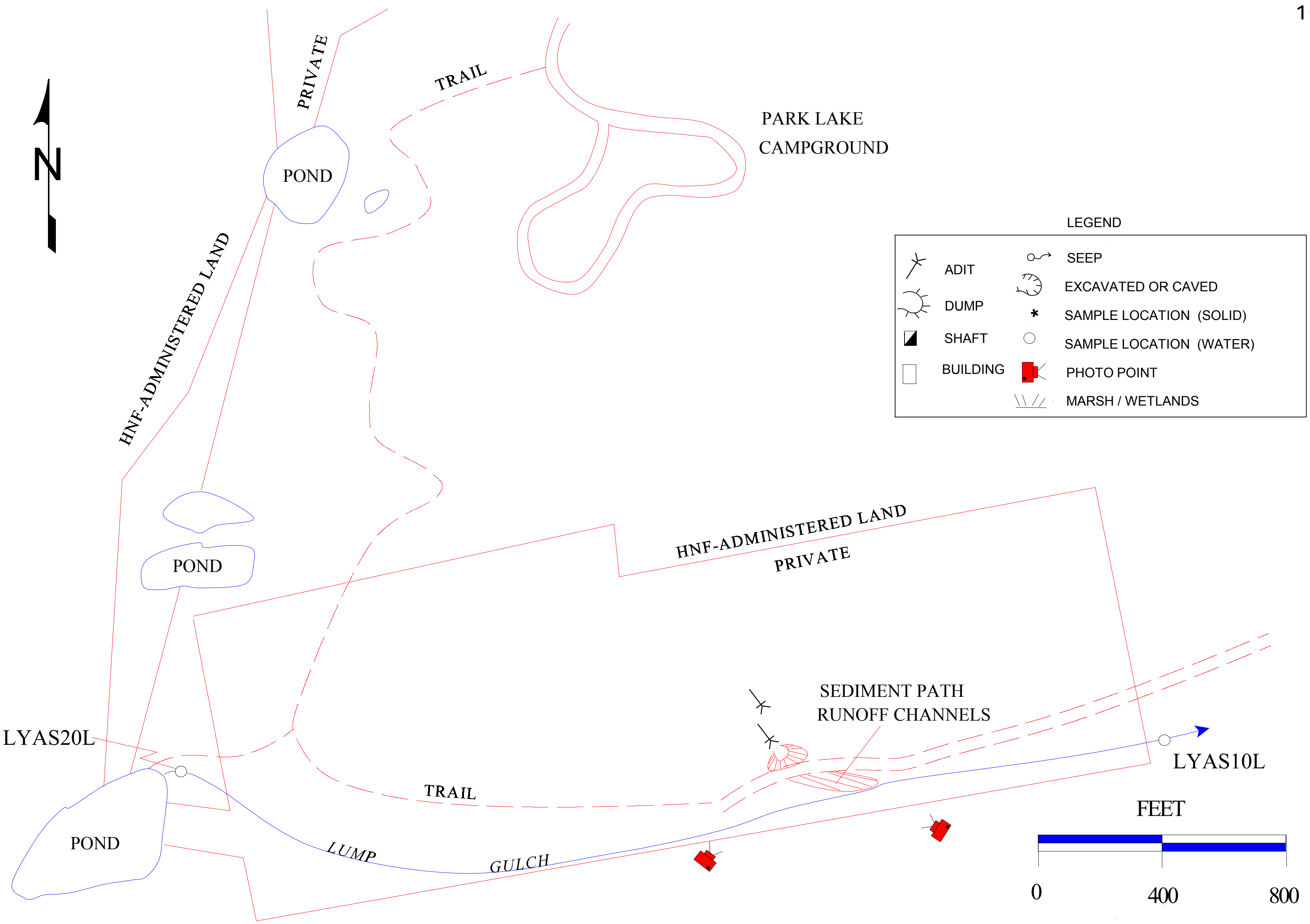



Figure 17. The Yama Group mine (10/14/93) is on private land adjacent to Lump Gulch. There were no discharges for the site, but waste material had been washed into the creek.

Figure 17a. The Yama Group mine waste-rock dump was on private land adjacent to Lump Gulch above the Park Lake Campground.

Figure 17b. The sediment path below the Yama Group mine extended from the base of the dump to Lump Gulch.

Table 24. Water-quality exceedences, Yama Group.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | **pH** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lump Gulch -Upstream (LYAS20L) | S | | | | | | | | | | | | | | | | | | S |
| Lump Gulch - Downstream (LYAS10L) | S | | | | | | | | | C | | | | | | | | | |

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

Note: The analytical results are listed in appendix IV.

### 2.18.3.4 Vegetation

Local undisturbed vegetation at the Yama group consisted of weeds, grasses, and coniferous trees. In the waste-rock dump area, the ground was barren to sparsely vegetated.

### 2.18.3.5 Summary of Environmental Condition

Dissolved metals concentrations generally increase downstream of the Yama group; only pH showed a significant improvement. As with other lead/zinc mines, the additional dissolved zinc in the downstream sample is not unexpected. The soil-waste material mixing area below the waste-rock dump is probably a significant factor in metals loading to Lump Gulch during periods of runoff.

## 2.18.4 Structures

The remnants of several cabins and possibly a powder shed were observed on private land. No structures associated with the Yama Group were observed on HNF-administered land.

## 2.18.5 Safety

No safety concerns were identified on HNF-administered land.

## 2.19 White Pine, B&G East, and Newburg Mines

### 2.19.1 Site Location and Access

The Newburgh, White Pine, and B & G East Mines (T8N RW2 section 29CCCD) are private holdings located within HNF-administered land, approximately six miles southeast of Clancy in the Elkhorn Mountains. Access to the site is by way of improved road along Warm Springs Creek and then primitive road along Middle Fork Warm Springs Creek.

### 2.19.2 Site History - Geologic Features

Two adits and two shafts with 1,000–1,500 feet of total workings compose the B & G mine. According to Roby *et al.* (1960), a vertical N80°E quartz-pyrite-arsenopyrite-cerrusite vein from one to six feet wide was mined. Production figures for 1910, 1934, and 1936 totalled 80 oz of gold, 1,430 oz of silver, 1,832 pounds of copper and 18,756 pounds of lead from 85 tons of ore, so gold was unusually high grade for a Boulder Batholith–related deposit. Smedes (1966) reported radioactivity at the dumps.

The Newburgh is a large mine on the east edge of the Boulder Batholith with over one mile of workings (Roby *et al.* 1960); however, little information is available on it. Presumably, a typical east-west Boulder Batholith vein of pyrite, galena, chalcopyrite, and arsenopyrite was mined, which contained considerable gold. Production figures show 10,238 tons of ore contained 12,365 oz of gold, 95,560 oz of silver, 92,602 pounds of copper, and 508,689 pounds of lead (Roby *et al.* 1960). Dumps were also processed at the nearby Warm Springs Mill and yielded about 0.1 oz/ton gold and 0.5 oz/ton silver (Roby *et al.* 1960).

The White Pine explores a 1–7-foot-wide, N85°–90°W-trending, near-vertical area of bleached and sericitized quartz monzonite enclosing stringers of pyrite, sphalerite, galena, arsenopyrite, chalcopyrite, and quartz (Smedes 1966). Production in the period from 1908 to 1929 was 36 oz of gold, 4,426 oz of silver, 928 pounds of copper, 82,894 pounds of lead, and 52,196 pounds of zinc from 255 tons of ore (Roby *et al.* 1960). This vein is similar and parallel to the Newburgh vein to the north.

### 2.19.3 Environmental Condition

The B&G mine included a two caved adits, one caved shaft, and one open shaft with associated waste-rock dumps. All of the workings were on private land. The aerial extent of the mine is less than a tenth of an acre. The average elevation of the site is 5,800 feet.

The Newburgh mine is about one-quarter mile east of the B&G mine and included an open adit, two large, high-sulfide waste-rock dumps, and a large Quonset hut. Most of the mine workings were located on private land; a small portion of this mine may be on HNF-administered land, but its boundaries could not be determined in the field. The aerial extent of the mine is approximately 20 acres. Its average elevation is 5,520 feet.

The White Pine mine is several hundred feet uphill from the Newburgh mine, and consisted of three collapsed adits, several high-sulfide waste-rock dumps, a partially collapsed cabin, and an ore bin. All of the workings were on private land. The aerial extent of the mine is approximately seven acres. The average elevation of the site is 5,800 feet.

Surface runoff from the Newburgh and White Pine Mines drained into an unnamed tributary to the Middle Fork of Warm Springs Creek. This unnamed tributary originated from a spring and a small marsh on the mountainside above the White Pine mine. As the tributary descended past the White Pine mine, it flowed over waste-rock materials and was fed by small discharges from the lower two adits. The discharge from the lowermost adit supported a healthy crop of green slime. At the Newburgh mine, there were two discharges that flowed into the creek. One discharge originated from the adit, the other from the base of the lower waste-rock dump. Both discharges were stained red with ferric hydroxides. The B & G East mine was on a dry hillside west of the other two mines. Surface-runoff from this site drained to the north, toward the Middle Fork of Warm Springs Creek. At this site, there was a flooded shaft. The depth to water is visually estimated to be 20 to 30 feet. No surface-water discharges originated from this site, and no seeps were observed on the hillside below.

### 2.19.3.1 Site Features - Sample Locations

The site was sampled on 6/23/94; because the workings of all three mines were on private land, sampling was restricted to collecting surface-water samples upstream and downstream of the mines. The upstream sample (PWPS10L) was collected from the unnamed tributary on HNF-administered land above the White Pine mine. At the sample location, the stream was flowing about 15 gpm, the SC was about 109 µmhos/cm, and the pH was 6.73. The downstream sample (PWSS10M) was collected from Middle Fork Warm Springs Creek on HNF-administered land about 1,200 feet downstream of the Newburg mine. At this sample location the stream was flowing about 550 gpm, the SC was about 177 µmhos/cm, and the pH was 7.58. No soil samples were collected. Site features and sample locations are shown in figure 18; photographs are shown in figures 18a and 18b.

### 2.19.3.2 Soil

Waste material at all three mines were well within private-land boundaries. There was no visible evidence of impact to soils on HNF-administered land below the three mines.

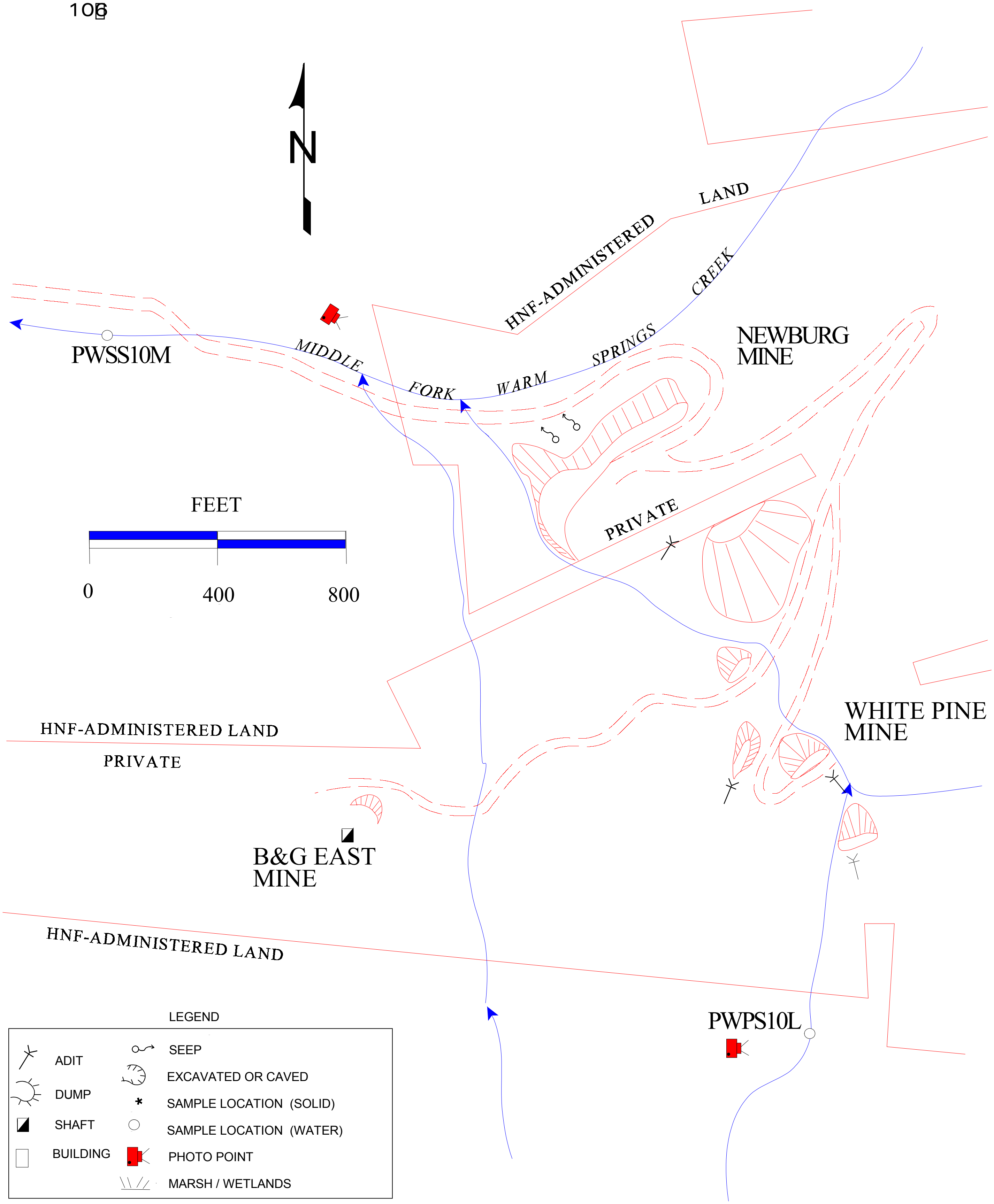



Figure 18. The White Pine, B&G, and Newburg mines (6/8/94) are on private land in an unnamed tributary of Middle Fork Warm Springs Creek. Samples were collected on HNF-administered land.

Figure 18a. Surface-water sample locations at the White Pine, B&G, and Newburg mines were on HNF-administered land upstream (shown) and downstream.


Figure 18b. The adit discharge of the Newburg mine flowed into Middle Fork Warm Springs Creek.

2.19.3.3 Water

The concentrations of dissolved metals at the upstream location were generally low and all were below MCLs and ALSs. Conversely, in the downstream sample, the concentrations of manganese and zinc exceeded standards (table 25). The concentration of other dissolved metals were generally higher in the downstream sample as well. The relative contribution of each mine could not be determined without more detailed sampling on private land. Middle Fork Warm Springs Creek upstream is private land, and there may be additional loading from unknown workings in that drainage as well.

Table 25. Water-quality exceedences, B&G, White Pine, and Newburg mines.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | **pH** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unnamed Cr. - Upstream (PWPS10L) | | | | | | | | | | | | | | | | | | | |
| M.F. Warm Springs Cr. - downstream (PWSS10M) | | | | | | | | | S | | | | A,C | | | | | | |

Exceedence codes:

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

The analytical results are listed in appendix IV.

2.19.3.4 Vegetation

Local undisturbed vegetation at the three mines consisted of grasses and coniferous trees. Alders were found along the banks of the unnamed tributary and Middle Fork of Warm Springs Creek. The waste-rock dumps were generally barren of vegetation.

2.19.3.5 Summary of Environmental Condition

Based on limited sampling, it is likely that at least one of the three mines is contributing a significant amount of dissolved metals to Middle Fork Warm Springs Creek. The concentration of dissolved-metals increased by 2 to 10 times those found in the upstream sample. The waste-rock dumps associated with all three sites were contained well inside the private–HNF-administered land boundary.

### 2.19.4 Structures

There were several structures on private land, but no structures were observed on HNF-administered land.

### 2.19.5 Safety

No safety concerns were identified on HNF-administered land.

## 2.20 Warm Springs Tailings

### 2.20.1 Site Location and Access

The Warm Springs tailings (T8N R2W section 20CADD) are on HNF-administered land along Middle Fork Warm Springs Creek, approximately five miles southeast of Clancy. Access to the site is by way of an improved road along Warm Springs Creek and a primitive road about one mile along Middle Fork Warm Springs Creek.

### 2.20.2 Site History - Geologic Features

The flotation mill operated from 1934 until 1939 (Roby *et al.* 1960) and processed high-sulfide ore and dump material from the Newburgh and White Pine mines (previous section). Two tailings composite samples had similar metals values: 0.0380–0.0165 oz/ton gold, 7.2–9.6 ppm silver, 120–159 ppm copper, 970–1560 ppm lead, 334–910 ppm zinc, and 3,170–4,840 ppm arsenic.

### 2.20.3 Environmental Condition

The Warm Springs tailings extended for more than one quarter mile along the Middle Fork of Warm Springs Creek. The site included four tailings impoundment dams and a wooden underdrain structure at the upper two dams. All of the tailings were on HNF-administered land. Numerous seeps and springs emerged from the tailings and were flowing into the creek. Many of the seeps area were stained red with ferric hydroxides. Tailings were being actively eroded along the entire course of the creek as it passed through the site. The erosion was especially bad near the second dam where the creek had cut a deep breach through the tailings material.

The aerial extent of the tailings is approximately eight acres. The average elevation of the site is 5,280 feet.

### 2.20.3.1 Site Features - Sample Locations

The site was sampled on 7/26 and 7/27/94. Surface-water samples were collected from Middle Fork Warm Springs Creek upstream of the tailings (PWSS10M), from seeps and an unnamed tributary on the north side of the flood plain above the first dam (PWSS20M) and (PWSSB0L), Middle Fork Warm Springs Creek below the first dam (PWSS50M), seeps and springs on the north and south side of the tailings above the second dam (PWSS60M), (PWSS70M), and (PWSS80M), from Middle Fork Warm Springs Creek below the second dam (PWSS90M) and downstream of the lower dam (PWSSA0M). An additional sample of Middle Fork Warm Springs Creek was collected about one mile downstream of the lower dam (PWSSC0M).

Soil samples were collected where soil and tailings have been washed into the creek above the first dam (PWSD10M), along an unnamed stream flowing in from the south (PWSD30M), where tailings and soil have been washed into the creek above the second dam (PWSD20M), and long Middle Fork Warm Springs Creek below the second dam (PWSD40L). Site features and sample locations are shown in figure 19; photographs are shown in figures 19a and 19b.

### 2.20.3.2 Soil

The concentrations of cadmium were below the method detection limit in all four samples, the concentrations of copper were below the Clark Fork background levels except for the soils along the tributary flowing into the second dam. Cadmium, copper, lead and zinc concentrations were generally well below phytotoxic limits. Arsenic concentrations were well above the 100 mg/kg phytotoxic limit in all four samples (table 26).

Table 26. Soil sampling results, Warm Springs mill tailings (mg/kg).

| Sample Location | As | Cd | Cu | Pb | Zn |
|---|---|---|---|---|---|
| Tailings/soil above first dam (PWSD10L) | 280[1,2] | 0.32 | 6.41 | 39.9[1] | 32.8 |
| Tailings/soil near second dam (PWSD20M) | 350[1,2] | 0.98[1] | 10.6 | 86.8[1] | 81.9[1] |
| Tailings/soil along unnamed tributary (PWSD30M) | 380[1,2] | 0.63[1] | 18.9[1] | 102[1] | 70.8[1] |
| Tailings/soil below second dam (PWSD40L) | 250[1,2] | 0.49[1] | 6.46 | 52.2[1] | 25.0 |

(1) Exceeds one or more Clark Fork Superfund background levels (table 3)
(2) Exceeds phytotoxic levels (table 3)

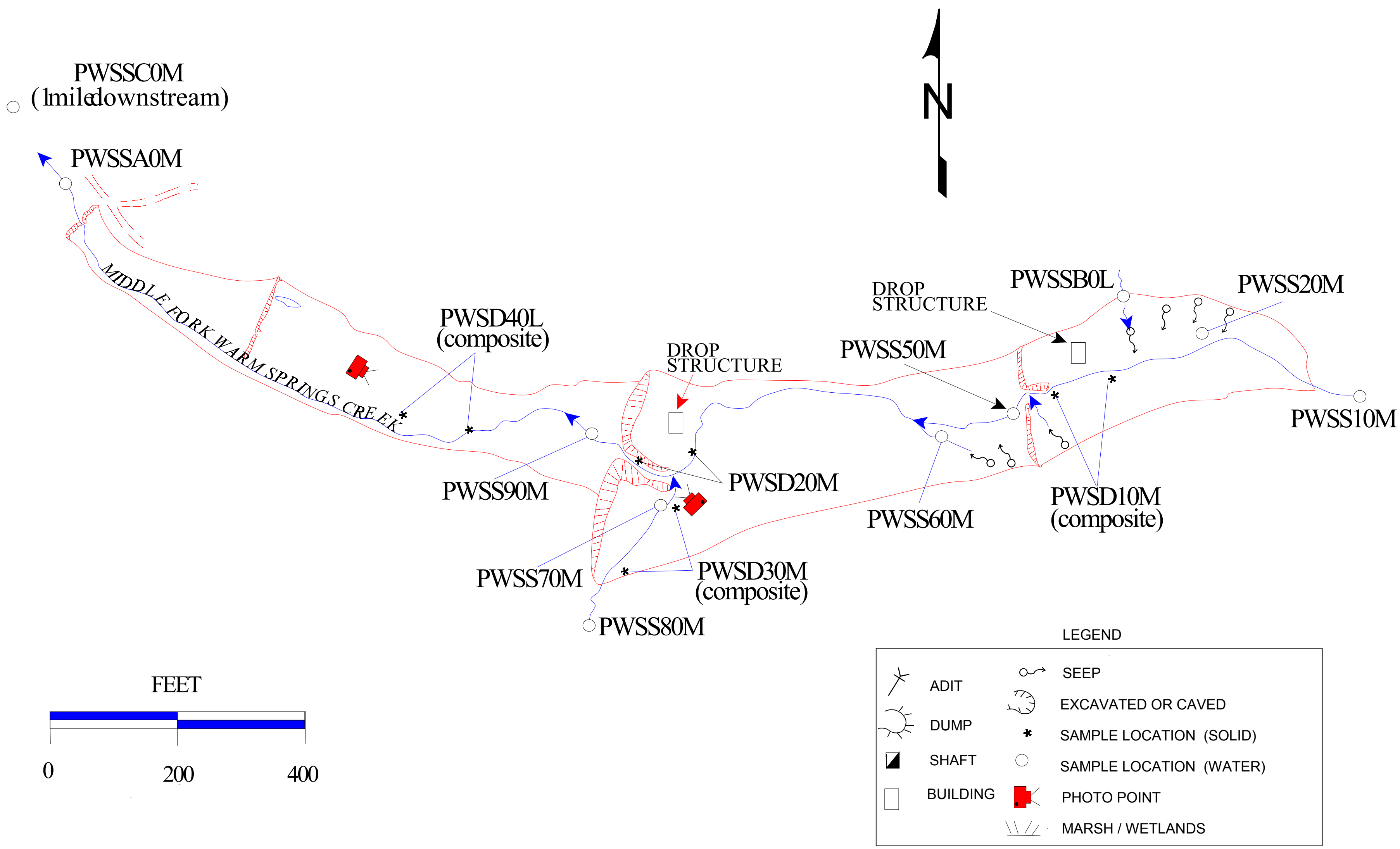



Figure 19. The Warm Springs mill tailings (8/18/93) are on HNF-administered lands along the Middle Fork Warm Springs Creek. Soil and water samples were collected throughout the area.

Figure 19a. The second tailings dam of the Warm Springs tailings was the largest. The dam had been breached by the stream.

Figure 19b. Tailings along Middle Fork Warm Springs Creek were several feet thick in some areas.

2.20.3.3 Water

The chemistry of the waters near the Warm Springs tailings reflect the geothermal source as well as the mine-waste source. All of the waters were warmer than 10$^{o}$C and several of the springs were above 17$^{o}$C. A geothermal source is the likely explanation for the relatively high concentration of fluoride in the springs on the north side of the drainage (table 27); these sites also had the highest water temperatures. The impact to water quality by dissolution of metals from tailings is difficult to distinguish. Probably the best indication is the concentration of zinc. Only those waters that had been in contact with tailings exceeded the aquatic life standard; the concentration of zinc at the three “upstream” locations was an order of magnitude less. The exception is the sample location above the tailings. There may have been tailings above this location or influence from the B&G, White Pine, and Newburg mines upstream.

Table 27. Water-quality exceedences, Warm Springs 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** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M.F. Warm Springs Cr - Upstream (PWSS10M) | | | | | | | | | | | | | A,C | | | | | | |
| Seeps above first dam (PWWS20M) | S,C | P | | | | | | C | | | | | | | S | | | | |
| Unnamed tributary - Upstream (PWSSB0L) | | | | | | | | | | | | | A,C | | P,S | | | | |
| M.F, Warm Springs Cr. -Downstream of first dam (PWSS50M) | | | | | | | | | | | | | A,C | | | | | | |
| Spring below first dam (PWSS60M) | | P | | | | | S | | | | | | A,C | | | | | | |
| Unnamed tributary above second dam (PWSS80M) | | | | | | | | | | | | | | | | | | | |
| Unnamed tributary at second dam (PWSS70M) | | | | | | | | | | | | | | | | | | | |
| M.F. Warm Springs Cr. -Downstream of second dam (PWSS90M) | | | | | | | | | | C | | | A,C | | | | | | |

Table 27. continued.

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M.F. Warm Springs Cr. -Downstream of fourth dam (PWSSA0M) | | | | | | | | | | | | | A,C | | | | | | |
| M.F. Warm Springs Cr. - Downstream (PWSSC0M) | | | | | | | | | | C | | | A,C | | | | | | |

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

Note: The analytical results are listed in appendix IV.

### 2.20.3.4 Vegetation

Local undisturbed vegetation at the site consisted of riparian grasses, willows, and coniferous trees. With the exception of the area surrounding the second dam, most of the tailings deposits were densely vegetated with grasses and brush. Near the second dam, the vegetation was sparse.

### 2.20.3.5 Summary of Environmental Condition

The concentration of arsenic is quite high in the soil/tailings near the Middle Fork of Warm Springs Creek. This is reflected in the surface-water samples collected nearby. The geothermal origin of the waters in the Warm Springs tailings area somewhat mask the impact to water quality by tailings leaching. The presence of zinc in the colder waters that had been in contact with tailings provides some measure of impact.

## 2.20.4 Structures

There were wooden drop structures behind the first and second dam. These structures, in fair condition, appeared to serve as water drains for the impounded tailings.

## 2.20.5 Safety

No safety concerns were identified for this site, although the drop structures may become unstable in the future.

**2.21 Badger Mine**

2.21.1 Site Location and Access

The Badger mine (T8N R3W section 24ABBB) is on HNF-administered land, approximately four miles southeast of Clancy. Access to the site is by way of improved road along Warm Springs Creek and North Fork Warm Springs Creek. The mine is about 700 feet off the main the main road.

2.21.2 Site History - Geologic Features

Roby *et al.* (1960) reported that the Badger mine operated occasionally from 1915 to 1947 and produced 195 tons of ore from which 72 oz of gold, 2,898 oz of silver, 915 pounds of copper, 49,740 pounds of lead, and 469 pounds of zinc were recovered. This indicates a larger operation than the Badger described herein, which consists of two caved adits; each only a couple hundred feet long. At this site, altered (to quartz, sericite, and pyrite) quartz monzonite contains disseminated molybdenite and is cut by quartz-pyrite veinlets.

2.21.3 Environmental Condition

The Badger mine consisted of two collapsed adits and three coalescing waste-rock dumps. The waste-rock dumps contain pyrite and good specimens of molybdenite. Based on the 1:24,000 ownership map, all of the mine workings are on HNF-administered land; however, at the time of the visit there was a locked gate across the access road and an electric fence surrounded the site. The mine is within a small unnamed tributary to the North Fork of Warm Springs Creek. At the time of the initial visit, the unnamed creek entered the site from the north, flowed around the east side of the waste-rock dumps, and then down alongside an old haul road. The creek had cut a gully 1–2 feet deep through some of the waste-rock material on the east side of the waste-rock dump.

About two hundred feet below the site, the creek was joined by a discharge that originated from the lower adit. At the adit, this discharge was stained orange with ferric hydroxides. Farther down the drainage, the creek sank into a marshy area and disappeared. At the time of the initial visit, water re-surfaced as a spring on north side of the main road, and then flowed a short distance into the North Fork of Warm Springs Creek. This spring was dry when the site was sampled. The aerial extent of the mine is less than a quarter acre. The average elevation of the site is 5,240 feet.

2.21.3.1 Site Features - Sample Locations

Samples were collected on 7/24/94. As noted, the ownership map indicated that the site was on HNF-administered land, but the access road was blocked by a locked gate, suggesting private ownership or an active permit. Sampling was therefore restricted to North Fork Warm

Springs Creek below the site. A surface-water sample (WBGS70M) was collected from North Fork Warm Springs above its confluence with the tributary where the stream flowed about 140 gpm, the SC was about 198 µmhos/cm, and the pH was 7.86. A second sample (WBGS60M) was collected downstream of the confluence where the stream flowed about 110 gpm, the SC was about 215 µmhos/cm, and the pH was 7.52. The tributary below the mine was dry at the time of sampling. Because access to the site was uncertain, no surface-water or soil samples were collected from the site. Site features and sample locations are shown in figure 20; photographs are shown in figures 20a and 20b.

2.21.3.2 Soil

No soil samples were collected from the site for reasons noted; there was no visible evidence of adverse impact to soils below the mine near North Fork Warm Springs Creek.

2.21.3.3 Water

Neither surface-water sample contained concentrations in excess of MCLs or ALSs (table 28). However, the sample collected from North Fork Warm Springs Creek below the tributary drainage in which the mine was located indicated slightly higher concentrations of several metals.

Table 28. Water-quality exceedences, Badger mine.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | **pH** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N.F. Warm Springs Cr - Upstream (WBGS70M) | | | | | | | | | | | | | | | | | | | |
| N.F. Warm Springs Cr. - Downstream (WBGS60M) | | | | | | | | | | | | | | | | | | | |

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

Note: The analytical results are listed in appendix IV.

2.21.3.4 Vegetation

Local undisturbed vegetation at the site consisted of grasses and coniferous trees. The waste-rock dumps were sparsely vegetated. Along the unnamed creek, there were riparian grasses and willows.

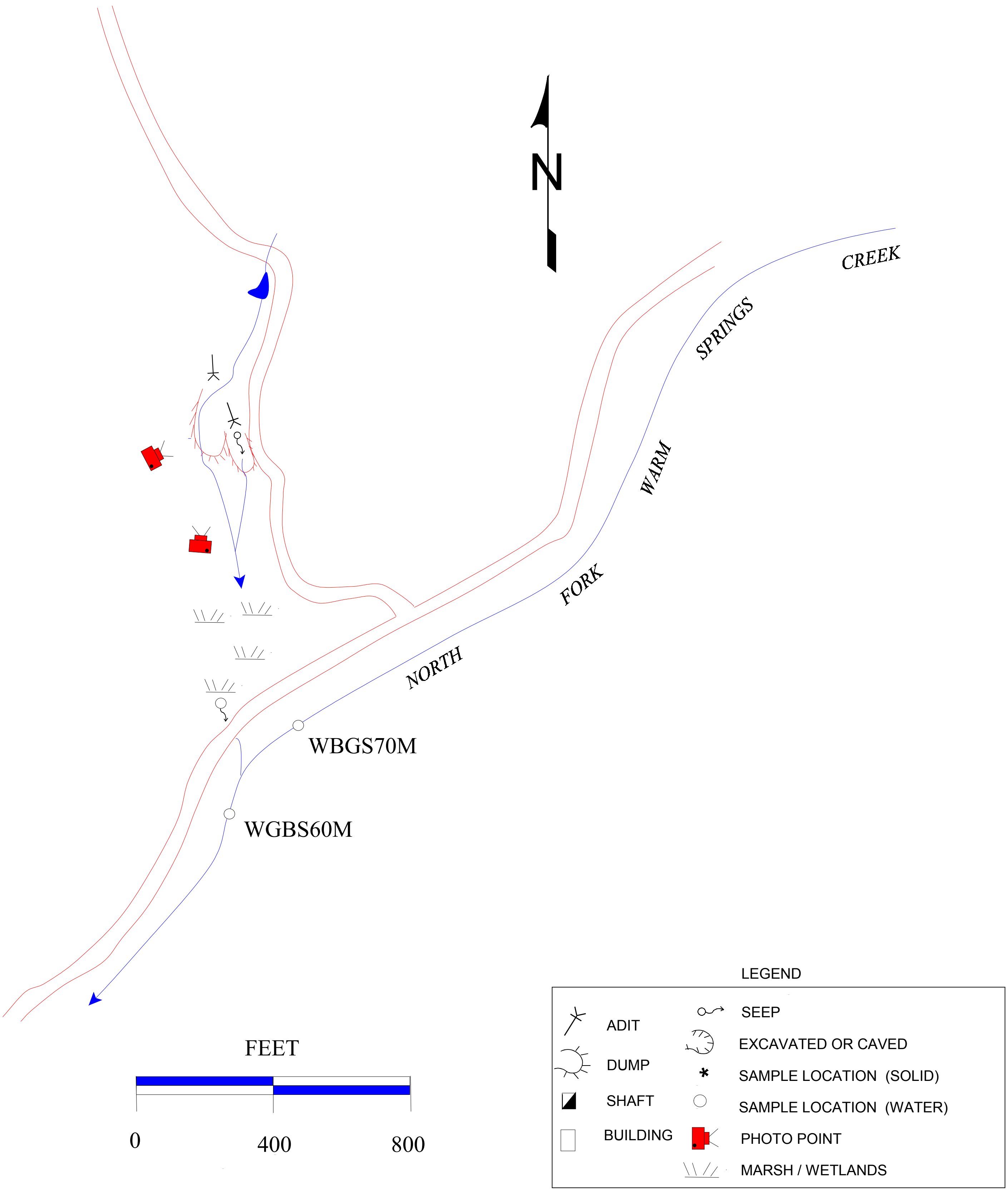



Figure 20. The Badger mine (6/7/94) lies in an unnamed tributary of North Fork Warm Springs Creek. The site was discharging water to a small wetlands below the site.

Figure 20a. The waste-rock dump of the Badger mine was being eroded by the unnamed stream flowing though the site.

Figure 20b. Waste material from the dumps of the Badger mine had been eroded and deposited downstream of the mine.

2.21.3.5 Summary of Environmental Condition

At the time of sampling, adverse impacts to soil and water of the North Fork Warm Springs drainage were minimal. Observations made during previous visits suggest a stronger impact during periods of high runoff. The lower adit of the mine, which discharged about 5 gpm, had an SC of about 240 µmhos/cm, and a relatively low pH of 6.66. As noted, the discharge stream bed was covered by ferric hydroxide precipitates.

2.21.4 Structures

No structures were observed on or near the site on HNF-administered land.

2.21.5 Safety

No safety concerns were identified on this site.

## 2.22 Little Tizer Wildcat

2.22.1 Site Location and Access

The Little Tizer Wildcat mine (T7N R2W section 33ACBC) is in the Elkhorn Mountains, about nine miles southeast of Jefferson City, Montana. The site is on HNF-administered land and is accessible via Forest Route 164, a primitive four-wheel-drive trail.

2.22.2 Site History - Geologic Features

This site was described in great detail by the USBM/USGS (1978). Mineralization was discovered in 1930, and the site was worked from 1937 to 1939, producing 4 oz of gold and 3 oz of silver from 4 tons of ore. The targets were narrow shear zones (N50-85°W 30-85°SW) from three inches to two feet wide in andesite and andesite breccia. Pyrite was the only visible sulfide. The highest three channel samples averaged 0.22 oz/ton gold and 0.22 oz/ton silver. Workings consist of five adits with a combined length of 800 feet and one 58-foot-deep shaft. A dump composite sample ran 0.364 oz/ton gold, 12.2 ppm silver, 96 ppm copper, 8,080 ppm lead, 1,105 ppm zinc, and 2,250 ppm arsenic.

2.22.3 Environmental Condition

Workings at the site consisted of four collapsed adits, one open adit, one collapsed shaft, and six waste-rock dumps (figure 21). An ore-car bridge over Little Tizer Creek and the remnants of several burned buildings were present on the site. During the site visit on August 12, 1993, the adit closest to Little Tizer Creek had a small discharge; this adit was not discharging water when the site was sampled on August 17, 1995. The two lowest waste-rock dumps were on the Little Tizer Creek flood plain.

### 2.22.3.1 Site Features - Sample Locations

Although the lowest adit had a discharge when the site was initially inventoried on August 12, 1993, this adit was not discharging water when the site was sampled on August 17, 1996. Water samples of Little Tizer Creek were collected upstream (TLTS10L) and downstream (TLTS20L) from the site. Site features and sample locations are shown in figure 21; photographs are shown in figures 21a.

### 2.22.3.2 Soil

The waste-rock dumps were comprised of course material and appeared reasonably stable. No signs of erosion were observed.

### 2.22.3.3 Water

Little Tizer Creek did not exceed MCLs or ALSs upstream or downstream of the site (table 29). Water quality downstream of the site was not significantly different from water quality upstream.

Table 29. Water-quality exceedences, Little Tizer Wildcat mine.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | **pH** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Little Tizer Creek - upstream of site (TLTS10L) | | | | | | | | | | | | | | | | | | | |
| Little Tizer Creek - downstream of site (TLTS20L) | | | | | | | | | | | | | | | | | | | |

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

Note: The analytical results are listed in appendix IV.

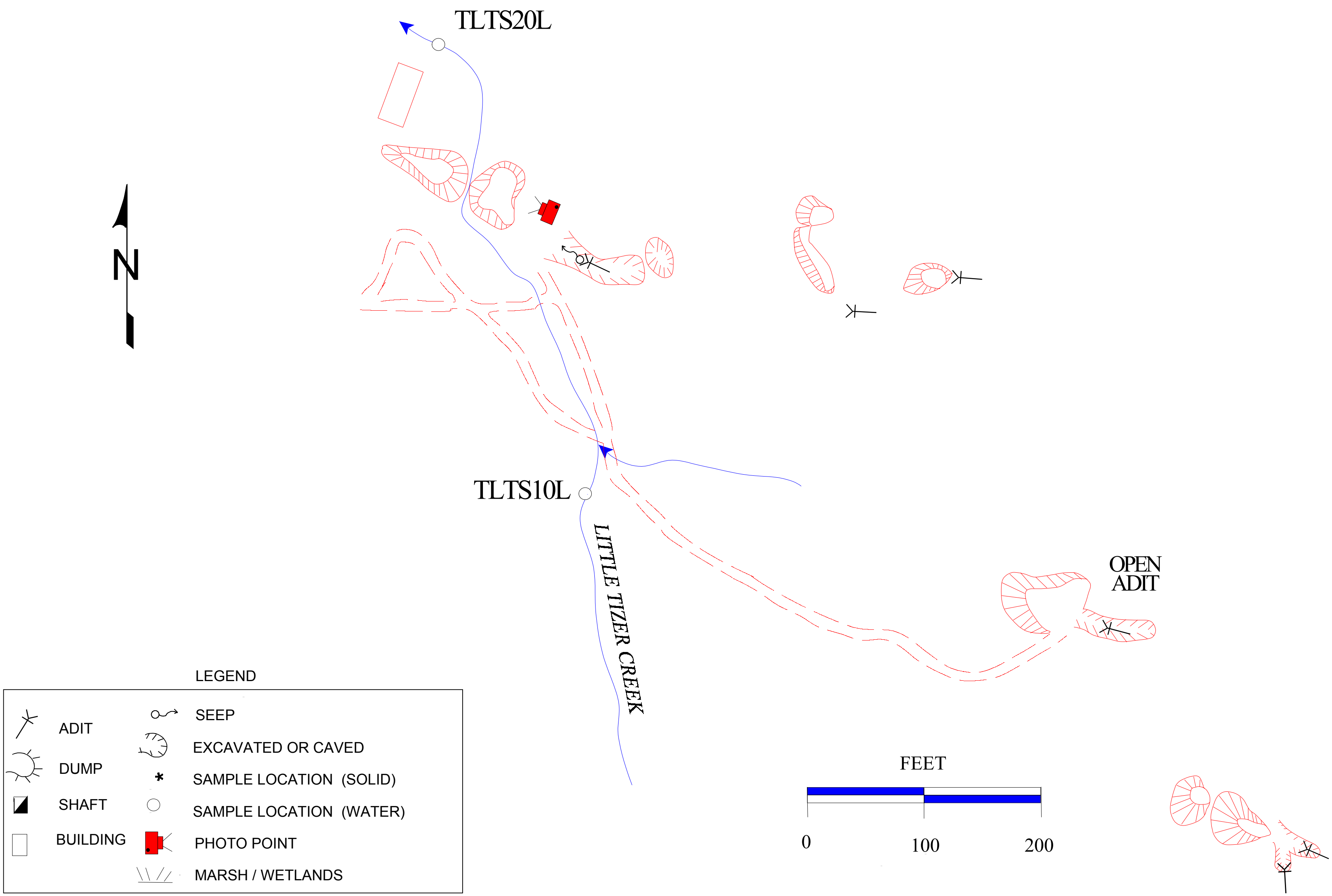



Figure 21. Little Tizer Wildcat mine (8/12/93) lies adjacent to Little Tizer Creek. The lower (north) adit was not discharging at the time samples were collected.

