Mine Inventory and Compilation of Mine-Adit Chemistry Data

By Stanley E. Church, M. Alisa Mast, E. Paul Martin, and Carl L. Rich

Chapter E5 of
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Abstract

An inventory of inactive mines and mine-related sites in the Animas River watershed study area was compiled from published and unpublished State and Federal sources. Site locations were spatially verified using digital orthophoto quadrangles to ensure an accurate, geographically referenced inventory. The inventory provides, where available, descriptive information for mine-related sites, the estimated volume of mine-waste piles and mill-tailings deposits, and the discharge and pH of mine adits with flowing water. Water-quality and discharge data for 232 samples collected at 110 mine sites during low-flow conditions in 1995–99 have been compiled. In addition, time-series data are presented for water quality at seven adits sampled over the annual hydrologic cycle. These data provide site-specific information about potential sources of deposit-related acidity and trace elements that can be used to support an environmental evaluation of the effect of historical mining in the study area.

Analysis of the spatial variation in water-quality data from mine adits at low flow shows considerable variability. Mine-adit water chemistry is controlled by the degree of hydrothermal alteration in the surrounding bedrock and the type and extent of base-metal sulfides in the mine workings. Time-series data collected from seven draining adits show that increases in discharge generally are not associated with spring runoff and that concentrations of many metals remain very nearly constant or show a slight increase during this seasonal event. Increases in discharge from a few mines during spring runoff may be controlled by surface water that infiltrates into the mine, forcing mine-pool water out at the adit. Mine-adit flow may represent a long-term source of metals that affect surface water quality.

Introduction

This chapter describes the mine inventory compiled for the Animas River watershed study area. One of the most important facets of a complete characterization of watersheds affected by historical mines is to determine the location of, as well as gather and report information about, the mines, mills, and other mine-related sites. Within the Animas River watershed, data on mine and mine-related sites were available from several previous investigations. However, these data had not previously been compiled into one database, and many of the sites identified in these investigations had only approximate locations.

Every mine, mill, or smelter site in a watershed represents a potential source of deposit-related acidity and trace metals that could affect water quality and ecosystem health through direct drainage, seepage, erosion, or runoff. Although more than 5,300 mining-related features have been mapped in the study area (fig. 1), the vast majority of these sites were small prospect pits, many of which were located along the large and extensively exposed quartz veins described in the area by Purington (1905). (See the account of the discovery of the Sunnyside mine in Bird, 1999.) Other prospects were located on iron-rich springs, or in areas covered with oxidized iron deposits where there might have been other interesting features potentially indicative of sulfide mineralization at depth (Verplanck and others, this volume, Chapter E15; Yager and Bove, this volume, Chapter E1, pl. 2).

Four mining districts lie within the Animas River watershed study area. Raymond (1877, p. 324) reported that the San Juan area was initially divided into two mining districts:

> The Animas district includes all locations made on the Animas River and its tributaries to a point two miles above Howardsville.
>
> The Eureka district joins the Animas at this point and extends to the divide between the waters of the Animas and those of the Gunnison and the Uncompahgre.

The Red Mountain district originally was defined by the basin of Red Mountain Creek north of Red Mountain Pass in Ouray County, but Schwarz (1888) suggested that it be expanded

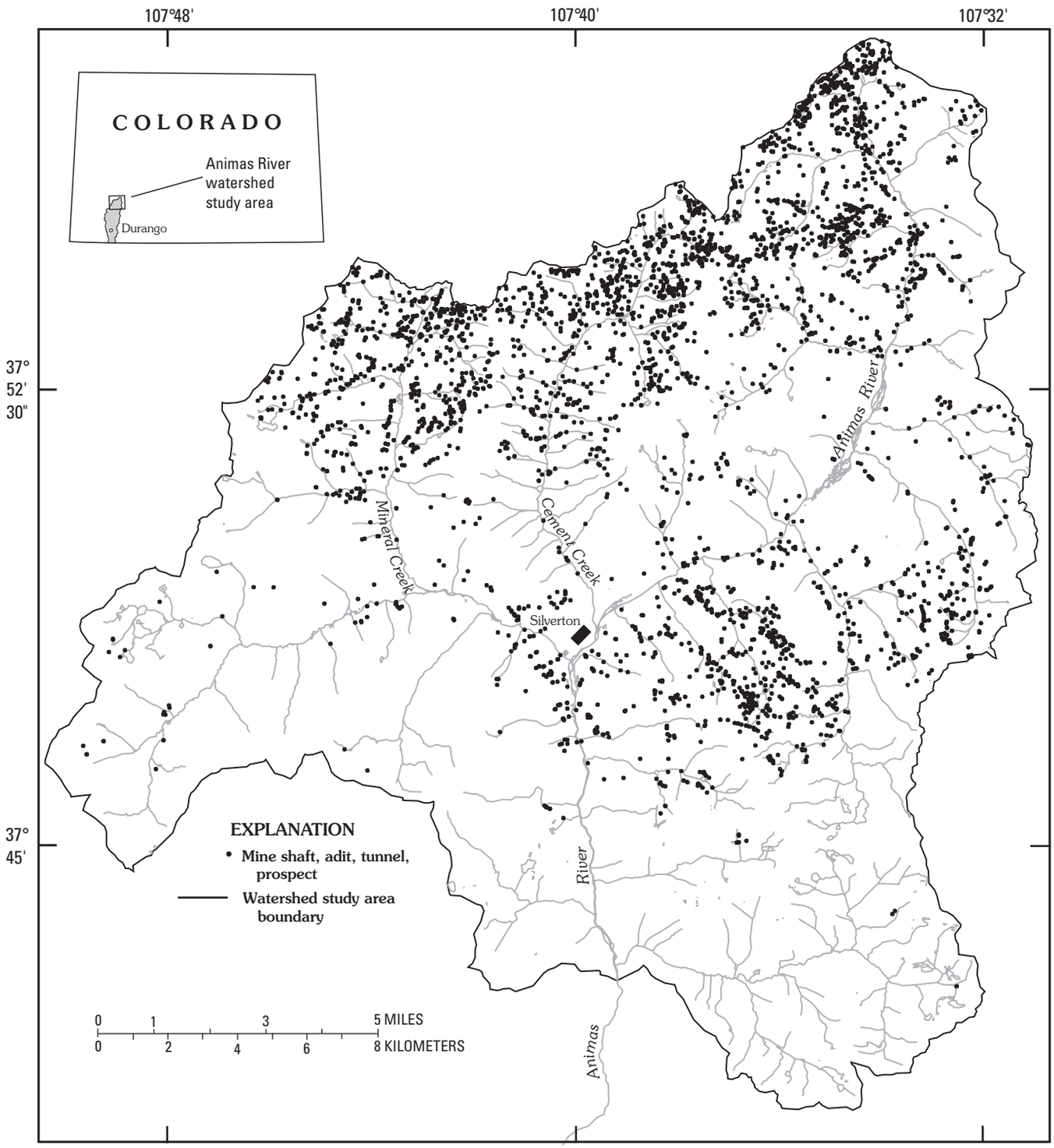

Figure 1. Locations of 5,397 mine shafts, adits, tunnels, and prospects from U.S. Geological Survey 1:24,000 scale topographic maps (Handies Peak, 1955; Howardsville, 1955; Ironton, 1955; Ophir, 1955; Silverton, 1955) and 373 AMLI_MINE_ID locations in Animas River watershed study area.

southward to include ores in chimney deposits associated with Red Mountain. Ransome (1901, p. 104) described the Red Mountain district as follows:

> ***bounded on the northeast by Grey Copper Creek, on the northwest by Red Creek, on the west and south by Mineral Creek, and on the east, with one or two exceptions near Red Mountain, by the ridge crest extending from Anvil Mountain northward to Red Mountain and thence northeast to the saddle at the head of Grey Copper Gulch.***

The Ice Lakes district in the headwaters of South Fork Mineral Creek was mentioned by Hodges (1899) in the report of precious-metal production by the U.S. Bureau of the Mint. Boundaries are not defined in the literature we examined, but the district includes the mines and mills in the headwaters of South Fork Mineral Creek. Approximate boundaries of the four mining districts are in figure 2.

Varnes (1963) described the mines and ores from the area of the Animas district south and east of Silverton, which he referred to as the "south Silverton mining area." Ores from this area are hosted in Paleozoic and Precambrian rocks and have different water chemistry than those from within the Silverton caldera (Bove and others, this volume, Chapter E3).

Purpose and Scope

This inventory focused on creation of a database of mine-related sites that have the potential for significant environmental effect to streams. The Animas River watershed study area contains numerous prospects and inactive mines. Although the potential exists for any one of these sites to adversely affect the environment, only a small fraction of them were considered likely to cause significant effects. Mine sites with draining adits, large workings, large mills, mine-waste dumps or rail loading zones were the primary focus of the mine inventory. Thus, prospects and smaller mine sites in the Animas River watershed study area were not inventoried in this study, and our survey is thereby not an exhaustive one (fig. 2). The primary objectives for this mine inventory were

- To create a modern digital database with accurate location data of mine and mill sites, large mill-tailings deposits, and smelter sites that have significant potential to cause environmental effects in streams
- To provide information, such as the size of mine-waste piles and mill-tailings deposits, ground- and surface-water quality, and numbers of mine features, that may be needed to assess site remediation and stream restoration activities
- To tabulate water-quality data collected over the 1995–99 period of study and provide a temporal and geologic framework for interpreting these data.

The mine inventory for the Animas River watershed study area was compiled from a variety of published references and maps of the districts. The inventory combines geographically referenced locations and descriptive information in a format that lays the foundation for answering environmental and remediation questions. The inventory includes inactive mines and mine-related sites in the upper Animas River basin, Cement Creek and Mineral Creek basins, and South Fork Mineral Creek subbasin in the vicinity of Silverton, Colo. (von Guerard and others, this volume, Chapter B, fig. 2).

Acknowledgments

We thank the following local residents, all familiar with historical mining in the watershed, for their assistance in locating and verifying mine sites: Steve Fearn, Larry Perino, William Simon, and especially Bill Jones, who provided extensive reviews of our mine location maps. We thank Jerry Hassemer for compiling unpublished data (table 5) from the Animas River Stakeholders Group, the Colorado Geological Survey, and the Colorado Division of Mines and Geology.

Methodology

The process used to compile the mine inventory included the following steps. First, data from previous investigations were assembled. We reduced the number of sites to be included in the inventory considerably by eliminating sites that likely had no environmental effect. Factors for inclusion or exclusion in the mine-site inventory focused on a site's contribution to environmental degradation, the physical hazard risk, and past production. Sites excluded from the inventory included numerous small prospects, sites located some distance from watercourses, and sites for which evidence of any environmental effect was lacking. For the remaining sites, representative locations were determined and features considered important relative to environmental effects were tabulated from existing sources. Published data, primarily from Ransome (1901), Henderson (1926), Burbank (1933), Varnes (1963), and Burbank and Luedke (1969), and unpublished data as well as our field investigations suggest that the inventory presented in this chapter is comprehensive in terms of identifying the larger and more environmentally significant historical mines and mine-related sites.

Determination of the representative location for a mine-related site involved review of public records and data obtained from the State of Colorado, United States Department of Agriculture (USDA) Forest Service, U.S. Bureau of Land Management (BLM), and U.S. Geological Survey (USGS) databases and published studies cited in the references. These location data then were combined into a single digital layer,

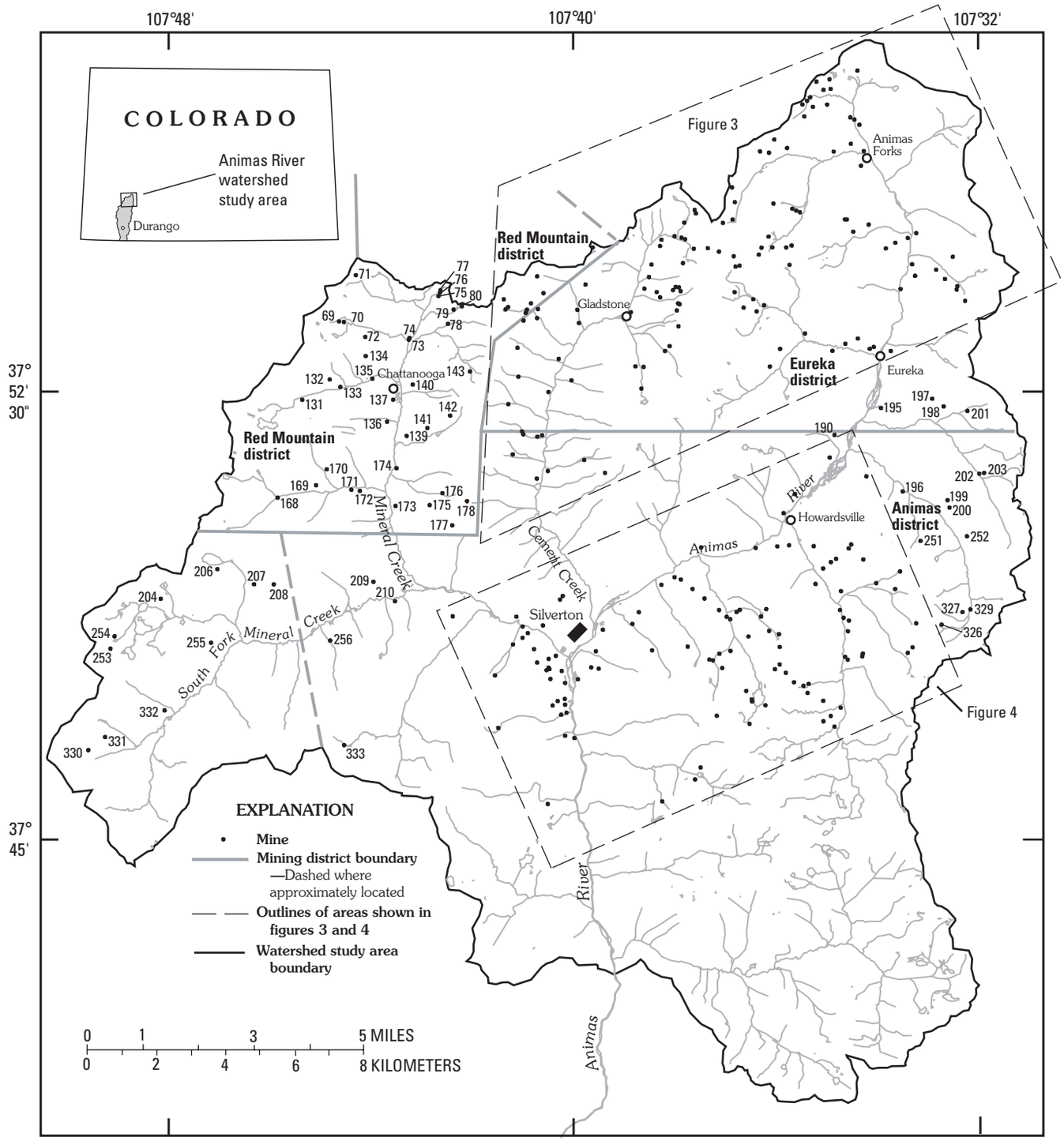

Figure 2. Approximate mining district boundaries and mine locations in Animas River watershed study area and vicinity; mine names are listed in tables 1 and 2. Extensions of boundaries of Red Mountain district to north into Ouray County, as described by Ransome (1901), are indicated by dashed lines.

and each site location was resolved to one representative point based on 1998 digital orthophoto quadrangles (DOQ). In some cases, the site location had to be determined strictly from a written description. Using DOQ image plots containing the resolved mine locations, USGS personnel and local residents familiar with the mines of the study area verified and revised the locations of the mine-related sites based on site visits, survey plats, and local knowledge of the area. Unpublished field inventories were used extensively to develop the final location data, as follows:

- U.S. Bureau of Mines (Barbara Hite, Unpublished mine land inventory report for the U.S. Bureau of Land Management, 1995)

- Colorado Geological Survey (Jonathan Lovekin, Michael Satre, William Sheriff, and Matthew Sares, Unpublished abandoned mine land inventory report for San Juan Forest, Columbine Ranger District, Colorado Geological Survey, 1997)

- Colorado Division of Minerals and Geology (Jim Herron, Bruce Stover, Paul Krabacher, and Dave Bucknam, Unpublished Mineral Creek feasibility investigations report, Upper Animas River Basin, Colorado Division of Minerals and Geology, 1997; Jim Herron, Bruce Stover, and Paul Krabacher, Unpublished Cement Creek reclamation feasibility report, Upper Animas River Basin, Colorado Division of Minerals and Geology, 1998; Jim Herron, Bruce Stover, and Paul Krabacher, Unpublished Upper Animas River reclamation feasibility report, Upper Animas River Basin, Colorado Division of Minerals and Geology, 1999; Jim Herron, Bruce Stover, and Paul Krabacher, Unpublished Lower Animas River reclamation feasibility report, Upper Animas River Basin, Colorado Division of Minerals and Geology, 2000)

- Local citizens who collectively make up the Animas River Stakeholders Group, ARSG (Peter Butler, Robert Owen, and William Simon, Unpublished report to Colorado Water Quality Control Commission, Animas River Stakeholders Group, 2001).

Data

The mine inventory for the Animas River watershed study area contains locations, site characteristics and features, and water-quality data for inactive mines and mine-related sites in a single data layer in the project database. (See Sole and others, this volume, Chapter G, for a complete explanation of how to access the mine inventory and project database.) Each of the 373 sites in the mine inventory has been assigned a site number called the AMLI_MINE_ID. This site number is a unique identifier and allows each site to be associated with scientific data and selected field sampling sites contained in the study database. Some historical mine sites contain extensive underground workings or have multiple shafts and adits within a small area. In some cases, these sites are represented in the mine inventory by a single site number. In other cases, particularly at complex sites where mines were consolidated or have been referred to by different names in the published literature, different mine levels were assigned different site names and numbers.

Table 1 lists the 373 mines, mills, large mill-tailings deposits, and smelter sites included in the inventory, and provides the geographic coordinates for each site. The location status field provides a relative measure of how accurately the site has been located. The decision to encode the location status field in table 1 with “verified” or “approximate” was determined by our comparison of the source description and field diagrams with the DOQ and locations symbolized on existing maps. A verified value means that USDA Forest Service, BLM, or USGS personnel, or local residents involved in the mining industry checked the mine-related location and agreed on its position with a high degree of confidence. Table 2 contains just the mine sites in the inventory and lists these sites alphabetically by name to facilitate cross-referencing of mine names with locations. Although we have not made an exhaustive search of the literature for synonyms, we have included them, where we have that information, in table 2. Table 3 provides an alphabetical list of the locations of mills, large mill-tailings deposits, and smelters in the study area. Figures 2–5 show locations of the inventoried sites. Locations of mines are shown in figures 2–4. Figures 3 and 4 provide more detailed maps of the upper Animas River basin near Eureka and the south Silverton mining area. Locations of mills, large mill-tailings deposits, and smelters are shown in figure 5. Together, these illustrations and tables should facilitate location of any of the mines, mills, large mill-tailings deposits, or smelter sites referred to in this volume and provide the identifier which can be used to find additional data from the database for each of these sites.

Production records for most mines in the watershed are largely proprietary. Jones (this volume, Chapter C) gives the total production for the entire watershed for various commodities by year. He also lists the sizes of the mills and dates of expansion, gives information on mining and milling technology, and provides a link between mineral production and the transportation network in the watershed.

The mine names in the inventory are those generally referred to in the published references, the most thorough of these early reports being that of Ransome (1901). Mine

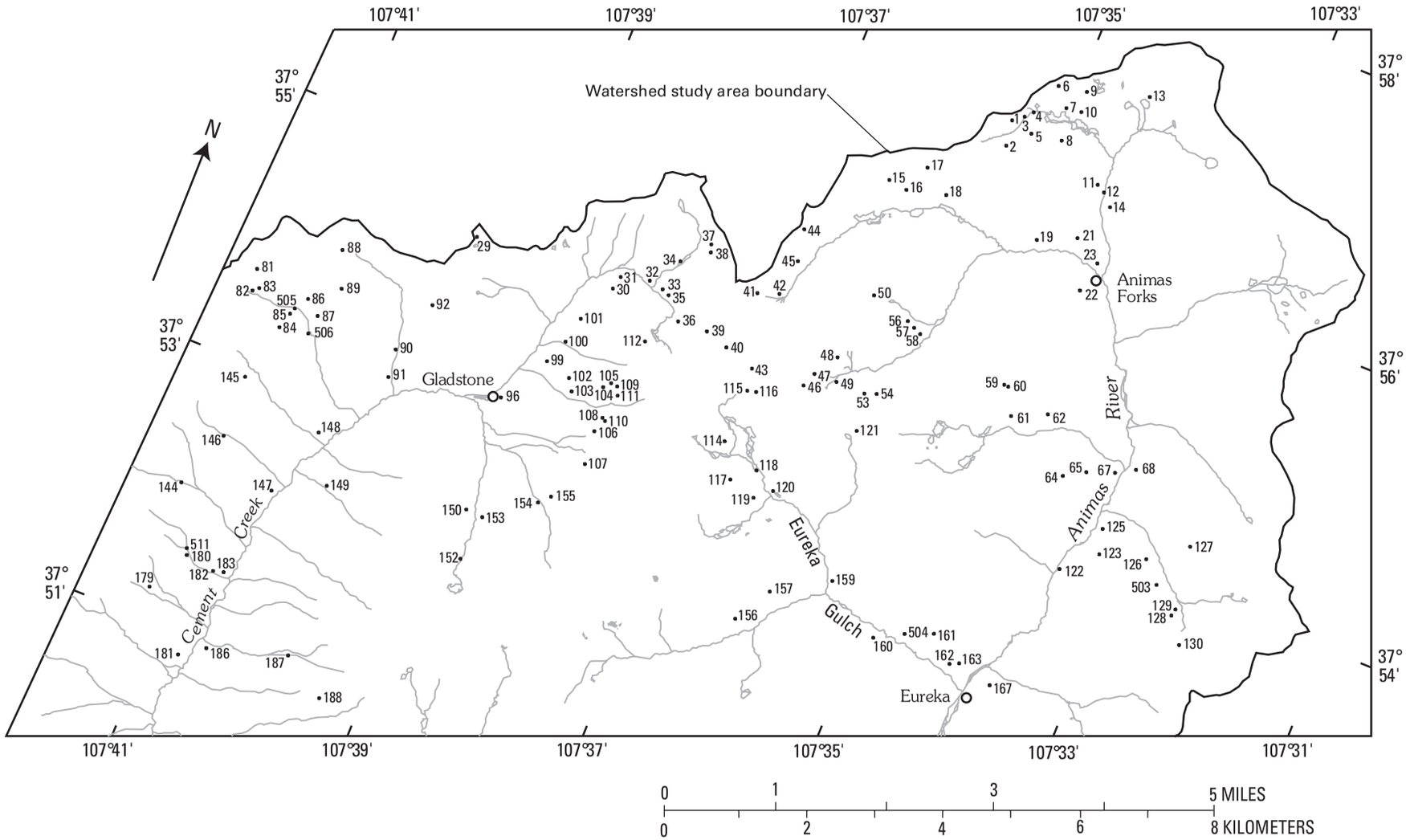

Figure 3. Eureka area showing mine locations; mine names are listed in tables 1 and 2.

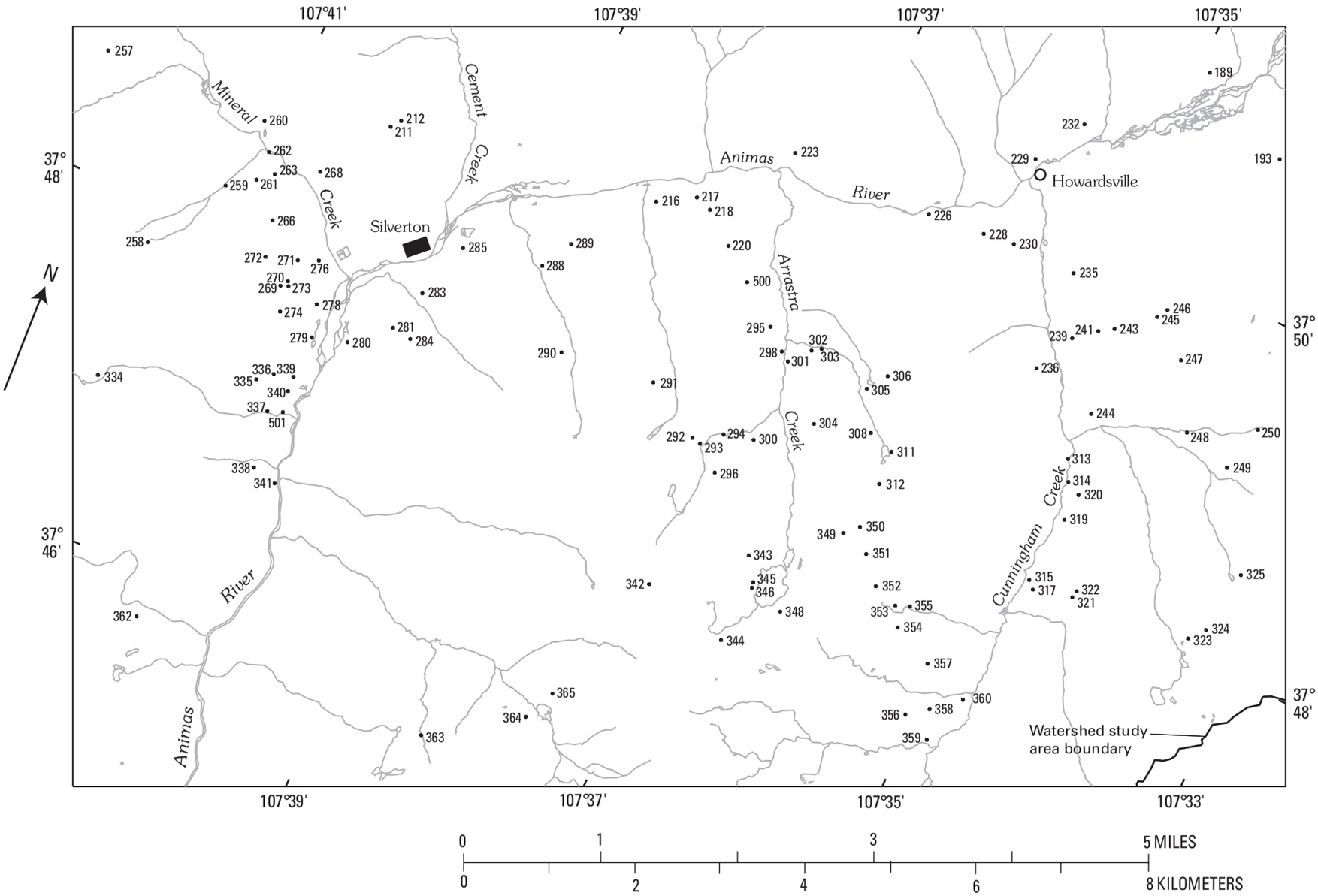

Figure 4. South Silverton area showing mine locations; mine names are listed in tables 1 and 2.

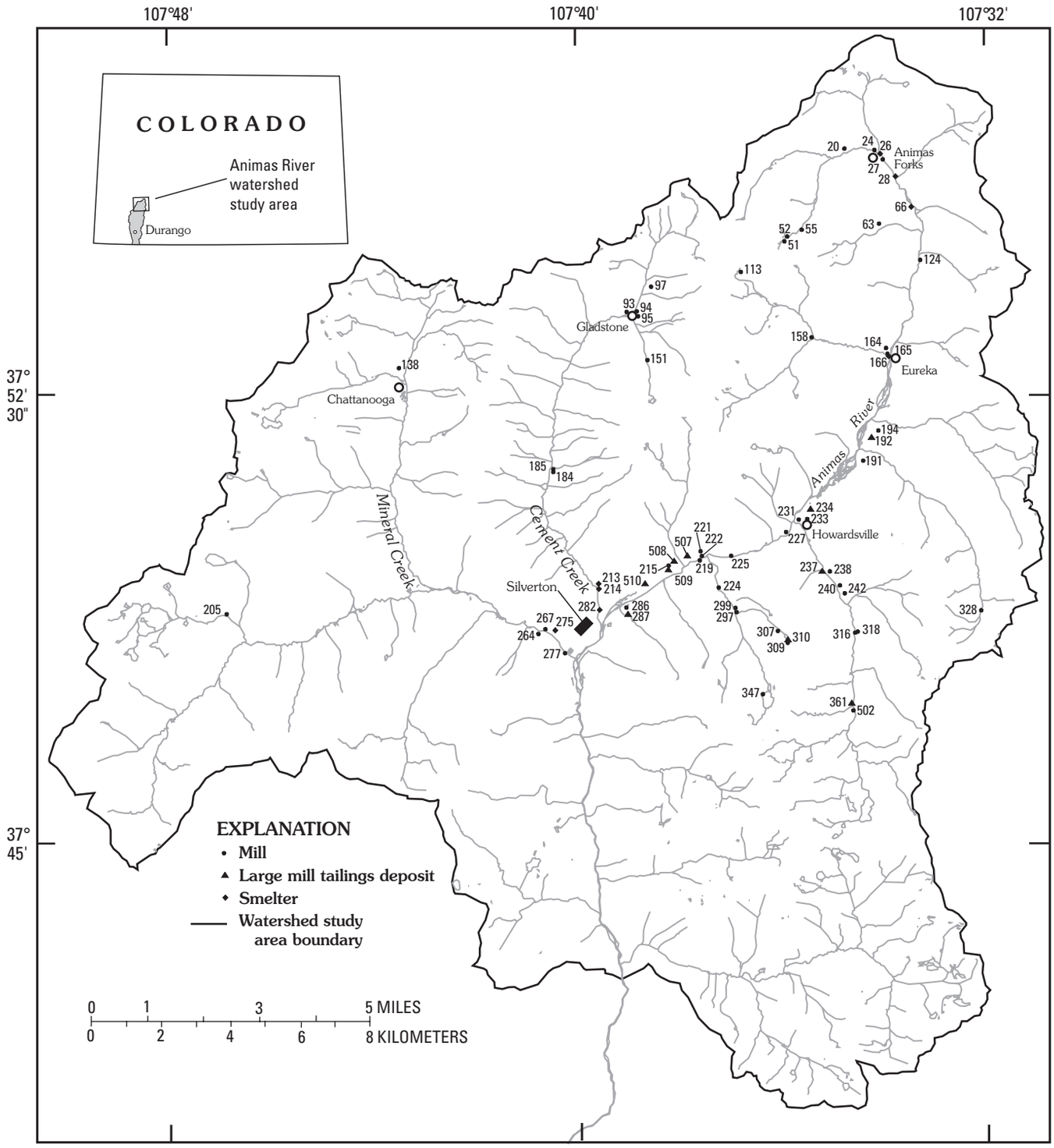

Figure 5. Locations of mill sites, large mill-tailings deposits, and smelter sites; site names are in table 3.

names or spellings often change with ownership during the development of a mining district. Furthermore, during times of economic downturn, consolidation of properties often occurred. For example, of the 110 mines listed as silver producers in the commodity report of the study area by the U.S. Bureau of the Mint (Munson, 1889), 68 mines that had previously reported silver production did not produce silver during 1889. Only 49 of 110 mines listed in Munson (1889) are in the mine inventory. Also, we have not attempted to document the many changes in mine names due to change in ownership or by consolidation of claims throughout the history of mining. As a result, not all mine names used in the literature or on claims records may be included in this mine inventory. One can conclude from this brief summary that mine names as well as mine features are transitory, especially in the early history of mining in the study area.

Table 4 presents descriptive information for many of the inventoried sites related to the potential for environmental effects. Sites that had only a single adit or shaft generally were associated with smaller disturbances, and these sites typically constitute only a physical hazard. They were not generally included in table 4. The shafts and adits columns give an indication of the extent of the surface workings at that site. Important point-source information typically used to evaluate sites for remediation included (1) number of flowing adits, (2) whether or not the adit drainage flowed over the mine waste, (3) whether the vegetation surrounding the outflow has died, or has a kill zone, (4) volume of the mine waste, (5) size of the area disturbed, and (6) distance to the receiving stream. Flow rates from the mine adits were highly variable throughout the year; discharge values are given at low flow in tables 5 and 6.

Results from the survey of mine sites conducted by the Animas River Stakeholders Group, the Colorado Geological Survey, and the Colorado Division of Mines and Geology are summarized in table 5. These data complement the work done by the USGS in that they include data from properties held privately to which USGS personnel did not have access. Analytical results from flowing adits sampled at low flow were done by contract EPA laboratories. These data supplement the low-flow adit water chemistry data collected by Mast and others (2000) and data of Nash and Fey (this volume, Chapter E6). Adit water chemistry data were used in the evaluation and ranking of mine and mill sites for remediation by the ARSG (Unpub. report to Colorado Water Quality Control Commission, ARSG, 2001). In a somewhat different approach, ratings of the mine waste, water quality and adit flow, and distance from the stream are factors that were considered in ranking the mine sites on public land for possible remediation (Nash and Fey, this volume).

Adit Flow and Chemistry

A primary focus of studies of abandoned historical mines in a watershed often has been to locate flowing adits. These adits represent point sources that discharge variable amounts of acid and potentially toxic trace elements, in many cases directly into streams. Identification of mine sites that have large discharges of acidic, metal-rich water is clearly an important goal for watershed remediation. We have compiled water-quality and discharge data for 232 samples collected at 110 mine sites during low-flow conditions in 1995–99. Mine-water data for 76 samples collected by the ARSG, Colorado Geological Survey, and Colorado Division of Mines and Geology are in table 5; data for 156 samples collected by the USGS are in table 6. These data were compiled to provide information on the spatial variability of mine-water chemistry in the basin and to estimate metal loads from mining-related sources. In table 7, we present time-series data from Mast and others (2000) for selected mine sites in the study area sampled for 1–3 years. Characterization of seasonal patterns in metal concentrations and discharge for mines is often lacking in mine remediation studies but is important for estimating annual metal loads from mining-related sources. In addition, this information provides an important seasonal context for interpretation of mine-water chemistry at sites where time-series data are not available.

Flow from mines in the watershed exhibited a wide range in discharge and chemistry (tables 5 and 6 and fig. 6). Adit discharge during the low-flow sampling period ranged from <0.002 at several small mine workings to as much as 1.2 ft^3/s (cubic feet per second) at the Yukon tunnel adit (mine # 186). The pH of adit water ranged from 2.3 at the Hercules mine (mine # 83) to as high as 8.6 at Pride of the West (mine # 319). Specific conductance ranged from 32 µS/cm (microsiemens per centimeter) at the Bandora mine (mine # 332) to 3,520 µS/cm at the Koehler tunnel (mine # 75). Mine drainage was dominantly a calcium-sulfate type water with sulfate ranging from 6.6 to 2,720 mg/L (milligrams per liter) and calcium ranging from 1.6 to 580 mg/L. The dominant base metals in mine drainage were copper and zinc. Copper concentrations ranged from the limit of detection (0.5) to 98,600 µg/L, although only 25 percent of samples had concentrations above 280 µg/L. Zinc concentrations ranged from 5 to 250,000 µg/L, but only 25 percent of samples had concentrations above 3,900 µg/L. The wide range in the chemical composition of mine water is primarily due to the variability in degree of hydrothermal alteration in the surrounding bedrock and the type and extent of base-metal sulfides in the mine workings. In general, acid-sulfate and quartz-sericite-pyrite altered rock produced mine water with low pH and high metal concentrations, whereas propylitically altered rock produced mine water with neutral pH and high calcium concentrations (fig. 6; Bove and others, this

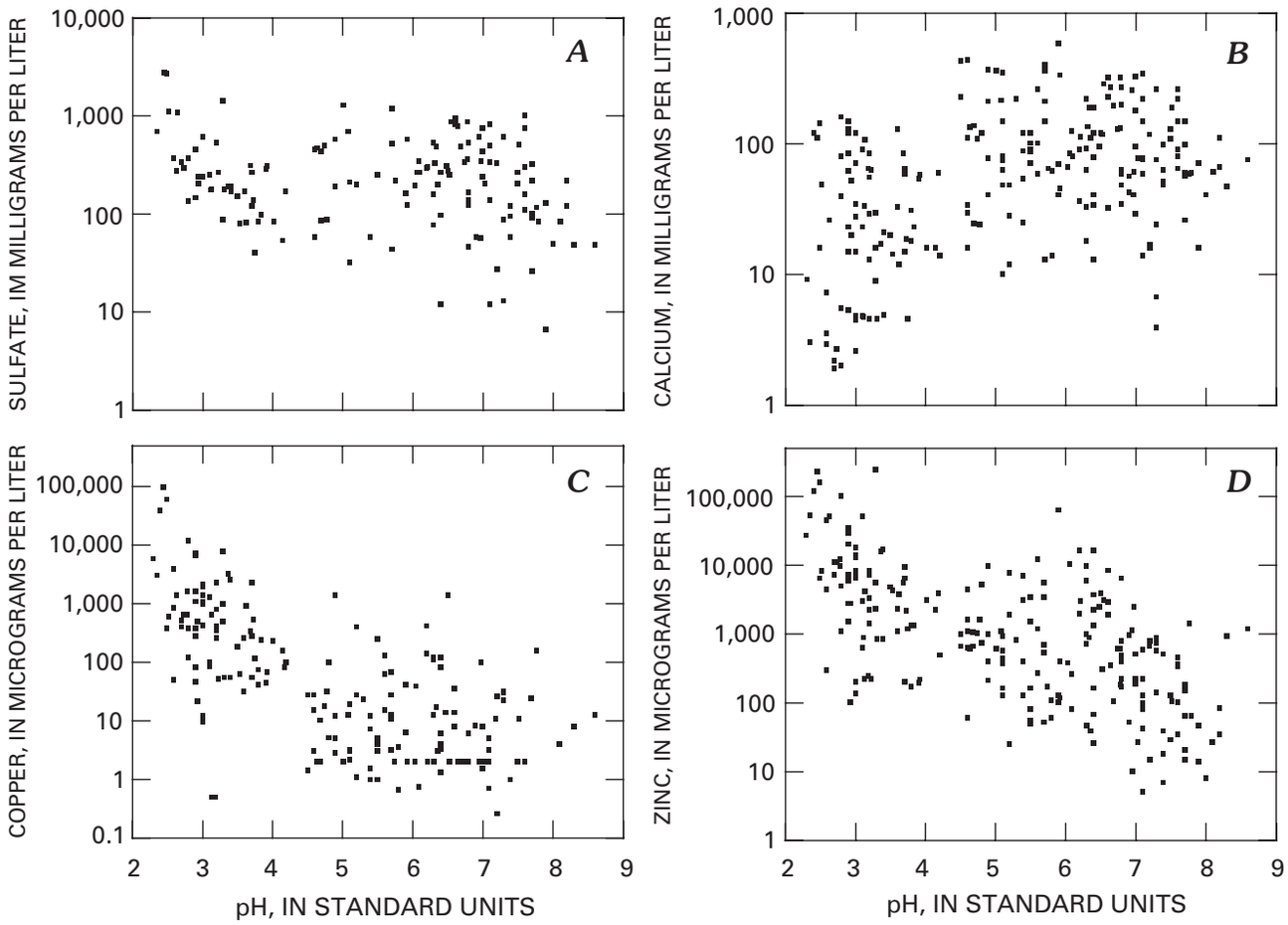

Figure 6. Dissolved concentrations of *A*, sulfate; *B*, calcium; *C*, copper; and *D*, zinc concentrations versus pH for mine-water samples collected in the Animas River watershed from 1995 to 1999. See tables 5 and 6 for complete tabulation of the data. Limit of detection, DL, for copper is 2 µg/L.

volume). Base-metal concentrations were highest in mines that had some historical production. A more detailed discussion of the relation between mine-water chemistry and hydrothermal alteration appears in Bove and others (this volume).