Figure 21a. The lower waste-rock dump of the Little Tizer Wildcat mine was deposited on both sides of Little Tizer Creek.

2.22.3.4 Vegetation

The waste dumps were sparsely vegetated with trees and grass. Around the waste-rock dumps, the ground was well vegetated. Undisturbed areas around the site were well vegetated and consisted of grasses, conifers, and brush.

2.22.3.5 Summary of Environmental Condition

The site did not appear to impact the water quality of Little Tizer Creek. Also, erosion of waste material did not appear to be a problem. Overall, the environmental impact of the site on HNF-administered land appeared negligible.

2.22.4 Structures

The remnants of several burned buildings were observed on the site. Also present on the site was an ore-car bridge over Little Tizer Creek.

2.22.5 Safety

The open adit and the ore-car bridge were obvious safety concerns.

## 2.23 Golden Age Mill

### 2.23.1 Site Location and Access

The Golden Age mill (T7N R2W section 15CBAB) is in the Elkhorn Mountains, about nine miles southeast of Jefferson City, Montana. The site is on HNF-administered land and is accessible by taking Forest Route 164, a primitive four-wheel-drive trail, to Forest Route 4032.

### 2.23.2 Site History - Geologic Features

This mill reportedly treated ore using mercury amalgamation, cyanidization, and flotation (USBM/USGS 1978)–it must have been very thorough. It operated between 1936 and 1951 (USBM/USGS 1978), and treated mostly oxidized ore from the Pataloma-Callahan mine (Klepper *et al.* 1971). Production statistics from this mine indicate that about 10,000 tons of ore may have been processed here. A composite sample of the tailings ran 0.0655 oz/ton gold, 8.2 ppm silver, 393 ppm copper, 3,640 ppm lead, 536 ppm zinc, and 282 ppm arsenic.

### 2.23.3 Environmental Condition

The site consisted of an ore bin, mill building, and tailings impoundment. The tailings were deposited in a wetlands area adjacent to Wilson Creek. Seeps emerged near the mill building and ore bin; part of the seepage flowed through the tailings impoundment before flowing into Wilson Creek. Several empty barrels also were observed in the area.

#### 2.23.3.1 Site Features - Sample Locations

Water samples from Wilson Creek were collected about 100 feet upstream (WGAS10L) and about 20 feet downstream (WGAS30L) from the site. A sample of the water flowing through the tailings impoundment was collected about five feet upstream from the confluence with Wilson Creek (WGAS20L). Site features and sample locations are shown in figure 22; photographs are shown in figures 22a and 22b.

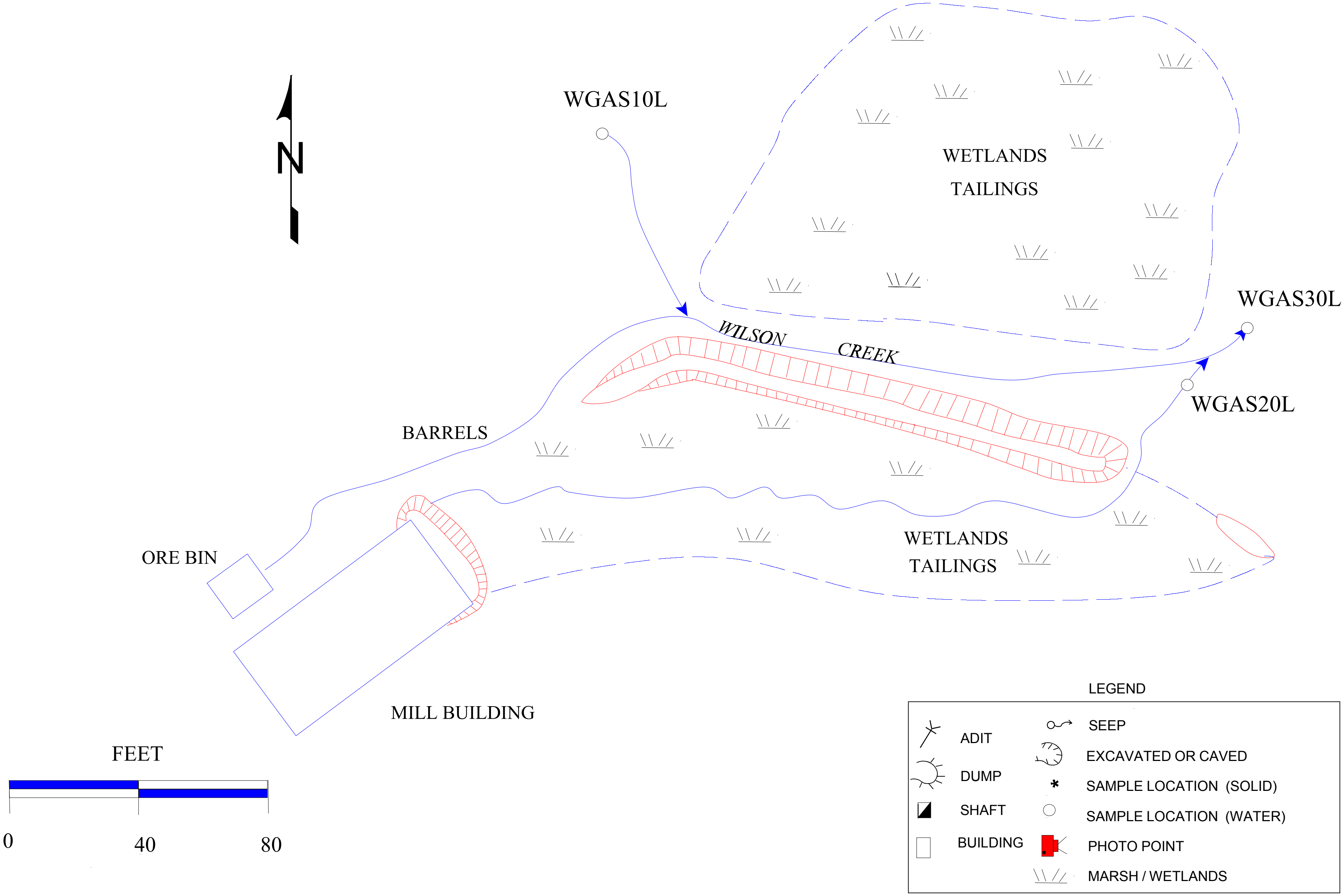



Figure 22. The Golden Age mill tailings (1993) were deposited on the flood plain of Wilson Creek.

Figure 22a. The Golden Age mill had several seeps that emerged near the ore bin and mill building.

Figure 22b. The tailings impoundment of the Golden Age mill were adjacent to Wilson Creek. The mill and ore bin are in the background.

2.23.3.2 Soil

The dam at the east end of the tailings impoundment tailings had been breeched. During high flows, tailings may be eroded into Wilson Creek. Soils adjacent to the tailings did not appear impacted.

2.23.3.3 Water

Water-quality standards were not exceeded in Wilson Creek upstream of the site nor in the water flowing through the tailings impoundments (table 30). The chronic aquatic life standard for mercury was exceeded in Wilson Creek downstream of the site; however, the concentration was at the detection limit of 0.1 ppb. Other than the mercury, water quality downstream of the site was not significantly different from water quality upstream.

Table 30. Water-quality exceedences, Golden Age mill.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | **pH** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wilson Creek-100 feet upstream of the site (WGAS10L) | | | | | | | | | | | | | | | | | | | |
| Tailings impoundment (WGAS20L) | | | | | | | | | | | | | | | | | | | |
| Wilson Creek-20 feet Downstream of the site (WGAS30L) | | | | | | | | | | C | | | | | | | | | |

Exceedence codes:

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

Note: The analytical results are listed in appendix IV.

2.23.3.4 Vegetation

The tailings south of Wilson Creek were vegetated with trees, grasses, and moss. North of Wilson Creek, the tailings were mostly under water; some of the trees were dead. Undisturbed areas around the site were well vegetated with grasses, conifers, and brush.

2.23.3.5 Summary of Environmental Condition

The site did not have a significant adverse impact on the water-quality of Little Tizer Creek. Erosion of waste material did not appear to be a problem. Overall, the environmental impact of the site on HNF-administered land was minor.

2.23.4 Structures

The mill building and ore bin were in good repair. The roof on the mill building was constructed out of corrugated metal and appeared to be weatherproof. Milling equipment was observed in the mill building.

2.23.5 Safety

There were no obvious safety concerns observed on the site.

## 2.24 Park–New Era Group

2.24.1 Site Location and Access

The Park–New Era Group (T7N R1W section 15A) includes numerous underground workings (Park–New Era, Marietta, Little Annie, and Gold Dust mines) and a stamp mill located at the head of Indian Creek southwest of Townsend. Indian Creek flows into the Missouri River near the east end of Canyon Ferry Lake. The disturbed area covers approximately 150–200 acres of privately owned land. The site can be accessed via the dirt road that follows Indian Creek.

2.24.2 Site History - Geologic Features

The Park–New Era and Phoenix mines are described by Reed (1951). At the Park–New Era, 11,000 tons of ore were mined. Four adits and one shaft were used in mining a vein (N45$^{o}$ E, 30$^{o}$ NE) containing pyrite, galena, and arsenopyrite deposited in fracture fillings and replacement structures. The vein, reportedly, was stoped continuously for more than 1,400 feet. Ore grade was reported as 0.3 oz/ton Au, 0.6 oz/ton Ag, and 0.3% Pb.

A shaft and three short adits at the Phoenix mine were used to mine less than 100 tons of ore from a vein (N25W, 75 NE) containing scant galena and occasional blebs of chalcopyrite. Horizontal extent of workings estimated at 400 feet.

## 2.24.3 Environmental Condition

Numerous adits, shafts, and prospects and the remnant of a mill were observed on this site. Several of the adits had discharges that flowed into Indian Creek. The discharge from the Gold Dust adit was notable for the bright iron-oxyhydroxide precipitate along its course. Several large waste-rock dumps below the main working were being actively eroded by Indian Creek. One of the dumps had an iron-stained seep. At the upstream end of the site, there was a small tailings impoundment that contained a shallow pool. Below the site, there were extensive streamside tailings deposits.

An empty cyanide drum observed along a small drainage near the mill was evidence that a cyanide leaching process was used to extract gold from the ore. Cyanide, therefore, may be a contaminant in the soils, tailings, and water around the site.

### 2.24.3.1 Site Features - Sample Locations

Water-quality samples were collected at the site on August 11, 1995. Background sample IMPS20L was collected from Indian Creek upstream of the site. The flow rate of the creek at this location was eight gpm. An additional background sample, IMPS10L, was collected from a spring west of the site that flowed at three gpm. Sample IMPS30M was collected from Indian Creek approximately a quarter mile downstream of the main workings. The flow rate of the creek at this location was 270 gpm.

Although streamside tailings and waste rock were present at the site, they were not sampled because they were on private land. Site features and sample locations are shown in figure 23; photographs are shown in figures 23a and 23b.

### 2.24.3.2 Soil

No soil samples were collected at the site; there was no evidence of adverse impact to soils on HNF-administered land.

### 2.24.3.3 Water

Water quality upstream of the site was good. However, downstream of the site, concentrations of cadmium, manganese, and zinc exceeded water-quality standards (table 31). Also, although arsenic and sulfate did not exceed standards, their concentrations were significantly elevated in the sample collected below the site.

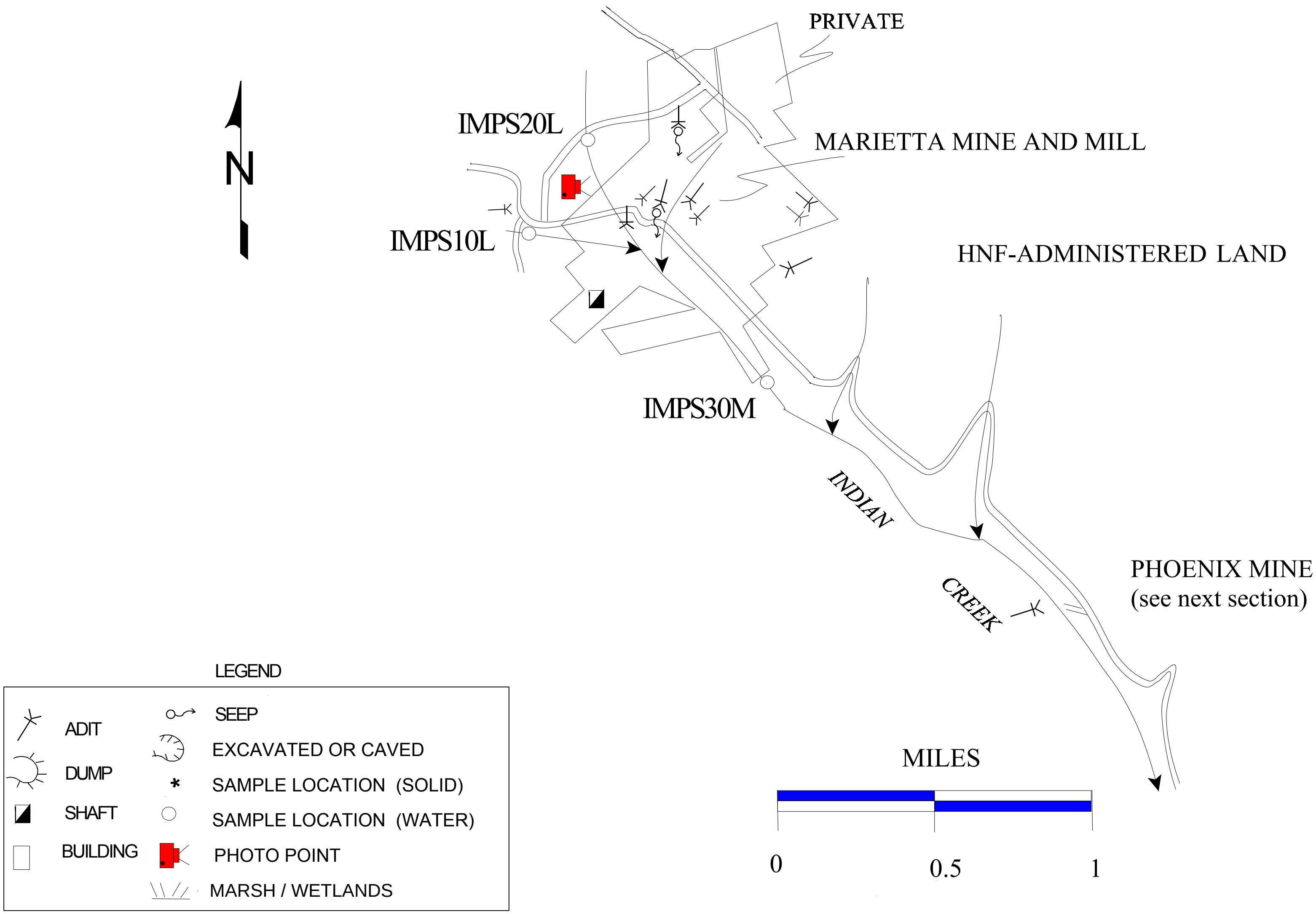



Figure 23. The Park-New Era Group (8/11/95), which includes the Marietta mine and mill, consists of several mines, most of which are still on private property.


Figure 23a. The Park–New Era Group covered approximately 150–200 acres of privately owned land.

Figure 23b. An empty cyanide drum was found along one of the small drainages leading to Indian Creek.

Table 31. Water-quality exceedences, Park–New Era Group.

| 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 and west of site (IMPS10L) | | | | | | | | | | | | | | | | | | | |
| Indian Creek, upstream of site (IMPS20L) | | | | | | | | | | | | | | | | | | | |
| Indian Creek, downstream of site (IMPS30M) | | | | A,C | | | | | S | | | | A,C | | | | | | |

Exceedence codes:

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

Note: The analytical results are listed in appendix IV.

#### 2.24.3.4 Vegetation

Most waste-rock dumps and tailings piles around the site were barren to sparsely vegetated. Where vegetation has taken hold, it generally consisted of grasses and small conifers.

#### 2.24.3.5 Summary of Environmental Condition

Discharges and waste material from this 150+ acre site add a significant metal load to Indian Creek. Cadmium and zinc exceeded chronic and acute aquatic life criteria as Indian Creek crossed back onto HNF-administered land. Vegetation was visibly impacted by the waste materials strewn across the drainage. Cyanide is a potential contaminant at the site, but no samples were analyzed to check for its presence in the soil and surface water.

### 2.24.4 Structures

Several cabins and mine buildings were present around the site. All that remained of the mill was a concrete foundation and a trestle where ore was apparently unloaded.

### 2.24.5 Safety

The wood trestle next to the mill foundation, on private land, may be a safety hazard. No hazards were observed on HNF-administered land.

## 2.25 Park-Marietta Mill Tailings and Phoenix Mine

### 2.25.1 Site Location and Access

The Park-Marietta mill tailings (T7S R1W section 14CBCD) and the Phoenix mine (T7N R1W section 23ADDA) are along Indian Creek, southwest of Townsend. Both sites were on HNF-administered land downstream of the Park–New Era Group discussed in the previous section. Access to the site is via a dirt road along Indian Creek.

### 2.25.2 Site History - Geologic Features

The Park Marietta Group is described by Reed (1951). The site includes 11 patented claims developed from 1880 to 1906, during which time several thousand tons of gold ore were shipped. Between 1906 and 1908, a small cyanide mill was built at the site, but the site remained mostly inactive until 1933. Between 1933 and 1945, about 5,400 tons of gold ore were mined and milled.

The mineralization is hosted by andesite. Ore mineralogy consists of pyrite, arsenopyrite, galena, and sparse sphalerite deposited in fracture fillings and replacement structures six inches to three feet wide. Most of the vein structures trend north to northeast and dip 35 degrees to the west. Production records from 1901 to 1951 indicate that the ore yielded 1.24 oz/ton Au, 7.5 oz/ton Ag, and 4.8% Pb.

### 2.25.3 Environmental Condition

A large tailings impoundment had been breached, and waste material had washed down the Indian Creek drainage for many miles. Close to the impoundment, the streamside tailings deposits were generally several inches to several feet thick. Proceeding downstream, the deposits became thinner and discontinuous. At several locations, iron-stained seeps flowed from the tailings into the creek.

At the Phoenix mine, about one mile downstream of the tailings impoundment, there was a streamside waste-rock dump that was surrounded by tailings. Seeps flowed from the tailings into Indian Creek.

#### 2.25.3.1 Site Features - Sample Locations

Soil and water-quality samples were collected at the sites on August 11, 1995. Water samples IMPS30M and IMPS40M were collected from Indian Creek upstream and downstream of the two sites, respectively. The flow rate at the upstream sampling point was 270 gpm; at the downstream location, the flow rate was 390 gpm. A third sample, IMPS50H, was collected from a seep near the toe of the Phoenix waste-rock dump. The flow rate of the seep was estimated to be less than one gpm.

Three soil samples were collected along Indian Creek to characterize the streamside tailings deposits. Sample IMPD10H was collected from the tailings behind the breached tailings dam; sample IMPD20M was collected about a half-mile below the impoundment; and sample IMPD30M was collected from the tailings that surround the waste-rock dump at the Phoenix mine. Site features and sample locations are shown in figure 24; photographs are shown in figures 24a and 24b.

### 2.25.3.2 Soil

Arsenic and lead concentrations exceeded phytotoxic levels at all three sample locations along Indian Creek (table 32). Copper and zinc also exceeded phytotoxic levels at the tailings impoundment. Concentrations of arsenic, copper, and zinc in soils decreased downstream, suggesting mixing leaching as the tailings are transported downstream.

Table 32. Soil sampling results, Park-Marietta tailings and Phoenix mine (mg/kg).

| **Sample Location** | **As** | **Cd** | **Cu** | **Pb** | **Zn** |
|---|---|---|---|---|---|
| Tailings within breached impoundment (IMPD10H) | 7040[1,2] | 3.1[1] | 182[1,2] | 4340[1,2] | 506[1,2] |
| Streamside tailings 0.5 miles below impoundment (IMPD20M) | 6130[1,2] | 6.6[1] | 79.7[1] | 3790[1,2] | 386[1] |
| Streamside tailings around toe of Phoenix waste-rock dump (IMPD30M) | 5510[1,2] | 3.1[1] | 50.5[1] | 4000[1,2] | 328[1] |

(1) Exceeds one or more Clark Fork Superfund background levels (table 3)
(2) Exceeds phytotoxic levels (table 3)

### 2.25.3.3 Water

Before Indian Creek flows through the Park-Marietta tailings impoundment, it already contained concentrations of cadmium (4.6 µg/L), manganese (0.9 µg/L) and zinc (630 µg/L), which exceeded water-quality standards. The source of this contamination was the discharges and streamside waste from the Park–New Era Group a short distance upstream (previous section). Below the tailings impoundment and the Phoenix mine, the creek had lower concentrations of these three contaminants, but zinc (190 µg/L) still exceeded aquatic life standards. In addition, the concentration of arsenic (62 µg/L) increased and was above the primary MCL (table 33). The arsenic very likely is leaching from streamside tailings, as indicated by the results from the sample of the seep at the Phoenix mine (IMPS50H). Also, the seep contained high concentrations of aluminum, cadmium, iron, lead, manganese, and zinc and had a low pH.

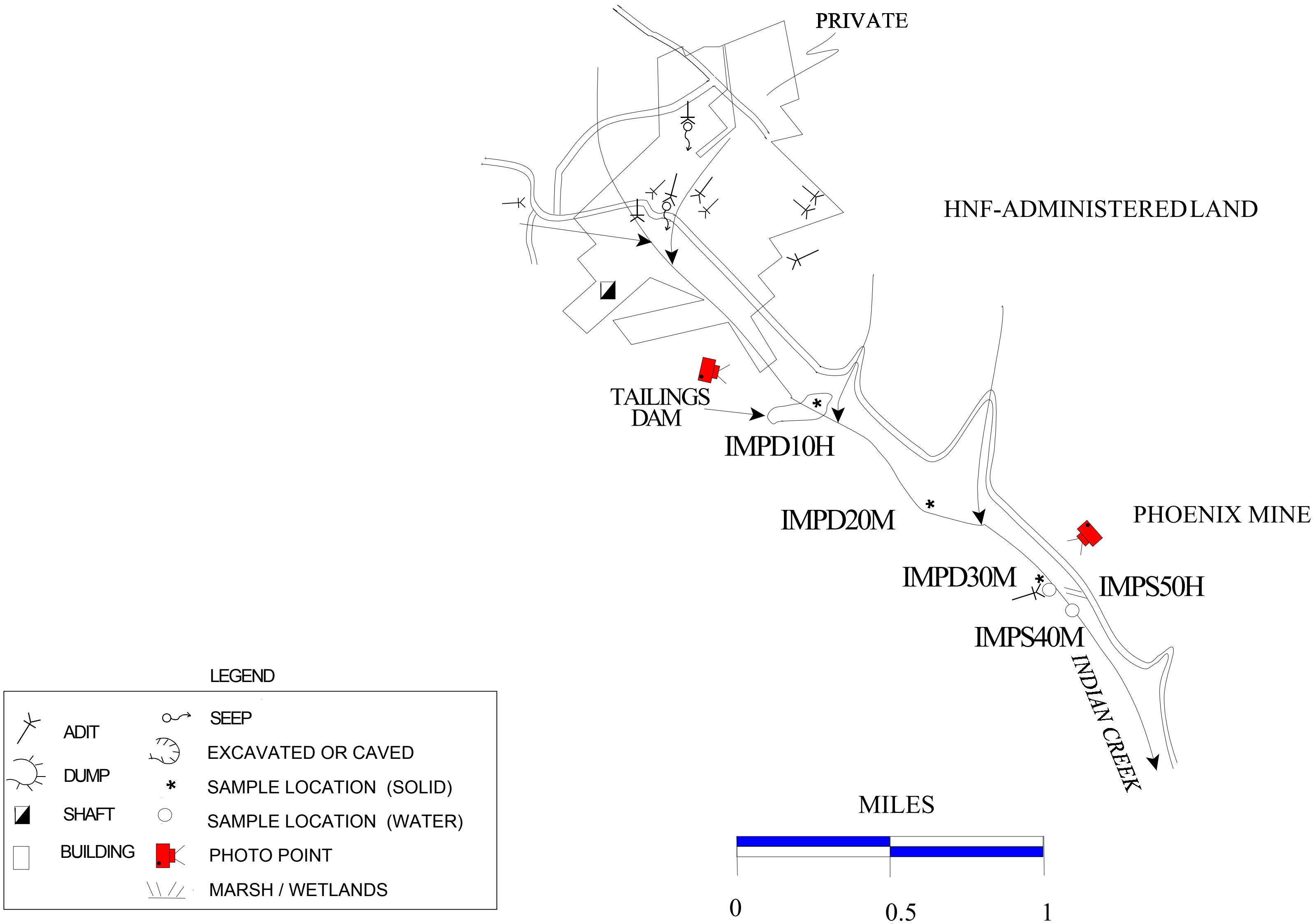



Figure 24. The Phoenix mine (1993) is on Indian Creek below the Park-Marietta mill. Tailings from the breached tailings impoundment have been deposited along the flood plain of Indian Creek.

Figure 24a. The breached tailings impoundment had eroded and mixed with soils. A soil sample (IMPD10H) was collected from the impoundment.

Figure 24b. Hazardous openings at the Phoenix mine were found on the hillside above the collapsed adit.

Table 33. Water-quality exceedences, Park-Marietta tailings and Phoenix mine.

| 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- Above tailings impoundment (IMPS30M) | | | | A,C | | | | | S | | | | A,C | | | | | | |
| Seep from tailings at toe of Phoenix dump (IMPS50H) | S | P | | C | | | S,A | C | S | | | | A,C | | | | | | * |
| Indian Creek- Below sites (IMPS40M) | | P | | | | | | | | | | | A,C | | | | | | |

Exceedence codes:

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

Note: The analytical results are listed in appendix IV.
* Laboratory pH was outside secondary MCL range

### 2.25.3.4 Vegetation

The tailings impoundment and many of the larger streamside tailings deposits were barren or sparsely vegetated. The tailings around the Phoenix mine waste-rock dump were vegetated with marsh grasses.

### 2.25.3.5 Summary of Environmental Condition

The Park-Marietta streamside tailings contained elevated concentrations of arsenic, cadmium, copper, lead, and zinc. Arsenic leaching from these deposits significantly degraded the water quality of Indian Creek. Other metals leaching into the creek include aluminum, cadmium, iron, lead, manganese, and zinc. Vegetation was visibly impacted along the drainage, especially near the tailings impoundment and the larger streamside deposits. Impact from the tailings extended at least several more miles down the drainage (see Last Chance Tailings and Humphrey Placer *in* Marvin *et al.* 1997).

The waste-rock dump at the Phoenix mine was in the flood plain of Indian Creek and was surrounded by a marshy streamside tailings deposit. Water from the marsh contained elevated metal concentrations. The metals probably are leached from the tailings rather than the waste rock.

## 2.25.4 Structures

No structures were observed on HNF-administered land near the sites.

<u>2.25.5 Safety</u>

No physical safety problems were noted for the Park-Marietta tailings. At the Phoenix mine, there was a partially caved adit with several dangerous subsidence features.

## 2.26 Kleinschmidt Mine

### 2.26.1 Site Location and Access

The Kleinschmidt mine (T7N R1W section 27ACCC) is in the Winston mining district and can be reached either via Kimber Gulch or via Weasel Creek and then crossing over the ridge into the Whitehorse Creek drainage. Four-wheel drive is not necessary in good weather but is definitely beneficial at times. The mine is located on the Winston 7.5-min. quadrangle.

### 2.26.2 Site History - Geologic Features

The Kleinschmidt is actually a group of 11 patented and additional nonpatented claims including the Little Olga, Quartette, El Potrero, Filler No. 1 & 2, Emil H., Dew Drop, Cynosure, Irish Syndicate, and Big and Little Casino, with the Little Olga as the principal producer. The primary dates of operation were from 1910 to 1927 (Earll 1964) although the property also contributed to the metal production of the area prior to 1900. Reed (1951) reported the last known activity was in 1949; an MBMG unpublished file reports activity in 1960. Pardee and Schrader (1933) estimate the total workings at 5,000 feet, whereas Reed (1951) estimated the entire group aggregated 9,000 feet of workings.

A 24-ton concentrating mill was built at the Little Olga (Pardee and Schrader 1933); the present mill, which is in ruins, may be a second structure. Ore minerals include galena, pyrite and chalcopyrite with lesser amounts of tetrahedrite, arsenopyrite, and sphalerite (Pardee and Schrader 1933).

The group of mines here are associated with fractures in the Little Olga stock, a quartz monzonite intrusive. The mine was known as a silver-lead-zinc property with most of the mineralization in steep, east-trending veins and with gold associated with the north-trending, low-angle veins (Reed 1951). Sericitic alteration, as well as silicification, surrounds the veins in the area (Reed 1951).

### 2.26.3 Environmental Condition

Most of the waste and tailings here are patented claims except for where the tailings impoundments have washed out and released tails down through the woods onto HNF-administered land along Whitehorse Creek east of the patented claims. The relative impact of the Kleinschmidt tailings was limited to the immediate area. The flow from the small tributary emanating from the springs below the mine disappeared before it reached Whitehorse Creek (at least seasonally). The erosion of the tailings was limited to an apron skirting the original impoundment. Spring runoff and storm events probably cause the largest erosive effect.

2.26.3.1 Site Features - Sample Locations

The site is of mixed ownership; the mine workings were on patented claims and so their dumps were not sampled. The HNF-administered land boundary was recently resurveyed and was located just to the east and down slope from the original tailings impoundment.

The water in the small unnamed creek had a slight iron stain as it flows through the tailings that had been deposited along the bed. The creek began at a series of springs south and west of the mill site at the Kleinschmidt, on private land. A flow estimated by bucket and stopwatch measured approximately 12 gpm at the sample site. As previously stated, the flow disappeared underground approximately 650 feet downstream of the tailings. The flow may exceed this limit during spring runoff and during exceptionally wet years.

The unnamed tributary of Whitehorse Creek was sampled approximately 450 feet downstream from the HNF-administered land boundary (WKLS10M). Pioneer Technical Services (1995) sampled the site in July 1994. Site features and sample locations are shown in figure 25; photographs are shown in figures 25a and 25b.

2.26.3.2 Soil

No soil sample was collected here. Pioneer Technical Services (1995) took samples of both tailings and waste in 1994, on HNF-administered land and private land. Their samples revealed elevated (>3x background) in Ag, As, Cd, Cu, Hg, Mn, Pb, Sb, and Zn in the tailings.

2.26.3.3 Water

No water-quality standards were exceeded in the downstream water sample (WKLS10L) collected by MBMG (table 34). A study conducted by DSL-AMRB/ Pioneer Technical Services found that, at the time of their study (07/24/94), the MCL level for arsenic and the chronic aquatic criteria for copper, lead and zinc were exceeded in the downstream sample. The flow at that time was not noted.

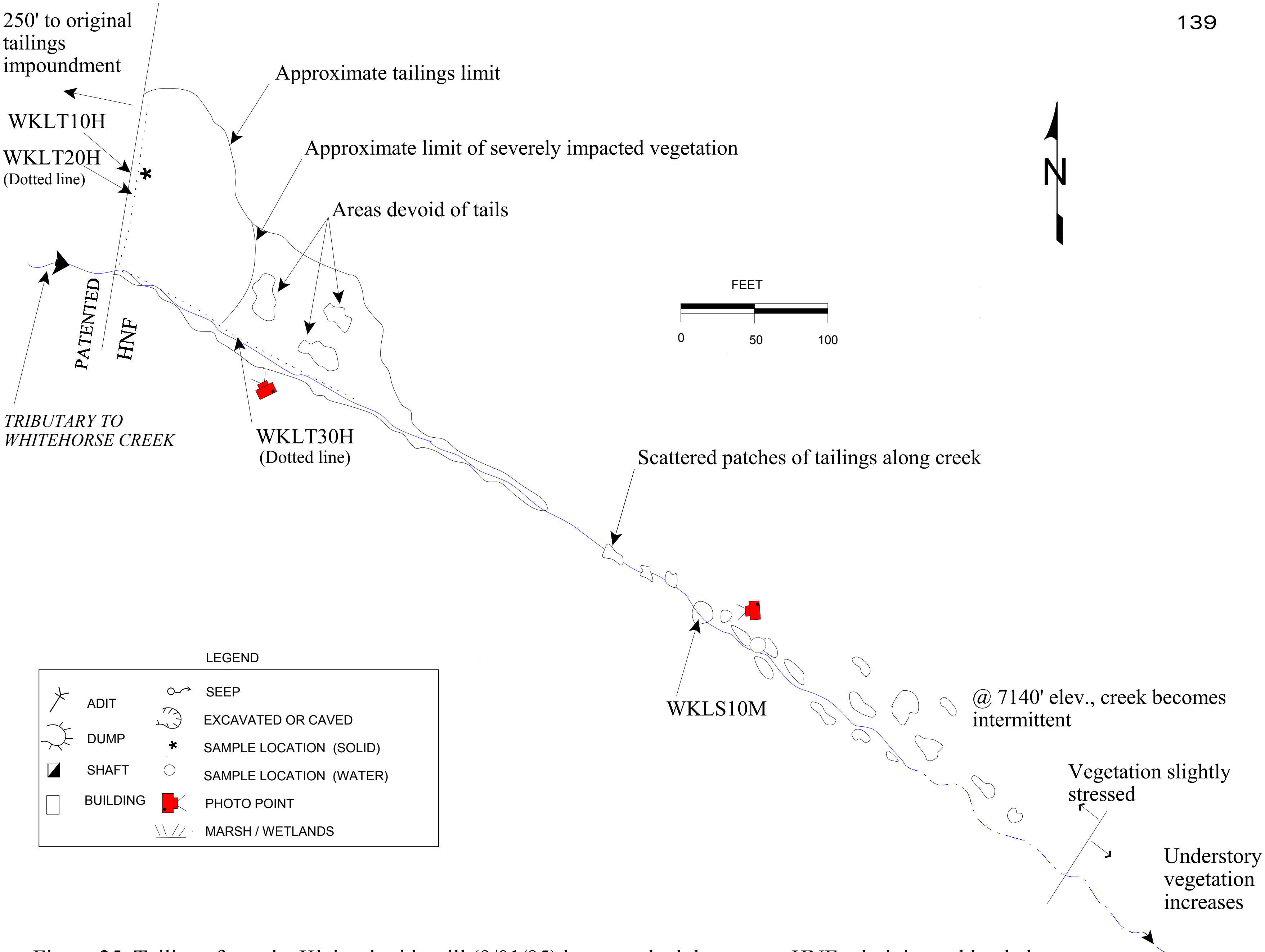



Figure 25. Tailings from the Kleinschmidt mill (9/01/95) have washed down onto HNF-administered land along an unnamed tributary of Whitehorse Creek.

Figure 25a. The understory vegetation at Kleinschmidt has been affected by tailings washing down through the forest.

Figure 25b. A small (12 gpm) flow to a tributary of Whitehorse Creek emanated from seeps near the Kleinschmidt mine.

Table 34. Water-quality exceedences, Kleinschmidt mine.

| Sample Site | Al | As | Ba | Cd | Cr | Cu | Fe | Pb | Mn | Hg | Ni | Ag | Zn | Cl | F | $NO_3$ | $SO_4$ | Si | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WKLS10M - downstream | | | | | | | | | | | | | | | | | | | |

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

Note: The analytical results are listed in appendix IV.

2.26.3.4 Vegetation

The vegetation here had been impacted below the tailings, an area where the tailings had washed down through the forest. Immediately below the original tailings impoundment, the trees had been cut down and left. It is unknown if they were dead before they were cut or not, but some standing dead timber remained. Below this area, the lodgepole pines were alive but the understory was sparsely vegetated in an area down slope from the tailings. The creek banks had sparse grasses and mosses growing on them. At a distance of approximately 650 feet down slope from the tailings the understory resumed what looked like normal growth. This also was the same point at which the creek disappeared underground. The drainage gradient changed at this point, which may indicate some fault or other structure crossing here.

2.26.3.5 Summary of Environmental Condition

Erosion of the tailings seemed to be an on-going process and did appear to have an impact on the vegetation of the local area. The creek's flow (at the time of this visit) was small and disappeared underground approximately 700 feet from its source and so was not a major erosive force. Sheetwash down slope is probably a more consistent erosional process.

2.26.4 Structures

All structures were on private land. There were at least four small log cabins still standing; the mill contained some rusting equipment but was largely in ruins.

2.26.5 Safety

The buildings here were on private ground and were not considered as safety threats. They were largely small log buildings with their roofs partially gone. The adits appeared to be collapsed, as viewed from the road. The dumps had steep slopes but, again, were all on private ground. There were numerous cattle grazing in the area. No safety concerns were identified on HNF-administered land.

## 2.27 Vosburg Mine and Mill

### 2.27.1 Site Location and Access

The Vosburg mine and mill (T8N R1W section 34CCCD) are on HNF-administered land in the Elkhorn Mountains. The site is within the Badger Creek drainage, which flows into Beaver Creek, a tributary to the Missouri River. Access to the site is by the dirt road that follows the Weasel Creek drainage and then crosses over a divide into the Badger Creek drainage.

### 2.27.2 Site History - Geologic Features

The Vosburg mine is described in Reed (1951) and Earl (1964). About 24,000 tons of ore were mined and milled between 1933 and 1946. Eight adits and a shaft were developed in a vein (N15 to 30W, 33 to 53 SW) hosted by quartz monzonite. Mineralization consists of pyrite, limonite, manganese oxide, galena, sphalerite, and quartz gangue. Average grade of ore was reported at 0.28 oz/ton Au, and 1.4 oz/ton Ag (Reed 1951). Some ore contained greater than 1 ounce/ton Au.

### 2.27.3 Environmental Condition

Environmental problems at the Vosburg mine included an adit discharge, a large volume of barren tailings on a steep slope adjacent to Badger Creek, and several seeps. The tailings covered several acres and were being actively eroded by the creek, the seeps, and the adit discharge. Subsequent to work conducted for this inventory, the site was reclaimed in 1995.

#### 2.27.3.1 Site Features - Sample Locations

Soil and water-quality samples were collected at the site on May 24, 1994, during the initial remediation activities. Soil samples BVOD10H, BVOD40M, and BVOD50M were collected along three small drainages that flowed across the tailings. Sample BVOD30M was collected from streamside tailings in the Badger Creek flood plain.

Water-quality sample BVOS10L was collected from the adit discharge after it emerged from the base of the adit’s waste-rock dump; the flow rate of the discharge was six gpm. Samples BVOS20M, BVOS40L, and BVOS50L were collected from three seeps that drained the tailings; the flow rates of the seeps were 3, 12, and 17 gpm, respectively. Samples BVOS30L, BVOS60L, and BVOS80L were collected from Badger Creek upstream, 200 feet downstream and 1,000 feet downstream of the site, respectively. The flow rate of the creek at the upstream sample location was about 720 gpm. Downstream, the flow rate increased to 900 gpm and then to 2,200 gpm. Site features and sample locations are shown in figure 26; photographs are shown in figures 26a and 26b.