Temporal variations in mine-water discharge and chemistry are illustrated in figures 7–15 for seven mines sampled approximately monthly over the snowmelt hydrograph in 1995–2000 (von Guerard and others, this volume, fig. 3). Discharge at the adits did not show a pronounced increase during snowmelt, except for a slight increase at the Forest Queen (mine # 195) in 1997, and the Avalanche (mine # 149) in 1998 (fig. 7). These results contrast markedly with streams and rivers in the watershed, which show large increases in flow during the snowmelt period. For example, flow in the Animas River downstream from Silverton increased by as much as 30-fold between winter base flow and peak snowmelt in 1997–99, whereas adit discharge varied by only 3- to 5-fold over the same period. Similar to discharge, the chemistry of water at the sampled mines also remained relatively constant throughout the year as illustrated by the time-series plot of mine-water pH in figure 8 and chemical constituent plots in figures 9–15. One possible hydrologic explanation for the lack of seasonality in mine discharge is that adits are primarily fed by ground water that discharges from fracture networks in the bedrock. The relatively constant chemistry even during snowmelt could be explained by a piston flow mechanism whereby chemically mature water at the bottom of the ground-water reservoir is pushed into the mine pool as snowmelt recharges the top of the ground-water system. These time-series data from different mines are important because they show that concentrations of metals from adit discharge may be relatively constant through the year and, without intervention, may represent a long-term source of metals to the watershed. In addition, these data provide an indication that low-flow sampling of adits may be sufficient to characterize annual metal concentrations and loads from most mines.

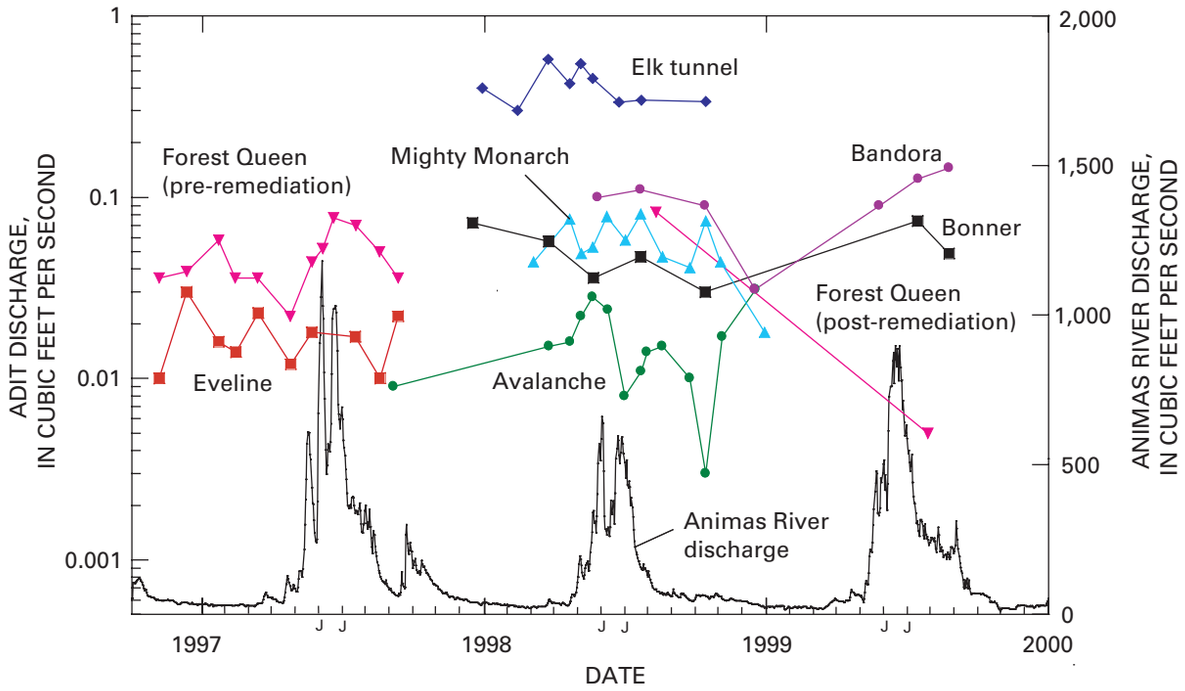

Figure 7. Graph of adit discharge versus date (beginning with January 1) from seven mines (Mast and others, 2000). The hydrograph determined at the Animas River gauge downstream from Silverton (USGS gauge 09359020) indicates periods of spring runoff, primarily during June and July where flow exceeds 150 ft^3/s (von Guerard and others, this volume). During summer 1999, the Animas River was at high flow through October because of abundant summer rains.

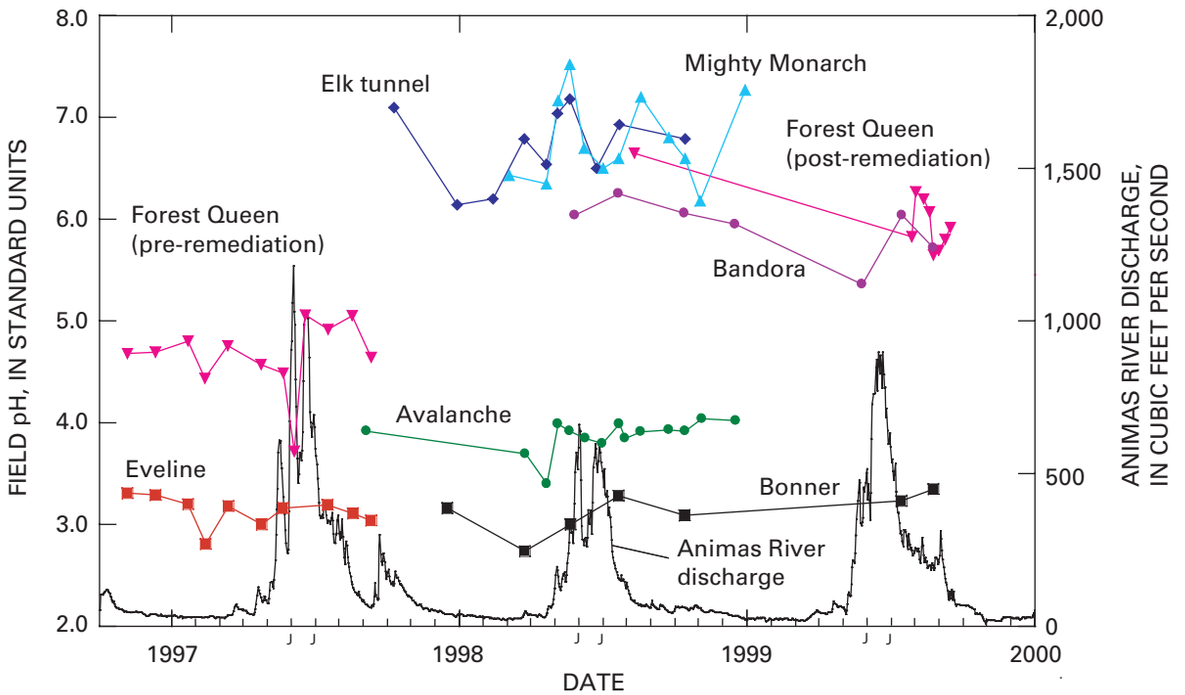

Figure 8. Graph of field pH versus time for mine adit water (Mast and others, 2000). The hydrograph determined at the Animas River gauge downstream from Silverton (USGS gauge 09359020) indicates periods of spring runoff, primarily during June and July where flow exceeds 150 ft^3/s (von Guerard and others, this volume). The Forest Queen mine data are labeled pre- and post-remediation.

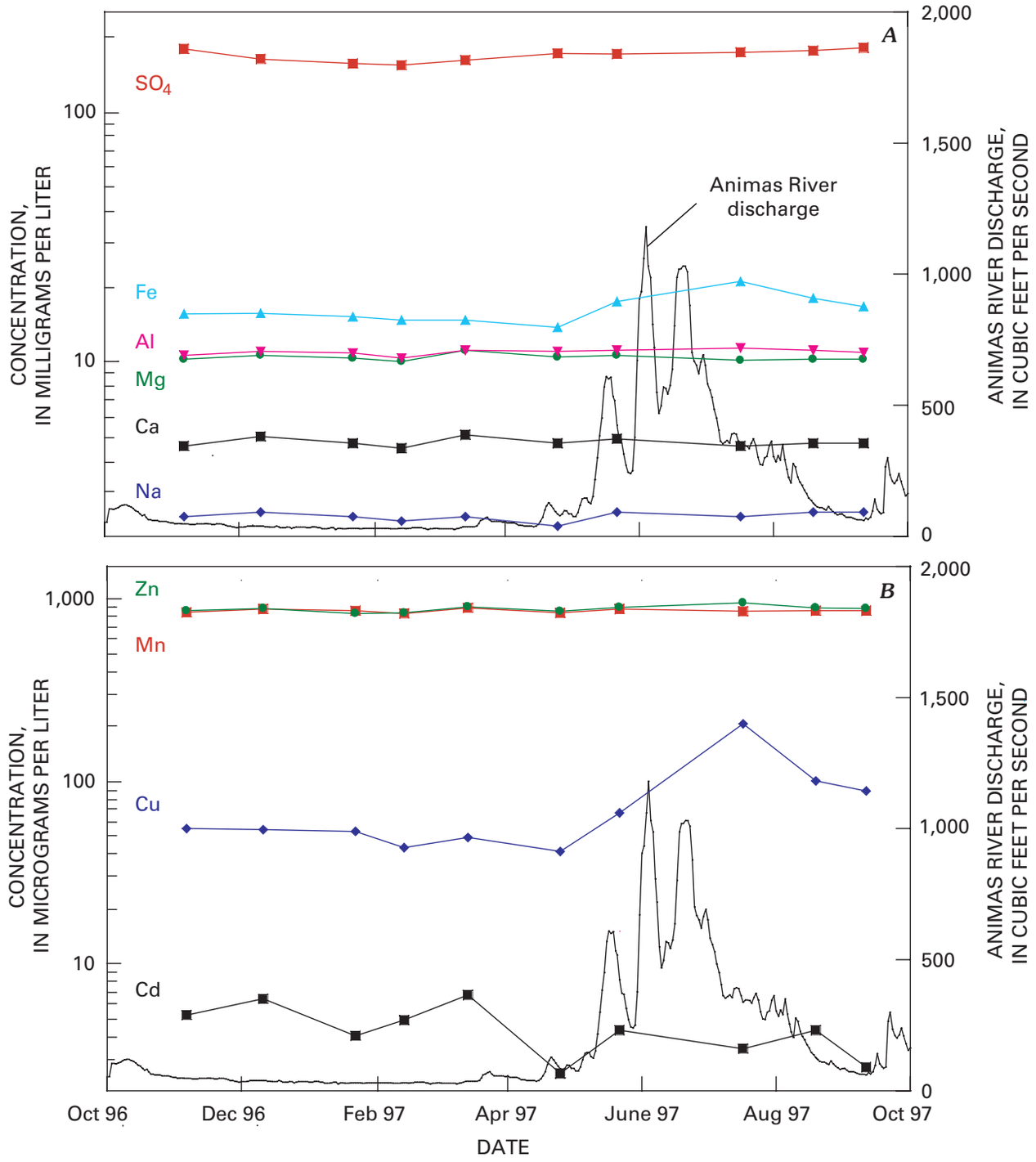

Figure 9. Concentrations of *A*, major, and *B*, trace elements in adit discharge from Eveline mine (site # 91; data from table 7). No lead was detected in the adit discharge (DL, detection limit=30 µg/L).

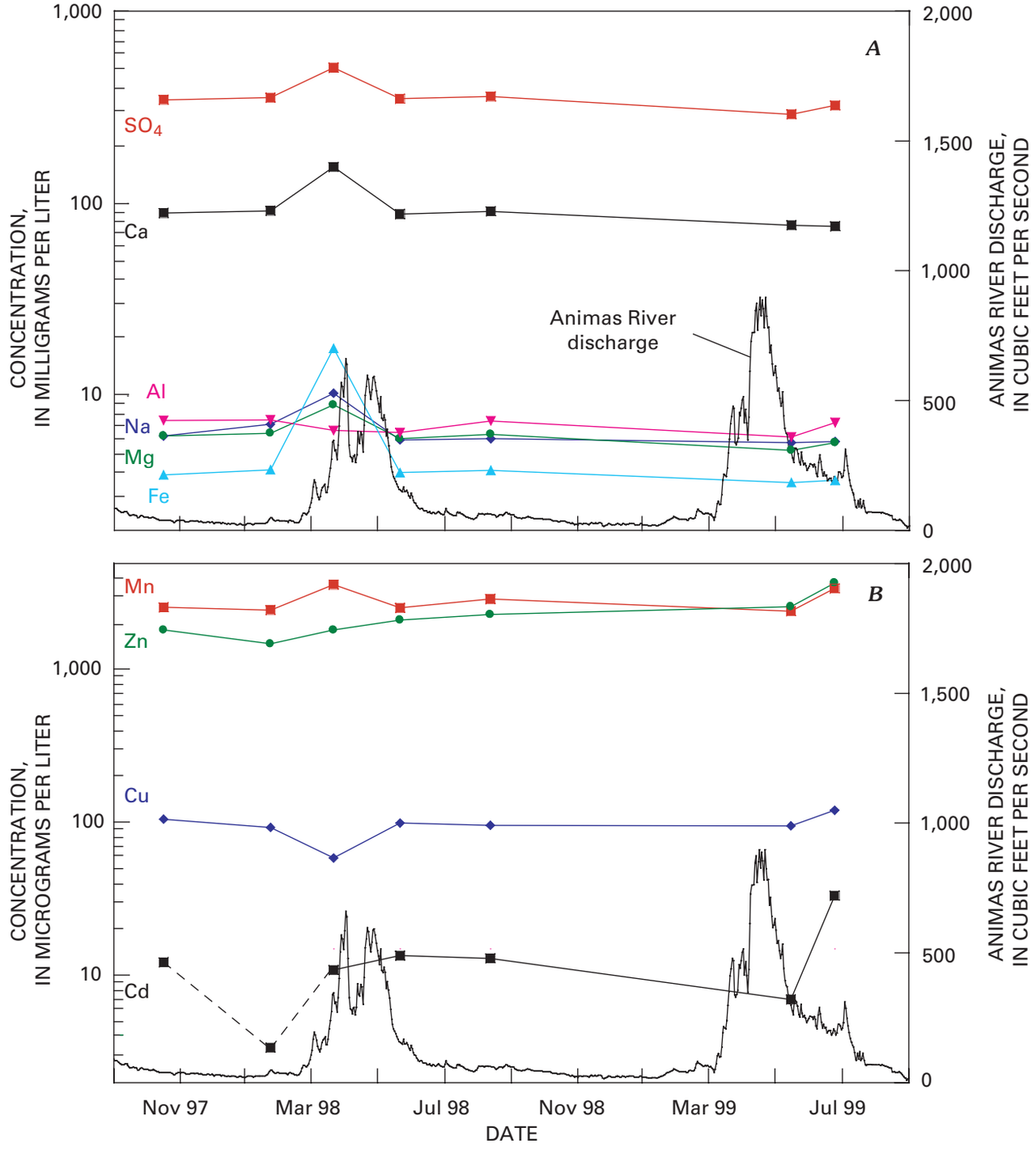

Figure 10. Concentrations of *A*, major, and *B*, trace elements in adit discharge from Bonner mine (site # 172; data from table 7). No lead was detected in the adit discharge (DL, detection limit=30 µg/L); cadmium was detected in some adit discharge samples (DL, detection limit=2 µg/L; connected using a dashed line).

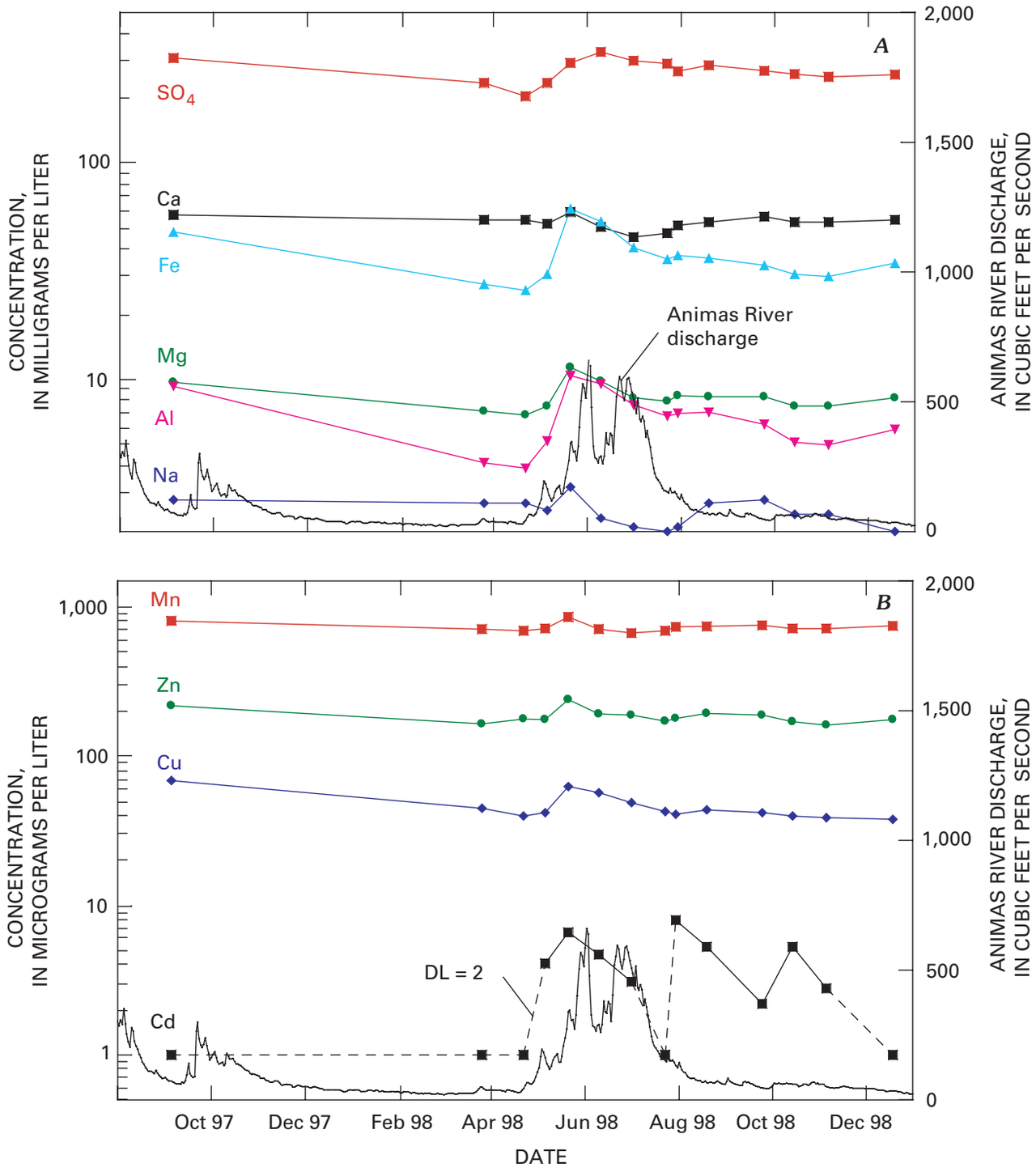

Figure 11. Concentrations of *A*, major, and *B*, trace elements in adit discharge from Avalanche mine (site # 149; data from table 7). No lead was detected in the adit discharge (DL, detection limit=30 µg/L); cadmium was detected in some adit discharge samples (DL, detection limit=2 µg/L; data points connected using a dashed line).

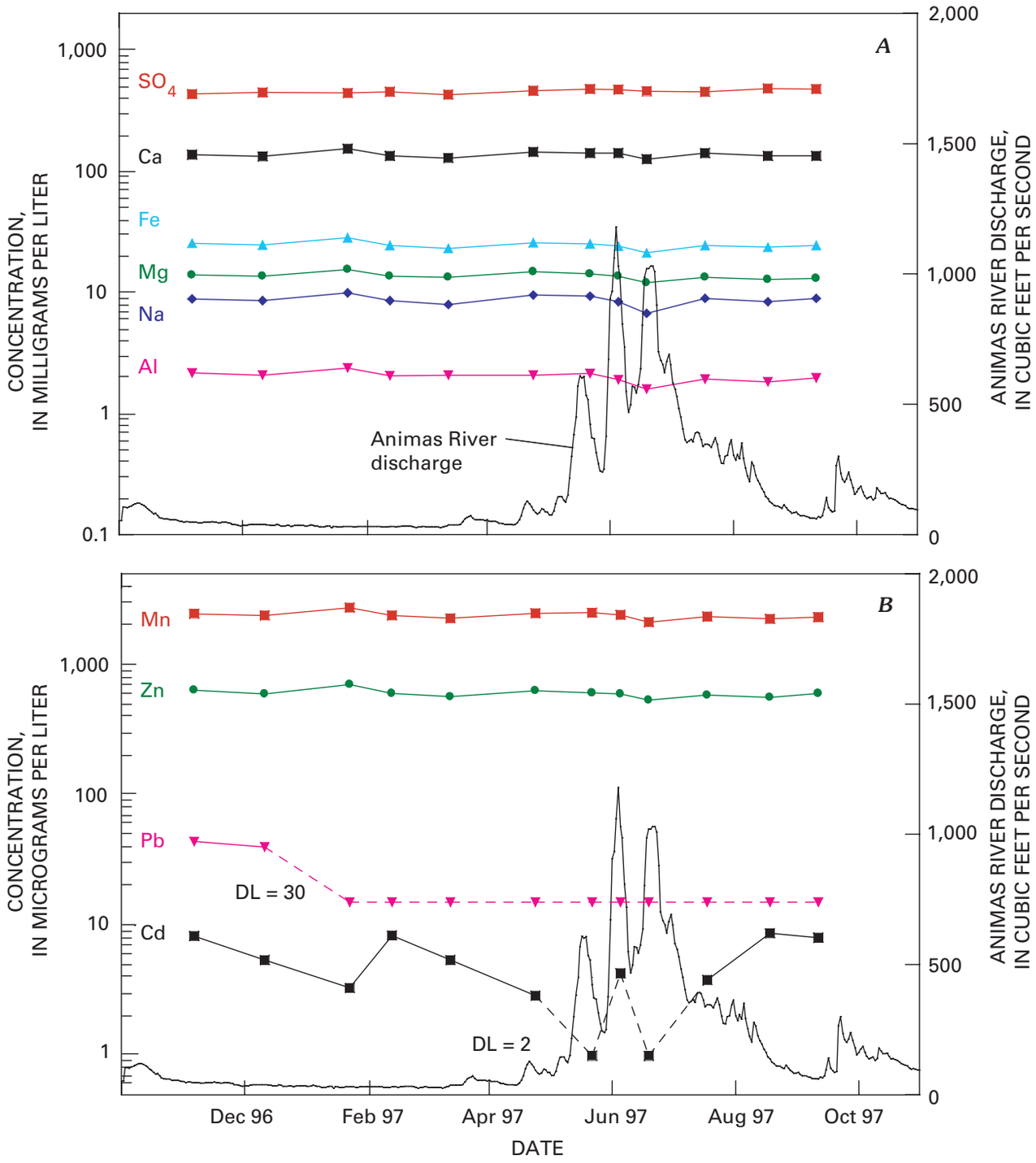

Figure 12. Concentrations of *A*, major, and *B*, trace elements in adit discharge from Forest Queen mine (site # 195; pre-remediation data from table 7). No copper was detected in the adit discharge (DL, detection limit=4 µg/L); cadmium and lead were detected in some adit discharge samples (DL, detection limit=2 µg/L and 30 µg/L, respectively; data points connected using a dashed line).

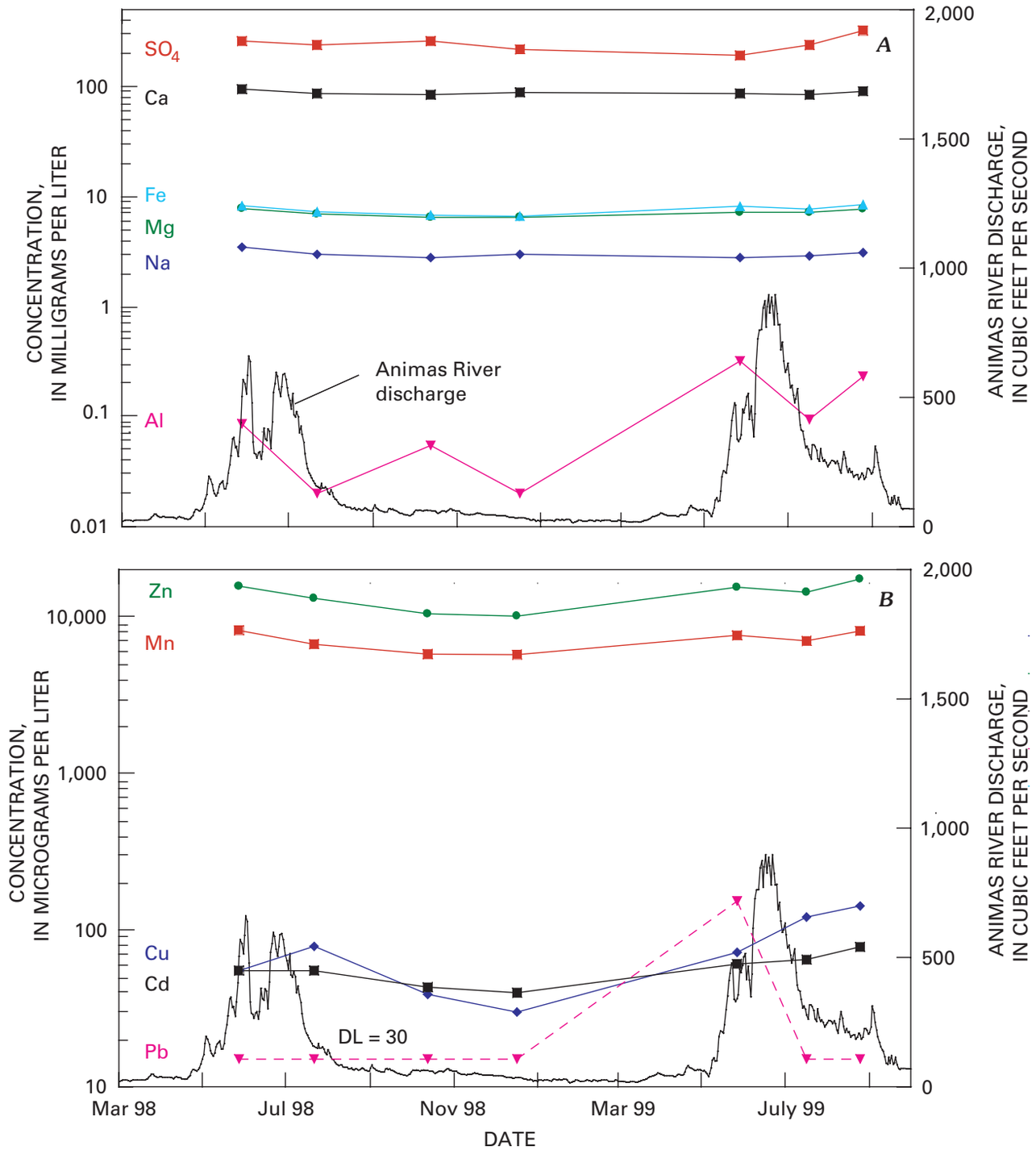

Figure 13. Concentrations of *A*, major, and *B*, trace elements in adit discharge from Bandora mine (site # 332; data from table 7). Lead was detected in only one sample (DL, detection limit=30 µg/L; data points connected using a dashed line).

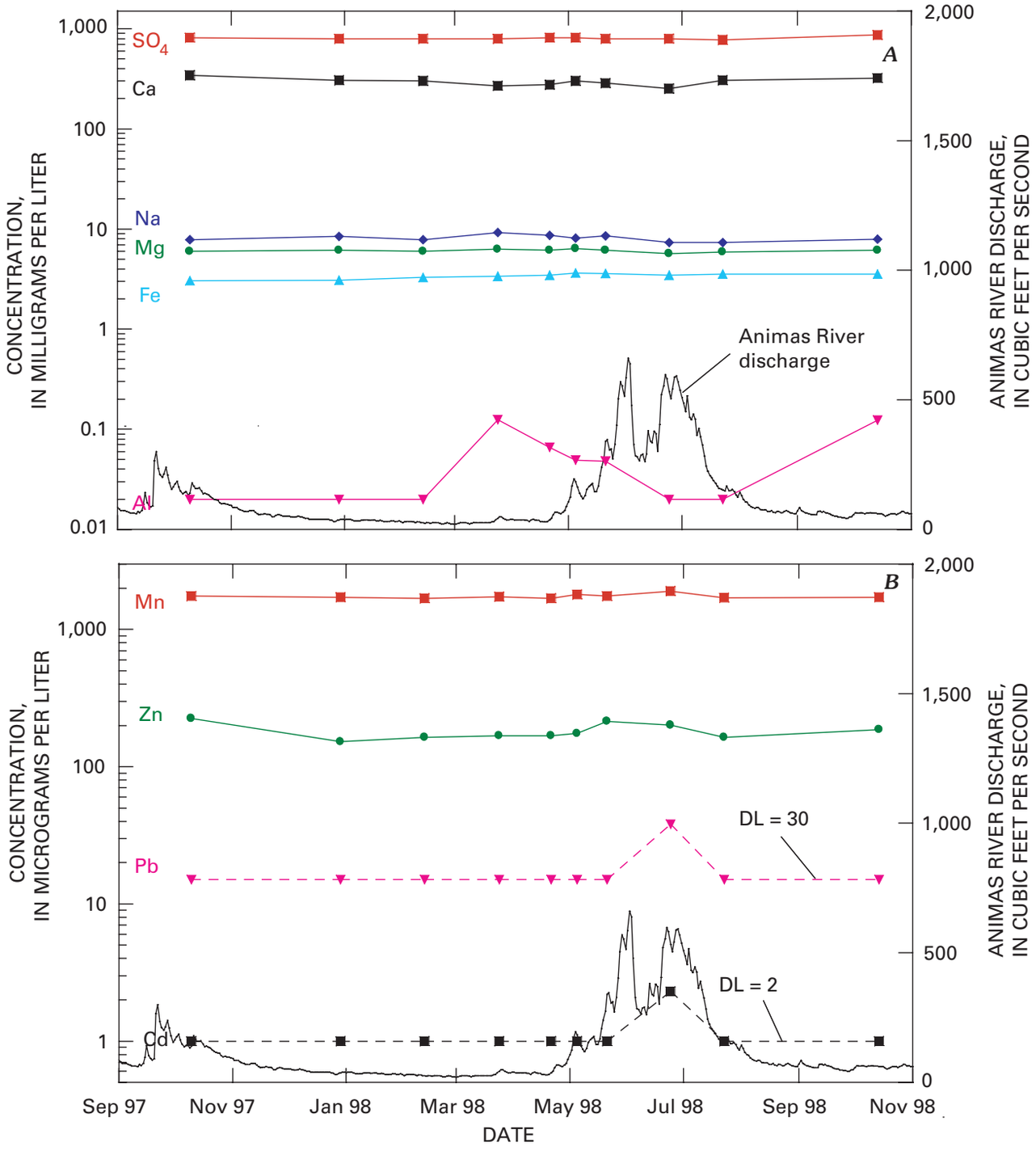

Figure 14. Concentrations of *A*, major, and *B*, trace elements in adit discharge from Elk tunnel (site # 147; data from table 7). No copper was detected in the adit discharge (DL, detection limit=4 µg/L, table 7); cadmium and lead were detected in some adit discharge samples (DL, detection limit=2 µg/L and 30 µg/L, respectively; data points connected using a dashed line).

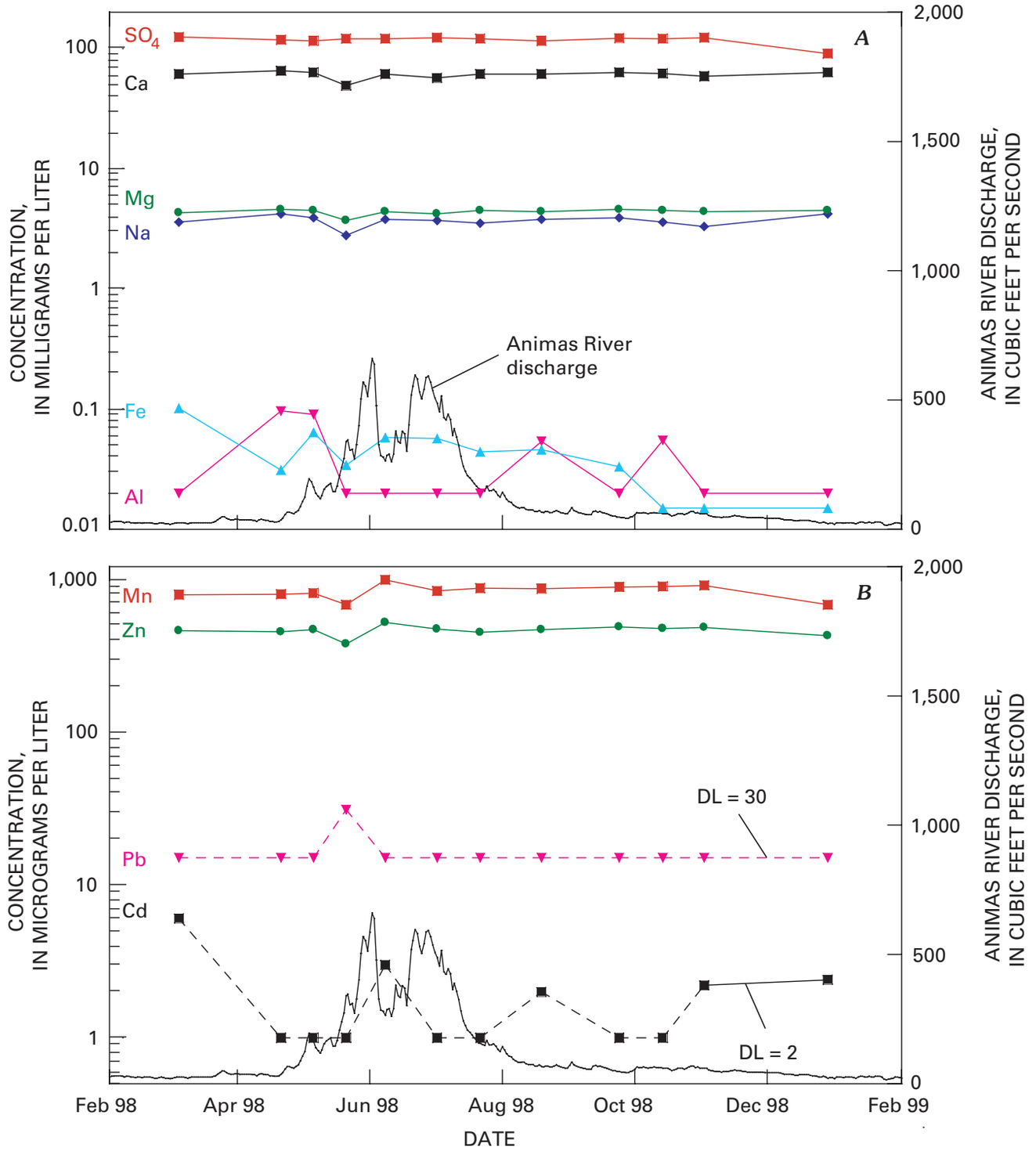

Figure 15. Concentrations of *A*, major, and *B*, trace elements in adit discharge from Mighty Monarch mine (site # 285; data from table 7). No copper was detected in the adit discharge (DL, detection limit=4 µg/L); cadmium and lead were detected in some adit discharge samples (DL, detection limit=2 µg/L and 30 µg/L, respectively; data points connected using a dashed line).

Figures 9–15, in which data are ordered by increasing values of pH of the adit drainage, show the variations of major- and trace-element concentrations for each suite of mine-water samples with time. The Eveline (mine # 91) and Bonner (mine # 172) are located on the margins of some of the most intensely altered areas of the watershed. The Eveline mine, which drains a localized area of quartz-sericite-pyrite altered rock, has the most acidic mine water (fig. 8) and was characterized by high concentrations of sulfate, zinc, and manganese with low concentrations of calcium (fig. 9). Discharge from the Eveline mine varied between 0.01 and 0.03 ft^3/s and did not appear to increase during spring snowmelt (fig. 7). For the dissolved constituent concentrations, iron and copper increased slightly following peak flow in 1997, although the other constituents remained remarkably constant during snowmelt. The Bonner mine is on the margins of an area of pervasive quartz-sericite-pyrite altered rock, and drainage is characterized by low pH (fig. 8), and high concentrations of sulfate, zinc, and manganese (fig. 10). Discharge from the Bonner mine varied between 0.03 and 0.07 ft^3/s and did not appear to increase during spring snowmelt (fig. 7). A slight increase evident in the concentration of some constituents at the adit in the May sample in 1998 may reflect flushing of solutes from the adit pool and waste materials at the onset of snowmelt. Constituent concentrations through the remainder of the sampling period remained relatively constant.

The Avalanche (mine # 149) and Forest Queen (mine # 195) drain areas of propylitically altered rock with zones of quartz-sericite-pyrite alteration localized along vein margins. Mine adit drainage from the Avalanche mine was acidic and was similar in composition to that of the Bonner mine (fig. 11). Discharge at the Avalanche mine varied from 0.003 to 0.031 ft^3/s and showed a distinct increase during snowmelt in 1998 (fig. 7). Concentrations of most dissolved constituents at the Avalanche mine also increased during spring runoff in 1998, although concentrations of aluminum and iron appeared to increase much more dramatically than other dissolved constituents. Discharge at the Forest Queen mine (pre-remediation) ranged from 0.022 to 0.077 ft^3/s during 1997 and was highest in June and July following peak snowmelt (fig. 7). Although most mine adits were monitored for a period of about a year, the Forest Queen mine was monitored for a longer period because it was opened and the discharge routed to a constructed passive treatment wetlands system in the summer of 1998 to remediate the water quality of drainage from this adit (data labeled pre- and post-remediation, fig. 7). Studies of the Forest Queen wetlands are in Stanton, Fey, and others (this volume, Chapter E25). Mine water from the Forest Queen mine was less acidic than at the Avalanche mine but had significantly higher concentrations of sulfate, manganese, and zinc (fig. 12). Despite the 3-fold increase in discharge observed in 1997, concentrations of dissolved constituents (except for cadmium) were remarkably constant throughout 1997.

The Bandora (mine # 332) is in the Precambrian and Paleozoic sedimentary rocks outside the Silverton caldera margin in weak sericite-pyrite altered rock. Mine drainage from the Bandora is characterized by neutral pH (fig. 8), low concentrations of sulfate, and high concentrations of zinc and manganese relative to the other mines (fig. 13). Discharge from the Bandora mine varied from 0.03 to 0.14 ft^3/s and was lowest during base flow in December 1998 (fig. 7). Dissolved constituent concentrations were relatively constant in 1998–99, although some metals, particularly zinc and manganese, appeared to be slightly higher during snowmelt than during base flow.