### 2.27.3.2 Soil

The concentration of arsenic exceeded phytotoxic levels at all four soil sample locations (table 35). Also, cadmium, copper, and lead concentrations were found to be elevated around the site.

Table 35. Soil sampling results, Vosburg mine and mill (mg/kg).

| **Sample Location** | **As** | **Cd** | **Cu** | **Pb** | **Zn** |
|---|---|---|---|---|---|
| Tailings along seep channel (BVOD50M) | 185[1,2] | 0.09 | 10.5 | 98.3[1] | 7.59 |
| Tailings along north seep channel (BVOD10H) | 248[1,2] | 0.11[1] | 15.0[1] | 107[1] | 9.04 |
| Tailings eroding from NW slope of pile M2 (BVOD40M) | 201[1,2] | 0.14[1] | 17.6[1] | 96.0[1] | 9.33 |
| Tailings deposited in flood plain of Badger Creek (BVOD30M) | 200[1,2] | 0.11[1] | 13.2[1] | 78.9[1] | 7.81 |

(1) Exceeds one or more Clark Fork Superfund background levels (table 3)
(2) Exceeds phytotoxic levels (table 3)

### 2.27.3.3 Water

The adit discharge and all of the seeps were found to have water-quality problems. The adit discharge had elevated levels of aluminum (99 µg/L) and arsenic (140 µg/L). The arsenic concentrations in the three seeps also were high, ranging from 55 to 910 µg/L. Two seeps exceeded the chronic aquatic life standard for lead, and one seep had an aluminum concentration above the secondary MCL. Upstream of the site, Badger Creek had no water-quality exceedences. Immediately downstream of the site, arsenic and lead were elevated. Further downstream, arsenic and lead concentrations declined slightly so that standards were not exceeded; however, the concentration of aluminum increased to a level that exceeded the secondary drinking-water standard (table 36).

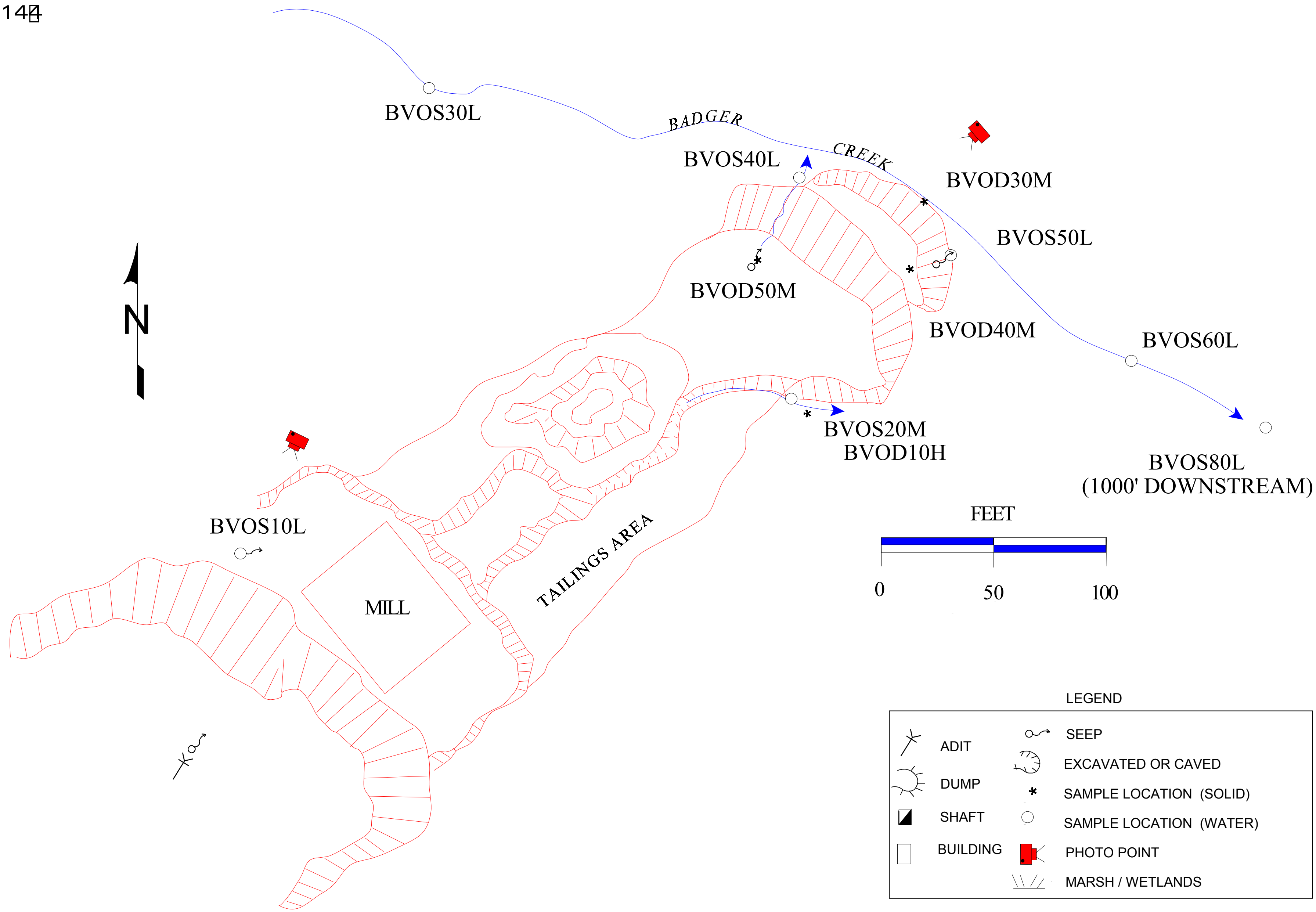



Figure 26.The Vosburg mine and Mill (1994) was the site of a large tailings release in 1994. Reclamation of the site and disposal of the tailings followed in 1995.

Figure 26a. The lower tailings pile of the Vosburg mill was drained by several seeps and was in the Badger Creek flood plain.

Figure 26b. The adit of the Vosburg mine discharged about six gpm. Sample BVOS10L was collected from the adit discharge after it emerged from the base of the waste-rock dump.

Table 36. Water-quality exceedences, Vosburg mine.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | **pH** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Badger Creek, above site (BVOS30L) | | | | | | | | | | | | | | | | | | | |
| Adit discharge (BVOS10L) | S,C | P | | | | | | | | | | | | | | | | | |
| Seep from tailings pile M2 (BVOS40L) | S | P,C | | | | | | C | | | | | | | | | | | |
| Seep from NW end of tailings pile M2 (BVOS50L) | | P | | | | | | | | | | | | | | | | | |
| Seep from tailings pile M1 (BVOS20M) | | P,A C | | | | | | C | | | | | | | | | | | |
| Badger Creek, 200' downstream of site (BVOS60L) | | P | | | | | | C | | | | | | | | | | | |
| Badger Creek, 1000' below site (BVOS80L) | S | | | | | | | | | | | | | | | | | | |

Exceedence codes:

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

(1) Laboratory pH did not exceed standard

Note: The analytical results are listed in appendix IV.

### 2.27.3.4 Vegetation

Most of the tailings at the site were barren or sparsely vegetated with grasses. Along the portion of Badger Creek that borders the site, many trees were dead or stressed.

### 2.27.3.5 Summary of Environmental Conditions

Arsenic laden mill tailings from the Vosburg mine and mill site were being actively eroded by Badger Creek and several seeps. Vegetative cover on the tailings was sparse to barren. Seeps flowing from the tailings contained high concentrations of aluminum, arsenic, and lead; the adit discharge at the site also contained high concentrations of metals. Immediately below the site, Badger Creek had elevated levels of arsenic and lead. Farther downstream, arsenic and lead concentrations decreased, but aluminum exceeded water-quality standards.

Streamside tailings deposits are substantial near to the site, but from 200 to 1,000 feet downstream, no tailings were observed. The lack of deposits along this reach is probably due to the steep stream gradient. It is likely that large tailings deposits could be found along low gradient reaches farther downstream.

#### 2.27.4 Structures

A concrete mill foundation was observed at the base of the waste-rock dump where the adit discharge re-emerged. Charred wood and some small debris were the only other remnants of the mill.

#### 2.27.5 Safety

No physical safety hazards were observed at the site.

### 2.28 Weasel Creek Mines

#### 2.28.1 Site Location and Access

This area of Weasel Creek (T8N R1W section 34DDBA), on HNF-administered land, may be reached by traveling up Beaver Creek road to Weasel Creek to a switchback and two cabins, on the Winston 7.5-min. quadrangle.

This site was sampled because it is, topographically, the highest public land in the Weasel Creek drainage yet it lies downstream from mining activity in the upper reaches of the drainage. It may be considered an upstream sample for the mines that lie below—the January, Sunrise, Freiburg, and the East Pacific. The discharge from the Carlson crosscut is practically the "headwaters" of Weasel Creek. Weasel Creek may be reached via Winston and the Beaver Creek Road; it is a tributary to Beaver Creek which in turn flows into the Missouri River.

#### 2.28.2 Site History - Geologic Features

The Beaver Creek and Weasel Creek areas are considered portions of the Winston mining district. Earll (1964) wrote an extensive study on the Winston district in addition to Reed (1951), who published a study of Broadwater County mines. Quartz-monzonite intrusives host most of the mineralization. These intrusives have stoped their way through the Elkhorn Mountains volcanics and the sediment of the Slim Sam Formation.

## 2.28.3 Environmental Condition

Weasel Creek appeared healthy in this area despite its origin in the Carlson cross cut and several mine workings above this point. The water flowing from and through the Carlson cross cut then crossed the waste dump below the road. The waste dump was in a wetlands area immediately above the sample site had sulfides as well as salts precipitated on the dumps. This dump is composed of iron-stained clays and quartz-pyrite. There was orange-stained water flowing from the base. The dump and a short, caved adit were on private land.

### 2.28.3.1 Site Features - Sample Locations

A sample from Weasel Creek was taken approximately 50 feet below the surveyed HNF-administered land boundary sign, just before the switchback in the road which leads up to the Vosburg mine. The site lies less than 100 feet east of the Weasel Creek road. No other landmarks were present; the stream gradient here was fairly flat, approximately 6–8 in. deep with fallen logs forming small steps or dams. No sedimentation or iron staining was observed. A generalized map of Weasel Creek and the location are shown in figure 27; a photograph of the sample site is shown in figure 27a.

### 2.28.3.2 Soil

No soil sample was taken because no waste or tailings were on HNF-administered land There was no visible indication of impacts to soils in the flood plain of the creek.

### 2.28.3.3 Water

As noted previously, this sample represents a general area upstream from the January, East Pacific, and Freiburg mines and downstream of the Carlson cross cut, all on private land. The visual condition of the stream here appeared healthy and vegetation was normal. Flow was estimated at 188 gpm by using bucket and stopwatch. There were no exceedences in the water quality data (table 37).

Table 37. Water-quality exceedences, Weasel Creek.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | **pH** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WWCS10M-Weasel Ck | | | | | | | | | | | | | | | | | | | |

Exceedence codes:

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

Note: The analytical results are listed in appendix IV.

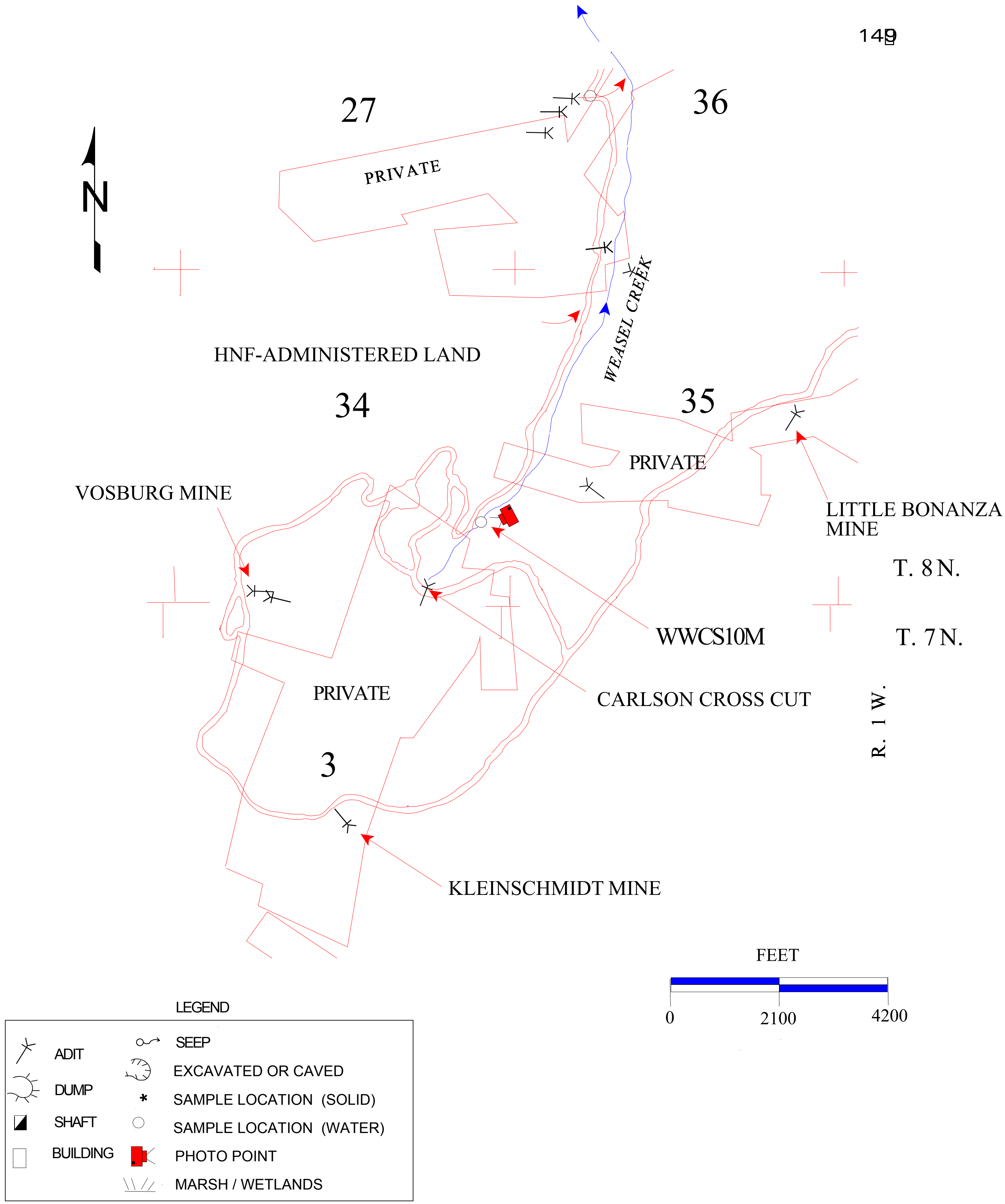



Figure 27. The area along Weasel Creek (8/30/95) has been previously mined. A sample was collected from the creek below the Vosburg mine and mill, the Kleinschmidt mine and mill, and the Carlson Crosscut.

Figure 27a. A surface-water sample (WWCS10M) was collected from Weasel Creek on HNF-administered land below several mines on private land.

2.28.3.4 Vegetation

The creek did not appear to be affected by the mining activity above it. The vegetation appeared healthy and green in consideration of grazing and the forest fire in 1988. Grasses, willows, and sedges grow in the valley, while lodgepole pine grows on the slopes to the east. Wildflowers were abundant, especially monkey flower.

2.28.3.5 Summary of Environmental Condition

No impacts of the mining activity on private land above this area appeared to affect the creek or the land, except in the immediate vicinity of the mines. As noted, however, waste material on private land upstream may be eroded and wash into the stream during storm events and spring runoff. Upstream at the Carlson cross cut, monkeyflower and fire weed blooms in profusion. The area is recuperating from the forest fire in the Elkhorn Mountains in 1988 started by a ‘67 Impala from Butte (Lonn 1995).

2.28.4 Structures

Two, frame and metal shingle buildings/cabins were at the mine immediately to the south (upstream) from the Weasel Creek site, but were not associated with the sampling site. They were recently partially destroyed in the forest fire; grazing cattle use them for shelter and are contributing to their destruction.

2.28.5 Safety

No safety issues are associated with this particular site, but the road crossing private land in front of the Carlson cross cut has been eroded. It is potentially a hazard, although it was on private land.

## 2.29 Stray Horse Mine

2.29.1 Site Location and Access

The Stray Horse mine (T8N R1W section 35CBCA) is on the northeast flank of the Elkhorn Mountains, about five miles southwest of Winston, Montana and about 19 miles southeast of Helena, Montana. The Stray Horse mine is on private property; HNF-administered land borders the mine on to the north, west, and south. The site is accessible by traveling the improved road east of Winston to Forest Route 405.

2.29.2 Site History - Geologic Features

Reed (1951) described this property in detail. Two near-vertical east-west veins 100 feet apart, each about two feet wide, in andesite were mined through five adits and several shallow shafts. Supposedly, the mine produced more than $200,000 worth of ore by 1901 but very little since. Average grade of the ore was 0.37 oz/ton gold, 21.1 oz/ton silver, and 10.7% lead.

2.29.3 Environmental Condition

The lowermost adit at the site discharged water. The water flowed over a waste-rock dump of unaltered andesite and into Weasel Creek. Waste-rock dumps were mostly barren, but appeared stable.

2.29.3.1 Site Features - Sample Locations

The Stray Horse mine was sampled on 08/29/1995. Water samples from Weasel Creek were collected upstream (WSHS10L) and downstream (WSHS20L) of the site. All samples were collected on HNF-administered land. At the upstream sample location, Weasel Creek flowed about 75 gpm, the SC was about 208 µmhos/cm, and the pH was about 8.2. At the downstream sample location, Weasel Creek flowed about 100 gpm, the SC was about 177 µmhos/cm, and the pH was about 8.3. Site features and sample locations are shown in figure 28; photographs are shown in figures 28a and 28b.

#### 2.29.3.2 Soil

Waste material at the Stray Horse mine did not appear to be impacting soil on HNF-administered land. Soil samples, therefore, were not collected.

#### 2.29.3.3 Water

The concentrations of cadmium and mercury exceeded the chronic aquatic life standard in the upstream sample (table 38). The mercury concentration, however, was only 0.01 µg/L greater than the detection limit of 0.1 µg/L.

Table 38. Water-quality exceedences, Stray Horse mine.

| Sample Site | Al | As | Ba | Cd | Cr | Cu | Fe | Pb | Mn | Hg | Ni | Ag | Zn | Cl | F | $NO_3$ | $SO_4$ | Si | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stray Horse mine--upstream of the site (WSHS10L) | | | | C | | | | | | C | | | | | | | | | |
| Stray Horse mine--downstream of the site (WSHS20L) | | | | | | | | | | | | | | | | | | | |

Exceedence codes:

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

Note: The analytical results are listed in appendix IV.

#### 2.29.3.4 Vegetation

Vegetation on HNF-administered land did not appear to be affected by mining activities at the Stray Horse mine.

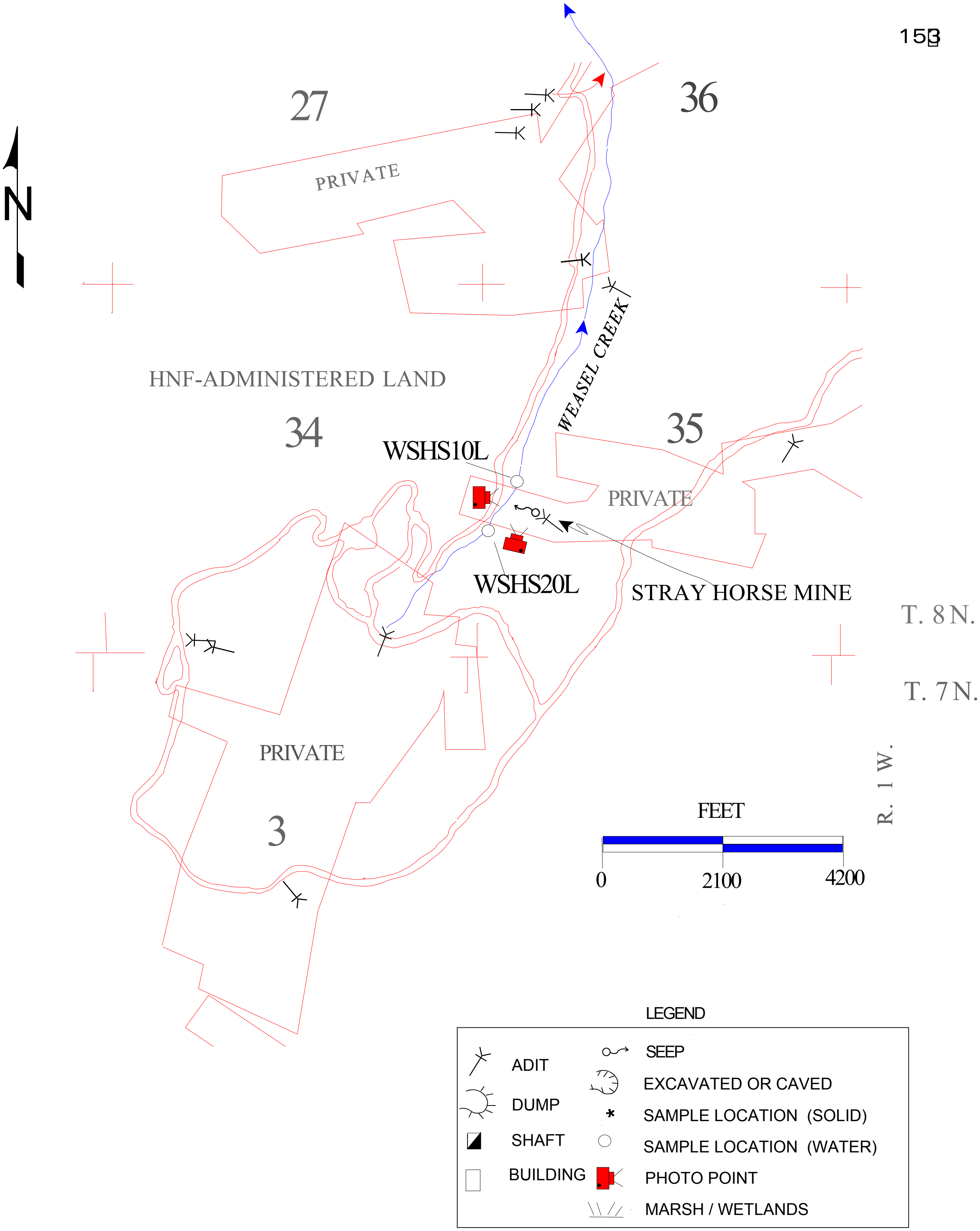



Figure 28. Surface-water samples were collected upstream and downstream of the Stray Horse mine (8/28/95). The boundaries shown are based on 7.5-min. USFS owernship maps.


Figure 28a. The upper waste-rock dumps of the Stray Horse mine are well above the flood plain of Weasel Creek.


Figure 28b. The lower waste-rock dump at the Stray Horse mine is adjacent to Weasel Creek.

2.29.3.5 Summary of Environmental Condition

Based on the results of water quality analysis, the Stray Horse mine does not appear to degrade water quality in Weasel Creek. There was no visible impact to soils or vegetation on HNF-administered land.

2.29.4 Structures

There were no structures observed on HNF-administered land. Other structures on private portions of the site were not inventoried or evaluated.

2.29.5 Safety

The Stray Horse mine was not evaluated for safety because it is privately owned; no safety concerns were identified on HNF-administered land.

## 2.30 Little Bonanza Mine

2.30.1 Site Location and Access

The Little Bonanza mine (T8N R1W section 35ADCA) is on private land upstream of HNF-administered land. The mine may be reached either by the road up Kimber Gulch or by the Beaver Creek/Weasel Creek road past the Carlson cross cut and over the divide to Kimber Gulch. It is located on the Winston 7.5-min. quadrangle.

2.30.2 Site History - Geologic Features

Earll (1964) described this mine's geologic setting in andesite of the Cretaceous Elkhorn Mountains volcanics. Three patented claims are involved: the Little Bonanza, Bedrock and the Little Bonanza Extension. The area has been mined since the late 1800s early 1900s. The size of the waste-rock dumps suggest less than 1,000 feet of workings. Small pieces of ore contained vuggy quartz, pyrite, galena, sericite, and copper-bearing minerals.

2.30.3 Environmental Condition

The site consisted of two collapsed adits and an associated waste-rock dump in the intermittent drainage of Kimber Gulch, all on private land. The waste dump is small, of relatively large fragments and had no major erosion features. Two adits, on private land, discharged water but appear to have no adverse environmental effects on HNF-administered land.

### 2.30.3.1 Site Features - Sample Locations

The water emanating from the adit appeared clear and cold. It, along with the water from various seeps associated with the area constitutes the majority of the water in Kimber Gulch in this area. A surface-water sample (KLBS10M) was collected from below the waste dump on HNF-administered land on 08/30/95. Flow was estimated at 55 gpm using a bucket and stopwatch. The pH measured 7.8 in the field and the SC was 162.5 µmhos/cm. The remainder of the workings were on patented claims. Site features and sample locations are shown in figure 29; photographs are shown in figures 29a and 29b.

### 2.30.3.2 Soil

No soil samples were taken at this site. The waste-rock dumps appeared stable; there was no visible indication of adverse impacts to soils on HNF-administered land.

### 2.30.3.3 Water

The concentrations of the constituents considered were generally well below the MCLs and ALSs (table 39). Although the quality of the water discharging from the adit could not be determined, the impact from site discharges were minimal at the time of sampling.

Table 39. Water-quality exceedences, Little Bonanza mine.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | **pH** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KLBS10M-downstream | | | | | | | | | | | | | | | | | | | |

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

Note: The analytical results are listed in appendix IV.

### 2.30.3.4 Vegetation

Sage and grasses were the dominant vegetation with the mine located adjacent to a stand of Douglas fir to the south on the north facing aspect. Vegetation did not appear to be affected by the mining activity here. Indeed, the water is greatly needed for the cattle and grasses. Raspberry bushes grow on most of the dumps.

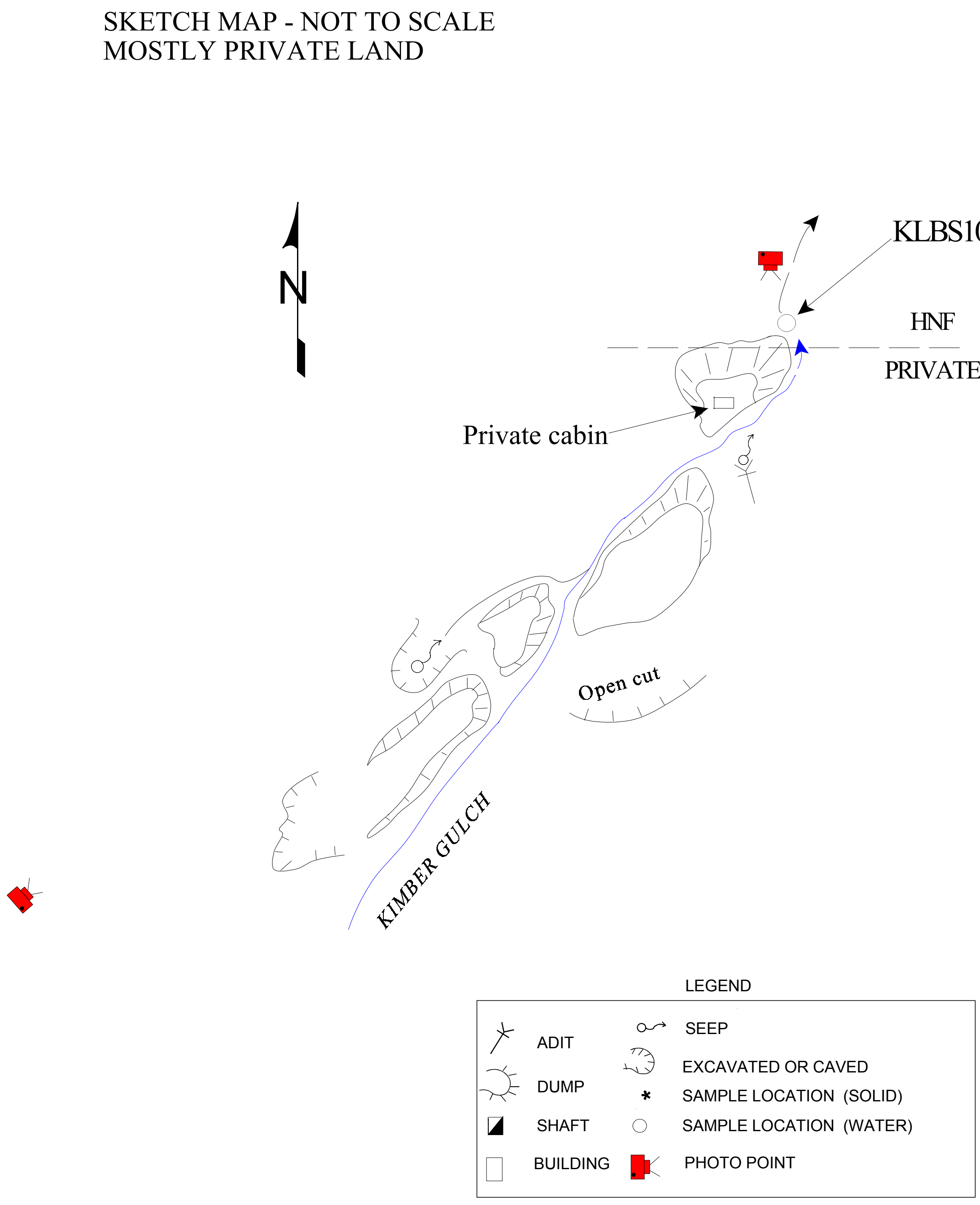



Figure 29. The Little Bonanza mine's discharges and waste dump were adjacent to HNF-administered land (9/18/93). A sample of Kimber Gulch was collected downstream.

Figure 29a. The Little Bonanza mine lies mostly on private land in Kimber Gulch.

Figure 29b. A surface-water sample was collected from Kimber Gulch below the Little Bonanza mine on HNF-administered land.

2.30.3.5 Summary of Environmental Condition

No major problems were noted on HNF-administered land below the site. All discharges were on private land, as well as all structures and openings.

2.30.4 Structures

There was one cabin in good repair on the private patented land, and it is apparently used for recreation.

2.30.5 Safety

No safety concerns were identified on HNF-administered land. All adits and waste dumps were on private land.

## 2.31 Sunrise and January Mines

### 2.31.1 Site Location and Access

The Sunrise and January mines (T8N R1W section 26CDCC) are on the northeast flank of the Elkhorn Mountains, about four miles southwest of Winston, Montana, and about 18 miles southeast of Helena, Montana. The January mine is on private property; the Sunrise mine is on HNF-administered land. The private property of the January mine borders HNF-administered land of the Sunrise mine on the north and west. The site is accessible by traveling the improved road east of Winston to Forest Route 405.

### 2.31.2 Site History - Geologic Features

At the Sunrise mine, a vein (N40°W 60°NE) of pyrite native gold, galena, sphalerite, and chalcopyrite was mined at the quartz monzonite-andesite contact (Reed 1951). Value of metals produced was about $50,000 (Reed 1951).

At the January mine, a 1- to 15-foot-wide zone (N70°–90°W, 40°–70°NE) of altered and broken rocks laced with gouge and stringers of quartz, rhodochrosite, pyrite, galena, sphalerite, chalcopyrite, tetrahedrite, and arsenopyrite was mined at the contact of Elkhorn Mountains volcanics and the January stock. Reed (1951) showed about 2,000 feet of workings in a longitudinal section, and stated that the average grade of ore mined was 0.108 oz/ton gold, 5.3 oz/ton silver, 0.11% copper, 5% lead, and 3.4% zinc.

## 2.31.3 Environmental Condition

The Sunrise mine consisted of a caved adit and a waste-rock dump. Water discharged from the cave adit; the waste-rock dump was in the flood plain of Weasel Creek. The discharge from the adit flowed onto private property before flowing into Weasel Creek.

The January mine consisted of one open adit, three caved adits, and associated waste-rock dumps. Water discharged from the caved adit and flowed into Weasel Creek; waste-rock dumps were in the flood plain of Weasel Creek. All visible potential environmental impacts at the January mine were on private property.

### 2.31.3.1 Site Features - Sample Locations

The Sunrise and January mines were sampled on 08/29/1995. A sample of the Sunrise mine adit discharge (WSRS20L), and samples from Weasel Creek were collected upstream (WSRS30L) and downstream (WSRS10L) of the two sites. All samples were collected on HNF-administered land. The flow of the adit discharge was about 15 gpm, the SC was about 47 µmhos/cm, and the pH was about 8.0. At the upstream sample location, the flow in Weasel Creek was about 135 gpm, the SC was about 202 µmhos/cm, and the pH was about 8.3. At the downstream sample location, the flow in Weasel Creek was 135 gpm, the SC was about 248 µmhos/cm, and the pH was about 7.96. Site features and sample locations are shown in figure 30; photographs are shown in figures 30a and 30b.

### 2.31.3.2 Soil

Waste material at the Sunrise mine did not appear to be impacting soil in undisturbed areas. Waste material at the January mine did not appear to be impacting soil on HNF-administered land. Soil samples, therefore, were not collected.

### 2.31.3.3 Water

Water-quality standards were exceeded in upstream and downstream samples (table 40). At both sample locations, the concentrations of zinc exceeded the acute and chronic aquatic life standards; zinc concentration downstream was about three times greater than the concentration upstream. The concentration of cadmium in the downstream sample also exceeded the primary MCL and acute and chronic aquatic life standards. The concentration of mercury in the downstream sample exceeded the chronic life standard; the concentration, however, was at the detection limit. Water-quality standards were not exceeded in the adit discharge sample.

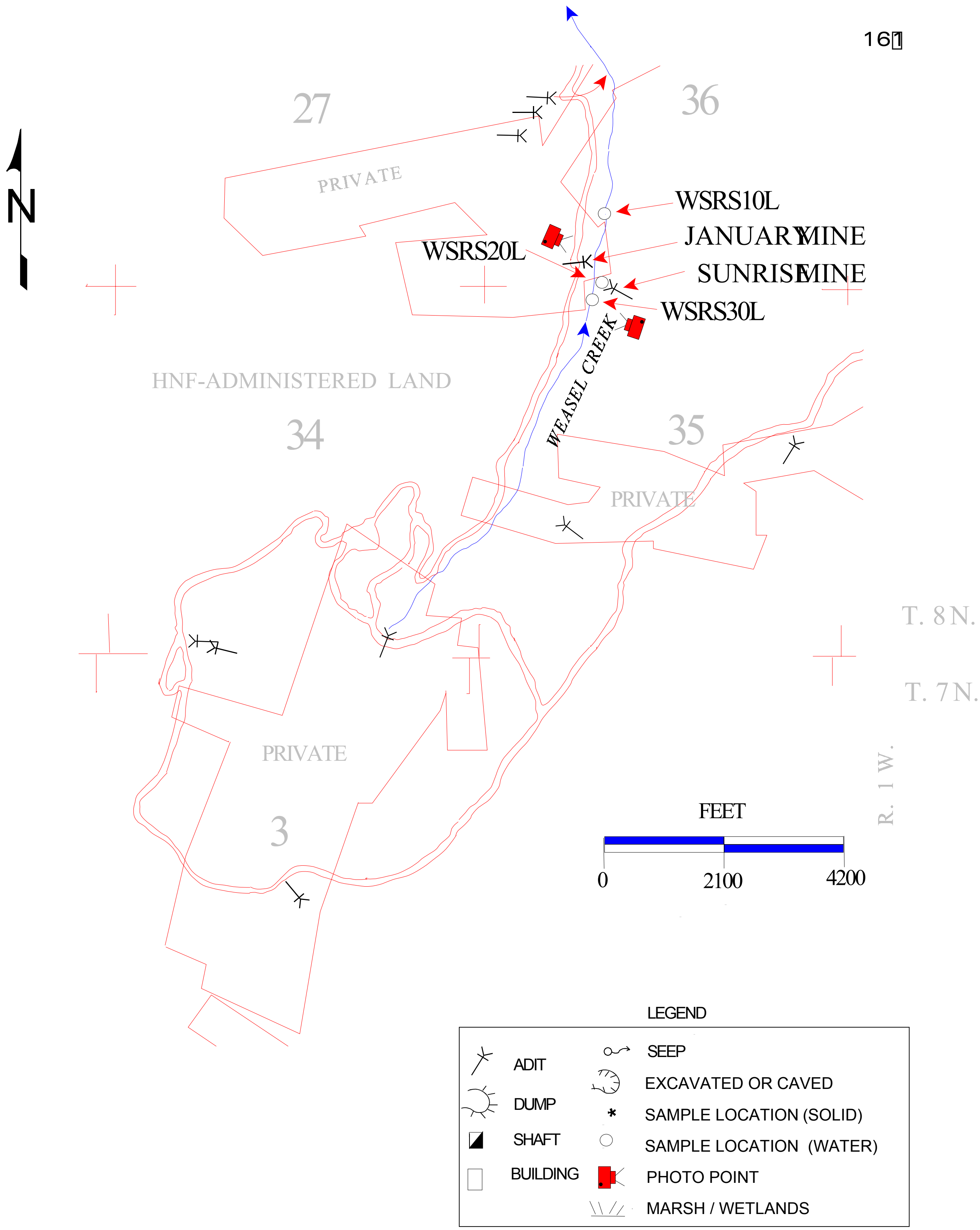



Figure 30. January and Sunrise mines (18/29/95) are adjacent to Weasel Creek. An adit discharge form the Sunrise mine flowed onto private property before flowing into Weasel Creek.


Figure 30a. Water from the caved adit and waste-rock dump at the Sunrise mine flowed to the north and joined Weasel Creek on private property.


Figure 30b. The waste-rock dump of the January mine is across Weasel Creek from the Sunrise mine. Adit discharge from the Sunrise mine is shown in the bottom of the photograph.

Table 40. Water-quality exceedences, Sunrise and January mines.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | **pH** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Weasel Creek--upstream of the mines (WSRS30L) | | | | | | | | | | | | | A,C | | | | | | |
| Sunrise--adit discharge (WSRS20L) | | | | | | | | | | | | | | | | | | | |
| Weasel Creek--Downstream of the Mines (WSRS10L) | | | | P,A C | | | | | | C | | | A,C | | | | | | |

Exceedence codes:

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

Note: The analytical results are listed in appendix IV.

2.31.3.4 Vegetation

The waste-rock dumps at the Sunrise and January mines were poorly vegetated. The area adjacent to the disturbed areas did not appear to be impacted from past mining activities and was well vegetated with grasses, conifers, brush, and weeds.

2.31.3.5 Summary of Environmental Condition

The poorly vegetated waste-rock dumps may potentially be eroded by Weasel Creek and stormwater runoff. The zinc concentration in the upstream sample exceeds the acute and chronic aquatic life standards; additionally, the concentration of zinc in Weasel Creek increased by more than a factor of three downstream of the two mines. Cadmium, undetected in the upstream sample and the adit discharge sample, exceeded the primary MCL and acute and chronic aquatic life standards in the downstream sample.

2.31.4 Structures

There were no structures on HNF-administered land near the site. Other structures on private portions of the site were not inventoried or evaluated.

2.31.5 Safety

The steep slopes near the caved adit at the Sunrise may pose a threat to safety. The January mine was not evaluated for safety because it is privately owned.

## 2.32 East Pacific Mine and Mill

2.32.1 Site Location and Access

The East Pacific mine and mill (T8N R1W section 26CBAB) is on the northeast flank of the Elkhorn Mountains, about four miles southwest of Winston, Montana and about 18 miles southeast of Helena, Montana. The north half of the site is on HNF-administered land. The site is accessible by traveling the improved road east of Winston to Forest Route 405.