The Elk tunnel (mine # 147) and Mighty Monarch (mine # 285) drain areas of propylitically altered rock and have the highest pH values of the seven mines (fig. 8). Although field pH values and metal concentrations at the two mines were similar, sulfate and calcium concentrations were much lower at the Mighty Monarch mine (fig. 15) than at the Elk tunnel (fig. 14). Seasonal variations in discharge, which ranged from 0.041 to .081 ft^3/s at the Mighty Monarch mine and 0.30 to 0.57 ft^3/s at the Elk tunnel, did not appear to be related to snowmelt (fig. 7). Concentrations of major and trace elements in adit water at the two mines also showed little variation during 1998 except for aluminum at the Elk tunnel and aluminum, cadmium, and iron at the Mighty Monarch mine.

Concentrations of both the major and the trace elements vary between mines and reflect the alteration and sulfide mineralogy (Bove and others, this volume). Concentrations of dissolved iron, aluminum, copper, and lead are clearly functions of both the alteration suite and the pH of the mine water (table 7 and figs. 9–15; dissolved lead concentrations are often below the limit of detection). Concentrations of magnesium and calcium, which provide acid neutralization, are a function of the geologic setting and the alteration. Loads (concentrations of dissolved constituent times the discharge) calculated for sulfate, calcium, copper, and zinc increase directly with discharge (fig. 16). Calculated loads for some other metals, such as iron and aluminum, do not show these same simple relationships because of solubility changes caused by differences in pH of the adit discharge. The preceding relationships indicate that the mine pool water is being forced out of the mine adits as the hydrologic head increases due to infiltration during spring runoff. Identification of those mine sites that have large discharges of acidic, metal-laden water is clearly an important goal for watershed remediation.

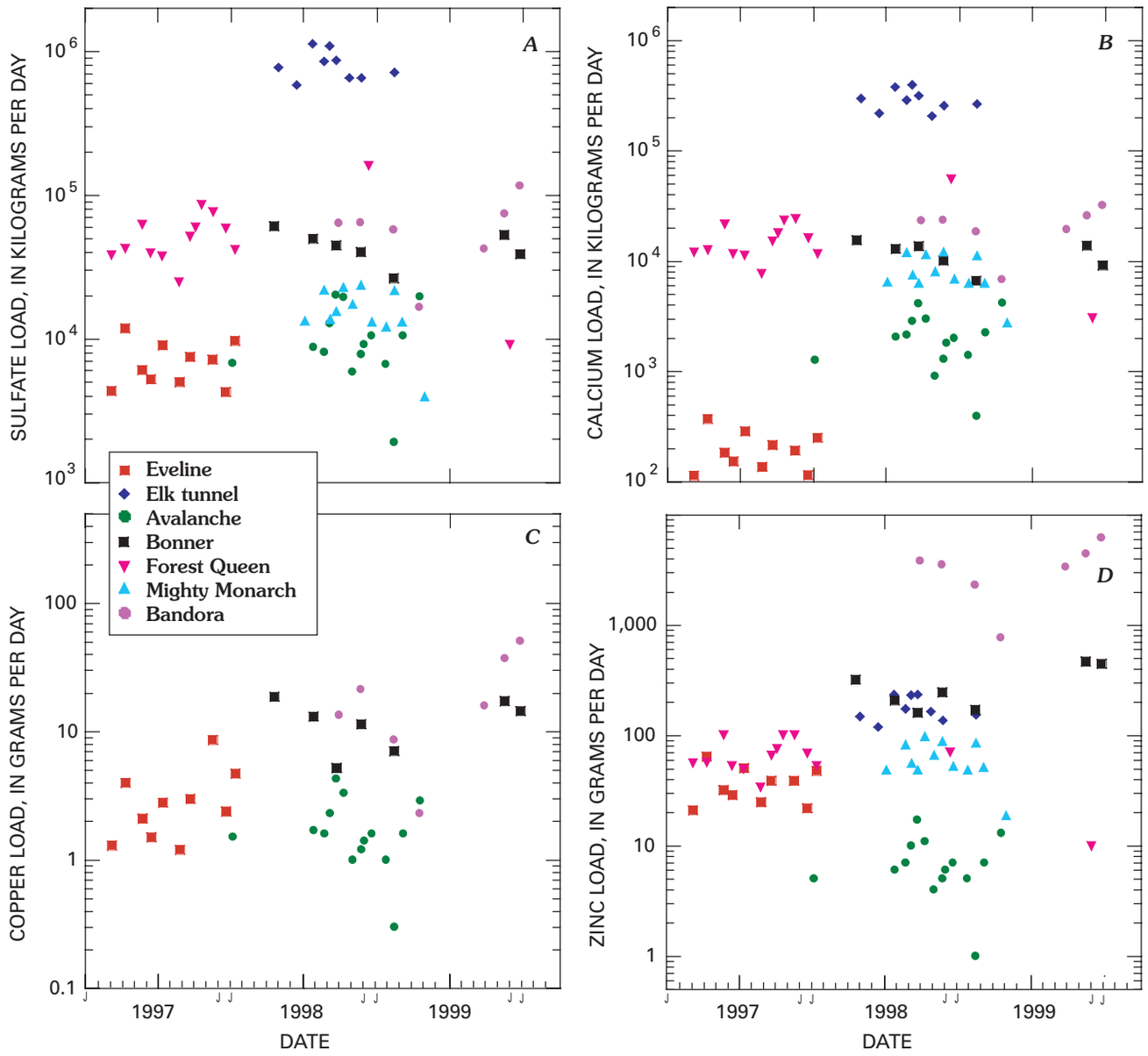

Figure 16. Loads of *A*, sulfate; *B*, calcium; *C*, copper; and *D*, zinc from the time-series adit discharge data from seven mine sites. The hydrograph determined at the Animas River gauge downstream from Silverton (USGS gauge 09359020) indicates periods of spring runoff, primarily during June and July where flow exceeds 150 ft^3/s (von Guerard and others, this volume).

Summary

Research of the historical record combined with modern digital mapping methods using digital orthophoto quadrangles (DOQ) and GIS technology has resulted in a new and more accurate inventory of the important past-producing mines, mills, and smelters in the Animas River watershed study area. Mine locations have been verified by project personnel or by local residents of Silverton and the surrounding area who have a working knowledge of the mining industry in the region. Compilations of new and existing data on the number of flowing adits, range of pH and dissolved metal concentrations, size of mine-waste piles and affected areas at these mine sites are summarized so that the data are available for use in potential remediation activity. Analysis of time-series data from seven mine sites (Mast and others, 2000) shows that the chemistry of the adit discharge from individual mines does not vary much of the year, but that the discharge at some sites shows a seasonal effect. Acidic mine drainage from historical mines represents a long-term source of contamination that affects surface water quality in the Animas River watershed study area.

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Tables 1–7

Table 1. Mines, mills, large mill-tailings deposits, and smelter sites listed by AML_MINE_ID number.

[Numbers refer to locations in figures 2–5 and in the Animas River watershed database; locations are either verified or approx. (approximate) on the basis of site visits or knowledge of resident experts; S-D, Shenandoah-Dives. Some mills located at the same sites were not originally numbered; we have added numbers in brackets for clarity]

Name	AMLI_MINE_ID	Latitude	Longitude	Location verified
Red Cloud mine	1	37.94532	107.59085	verified
Sewell mine	2	37.94221	107.59024	verified
Boston mine	3	37.94630	107.58929	verified
Dewitt mine	4	37.94720	107.58826	verified
Little Chief mine	5	37.94470	107.58737	verified
Uncompahgre Chief mine	6	37.95128	107.58621	verified
London mine	7	37.94914	107.58385	verified
Early Bird crosscut	8	37.94528	107.58268	verified
Ben Butler mine	9	37.95190	107.58187	verified
Prairie mine	10	37.94938	107.58150	verified
Hermes group	11	37.94194	107.57503	verified
Riverside mine	12	37.94136	107.57370	verified
Lucky Jack mine	13	37.95416	107.57264	verified
Eagle Chief mine	14	37.93998	107.57201	verified
Little Ida mine	15	37.93307	107.60487	verified
Burrows mine	16	37.93273	107.60190	verified
Vermillion mine	17	37.93617	107.60016	verified
Vermillion tunnel	18	37.93395	107.59594	verified
Frisco tunnel	19	37.93299	107.58053	verified
Bagley Mill (Frisco)	20	37.93287	107.58024	verified
Adit with unknown name	21	37.93503	107.57487	verified
Silver Coin mine	22	37.92926	107.57153	verified
Columbus mine	23	37.93308	107.57061	verified
Columbus Mill	24	37.93249	107.57045	verified
Animas Forks Smelter	26	37.93153	107.56856	verified
Gold Prince Mill	27	37.93007	107.56772	verified
Brown, Epley & Co. Smelter	28	37.92567	107.56361	verified
Corkscrew Pass mine	29	37.90803	107.66011	verified
Mogul South mine	30	37.90838	107.63789	verified
Mogul mine	31	37.91003	107.63744	verified
Mogul North mine	32	37.91092	107.63309	verified
Grand Mogul stope complex	33	37.91053	107.63079	verified
Queen Anne mine	34	37.91448	107.62986	verified
Grand Mogul	35	37.91014	107.62961	verified
Lower Ross Basin mine	36	37.90763	107.62676	verified
Columbia mine	37	37.91778	107.62645	verified
Upper Queen Anne mine	38	37.91687	107.62607	verified
Brenneman mine	39	37.90780	107.62212	verified
George Washington mine	40	37.90689	107.61843	verified
Mountain Queen mine	41	37.91439	107.61714	verified
Mountain Queen tunnel	42	37.91529	107.61396	verified
Lake mine	43	37.90567	107.61359	verified
Silver Chord mine	44	37.92367	107.61413	verified

Table 1. Mines, mills, large mill-tailings deposits, and smelter sites listed by AML_MINE_ID number.—Continued

Name	AMLI_MINE_ID	Latitude	Longitude	Location verified
Indian Chief mine	45	37.91981	107.61321	verified
Sunnyside Extension	46	37.90610	107.60532	verified
Mastodon mine (Handies Peak quadrangle)	47	37.90789	107.60442	verified
Independence mine (Handies Peak quadrangle)	48	37.91079	107.60209	verified
Gold Prince mine	49	37.90798	107.60085	verified
Custer mine	50	37.91941	107.60046	verified
Hanson Mill (Sunnyside Extension Mill)	51	37.90887	107.59989	verified
Mastodon Mill	52	37.91013	107.59899	verified
Silver Queen mine	53	37.90794	107.59624	verified
Sound Democrat mine	54	37.90845	107.59447	verified
Sound Democrat Mill	55	37.91188	107.59423	verified
Sunbank group, upper level	56	37.91805	107.59420	verified
Sunbank group, lower level	57	37.91757	107.59292	verified
Evening Star mine	58	37.91714	107.59171	verified
Scotia mine	59	37.91525	107.57688	verified
Golden Fleece mine	60	37.91522	107.57622	verified
San Juan Queen mine	61	37.91204	107.57415	verified
Sandiago tunnel	62	37.91388	107.56902	verified
Treasure Mountain Mill	63	37.91342	107.56898	verified
Toltec mine, upper level	64	37.90765	107.56339	verified
Toltec mine, middle level	65	37.90912	107.56027	verified
Eclipse Smelter	66	37.91776	107.55841	verified
Toltec mine, lower level	67	37.91035	107.55617	verified
Adit with unknown name	68	37.91163	107.55335	verified
Upper Bullion King	69	37.88872	107.74383	verified
Lower Bullion King mine	70	37.88856	107.74219	verified
Mineral Basin mine	71	37.90081	107.73827	verified
Lower Porphyry Gulch mine	72	37.88465	107.73515	verified
Silver Ledge mine	73	37.88394	107.72082	verified
Bradley Pit	74	37.88436	107.72059	verified
Koehler tunnel	75	37.89531	107.71101	verified
Junction mine	76	37.89627	107.71050	verified
Longfellow mine	77	37.89685	107.71036	verified
St. Paul mine	78	37.88806	107.70787	verified
Congress mine	79	37.89179	107.70601	verified
Carbon Lake mine	80	37.89263	107.70330	verified
JSP mine	81	37.89446	107.68946	verified
Galena Queen mine	82	37.89184	107.68887	verified
Hercules mine	83	37.89242	107.68806	verified
Henrietta mine, #3 level	84	37.88892	107.68295	verified
Henrietta mine, #7 level	85	37.89093	107.68222	verified
Lark mine	86	37.89341	107.68050	verified
Joe and Johns mine	87	37.89192	107.67819	verified
Webster mine	88	37.90046	107.67844	verified
Joe and Johns mine, upper level	89	37.89607	107.67635	verified
Galty Boy mine	90	37.89169	107.66520	verified
Eveline mine	91	37.88826	107.66467	verified

Table 1. Mines, mills, large mill-tailings deposits, and smelter sites listed by AML_MINE_ID number.—Continued

Name	AMLI_MINE_ID	Latitude	Longitude	Location verified
Burns group	92	37.89833	107.66251	verified
Mogul Mill	93	37.89067	107.65146	verified
Gold King Mill	94	37.89079	107.64814	verified
Lead Carbonate Mill	95	37.88953	107.64773	verified
American tunnel, Sunnyside mine	96	37.89106	107.64755	verified
Red and Bonita Mill	97	37.89716	107.64349	verified
Red and Bonita mine	99	37.89723	107.64308	verified
Adams mine	100	37.90026	107.64157	verified
Pride of Bonita mine	101	37.90352	107.64072	verified
Salomon group	102	37.89633	107.63902	verified
Gold King mine, #7 level	103	37.89494	107.63788	verified
Gold King mine, Sampson level	104	37.89685	107.63364	verified
Gold King mine, upper Sampson level	105	37.89765	107.63273	verified
Lead Carbonate mine	106	37.89150	107.63237	verified
Minnehaha mine	107	37.88738	107.63185	verified
Mocking Bird mine	108	37.89336	107.63198	verified
Gold King mine, Paul level	109	37.89757	107.63169	verified
Benitoite mine	110	37.89312	107.63145	verified
Gold King mine, #1 level	111	37.89655	107.63111	verified
Adelphin mine	112	37.90388	107.63031	verified
Sunnyside-Thompson Mill	113	37.90097	107.61417	verified
Clipper mine	114	37.89626	107.61332	verified
Belle Creole mine	115	37.90298	107.61301	verified
Sunnyside mine	116	37.90322	107.61168	verified
Ben Franklin prospect	117	37.89222	107.61034	verified
Ben Franklin mine	118	37.89442	107.60714	verified
Bavarian mine	119	37.89122	107.60602	verified
Terry tunnel of Sunnyside mine, F level	120	37.89286	107.60362	verified
Lake Parson mine	121	37.90340	107.59519	verified
Tom Moore tunnel	122	37.89702	107.55855	verified
Tom Moore mine	123	37.90048	107.55376	approx.
Silver Wing Mill	124	37.90403	107.55555	verified
Silver Wing mine	125	37.90348	107.55473	verified
Silver Bell mine	126	37.90205	107.54681	verified
Fredericka group	127	37.90543	107.54129	verified
Great Eastern	128	37.89685	107.54004	verified
Lower Great Eastern	129	37.89772	107.53982	verified
Klondyke mine	130	37.89388	107.53726	verified
Upper Mill Creek mine	131	37.86820	107.75593	verified
Silver Cloud mine	132	37.87354	107.74688	verified
Silver Crown mine	133	37.87158	107.74339	verified
Silver King mine	134	37.87966	107.73501	verified
Chattanooga Curve mine	135	37.87373	107.73281	verified
Imogene mine	136	37.86248	107.72797	verified
Ferricrete mine	137	37.86823	107.72598	verified
Silver Ledge Mill	138	37.87615	107.72586	verified
Lower Browns Gulch mine	139	37.85875	107.72151	verified

Table 1. Mines, mills, large mill-tailings deposits, and smelter sites listed by AML_MINE_ID number.—Continued

Name	AMLI_MINE_ID	Latitude	Longitude	Location verified
Gold Finch group	140	37.87220	107.71951	verified
Brooklyn mine	141	37.86083	107.71468	verified
Upper Browns Gulch	142	37.86407	107.70719	verified
U.S. Basin mine	143	37.87561	107.70060	verified
Minnesota Gulch mine	144	37.86706	107.68800	verified
Kansas City mine, #1 level	145	37.88181	107.68498	verified
Hoosier Boy mine	146	37.87421	107.68466	verified
Elk tunnel	147	37.87021	107.67475	verified
Mammoth tunnel	148	37.87887	107.67137	verified
Avalanche mine	149	37.87325	107.66717	verified
Big Colorado mine	150	37.87691	107.64606	verified
King mine	152	37.87111	107.64408	verified
Natalie/Occidental mine	153	37.87676	107.64336	verified
Occidental mine	154	37.88094	107.63630	verified
Black Hawk mine	155	37.88220	107.63478	verified
South Fork mine #16	156	37.87679	107.60172	verified
South Fork mine #17	157	37.88140	107.59836	verified
Sunnyside Mill #1	158	37.88401	107.59107	verified
Midway tunnel	159	37.88543	107.59010	verified
Moonbeam mine	160	37.88090	107.58105	verified
Ransom mine, upper level	161	37.88409	107.57269	verified
Sunnyside “Mill-level tunnel” 1937-38	162	37.88140	107.56875	verified
Senator mine	163	37.88189	107.56742	verified
Sunnyside Eureka Mill	164	37.88123	107.56677	verified
Sunnyside Mill #2	165	37.87974	107.56627	verified
Winspear Smelter	166	37.87907	107.56586	verified
Protection mine	167	37.88082	107.56184	verified
Paradise mine	168	37.84263	107.76407	verified
Ruby Trust	169	37.84585	107.75141	verified
Freda mine	170	37.85004	107.74789	verified
Independence mine (Silverton quadrangle)	171	37.84469	107.73976	verified
Bonner mine	172	37.84437	107.73694	verified
Molly Gulch mine	173	37.84045	107.72521	verified
Magnet mine	174	37.85032	107.72485	verified
Liberty Bond Creek mine	175	37.84066	107.71395	verified
Brobdignad mine	176	37.84379	107.70975	verified
Zuni mine	177	37.83537	107.70652	verified
Irene mine	178	37.84170	107.70164	verified
Omaha mine	179	37.85391	107.68654	verified
Monarch	180	37.85914	107.68306	verified
May Day mine (synonym: Mayday)	181	37.84758	107.67863	verified
Anglo Saxon mine, upper level	182	37.85855	107.67843	verified
Anglo Saxon mine	183	37.85888	107.67687	verified
Yukon Mill	184	37.84923	107.67544	verified
Boston & Silverton Mill	185	37.84990	107.67545	verified
Yukon tunnel (Gold Hub)	186	37.84957	107.67499	verified
Lamont mine	187	37.85244	107.66298	verified

Table 1. Mines, mills, large mill-tailings deposits, and smelter sites listed by AML_MINE_ID number.—Continued