2.32.2 Site History - Geologic Features

Reed (1951) gave a comprehensive summary of the mine and mill. The mine was worked periodically since the 1880s until at least 1949, producing over $2 million worth of metals. Development at the site consisted of several shafts, four main shafts, and ten levels, with about five miles of workings. A gravity mill operated on the site. The vein mined had a N75°E 70°–85°NW attitude, is 1 in.–5 feet wide, contains quartz, pyrite, sphalerite, chalcopyrite, tetrahedrite, native gold, calcite, and rhodochrosite, and is hosted by an andesite flow within the Elkhorn Mountains volcanics. An interesting feature of the vein is that it did not contain the usual fault gouge. Average grade was 0.29 oz/ton gold, 10.2 oz/ton silver, 6.3% lead, and 2.2% zinc. A dump composite sample assayed 0.0105 oz/ton gold, 21.8 ppm silver, 88 ppm copper, 1,280 ppm lead, 4,170 ppm zinc, and 230 ppm arsenic. A tailings composite sample contained 0.0220 oz/ton gold, 66.4 ppm silver, 699 ppm copper, 7,410 ppm lead, 1.0% zinc, and 988 ppm arsenic.

2.32.3 Environmental Condition

The site consisted of discharging adits, waste rock dumps, a mill building, and a tailings impoundment. The discharging adits were on the private portion of the site; the water infiltrated into the ground before flowing onto HNF-administered land. On the HNF-administered portion of the site, several seeps emerged. Water from the seeps completely infiltrated into the tailings, but re-emerged at the toe of the tailings impoundment. The tailings and waste rock appeared to be stable.

2.32.3.1 Site Features - Sample Locations

The East Pacific mine and mill were sampled on 08/28/1995. A residence uses water from a spring upstream of the site for domestic purposes. A sample of spring water was collected from an outside faucet at the residence (WEPS20L). The flow of the spring was not measured, but the SC was about 101 µmhos/cm, and the pH was about 8.1. The seep at the toe of the tailings impoundment was sampled just below the road north of the site (WEPS10L). The spring was flowing at about 33 gpm, the SC was about 359 µmhos/cm, and the pH was about 8.1. Site features and sample locations are shown in figure 31; photographs are shown in figures 31a and 31b.

2.324.3.2 Soil

Waste material at the site did not appear to be impacting adjacent soils. Soil samples, therefore, were not collected.

2.32.3.3 Water

Water-quality standards were not exceeded in the spring located upstream of the site. The concentration of cadmium exceeded the primary drinking water MCL, and the acute and chronic aquatic life standards in water seeping from the toe of the tailings impoundment; the concentration of lead exceeded the chronic life standard (table 41). Although below standards, the concentration of arsenic increased and the concentration of zinc decreased by almost an order of magnitude in the downstream sample compared to the upstream sample.

2.32.3.4 Vegetation

Most of the site was barren. Undisturbed areas around the site were well vegetated with grasses, conifers, brush, and weeds.

2.32.3.5 Summary of Environmental Condition

The waste-rock dumps and tailings appeared to be stable and not being eroded. Water quality was significantly degraded as it flows through the site.

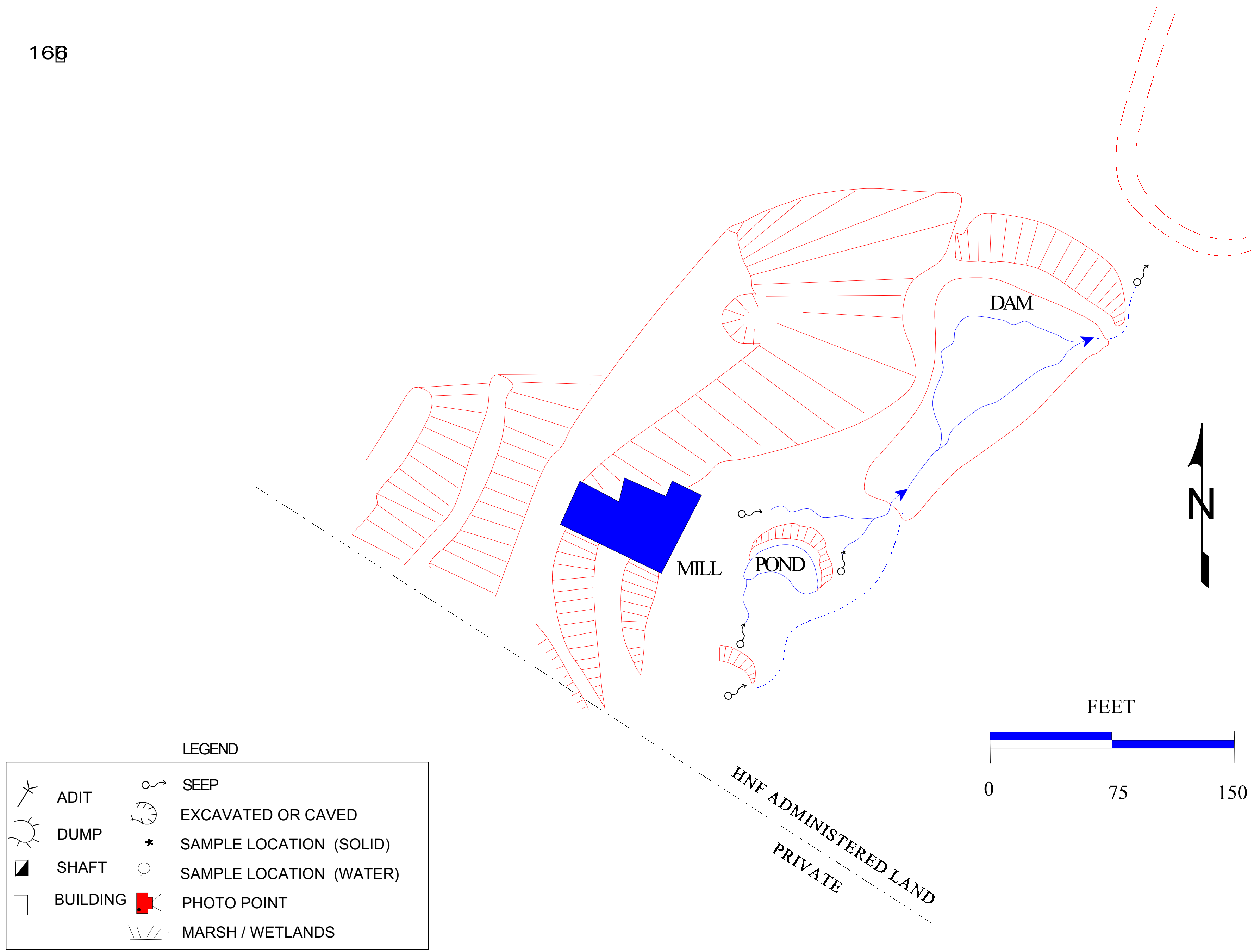



Figure 31. The East Pacific mine and mill (8/28/95) had discharges on HNF-administered land. A spring on private land above the site was being used for domestic drinking water


Figure 31a. The East Pacific mine and mill had several seeps and were being eroded by the stream.

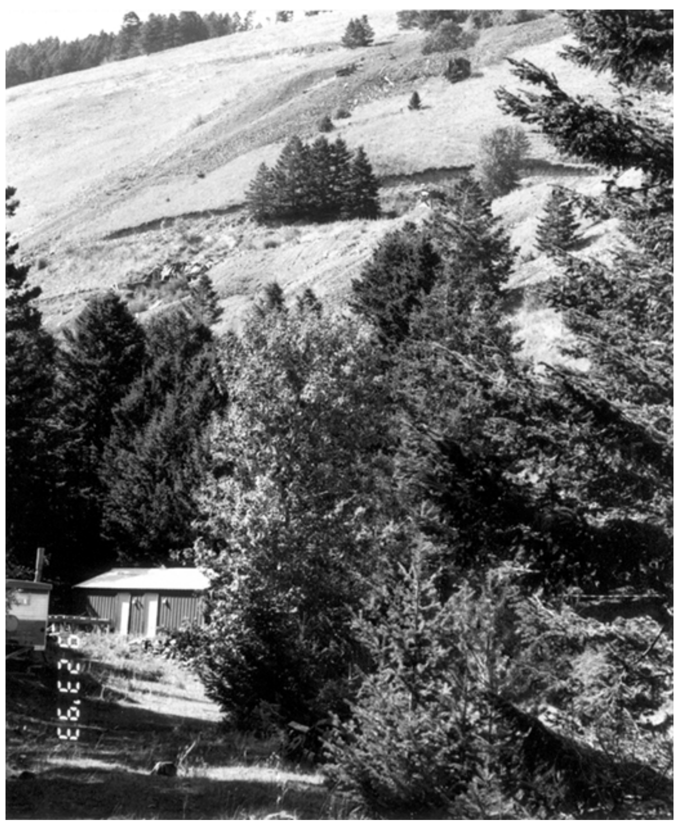



Figure 31b. The upper workings at the East Pacific mine and mill are on a steep hillside. Springs emerged at several points within the disturbed area.

Table 41. Water-quality exceedences, East Pacific 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 Pacific mine and mill-Upstream (WEPS20L) | | | | | | | | | | | | | | | | | | | |
| East Pacific mine and mill-Downstream (WEPS10L) | | | | P,A C | | | | C | | | | | | | | | | | |

Exceedence codes:
P - Primary MCL
S - Secondary MCL
A - Aquatic Life Acute
C - Aquatic Life Chronic
Note: The analytical results are listed in appendix IV.

### 2.32.4 Structures

The mill building was in fair condition. Other structures on private portions of the site were not inventoried or evaluated.

### 2.32.5 Safety

The portion of the site on HNF-administered land did not pose any obvious threats to safety.

## 2.33 Freiburg Mine

### 2.33.1 Site Location and Access

The Freiburg mine (T8N R1W section 26CABA) is on the northeast flank of the Elkhorn Mountains, about four miles southwest of Winston, Montana, and about 18 miles southeast of Helena, Montana. The site is on private property. The site is bordered by HNF-administered land on the north, south, and east. The site is accessible by traveling the improved road east of Winston to Forest Route 405.

### 2.33.2 Site History - Geologic Features

Two caved adits and one caved shaft exist at the Freiburg. Waste rock consists of unaltered feldspar porphyry. According to Reed (1951), a N70°E 75°SE vein of pyrite, galena, and chalcopyrite was mined from quartz monzonite and andesite. Also, sphalerite was observed in the dumps.

### 2.33.3 Environmental Condition

An adit at the site discharged water at a very low rate (<1 gpm). The water completely infiltrated into ground before flowing onto HNF-administered land. Weasel Creek flowed through the site; the waste-rock dumps, the adits, and the shaft were several hundred feet away from Weasel Creek and HNF-administered land (figure 32). The unnamed stream that drained the East Pacific mine (previous section) flowed into Weasel Creek; the confluence of the two was on private property.

#### 2.33.3.1 Site Features - Sample Locations

The Freiburg mine was sampled on 08/28/1995. Water samples from Weasel Creek were collected upstream (WFBS10L) and downstream (WFBS20L) of the site on HNF-administered land. At the upstream sample location, the flow in Weasel Creek was 180 gpm, the SC was about 265 µmhos/cm, and the pH was about 8.0. At the downstream sample location, the flow in Weasel Creek was about 450 gpm, the SC was about 294 µmhos/cm, and the pH was about 8.0. Site features and sample locations are shown in figure 32; photographs are shown in figures 32a.

#### 2.33.3.2 Soil

Waste material at the site did not appear to be impacting soil on HNF-administered land. Soil samples, therefore, were not collected.

#### 2.33.3.3 Water

Water-quality standards were exceeded in upstream and downstream samples (table 42). The mercury concentration in the upstream sample exceeded the chronic aquatic life standard; the concentration, however, was only 0.01 µg/L greater than the detection limit of 0.10 µg/L. At both sample locations, the concentrations of cadmium and zinc exceeded the acute and chronic aquatic life standards. The concentrations of cadmium in upstream and downstream samples was 12.4 and 11.9 µg/L, respectively. The concentrations of zinc in upstream and downstream samples was 543 and 540 µg/L, respectively. The flow in Weasel Creek more than doubled as it flowed through the site; cadmium and zinc must be contributed to Weasel Creek. If not, their concentrations would probably decrease in the downstream sample due to dilution. Some of the cadmium contribution could be to attributed to East Pacific mine drainage which, on 08/28/1995, contained 12 µg/L cadmium. The concentration of zinc, however, cannot be explained by the East Pacific mine drainage because the zinc concentration in the drainage was 0.852 µg/L.

Table 42. Water-quality exceedences, Freiburg mine.

| Sample Site | Al | As | Ba | Cd | Cr | Cu | Fe | Pb | Mn | Hg | Ni | Ag | Zn | Cl | F | $NO_3$ | $SO_4$ | Si | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freiburg mine--upstream of the site (WFBS10L) | | | | A,C | | | | | | | | | A,C | | | | | | |
| Freiburg mine--downstream of the site (WFBS20L) | | | | A,C | | | | | | | | | A,C | | | | | | |

Exceedence codes:

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

Note: The analytical results are listed in appendix IV.

2.33.3.4 Vegetation

Vegetation on HNF-administered land did not appear to be impacted from past mining activities; the site was is well vegetated with grasses, conifers, brush, and weeds.

2.33.3.5 Summary of Environmental Condition

The waste-rock dumps on private land appeared stable and were not being eroded onto HNF-administered land. Zinc and cadmium were contributed to Weasel Creek as it flows through the site. Some of the cadmium may be contributed from East Pacific mine drainage; zinc contribution to Weasel Creek is not readily attributable to East Pacific mine drainage.

## 2.33.4 Structures

Near the site, there were not any structures on HNF-administered land. Other structures on private portions of the site were not inventoried or evaluated.

## 2.33.5 Safety

The site was not evaluated for safety because it is privately owned. On HNF-administered land near the site, obvious threats to safety were not observed.

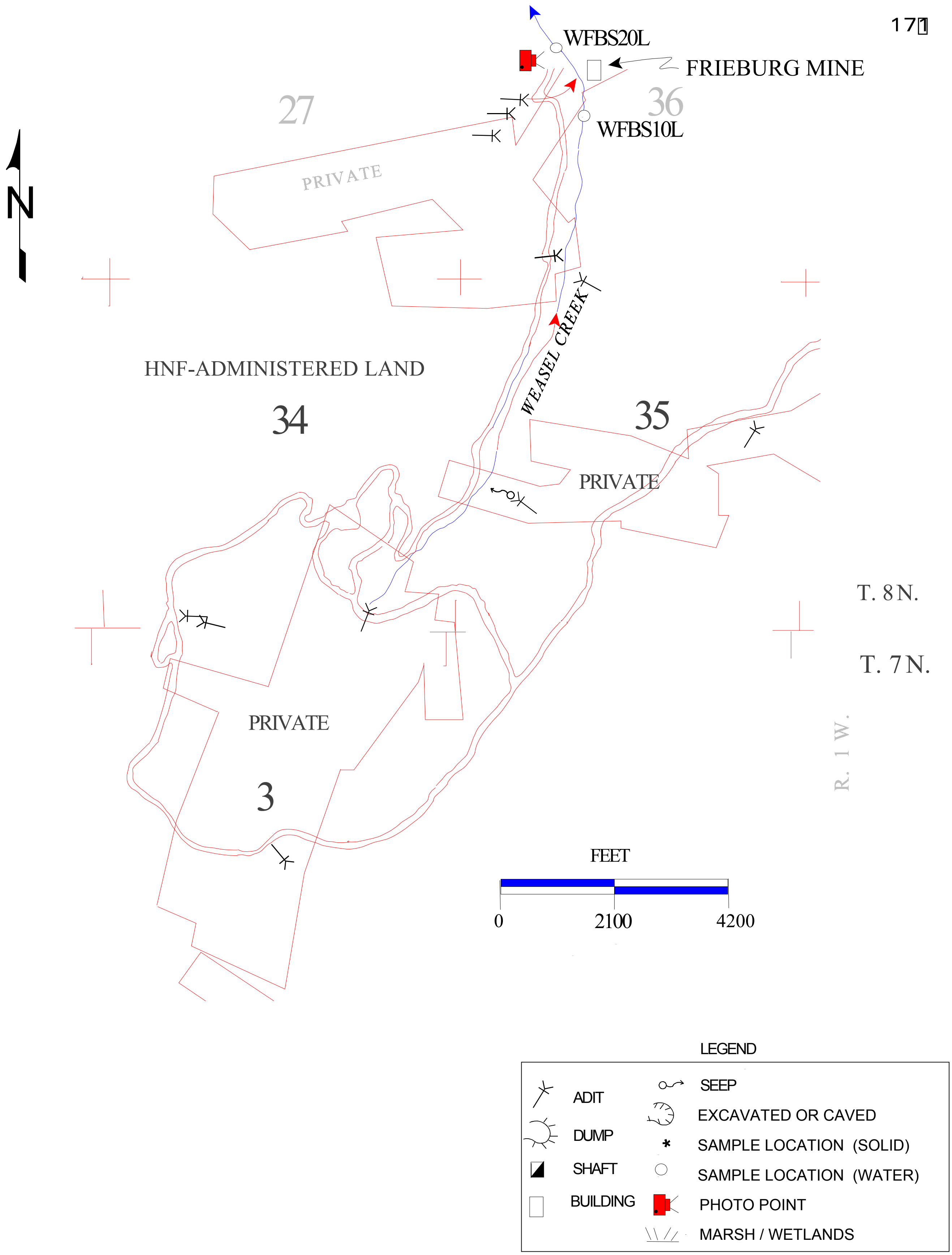



Figure 32. The Frieburg mine (8/28/95) is downstream of several other mines on Weasel Creek. Samples were collected upstream and downstrean on HNF-administered land.

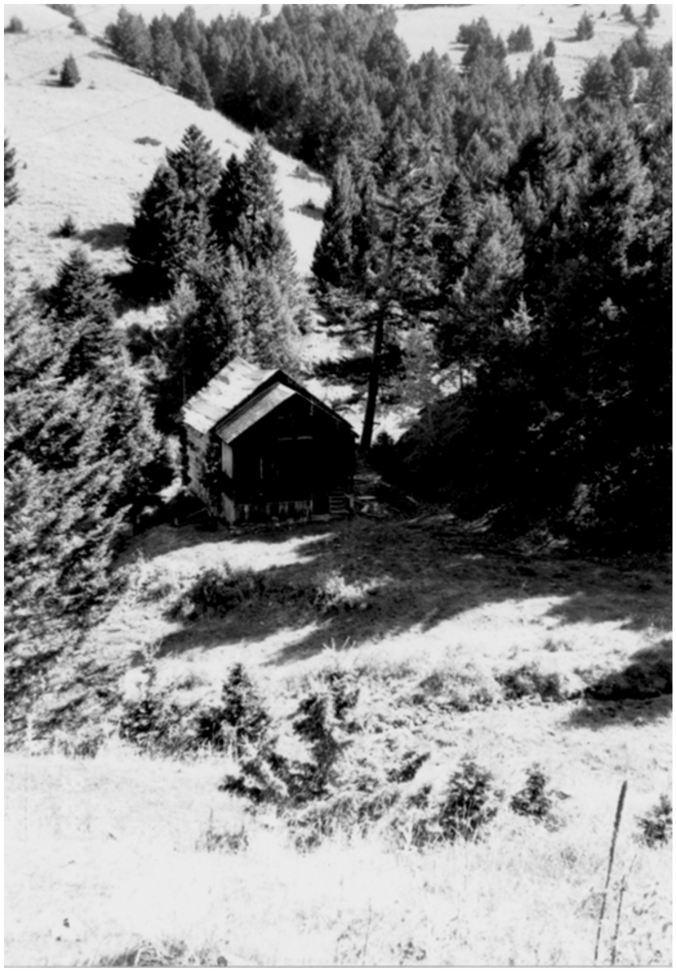


Figure 32a. The Freiburg mine site is on private land. Weasel Creek, which flowed onto HNF-administered land, is the foreground.

## 2.34 Argo Mine

2.34.1 Site Location and Access

The Argo mine (T11N R1E section 27BDBA) is on private land above HNF-administered land. The mine is located on the Hellgate Gulch 7.5 min. quadrangle at an elevation of approximately 5,200 feet with the Argo mine and mill to the east of the road. The Conshohocken, Mike Finch, and Hellgate claims lie to the west of the road and slightly upstream from the Argo (Pardee and Schrader 1933). Hellgate Gulch runs northeast from Canyon Ferry Lake, one of series of northeast trending gulches in this area. Approximately five miles east of East Helena via U.S. Highway 12 (287), turn north on County Highway 284, cross at the Canyon Ferry Dam and continue north and east on Highway 284 to Hellgate Gulch (road 693) and at 2.2 miles from the turnoff take a left before the ranch. The mine site is approximately 3.2 miles up Hellgate Gulch from this junction just above where Fisher Gulch joins it from the east. It is easily recognizable by its streamside tailings and mine buildings. The road degrades into a trail about 1,000 feet upstream from the mine.

Two patented claims, one trending NE and the other E-W, are private (see Canyon Ferry 1:100,000-scale BLM map). All of the tailings and the adit are on private land, the boundaries of which have been recently re-surveyed (October 5, 1995, Mineral Survey corners relocated, claim lines run N 60°E).

## 2.34.2 Site History - Geologic Features

Pardee and Schrader (1933) described the Argo as a copper-bearing, 4- to 5-foot-wide quartz/iron oxide/copper carbonate vein, at least 600 feet in pitch length and 500 or more feet long. Paragenesis of minerals are listed as ankerite, quartz, and chalcopyrite with the oxidized portion characterized by dark brown limonite "iron cap."

Production figures from 1902 to 1918 show the Argo yielded 2,997,787 pounds copper and $500,974 in net smelter returns (Pardee and Schrader 1933). This report claims the tailings below the mill average 12 pounds of copper per ton.

## 2.34.3 Environmental Condition

The site consisted of two adits, tailings, and a mill building on private land; the lower adit was visited. It was flooded but did not discharge water; it had an iron gate but was not locked. The waste-rock dump associated with the adit was on HNF-administered land. The dump appeared stable and there was not indication of impacts to soil or water. The dump was dry and composed of Precambrian shales (red and green Spokane?) with <1% chalcopyrite/pyrite.

Pioneer Technical Services (1995) sampled the area in 1993, with results similar to MBMG in 1995. Both found a release of copper downstream of the site probably attributable to the streamside tailings, but MBMG's results showed 0.0075 mg/L Cu which is below the acute and chronic aquatic life standards. Pioneer ranked the Argo 246 out of 273 sites that they evaluated.

### 2.34.3.1 Site Features - Sample Locations

The tailings, which were in contact with Hellgate Creek, and the mill at the Argo mine were on a patented claim and were not sampled. A sample was collected from Hellgate Creek upstream and downstream of the site. Upstream, the pH was 7.82; the SC was 552 µmhos/cm. Downstream, the pH was 8.22; the SC was 577 µmhos/cm. Hellgate Creek was flowing at approximately 60 gpm at both sample sites. Site features and sample locations are shown in figure 33; photographs are shown in figures 33a and 33b.

2.34.3.2 Soil

No soil samples were collected because most of the potential environmental problems are on private land. Samples were collected on private land by Pioneer in 1995.

2.34.3.3 Water

The concentrations of dissolved metals in Hellgate Gulch were generally the same, both upstream and downstream. No criteria were exceeded in the samples (table 43), although the concentration of copper was significantly greater downstream. No excessive sedimentation was observed at either sample site.

Table 43. Water-quality exceedences, Argo mine.

| **Sample Site** | **Al** | **As** | **Ba** | **Cd** | **Cr** | **Cu** | **Fe** | **Pb** | **Mn** | **Hg** | **Ni** | **Ag** | **Zn** | **Cl** | **F** | **$NO_3$** | **$SO_4$** | **Si** | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HARS10H-upstream | | | | | | | | | | | | | | | | | | | |
| HARS20H-downstream | | | | | | | | | | | | | | | | | | | |

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

Note: The analytical results are listed in appendix IV.

2.34.3.4 Vegetation

The tailings on private land were nearly barren with a few areas of sparse vegetation in small depressions. They did not appear to affect the vegetation in the surrounding area or the willows along the creek. The waste dump had a few fir trees started on it but was still largely barren on the northwest end.

2.34.3.5 Summary of Environmental Condition

No adit discharge was evident on the Argo mine site; there was standing water in the lower adit, however. Water erosion of the tailings on private land was evident and wind erosion possible, but the water downstream did not exceed any water-quality criteria.

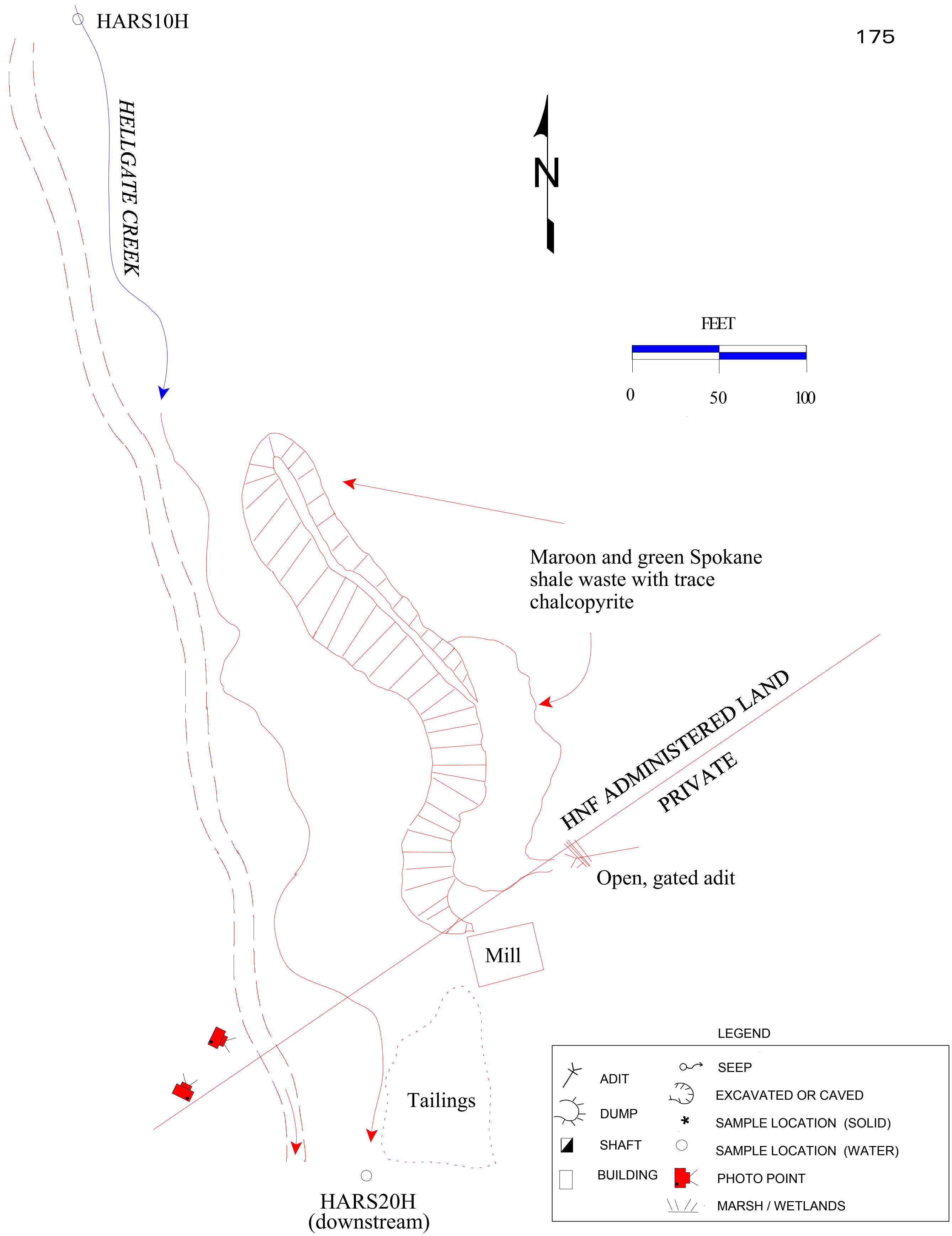



Figure 33. At the Argo mine (10/13/95), Hellgate Creek flowed past a waste-rock dump ansd was actively eroding tailings in the flood plain.

Figure 33a. The waste-rock dump of the Argo mine is on HNF-administered land in Hellgate Creek. The tailings are on private land (lower right of photo). Also pictured are flattened buildings on private land.

Figure 33b. The layered tailings on private land were being actively eroded by Hellgate Creek. The extent of the tailings is marked by sparse vegetation.

2.34.4 Structures

The Hellgate claim, west of the road, had one board and batten shack remaining standing (but leaning) with rusting junk and loose boards lying about. The Argo mill, which was a log structure was still standing but the roof was nearly gone, and the sides were leaning. Small board shacks west of the road up Hellgate Gulch and north of the road up Harris Gulch were completely flattened.

2.34.5 Safety

The log mill building was still partially standing and probably should be considered hazardous. It is on private land. All other buildings were totally collapsed. Four iron boilers remained on site. The waste-rock dump had steeply sloped sides but there was little danger of failure. The lower adit, on private land, was open, flooded, and probably should be considered somewhat dangerous. It did have an iron gate but the gate was unlocked at the time of this visit. The tailings, also on private land, showed tracks of ATVs playing on them and, in addition to the health hazards associated with this the tails, they also had a steep side where the creek had eroded them on which an ATV could tip over.

## 2.35 Jay Gould Tunnel and Tailings

2.35.1 Site Location and Access

The Jay Gould tunnel (T13N R7W section 13BBCC) can be easily reached off the Stemple Pass road (Virginia Creek) turning south and east and proceeding approximately 1.5 miles to the site of the fairly new mill and the tunnel discharge. The tailings lie 0.3 miles to the northeast, down the small road that parallels Foolhen Creek.

2.35.2 Site History - Geologic Features

Pardee and Schrader (1933) talk about the drain tunnel being driven to drain the flooded workings at the Jay Gould proper, which is on Gould Creek. As of 1927, the tunnel had progressed to a length of 3,500 feet and had intersected water. It is unclear if the workings were ever completed to their planned length of 4,700 feet. McClernan (1983) stated that the drain tunnel portal was caved but was discharging water when he visited it in 1978.

The waste rock consists of Belt sediment probably Spokane or Empire formations, predominantly shales or argillites (Pardee and Schrader 1933). There are fragments of calcite and quartz veins on the dumps, as well as intrusive (diorite?). Sulfides are rare on the dumps; dump material is fairly coarse. There were at least two generations of waste evident and two generations of mills with fairly recent activity involving waste and mills.

## 2.35.3 Environmental Condition

The site consisted of a modern mill site as well as the ruins of an older mill site, rusting junk, several cabins and mine buildings in varying states of disrepair, and an area approximately 700 feet by 75 feet of tailings that appeared to have been eroded, were present. The tunnel had a 120 gpm discharge at the time of this visit.

### 2.35.3.1 Site Features - Sample Locations

A sample was taken from the adit discharge (FJGS10H), from immediately below the mill site (FJGS20H) and from immediately below the tailings (FJGS30H). These samples were collected on 09/28/95 and 09/29/95. DSL-AMRB (Pioneer Technical Services 1995) previously sampled this site in 1993. No upstream sample could be taken because the stream had been captured by the workings more than a mile upstream. Water flowing from the tunnel was clear and cold. The flow was estimated at 120 gpm increasing to 150 gpm downstream. The water flowed from the tunnel, under the road, past and under the waste rock dumps and rusting mine trash, down the valley towards the tailings. When the flow reached the tailings, it had been channeled into a wooden flume which carried it under the tailings. The flume had been breached in several places and obviously the creek, over time, had eroded a large volume of tailings. The water exited the tailings area in an alder infested area and flowed down valley to Virginia Creek. Site features and sample locations are shown in figure 34 and 35; photographs are shown in figures 34a, 34b, 35a, and 35b.

### 2.35.3.2 Soil

Soil samples were not collected. The waste rock had not affected the soil surrounding it. The tailings appeared to have no effect on the surrounding vegetation either.

### 2.35.3.3 Water

There were no Water-quality exceedences on Fool Hen Creek attributable to the Jay Gould tunnel and tailings (table 44). Pioneer Technical Services (1995) reported arsenic levels exceeding the MCL in their downstream sample; they also found an “observed release” of lead from the site with the chronic aquatic life criteria for lead exceeded downstream. No such exceedences were found in our sampling, indicating a seasonal or other time-related variability in releases of metals.

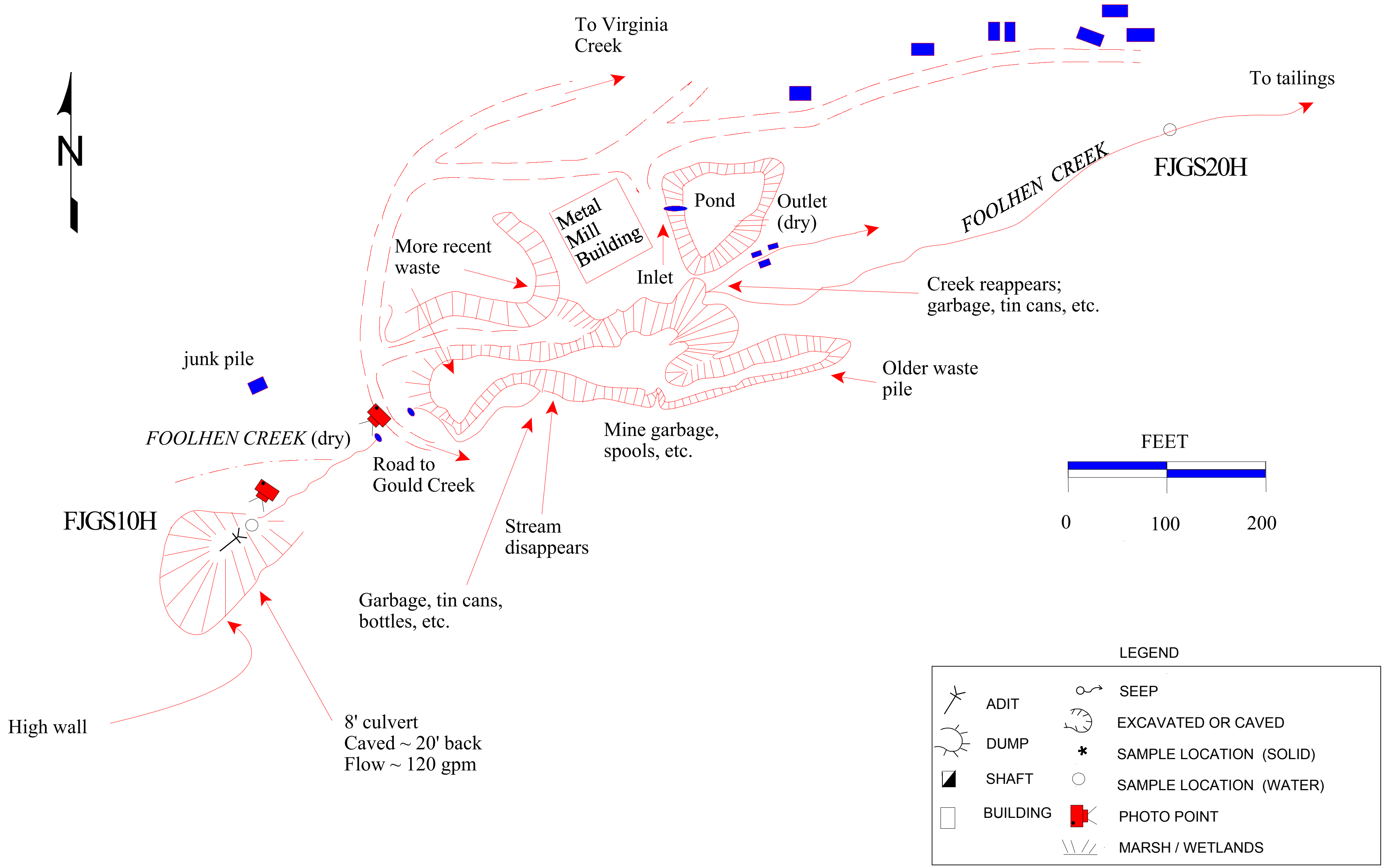



Figure 34. The workings of the Jay Gould tunnel are extensive (9/29/95). Foolhen Creek emerged from the upper adit and infiltrated the waste-rock dumps. The creek re-emerged below the lower dump.

Figure 34a. Jay Gould tunnel's portal consisted of an eight foot culvert and was discharging about 120 gpm.

Figure 34b. Water plants were growing in the discharge from the tunnel (upper center of photo).

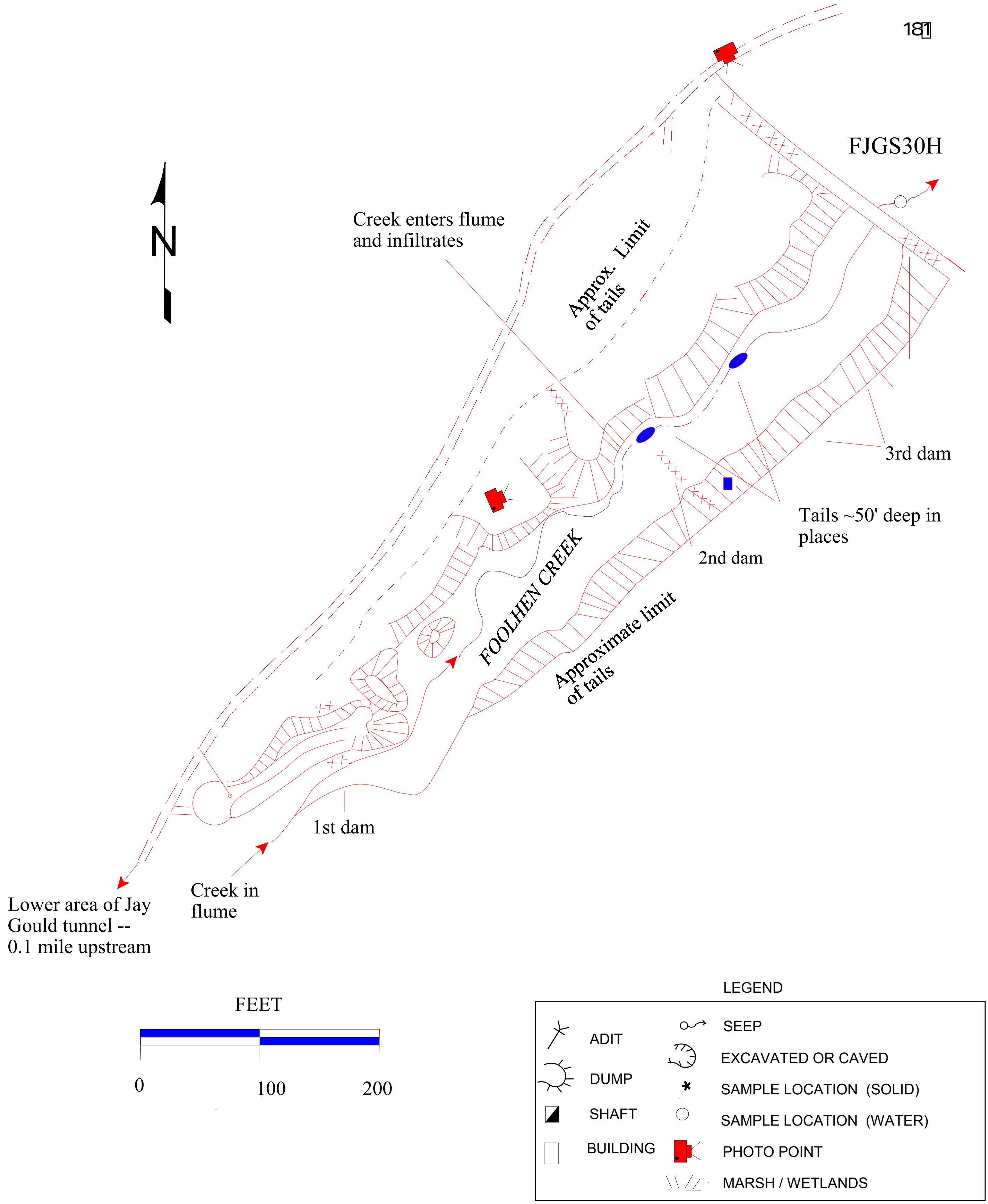



Figure 35. The Jay Gould tailings (10/19/95) consisted of tailings and alluvium eroded by Foolhen Creek.


Figure 35a. Jay Gould tailings were deeply incised and generally barren to sparsely vegetated.


Figure 35b. The lowermost tailings dam on Foolhen Creek has been deeply eroded tailings.

Table 44. Water-quality exceedences, Jay Gould tunnel.

| Sample Site | Al | As | Ba | Cd | Cr | Cu | Fe | Pb | Mn | Hg | Ni | Ag | Zn | Cl | F | $NO_3$ | $SO_4$ | Si | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FJGS10H - adit discharge | | | | | | | | | | | | | | | | | | | |
| FJGS20H - downstream of mill | | | | | | | | | | | | | | | | | | | |
| FJGS30H - downstream of tailings | | | | | | | | | | | | | | | | | | | |

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

Note: The analytical results are listed in appendix IV.

### 2.35.3.4 Vegetation

The adit discharge was choked with an unidentified type of water plant, and the rest of the stream was lined with grasses and shrubs. As the water entered the tailings area it was channeled into a flume and flowed under the tailings until it emerged at the far end. The tailings were not well vegetated but did have sparse grasses and weeds growing on them. No other signs of stressed vegetation were noted besides the lack of growth on the tailings themselves. The older generation waste dumps have been vegetated with Douglas fir and other conifers, while the younger generation of dumps have not had enough time to have vegetation grow on them. The small pond below the new mill had grasses, thistles, and cattails growing on its banks.

### 2.35.3.5 Summary of Environmental Condition

The volume of tailings and waste were quite large; Pioneer Technical Services (1995) estimated 175,000 cubic yards of tailings alone. One wonders where the missing volume has been deposited when examining the depth to which they appeared to have been placed on the lower end. Downstream, on Virginia Creek, and below is probably the final resting place of much of the material. Wind and water erosion continues because of the lack of stabilizing vegetation on the tailings. The waste dumps at the tunnel seemed fairly stable; the water quality from the adit is good.

## 2.35.4 Structures

Five log cabins lined the road down to the tailings area. The walls were largely intact, but the roofs were in varying states of disrepair. Two small sheds lie west of the road, both in good condition but not well built. A metal mill building, approximately 75 feet by 80 feet, was in excellent condition and appeared as if it had never been used. Transformers were still present on the power pole.

2.35.5 Safety

The pond in front of the mill building poses a hazard if it ever breached as well as a physical hazard if non-swimmers were to play in it. The site is highly visible and accessible. Rusting junk was an eyesore if not also a physical hazard and was scattered throughout the mine and tailings site. Standing log cabins also posed a small risk. The adit was supported at the portal by an 8 foot galvanized culvert and was at least partially open in back of the culvert. The discharge made it unappealing to enter, but some energetic geologist or explorer could be tempted to enter it.

The tailings area had some four-wheeler traffic and the steep, unconsolidated slopes were dangerous. The flume that ran under the tailings was breached to the surface in several places. Galvanized, discarded cyanide drums were utilized in the various dam constructions, especially the middle dam. These were obviously empty when placed, but they have been eroded and have fallen into the drainage. Other 55-gallon drums were found in other areas.

## 2.36 Gould and Peggy Ann Mines

2.36.1 Site Location and Access

This section is a general description of an area on HNF-administered land below the Gould mine on Gould Creek, located below the Peggy Ann patented claim and edge of the Forest Service boundary in T13N R7W section 24AADA.  It is above a large tract of private land and can be found on the Stemple Pass/Granite Butte 7.5 min. quadrangles. Access to the site is along a primitive road along Gould Creek.

2.36.2 Site History - Geologic Features

The Gould mine was discovered in 1884 and was worked during the period through 1890, then from 1903 to 1907, 1910 to 1914, and 1922 to 1933 (Pardee and Schrader 1933). Knopf (1913) and Pardee and Schrader (1933) do not mention the Peggy Ann, but the latter do discuss the Jay Gould mine located approximately two miles farther upstream on Gould Creek. McClernan (1982) also briefly describes the Peggy Ann as a gold-silver producer being developed in 1975. McClernan’s reference, Lawson (1976), describes the Peggy Ann property as “developing” with a crew of six employees.

A mill was located above this site at the Gould mine. DSL-AMRB had Pioneer Technical Services (1995) sample locally around the Jay Gould mine site, and they reported observed releases of mercury and lead into the creek, but the elements' levels did not exceed any MCLs or aquatic life criteria.

## 2.36.3 Environmental Condition

HNF-administered land appeared minimally disturbed by mining activity upstream, if at all. The private, patented claim was well maintained and appeared to have recent activity. A MBMG research specialist found tailings in the creek in this area.

### 2.36.3.1 Site Features - Sample Locations

The site was sampled on 09/29/95 to assess whether mining activity upstream at the Peggy Ann, Jay Gould, and other mines had any effect on the creek below it. Only one site was sampled because the creek appeared in such good condition at this point. Site features and the sample location are shown in figure 36; a photograph is shown in figure 36a.

### 2.36.3.2 Soil

No soil sample was taken. As previously stated, most of the mining activity took place almost two miles upstream from this site. There were no visible impacts to soils on HNF-administered land.

### 2.36.3.3 Water

There were no Water-quality exceedences at this site (table 45). The stream, as measured by bucket and stopwatch, flowed at a rate of 600 gpm. Field pH measured 7.02 and the SC was 210 µmhos/cm. The water appeared clear and cold with no excessive sedimentation.

Table 45. Water-quality exceedences, Gould Creek.

| Sample Site | Al | As | Ba | Cd | Cr | Cu | Fe | Pb | Mn | Hg | Ni | Ag | Zn | Cl | F | $NO_3$ | $SO_4$ | Si | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GPAS10M-downstream | | | | | | | | | | | | | | | | | | | |

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

Note: The analytical results are listed in appendix IV.

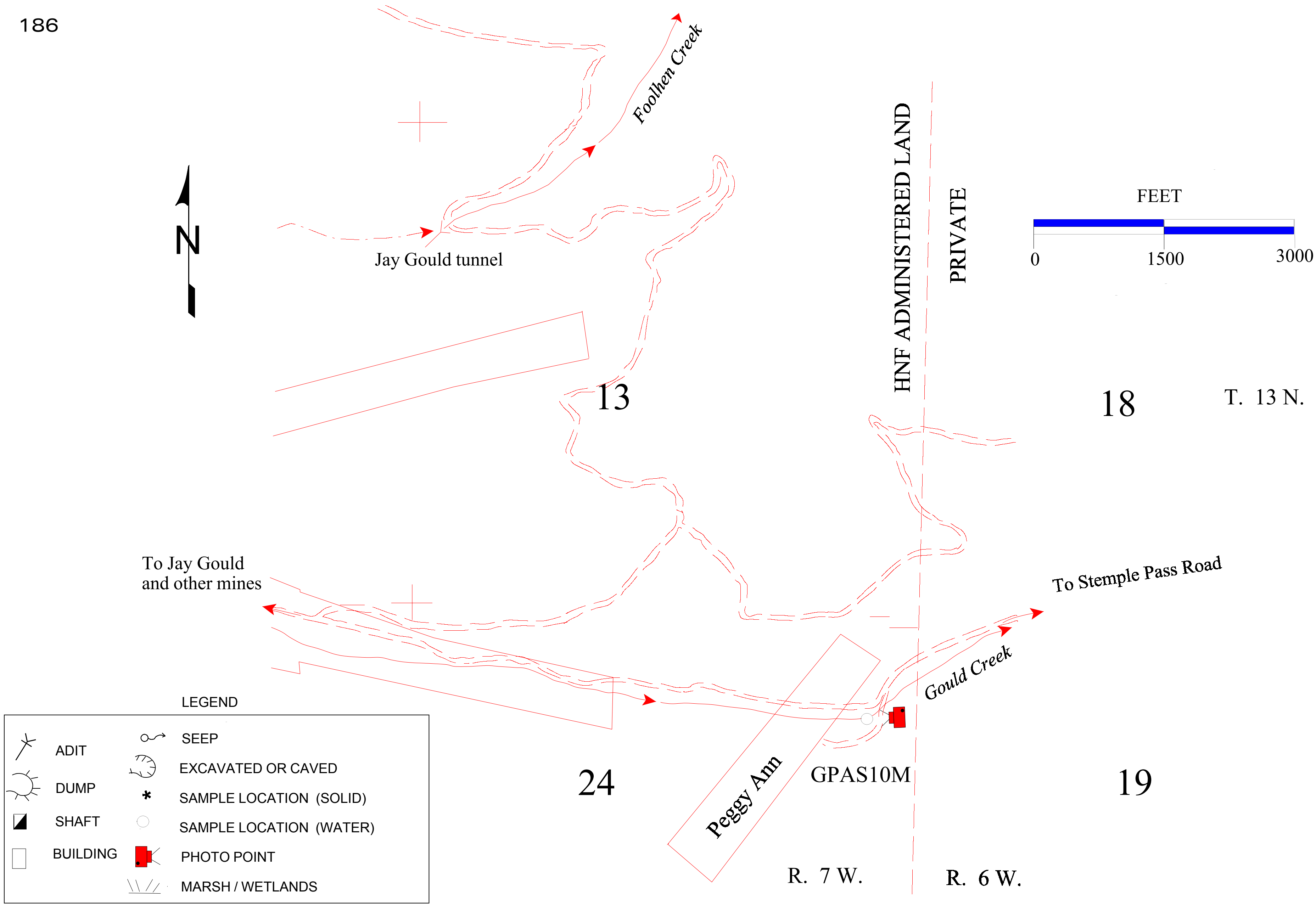



Figure 36. The area near the Peggy Ann mine in Gould Creek was mined intermittently from the 1880's to the 1970's. The boundaries shown are based on 7.5-minute USFS ownership maps.

Figure 36a. A sample (GPAS10M) was collected from Gould Creek below the Gould and Peggy Ann mines.

2.36.3.4 Vegetation

The vegetation showed no signs of being influenced by past mining activities upstream. Willows along the banks of Gould Creek, as well as alders, horsetails, and other riparian species, appeared healthy.

2.36.3.5 Summary of Environmental Condition

Mining on Gould Creek may have environmental effects on private land but was not affecting the creek downstream on HNF-administered land.

2.36.4 Structures

The only structures here were on the private, patented claim of the Peggy Ann. They were well maintained and seemed to be currently used, at least seasonally. Structures on patented land included a log ore bin, a cinder block mine building, a shed and a log cabin. The portal on private land was open, but locked, and in good condition.

2.36.5 Safety

The road into this site is in good condition at least until it starts gaining elevation where it degrades into a four-wheel-drive road. No hazards on public land were noted.

## 2.37 Summary of the Upper Missouri River Basin

Most of the mine and mill sites exhibiting a potential to cause environmental problems on HNF-administered land in the Tenmile–Prickly Pear Creek drainage are on private land. Of the 22 that were found to have the potential to have adverse effects on soil or water quality on HNF-administered land, 15 were on private land. Nearly all of the sites were discharging water to nearby stream; several had waste material in contact with the streams. The relative severity of the impacts to HNF-administered land in this area was generally small; the concentrations of metals in the receiving streams, while elevated, were low. The exceptions to this include such mines and mills as those in the Frohner basin; these sites contribute a significant amount of dissolved metals to surface water and ground water. Repeated visits to some sites exemplify the need for multiple sampling events. For example, the amount of water discharging from the development area of the Beatrice mine was dramatically different in the spring than in late summer.

The Tenmile Creek drainage, a source of drinking water for the city of Helena, has a large amount of waste from mines and mills. The Beatrice and Armstrong mines, both in the Minnehaha Creek tributary, are on HNF-administered land; other mines of concern are on private land. All of the mines and nearly all of the land along the main stem of Tenmile Creek are on private land or mixed private and small portions of HNF-administered land with unknown boundaries. These private and mixed ownership sites include the Bunker Hill mine, the Evergreen mine, the Lee Mountain mine, and the Lexington mine.

An accurate assessment of the cumulative impact of mining on the drainage would require extensive sampling on private land. A sample of Tenmile Creek was collected on 8/2/95 above Rimini on HNF-administered land. The concentrations of aluminum, arsenic, and zinc were elevated, but only aluminum exceeded an MCL (table 46). Downstream of Rimini, the concentrations of several metals increased significantly. The concentration of arsenic increased from 3.4 to 9.3 µg/L and the concentration of zinc increased from 98.5 to 2057 µg/L. Aluminum, which exceeded the secondary drinking water limit, and pH, which was slightly higher than the recommended limit, were both within the standards downstream of Rimini.

Table 46. Water-quality exceedences, Tenmile Creek near Rimini.

| Sample Site | Al | As | Ba | Cd | Cr | Cu | Fe | Pb | Mn | Hg | Ni | Ag | Zn | Cl | F | $NO_3$ | $SO_4$ | Si | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TMRS10L - above Rimini | S | | | | | | | | | | | | | | | | | | S |
| TMRS20L -below Rimini | | | | | | | | | | | | | A,C | | | | | | |

Exceedence codes:

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

Note: The analytical results are listed in appendix IV.

Other drainages in the Upper Missouri River watershed also have clusters of mines and mills, but overall, the impacts are local. The possible exception is Indian Creek, which has several mines and mills. Waste material is deposited over a long stretch of the drainage. Table 47 lists the mines considered in this report. The exceedence of one or more MCLs and ALSs is noted for each site. All of the samples, whether upstream or downstream of the site, were considered.

Table 47. Summary of water-quality exceedences, Upper Missouri River drainage.

| Sample Site | Al | As | Ba | Cd | Cr | Cu | Fe | Pb | Mn | Hg | Ni | Ag | Zn | Cl | F | $NO_3$ | $SO_4$ | Si | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Peerless Jenny | | | | | | | | | | | | | A,C | | | | | | |
| Sallie Bell | | | | S,A C | | A,C | | C | S | C | | | A,C | | | | | | S |
| Banner Creek tails | | | | | | | | | | C | | | | | | | | | |
| Justice & Lower Justice | S,A C | P,A C | | P,S, A,C | | A,C | S,A | P,S, A,C | S | | | C | S, A C | | | | S | | S |
| Armstrong | | | | C | | | | | | | | | A,C | | | | | | S |
| Beatrice | S,C | | | | | | S | | | | | | | | | | | | S |
| Bluebird | | | | P,A C | | | | | S | C | | | A,C | | | | | | |
| Salvai | | | | C | | | | | S | | | | A,C | | | | | | |
| Kady Gulch | S,A | | | C | | | | | S | | | | A,C | | | | | | |

Table 47. continued.

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Edelweiss - Argentine | | | | | | | | | S | | | A,C | A,C | | | | | | |
| Lone Eagle Quartz | | | | C | | | | | S | C | | | A,C | | | | | | |
| Frohner Lead | S,A C | | | P,A C | | A,C | S | P | S | C | | | A,C | | | | | | S |
| Frohner & Nellie Grant | S,C | P,C | | P,A C | | A,C | S | P,A C | S | | | | A,C | | | | | | S |
| Yama Group | S | | | | | | | | | C | | | | | | | | | S |
| White Pine, B&G, Newburg | | | | | | | | | S | | | | A,C | | | | | | |
| Warm Spring tails | S,C | P | | | | | S | C | | C | | | A,C | | | | | | |
| Badger | | | | | | | | | | | | | | | | | | | |
| Little Tizer Wildcat | | | | | | | | | | | | | | | | | | | |
| Golden Age | | | | | | | | | | C | | | | | | | | | |
| Park - New Era | | | | A,C | | | | | S | | | | A,C | | | | | | |
| Park Marietta & Phoenix | S | P | | A,C | | | S,A | C | S | | | | A,C | | | | | | |
| Kleinschmidt | | | | | | | | | | | | | | | | | | | |
| Vosburg | S,C | P,A C | | | | | | C | | | | | | | | | | | |
| Weasel Creek | | | | | | | | | | | | | | | | | | | |
| Stray Horse | | | | C | | | | | | C | | | | | | | | | |
| Little Bonanza | | | | | | | | | | | | | | | | | | | |
| Sunrise & January | | | | P,A C | | | | | | | | | A,C | | | | | | |
| East Pacific | | | | P,A C | | | | C | | | | | | | | | | | |
| Freiburg | | | | A,C | | | | | | | | | A,C | | | | | | |
| Argo | | | | | | | | | | | | | | | | | | | |

Table 47. continued.

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jay Gould | | | | | | | | | | | | | | | | | | | |
| Gould and Peggy Ann | | | | | | | | | | | | | | | | | | | |

Exceedence codes:

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

Note: The analytical results are listed in appendix IV.

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# Appendix I

## USFS -MBMG Field Form

## PART A

*(To be completed for all identified sites)*

### LOCATION AND IDENTIFICATION

ID# ________________ Site Name(s) ______________________________
FS Tract # ____________________ FS Watershed Code ____________________
Forest ____________________ District ____________________
Location based on: GPS___ Field Map___ Existing Info___ Other______________
Lat____________ Long____________ xutm_________ yutm_________ zutm_________
Quad Name ______________________ Principal Meridan ____________________
Township __________ Range __________ Section _____ ¼_____ ¼_____ ¼_____
State _____ County ____________________ Mining District ____________________

Ownership of *all* disturbances:

_____ National Forest (NF)
_____ Mixed private and National Forest (or unknown)
_____ Private.

*If private only*, impacts from the site on National Forest Resources are
____Visually apparent ____Likely to be significant ____Unlikely or minimal

**If all disturbances are private and impacts to National Forest Resources are unlikely or minimal - STOP**

---

## PART B

*(To be completed for all sites on or likely effecting National Forest 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 (water 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 disturbance
_____ _____ 6. Hazardous wastes/materials (chemical containers, explosives, etc)
_____ _____ 7. Open adits/shafts, highwalls, or hazardous structures/debris
_____ _____ 8. Site visit *(If yes, take picture of site)*, Film number(s) __________
*If yes*, provide name of person who visited site and date of visit
Name: ____________________________ Date: ____________
*If no*, list source(s) of information (If based on personal knowledge, provide name of person interviewed and date):

______________________________________________

**If the answers to questions 1 through 6 are all No - STOP**

---

# PART C

*(To be completed for all sites not screened out in Parts A or B)*

Investigator ______________________________ Date ______________
Weather ________________________________________________

## 1. GENERAL SITE INFORMATION

*Take panoromic picture(s) of site*, Film Number(s) __________
Size of disturbed area(s) __________acres Average Elevation __________feet
Access: _____No trail _____Trail _____4wd only _____Improved road
_____Paved road
Name of nearest town (by road): ____________________
Site/Local Terrain: _____Rolling or flat _____Foothills _____Mesa _____Mountains
_____Steep/narrow canyon
Local undisturbed vegetation (*Check all that apply*): _____Barren or sparsely vegetated
_____weeds/grasses _____Brush _____Riparian/marsh _____Deciduous trees
_____Pine/spruce/fir
Nearest wetland/bog: ___On site, ___0-200 feet, ___200 feet - 2 miles, ___> 2 miles
Acid Producers or Indicator Minerals: ___Arsenopyrite, ___Chalcopyrite, ___Galena,
___Iron Oxide, ___Limonite, ___Marcasite, ___Pyrite, ___Pyrrhotite,
___Sphalerite, ___Other Sulfide
Neutralizing Host Rock: ___Dolomite, ___Limestone, ___Marble, ___Other Carbonate

## 2. OPERATIONAL HISTORY

Dates of significant mining activity________________________________

MINE PRODUCTION

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Commodity(s) | | | | | | | |
| Production (ounces) | | | | | | | |

Years that Mill Operated______________________________________
Mill Process: ___Amalgamation, ___Arrastre, ___CIP (Carbon-in-Pulp), ___Crusher only,
___Cyanidation, ___Flotation, ___Gravity, ___Heap Leach, ___Jig Plant,
___Leach, ___Retort, ___Stamp, ___ No Mill, ___Unknown

MILL PRODUCTION

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Commodity(s) | | | | | | | |
| Production (ounces) | | | | | | | |

## 3. HYDROLOGY

Name of nearest Stream __________________ which flows into ___________________
Springs (*in and around mine site*): ____ Numerous ____ Several ____ None
Depth to Groundwater ______ ft, Measured at: ____shaft/pit/hole ____well ____wetland
Any waste(s) in contact with active stream ____Yes ____No

## 4. TARGETS *(Answer the following based on general observations only)*

Surface Water
Nearest surface water inake ________miles, Probable use ______________________
Describe number and uses of surface water intakes observed for 15 miles downstream of site: ____________________________________________________________________

Wells
Nearest well ______miles, Probable use _____________________
Describe number and use of wells observed within 4 miles of site:

Population
Nearest dwelling ______miles, Number of months/year occupied ______ months
Estimate number of houses within 2 miles of the site (*Provide estimates for 0-200ft, 200ft-1mile, 1-2miles, if possible*)

Recreational Usage
Recreational use on site: ____High *(Visitors observed or evidence such as tire tracks, trash, graffiti, fire rings, etc.; and good access to site)*, ____Moderate *(Some evidence of visitors and site is accessible from a poor road or trail)*, ____Low *(Little, if any, evidence of visitors and site is not easily accessible)*
Nearest recreational area ______miles, Name or type of area: ____________________

## 5. SAFETY RISKS

______Open adit/shaft, ______Highwall or unstable slopes, ______Unstable structures,
______Chemicals, ______Solid waste including sharp rusted items, ______Explosives

## 6. MINE OPENINGS

*Include in the following chart all mine openings located on or partially on National Forest lands. Also, include mine openings located entirely on private land if a point discharge from the opening crosses onto National Forest land. In this case, enter data for the point at which the discharge flows onto National Forest land; you do not need to enter information about the opening itself.*

TABLE 1 - ADITS, SHAFTS, PITS, AND OTHER OPENINGS

| | | | | | | |
|---|---|---|---|---|---|---|
| Opening Number | | | | | | |
| Type of Opening | | | | | | |
| Ownership | | | | | | |
| Opening Length (ft) | | | | | | |
| Opening Width (ft) | | | | | | |
| Latitude (GPS) | | | | | | |
| Longitude (GPS) | | | | | | |
| Condition | | | | | | |
| Ground water | | | | | | |
| Water Sample # | | | | | | |
| Photo Number | | | | | | |

Comments (*When commenting on a specfic mine opening, reference opening number used in Table 1*):

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

**Codes Applicable for all entries:** NA= Not applicable, UNK=Unknown, OTHER=Explain in comments, NO=NO or none

**Type of opening:** ADIT=Adit, SHAFT=Shaft, PIT=Open Pit/Trench, HOLE=Prospect Hole, WELL=Well

**Ownership:** NF=National Forest, MIX=National Forest and Private (Also, for unknown), PRV=Private

**Condition** *(Enter all that apply)*: INTACT=Intact, PART=Partially collapsed or filled, COLP=Filled or collapsed, SEAL=Adit plug, GATE=Gated barrier,

**Ground water** (*Water or evidence of water discharging from opening*): NO=No water or indicators of water, FLOW=Water flowing, INTER=Indicators of intermittant flow, STAND= Standing water only (*In this case, enter an estimate of depth below grade*)

## 7. MINE/MILL WASTE

*Include in the following chart all mine/mill wastes located on or partially on National Forest lands. Also, include mine/mill wastes located entirely on private land if is visually effecting or is very likely to be effecting National Forest resources. In this case enter data for the point at which a discharge from the waste flows onto National Forest land, or where wastes has migrated onto National Forest land; only enter as much information about the waste as relevant and practicable.*

TABLE 2 - DUMPS, TAILINGS, AND SPOIL PILES

| | | | | | | |
|---|---|---|---|---|---|---|
| Waste Number | | | | | | |
| Waste Type | | | | | | |
| Ownership | | | | | | |
| Area (acres) | | | | | | |
| Volume (cu yds) | | | | | | |
| Size of Material | | | | | | |
| Wind Erosion | | | | | | |
| Vegetation | | | | | | |
| Surface Drainage | | | | | | |
| Indicators of Metals | | | | | | |
| Stability | | | | | | |
| Location with respect to Floodplain | | | | | | |
| Distance to Stream | | | | | | |
| Water Sample # | | | | | | |
| Waste Sample # | | | | | | |
| Soil Sample # | | | | | | |
| Photo Number | | | | | | |

**Codes Applicable for all entries:** NA= Not applicable, UNK=Unknown, OTHER=Explain in comments, NO=NO or none

**Waste Type:** WASTE=Waste rock dump, MILL=Mill tailings, SPOIL=Overburden or spoil pile, HIGH=Highwall, PLACER=Placer or hydraulic deposit, POND=Settling pond or lagoon, ORE=Ore Stockpile, HEAP=Heap Leach

**Ownership:** NF=National Forest, MIX=National Forest and Private (*Also, for unknown*), PRV=Private

**Size of material** (*If composed of different size fractions, enter the sizes that are present in significant amounts*): FINE=Finer than sand, SAND=sand, GRAVEL=>sand and <2", COBBLE=2"-6", BOULD=>6"

**Wind Erosion**, Potential for: HIGH=Fine, dry material that could easily become airborne, airborne dust, or windblown deposits, MOD=Moderate, Some fine material, or fine material that is usually wet or partially cemented; LOW=Little if any fines, or fines that are wet year-round or well cemented.

**Vegetation** (*density on waste*): DENSE=Ground cover > 75%, MOD=Ground cover 25% - 75%, SPARSE=Ground cover < 25%, BARREN=Barren

**Surface Drainage** (*Include all that apply*): RILL=Surface flow channels mostly < 1' deep, GULLY=Flow channels >1' deep, SEEP=Intermittant or continuous discharge from waste deposit, POND=Seasonsal or permanent ponds on feature, BREACH=Breached, NO=No indicators of surface flow observe

**Indicators of Metals** (*Enter as many as exist*): NO=None, VEG=Absence of or stressed vegetation, STAIN=yellow, orange, or red precipitate, SALT=Salt deposits, SULF=Sulfides present

**Stability:** EMER=Imminent mass failure, LIKE=Potential for mass failure, LOW=mass failure unlikely

**Location w/respect to Stream:** IN=In contact with normal stream, NEAR=In riparian zone or floodplain, OUT=Out of floodplain

## 8. SAMPLES

*Take samples only on National Forest lands.*

TABLE 3 - WATER SAMPLES FROM MINE SITE DISCHARGES

| | | | | | | |
|---|---|---|---|---|---|---|
| Sample Number | | | | | | |
| Date sample taken | | | | | | |
| Sampler (*Initials*) | | | | | | |
| Discharging From | | | | | | |
| Feature Number | | | | | | |
| Indicators of Metal Release | | | | | | |
| Indicators of Sedimentation | | | | | | |
| Distance to stream (ft) | | | | | | |
| Sample Latitude | | | | | | |
| Sample Longitude | | | | | | |
| Field pH | | | | | | |
| Field SC | | | | | | |
| Flow (*gpm*) | | | | | | |
| Method of measurement | | | | | | |
| Photo Number | | | | | | |

Comments: ***(When commenting on a specfic water sample, reference sample number used in Table 3)***:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

**Codes Applicable for all entries:** NA= Not applicable, UNK=Unknown, OTHER=Explain in comments, NO=NO or none

**Discharging From:** ADIT=Adit, SHAFT=Shaft, PIT=Pit/Trench, HOLE=Prospect Hole, WASTE=Waste rock dump, MILL=Mill tailings, SPOIL=Overburden or spoil pile, HIGH=Highwall, PLACER=Placer or hydraulic deposit, POND=Settling pond or lagoon, WELL=Well

**Feature Number:** Corresponding number from Table 1 or Table 2 (*Opening Number or Waste Number*)

**Indicators of Metal Release** (*Enter as many as exist*): NO=None, VEG=Absence of, or stressed vegetation/ organisms in and along drainage path, STAIN=yellow, orange, or red precipitate, SALT= Salt deposits, SULF=Sulfides present, TURB=Discolored or turbid discharge

**Indicators of Sedimentation** (*Enter as many as exist*): NO=None, SLIGHT=Some sedimentation in channel, banks and channel largely intact, MOD=Sediment deposits in channel, affecting flow patterns, banks largely intact, SIGN=Sediment deposits in channel and/or along stream banks extending to nearest stream

**Method of Measurement:** EST=Estimate, BUCK=Bucket and time, METER=Flow meter

## TABLE 4 - WATER SAMPLES FROM STREAM(S)

| Location relative to mine site/features | Upstream (Background) | Downstream | | |
|---|---|---|---|---|
| Sample Number | | | | |
| Date sample taken | | | | |
| Sampler (Initials) | | | | |
| Stream Name | | | | |
| Indicators of Metal Release | | | | |
| Indicators of Sedimentation | | | | |
| Sample Latitude | | | | |
| Sample Longitude | | | | |
| Field pH | | | | |
| Field SC | | | | |
| Flow (gpm) | | | | |
| Method of measurement | | | | |
| Photo Number | | | | |

Comments: ***(When commenting on a specfic water sample, reference sample number used in Table 4)***:

________________________________________

________________________________________

________________________________________

________________________________________

**Codes Applicable for all entries:** NA= Not applicable, UNK=Unknown, OTHER=Explain in comments, NO=NO or none

**Indicators of Metal Release** (*Enter as many as exist*): NO=None, VEG=Absence of, or stressed streamside vegetation/organisms in and along drainage path, STAIN=yellow, orange, or red precipitate, SALT=Salt deposits, SULF=Sulfides present, TURB=Discolored or turbid discharge

**Indicators of Sedimentation** *(Enter as many as exist)*: NO=None, SLIGHT=Some sedimentation in channel, natural banks and channel largely intact, MOD=Sediment deposits in channel, affecting stream flow patterns, natural banks largely intact, SIGN=Sediment deposits in channel and/or along stream banks extending ½ a mile or more downstream

**Method of Measurement**: EST=Estimate, BUCK=Bucket and time, METER=Flow meter

## TABLE 5 - WASTE SAMPLES

| | | | | |
|---|---|---|---|---|
| Sample Number | | | | |
| Date of sample | | | | |
| Sampler (*Initials*) | | | | |
| Sample Type | | | | |
| Waste Type | | | | |
| Feature Number | | | | |
| Sample Latitude | | | | |
| Sample Longitude | | | | |
| Photo Number | | | | |

Comments: *(When commenting on a specfic waste or soil sample, reference sample number used in Table 5)*:

______________________________________________
______________________________________________
______________________________________________
______________________________________________
______________________________________________

**Codes Applicable for all entries:** NA= Not applicable, UNK=Unknown, OTHER=Explain in comments, NO=NO or none
**Sample Type:** SING=Single sample, COMP=composite sample (enter length)
**Waste Type:** WASTE=Waste rock dump, MILL=Mill tailings, SPOIL=Overburden or spoil pile, HIGH=Highwall, PLACER=Placer or hydraulic deposit, POND=Settling pond or lagoon sludge, ORE=Ore Stockpile, HEAP=Heap Leach
**Feature Number:** Corresponding number from Table 2 (*Waste Number*)

## TABLE 6 - SOIL SAMPLES

| | | | | |
|---|---|---|---|---|
| Sample Number | | | | |
| Date of sample | | | | |
| Sampler (*Initials*) | | | | |
| Sample Type | | | | |
| Sample Latitude | | | | |
| Sample Longitude | | | | |
| Likely Source of Contamination | | | | |
| Feature Number | | | | |
| Indicators of Contamination | | | | |
| Photo Number | | | | |

Comments: *(When commenting on a specfic waste or soil sample, reference sample number used in Table 6)*:

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

**Codes Applicable for all entries:** NA= Not applicable, UNK=Unknown, OTHER=Explain in comments, NO=NO or none

**Sample Type:** SING=Single sample, COMP=composite sample (enter length)

**Likely Source of Contamination:** ADIT=Adit, SHAFT=Shaft, PIT=Open Pit, HOLE=Prospect Hole, WASTE=Waste rock dump, MILL=Mill tailings, SPOIL=Overburden or spoil pile, PLACER= Placer or hydraulic deposit, POND=Settling pond or lagoon, ORE=Ore Stockpile, HEAP=Heap Leach

**Feature Number:** Corresponding number from Table 1 or 2 (*Opening or Waste Number*)

**Indicators of Contamination** (*Enter as many as exist*): NO=None, VEG=Absence of vegetation, PATH=Visible sediment path, COLOR=Different color of soil than surrounding soil, SALT=Salt crystals

## 9. HAZARDOUS WASTES/MATERIALS

TABLE 7 - HAZARDOUS WASTES/MATERIALS

| | | | | |
|---|---|---|---|---|
| Waste Number | | | | |
| Type of Containment | | | | |
| Condition of Containment | | | | |
| Contents | | | | |
| Estimated Quantity of Waste | | | | |

Comments: *(When commenting on a specfic hazardous waste or site condition, reference waste number used in Table 7)*:

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

**Codes Applicable for all entries**: NA= Not applicable, UNK=Unknown, OTHER=Explain in comments, NO=NO or none

**Type of Containment**: NO=None, LID=drum/barrel/vat with lid, AIR=drum/barrel/vat without lid, CAN=cans/jars, LINE=lined impoundment, EARTH=unlined impoundment

**Condition of Containment**: GOOD=Container in good condition, leaks unlikely, FAIR=Container has some signs of rust, cracks, damage but looks sound, leaks possible, POOR=Container has visible holes, cracks or damage, leaks likely, BAD=Pieces of containers on site, could not contain waste

**Contents**: from label if available, or guess the type of waste, e.g., petroleum product, solvent, processing chemical.

**Estimated Quantity of Waste**: Quantity still contained and quantity released

## 10. STRUCTURES

*For structures on or partially on National Forest lands.*

TABLE 8 - STRUCTURES

| | | | | | | |
|---|---|---|---|---|---|---|
| Type | | | | | | |
| Number | | | | | | |
| Condition | | | | | | |
| Photo Number | | | | | | |

Comments:

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

**Codes Applicable for all entries:** NA= Not applicable, UNK=Unknown, OTHER=Explain in comments, NO=NO or none
**Type:** CABIN=Cabin or community service (*store, church, etc.*), MILL=mill building, MINE=building related to mine operation, STOR=storage shed, FLUME=Ore Chute/flume or tracks for ore transport
**Number:** Number of particular type of structure all in similar condition or length in feet
**Condition:** GOOD=all components of structure intact and appears stable, FAIR=most components present but signs of deterioration, POOR=major component (*roof, wall, etc*) of structure has collapsed or is on the verge of collapsing, BAD=more than half of the structure has collapsed

## 11. MISCELLANEOUS

Are any of the following present? (Check all that apply): _____Acrid Odor, _____Drums, _____Pipe, _____Poles, _____Scrap Metal, _____Overhead wires, _____Overhead cables, _____Headframes, _____Wooden Structures, _____Towers, _____Power Substations, _____Antennae, _____Trestles, _____Powerlines, _____Transformers, _____Tramways, _____Flumes, _____Tram Buckets, _____Fences, _____Machinery, _____Garbage

Describe any obvious removal actions that are needed at this site:

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

General Comments/Observations (not otherwise covered)

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

## 12. SITE MAP

Prepare a sketch of the site. Indicate all pertinent features of the site and nearby environment. Include all significant mine and surface water features, access roads, structures, etc. Number each important fearue at the mine site and use these number throughout this form when referring to a particular feature (Tables 1 and 2). Sketch the drainage routes off the site into the nearest stream.