Name	AMLI_MINE_ID	Latitude	Longitude	Location verified
Uncle Sam mine	188	37.84905	107.65613	verified
Legal Tender mine (Howardsville quadrangle)	189	37.85299	107.58202	verified
Auburn tunnel	190	37.85891	107.58043	verified
Hamlet Mill	191	37.85206	107.57429	verified
Kittimack tailings	192	37.85822	107.57155	verified
Hamlet mine	193	37.84805	107.56993	verified
Kittimack Mill	194	37.85987	107.56930	verified
Forest Queen mine	195	37.86593	107.56509	verified
Ruby mine	196	37.84408	107.55797	verified
Occident tunnel	197	37.86834	107.54820	verified
Caledonia mine	198	37.86630	107.54443	verified
Gold Nugget mine	199	37.84178	107.54319	verified
Dewey mine	200	37.83983	107.54259	verified
Kittimack mine	201	37.86512	107.53659	verified
Esmeralda mine, lower level	202	37.84867	107.53273	verified
Esmeralda mine, upper level	203	37.84887	107.53113	verified
Golden Gate mine	204	37.81614	107.80257	verified
Ice Lake Mill	205	37.81240	107.78206	verified
Waco mine	206	37.82392	107.78391	verified
Burbank mine	207	37.81996	107.77184	verified
Ensle tunnel	208	37.81992	107.76531	verified
Black Diamond mine	209	37.82061	107.73250	verified
Molly group	210	37.81554	107.72538	verified
Coming Wonder	211	37.81595	107.67100	verified
Little Casino mine	212	37.81687	107.67011	verified
Kendrick-Gelder Smelter (Ross)	213	37.82024	107.66069	verified
Greene Smelter	214	37.81894	107.66061	verified
William Crooke Mill	215	37.82496	107.63784	verified
Blair Mountain tunnel	216	37.81978	107.63758	verified
Amy tunnel	217	37.82175	107.63323	verified
Aspen mine	218	37.82115	107.63117	verified
Silver Lake Mill #2	219	37.82629	107.62765	verified
Legal Tender mine (Silverton quadrangle)	220	37.81867	107.62731	verified
Mayflower Mill (S-D Mill)	221	37.82865	107.62743	verified
MearsWilfley Mill	222	37.82743	107.62699	verified
Valley Forge mine	223	37.82954	107.62447	verified
Ward and Shepard Mill	224	37.81927	107.62150	verified
Contention Mill	225	37.82748	107.61742	verified
Joseph Neff mine	226	37.82939	107.60647	verified
Pride of the West Mill [#2]	227	37.83362	107.59950	verified
Little Nation mine	228	37.82979	107.59935	verified
Union tunnel (Silver Star)	229	37.83847	107.59726	verified
Hidden Treasure mine	230	37.83007	107.59547	verified
Little Nation Mill	231	37.83684	107.59537	verified
Progressive mine	232	37.84348	107.59351	verified
Pride of the West Mill [#4] (Dixilyn, P&G, Howardsville, Silver Wing)	233	37.83698	107.59259	verified

Table 1. Mines, mills, large mill-tailings deposits, and smelter sites listed by AML_MINE_ID number.—Continued

Name	AMLI_MINE_ID	Latitude	Longitude	Location verified
Pride of the West Mill tailings	234	37.83966	107.59151	verified
Hemetite mine	235	37.82983	107.58736	verified
Smuggler mine	236	37.81994	107.58678	verified
Old Hundred Mill tailings	237	37.82357	107.58655	verified
Old Hundred Mill	238	37.82342	107.58522	verified
Old Hundred mine, Mill-level tunnel (3200 level)	239	37.82399	107.58427	verified
Green Mountain Mill	240	37.81978	107.58193	verified
Old Hundred mine, #2 level	241	37.82565	107.58171	verified
Vertex Mill	242	37.81775	107.58036	verified
Old Hundred mine, #5 level	243	37.82649	107.57999	verified
Emma mine	244	37.81803	107.57840	verified
Old Hundred mine, #7 level (new)	245	37.82923	107.57581	verified
Old Hundred mine, #7 level (old)	246	37.83025	107.57502	verified
Veta Madre tunnel	247	37.82631	107.57101	approx.
Gary Owen mine	248	37.82014	107.56677	verified
Antiperiodic mine	249	37.81857	107.56055	verified
Big Ten mine	250	37.82317	107.55893	verified
Ridgeway mine	251	37.83115	107.55216	verified
Little Maud mine	252	37.83234	107.53684	verified
Diamond mine (Ophir quadrangle)	253	37.80311	107.81913	verified
Lucy mine	254	37.80636	107.81780	verified
Kinney tunnel	255	37.80466	107.78597	verified
Copper Gulch mine	256	37.80528	107.74674	verified
Silverheel mine	257	37.81159	107.70637	verified
Belcher mine	258	37.79613	107.69243	verified
North Star (Sultan), #4 level	259	37.80423	107.68652	verified
Columbine mine	260	37.81148	107.68538	verified
North Star (Sultan), #6 level	261	37.80596	107.68335	verified
Blanchard placer	262	37.80891	107.68334	verified
North Star (Sultan), #7 level	263	37.80718	107.68160	approx.
North Star (Sultan) Mill	264	37.80729	107.68037	verified
Sultan tunnel	266	37.80299	107.67956	verified
Victoria Mill	267	37.80853	107.67810	verified
Victoria mine	268	37.80917	107.67664	verified
Blue Jay mine	269	37.79749	107.67542	verified
Ricker tunnel	270	37.79817	107.67482	verified
Ajax tunnel	271	37.80043	107.67475	verified
Gladstone mine	272	37.79947	107.67853	verified
Little Dora mine	273	37.79777	107.67451	verified
Jenny Parker mine	274	37.79519	107.67418	verified
Martha Rose Smelter	275	37.80822	107.67485	verified
Empire tunnel	276	37.80124	107.67238	verified
Hercules Mill (Empire)	277	37.80231	107.67167	verified
Diamond mine (Silverton quadrangle)	278	37.79727	107.67044	verified
Ideal placer	279	37.79413	107.66934	verified
Marcella mine	280	37.79513	107.66512	verified
Kendall Lode	281	37.79820	107.66075	verified

Table 1. Mines, mills, large mill-tailings deposits, and smelter sites listed by AML_MINE_ID number.—Continued

Name	AMLI_MINE_ID	Latitude	Longitude	Location verified
Rough & Ready Smelter	282	37.81347	107.66039	verified
Idaho mine	283	37.80241	107.65918	approx.
Clara mine	284	37.79788	107.65827	verified
Mighty Monarch mine	285	37.80804	107.65687	verified
Lackawanna tailings (removed)	286	37.81447	107.65173	verified
Lackawanna Mill	287	37.81409	107.65163	verified
Lackawanna mine	288	37.80956	107.64713	approx.
Last Chance mine	289	37.81265	107.64501	verified
Scranton City mine	290	37.80265	107.64069	verified
Happy Jack mine	291	37.80361	107.62894	verified
Nevada mine, upper level	292	37.80021	107.62182	verified
Nevada mine, lower level	293	37.80000	107.62067	verified
Unity tunnel level of Silver Lake mine	294	37.80174	107.61850	verified
Grey Eagle mine	295	37.81315	107.61859	verified
New York mine	296	37.79800	107.61758	verified
Iowa Mill	297	37.81289	107.61569	verified
Ezra R mine	298	37.81140	107.61610	verified
Little Giant Mill	299	37.81399	107.61605	verified
Last Chance tunnel	300	37.80245	107.61486	verified
Argentine tunnel	301	37.81076	107.61493	verified
Jess mine	302	37.81265	107.61282	verified
Little Giant mine	303	37.81319	107.61178	approx.
Mayflower mine (S-D mine, main level)	304	37.80624	107.60891	verified
Black Prince tunnel	305	37.81145	107.60475	verified
King Solomon mine	306	37.81338	107.60303	verified
Big Giant Mill	307	37.80802	107.60219	verified
Big Giant mine	308	37.80767	107.60209	verified
North Star Mill [#1]	309	37.80492	107.59899	verified
North Star Mill tailings	310	37.80587	107.59897	verified
Gold Lake mine	311	37.80681	107.59886	verified
Potomac mine	312	37.80347	107.59861	verified
Galena Mountain group	313	37.81312	107.57875	verified
Lawrence tunnel (Osceola mine)	314	37.81109	107.57758	verified
Green Mountain mine, lower level	315	37.80084	107.57709	verified
Pride of the West Mill [#3]	316	37.80754	107.57700	verified
Green Mountain mine, middle level	317	37.80014	107.57621	verified
Pride of the West Mill [#1]	318	37.80782	107.57617	verified
Pride of the West mine, #1 level	319	37.80755	107.57616	verified
Compromise tunnel	320	37.81033	107.57578	verified
Green Mountain mine, upper level	321	37.80101	107.57143	approx.
Little Fanney mine	322	37.80170	107.57123	verified
Oyama tunnel	323	37.80189	107.55642	verified
Old Abe mine	324	37.80334	107.55484	verified
Buffalo Boy mine	325	37.80960	107.55366	verified
Mastodon mine (Howardsville quadrangle)	326	37.80925	107.54527	verified
Queen of Maggie mine	327	37.81251	107.53838	verified
Intersection Mill	328	37.81326	107.53584	verified

Table 1. Mines, mills, large mill-tailings deposits, and smelter sites listed by AML_MINE_ID number.—Continued

Name	AMLI_MINE_ID	Latitude	Longitude	Location verified
Iron Mask mine	329	37.81321	107.53572	verified
Rolling Mountain mine	330	37.77659	107.82640	verified
Big Three mine	331	37.77999	107.82088	verified
Bandora mine	332	37.78699	107.80130	verified
Putnam Basin mine	333	37.77791	107.74216	verified
Deadwood Gulch mine	334	37.78238	107.69139	verified
Champion mine, #3 level	335	37.78824	107.67347	verified
Champion mine, #4 level	336	37.78940	107.67179	verified
Alletha mine	337	37.78584	107.67067	verified
Turk tunnel	338	37.78031	107.66935	verified
Pittsburg tunnel, Champion mine	339	37.78993	107.66945	verified
Fairview mine	340	37.78844	107.66935	verified
King tunnel	341	37.77972	107.66627	verified
Titusville mine	342	37.78552	107.61939	verified
Silver Lake mine, #1 level	343	37.79200	107.60969	verified
Buckeye mine	344	37.78338	107.60857	verified
Iowa mine	345	37.78979	107.60784	verified
Melville mine	346	37.78925	107.60772	verified
Silver Lake Mill #1	347	37.79164	107.60714	verified
Royal Tiger mine	348	37.78824	107.60337	verified
Terrible mine	349	37.79769	107.60021	verified
North Star (Solomon) mine, #4 level (S-D 1700 level)	350	37.79888	107.59865	verified
North Star (Solomon) mine, #5 level	351	37.79674	107.59661	verified
Dives mine	352	37.79426	107.59394	verified
Spotted Pup tunnel	353	37.79330	107.59080	verified
Shenandoah tunnel	354	37.79144	107.58945	verified
Shenandoah-Dives mine, 900 level	355	37.79381	107.58910	verified
Mountaineer mine (Highland Mary, #1 level)	356	37.78402	107.58428	verified
Trilby tunnel	357	37.78940	107.58431	verified
Bradley tunnel	358	37.78543	107.58182	verified
Highland Mary, #7 level	359	37.78263	107.58064	verified
Innis tunnel (Highland Mary, #8 level)	360	37.78759	107.57857	verified
Highland Mary Mill tailings	361	37.78940	107.57813	verified
Molas group	362	37.76248	107.67508	verified
Mabel group	363	37.76313	107.63738	verified
Montana mine	364	37.76889	107.62659	verified
Little Ray mine	365	37.77198	107.62476	verified
Upper Aspen mine	500	37.81618	107.62341	verified
Thunder tunnel	501	37.78637	107.66888	verified
Highland Mary Mill	502	37.78740	107.57761	verified
Sioux City	503	37.89963	107.54390	verified
Ransom mine	504	37.88275	107.57682	verified
Henrietta mine, #8 level	505	37.89174	107.68185	verified
Henrietta mine, #9 level	506	37.88954	107.67850	verified

Table 1. Mines, mills, large mill-tailings deposits, and smelter sites listed by AML_MINE_ID number.—Continued

Name	AMLI_MINE_ID	Latitude	Longitude	Location verified
Mayflower Mill tailings repository # 1	507	37.82761	107.63177	verified
Mayflower Mill tailings repository # 2	508	37.82624	107.63609	verified
Mayflower Mill tailings repository # 3	509	37.82400	107.63794	verified
Mayflower Mill tailings repository # 4	510	37.82040	107.64553	verified
Mine with unknown name	511	37.85992	107.68346	verified

Table 2. Mine sites listed alphabetically.

[Numbers refer to locations in figures 2–4; synonyms where referenced are from the data tables in Wilson (2003), MAS data from the former U.S. Bureau of Mines, and MRDS data from the U.S. Geological Survey (McFaul and others, 2000); S-D, Shenandoah-Dives]

Name	AMLI_MINE_ID	Synonyms	Reference
Adams mine	100		
Adelphin mine	112		
Adit with unknown name	21		
Adit with unknown name	68		
Ajax tunnel	271	Montezuma, Boston tunnel	
Alletha mine	337	Alethea group	MAS
American tunnel, Sunnyside mine	96	Gold King Mill-level tunnel	
Amy tunnel	217		
Anglo Saxon mine	183		
Anglo Saxon mine, upper level	182		
Antiperiodic mine	249		
Argentine tunnel	301	Iowa tunnel	
Aspen mine	218		
Auburn tunnel	190	Auburn group	MAS
Avalanche mine	149		
Bandora mine	332		
Bavarian mine	119		
Belcher mine	258		
Belle Creole mine	115		
Ben Butler mine	9		
Ben Franklin mine	118		
Ben Franklin prospect	117		
Benitoite mine	110		
Big Colorado mine	150		
Big Giant mine	308		
Big Ten mine	250		
Big Three mine	331		
Black Diamond mine	209		
Black Hawk mine	155		
Black Prince tunnel	305		
Blair Mountain tunnel	216		
Blanchard placer	262		
Blue Jay mine	269		
Bonner mine	172		
Boston mine	3		
Bradley Pit	74		
Bradley tunnel	358		
Brenneman mine	39		

Table 2. Mine sites listed alphabetically.—Continued

Name	AMLI_MINE_ID	Synonyms	Reference
Brobdignad mine	176	Bobdignad mine	Munson (1889)
Brooklyn mine	141		
Buckeye mine	344		
Buffalo Boy mine	325		
Burbank mine	207		
Burns group	92		
Burrows mine	16		
Caledonia mine	198	Caldonian mine	MAS
Carbon Lake mine	80		
Champion mine, #3 level	335	Mystery Gold group	
Champion mine, #4 level	336		
Chattanooga Curve mine	135		
Clara mine	284		
Clipper mine	114		
Columbia mine	37		
Columbine mine	260		
Columbus mine	23		
Coming Wonder	211	Emerald mine	
Compromise tunnel	320		
Congress mine	79		
Copper Gulch mine	256		
Corkscrew Pass mine	29		
Custer mine	50		
Deadwood Gulch mine	334		
Dewey mine	200		
Dewitt mine	4		
Diamond mine (Ophir quadrangle)	253		
Diamond mine (Silverton quadrangle)	278		
Dives mine	352		
Eagle Chief mine	14		
Early Bird crosscut	8	Paris mine	
Elk tunnel	147		
Emma mine	244	Oregon and Galena mine	MAS
Empire tunnel	276	Little Dora, Hercules mine	
Ensle tunnel	208		
Esmeralda mine, lower level	202		
Esmeralda mine, upper level	203		
Eveline mine	91		
Evening Star mine	58		
Ezra R mine	298		
Fairview mine	340		
Ferricrete mine	137		
Forest Queen mine	195		
Freda mine	170		
Fredericka group	127		
Frisco tunnel	19		
Galena Mountain group	313		
Galena Queen mine	82		
Galty Boy mine	90	Galtie Boy, Hercules mine	MAS and MRDS
Gary Owen mine	248	Gary Owens mine	MAS
George Washington mine	40		

Table 2. Mine sites listed alphabetically.—Continued

Name	AMLI_MINE_ID	Synonyms	Reference
Gladstone mine	272		
Gold Finch group	140		
Gold King mine, #1 level	111		
Gold King mine, #7 level	103		
Gold King mine, Paul level	109		
Gold King mine, Sampson level	104		
Gold King mine, upper Sampson level	105		
Gold Lake mine	311	McMillan mine	
Gold Nugget mine	199		
Gold Prince mine	49	Sunnyside Extension, Mastedon mine	MRDS
Golden Fleece mine	60		
Golden Gate mine	204		
Grand Mogul	35		
Grand Mogul Stope Complex	33		
Grey Eagle mine	295		
Great Eastern	128	Sioux City	MRDS
Green Mountain mine, lower level	315		
Green Mountain mine, middle level	317		
Green Mountain mine, upper level	321	Philadelphia mine	
Hamlet mine	193		
Happy Jack mine	291		
Hemetite mine	235		
Henrietta mine, #3 level	84		
Henrietta mine, #7 level	85	Mineral King	
Henrietta mine, #8 level	505		
Henrietta mine, #9 level	506		
Hercules mine	83		
Hermes group	11		
Hidden Treasure mine	230		
Highland Mary, #7 level	359		
Hoosier Boy mine	146		
Idaho mine	283		
Ideal placer	279		
Imogene mine	136		
Independence mine (Handies Peak quadrangle)	48		
Independence mine (Silverton quadrangle)	171		
Indian Chief mine	45		
Innis tunnel	360	Highland Mary, #8 level	
Iowa mine	345		
Irene mine	178		
Iron Mask mine	329		
Jenny Parker mine	274	Jennie Parker mine	MAS
Jess mine	302	Peerless mine	
Joe and Johns mine	87		
Joseph Neff mine	226		
JSP mine	81		
Junction mine	76		
Kansas City mine, #1 level	145		
Kendall Lode	281		
King mine	152		

Table 2. Mine sites listed alphabetically.—Continued

Name	AMLI_MINE_ID	Synonyms	Reference
King Solomon mine	306		
King tunnel	341		
Kinney tunnel	255		
Kittimack mine	201	Kittimac mine	MRDS
Klondyke mine	130		
Koehler tunnel	75		
Lackawanna mine	288		
Lake mine	43		
Lake Parson mine	121		
Lamont mine	187		
Lark mine	86		
Last Chance mine	289		
Last Chance tunnel	300		
Lawrence tunnel	314	Osceola mine	
Lead Carbonate mine	106		
Legal Tender mine (Howardsville quadrangle)	189		
Legal Tender mine (Silverton quadrangle)	220		
Liberty Bond Creek mine	175		
Little Casino mine	212		
Little Chief mine	5		
Little Dora mine	273		
Little Fanney mine	322		
Little Giant mine	303		
Little Ida mine	15		
Little Maud mine	252	Little Maude mine	MAS
Little Nation mine	228	Royal Charter mine	MRDS
Little Ray mine	365		
London mine	7		
Longfellow mine	77		
Lower Browns Gulch mine	139		
Lower Bullion King mine	70		
Lower Great Eastern	129		
Lower Porphyry Gulch mine	72		
Lower Ross Basin mine	36		
Lucky Jack mine	13		
Lucy mine	254	Last Hope mine	MRDS
Mabel group	363	Maybell	Munson (1889)
Magnet mine	174		
Mammoth tunnel	148		
Marcella mine	280	Marcello mine	MRDS
Mastodon mine (Handies Peak quadrangle)	47		
Mastodon mine (Howardsville quadrangle)	326		
May Day mine	181	Mayday	
Mayflower mine	304	S-D mine, main level	
Melville mine	346		
Midway tunnel	159		
Mighty Monarch mine	285		
Mine with unknown name (Silverton quadrangle)	511		
Mineral Basin mine	71		
Minnehaha mine	107		