## 13. RECORDED INFORMATION

**Owner(s) of patented land**
Name: ______________________________
Address: ______________________________
Telephone Number: ______________________________

**Claimant(s)**
Name: ______________________________
Address: ______________________________
Telephone Number: ______________________________

**Surface Water** (*From water rights*)
Number of Surface Water Intakes within 15 miles downstream of site used for:
_____Domestic, _____Municipal, _____Irrigation, _____Stock,
_____Commerical/Industrial, _____ Fish Pond, _____Mining,
_____Recreation, _____Other

**Wells** (*From well logs*)
Nearest well _____miles
Number of wells within _____0-¼ miles _____¼-½ miles _____½-1 mile _____1-2 miles
_____2-3 miles _____3-4 miles of site

**Sensitive Environments**
List any sensitive environments (as listed in the HRS) within 2 miles of the site or along receiving stream for 15 miles downstream of site (*wetlands, wilderness, national/state park, wildlife refuge, wild and scenic river, T&E or T&E habitat, etc*):

______________________________
______________________________
______________________________

**Population** (*From census data*)
Population within _____0-¼ miles _____¼-½ miles _____½-1 mile _____1-2 miles
_____2-3 miles _____3-4 miles of site

**Public Interest**
Level of Public Interest: _____Low, _____Medium, _____High
Is the site under regulatory or legal action? _____Yes, _____No

Other sources of information (MILs #, MRDS #, other sampling data, etc):

______________________________
______________________________
______________________________
______________________________
______________________________

# Appendix II

## List of Sites in the Helena National Forest

| MBMG ID | SITE NAME | TOWNSHIP | RANGE | SECTION | TRACT | VISIT |
|---|---|---|---|---|---|---|
| BW000495 | MONTE CRISTO / MONTE CHRISTO | 8N | 01W | 28 | ABDC | Y |
| BW000561 | WARNER CREEK PROSPECT | 06N | 02W | 12 | CADB | Y |
| BW000579 | ALBERTA | 07N | 01W | 10 | ADBD | Y |
| BW000585 | ALICE LODE | 07N | 01W | 10 | ADBA | Y |
| BW000627 | LITTLE JIM NO.1-5 CLAIMS | 07N | 01W | 16 | ADBD | N |
| BW000639 | SILVER DYKE NO1 CLAIM | 07N | 01W | 04 | CCAC | N |
| BW000645 | SUSIE NO.1 CLAIM | 08N | 01W | 27 | CACC | N |
| BW000651 | VICTORIA GROUP | 08N | 01W | 28 | CDBA | N |
| BW000657 | EAGLE MINE | 07N | 01W | 28 | ACCD | Y |
| BW000669 | EUREKA CREEK DIVIDE PROSPECT | 07N | 01W | 21 | BCBA | Y |
| BW000675 | GOLDEN HOPE NO.1 AND NO.2 PROSPECT | 07N | 01W | 21 | CBBB | Y |
| BW000693 | LONGFELLOW CREEK PROSPECT | 07N | 01W | 18 | ACDB | N |
| BW000723 | MOUNTAIN DUDE LODE | 07N | 01W | 10 | BDDB | Y |
| BW000729 | ROADSIDE PROSPECT | 07N | 01W | 28 | BCCC | N |
| BW000735 | SALT LICK PROSPECT | 07N | 01W | 16 | DBDC | Y |
| BW000741 | SILVERINE AND WASP LODES | 06N | 01W | 16 | CBBC | Y |
| BW003796 | MCFADGEN-NAVE PROSPECT | 07N | 01W | 20 | BCDA | N |
| BW003806 | IRISH SYNDICATE MINE | 07N | 01W | 3 | BDDC | Y |
| BW003836 | LONESOME PINE | 8N | 1W | 21 | AAAA | Y |
| BW003851 | MIKE FINCH CLAIM | 11N | 01E | 27 | BAAA | |
| BW003881 | PETER THE GREAT | 07N | 01W | 21 | BDDD | N |
| BW003886 | QUARTETTE MINE | 07N | 01W | 03 | BDDC | Y |
| BW003891 | RASPBERRY GROUP | 07N | 01W | 16 | BDAD | Y |
| BW003896 | REX CLAIM | 11N | 01E | 26 | DBBB | Y |
| BW003901 | BAR GULCH | 11N | 01E | 20 | BAAD | Y |
| BW003921 | UNNAMED PROSPECT | 11N | 02E | 30 | ADDD | N |
| BW003946 | AVALANCHE GULCH | 11N | 02E | 20 | DCBB | N |
| BW003971 | CHAMPION MINE | 07N | 01W | 04 | BDDC | N |
| BW003976 | CROSSCUT MINE | 07N | 01W | 16 | DDDD | N |
| BW003991 | EMIL H. MINE | 07N | 01W | 03 | DBBB | Y |
| BW004011 | ETTA | 06N | 01W | 2 | ABDD | Y |
| BW004086 | NOON & EDNA | 08N | 01W | 18 | | N |
| BW004091 | BEAVER CREEK PLACER | 08N | 01W | 22 | BBAD | N |
| BW004116 | VINYARD COPPER MINE | 11N | 01E | 19 | DAAC | N |
| BW004196 | TORONTO | 07N | 01W | 21 | ACCC | N |
| BW004206 | WHITE HORSE | 07N | 01W | 10 | DDBB | Y |
| BW004241 | LOWER MAIN & SULLIVAN | 8N | 1W | 22 | AAAB | Y |
| BW004271 | COONEY | 07N | 01W | 26 | BDDB | Y |
| BW004306 | HELLGATE CLAIM | 11N | 01E | 27 | ABBD | Y |
| BW004321 | WEASEL CREEK | 08N | 01W | 34 | DDBD | Y |
| BW004326 | LODE MINE | 07N | 01W | 4 | BDDC | N |
| BW004331 | AUGUST RUST | 8N | 1W | 16 | BABC | Y |
| BW004336 | DENVER | 8N | 1W | 21 | DCAD | Y |
| BW004346 | LAME DEER | 08N | 01W | 34 | CCAD | Y |
| BW004431 | SILVER SADDLE | 08N | 01W | 27 | CCAA | N |
| BW004466 | MARGARET CLAIM | 11N | 01E | 17 | DBBB | Y |
| BW004471 | SILVER DOLLAR | 07N | 01W | 26 | CADB | Y |
| BW004486 | PHOENIX MINE | 07N | 01W | 23 | ADDA | Y |
| BW004516 | SPRING HILL / HARDMORE | 07N | 01W | 35 | BBDB | Y |
| BW004526 | NORMANDY CLAIMS | 09N | 03E | 24 | ACDB | N |
| BW004531 | HUMMINGBIRD | 10N | 02E | 13 | ADBB | Y |
| BW004581 | W. A. CLARK | 06N | 01W | 2 | ABCA | Y |
| BW004596 | LITTLE GIANT # 5805 | 06N | 01W | 2 | ABCD | Y |
| BW004601 | MAMMOUTH | 07N | 01W | 28 | ACBC | Y |
| BW004606 | CENTRAL GROUP / CONTROL GROUP | 07N | 01W | 26 | CDCB | N |
| BW006123 | LITTLE BONANZA | 08N | 01W | 35 | ADCA | Y |
| BW006127 | LITTLE OLGA | 07N | 01W | 03 | ACCB | Y |
| BW006135 | NATIVE SILVER | 8N | 1W | 16 | DDCC | Y |
| BW006139 | MIGHTY MONARCH | 06N | 01W | 29 | DAAA | Y |
| BW006143 | MILLER | 10N | 02E | 13 | DCAB | Y |

| | | | | | | |
|---|---|---|---|---|---|---|
| BW006163 | ORPHAN BOY | 08N | 01W | 04 | ADBA | N |
| BW006179 | SADIE | 06N | 01W | 28 | BBBD | Y |
| BW006187 | NORTH STRAY HORSE | 08N | 01W | 35 | BDBD | Y |
| BW006195 | CONSHOHOCKEN | 11N | 01E | 22 | CDCD | Y |
| BW006207 | BULLION KING | 07N | 01W | 14 | BBDC | Y |
| BW006211 | BONANZA | 06N | 01W | 19 | CBAC | Y |
| BW006239 | GOLD BUG | 8N | 1W | 09 | BDAD | Y |
| BW006251 | BIG CHIEF | 07N | 01W | 11 | BCBC | Y |
| BW006259 | IDEAL | 11N | 01E | 27 | ABBD | Y |
| BW006275 | BUCKEYE | 08N | 01W | 21 | AABA | Y |
| BW006279 | SUNSHINE | 08N | 01W | 23 | BCAC | Y |
| BW006283 | SUNRISE | 08N | 01W | 26 | CDCD | Y |
| BW006299 | PIONEER MINE | 07N | 01W | 35 | DBAB | N |
| BW006311 | GOLD DUST | 07N | 01W | 15 | ABDD | Y |
| BW006315 | VOSBURG MINE AND MILL | 08N | 01W | 34 | CCCD | Y |
| BW006319 | SUPERIOR MINE | 10N | 02E | 13 | DBAC | Y |
| BW006323 | JAWBONE | 07N | 01W | 15 | BACC | Y |
| BW006327 | LITTLE ANNIE | 07N | 01W | 14 | BBDB | Y |
| BW006335 | MARIETTA | 07N | 01W | 15 | AADC | Y |
| BW006339 | NEW HOPE | 07N | 01W | 11 | BCCD | Y |
| BW006343 | PARK-NEW ERA | 07N | 01W | 15 | DAAC | Y |
| BW006347 | SHEP | 07N | 01W | 13 | CDBD | N |
| BW006351 | ST. LOUIS | 07N | 01W | 26 | BBAB | N |
| BW006387 | KLEINSCHMIDT / LITTLE OLGA | 07N | 01W | 03 | ACCC | Y |
| BW006411 | THOMPSON GULCH | 11N | 02E | 08 | BDBD | Y |
| BW006427 | HELLGATE PLACER | 10N | 01E | 09 | ADBD | N |
| BW006431 | MAGPIE GULCH | 11N | 01E | 21 | BCBA | N |
| BW006611 | CROSS MINE | 07N | 01W | 21 | CDAD | Y |
| BW006615 | ARGO / ECLIPSE | 11N | 01E | 27 | ABDB | Y |
| BW006627 | LOOMIS MINE | 06N | 01W | 16 | DCCD | Y |
| BW006635 | MOUNTAIN VIEW MINE | 08N | 01W | 23 | BCAC | Y |
| BW006655 | VIOLA MINE | 08N | 01W | 23 | BCCC | Y |
| BW006679 | FREIBURG / FREIBERG | 08N | 01W | 26 | BCCA | Y |
| BW006683 | QUEEN BEE MINE | 07N | 01W | 27 | ADAB | N |
| BW006727 | VULTURE MINE | 07N | 01W | 08 | DAD | Y |
| BW006751 | EAST PACIFIC MINE | 08N | 01W | 26 | BCDC | Y |
| BW006759 | JANUARY MINE | 08N | 01W | 26 | CDCB | Y |
| BW008074 | CARLSON CROSSCUT | 08N | 01W | 34 | DCDD | Y |
| BW008079 | STRAY HORSE | 08N | 01W | 35 | CBDA | Y |
| BW008082 | LOWER SUNSHINE | 08N | 01W | 22 | AABA | N |
| BW008134 | DOOLITTLE | 10N | 01E | 01 | ABBC | Y |
| BW008145 | NORTH PHOENIX | 07N | 01W | 23 | ABDA | Y |
| BW008149 | SCHABERT | 10N | 03E | 18 | AACA | Y |
| BW008164 | BUCKEYE | 07N | 01W | 24 | BDBB | Y |
| BW008226 | UNNAMED LOCATION | 11N | 01E | 13 | BDAD | N |
| BW008246 | LITTLE JOE | 07N | 01W | 14 | BCAC | Y |
| BW008248 | > >UNNAMED< < DIAMOND HILL | 07N | 01W | 35 | CACD | N |
| BW008249 | UNNAMED LOCALITY | 07N | 01W | 24 | CCAD | Y |
| BW008261 | GOLDEN GLOW | 07N | 01W | 03 | CADB | Y |
| BW008262 | GW ONE | 08N | 01W | 28 | ADAB | N |
| BW008263 | GW TWO | 08N | 01W | 28 | DABC | N |
| BW008281 | UNNAMED 7N1W10DDDC | 07N | 01W | 10 | DDDC | Y |
| BW008282 | PARK-MARIETTA TAILINGS | 07N | 01W | 14 | CBCD | Y |
| JF001031 | S. HIDDEN LAKE PROSPECT | 06N | 02W | 6 | BCDC | Y |
| JF001055 | OLD FAITHFUL PROSPECT | 06N | 02W | 12 | DCDD | N |
| JF001067 | GOLD SERIES (BIG MARY) CLAIM | 07N | 02W | 09 | ADBA | N |
| JF001073 | J C COPPER CLAIM | 07N | 02W | 31 | DDAB | N |
| JF001079 | MOONLIGHT CLAIMS | 08N | 02W | 09 | BBAB | N |
| JF001085 | OHIO CLAIM | 07N | 02W | 29 | CCAA | N |
| JF001091 | ROAD JUNCTION PROSPECT | 07N | 02W | 19 | ACAA | Y |
| JF001097 | SAINT JOSEPH CLAIM | 07N | 02W | 18 | DCAA | N |

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|---|---|---|---|---|---|---|
| JF001103 | TOP PROSPECT | 07N | 02W | 20 | ACAA | N |
| JF001109 | UPPER TIZER LAKE PROSPECT | 06N | 02W | 6 | AADC | N |
| JF001175 | GREENLEAF MINES | 08N | 02W | 07 | DACA | Y |
| JF001247 | VALERIE AND PARTICIA CLAIMS | 07N | 02W | 22 | DADB | N |
| JF001319 | ELK NO. 1 PLACER | 07N | 02W | 28 | ABBD | N |
| JF001367 | WEST RIDGE PROSPECT | 07N | 02W | 18 | DDCB | N |
| JF001379 | ZALINSKI PROSPECT | 07N | 02W | 19 | BBDA | N |
| JF001391 | CASEY MEADOWS PROSPECT | 08N | 02W | 14 | DAAA | Y |
| JF001403 | HIGH RIDGE PROSPECT | 08N | 02W | 13 | DCBD | N |
| JF001409 | LAVA MOUNTAIN PROSPECT | 08N | 02W | 29 | BDBC | Y |
| JF001415 | MAVERICK PROSPECT | 08N | 02W | 29 | AABB | N |
| JF001421 | LS PROSPECT | 06N | 02W | 12 | CDCA | N |
| JF001523 | WESTON MINE | 08N | 02W | 03 | | N |
| JF001529 | WILLARD GROUP | 08N | 02W | 19 | ACCB | Y |
| JF001583 | BIG TIZER WILDCAT MINE | 07N | 02W | 22 | CBAA | Y |
| JF001589 | PATALOMA | 07N | 02W | 22 | ABCB | Y |
| JF001595 | CALAHAN / CALLAHAM??? | 07N | 02W | 22 | ABAD | Y |
| JF001601 | LITTLE TIZER WILDCAT MINE | 07N | 02W | 33 | ACCB | Y |
| JF001661 | RACHAEL / RACHEL | 08N | 02W | 30 | DBBD | Y |
| JF001727 | UPPER WILSON CREEK | 07N | 02W | 8 | CCCB | N |
| JF001823 | BLACK BEAR | 08N | 02W | 29 | | N |
| JF002025 | BADGER | 08N | 03W | 24 | ABBB | Y |
| JF002091 | LOEBER | 08N | 05W | 15 | | N |
| JF002241 | GOLDEN AGE MINE / MILL | 07N | 02W | 15 | CBAD | Y |
| JF002295 | CENTER REEF | 07N | 02W | 33 | CABC | Y |
| JF002391 | SUMMIT | 06N | 02W | 23 | DBBC | Y |
| JF002415 | BLACKJACK | 07N | 02W | 32 | DDBA | Y |
| JF002463 | YELLOWJACKET | 09N | 03W | 18 | BDDA | Y |
| JF002469 | BELLE / BEST | 07N | 02W | 15 | BCAA | Y |
| JF002481 | EDELWEISS - ARGENTINE | 07N | 05W | 02 | BDBB | Y |
| JF002565 | KADY GULCH GROUP | 07N | 05W | 01 | BC | N |
| JF002583 | NELLIE GRANT MINE | 08N | 06W | 14 | CCBA | Y |
| JF002739 | ARGONNE | 08N | 06W | 13 | BCCB | N |
| JF002775 | SALVAI MINE | 07N | 04W | 19 | AAA | Y |
| JF002781 | HOMESTAKE SHAFT, MT WASHINGTON MIN | 07N | 04W | 18 | DAAC | N |
| JF002805 | BLACKBIRD GROUP | 07N | 05W | 12 | DDAB | N |
| JF002811 | BONANZA | 07N | 04W | 07 | BCDD | N |
| JF002817 | DEWEY TUNNELS | 07N | 04W | 07 | CBBA | N |
| JF002823 | ROSALIE | 07N | 04W | 07 | ACCD | N |
| JF002913 | FORREST | 08N | 04W | 18 | BBBD | Y |
| JF002967 | PANAMA | 08N | 05W | 23 | CCCA | Y |
| JF004801 | LONE EAGLE QUARTZ MINE | 08N | 04W | 31 | BABB | Y |
| JF004891 | R. D. POTEE | 08N | 03W | 13 | BDDD | N |
| JF004946 | SILVER KING | 07N | 05W | 13 | AACC | Y |
| JF005171 | BLUEBIRD MINE | 07N | 05W | 13 | ACDD | Y |
| JF005191 | NEWBURGH MINE | 08N | 02W | 30 | DDAD | Y |
| JF005211 | BOSPHORUS | 08N | 02W | 04 | BDDB | N |
| JF005216 | IRON SIDE / IRONSIDE | 08N | 02W | 16 | CACC | N |
| JF005226 | CHICAGO | 09N | 02W | 26 | ABCC | Y |
| JF005326 | CORBIN COPPER CO. | 07N | 04W | 07 | CABB | N |
| JF005386 | FROHNER MINE AND MILL | 08N | 05W | 15 | DACA | Y |
| JF005441 | YAMA GROUP MINE | 08N | 05W | 13 | DDCA | Y |
| JF005446 | BLUE STONE | 07N | 04W | 19 | DCCB | Y |
| JF005478 | WHITE PINE MINE | 08N | 02W | 32 | BBBA | Y |
| JF005526 | B & G MINE / B&G | 08N | 02W | 31 | AABA | Y |
| JF006125 | GOLDEN GATE MINE | 08N | 02W | 08 | BDDA | N |
| JF006189 | INVAY GROUP (INAY GROUP) | 08N | 02W | 20 | BDBA | N |
| JF006205 | CHRISTMAS GIFT MINE | 08N | 02W | 03 | | N |
| JF006245 | EUCLID MINE | 08N | 02W | 08 | DBBB | N |
| JF006249 | CARBONATE CREEK | 08N | 02W | 30 | BBDB | N |
| JF006293 | MASTADON PROSPECT | 07N | 02W | 18 | DAAC | Y |

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|---|---|---|---|---|---|---|
| JF006301 | MAY | 07N | 05W | 01 | ABDD | Y |
| JF006425 | LONE TREE | 08N | 02W | 03 | | N |
| JF006625 | BELL MINE | 07N | 05W | 12 | DBBD | N |
| JF007454 | UPPER QUARTZ CREEK | 08N | 04W | 19 | CCDA | Y |
| JF007455 | QUARTZ CREEK ADIT | 08N | 04W | 30 | BDDB | Y |
| JF007456 | MORGAN GULCH | 08N | 04W | 31 | CDAA | Y |
| JF007458 | KADY POND | 07N | 04W | 06 | BDCC | Y |
| JF007459 | WOOD CHUTE PROSPECT | 07N | 05W | 24 | AAAD | Y |
| JF007460 | ALPHA OMEGA | 08N | 05W | 36 | CDDC | N |
| JF007470 | BALLARD | 07N | 02W | 32 | DADA | Y |
| JF007471 | KADY GULCH MINE | 07N | 04W | 06 | BCBA | Y |
| JF007474 | CURTAIN GULCH ADITS | 07N | 04W | 18 | CADA | Y |
| JF007476 | FROHNER LEAD MINE | 08N | 05W | 15 | DBCC | Y |
| JF008045 | WARM SPRINGS MILL TAILINGS | 08N | 02W | 30 | CADD | Y |
| JF008047 | B & G EAST MINE | 08N | 02W | 31 | AABB | Y |
| JF008068 | FROHNER BASIN MILL TAILINGS | 08N | 05W | 14 | CA | Y |
| JF008270 | WARM SPRINGS TAILINGS ADIT | 08N | 02W | 30 | DBDC | Y |
| JF008271 | B&G SHAFT | 08N | 02W | 31 | | Y |
| LC000997 | LUCKY LINDA MINE | 08N | 05W | 16 | DBDB | Y |
| LC001003 | VALLEY FORGE | 09N | 05W | 33 | CCAD | Y |
| LC001015 | PEGGY ANN MINE | 13N | 07W | 24 | AACC | Y |
| LC001021 | RED ROCK CLAIMS | 16N | 07W | 04 | ADCA | N |
| LC001039 | WIGGINS MINE | 13N | 08W | 32 | CACD | N |
| LC001093 | OLD BACHELOR MINE | 13N | 07W | 15 | ACCC | N |
| LC001105 | DISCOVERY AND MARGURETE MINE | 14N | 09W | 08 | CBDB | N |
| LC001117 | RAY JENSEN MINERAL DEPOSIT CLAIM | 08N | 05W | 08 | AADB | Y |
| LC001129 | LINCOLN GULCH PLACER | 14N | 09W | 08 | CAAD | Y |
| LC001171 | DANIEL STANTON | 08N | 05W | 05 | DADD | Y |
| LC001183 | ADELE MINE | 16N | 07W | 34 | ABAB | Y |
| LC001201 | BOBBY BOY MINE | 15N | 06W | 19 | DDBC | Y |
| LC001207 | COPPER BOWL MINE | 16N | 06W | 30 | ACCC | N |
| LC001225 | HUMDINGER GROUP | 13N | 09W | 35 | CAAD | Y |
| LC001231 | ILLINI MINE | 13N | 09W | 27 | | N |
| LC001237 | ARMSTRONG MINE | 08N | 05W | 06 | BCAB | Y |
| LC001273 | UNNAMED URANIUM | 09N | 05W | 34 | CADD | Y |
| LC001327 | AJAX MINE | 11N | 07W | 09 | BCBA | Y |
| LC001333 | ALPHA MINE | 13N | 07W | 14 | BBBC | N |
| LC001345 | ANACONDA | 15N | 06W | 21 | DDDD | Y |
| LC001357 | BADGER MINE | 13N | 07W | 15 | ABAB | Y |
| LC001369 | PEERLESS JENNY / PEERLESS JENNIE | 08N | 05W | 21 | BDBB | Y |
| LC001381 | LITTLE LILLY | 08N | 05W | 04 | CBCD | N |
| LC001387 | EUREKA | 08N | 05W | 04 | DBAB | N |
| LC001393 | O.H.BASSETT | 08N | 05W | 04 | BCDB | Y |
| LC001399 | ALLEY | 08N | 05W | 08 | ADAA | N |
| LC001411 | HORSEFLY ADIT | 08N | 05W | 10 | ACDD | Y |
| LC001417 | LOCALITY 18 | 08N | 05W | 21 | ACBC | Y |
| LC001429 | LITTLE SAMPSON | 08N | 05W | 04 | BCCB | N |
| LC001447 | TRANSIT MINE | 08N | 05W | 08 | ABBB | Y |
| LC001465 | PORPHYRY DIKE | 08N | 06W | 24 | DADA | N |
| LC001471 | WARD THOMPSON | 15N | 06W | 16 | DABC | Y |
| LC001489 | COPPER HILL | 14N | 06W | 02 | DADA | Y |
| LC001501 | MAMMOTH | 08N | 05W | 04 | ADBB | N |
| LC001513 | ECLIPSE | 14N | 06W | 04 | DCDD | Y |
| LC001519 | CHARLEY COPPER & SILVER CLAIMS | 13N | 07W | 35 | ABBB | Y |
| LC001525 | RAINY DAY MINE | 15N | 09W | 04 | DCBC | Y |
| LC001531 | HIDDEN VEIN COPPER DEPOSIT | 15N | 05W | 32 | ACCB | N |
| LC001543 | CRYSTAL MINING | 14N | 06W | 24 | AABB | N |
| LC001555 | BUTTERFLY MINE | 13N | 08W | 14 | CCCA | Y |
| LC001579 | COPPER QUEEN | 11N | 01W | 15 | ADCC | Y |
| LC001585 | JOHN NEUFELD | 14N | 05W | 16 | DDD | N |
| LC001591 | GRUNTER & BLUE BELL | 14N | 06W | 02 | DADD | Y |

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|---|---|---|---|---|---|---|
| LC001597 | COPPER CAMP / RAINY DAY MINE | 15N | 09W | 04 | DBCC | Y |
| LC001675 | HEDDLESTON DEPOSITS | 15N | 06W | 28 | BBAB | N |
| LC001723 | HEDDLESTON GROUP | 15N | 06W | 16 | DABC | N |
| LC001741 | GOSSAN & JUNIOR CLAIMS | 15N | 06W | 16 | BDCB | Y |
| LC001753 | RED MOUNTAIN TUNNEL | 08N | 05W | 04 | BBBB | Y |
| LC001765 | EVERGREEN | 08N | 05W | 05 | DDCA | Y |
| LC001771 | FREE SPEACH #1 / FREE SPEECH #1 | 08N | 05W | 04 | ACCD | N |
| LC001795 | COPPER DYKE MINE | 08N | 05W | 17 | BBDA | N |
| LC001801 | CONSOLATION | 15N | 06W | 21 | ABCD | Y |
| LC001807 | BUNKER HILL | 08N | 05W | 04 | CCBB | Y |
| LC001813 | LEXINGTON | 08N | 05W | 04 | DBBC | Y |
| LC001843 | SILVER BELL MINE | 13N | 07W | 18 | BABC | N |
| LC001885 | DAN OKER'S MINE | 14N | 07W | 21 | DCBD | N |
| LC001897 | BEATRICE / BEATTRICE | 08N | 06W | 01 | BBCB | Y |
| LC001903 | RED STAR | 13N | 07W | 19 | BACA | Y |
| LC001909 | LUCKY STRIKE | 13N | 07W | 08 | DBCD | Y |
| LC001915 | SHEEP CREEK NO. 1 & 2 PLACER | 16N | 08W | 08 | CACC | N |
| LC001945 | MONTE CHRISTO / MONTE CRISTO | 08N | 05W | 17 | BBBB | Y |
| LC001951 | CARBONATE | 15N | 06W | 20 | BDCB | Y |
| LC001957 | R. T. C. LODE | 15N | 06W | 16 | DABC | Y |
| LC001975 | LEE MOUNTAIN | 09N | 05W | 33 | CCDC | Y |
| LC003904 | BLUE JAY PLACER | 13N | 07W | 10 | BCAA | N |
| LC003924 | JOLLY ROGER MINE | 08N | 05W | 16 | BAAB | Y |
| LC003939 | ALICE LODE | 08N | 05W | 05 | | N |
| LC003944 | BIG BEN | 12N | 07W | 11 | DCCB | Y |
| LC004209 | LUCKY JOE MINE | 08N | 06W | 1 | BDA | N |
| LC004229 | STRAWBERRY MINE | 11N | 05W | 18 | DCBA | Y |
| LC004239 | SWANSEA MINE | 13N | 07W | 18 | BABD | N |
| LC004274 | LUCKY BERNICE NO. 3 | 17N | 06W | 30 | | N |
| LC004294 | NELLIE MILES LODE | 17N | 08W | 22 | CDDD | N |
| LC004314 | GOLD DOLLAR MINE | 13N | 08W | 06 | | N |
| LC004324 | MAMMOTH MINE | 13N | 07W | 05 | CBAD | Y |
| LC004334 | MONITOR CREEK PLACER | 08N | 06W | 24 | DABB | N |
| LC004344 | OLD AMBER MINE | 11N | 01W | 11 | ACBA | Y |
| LC004349 | OPHIR CAVE | 11N | 07W | 09 | CCCA | Y |
| LC004369 | BLACKTAIL CAVE | 16N | 05W | 32 | CBBD | N |
| LC004384 | SILVER CORD | 08N | 05W | 05 | DDDD | N |
| LC004389 | SILVER CRESENT | 08N | 05W | 20 | ACC | N |
| LC004409 | UPPER COPPER CREEK AREA | 15N | 09W | 04 | ACCA | N |
| LC004439 | GENERAL MINE | 08N | 05W | 08 | ACBA | N |
| LC004449 | S.P.BASSETT | 08N | 05W | 05 | DDDD | N |
| LC004474 | BLACK WATCH | 13N | 08W | 18 | CDAD | Y |
| LC004489 | NORA DARLING | 11N | 07W | 17 | CDAD | Y |
| LC004559 | MIKE HORSE | 15N | 06W | 28 | DCAA | Y |
| LC004584 | BACHELOR GOLD MINING COMPANY | 13N | 06W | 07 | CBAA | N |
| LC004589 | CAPPOLIS | 08N | 06W | 1 | BDAD | N |
| LC004619 | BLUE STAR | 13N | 07W | 17 | BACB | Y |
| LC004966 | MAY LILLY / MAY LILY | 08N | 05W | 30 | ADCA | Y |
| LC007264 | SOUTH PACIFIC | 08N | 05W | 04 | ACAA | N |
| LC007268 | TEAL LAKE | 08N | 05W | 04 | CCBC | Y |
| LC007276 | VICTORY MINE / EVENING STAR | 11N | 07W | 17 | CADA | Y |
| LC007278 | VICTORY MINE | 13N | 07W | 15 | BCCB | Y |
| LC007284 | WOLFTONE | 08N | 05W | 04 | BBBD | N |
| LC007296 | OKER MINE / SANDBAR CREEK ADITS | 14N | 06W | 05 | BAAC | Y |
| LC007302 | SKYSCRAPER | 15N | 06W | 21 | DACA | Y |
| LC007304 | PAYMASTER | 15N | 06W | 20 | DBDD | Y |
| LC007312 | CYCLONE MINE | 13N | 07W | 28 | BCDC | Y |
| LC007317 | PRIZE MINE | 13N | 07W | 27 | ACCD | Y |
| LC007319 | RED WING | 15N | 06W | 27 | BDBB | N |
| LC007321 | REX BEACH | 15N | 06W | 21 | AABA | Y |
| LC007323 | ROVER MINE | 14N | 07W | 29 | | N |

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|---|---|---|---|---|---|---|
| LC007324 | RUSSEL MINE | 08N | 05W | 05 | BCA | N |
| LC007329 | CRUMB MINE | 13N | 08W | 23 | DBBA | Y |
| LC007332 | GOLDEN MESSENGER MINE | 11N | 01W | 4 | CBAA | Y |
| LC007336 | GOLDEN CHARM MINE | 11N | 01W | 06 | ADBD | Y |
| LC007338 | HOG CLAIM | 15N | 06W | 28 | BDDD | N |
| LC007340 | J J HILL CLAIMS | 08N | 05W | 03 | ACCB | Y |
| LC007341 | JERUSHA MINE | 11N | 06W | 05 | BABD | Y |
| LC007342 | JUSTICE MINE | 08N | 05W | 06 | CCAC | Y |
| LC007347 | COTTER BASIN MINE | 15N | 09W | 11 | BDCB | Y |
| LC007348 | GOLCONDA | 13N | 07W | 15 | DDCD | N |
| LC007349 | BYRNES CREEK COPPER | 16N | 08W | 36 | CBBC | Y |
| LC007350 | GIANT CLAIM | 15N | 09W | 22 | DCBD | Y |
| LC007358 | MIDNIGHT | 15N | 06W | 21 | BABC | N |
| LC007359 | HOGALL | 15N | 06W | 28 | DDCD | N |
| LC007360 | AMERICAN FLAG | 08N | 05W | 04 | ACBD | N |
| LC007363 | BIG COPPER LODE | 11N | 01W | 05 | ACBB | Y |
| LC007368 | IRON HILL CLAIM | 15N | 06W | 21 | DACC | Y |
| LC007370 | GOULD PLACER MINE | 08N | 05W | 20 | ABAA | N |
| LC007373 | HAMLET | 08N | 05W | 04 | CBCC | Y |
| LC007374 | HOMESTAKE MINE | 13N | 07W | 15 | BABD | Y |
| LC007380 | JOHNNY MINE | 08N | 05W | 05 | BDA | N |
| LC007382 | OMEGA MINE | 13N | 07W | 14 | BABB | N |
| LC007384 | KLEINSCHMIDT | 15N | 06W | 28 | CDBB | N |
| LC007386 | LAST CHANCE MINE | 14N | 07W | 29 | BADC | N |
| LC007387 | LITTLE DANDY | 11N | 01W | 4 | DBBB | Y |
| LC007389 | CARBONATE HILL | 16N | 06W | 16 | BDDA | Y |
| LC007392 | BETSY ROSS MINE | 08N | 05W | 07 | | N |
| LC007393 | BLACKFOOT MINE | 14N | 09W | 29 | AABB | Y |
| LC007396 | CALLIOPE MINE / COPPER GATE | 15N | 06W | 16 | CDCD | Y |
| LC007400 | CARLSON MINE | 08N | 06W | 25 | BABC | N |
| LC007401 | COLUMBIA MINE | 14N | 07W | 20 | DBCD | N |
| LC007408 | EUREKA CLAIM | 15N | 06W | 21 | BBAC | N |
| LC007410 | STONEWALL CREEK | 15N | 09W | 22 | CDDC | Y |
| LC007415 | GOULD CREEK / PEGGY ANN | 13N | 07W | 24 | AADA | Y |
| LC007419 | LINCOLN CREEK | 14N | 09W | 21 | BCBC | N |
| LC007421 | LIVERPOOL CREEK | 14N | 09W | 12 | | N |
| LC007422 | KEEP COOL CREEK | 14N | 08W | 09 | CCDA | N |
| LC007423 | SEVEN-UP PETE CREEK | 14N | 08W | 13 | ABBB | N |
| LC007430 | MCAWBER | 08N | 05W | 04 | CCAA | Y |
| LC007433 | MILLIRON | 15N | 06W | 16 | BCDD | Y |
| LC007438 | NAKOMA MINE | 13N | 07W | 15 | CAAD | Y |
| LC007439 | JAY GOULD TUNNEL | 13N | 07W | 13 | BBCC | Y |
| LC007444 | TENMILE CREEK & TRIBUTARIES | 08N | 05W | 08 | | N |
| LC007451 | BEATRICE SOUTH | 08N | 06W | 01 | BBCB | Y |
| LC007452 | UNKNOWN (BEAVER CREEK) | 08N | 05W | 03 | BAAB | Y |
| LC007453 | UPPER TENMILE SHAFT | 08N | 06W | 13 | BBDA | Y |
| LC007462 | UNNAMED | 09N | 05W | 08 | CCD | N |
| LC007475 | SALLIE BELL | 08N | 05W | 10 | DCAD | Y |
| LC008000 | WOODROW WILSON | 08N | 05W | 20 | CCAD | Y |
| LC008016 | UNNAMED OPEN SHAFT | 11N | 07W | 17 | BDCA | Y |
| LC008024 | UNNAMED LINCOLN GULCH MINES | 14N | 09W | 07 | ABCA | Y |
| LC008025 | BLACKFOOT TAILINGS | 14N | 09W | 29 | AAAD | Y |
| LC008026 | MARY P. | 15N | 06W | 21 | DCBD | Y |
| LC008027 | WHITE HOPE MINE | 15N | 06W | 34 | BAAA | N |
| LC008028 | EDITH | 15N | 06W | 21 | CBBA | N |
| LC008046 | LOWER JUSTICE MINE | 08N | 05W | 06 | BDBC | Y |
| LC008067 | BANNER CREEK TAILINGS | 08N | 05W | 16 | BCD | Y |
| LC008075 | WIGGINS WEST | 13N | 08W | 31 | BBDD | Y |
| LC008076 | MADISON WONDER | 13N | 09W | 25 | BAAD | Y |
| LC008077 | MADISON NORTHWEST | 13N | 09W | 24 | CADB | Y |
| LC008078 | PACK HORSE | 13N | 08W | 08 | ABAB | Y |

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| LC008133 | DAVIS GULCH ADITS | 13N | 07W | 08 | CCDC | Y |
| LC008140 | GRANITE BUTTE PROSPECTS | 13N | 07W | 26 | BBDC | Y |
| LC008147 | POORMAN MINES | 13N | 07W | 28 | DDBD | Y |
| LC008150 | UNKNOWN | 13N | 07W | 19 | BBDD | Y |
| LC008156 | UNNAMED POORMAN | 13N | 07W | 09 | BCBC | Y |
| LC008202 | GREEN MOUNTAIN OCCURRENCE | 16N | 07W | 24 | DACA | N |
| LC008223 | DAN KIM | 08N | 05W | 20 | BBAC | Y |
| LC008265 | ROADSIDE DUMPS | 08N | 05W | 21 | BAAA | N |
| MR003127 | PORCUPINE | 09N | 04E | 28 | ABBA | Y |
| MR003157 | BIG HAT LODE | 10N | 03E | 12 | CBAC | |
| MR003382 | SNOWBANK | 09N | 04E | 28 | CAAC | Y |
| MR003692 | ATLANTA GULCH | 09N | 04E | 05 | CAAA | N |
| MR008161 | BIGLER | 09N | 04E | 28 | CADA | Y |
| PO002254 | FISHER GROUP | 16N | 10W | 27 | CDD | N |
| PO002260 | BUGLE MOUNTAIN GROUP | 16N | 10W | 27 | DBAA | N |
| PO002320 | DEER CREEK MINE | 13N | 10W | 36 | BDCB | N |
| PO002326 | CHICKEN CREEK PLACER | 13N | 10W | 36 | BCDA | Y |
| PO002350 | SUNSHINE | 13N | 10W | 24 | CDCD | N |
| PO002458 | SUNRISE MINE | 08N | 07W | 12 | ACCC | Y |
| PO002464 | NORTH POLE MINE | 08N | 06W | 6 | | N |
| PO002470 | MONARCH MINE | 08N | 06W | 31 | BAAB | Y |
| PO002492 | LINCOLN VALLEY BENTONITE | 14N | 10W | 15 | BCDB | N |
| PO002522 | BULLION | 08N | 06W | 12 | BBCC | N |
| PO002564 | GRAY | 12N | 08W | 20 | ACCC | N |
| PO002576 | HILL TOP / HILLTOP | 13N | 10W | 21 | ACCD | N |
| PO002624 | SURETHING MINE | 08N | 06W | 15 | DDBA | Y |
| PO002630 | TREASURE MOUNTAIN MINE | 08N | 06W | 08 | BDCD | Y |
| PO002636 | VIKING MINE | 08N | 06W | 05 | BABD | Y |
| PO002642 | WALL STREET MINE | 11N | 07W | 27 | BCDB | Y |
| PO002774 | ADAMS BROTHERS MINE | 08N | 06W | 05 | CCCA | Y |
| PO002840 | OHIO-SPECULATOR MINE | 08N | 07W | 13 | | N |
| PO002882 | ANNA R AND HATTIE M | 08N | 06W | 10 | | N |
| PO002888 | BIG DICK / (BLACK JACK) | 08N | 06W | 06 | BDBD | Y |
| PO002906 | ESMERALDA | 11N | 07W | 23 | DCBB | Y |
| PO002918 | MCCACRAN | 13N | 10W | 03 | DCCA | N |
| PO002924 | BLUEBIRD | 08N | 07W | 01 | CACB | N |
| PO002936 | TELEGRAPH / TELEGRAPH CREEK | 08N | 06W | 11 | ABAC | Y |
| PO004640 | CORBIN MINE | 13N | 10W | 21 | BACC | Y |
| PO004685 | FLORA MINE | 08N | 07W | 01 | BBAC | N |
| PO004715 | HIGGINS PROSPECT | 13N | 10W | 21 | ACCD | Y |
| PO004720 | HOBBY HORSE MINE | 13N | 10W | 21 | DCBD | N |
| PO004795 | BLACKFEET NO. 1 | 08N | 07W | 1 | | N |
| PO004890 | PLUTARC MINE | 13N | 10W | 21 | ACBD | Y |
| PO004895 | PORTO RICO MINE | 16N | 10W | 19 | AADD | N |
| PO004905 | ARNOLD MINE | 11N | 07W | 27 | CBDD | Y |
| PO004950 | KIMBALL MINES | 08N | 07W | 12 | ABAC | Y |
| PO004955 | KLONDIKE MINE | 16N | 10W | 17 | CDBA | N |
| PO004970 | LILLY ORPHAN BOY /LITTLE ORPHAN BOY | 08N | 06W | 15 | CAAB | Y |
| PO004975 | LITTLE DAISY MINE | 11N | 07W | 20 | DADB | Y |
| PO004995 | MCKAY MINE | 11N | 07W | 23 | DCBB | Y |
| PO005000 | MINERAL HILL PROSPECT | 16N | 10W | 17 | CDBA | N |
| PO005030 | HOPKINS PROSPECT | 13N | 10W | 23 | BCBB | N |
| PO005035 | CHIMNEY CREEK PLACER | 13N | 10W | 27 | CACB | N |
| PO005045 | HARDLUCK | 08N | 06W | 20 | AADD | Y |
| PO005050 | NANCY MINE | 11N | 07W | 19 | DABD | Y |
| PO005055 | NEGROS | 09N | 07W | 36 | CDBA | Y |
| PO005065 | PRICE GROUP MINE | 11N | 07W | 21 | CADB | Y |
| PO005070 | WOLVERINE | 08N | 06W | 20 | BBCC | N |
| PO005095 | CHARTER OAK | 09N | 07W | 36 | ACCD | Y |
| PO005110 | GOLDEN ANCHOR | 08N | 07W | 01 | BBCD | Y |
| PO005140 | JULIA MINE | 08N | 06W | 08 | ABAB | Y |

| | | | | | | |
|---|---|---|---|---|---|---|
| PO005170 | CYCLONE MINE / WHIRLWIND | 11N | 07W | 17 | DCCC | Y |
| PO005175 | UNNAMED QUARRIES | 11N | 07W | 19 | CAA | N |
| PO005185 | MASCOTTE MINE | 12N | 08W | 14 | CCBB | Y |
| PO005195 | BUMBLEBEE / MORNINGSTAR | 11N | 07W | 20 | BBCD | Y |
| PO005230 | ELDORADO MINE | 11N | 07W | 17 | DCCD | Y |
| PO005235 | HILDA / BLACKFOOT GOLD/ BLACKFOOT | 13N | 10W | 22 | DCBB | Y |
| PO005320 | HUBCAMP / HUB CAMP | 08N | 06W | 04 | BAAD | Y |
| PO005325 | LOWER TELEGRAPH | 09N | 06W | 33 | CBDB | N |
| PO005360 | THIRD TERM | 09N | 06W | 28 | DACB | Y |
| PO005435 | ONTARIO | 08N | 06W | 22 | CAAA | Y |
| PO007461 | UNNAMED | 10N | 6W | 13 | BCAB | N |
| PO007463 | DIVIDE SHAFTS | 08N | 06W | 11 | ADDD | Y |
| PO007464 | NORTH FORK O'KEEFE CREEK | 08N | 06W | 11 | CDBA | Y |
| PO007465 | NEWMAN'S CAMP / NEWMANS CAMP | 08N | 06W | 15 | BAAA | Y |
| PO007467 | TRACK ADIT (?) | 08N | 06W | 16 | ADAB | Y |
| PO007468 | O'KEEFE MOUNTAIN ADITS | 08N | 06W | 22 | BADA | Y |
| PO007469 | POND SHAFT | 08N | 06W | 15 | CCDA | Y |
| PO007472 | MARY QUARTZ LODE | 08N | 06W | 05 | BABA | Y |
| PO007473 | UNNAMED | 11N | 07W | 19 | CADA | N |
| PO008015 | UNNAMED MINE- SEC 20 | 11N | 07W | 20 | AAAC | Y |
| PO008121 | SMITH JONES | 13N | 10W | 01 | CCBD | N |
| PO008169 | LADY SMITH / SHAMROCK GROUP | 11N | 07W | 27 | BCDB | Y |
| PO008170 | STUMBLE UPON | 11N | 07W | 21 | CCAC | Y |
| PO008225 | WILSON CREEK PLACER | 13N | 10W | 22 | BABD | N |
| PO008227 | O'KEEFE CREEK / COPPER KING ? | 08N | 06W | 10 | DDCA | Y |
| PO008235 | STEEL FRAME SHAFT | 08N | 06W | 11 | DBCD | Y |
| PO008236 | HOPE ADIT | 08N | 06W | 16 | AABC | Y |
| PO008237 | POND ADIT | 08N | 06W | 15 | CBDC | Y |
| PO008238 | NORTH ONTARIO | 08N | 06W | 22 | BADD | Y |
| PO008243 | UPPER KIMBAL (KIMBAL NORTH) | 08N | 07W | 01 | DCAA | Y |
| PO008244 | BIG DICK MILLSITE | 08N | 07W | 01 | DADD | Y |
| PO008250 | BLUEBIRD EAST | 08N | 07W | 01 | ACCC | N |
| PO008254 | MONARCH MILL | 08N | 06W | 30 | CACC | Y |
| PO008259 | UNNAMED SEC 15 | 08N | 06W | 15 | | N |
| PO008260 | SURETHING SOUTH | 08N | 06W | 15 | DDDC | Y |
| PO008276 | NANCY HELEN | 11N | 07W | 19 | DBCB | Y |
| PO008279 | UNNAMED SEC 19 | 11N | 07W | 19 | AABC | Y |
| PO008286 | OPEN ADITS | 11N | 07W | 19 | AADB | Y |
| PO008358 | BULLION SOUTH | 08N | 06W | 11 | ADAA | Y |

# Appendix III

## Description of Mines and Mills
## in the Upper Missouri River Drainage
## Helena National Forest

## Mines and Prospects Descriptions

### B & G
JF005526

Two caved adits, one caved shaft, and one flooded open shaft with 1,000–1,500 feet of total workings compose the B & G. According to Roby *et al.* (1960), a vertical N80°E quartz-pyrite-arsenopyrite-cerrusite vein from one to six feet wide was mined. Production figures for 1910, 1934, and 1936 are 80 oz of gold, 1,430 oz of silver, 1,832 pounds of copper and 18,756 pounds of lead from 85 tons of ore, so gold was unusually abundant for a Boulder Batholith–related deposit. Smedes (1966) reported radioactivity at the dumps.

### Badger
JF002025

Roby *et al.* (1960) reported that the Badger operated occasionally from 1915 to 1947 and produced 195 tons of ore from which 72 oz of gold, 2,898 oz of silver, 915 pounds of copper, 49,740 pounds of lead, and 469 pounds of zinc were recovered. This indicates a larger operation than the Badger described herein, which consists of two caved adits, each only a couple hundred feet long. At this site, altered (to quartz, sericite, and pyrite) quartz monzonite contains disseminated molybdenite and is cut by quartz-pyrite veinlets. A small amount of water emerges from one of the adits.

### Bluebird
JF005175

The Bluebird has a long-lived history of both production and environmental damage. The following information was compiled from Winchell and Winchell (1912), Knopf (1913), Roby *et al.* (1960), and Becraft *et al.* (1963). The mine was discovered about 1887 and worked on an intermittent basis until 1946. A steeply south-dipping, N80°W vein of quartz, tourmaline, pyrite, and tetrahedrite, with some sphalerite, galena, arsenopyrite, chalcopyrite, and rhodochrosite was mined from andesitic tuff of the Elkhorn Mountains volcanics. The vein lies along a contact between the tuff and a granitic dike. Workings (all now caved) consisted of a 1000 foot vertical shaft and three adits with a combined length of more than 5,000 feet. Production records 1902–1946 show that 17,989 tons of ore were mined, with an average grade of 0.19 oz/ton gold, 18.65 oz/ton silver, 2.69% copper, and 0.57% lead.

In 1993, water was originating from all three caved adits; the upper, main portal had a large volume acid discharge that visibly affected Curtain Creek until its waters sank below ground near the Salvai mine.

### Bluestone
JF005446

One caved and one locked adit apparently investigated an obvious vertical N80°W shear zone in Elkhorn Mountains andesite. Becraft *et al.* (1963) stated that a 4-inch to 2-foot wide vein of arsenopyrite, pyrite, galena, sphalerite, and chalcopyrite was mined. Production from 1919 to 1925 was 25 tons of ore bearing 3 oz of gold, 352 oz of silver, and 2011 pounds of copper (Roby *et al.* 1960). The site is devoid of water, although the toxic Curtain Creek runs nearby and has affected vegetation.

Chicago
JF005226

One caved inclined shaft with 1,000–2,000 feet of associated workings and one caved adit several hundred feet long are present at the Chicago. The literature contains conflicting reports of the geology buried within. Roby *et al.* (1960) stated that an east-west vein in andesite was mined. Smedes (1966) thought the deposit followed the base of the middle Elkhorn Mountains volcanics member, and contained quartz, pyrite, arsenopyrite, sphalerite, epidote, magnetite, tourmaline, diopside, and carbonate minerals. Both agree that gold was the major commodity—from 1910 until 1922, 89 tons of ore containing 87 oz of gold, 156 oz of silver, 199 pounds of copper, and 328 pounds of lead were produced.

Curtain Gulch Adits
JF007474

Two caved adits, each about 100 feet long, explore a breccia zone in Elkhorn Mountains volcanics that contains quartz, kaolinite, and iron oxides.

Edelweiss-Argentine
JF002481

Numerous adits, open and caved, and open cuts are present on this large block of private ground. There are also at least three mine discharges. It appears that a typical east-west Boulder Batholith vein at least four feet thick of quartz, pyrite, sphalerite and clays was investigated. Apparently, the deposit was not discovered until 1946 or 1947 (Roby *et al.* 1960), and no production has been recorded (Elliott *et al.* 1992).

Forest
JF001913

Two caved shafts with several thousand feet of associated workings are present at the Forest site. Vein material appears typical of the Boulder Batholith, with quartz, pyrite, galena, sphalerite, and chalcopyrite. A gravity mill operated at the site, and coarse tailings of quartz, feldspar, iron-stained clays extend down a dry slope for 500 feet. Becraft *et al.* (1963) stated that part of the dump is weakly radioactive.

Frohner
JF005386

The Frohner mined a section of the northwest-striking vein system that extends more than a mile from the Nellie Grant to the Frohner Lead. This zone dips 60°SW, is up to 40 feet wide, and contains much arsenopyrite (Becraft *et al.* 1960), as well as pyrite, galena, and sphalerite. At least 2,000 feet of workings are present, and production 1928–1954 was 161 oz of gold, 7,329 oz of silver, 2,305 pounds of copper, 91,503 pounds of lead, and 26,000 pounds of zinc from 1917 tons of ore (Roby *et al.* 1960). Water emerges from the caved adit and forms gray terraces before entering Frohner Creek.

Frohner Lead
JF007476

Here, the northwestern extension of the Frohner–Nellie Grant vein was mined through at least three shafts (presently caved or covered) and one adit (caved). Total length of workings must be 1,000–2,000 feet. Vein material on the dump contains chalcedony, quartz, pyrite, galena, and tetrahedrite, and a select sample of this assayed at 0.104 oz/ton gold, 1.64 oz/ton silver, 0.099% copper, 0.45% lead, 0.081% zinc, and 1.49% arsenic. A small discharge originates from the caved adit.

### Frohner Basin Mill
JF008068

Little is known about the history of this site, except that an original gravity mill was replaced by a flotation mill built to re-treat the gravity tailings (Roby et al. 1960). In 1993, there did appear to be two distinct types of tailings: an upper area of unvegetated gray to red-brown clays, and a lower, partially revegetated area of coarse sand to gravel sized pieces of quartz-pyrite vein that may be untreated gravity tailings. Assay results support this theory: upper tailings results were less than 0.006 oz/ton gold, 0.10 oz/ton silver, 0.013% copper, 0.04% lead, 0.047% zinc, and less than 0.04% arsenic; lower tailings results were 0.110 oz/ton gold, 0.98 oz/ton silver, 0.041% copper, 0.26% lead, 0.821 % zinc, and 0.53% arsenic. Drilling is necessary to estimate volumes.

### Horsefly
LC001411

At the Horsefly, a N85°E 65°SE (Becraft et al. 1963) vein three feet wide of quartz, pyrite, and arsenopyrite and hosted by quartz monzonite, was mined. The adit is caved and is probably 200–300 feet long. Becraft *et al.* (1963) reported that the dump was slightly radioactive and also reported an adit discharge, but it was dry in 1993.

### Kady Gulch
JF007471

A caved N74°W adit discharges water and has an associated streamside dump of mostly clays. The adit must be a few hundred feet long. Vein mineralogy is quartz, chalcedony, pyrite, galena, and sphalerite, and a select sample of this material contained 0.010 oz/ton gold, 3.5 oz/ton silver, 0.287% copper, 1.5% lead, 0.941% zinc, and 0.21% arsenic. Two more very short caved adits head southwest just uphill.

### Kady Pond
JF007258

Two caved adits, each only about 100 feet long, head southwest to examine quartz-pyrite veinlets in iron-stained quartz monzonite.

Lone Eagle Quartz

JF004801

The Lone Eagle is an old metal mine that was reopened in 1952 to explore for uranium (Becraft 1956, Becraft *et al.* 1963). Sixty-five tons of uranium ore with 0.24-0.28% $U_3O_8$ were shipped between 1952 and 1955 (Roby *et al.* 1960). The vein consists of quartz, pitchblende, pyrite, sphalerite and galena, and is one to five feet wide and 230 feet long (Roby *et al.* 1960). Maps by Becraft *et al.* (1963) show a 275-foot crosscut and a 360-foot drift along the N45°E 50°–75°SE vein. They also show a parallel 10-foot-thick quartz-pyrite vein that was untested. A select sample of vein material from the dump ran 0.008 oz/ton gold, 5.96 oz/ton silver, 1.20% copper, 0.17% lead, 0.829% zinc, and 0.49% arsenic.

In 1993, the caved adit discharged water across the dump; a dump composite sample contained 0.006 oz/ton gold, 0.4 oz/ton silver, 0.007% copper, 0.26% lead, 0.079% zinc, and 0.08% arsenic.

May and Manganese

JF006301

One caved adit 300–500 feet long was driven N85°W on a quartz-pyrite-manganese oxide vein.

Morgan Gulch

JF007456

Numerous short workings, including at least one locked adit, three caved adits, one covered shaft, and many trenches are scattered across an area one mile long by 500 feet wide in iron-stained quartz monzonite. One quartz-pyrite-chlorite vein is exposed; it strikes N88°W. A select sample of brecciated quartz and iron and manganese oxides contained 0.016 oz/ton gold, 24.3 oz/ton silver, 0.478% copper, 0.23% lead, 0.979% zinc, and 0.21% arsenic.

Nellie Grant

JF002583

The Nellie Grant was a large disturbance which, in 1993, was "reclaimed", at least visually. However, a substantial discharge still emerges from the old shaft. Workings appeared to be extensive. Becraft *et al.* (1963) provided the following information. A N72°W 83°SW vein, probably the extension of the Frohner vein, was mined. Mineralogy is typical of the Boulder Batholith: quartz, pyrite, sphalerite, chalcopyrite, and galena. Production 1948–1957 was 1,057 tons of ore yielding 293 oz of gold, 10,272 oz of silver, 3,481 pounds of copper, 216,242 pounds of lead, and 47,156 pound of zinc.

Newburg

JF005191

The Newburgh is a large mine on the east edge of the Boulder Batholith with over one mile of workings (Roby *et al.* 1960). However, little information is available on it. Presumably, a typical east-west Boulder Batholith vein of pyrite, galena, chalcopyrite, and arsenopyrite was mined, which contained considerable gold. Production figures show 10,238 tons of ore containing 12,365 oz of gold, 95,560 oz of silver, 92,602 pounds of copper, and 508,689 pounds of lead were produced (Roby *et al.* 1960). Dumps were also processed at the nearby Warm Springs Mill and yielded about 0.1 oz/ton gold and 0.5 oz/ton silver (Roby *et al.* 1960). Smedes (1966) also reported radioactivity at the mine.

Three caved adits exist at the Newburgh, and the site contains an adit and a dump discharge.

Quartz Creek
JF007455

One caved 100-foot adit and one 10-foot open adit compose the Quartz Creek mine. A vertical N35°E zone of chalcedony-pyrite vein and quartz breccia in quartz monzonite is exposed.

Panama
JF002967

Three caved adits with a combined length estimated at 500 feet drift on a S84°W 77°NE, 6-inch to 4-foot-wide vein exposed in a trench. The vein consists of quartz, pyrite, and galena. Becraft *et al.* (1963) also noted that part of this zone is brecciated and cemented by primary carbonate minerals, including rhodochosite.

Rachel
JF001661

One caved and one open adit have been driven in white tuff of the Elkhorn Mountains volcanics. Length  probably totals a few hundred feet. The open adit hosts a small discharge of water, which sinks quickly into the ground.

Sallie Bell (Red Mountain Mine)
LC007475

The large operation appears to have mined the usual east-west striking Boulder Batholith vein of quartz, pyrite, galena, sphalerite, and chalcocite. A select sample contained 0.166 oz/ton gold, 12.8 oz/ton silver, 0.086% copper, 5.31% lead, 3.88% zinc, and 1.58% arsenic. It is difficult to tell the extent of the old workings because they have been covered by more recent surface work. A high-volume acid discharge issues from a caved adit.

Salvai
JF002775

The acid stream that originates two miles upstream at the Bluebird flows across one of the Salvai dumps, so the Salvai is of some environmental concern. The mine includes two adits, one caved and one locked. The stream flows across a mineralized dump of Elkhorn Mountain volcanics containing 1–5% disseminated pyrite and quartz veinlets. A composite dump sample assayed 0.016 oz/ton gold, 1.5 oz/ton silver, 0.068% copper, 0.59% lead, 0.092% zinc, and 0.60% arsenic.

The mine was discovered in 1903 (Pardee and Schrader 1933). Mineralization consists of two east-striking veins that dip steeply north and contain chalcocite, chalcopyrite, galena, arsenopyrite, ruby silver, and bournonite (Pardee and Schrader 1933). One vein is five feet wide, the other is a 64-foot-wide low-grade shear zone (Pardee and Schrader 1933). The mine was mostly worked in the late 1920s (Becraft *et al.* 1963). Production 1928–1929 was 459 tons of ore from which 163 oz of gold, 9,283 silver, and 21,820 pounds of copper were recovered (Roby *et al.* 1960).

Silver King

JF004946

Two caved adits are evident here, with about 1,000 feet of associated workings. Dumps are composed of unaltered Elkhorn Mountains volcanics and are covered by vegetation. Knopf (1913) claimed that the workings were accessed through a 400-foot inclined shaft. Supposedly, five parallel N30°–45°E veins a few inches to eight feet wide were mined; they contain pyrite, galena, sphalerite, and molybdenite.

Upper Quartz Creek

JF007454

One caved adit (200–300 feet long) and some prospect pits examine a N30°W brecciated vein of chalcedony and pyrite. Placer workings below indicate that gold content is high, but a select vein sample ran only 0.010 oz/ton gold, 0.34 oz/ton silver, 0.099% copper, 0.01% lead, 0.041% zinc, and 0.04% arsenic.

Warm Springs Mill

JF001505

This flotation mill operated from 1934 until 1939 (Roby *et al.* 1960) and processed high-sulfide ore and dump material from the Newburgh and White Pine mines. An extensive area of tailings exists, and contains discharges, seeps, and active stream erosion of waste. Two tailings composite samples had similar metals values:  0.0380–0.0165 oz/ton gold, 7.2–9.6 ppm silver, 120–159 ppm copper, 970–1,560 ppm lead, 334-910 ppm zinc, and 3,170–4,840 arsenic.

White Pine

JF005478

The White Pine explores a 1–7 foot wide, N85°–90°W-trending, near-vertical area of bleached and sericitized quartz monzonite enclosing stringers of pyrite, sphalerite, galena, arsenopyrite, chalcopyrite, and quartz (Smedes 1966). Production 1908-1929 was 36 oz of gold, 4426 oz of silver, 928 pounds of copper, 82,894 pounds of lead, and 52,196 pounds of zinc from 255 tons of ore (Roby *et al.* 1960). This vein is similar and parallel to the Newburgh vein to the north. Three adits were noted and in 1993 the middle open one hosted a discharge, and Warm Springs Creek flowed around several dumps.

## Willard

JF001529

The Willard now consists of two shallow caved shafts and one caved adit about 200 feet long. It appears to investigate a N62°E zone of iron-stained quartz monzonite and thin quartz-pyrite-arsenopyrite veinlets. According to Stone (1911), two east-west veins 20 feet wide were mined, and 400 tons of ore worth $16,000 was mined before 1910.

## Yama

JF005441

Three adits from 90 to 500 feet long were used to investigate a N80°E 70-80°SE vein five to six feet wide of quartz, sphalerite, and galena (Roby *et al.* 1960). Ore supposedly averaged 8% lead and 8% zinc (Roby *et al.* 1960). Storm runoff probably washes some mineralized dump material into Lump Gulch Creek.

# Appendix IV

## Soil and Water Analytical Results
## Upper Missouri River Drainage
## Helena National Forest

HELENA NATIONAL FOREST
East of the Continental Divide
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) | F (mg/l) | NO3 (mg/l) | SO4 (mg/l) | SiO2 (mg/l) | Field pH (SU) | Field SC (umhos/cm) | Temp (C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ARGO MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| HARS10H | 96Q0515 | HELLGATE GULCH UPST ARGO MINE | <30. | <1. | 35 | <2. | <2. | <2. | <.003 | <2. | <.002 | <.1 | <2. | <1. | <2. | 1.5 | 0.2 | 0.05 | 72 | 9.7 | 7.82 | 552.9 | 8.3 |
| HARS20H | 96Q0516 | HELLGATE GULCH DNST ARGO MINE | <30. | <1. | 56 | <2. | <2. | 7.5 | <.003 | <2. | <.002 | <.1 | <2. | <1. | <2. | 1.5 | 0.2 | 0.05 | 75 | 10.2 | 8.22 | 577 | 7.6 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **ARMSTRONG MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| TAMS10L | 95Q0008 | MINNEHAHA CREEK, U/S OF SITE | 148 | 7.8 | 5.2 | <2. | <2. | 8.1 | 0.035 | 2.2 | 0.014 | <0.1 | <2. | <1. | 48 | <.5 | 0.059 | <.05 | 10.5 | 26.3 | 6.48 | 34 | 11.9 |
| TAMS20L | 95Q0004 | MINNEHAHA CREEK, D/S OF SITE | 86.1 | 3.3 | 4.8 | 3.1 | <2. | 10.6 | 0.045 | <2. | 0.021 | <0.1 | <2. | <1. | 402 | <.5 | 0.13 | <.05 | 16.8 | 30.6 | 6.81 | 63 | 14.4 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 2 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 1 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 1/1 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 1 | 0 | - | 1+/1 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 1/1 | - | - | - | - | - | - | - | - |
| **BADGER MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| WBGS60M | 95Q0059 | N. FK. WARM SPRINGS CR., D/S OF UNNAMED TRIB. | <30. | 1.8 | 15.8 | <2. | <2. | <2. | 0.036 | <2. | 0.004 | <.1 | <2. | <1. | 9.7 | 1 | 0.206 | 0.1 | 15 | 26.3 | 7.52 | 215 | 14.5 |
| WBGS70M | 95Q0053 | N. FK. WARM SPRINGS CR., U/S OF UNNAMED TRIB. | <30. | 1.5 | 16.9 | <2. | 3.2 | <2. | 0.041 | <2. | 0.003 | <.1 | <2. | <1. | 2.8 | 1 | 0.211 | 0.1 | 15 | 26.5 | 7.86 | 196 | 15.6 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0+/0 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **BANNER CREEK TAILINGS** | | | | | | | | | | | | | | | | | | | | | | | |
| BBCS10L | 94Q0847 | W. BR. BANNER CR., U/S OF SITE | <30. | <1. | 5 | <2. | <2. | 7.1 | 0.032 | <2. | 0.003 | <0.1 | <2. | <1. | 20.2 | 0.2 | 0.115 | 0.051 | 7.5 | 10 | 7.51 | 52.81 | 1.8 |
| BBCS20L | 94Q0845 | BANNER CR., D/S OF SITE | <30. | <1. | 13.8 | <2. | <2. | 6 | 0.196 | <2. | 0.068 | <0.1 | <2. | <1. | 39.8 | 0.33 | 0.131 | 0.107 | 10.5 | 12 | 8.47 | 50.88 | 2 |
| BBCS30L | 94Q0841 | E. BR. BANNER CR., D/S OF SITE | <30. | <1. | 13.6 | <2. | <2. | 2.3 | 0.033 | <100. | 0.007 | 0.15 | <2. | <1. | 69.6 | 0.3 | 0.09 | 0.077 | 17.5 | 13 | 8.06 | 71.8 | 1.7 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 1 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0+/0 | 0/0 | 0/0 | - | 0/0 | - | 1+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **BEATRICE MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| MBES10L | 96Q0187 | BEATRICE MINE * UPSTREAM | 54.8 | 2.9 | 8.5 | <2. | <2. | 3.4 | 0.076 | <2. | 0.015 | <0.1 | <2. | <1. | 16.9 | <0.5 | 0.08 | <0.05 | <2.5 | 12.4 | 6.88 | 28.2 | 10 |
| MBES20L | 96Q0185 | BEATRICE MINE * DOWNSTREAM | 97.1 | 3.6 | 7.6 | <2. | <2. | 7.3 | 0.64 | <2. | 0.045 | <.1 | <2. | <1. | 11.8 | <.5 | 0.064 | <.05 | <2.5 | 12.1 | 6.14 | 27.9 | 10.5 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 2 | - | - | - | - | 0 | 1 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 1 | 0 | - | 0+/0 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **BLUEBIRD MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| CBBS10M | 94Q0791 | SPRING AT HEAD OF CURTAIN GULCH, U/S OF SITE | <30. | 1.1 | 6.1 | <2. | <2. | 2.7 | 0.017 | <2. | 0.016 | <0.1 | <2. | <1. | 16.5 | 5.4 | 0.09 | 0.16 | 10.2 | 11 | 8.21 | 142.63 | 6.3 |
| CBBS20H | 94Q0801 | CURTAIN GULCH, 400 FT. D/S OF SITE | <30. | 2.5 | 8.6 | 8.3 | <2. | 11.8 | <.003 | <2. | 1.58 | 0.733 | 4.9 | <1. | 1067 | 2.58 | 0.14 | 0.258 | 110 | 15 | 7.43 | 316.97 | 5 |
| PSAS20H | 94Q0803 | CURTAIN GULCH, 1.5 MILES D/S OF SITE | <30. | 1 | 7.5 | 3.7 | <2. | 10.6 | 0.076 | <2. | 0.675 | <0.1 | 2.9 | <1. | 518 | 1.5 | 0.17 | <.05 | 101 | 14 | 7.9 | 276.48 | 4.5 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 1 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 2 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 1/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 2/2 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 2+/2 | 0/0 | 0/0 | - | 0/0 | - | 1+ | 0/0 | 0+ | 2/2 | - | - | - | - | - | - | - | - |
| **EAST PACIFIC MINE AND MILL** | | | | | | | | | | | | | | | | | | | | | | | |
| WEPS10L | 96Q0288 | EAST PACIFIC MINE * MINE DRAIN N SIDE | <30. | 11.1 | 12.4 | 12 | <2. | 2.7 | <.03 | 9.4 | 0.015 | <.1 | <2. | <1. | 0.852 | 1 | 0.3 | 0.15 | 80 | 19.5 | 8.06 | 359 | 12 |
| WEPS20L | 96Q0289 | EAST PACIFIC MINE * UPSTREAM | <30. | 1.5 | 8 | <2. | <2. | 2.1 | <.03 | <2. | <.002 | <.1 | <2. | <1. | 5.4 | 0.5 | <.1 | 0.05 | 10 | 23.7 | 8.1 | 101 | 10.2 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 1 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 1/1 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 1+/1 | 0/0 | 0/0 | - | 1/1 | - | 0+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **EDELWEISS-ARGENTINE MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| PAAS10L | 94Q1153 | S. FK. QUARTZ CR., D/S OF SITE | <30. | 1.2 | 10 | <10. | <2. | <10. | 0.05 | <100. | 0.403 | <0.1 | <30. | 23 | 143 | <.5 | 0.03 | <.05 | 38.8 | 13 | 6.92 | 142 | 13.9 |
| PAAS20L | 94Q1154 | S. FK. QUARTZ CR., U/S OF SITE | <30. | 1.7 | <2. | <2. | <2. | <2. | 0.03 | <2. | 0.004 | <0.1 | <2. | <1. | 13.1 | 1.2 | 0.11 | <.05 | 9.6 | 16 | 7.16 | 73 | 13.3 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0+ | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 1 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0+/0+ | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 1 | 1/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0+/0+ | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 1+ | 1/0 | - | - | - | - | - | - | - | - |
| **FREIBURG MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| WFBI50L | 96Q0290 | WEASEL CREEK 800' UPSTREAM OF MINES | <30. | 12.4 | 11.2 | 4.4 | <2. | 2.9 | 0.005 | <2. | 0.014 | 0.11 | <2. | <1. | 543.1 | 1.5 | 0.2 | 0.5 | 55 | 21.6 | 8 | 265 | 15.5 |
| WFBS20L | 96Q0287 | WEASEL CREEK * 600' DWNSTREAM FROM TRIB. | <30. | 11.9 | 13.3 | 4.6 | <2. | 3.9 | <.03 | <2. | 0.013 | <.1 | <2. | <1. | 540 | 1.5 | 0.3 | 0.45 | 60 | 21.7 | 8.04 | 293 | 15 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 2/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 2/2 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 2+/2 | 0/0 | 0/0 | - | 0/0 | - | 1+ | 0/0 | 0+ | 2/2 | - | - | - | - | - | - | - | - |

HELENA NATIONAL FOREST
East of the Continental Divide
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) | F (mg/l) | NO3 (mg/l) | SO4 (mg/l) | SiO2 (mg/l) | Field pH (SU) | Field SC (umhos/cm) | Temp (C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FROHNER MINE AND MILL** | | | | | | | | | | | | | | | | | | | | | | | |
| PFRS10L | 94Q0835 | FROHNER CR., U/S OF SITE | <30. | <1. | 8.8 | <2. | <2. | <2. | 0.044 | <2. | <.002 | <0.1 | <2. | <1. | 2.5 | <.2 | 0.072 | 0.35 | 4.5 | 15 | 6.98 | 35.57 | 1.5 |
| PNGS10L | 94Q0826 | FROHNER CR., D/S OF SITE | 96 | 4.3 | 13.5 | 4.2 | <2. | 5.1 | 0.194 | <2. | 1.08 | 0.114 | 1.8 | <1. | 711 | 0.75 | 0.158 | 0.062 | 31.8 | 19 | 5.68 | 104 | 1.7 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 1 | - | - | - | - | 0 | 0 | - | 1 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 1 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 1/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 1/1 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 1 | 0 | - | 1+/1 | 0/0 | 0/0 | - | 0/0 | - | 1+ | 0/0 | 0+ | 1/1 | - | - | - | - | - | - | - | - |
| **FROHNER BASIN MILL TAILINGS AND NELLIE GRANT MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| PNGS10L | 94Q0792 | FROHNER BASIN CREEK, U/S OF SITES | 360 | 10 | 13.7 | 3.9 | <2. | 8 | 0.646 | 6.9 | 0.905 | <0.1 | <2. | <1. | 651 | 0.4 | 0.076 | <.05 | 29 | 18 | 7.4 | 75.28 | 2.5 |
| PNGS20L | 94Q0795 | UNNAMED TRIBUTARY #1, U/S OF SITES | 72 | 1.1 | 16.1 | <2. | <2. | 4.9 | 0.069 | <2. | 0.006 | <0.1 | <2. | <1. | 5.6 | 0.5 | 0.074 | <.05 | 1.7 | 13 | 7.6 | 47.24 | 2.5 |
| PNGS30L | 94Q0805 | UNNAMED TRIBUTARY #2, U/S OF SITES | 49 | 4 | 16 | <2. | <2. | 2.6 | 0.057 | <2. | 0.003 | <0.1 | <2. | <1. | 15.7 | 0.6 | 0.05 | <.05 | 2.4 | 14 | 7.5 | 64.37 | 3 |
| PNGS40L | 94Q0813 | SEEP FROM TAILINGS | 60 | 204 | 17.2 | 2.2 | <2. | 22.5 | 1.08 | 88.4 | 0.078 | <0.1 | <2. | <1. | 388 | 0.6 | 0.18 | 0.11 | 2.5 | 11 | 6.9 | 76.76 | 2.5 |
| PNGS50L | 94Q0814 | FROHNER BASIN CREEK, NEAR FS BOUNDARY | 245 | 18.4 | 15.6 | 5.4 | <2. | 7.1 | 0.45 | 5.9 | 0.77 | <0.1 | 2 | <1. | 691 | 0.4 | 0.09 | 0.06 | 26.7 | 17 | 6.8 | 73.83 | 1.8 |
| PNGS60L | 94Q0816 | E. BR. FROHNER BASIN CREEK, NEAR FS BOUNDARY | 65 | 11.6 | 20.2 | <2. | <2. | 3.9 | 0.13 | <2. | 0.009 | <0.1 | <2. | <1. | 40.3 | 0.8 | 0.085 | 0.08 | 3.7 | 13 | 7.2 | 46.2 | 1.8 |
| PNGS70L | 94Q0797 | LUMP GULCH, U/S OF CONFLUENCE W/ FROHNER CR. | 62 | 4.5 | 18.5 | 5.3 | <2. | 5 | 0.072 | <2. | 0.027 | <0.1 | 2 | <1. | 1651 | 0.7 | 0.05 | <.05 | 44.1 | 14 | 7.3 | 90.23 | 3.1 |
| PNGS80M | 94Q0807 | BRANCH OF FROHNER BASIN CR., D/S OF SITES | 60 | 4.4 | 17.2 | 5.5 | <2. | 6 | 0.15 | <2. | 0.11 | <0.1 | 2.2 | <1. | 1599 | 0.8 | 0.08 | <.05 | 43.4 | 14 | 7.2 | 32.99 | 2.5 |
| PNGS90L | 94Q0811 | LUMP GULCH, D/S OF CONFLUENCE WITH FROHNER CR. | 62 | 2.5 | 20.5 | 2.1 | <2. | 7 | 0.233 | <2. | 0.058 | <0.1 | <2. | <1. | 607 | 0.8 | 0.08 | <.05 | 21.3 | 13 | 7.6 | 79.71 | 2.5 |
| No. Exceeded CWA-Primary | | | - | 1 | 0 | 3 | 0 | - | - | 1 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 8 | - | - | - | - | 0 | 3 | - | 5 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 4/0 | 0/0 | 1/0 | 1 | 1/0 | - | 0 | 0/0 | 0 | 6/6 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 2 | 1 | - | 6+/6 | 0/0 | 1/1 | - | 3/1 | - | 0+ | 0/0 | 0+ | 6/6 | - | - | - | - | - | - | - | - |
| **FROHNER LEAD MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| PFLS10M | 94Q0790 | ADIT A01 (WEST ) DISCHARGE | 977 | 18.7 | 20 | 15.1 | <2. | 197 | 0.416 | 1031 | 1.82 | 0.97 | 1.9 | 1.4 | 1104 | <.2 | 0.23 | 0.089 | 49.4 | 26 | 4.17 | 166.51 | 3.8 |
| PFLS20M | 94Q0810 | ADIT A02 (EAST) DISCHARGE | 124 | 4.4 | 56.1 | 6.9 | <2. | 16 | 0.112 | 36.8 | 0.427 | <0.1 | <2. | <1. | 675 | 0.28 | 0.11 | 0.11 | 41 | 20 | 5.68 | 121.42 | 3.1 |
| PFLS30L | 94Q0809 | UNNAMED TRIB. TO LUMP GULCH, D/S OF SITE | 164 | 3.7 | 52.9 | 3.9 | <2. | 3 | 0.068 | <2. | 0.038 | <0.1 | <2. | <1. | 496 | 0.3 | 0.08 | <.05 | 19.7 | 16 | 7.2 | 71.33 | 3 |
| PFLS40M | 94Q0794 | SEEP BELOW WASTE DUMP WA02 | 200 | 13.5 | 39.2 | 7.3 | <2. | 8.8 | 0.36 | 26.7 | 0.332 | <0.1 | 1.9 | <1. | 1338 | 0.6 | 0.1 | <.05 | 40.9 | 19 | 4.69 | 106.93 | 1.4 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 3 | 0 | - | - | 1 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 4 | - | - | - | - | 0 | 2 | - | 3 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 3 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 1 | 0 | - | 4/1 | 0/0 | 1/1 | 0 | 1/1 | - | 0 | 0/0 | 0 | 4/4 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 4 | 0 | - | 4/4 | 0/0 | 1/1 | - | 3/3 | - | 1+ | 0/0 | 1+ | 4/4 | - | - | - | - | - | - | - | - |
| **GOLDEN AGE MILL** | | | | | | | | | | | | | | | | | | | | | | | |
| GWAS10L | 96Q0255 | GOLDEN AGE MILL * 100' UPST TAILINGS | <80. | <1. | 19.7 | <2. | <2. | 4.7 | 0.231 | <2. | 0.012 | <.1 | <2. | <1. | 13.8 | <.5 | | <.05 | 10 | 18.9 | 7.08 | 423 | 11.5 |
| WGAS20L | 96Q0254 | GOLDEN AGE MILL * TAILINGS DISCHARGE | <80. | <1. | 3.7 | <2. | <2. | 8.4 | 0.019 | <2. | 0.007 | <.1 | <2. | <1. | 25 | 0.5 | | <.05 | 17.5 | 27.2 | 7.04 | 529 | 8 |
| WAGS30L | 96Q0256 | GOLDEN AGE MILL * 20' DNST TAILINGS | <80. | <1. | 13.4 | <2. | <2. | <2. | 0.227 | <2. | 0.01 | 0.1 | <2. | <1. | 8.3 | <.5 | | <.05 | 10 | 19.1 | 7.74 | 370 | 11 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | - | 0/0 | - | 1+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **HUB CAMP MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| THCS10H | 95Q0212 | HUB CAMP ADIT DISCHARGE | <30. | 11.8 | 4.9 | <2. | <2. | 2.4 | 0.012 | <2. | 0.003 | <.1 | 2.8 | <1. | 29.3 | 1.5 | 0.1 | <.05 | 162.5 | 16.2 | 8.21 | 662 | 16.5 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0+/0 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **JAY GOULD MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| FJGS10H | 96Q0425 | ADIT DISCHARGE FROM JAY GOULD TUNNEL | <30. | <1. | 360.7 | <2. | <2. | <2. | <.02 | <2. | <.002 | <.1 | <2. | <1. | <8. | 0.5 | <.1 | 0.15 | 5 | 9.1 | 3.31 | 23.8 | 9.1 |
| FJGS10H | 96Q0454 | FOOLHEN CREEK BELOW JAY GOULD TUNNEL TLS | <80. | <1. | 367.6 | <2. | <2. | <2. | 0.008 | <2. | 0.007 | <.1 | <2. | <1. | 2.9 | 0.5 | <.1 | 0.15 | 5 | 9.3 | 4.69 | 232.7 | 8.8 |
| FJGS20H | 96Q0424 | FOOL HEN CREEK DOWNSTREAM FORM JAY GOULD | <30. | <1. | 373.7 | <2. | <2. | <2. | <.02 | <2. | <.002 | <.1 | <2. | <1. | <8. | 1 | <.1 | 0.2 | 5 | 9.2 | 4.76 | 294.5 | 9.2 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0+/0 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **JUSTICE MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| TJUS10H | 95Q0016 | ADIT DISCHARGE | 9250 | 1660 | 16.2 | 57.8 | 4.3 | 654 | 75.3 | 1324 | 0.6 | 0.18 | 26.6 | 2.2 | 4654 | 2.5 | 0.96 | <.10 | 480 | 47.3 | 2.89 | 1650 | 6.9 |
| TJUS20L | 95Q0013 | UNNAMED TRIB. TO MINNEHAHA CR., D/S OF SITE | <30. | 15.6 | <2. | <2. | <2. | <2. | 0.029 | 8.9 | 0.003 | <0.1 | <2. | <1. | 5.8 | <.5 | 0.164 | 0.056 | 3.6 | 31.9 | 5.69 | 23 | 5.5 |
| TJUS30L | 95Q0010 | MINNEHAHA CR., D/S OF CONFLUENCE W/UNNAMED TRIB. | 221 | 7.1 | 4.8 | <2. | <2. | 10.2 | 0.034 | 3.8 | 0.027 | <0.1 | <2. | <1. | 63.5 | <.5 | 0.091 | <.05 | 10.4 | 26.2 | 6.66 | 42 | 10.2 |
| TJUS40H | 95Q0012 | SEEP ALONG MINNEHAHA CR. | 16600 | 1.8 | 19.1 | 52.5 | <2. | 660 | 0.39 | 51.2 | 1.67 | <0.1 | 44 | <1. | 3970 | <.5 | 1.32 | <.05 | 272 | 80.5 | 3.53 | 610 | 10.3 |
| TJUS50L | 95Q0006 | TRIB. TO MINNEHAHA CR., U/S OF SITE | 30.5 | 1 | 6.6 | <2. | <2. | <10. | 0.038 | <2. | 0.002 | <0.1 | <2. | <1. | 6.5 | <.5 | 0.048 | <.05 | 6.7 | 24.2 | 6.25 | 38 | 9.7 |
| TJUS60L | 95Q0002 | MINNEHAHA CR., U/S OF SITE | 33.1 | <1. | 5.6 | <2. | <2. | 7.9 | 0.038 | <2. | 0.002 | <0.1 | <2. | <1. | 4.7 | <.5 | 0.03 | 0.0455 | 6.1 | 18.5 | 6.56 | 35 | 8.3 |
| No. Exceeded CWA-Primary | | | - | 1 | 0 | 2 | 0 | - | - | 2 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 3 | - | - | - | - | 0 | 2 | - | 2 | - | - | 0 | 0 | 0 | 0 | - | 2 | 0 | 4 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 2 | 1 | - | 2/2 | 0/0 | 2/2 | 1 | 1/1 | - | 0 | 0/0 | 0 | 2/2 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 3 | 1 | - | 2+/2 | 0/0 | 2/2 | - | 4/3 | - | 1+ | 0/0 | 1+ | 2/2 | - | - | - | - | - | - | - | - |
| **KADY GULCH MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| KKGS10L | 94Q1180 | UNNAMED TRIB TO KADY GULCH, U/S OF SITE | 180 | <1. | 4 | 2.4 | <2. | 10.2 | 0.011 | <2. | 0.149 | <0.1 | <2. | <1. | 337 | <.5 | 0.11 | <.05 | 22.5 | 17 | 6.88 | 86.28 | 11.9 |
| KKGS20L | 94Q1184 | UNNAMED TRIB TO KADY GULCH, D/S OF SITE | 31.9 | <1. | 4.4 | <2. | <2. | 3.4 | 0.012 | <2. | 0.003 | <0.1 | <2. | <1. | 164 | <.5 | 0.12 | 0.045 | 23.8 | 17 | 7.31 | 89 | 10.1 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 1 | - | - | - | - | 0 | 0 | - | 1 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 2/1 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 1 | 0 | - | 1+/1 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 2/1 | - | - | - | - | - | - | - | - |