Table 2. Mine sites listed alphabetically.—Continued

Name	AMLI_MINE_ID	Synonyms	Reference
Minnesota Gulch mine	144		
Mocking Bird mine	108		
Mogul mine	31		
Mogul North mine	32		
Mogul South mine	30		
Molas group	362	Ione mine, Molas mine	MRDS
Molly group	210		
Molly Gulch mine	173		
Monarch	180		
Montana mine	364		
Moonbeam mine	160		
Mountain Queen mine	41		
Mountain Queen tunnel	42		
Mountaineer mine	356	Lookout mine, Old Highland Mary mine, #1 level	
Natalie/Occidental mine	153	Silver Ledge mine	
Nevada mine, lower level	293		
Nevada mine, upper level	292		
New York mine	296		
North Star (Solomon) mine, #4 level (S-D 1700 level)	350	King Soloman mine	
North Star (Solomon) mine, #5 level	351	King Soloman mine	
North Star (Sultan), #4 level	259	Sultan mine	
North Star (Sultan), #6 level	261	Sultan mine	
North Star (Sultan), #7 level	263	Sultan mine	
Occident tunnel	197		
Occidental mine	154		
Old Abe mine	324		
Old Hundred mine, #2 level	241		
Old Hundred mine, #5 level	243	Old Hundred mine, 2600 level	
Old Hundred mine, #7 level (new)	245		
Old Hundred mine, #7 level (old)	246		
Old Hundred mine, Mill-level tunnel (3200 level)	239		
Omaha mine	179		
Oyama tunnel	323		
Paradise mine	168	Governor mine, Paradise portal	
Pittsburg tunnel, Champion mine	339		
Potomac mine	312		
Prairie mine	10		
Pride of Bonita mine	101		
Pride of the West mine (#1 level)	319		
Progressive mine	232		
Protection mine	167		
Putnam Basin mine	333		
Queen Anne mine	34		
Queen of Maggie mine	327		
Ransom mine	504		
Ransom mine, upper level	161		
Red and Bonita mine	99		
Red Cloud mine	1		
Ricker tunnel	270		
Ridgeway mine	251		

Table 2. Mine sites listed alphabetically.—Continued

Name	AMLI_MINE_ID	Synonyms	Reference
Riverside mine	12		
Rolling Mountain mine	330		
Royal Tiger mine	348		
Ruby mine	196		
Ruby Trust	169		
Salomon group	102		
San Juan Queen mine	61		
Sandiago tunnel	62		
Scotia mine	59		
Scranton City mine	290		
Senator mine	163		
Sewell mine	2		
Shenandoah tunnel	354		
Shenandoah-Dives mine, 900 level	355		
Silver Bell mine	126		
Silver Chord mine	44		
Silver Cloud mine	132		
Silver Coin mine	22		
Silver Crown mine	133		
Silver King mine	134		
Silver Lake mine, #1 level	343		
Silver Ledge mine	73		
Silver Queen mine	53		
Silver Wing mine	125		
Silverheel mine	257		
Sioux City	503		
Smuggler mine	236		
Sound Democrat mine	54		
South Fork mine #16	156		
South Fork mine #17	157		
Spotted Pup tunnel	353	S-D mine, 1100 level, Dives-Shenandoah mine	
St. Paul mine	78		
Sultan tunnel	266		
Sunbank group, lower level	57		
Sunbank group, upper level	56		
Sunnyside “Mill-level tunnel”	162		
Sunnyside Extension	46		
Sunnyside mine	116		
Terrible mine	349		
Terry tunnel of Sunnyside mine, F level	120		
Thunder tunnel	501		
Titusville mine	342		
Toltec mine, lower level	67		
Toltec mine, middle level	65		
Toltec mine, upper level	64		
Tom Moore #1, 2	123		
Tom Moore tunnel	122		
Trilby tunnel	357		
Turk tunnel	338	King mine	
U.S. Basin mine	143		

Table 2. Mine sites listed alphabetically.—Continued

Name	AMLI_MINE_ID	Synonyms	Reference
Uncle Sam mine	188		
Uncompahgre Chief mine	6		
Union tunnel	229	Silver Star mine	
Unity tunnel level of Silver Lake mine	294		
Upper Aspen mine	500		
Upper Browns Gulch	142		
Upper Bullion King	69		
Upper Joe and Johns mine	89		
Upper Mill Creek mine	131		
Upper Queen Anne mine	38		
Valley Forge mine	223		
Vermillion mine	17		
Vermillion tunnel	18		
Veta Madre tunnel	247	Neigold mine	
Victoria mine	268		
Waco mine	206		
Webster mine	88		
Yukon tunnel	186	Gold Hub, Ariadne	MRDS
Zuni mine	177		

Table 3. Mills, large mill-tailings deposits, and smelter sites[1].

[Numbers refer to locations in figure 5; some mills located at the same sites were not originally numbered; we have added numbers in brackets for clarity]

Name	AMLI_MINE_ID
Mills	
Bagley Mill (Frisco)	20
Big Giant Mill	307
Boston & Silverton Mill	185
Columbus Mill	24
Contention Mill (Arpad/North Star [#2])	225
Gold King Mill	94
Gold Prince Mill	27
Green Mountain Mill	240
Hamlet Mill	191
Hanson Mill (Sunnyside Extension Mill)	51
Hercules Mill (Empire)	277
Highland Mary Mill	502
Ice Lake Mill	205
Intersection Mill	328
Iowa Mill	297
Kittimack Mill	194
Lackawanna Mill	287
Lead Carbonate Mill	95
Little Giant Mill	299
Little Nation Mill	231
Mastodon Mill	52
Mayflower Mill (Shenandoah Dives Mill)	221

Table 3. Mills, large mill-tailings deposits, and smelter sites[1].—Continued

Name	AMLI_MINE_ID
Mills—Continued	
Mears-Wilfley Mill	222
Mogul Mill	93
Natalie/Occidental Mill	151
North Star (Sultan) Mill	264
North Star Mill #1	309
Old Hundred Mill	238
Pride of the West Mill [#1]	318
Pride of the West Mill [#2]	227
Pride of the West Mill [#3]	316
Pride of the West Mill [#4] (Dixilyn, P&G, Howardsville, Silver Wing)	233
Red and Bonita Mill	97
Silver Lake Mill #1	347
Silver Lake Mill #2	219
Silver Ledge Mill	138
Silver Wing Mill	124
Sound Democrat Mill	55
Sunnyside Eureka Mill	164
Sunnyside Mill #1	158
Sunnyside Mill #2	165
Sunnyside-Thompson Mill	113
Treasure Mountain Mill	63
Vertex Mill	242
Victoria Mill	267
Ward and Shepard Mill	224
William Crooke Mill	215
Yukon Mill	184
Mill-tailings deposits	
Highland Mary Mill tailings	361
Kittimack tailings	192
Lackawanna tailings (removed)	286
Mayflower Mill tailings repository # 1	507
Mayflower Mill tailings repository # 2	508
Mayflower Mill tailings repository # 3	509
Mayflower Mill tailings repository # 4	510
North Star Mill tailings	310
Old Hundred Mill tailings	237
Pride of the West Mill tailings	234
Smelters	
Animas Forks Smelter	26
Brown, Epley & Co. Smelter	28
Eclipse Smelter	66
Greene Smelter	214
Kendrick-Gelder Smelter (Ross)	213
Martha Rose Smelter	275
Rough & Ready Smelter	282
Winspear Smelter	166

[1]Additional data on mills and smelters are in Jones (this volume).

Table 4. Physical parameters that may contribute to the environmental effect of historical mines.

[Volume of mine waste estimated in cubic yards, yd^3; size, distance originally in feet, converted to meters, m, or square meters, m^2; Ref.=footnote; blank, no data]

AMLI_MINE_ID	NAME	Ref.	No. shafts	No. adits	No. of flowing adits	Adit drainage flows over mine waste dump	Kill zone	Volume of mine waste yd^3	Size of disturbed area m^2	Distance to stream m
100	Adams mine	2	0	1	0	no	yes	800	1,000	320
271	Ajax tunnel	5				yes	no			
217	Amy tunnel	4	0	1	1	yes	no	20,000		
183	Anglo Saxon mine	2	0	1	1	yes	no	2,200	870	50
249	Antiperiodic mine	4	0	2	0	no	no		2,900	in stream
301	Argentine tunnel	4	0	1	1					
218	Aspen mine	4	0	5?	1				2,700	
190	Auburn tunnel	4	0	1	1	yes	no	3,100	1,100	340
332	Bandora mine	1		9	4	yes	yes	5,500	5,700	97
119	Bavarian mine	4	0	1	1	yes	no	2,100	300	180
9	Ben Butler mine	3	2	0	0	no	yes	400–600	1,400	410
118	Ben Franklin mine	4	1	1	0	no	yes	500	1,500	in stream
117	Ben Franklin prospect	4	0	1	1	yes	no	250	290	140
150	Big Colorado mine	2	0	1	1	no	no	27,000	2,100	45
155	Black Hawk mine	2	0	2	2	yes	no	12,000	610	67
305	Black Prince tunnel	4	0	1	1	yes	no		770	42
216	Blair Mountain tunnel	4	0	1	1					
172	Bonner mine	1		5	2	yes	yes	24,500	3,300	in stream
3	Boston mine	3	1	1	0	yes	yes	900	2,700	180
358	Bradley tunnel	4	0	1	1	yes	yes		3,900	in stream
39	Brenneman mine	2	2	0	0	no	yes	1,800		
141	Brooklyn mine	1		1	1	yes	yes		15,000	50 260
325	Buffalo Boy mine	4	0	1	1	yes	yes	7,000	2,400	in stream
207	Burbank mine	5				yes	yes		2,200	in stream
16	Burrows mine	3	1	2	2	yes	yes	3,400	850	
198	Caledonia mine	4	0	3	0	no	no		2,300	480
80	Carbon Lake mine	1	3	0		no	yes	4,000		
335	Champion mine, #3 level	4	0	1	1					
336	Champion mine	4	0	1	1				1,500	270
114	Clipper mine	4	1	1	0	no	yes	1,100	370	190
37	Columbia mine	2	5	1	0	yes	yes	6,500		
24	Columbus Mill	3								
23	Columbus mine	3	0	1	1	yes	yes	24,000	2,500	39
320	Compromise tunnel	5	0	1	0	no	no		3,900	28
79	Congress mine	5	1			no	yes		1,400	19
29	Corkscrew Pass mine	2	0	1	0	no	no	1,300	100	
14	Eagle Chief mine	3	0	1	0	no	yes	1,500	280	100
8	Early Bird crosscut	3	0	2	1	yes		2,900	1,700	160
66	Eclipse Smelter	5	0	0	0	no		300		
147	Elk tunnel	2	0	1	1	yes	no	1,100	650	50
244	Emma mine	4	0	1	1					
276	Empire tunnel	5				yes	no			
202	Esmeralda mine, lower level	4	0	1	1					
203	Esmeralda mine, upper level	4	0	1	0					
91	Eveline mine	2	0	1	1	yes	no		250	215
298	Ezra R mine	4	0	1	1	yes				
137	Ferricrete mine	1	0	1	1					
19	Frisco tunnel	3	0	1	1	no	yes	20,500		
82	Galena Queen mine	2	1	0	0	no	yes	7,200	4,400	in stream
90	Galty Boy mine	2	0	1	0	no	no	1,000	680	566
248	Gary Owen mine	4	0	1	0	no	no			

Table 4. Physical parameters that may contribute to the environmental effect of historical mines.—Continued

AMLI_MINE_ID	NAME	Ref.	No. shafts	No. adits	No. of flowing adits	Adit drainage flows over mine waste dump	Kill zone	Volume of mine waste yd^3	Size of disturbed area m^2	Distance to stream m
272	Gladstone mine	5				no	yes		3,500	340
103	Gold King mine, #7 level	5				no	no		small	in stream
60	Golden Fleece mine	3	0	1	1	yes	yes	6,500	4,100	
35	Grand Mogul	2	0	1	1	yes	yes	9,000	2,200	45
33	Grand Mogul Stope Complex	2	0	1	0	no	yes	8,000	1,400	26
240	Green Mountain Mill (Buffalo Boy tailings)	4				no	no	400	1,500	71
315	Green Mountain mine, lower level	4	0	2	1	yes	no		3,300	115
193	Hamlet mine	4	0	6	1	yes	no	10,700	2,000	
84	Henrietta mine, #3 level	2	0	1	0	yes	yes	<2,000	3,500	500
85	Henrietta mine, #7 level	2	0	1	1	yes	yes	30,000	4,800	in stream
505	Henrietta mine, #8 level	2	0	1	1	no	yes		5,600	in stream
506	Henrietta mine, #9 level	2	0	1	0			700		
83	Hercules mine	2	1	0	0	no	yes	4,680	3,500	in stream
11	Hermes Group	5	0	2	0	no	yes	1,300		
230	Hidden Treasure mine	4	0	1	1	yes	no			
359	Highland Mary mine, #7 level	5				no	no		1,900	18
361	Highland Mary Mill tailings	4				no	no	35,000	5,800	in stream
283	Idaho mine	4	0	1	1	no	no		1,400	
136	Imogene mine	1		1	1	yes	yes		520	in stream
171	Independence mine (Silverton quadrangle)	5				yes	no		470	in stream
45	Indian Chief mine	3	0	2	1	yes	yes	400	860	
360	Innis tunnel	4	0	1	1	yes	no			
297	Iowa Mill	4				no	no	500		
345	Iowa mine, A-level	4	0	4	2	yes	no	27,000	18,000	70
329	Iron Mask mine	4	1	1	0				720	in stream
274	Jenny Parker mine	5				no	no		1,500	365
302	Jess mine	4	0	1	1					
87	Joe and Johns mine	2	0	1	1	no	yes		1,040	110
226	Joseph Neff mine	4	0	1	1					
81	JSP mine	2	0	1	0	no	yes	300		
145	Kansas City mine, # 1 level	2	0	5	2	yes	yes	8,500	2,000	180
306	King Solomon mine	4	0	1	1	no	no		950	130
201	Kittimack mine	4	0	many	1	yes	no	7,850	1,200	210
192	Kittimack tailings	4				no	no	23,000	35,000	67
75	Koehler tunnel	1	3	1		no, piped	yes	15,000 to repository		
86	Lark mine	2	0	1	1	no	no	3,500	2,660	216
289	Last Chance mine	4	0	1	1	yes	no		500	
106	Lead Carbonate mine	2	0	many	0	no	yes	3,500	2,500	in stream
189	Legal Tender mine (Howardsville quadrangle)	4	0	2	2	yes	no	1,700		
212	Little Casino mine	4	0	1	1	yes	no		430	>1,000
5	Little Chief mine	3	0	1	1	yes	yes	700		
15	Little Ida mine	3	0	6	4	yes	yes	1,100		
252	Little Maud mine	4	0	1	1					
228	Little Nation mine	4	0	3	1					

Table 4. Physical parameters that may contribute to the environmental effect of historical mines.—Continued

AMLI_MINE_ID	NAME	Ref.	No. shafts	No. adits	No. of flowing adits	Adit drainage flows over mine waste dump	Kill zone	Volume of mine waste yd^3	Size of disturbed area m^2	Distance to stream m
7	London mine	3	1	4	3	yes	yes	3,300	2,700	in stream
77	Longfellow mine	1	1	2		yes	yes	5,500		
70	Lower Bullion King	5				no	yes		3,500	in stream
129	Lower Great Eastern	5		3		no	no	5,000		
36	Lower Ross Basin mine	2	0	1	0	no	yes	900		
13	Lucky Jack mine	3	2	2	1	yes	yes	2,800	2,800	in stream
148	Mammoth tunnel	2	0	1	1	no	no	<100	590	100
280	Marcella mine	5		1	1					
221	Mayflower Mill (S-D Mill)	5				no	yes	750		
159	Midway mine	5	0	1	1	yes	no		5,900	40
285	Mighty Monarch mine	4	0	1	1					
31	Mogul mine	2	1	1	1	yes	yes	25,000	4,700	63
32	Mogul North mine	2	0	1	0	no	no	400	310	19
30	Mogul South mine	2	0	1	1	no	no	800	380	86
180	Monarch	2	0	1	1	yes	no		1,200	in stream
160	Moonbeam mine	4	0	1	1	yes	no	1,000	small	
41	Mountain Queen mine	3	1	0	0	no	yes	1,900	2,200	576
42	Mountain Queen tunnel	3	0	1	1	yes	yes	3,200	215	
153	Natalie/Occidental mine	2	0	1	1	yes	yes	6,800	1,500	in stream
310	North Star Mill tailings	5				no	no			
259	North Star mine, #4 level (Sultan)	1		4	0		no			
261	North Star mine, #6 level (Sultan)	1		1	0	no	no	3,500	7,100	237
263	North Star mine, #7 level (Sultan)	1		1	1	no	yes	40,000	15,000	in stream
154	Occidental mine	2	0	1	0	no	no	1,000	920	in stream
237	Old Hundred Mill tailings	5				no	no	400	2,000	in stream
239	Old Hundred mine, Mill-level tunnel	4		many	1			400		
323	Oyama tunnel	4	0	1	1	no	no			
168	Paradise mine	1		4	4	yes	yes	700		
182	Porcupine Gulch adit (sublevel, Anglo Saxon mine)	2	0	1	1	no	no	1,600		
10	Prairie mine	3	0	1	1			600		
227	Pride of the West Mill [#2]	4				no	no	1,200		
233	Pride of the West Mill [#4] (Dixilyn, P&G, Howardsville, Silver Wing)	4						large, permitted		
319	Pride of the West mine	4	0	1	1					
232	Progressive mine	4	0	1	1	yes	no		3,000	
167	Protection mine	3	0	1	0	no	no	20,000	2,200	210
34	Queen Anne mine	2	0	1	1	yes	no	5,000	380	86
327	Queen of Maggie mine	4	0	1	1					
504	Ransom mine	4		1	1					
99	Red and Bonita mine	2	0	2	1	no	yes	6,000	1,100	200
1	Red Cloud mine	3	4	1	0	no	yes	3,000	630	310
270	Ricker tunnel	5				no	yes		1,100	330
251	Ridgeway mine	5	0	1	1					
12	Riverside mine	3	0	1	1	yes	yes	<100		
348	Royal Tiger mine	4	0	3	1	yes	yes	18,000	7,300	in stream
169	Ruby Trust	1		1	1	yes	yes	5,000–6,000		
62	Sandiago tunnel	3	0	1	1	no	no	9,000	2,100	

Table 4. Physical parameters that may contribute to the environmental effect of historical mines.—Continued

AMLI_MINE_ID	NAME	Ref.	No. shafts	No. adits	No. of flowing adits	Adit drainage flows over mine waste dump	Kill zone	Volume of mine waste yd^3	Size of disturbed area m^2	Distance to stream m
163	Senator mine	3	0	1	1	yes	no	4,000	440	190
355	Shenandoah-Dives mine, 900 level	4	0	1	1			0		
126	Silver Bell mine	3	0	1	0	no	yes	1,900	250	80
133	Silver Crown mine	5				no	no			
347	Silver Lake Mill #1	4				no	no	50,000	11,000	
343	Silver Lake mine, #1 level	4	0	1	0					
53	Silver Queen mine	3	1	2	2	yes	yes	15,000		375
125	Silver Wing mine	3	0	1	1	no	yes	10,000	4,900	
503	Sioux City	3	0	4	0	no		5,000	1,600	122
236	Smuggler mine	4	0	1	1					
54	Sound Democrat mine	3	0	2	1	yes	yes	14,000	590	220
156	South Fork mine #16	5	0	1	1	yes	yes	2,000		
157	South Fork mine #17	5	0	1	1	yes	yes	400		
353	Spotted Pup tunnel	5				no	no		400	>1,000
164	Sunnyside Eureka Mill	4						12,000	3,500	in stream
165	Sunnyside Mill #2	5				no	yes			
116	Sunnyside mine	4	1	0	0	no	no	60,000	10,000	333
67	Toltec mine, lower level	3	0	1	1	yes	no	3,800	530	19
123	Tom Moore mine	3	0	1	1	yes	no	4,000	750	in stream
21	unnamed adit	3	1	2	0	no	yes	1,200		
229	Union tunnel	4	0	1	1					
294	Unity tunnel, Silver Lake mine	4	0	2	0	yes	no	35,000	900	in stream
142	Upper Browns Gulch	1		1	1	yes	yes			
69	Upper Bullion King	5				no	no		330	1
89	Upper Joe and Johns mine	2	0	1	0	no	yes		<100	470
38	Upper Queen Anne mine	2	0	1	0			900	500	560
223	Valley Forge mine	4	0	1	1					
17	Vermillion mine	3	0	1	1	yes	yes	5,100	1,100	in stream
18	Vermillion tunnel	3	0	1	1	yes	no	10,800	2,700	
186	Yukon tunnel	2	0	1	1	yes	yes	18,000	6,200	in stream

[1]Ref.: Unpub. Mineral Creek feasibility investigation report, (CDMG, 1997); Unpub. abandoned mine land inventory report, San Juan Forest, Columbine district, CGS, 1997.