HELENA NATIONAL FOREST
East of the Continental Divide
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) | F (mg/l) | NO3 (mg/l) | SO4 (mg/l) | SiO2 (mg/l) | Field pH (SU) | Field SC (umhos/cm) | Temp (C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **KLEINSCHMIDT MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| WKLS10L | 96Q0298 | WHITE HORSE CREEK BELOW KLEINSCHMIDT MIN | <30. | 46.6 | 10.5 | <2. | <2. | 2 | 0.025 | <2. | 0.007 | <.1 | <2. | <1. | 6.8 | 0.5 | <.1 | 0.55 | 5 | 22.4 | 7.68 | 94 | 11.2 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0+/0 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **LITTLE BONANZA MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| KLBS10M | 96Q0297 | KIMBER GULCH * DOWN FROM LITTLE BON. MIN | <30. | 35.3 | 20.1 | <2. | <2. | <2. | <.003 | <2. | 0.004 | <.1 | <2. | <1. | 92.9 | 1 | <.1 | 0.35 | 15 | 23.4 | 7.8 | 162.5 | 7.6 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0+/0 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **LITTLE TIZER WILDCAT MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| TLTS10L | 96Q0258 | LITTLE TIZER MINE * E FORK UPST SITE | <80. | <1. | 4.4 | <2. | <2. | <2. | 0.011 | <2. | <.002 | <.1 | <2. | <1. | 6.1 | <.5 | | <.05 | <2.5 | 8.4 | 6.97 | | 5.5 |
| TLTS20L | 96Q0257 | LITTLE TIZER MINE * E FORK DNST MILL | <80. | <1. | 4 | <2. | <2. | 2.2 | 0.017 | <2. | 0.003 | <.1 | <2. | <1. | 4.5 | <.5 | | 0.25 | 2.5 | 9 | 6.9 | | 6 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0+/0 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **LONE EAGLE QUARTZ MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| PLES10H | 94Q1169 | ADIT DISCHARGE | <30. | 1.2 | 40.1 | 2.5 | <2. | <2. | 0.01 | <2. | 2.1 | 0.12 | 7.6 | <1. | 849 | 1.5 | 0.261 | <.05 | 90 | 17 | 7.38 | 534.39 | 10 |
| PLES20M | 94Q1182 | S. FK. QUARTZ CR., U/S OF SITE AND WETLANDS | <30. | <1. | 10.8 | <2. | <2. | <2. | 0.013 | <2. | 0.003 | <0.1 | <2. | <1. | 26.4 | <.5 | 0.09 | 0.16 | 15.6 | 13 | 8 | 123 | 11.5 |
| PLES30L | 94Q1186 | S. FK. QUARTZ CR., D/S OF SITE AND WETLANDS | <30. | <1. | 11.4 | <2. | 3 | <2. | 0.18 | <2. | 0.045 | <0.1 | <2. | <1. | 20.7 | <.5 | 0.41 | <.05 | 14.9 | 13 | 6.97 | 130 | 13.7 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 1 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 1/1 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 1+/1 | 0/0 | 0/0 | - | 0/0 | - | 1+ | 0/0 | 0+ | 1/1 | - | - | - | - | - | - | - | - |
| **LOWER JUSTICE MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| TAMS10L | 95Q0008 | MINNEHAHA CR., D/S OF SITE | 148 | 7.6 | 5.2 | <2. | <2. | 8.1 | 0.035 | 2.2 | 0.014 | <0.1 | <2. | <1. | 48 | <.5 | 0.059 | <.05 | 10.5 | 26.3 | 6.48 | 34 | 11.9 |
| TJUS30L | 95Q0010 | MINNEHAHA CR., U/S OF SITE | 221 | 7.1 | 4.8 | <2. | <2. | 10.2 | 0.034 | 3.8 | 0.027 | <0.1 | <2. | <1. | 63.5 | <.5 | 0.091 | <.05 | 10.4 | 26.2 | 6.66 | 42 | 10.2 |
| TLJS10L | 95Q0015 | UNNAMED TRIB., BELOW ADIT DISCHARGE AND MARSH | <30. | 32.6 | 6 | <2. | <2. | <2. | 0.038 | <2. | 0.002 | <0.1 | <2. | <1. | 3.3 | <.5 | 0.168 | <.05 | 6.1 | 27.5 | 6.89 | 72 | 12 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 2 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 1 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 2 | 0 | - | 0+/0 | 0/0 | 0/0 | - | 1/0 | - | 0+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **MARIETTA GROUP** | | | | | | | | | | | | | | | | | | | | | | | |
| IMPS10L | 96Q0220 | MARIETTA PARK * SAMPLE BELOW CABIN | <30. | <1. | 27.1 | <2. | <2. | <2. | 0.009 | <2. | <.002 | <.1 | <2. | <1. | 12.9 | 0.5 | <.1 | 0.05 | 10 | 11.9 | 7.54 | 96 | 12.4 |
| IMPS20L | 96Q0232 | MARIETTA PARK * FOREST SERVICE ROAD | 46.6 | <1. | 33.3 | <2 | <2. | <2. | 0.049 | <2. | 0.005 | <.1 | <2. | <1. | 6.5 | <.5 | <.1 | <.05 | <2.5 | 17.4 | 7.7 | 84 | 13.6 |
| IMPS30M | 96Q0226 | MARIETTA PARK GROUP | | | | | | | | | | | | | | | | | | | 7.71 | 222 | 14 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 1+/1 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **MARIETTA MILL TAILINGS AND PHOENIX MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| IMPS30M | 96Q0225 | MARIETTA PARK GROUP | 33.3 | 42.3 | 29.8 | 4.6 | <2. | 3.4 | 0.023 | <2. | 0.05 | <.1 | <2. | <1. | 630.5 | <.5 | 0.1 | 0.15 | 60 | 16.1 | 7.71 | 222 | 14 |
| IMPS40M | 96Q0218 | MARIETTA PARK * 2 MI BELOW NF PROP BNDRY | | 63.6 | 23.1 | <2. | <2. | 2.1 | | 2.3 | | <.1 | <2. | <1. | 200.8 | | | | | | 8.02 | 221 | 14.6 |
| IMPS40M | 96Q0217 | MARIETTA PARK * 2 MI BELOW NF PROP BNDRY | <30. | 61.7 | 36.7 | <2. | <2. | <2. | 0.013 | <2. | 0.009 | <.1 | <2. | <1. | 191.7 | <.5 | <.1 | 0.1 | 47.5 | 15.7 | 8.02 | 221 | 14.6 |
| IMPS50H | 96Q0219 | MARIETTA PARK * SEEP FROM WASTE PILE | 50.2 | 85.9 | 44.4 | 3 | <2. | 4.4 | 9.4 | 3.3 | 0.923 | <.1 | 2.2 | <1. | 310.6 | 1 | <.1 | <.05 | 85 | 26.7 | 6.97 | 379 | 16.7 |
| No. Exceeded CWA-Primary | | | - | 2 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 1 | - | - | - | - | 0 | 1 | - | 2 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 1/0 | 0/0 | 0/0 | 1 | 0/0 | - | 0 | 0/0 | 0 | 3/3 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 2+/2 | 0/0 | 0/0 | - | 1/0 | - | 0+ | 0/0 | 0+ | 3/3 | - | - | - | - | - | - | - | - |
| **NEWBURGH, WHITE PINE, AND B & G EAST MINES** | | | | | | | | | | | | | | | | | | | | | | | |
| PWPS10L | 94Q1177 | UNNAMED TRIB TO MID. FK. WARM SPRINGS CR., U/S | <30. | 1.7 | 3.8 | <2. | <2. | <2. | 0.06 | <2. | 0.037 | <0.1 | <2. | <1. | 10.2 | 1.7 | 0.056 | <.05 | 5.7 | 21 | 6.73 | 109 | 16 |
| PWSS10M | 94Q1178 | UNNAMED TRIB TO MID. FK. WARM SPRINGS CR., D/S | 36 | 7 | 8.7 | <2. | <2. | 3.2 | 0.1 | <2. | 0.107 | <0.1 | <2. | <1. | 274 | <.5 | 0.125 | 0.068 | 35.8 | 22 | 7.58 | 177 | 11 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 1 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 1/1 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0+/0 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 1/1 | - | - | - | - | - | - | - | - |
| **NORTH ONTARIO MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| ONOS10L | 96Q0216 | NORTH ONTARIO * DOWNSTREAM | <30. | 12.5 | 4.1 | 3.1 | <2. | 10.8 | 0.016 | <2. | 0.016 | <.1 | <2. | <1. | 227.4 | <.5 | <.1 | <.05 | 17.5 | 31.5 | 7.24 | 46.2 | 4.2 |
| ONOS20L | 96Q0214 | NORTH ONTARIO * DOWNSTREAM | <30. | 12.3 | 4.9 | 2.3 | <2. | 3.4 | 0.01 | 2.1 | 0.004 | <.1 | <2. | <1. | 162.5 | <.5 | <.1 | <.05 | 17.5 | 30.8 | 7.24 | 49.5 | 4.2 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 2/1 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 2/2 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 2/1 | - | - | - | - | - | - | - | - |

HELENA NATIONAL FOREST
East of the Continental Divide
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) | F (mg/l) | NO3 (mg/l) | SO4 (mg/l) | SiO2 (mg/l) | Field pH (SU) | Field SC (umhos/cm) | Temp (C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **O'KEEFE CREEK MINE (COPPER KING?)** | | | | | | | | | | | | | | | | | | | | | | | |
| OOKS10L | 96Q0209 | OKEEFE MINE * DOWNSTREAM PO008227 | <30. | 3.1 | 6.8 | <2. | <2. | 2 | 0.368 | <2. | 0.011 | <.1 | <2. | <1. | 31.7 | <.5 | <.1 | <.05 | 7.5 | 16.7 | 7.69 | 66.4 | 14 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 1 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0+/0 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **ONTARIO MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| OONS10M | 96Q0188 | ONTARIO MINE * LOWER ADIT | 2869 | 13 | 13.4 | 5.8 | <2. | 21.2 | 4 | <2. | 1 | <.1 | 7 | <1. | 850.4 | 0.6 | 0.29 | <0.05 | 95 | 51.1 | 4.67 | 170.7 | 5.4 |
| OONS20M | 96Q0190 | ONTARIO MINE * UPPER ADIT STREAM | 11000 | 1.6 | 21.5 | 28.4 | <2. | 157 | 0.393 | <2. | 2 | <0.1 | 7.1 | <1. | 4056 | 1 | 0.3 | <0.05 | 162.5 | 69.2 | 3.76 | 368.8 | 12 |
| OONS30M | 96Q0192 | ONTARIO MINE * SEEP NEAR BASE OF FALLS | 2490 | 77.1 | 14.4 | 14.4 | <2. | 134.7 | 2.8 | 304.7 | 1.3 | <0.1 | 6.8 | <1. | 2695 | 1 | 0.2 | <0.05 | 125 | 60 | 3.36 | 381 | 25 |
| OONS40M | 96Q0186 | ONTARIO MINE * CULVERT BELOW DEVELOPMENT | 4376 | 17.9 | 13.5 | 11.8 | <2. | 85 | 1.7 | 27 | 1.4 | <.1 | 8.1 | <1. | 1692 | 0.5 | 0.22 | <.05 | 105 | 54.1 | 3.99 | 301.2 | 11.9 |
| OONS50L | 96Q0441 | ONTARIO CREEK BELOW TAILINGS PO005435 | 115.2 | 4.9 | 10.3 | <2 | <2. | 8 | 0.129 | 17.4 | 0.243 | <.1 | <2. | <1. | 235.5 | 1.3 | <.1 | <.05 | 30 | 36 | 7.29 | 80.2 | 5.9 |
| OONS60L | 96Q0440 | ONTARIO CREEK ABOVE TAILINGS | 53.7 | <1. | 12.8 | <2. | <2. | <2. | 0.086 | <2. | 0.04 | <.1 | <2. | <1. | 30 | 0.5 | <.1 | <.05 | 22.5 | 30 | 7.35 | 57.6 | 5.3 |
| No. Exceeded CWA-Primary | | | - | 1 | 0 | 4 | 0 | - | - | 1 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 6 | - | - | - | - | 0 | 4 | - | 5 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 4 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 4 | 0 | - | 4/3 | 0/0 | 4/3 | 3 | 1/1 | - | 0 | 0/0 | 0 | 5/5 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 5 | 0 | - | 4+/4 | 0/0 | 4/4 | - | 3/3 | - | 0+ | 0/0 | 0+ | 5/5 | - | - | - | - | - | - | - | - |
| **PEGGGY ANN MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| GPAS10M | 96Q0453 | GOULD CREEK BELOW PEGGY ANN MINE | <80. | <1. | 37.4 | <2. | <2. | <2. | 0.015 | <2. | 0.007 | <.1 | <2. | <1. | <2. | <.5 | 0.3 | <.05 | 5 | 14 | 7.02 | 210 | 7.1 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **PEERLESS JENNY MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| BPJS10M | 94Q0650 | BANNER CR., D/S OF SITE | <30. | <1. | 15.3 | <2. | <2. | 3 | 0.034 | <2. | 0.328 | <0.1 | <2. | <1. | 248 | <2 | 0.167 | 0.069 | 33.4 | 16 | 7.43 | 122.45 | 5.7 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 1 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 1/1 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0+/0 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 1/1 | - | - | - | - | - | - | - | - |
| **SALLIE BELL MINE (RED MOUNTAIN?)** | | | | | | | | | | | | | | | | | | | | | | | |
| BRMS10L | 94Q0837 | UNNAMED CR., D/S OF SITE | 28 | 2.1 | 16.9 | 10.9 | <2. | 34.7 | 0.033 | 3.7 | 0.397 | <0.1 | <2. | <1. | 2070 | 0.3 | 0.108 | 0.14 | 31.7 | 17 | 8.92 | 77.87 | 1.2 |
| BRMS20L | 94Q0839 | UNNAMED CR., U/S OF SITE | <30. | 19.8 | <2. | <2. | <2. | <2. | 0.011 | <2. | <.002 | <0.1 | <2. | <1. | 9.5 | <.2 | 0.077 | 0.077 | 5 | 15 | 8.81 | 68.92 | 1.6 |
| BRMS30L | 94Q0828 | BEAVER CR., D/S OF CONFLUENCE W/UNNAMED CR. | <30. | 3 | 10.4 | <2. | <2. | 7.1 | 0.057 | <2. | 0.014 | 0.116 | <2. | <1. | 152 | 0.4 | 0.07 | 0.084 | 10.5 | 19 | 5.79 | 75.52 | 2.8 |
| BRMS40L | 94Q0831 | BEAVER CR., U/S OF CONFLUENCE W/UNNAMED CR. | 47 | 2 | 13.8 | <2. | <2. | 6.5 | 0.096 | <2. | 0.025 | 0.114 | <2. | <1. | 23.7 | 0.5 | 0.144 | 0.21 | 9.5 | 20 | 7.02 | 87.26 | 2.7 |
| BRMS50L | 94Q0833 | UNNAMED CR., AT CONFLUENCE W/BEAVER CR. | <30. | 3.7 | 7.1 | <2. | <2. | 4.5 | 0.018 | <100. | <.002 | 0.143 | <2. | <1. | 271 | 0.5 | 0.111 | 0.21 | 9.5 | 18 | 8.2 | 53.47 | 2.5 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 1 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 1 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 4 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 1/1 | 0/0 | 1/1 | 0 | 0/0 | - | 0 | 0/0 | 0 | 3/2 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 1+/1 | 0/0 | 1/1 | - | 1/0 | - | 3+ | 0/0 | 0+ | 3/2 | - | - | - | - | - | - | - | - |
| **STRAY HORSE MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| WSHS10L | 96Q0293 | WEASEL CREEK * 500' UPSTREAM OF TRIBUT. | <30. | 14.3 | 5.1 | 2.7 | <2. | 2.2 | <.003 | <2. | <.002 | 0.11 | <2. | <1. | 28.6 | 1 | 0.2 | 0.65 | 27.5 | 21.3 | 8.23 | 177 | 11.1 |
| WSHS20L | 96Q0294 | WEASEL CREEK * 400' DWNSTREAM FROM TRIB. | <30. | 4.6 | 13 | <2. | <2. | <2. | 0.014 | <2. | 0.042 | <.1 | 2 | <1. | 9.8 | 2 | 0.2 | 0.5 | 90 | 17.1 | 8.28 | 208 | 10.2 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 1/1 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 1+/1 | 0/0 | 0/0 | - | 0/0 | - | 1+ | 0/0 | 0+ | 1/1 | - | - | - | - | - | - | - | - |
| **SUNRISE AND JANUARY MINES** | | | | | | | | | | | | | | | | | | | | | | | |
| WSRS10L | 96Q0292 | WEASEL CREEK * 1200' DWNSTREAM FROM MINE | <30. | 12.2 | 18.3 | 5.1 | <2. | 2.2 | 0.016 | <2. | 0.019 | 0.1 | <2. | <1. | 684.1 | 1.5 | 0.3 | 0.5 | 50 | 21.3 | 7.96 | 248 | 10.8 |
| WSRS20L | 96Q0295 | SUNRISE MINE DISCHARGE FROM ADIT | <30. | 13 | 9.9 | <2. | <2. | <2. | <.003 | <2. | 0.004 | <.1 | <2. | <1. | 61.3 | 1 | <.1 | 0.6 | 35 | 20.7 | 7.97 | 46.5 | 12.7 |
| WSRS30L | 96Q0291 | WEASEL CREEK * 100' UPSTREAM OF SUNRISE | <30. | 13 | 10.7 | <2. | <2. | <2. | <.003 | <2. | <.002 | <.1 | <2. | <1. | 191.8 | 1 | <.1 | 0.55 | 35 | 21.4 | 8.33 | 202 | 11.1 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 1 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 1/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 2/2 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 1+/1 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 2/2 | - | - | - | - | - | - | - | - |
| **SALVAI MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| PSAS10H | 94Q0799 | WOOD CHUTE GULCH, D/S OF SITE | <30. | 1.9 | 7.3 | 3.4 | <2. | 9 | 0.055 | <100. | 0.559 | <0.1 | 2.9 | <1. | 502 | 1.5 | 0.18 | <.05 | 102 | 14 | 7.75 | 282.42 | 4.8 |
| PSAS20H | 94Q0803 | CURTAIN GULCH, U/S OF SITE (SEE BLUEBIRD MINE) | <30. | 1 | 7.5 | 3.7 | <2. | 10.6 | 0.076 | <2. | 0.675 | <0.1 | 2.9 | <1. | 518 | 1.5 | 0.17 | <.05 | 101 | 14 | 7.9 | 276.48 | 4.5 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 2 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 2/2 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 2/2 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 2/2 | - | - | - | - | - | - | - | - |
| **TELEGRAPH CREEK MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| MTGS10M | 96Q0191 | TELEGRAPH ADIT | 379.7 | <1. | 27.4 | 2.5 | <2. | 66.8 | 0.199 | <2. | 0.382 | <0.1 | 5.3 | <1. | 325.5 | <0.5 | <0.1 | 0.1 | 55 | 27.4 | 4.96 | 104.8 | 7.2 |
| MTGS20M | 96Q0213 | TELEGRAPH ADIT | 421.6 | <1. | 19.2 | <2. | <2. | 16.1 | 0.125 | 15.7 | 0.156 | <.1 | 2.4 | <1. | 121.9 | 0.5 | <.1 | <.05 | 40 | 27 | 4.53 | 96.8 | 10.8 |
| MTGS30M | 96Q0211 | TELEGRAPH ADIT | 460.6 | <1. | 20.5 | <2. | <2. | 16.4 | 0.147 | 24.2 | 0.159 | <.1 | 2.5 | <1. | 118.9 | 0.5 | <.1 | <.05 | 40 | 27.1 | 4.53 | 96.8 | 10.8 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 3 | - | - | - | - | 0 | 0 | - | 3 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 3 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 1/1 | 0 | 0/0 | - | 0 | 0/0 | 0 | 2/1 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 3 | 0 | - | 1+/1 | 0/0 | 3/3 | - | 2/2 | - | 0+ | 0/0 | 0+ | 3/1 | - | - | - | - | - | - | - | - |

HELENA NATIONAL FOREST
East of the Continental Divide
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) | F (mg/l) | NO3 (mg/l) | SO4 (mg/l) | SiO2 (mg/l) | Field pH (SU) | Field SC (umhos/cm) | Temp (C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **VOSBURG MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| BVOS10L | 94Q1024 | VOSBURG ADIT; ADIT DISCHARGE | 96.6 | 142 | 5.9 | <2. | <2. | <2. | 0.056 | <2. | 0.008 | <0.1 | <2. | <1. | 12.7 | 0.56 | 0.115 | 0.95 | 11 | 18 | 7.1 | 104.9 | 4 |
| BVOS20M | 94Q1025 | VOSBURG MINE; SEEP FROM TAILINGS | 33.9 | 910 | 8.7 | <2. | <2. | 7.3 | 0.074 | 3.9 | 0.032 | <0.1 | <2. | <1. | 13.9 | 0.54 | 0.062 | 0.25 | 50 | 17 | 7.5 | 151.2 | 6.7 |
| BVOS30L | 94Q1026 | VOSBURG MINE; BADGER CREEK UPSTREAM OF | 43.9 | 8.1 | 3.1 | <2. | <2. | <2. | 0.023 | <2. | 0.004 | <0.1 | <2. | <1. | 3 | <.5 | 0.066 | 0.205 | 5.26 | 16 | 7.3 | 54 | 4.2 |
| BVOS40L | 94Q1028 | VOSBURG MINE; SOUTH TAILINGS SEEP | 85.3 | 323 | 2.7 | <2. | <2. | 9.5 | 0.103 | 13.4 | 0.049 | <0.1 | <2. | <1. | 13.6 | 2.16 | 0.101 | 0.24 | 9.4 | 14 | 7.2 | 78.8 | 6.3 |
| BVOS50L | 94Q1029 | VOSBURG MINE; TAILING SEEP WEST OF LOWER | <30. | 54.8 | 8 | <2. | <2. | <2. | 0.012 | <2. | 0.007 | <0.1 | <2. | <1. | 5 | 0.63 | 0.11 | 1.54 | 15 | 19 | 6.75 | 97.3 | 3.5 |
| BVOS60L | 94Q1030 | VOSBURG MINE; BADGER CREEK 200' DOWNSTR | 48.8 | 50.1 | 2.6 | <2. | <2. | 4.1 | 0.048 | 4.3 | 0.016 | <0.1 | <2. | <1. | 8.6 | 0.67 | 0.037 | 0.46 | 6.5 | 17 | 7.06 | 58.2 | 6 |
| BVOS70L | 94Q1031 | VOSBURG MINE; SEEP FROM TAILINGS | <30. | 2.4 | <2. | <2. | <2. | <2. | | <2. | <.002 | <0.1 | <2. | <1. | 4.8 | <.5 | <.1 | <.05 | <2.5 | | 7.01 | 10 | 8 |
| BVOS80L | 94Q1032 | VOSBURG MINE; BRIDGE CREEK 1000' DWNSTR | 55.8 | 41.4 | 3.2 | <2. | <2. | <2. | 0.047 | <2. | 0.004 | <0.1 | <2. | <1. | 2 | <.5 | 0.045 | 0.3 | 7.2 | 17 | 7.14 | 69 | 5.7 |
| No. Exceeded CWA-Primary | | | - | 5 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 3 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 1 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 1 | 2 | - | 0/0 | 0/0 | 0/0 | - | 3/1 | - | 0+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **WARM SPRINGS MILL TAILINGS** | | | | | | | | | | | | | | | | | | | | | | | |
| PWSS10M | 95Q0055 | M. FK. WARM SPRINGS CR., U/S OF SITE | <30. | 10.9 | 8.8 | <2. | <2. | <2. | 0.04 | <2. | 0.124 | <.1 | <2. | <1. | 275.45 | <.05 | 0.176 | 0.35 | 47.5 | 23.5 | 7.95 | 251 | 14.9 |
| PWSS20M | 95Q0069 | SEEP FROM TAILINGS, EAST END OF SITE | 128 | 96.6 | 4.8 | <2. | <2. | 2.8 | 0.229 | 4.5 | 0.033 | <.1 | <2. | <1. | 25.5 | 1 | 2.58 | 0.45 | 10 | 31.4 | 7.01 | 150 | 20.5 |
| PWSS50M | 95Q0065 | M. FK. WARM SPRINGS CR., D/S OF DAM #1 | <30. | 13.3 | 8.3 | <2. | <2. | 2.6 | 0.054 | <2. | 0.104 | <.1 | <2. | <1. | 185.5 | <.5 | 0.225 | 0.1 | 47.5 | 24.3 | 8.23 | 233 | 17.5 |
| PWSS60M | 95Q0068 | SEEP FROM TAILINGS, MIDDLE OF SITE | <30. | 91.9 | 33.7 | <2. | <2. | <2. | 0.386 | 2.4 | 0.247 | <.1 | 4 | <1. | 1457.5 | <.5 | 0.21 | 0.05 | 80 | 24.4 | 7.07 | 276 | 17.9 |
| PWSS70M | 95Q0070 | UNNAMED TRIB. NEAR CONFLUENCE WITH WARM SPR. CR. | <30. | 32.4 | 21.3 | <2. | <2. | <2. | 0.099 | <2. | 0.035 | <.1 | <2. | <1. | 23.6 | 0.5 | 0.194 | <.05 | 32.5 | 25.4 | 8.11 | 245 | 18 |
| PWSS80M | 95Q0067 | UNNAMED TRIB., U/S OF TAILINGS | <30. | 3 | 22.1 | <2. | <2. | <2. | 0.01 | <2. | 0.002 | <.1 | <2. | <1. | 30.5 | 0.5 | 0.117 | 1 | 35 | 25.3 | 8.04 | 246 | 11.9 |
| PWSS90M | 95Q0066 | M. FK. WARM SPRINGS CR., BELOW BREACH IN DAM #2 | <30. | 24.3 | 9.5 | <2. | <2. | 2 | 0.108 | <2. | 0.12 | 0.39 | <2. | <1. | 243.4 | <.5 | 0.19 | 0.05 | 45 | 23.8 | 7.35 | 231 | 15.8 |
| PWSSA0M | 95Q0061 | M. FK. WARM SPRINGS CR., D/S OF DAM #4 | <30. | 26.1 | 6.7 | <2. | <2. | <2. | 0.069 | <2. | 0.099 | <.1 | <2. | <1. | 249.9 | <.5 | 0.245 | 0.2 | 45 | 24 | 7.35 | 228 | 11.9 |
| PWSSB0L | 95Q0071 | SPRING NORTH OF TAILINGS, NE EDGE OF SITE | <30. | 2.2 | 2.7 | <2. | <2. | <2. | 0.032 | 2.1 | 0.2 | <.1 | <2. | <1. | 225.8 | 1 | 5.56 | <.05 | <2.5 | 14.9 | 7.9 | 134 | 19.2 |
| PWSSC0M | 95Q0063 | M. FK. WARM SPRINGS CR., 1 MILE D/S OF SITE | <30. | 27.5 | 9.4 | <2. | <2. | <2. | 0.034 | <2. | 0.021 | 0.5 | <2. | <1. | 188.38 | <.5 | 0.3 | 0.1 | 42.5 | 24.1 | 7.53 | 220 | 12.1 |
| No. Exceeded CWA-Primary | | | - | 2 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 1 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 1 | - | - | - | - | 0 | 1 | - | 6 | - | - | 0 | 0 | 0 | 2 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 7/5 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 1 | 0 | - | 0+/0 | 0/0 | 0/0 | - | 1/0 | - | 2+ | 0/0 | 0+ | 7/5 | - | - | - | - | - | - | - | - |
| **WEASEL CREEK MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| WWCS10M | 96Q0296 | WEASEL CRK"DWNSTREAM FROM WEASEL CRK MIN | <30. | 11.7 | 6.8 | <2. | <2. | <2. | <.003 | <2. | 0.009 | <.1 | <2. | <1. | 76.8 | 0.5 | <.1 | 0.7 | 27.5 | 20.5 | 7.79 | 167.3 | 8.7 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 0 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0+/0 | 0/0 | 0/0 | - | 0/0 | - | 0+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |
| **YAMA GROUP MINE** | | | | | | | | | | | | | | | | | | | | | | | |
| LYAS10L | 94Q1151 | LUMP GULCH, D/S OF SITE | 65 | 3.4 | 16.4 | <2. | <2. | 11.9 | 0.18 | 2.4 | 0.044 | 0.16 | <2. | <1. | 65.3 | 0.8 | 0.21 | <.05 | 11.7 | 13 | 7.48 | 76 | 16 |
| LYAS20L | 94Q1152 | LUMP GULCH, U/S OF SITE | 51 | 1.9 | 15.1 | <2. | 3.4 | 3.2 | 0.13 | <2. | 0.008 | <0.1 | <2. | <1. | 48.4 | 1.8 | 0.12 | <.05 | 11.8 | 13 | 6.41 | 72 | 15.8 |
| No. Exceeded CWA-Primary | | | - | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 0 | - | - | - | 0 | 0 | 0 | - | - | - | - |
| No. Exceeded CWA-Secondary | | | 2 | - | - | - | - | 0 | 0 | - | 0 | - | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 1 | - | - |
| No. Exceeded AQLC-Acute (1) | | | 0 | 0 | - | 0/0 | 0/0 | 0/0 | 0 | 0/0 | - | 0 | 0/0 | 0 | 0/0 | - | - | - | - | - | - | - | - |
| No. Exceeded AQLC-Chronic (1) | | | 0 | 0 | - | 0+/0 | 0/0 | 0/0 | - | 0/0 | - | 1+ | 0/0 | 0+ | 0/0 | - | - | - | - | - | - | - | - |

Notes:
* Critical elements. Lab data have been qualified according to QAPP.
\+ MDL is above given standard. Therefore, additional exceedences may exist.
(1) Where two values are listed, criteria is hardness dependent. Values are calculated on hardness of 100 and 200 mg/L, respectively.

**HELENA NATIONAL FOREST**
**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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BEATRICE MINE** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MBED10M | 96S0027 | | 2.37 | U | | 9.1 | | | 51.10 | | | 0.79 | B | | 2.62 | B | | 16.39 | | | 0.06 | | | 3.95 | B | | 17.4 | | | 25.2 | | |
| **FROHNER BASIN MILL TAILINGS** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PNGD10H | 94S0085 | Streamside tailings, Frohner Basin Creek | 61.44 | | | 6800.0 | | | 38.97 | | | 4.37 | B | | 0.23 | U | | 213.72 | | | 2.89 | | | 0.96 | B | | 9020.0 | | | 537.9 | | |
| PNGD20H | 94S0084 | Streamside tailings, Frohner Basin Creek | 20.72 | | | 3100.0 | | | 31.72 | | | 11.89 | | | 0.55 | B | | 332.83 | | | 0.30 | | | 1.25 | B | | 2150.0 | | | 1290.0 | | |
| **NORTH ONTARIO MINE** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ONOD10L | 96S0037 | | 0.80 | B | | 86.2 | | | 62.68 | | | 2.11 | B | | 3.67 | B | | 106.29 | | | 0.13 | | | 3.05 | B | | 140.6 | | | 151.3 | | |
| **ONTARIO MINE** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| OOND10H | 96S0028 | | 15.47 | | | 11000.0 | | | 61.71 | | | 1.13 | B | | 4.19 | B | | 66.90 | | | 0.98 | | | 2.60 | B | | 1080.0 | | | 116.0 | | |
| OOND20H | 96S0029 | | 27.62 | | | 3100.0 | | | 8.16 | | | 2.97 | B | | 5.19 | U | | 102.45 | | | 0.13 | | | 5.19 | U | | 699.6 | | | 336.5 | | |
| **PARK MARIETTA AND PHOENIX** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MPD10H | 96S0033 | Tailings within breached Impoundment | 15.17 | | | 7036.0 | | | 118.85 | | | 3.13 | | | 14.25 | | | 182.04 | | | 0.42 | | | 4.87 | B | | 4340.7 | | | 506.0 | | |
| MPD20M | 96S0034 | Streamside tailings 0.5 miles below impoundment | 12.69 | | | 6133.5 | | | 115.31 | | | 6.57 | | | 10.48 | | | 79.71 | | | 0.19 | | | 3.45 | B | | 3788.4 | | | 386.3 | | |
| MPD30M | 96S0035 | Streamside tailings below Phoenix dump | 13.39 | | | 5508.6 | | | 88.35 | | | 3.09 | B | | 5.72 | B | | 50.49 | | | 0.39 | | | 2.14 | B | | 4003.1 | | | 328.4 | | |
| **SALVAI MINE** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PSAD10M | 94S0086 | Streamside waste rock dump | 16.49 | | | 2160.0 | | | 95.16 | | | 4.36 | | | 16.00 | B | | 500.00 | | | 0.16 | | | 9.40 | | | 2440.0 | | | 395.2 | | |
| **VOSBURG MINE** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BVOD10H | 94S0163 | Tailings along north seep channel | 0.81 | | | 247.8 | | | 2.40 | | | 0.11 | B | | 0.27 | | | 14.97 | | | 1.14 | | | 0.10 | | | 106.7 | | | 9.0 | | |
| BVOD30M | 94S0165 | Tailins in floodplain of Badger Creek | 0.66 | | | 200.4 | | | 1.49 | | | 0.11 | B | | 0.29 | | | 13.17 | | | 1.11 | | | 0.06 | | | 78.9 | | | 7.8 | | |
| BVOD40M | 94S0166 | Tailings below M2 pile | 0.88 | | | 200.6 | | | 1.39 | | | 0.14 | | | 0.30 | B | | 17.58 | | | 1.09 | | | 0.10 | | | 96.0 | | | 9.3 | | |
| BVOD50M | 94S0167 | Tailings along seep channel | 0.70 | | | 185.2 | | | 1.65 | | | 0.09 | B | | 0.45 | | | 10.46 | | | 1.13 | | | 0.08 | B | | 98.3 | | | 7.6 | | |
| **WARM SPRINGS MILL TAILINGS** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PWSD10L | 95S0001 | Streamside tailings, east of dam 1 | 0.51 | U | N | 280.0 | | | 3.49 | B | | 0.32 | B | | 0.56 | B | | 6.41 | | | 0.09 | B | | 0.51 | U | | 39.9 | | | 32.8 | | |
| PWSD20M | 95S0002 | Streamside tailings, breach in dam 2 | 0.44 | B | N | 350.0 | | | 2.84 | | | 0.98 | B | | 1.09 | B | | 10.58 | | | 0.05 | B | | 0.54 | B | | 66.8 | | | 81.9 | | |
| PWSD30M | 95S0003 | Streamside tailings, unnamed trib at dam 2 | 0.66 | B | N | 380.0 | | | 1.77 | B | | 0.63 | B | | 1.90 | B | | 18.90 | | | 0.06 | B | | 0.55 | U | | 101.9 | | | 70.8 | | |
| PWSD40L | 95S0004 | Streamside tailings, between dams 2 and 3 | 0.49 | U | N | 250.0 | | | 1.77 | B | | 0.49 | U | | 0.49 | U | | 6.46 | | | 0.07 | B | | 0.25 | B | | 52.2 | | | 25.0 | | |

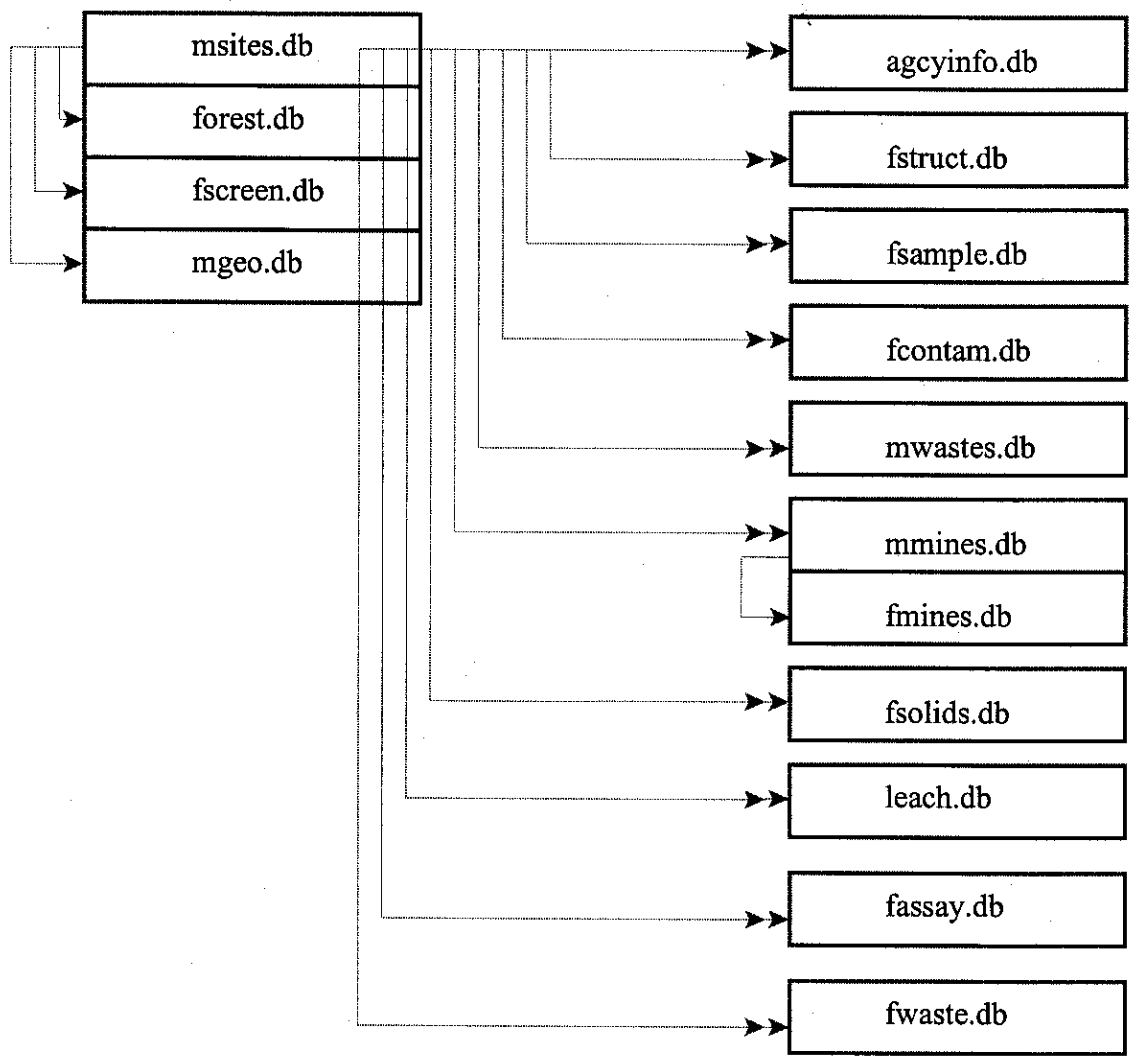
Notes:
B - Detected but below method detection limit
U - Analyzed for but below instrument detection limit
N - Spike sample recovery not within control limits
* - Duplicate analysis not within control limits

Appendix V

MBMG - USFS
AIM Data Base Tables and Field

AIM data base tables.

Data Model: FORESTR2.FSL



Sites Table
Id Number
Name
Alt Name
Mine District
County
Mrds #
Amli #
Mils #
Latitude
Longitude
Township
Range
Section
Tract
Utm Northing
Utm Easting
Utm Zone
Average Elevation
Elevation Units
Land Owner
1:250K Map
1:100K Map
1:24K Map
Property Type
Disturbance Type
Current Status
Mine Method
Map
Scale
Year of Production
Process Method
Process Capacity
Published Reserves - Measured
Published Reserves - Indicated
Published Reserves - Geological
Description of Workings
Depth of Workings
Width of Workings
Length of Workings
Disturbed Area of Workings
Surface Map
Surface Agency
Surface Address
Surface City
Surface Zip
Underground Map
Underground Agency
Underground Address
Underground City
Underground Zip
Date of Update
Longview
Plan View
Bibliography

Mines Tables
Id
Type Opening
Latitude
Longitude
Utm Northing
Utm Easting
Utm Zone
Waste Production Rate
Ore Production Rate
Opening Type
Condition
Size Open Length
Size Open Width
Status Rank
Elevation
Elevation Unit

Mine Open Table
Id
Type
Condition
Ground Water
Photo
Ownership
Comments

Wastes Table
Id
Type Waste
Rock Type
Au oz
Ag oz
Cu lb
Pb lb
Zn lb
As lb
Tons
Mineralized

Agency Table
Id
Agency
Division
District/Area
Ftract
Fwatershed Code
Forest
District
Owner
Own Impacts
Report

Forest Table
Id
Investigator
Date
Photos
Access
Nearest Wetlands
Drainage Basin
Waste Contact Stream
Nearest Surface Intake
Num of Surface Intakes
Uses of Surface Intake
Nearest Well
Nearest Dwelling
Number of Months Occupied
Number Houses 2 Miles
Recreational Usage
Nearest Rec Area
Name of Area
Hmo Adit
Hmo Wall
Hmo Struct
Hmo Chem
Hmo Solid
Hmo Explosives
Sensitive Environments
Pop Within .25 Miles
Pop Within .5 Miles
Pop Within 1 Miles
Pop Within 2 Miles
Pop Within 3 Miles
Pop Within 4 Miles
Public Interest

Fwastes Table
Id
Type
Wind Erosion
Vegetation
Surface Drainage
Stability
Location/Flood Plain
Distance to Stream
Photos

Fcontamination
Id
Type of Contamination
Estimated Quantity

Fstructure
Id
Type
Condition

Samples
Id
Sample Id
pH
Sc
Temp
Flow Rate
Flow Units
Flow Method
Soil Interval
Remarks

Water
Id
Sample Id
Source
Date
Sampler
Location Rel Stream
Stream
Sedimentation
Photo
Indicators of Metal

Soil
Id
Sample Id
Type
Sampler
Sample Type
Source
Indicator of Contamination
Photos