[2]Ref.: Unpub. Cement Creek reclamation feasibility report, CDMG, 1998.

[3]Ref.: Unpub. Upper Animas River reclamation feasibility report, CDMG, 1999.

[4]Ref.: Unpub. Lower Animas River reclamation feasibility report, CDMG, 2000.

[5]Ref.: Unpub. report to Colorado Water Quality Control Commission, ARSG, 2001.

Table 5. Adit chemistry determined at low flow for selected sites sampled by State of Colorado.

[Adit flow in cubic feet/second, ft^3/s; all samples were filtered at 0.45 micrometers, concentrations expressed in milligrams per liter, mg/L; or in micrograms per liter, µg/L; n.d., not detected; all methods and data are in the database (Sole and others, this volume). "Reference" column refers to the footnote number]

AMLI_MINE_ID	Name	Date	Sample designation	Reference	Discharge ft^3/s	pH	Specific conductance µS/cm	Sulfate mg/L	Na mg/L	K mg/L	Mg mg/L	Ca mg/L	Al µg/L	Fe µg/L	Mn µg/L	Cu µg/L	Ni µg/L	Zn µg/L	Cd µg/L	Pb µg/L
5	Little Chief mine	9/1/97	DM3	3	0.005	3.5	330	150	0.30	n.d.	2.7	20	7,700	4,300	7,500	180	13	4,800	26	4.5
7	London mine, w	9/1/97	DM5	3	0.0003	6.4	67	12	0.69	n.d.	0.6	13	n.d.	8.0	1.0	4.0	n.d.	26	n.d.	n.d.
7	London mine, n	9/1/97	DM6	3	0.0003	6.3	640	78	1.2	n.d.	1.3	18	440	1,900	1,200	120	n.d.	6,000	26	120
7	London mine, main	9/1/97	DM7	3	0.002	6.3	460	160	5.6	n.d.	4.3	63	n.d.	740	1,700	13	n.d.	9,800	64	n.d.
8	Early Bird Crosscut (Paris)	9/1/97	DM4	3	0.0003	3.6	380	170	0.32	2.3	6.8	33	6,100	2,900	6,700	260	23	2,300	19	78
10	Prairie mine	9/1/97	DM8	3	0.001	6.9	270	57	2.8	n.d.	3.0	43	n.d.	6.0	87	n.d.	n.d.	950	4.5	n.d.
12	Riverside mine	9/1/97	DM9	3	0.0003	7.1	80	12	0.55	n.d.	1.7	14	n.d.	41	110	n.d.	n.d.	79	n.d.	13
13	Lucky Jack mine	9/1/97	DM2	3	0.101	5.1	81	32	0.84	n.d.	1.3	10	260	190	120	19	n.d.	920	3.8	230
15	Little Ida mine, s	9/1/97	DM14	3	0.004	7.2	99	27	0.78	n.d.	1.0	17	97	15	140	26	n.d.	780	3.9	36
16	Burrows mine, w	9/1/97	DM15	3	0.002	5.7	120	44	0.48	n.d.	1.3	13	500	7.0	860	67	n.d.	5,700	24	540
16	Burrows mine, e	9/1/97	DM16	3	0.003	5.4	170	57	1.0	n.d.	1.6	25	40	n.d.	350	12	n.d.	6,900	20	n.d.
17	Vermillion mine	9/1/97	DM17	3	0.016	3.1	1,000	250	0.32	n.d.	1.8	23	3,100	21,000	7,300	1,300	n.d.	52,000	210	1,600
18	Vermillion tunnel	9/1/97	DM18	3	0.24	6.3	570	160	4.0	n.d.	5.4	91	n.d.	18	1,200	n.d.	n.d.	1,000	3.3	1.1
19	Frisco tunnel	9/1/97	DM19	3	0.15	6.4	650	260	4.8	2.1	7.6	120	140	210	7,600	n.d.	n.d.	3,700	11	n.d.
23	Columbus mine	9/1/97	DM20	3	0.003	3.3	1,600	1,400	0.93	n.d.	9.5	30	19,000	77,000	14,000	7,700	75	250,000	1,000	350
31	Mogul mine	10/1/96	SO5	2	0.02	2.9	1,100	450	3.3	1.0	4.2	84	5,000	48,000	9,700	6,500	21	29,000	160	180
34	Queen Anne mine	10/1/96	SO1	2	0.05	6.4	300	97	1.0	n.d.	2.8	41	100	120	1,200	84	n.d.	2,200	9.1	1.6
35	Grand Mogul mine	10/1/96	SO3	2	0.02	3.4	510	190	1.0	n.d.	7.9	21	10,000	730	7,100	2,600	12	17,000	88	38
41	Mountain Queen mine	9/1/97	DM10	3	0.005	3.7	310	120	0.46	n.d.	1.7	15	4,000	9,100	4,100	2,300	n.d.	6,500	62	140
45	Indian Chief mine	9/1/97	DM28	3	0.004	6.8	180	46	0.87	n.d.	1.8	35	n.d.	12	600	n.d.	n.d.	220	1.0	23
53	Silver Queen mine	9/1/97	DM25	3	0.0007	3.2	680	540	0.47	n.d.	4.0	55	1,400	15,000	72,000	2,300	21	8,400	28	360
54	Sound Democrat mine	9/1/97	DM26	3	0.008	3.7	480	260	0.24	n.d.	6.6	59	1,500	260	46,000	280	17	9,400	22	150
60	Golden Fleece mine	9/1/97	DM27	3	0.008	3.8	220	84	0.22	n.d.	1.8	18	1,800	1,300	7,000	41	n.d.	1,300	7.8	69
67	Toltec mine, lower level	9/1/97	DM29	3	0.0015	8.1	340	84	5.1	n.d.	8.7	61	n.d.	n.d.	33	4.0	n.d.	27	n.d.	n.d.
87	Joe and Johns mine	10/1/96	SO6	2	<0.002	2.7	1,400	330	0.28	n.d.	1.9	1.9	13,000	62,000	290	510	33	11,000	53	550
91	Eveline mine	10/1/96	SO24	2	<0.002	3.4	470	170	2.3	n.d.	10.0	4.9	11,000	15,000	850	56	16	850	10	1.4
118	Ben Franklin mine	9/1/98	DM32	4	0.022	6.1	720	260	1.2	n.d.	15.0	81	140	64	88	n.d.	n.d.	260	0.8	1.9
119	Bavarian mine	9/1/98	DM33	4	0.001	3.3	500	88	0.38	n.d.	1.0	16	130	2,900	4,100	500	n.d.	2,300	5.4	430
123	Tom Moore mine	9/1/97	DM22	3	0.072	7.3	350	89	2.4	n.d.	2.2	75	n.d.	14	540	n.d.	n.d.	840	2.0	n.d.
125	Silver Wing mine	9/1/97	DM21	3	0.037	6.5	380	270	3.8	n.d.	4.9	120	410	1,800	3,400	1,400	n.d.	3,900	15	n.d.
133	Silver Crown mine	7/20/95	258/4194–1.307	1	0.11	7.1	413	139	3.8	0.3	3.2	75	7.0	50	60	0.7	2.6	42	0.3	<0.2
136	Imogene mine	7/19/95	259/4193–1.304	1	0.25	5.9	247	162	3.6	0.3	2.8	41	250	10,000	820	n.d.	2.1	100	n.d.	1.4
141	Brooklyn mine	7/18/95	261/4193–1.306	1	0.045	3.2	1,006	526	1.2	0.5	15.0	84	2,300	38,000	>5,000	810	19	7,300	38	62
143	U.S. Basin mine	8/24/95	262/4195–1.300	1	0.042	5.1	512	212	2.0	0.7	11.0	63	280	1,500	2,900	3.2	5.6	160	0.7	8.8
145	Kansas City # 1 mine	10/1/96	SO20	2	<0.002	3.0	1,400	600	1.0	n.d.	13.0	120	10,000	57,000	32,000	2,100	30	8,300	25	100
147	Elk tunnel	10/1/96	SO19	2	0.38	7.0	1,500	740	7.9	n.d.	6.4	330	n.d.	3,500	1,700	n.d.	n.d.	190	n.d.	n.d.
148	Mammoth tunnel	10/1/96	SO18	2	0.07	4.9	1,500	580	5.1	2.4	18.0	210	1,700	53,000	4,400	12	20	1,000	1.3	n.d.
150	Big Colorado mine	10/1/96	SO17	2	0.04	4.6	820	450	3.9	2.8	13.0	110	6,800	75,000	2,200	15	37	1,100	4.8	n.d.
153	Natalie/Occidental mine	10/1/96	SO13	2	0.89	6.3	1,000	540	3.7	n.d.	9.0	220	770	13,000	2,300	n.d.	n.d.	710	2.1	n.d.
155	Black Hawk mine	10/1/96	SO12	2	0.2	7.3	1,200	610	3.3	1.1	11.0	260	n.d.	50	2,500	n.d.	10	580	1.8	n.d.

Table 5. Adit chemistry determined at low flow for selected sites sampled by State of Colorado.—Continued

AMLI_MINE_ID	Name	Date	Sample designation	Reference	Discharge ft³/s	pH	Specific conductance µS/cm	Sulfate mg/L	Na mg/L	K mg/L	Mg mg/L	Ca mg/L	Al µg/L	Fe µg/L	Mn µg/L	Cu µg/L	Ni µg/L	Zn µg/L	Cd µg/L	Pb µg/L
159	Midway tunnel	9/1/98	DM74	4	0.018	7.6	1,200	750	8.4	n.d.	6.6	260	56	n.d.	12	n.d.	n.d.	35	n.d.	n.d.
160	Moonbeam mine	9/1/98	DM35	4	0.067	7.6	550	160	2.0	n.d.	3.7	90	n.d.	71	400	n.d.	n.d.	360	0.7	1.7
163	Senator mine	9/1/97	DM24	3	0.163	6.6	1,200	940	6.6	3.1	25.0	230	1,700	26,000	16,000	8.0	17	1,900	3.9	6.8
183	Anglo Saxon mine	10/1/96	SO16	2	0.09	6.6	1,700	810	9.2	3.5	20.0	320	340	31,000	9,200	14	22	2,900	3.0	n.d.
186	Yukon mine (Gold Hub)	10/1/96	SO14	2	1.21	7.1	950	500	5.7	n.d.	6.5	220	n.d.	1,100	1,000	n.d.	n.d.	99	n.d.	n.d.
190	Auburn mine	9/1/98	DM36	4	0.243	7.7	950	320	3.5	n.d.	5.0	150	n.d.	160	270	n.d.	n.d.	150	n.d.	2.0
193	Hamlet mine	9/1/98	DM39	4	0.331	7.6	860	300	5.3	n.d.	8.2	150	n.d.	210	550	n.d.	n.d.	100	n.d.	n.d.
203	Esmeralda mine	9/1/98	DM40	4	0.035	8.0	780	50	3.3	n.d.	3.2	41	n.d.	n.d.	14	n.d.	n.d.	8.0	n.d.	n.d.
208	Ensle tunnel	8/24/95	255/4189–1.303	1	<0.002	2.9	470	145	0.30	0.3	2.3	15	3,100	18,000	380	46	4.2	1,500	7.9	12
212	Little Casino mine (Coming Wonder)	9/1/98	DM73	4	0.004	7.6	400	110	5.7	n.d.	11.0	64	n.d.	5.0	47	n.d.	n.d.	460	0.8	n.d.
216	Blair Mtn. tunnel	9/1/98	DM65	4	0.06	7.0	850	440	5.0	n.d.	2.9	180	n.d.	620	360	8.0	n.d.	n.d.	n.d.	n.d.
218	Aspen mine	9/1/98	DM64	4	0.421	7.1	750	330	3.4	n.d.	2.5	150	n.d.	n.d.	2.0	5.0	n.d.	590	3.6	n.d.
223	Valley Forge mine	9/1/98	DM57	4	0.111	7.4	340	58	2.9	n.d.	3.9	51	n.d.	n.d.	n.d.	n.d.	n.d.	7.0	n.d.	n.d.
226	Joseph Neff mine	9/1/98	DM75	4	0.013	5.5	500	250	6.1	n.d.	8.6	86	1,400	380	400	n.d.	n.d.	79	n.d.	n.d.
228	Little Nation mine	9/1/98	DM56	4	0.137	7.0	580	240	3.7	n.d.	6.1	95	72	5,500	1,300	n.d.	n.d.	510	1.0	1.4
230	Hidden Treasure mine	9/1/98	DM44	4	0.008	6.8	300	140	4.5	n.d.	8.0	48	n.d.	3,200	1,400	n.d.	n.d.	400	1.1	n.d.
236	Smuggler mine	9/1/98	DM46	4	0.023	7.7	310	92	4.3	n.d.	5.4	57	n.d.	1,800	630	n.d.	n.d.	15	n.d.	n.d.
239	Old Hundred mine	9/1/98	DM45	4	1.146	8.2	500	220	3.9	n.d.	3.4	110	n.d.	n.d.	n.d.	n.d.	n.d.	83	0.7	0.7
244	Emma mine	9/1/98	DM47	4	0.036	7.5	600	260	4.4	n.d.	6.9	130	n.d.	7.0	10	n.d.	n.d.	29	n.d.	n.d.
285	Mighty Monarch mine	9/1/98	DM67	4	0.064	7.4	350	120	3.5	n.d.	4.5	63	n.d.	47	850	n.d.	n.d.	500	1.6	n.d.
289	Last Chance mine	9/1/98	DM66	4	0.277	7.4	290	96	3.0	n.d.	2.6	49	n.d.	250	410	n.d.	n.d.	18	n.d.	n.d.
298	Ezra R mine	9/1/98	DM58	4	0.011	7.7	220	100	2.4	n.d.	0.8	60	n.d.	n.d.	11	n.d.	n.d.	64	n.d.	n.d.
301	Argentine tunnel	9/1/98	DM78	4	0.041	8.2	370	120	2.8	n.d.	2.0	66	n.d.	n.d.	2.0	n.d.	n.d.	34	n.d.	n.d.
302	Jess mine	9/1/98	DM77	4	0.006	7.9	380	130	2.5	n.d.	2.7	71	n.d.	59	200	n.d.	n.d.	47	n.d.	n.d.
305	Black Prince mine	9/1/98	DM60	4	0.061	7.9	62	6.6	0.31	n.d.	0.4	16	n.d.	n.d.	n.d.	n.d.	n.d.	14	n.d.	n.d.
306	King Solomon mine	9/1/98	DM59	4	0.001	7.7	98	26	1.0	n.d.	1.2	26	n.d.	14	5.0	24	n.d.	180	1.0	3.8
315	Green Mtn. mine	9/1/98	DM52	4	0.008	8.3	240	48	2.1	n.d.	2.4	47	n.d.	5.0	4.0	7.8	n.d.	940	5.7	13
319	Pride of the West mine	9/1/98	DM51	4	0.227	8.6	350	48	1.7	n.d.	5.2	75	n.d.	n.d.	230	13	n.d.	1,200	6.3	2.8
323	Oyama tunnel	9/1/98	DM49	4	0.072	7.7	390	220	12.0	2.2	12.0	98	n.d.	210	870	n.d.	n.d.	21	n.d.	n.d.
327	Queen of Maggie mine	9/1/98	DM71	4	0.007	4.6	230	58	2.9	4.1	11.0	34	n.d.	1,200	20	n.d.	n.d.	59	0.7	n.d.
332	Bandora mine	7/19/95	235/4185–1.3000	1	0.071	6.2	32	290	2.1	0.3	7.1	90	25	11,000	>5,000	140	23	16,000	88	<0.2
345	Iowa mine	9/1/98	DM62	4	0.001	7.3	41	13	0.18	n.d.	0.5	6.7	n.d.	n.d.	13	22	n.d.	880	6.1	18
345	South Iowa mine adit	9/1/98	DM79	4	0.002	5.2	110	200	0.29	n.d.	1.0	12	390	57	130	400	n.d.	7,500	29	970
348	Royal Tiger mine	9/1/98	DM63	4	0.007	4.9	350	190	1.0	n.d.	8.2	41	5,700	340	6,500	1,400	16	9,800	38	2,200
360	Innis tunnel	9/1/98	DM53	4	0.053	7.8	300	83	3.3	n.d.	3.3	60	n.d.	n.d.	2.0	n.d.	n.d.	64	n.d.	n.d.
504	Lower Ransom mine	9/1/98	DM69	4	0.061	7.6	1,300	1,000	4.9	n.d.	7.5	220	n.d.	14	78	n.d.	n.d.	330	n.d.	n.d.

[1]Reference: Unpub. abandoned mine land inventory report, San Juan Forest, Columbine district, CGS, 1997.

[2]Reference: Unpub. Cement Creek reclamation feasibility report, CDMG, 1998.

[3]Reference: Unpub. Upper Animas River reclamation feasibility report, CDMG, 1999.

[4]Reference: Unpub. Lower Animas River reclamation feasibility report, CDMG, 2000.

Table 6. Adit chemistry determined at low flow for selected sites sampled by U.S. Geological Survey.

[Adit flow in cubic feet/second, ft^3/s; all samples were filtered at 0.45 micrometers; concentrations expressed in milligrams per liter, mg/L; or in micrograms per liter, µg/L; < detection limit, not detected; --, not determined; all methods and data are in the database (Sole and others, this volume)]

AMLI_MINE_ID	Name	Date	Sample designation	Discharge ft^3/s	pH	Specific conductance µS/cm	Sulfate mg/L	Na mg/L	K mg/L	Mg mg/L	Ca mg/L	Al µg/L	Fe µg/L	Mn µg/L	Cu µg/L	Ni µg/L	Zn µg/L	Cd µg/L	Pb µg/L
Detection limit —							*2*	*0.5*	*0.03*	*0.01*	*0.02*	*2*	*50*	*0.2*	*0.5*	*0.5*	*0.5*	*0.02*	*0.05*
7	London mine	9/4/98	MS22	0.011	6.8	405	167	5.2	1.25	3.91	59	20	15	1,400	6.0	10	6,450	44	15
8	Early Bird Crosscut	8/13/97	NAW150	0.0045	3.2	350	--	0.53	--	5.30	13	4,400	1,400	3,800	260	18	1,400	24	69
		9/14/98	NAW727	0.0022	3.2	330	--	< 0.5	--	6.90	29	6,300	2,300	6,800	350	19	2,200	23	83
9	Ben Butler mine	8/14/97	NAW156	0.0045	3.0	600	--	< 0.5	--	0.64	4.5	1,500	3,200	210	1,100	4.2	13,000	110	2,500
		9/14/98	NAW726	0.0067	3.0	530	--	< 0.5	--	0.56	4.8	1,700	4,300	320	1,400	3.5	18,000	110	1,800
		9/2/99	NAW822	0.0067	2.9	230	--	< 0.5	--	0.65	5.4	2,500	5,800	310	1,100	5.0	20,000	110	2,400
13	Lucky Jack mine	10/3/98	MS23	0.01	3.5	284	80	1.0	0.68	1.75	14	1,220	2,050	615	63	10	4,280	21	253
15	Little Ida mine	9/7/97	NAW380	0.011	7.3	90	--	0.64	--	0.69	3.9	160	110	130	30	1.7	740	4.0	49
17	Vermillion mine	9/27/99	MS55	0.005	2.6	783	269	0.38	0.62	1.82	26	3,280	21,500	7,340	1,410	10	49,800	202	1,380
19	Frisco tunnel	8/24/98	MS3	0.062	6.2	845	300	4.6	2.74	6.93	113	116	226	6,860	2.0	10	3,000	4.9	15
		9/11/98	NAW704	0.067	5.4	580	--	4.8	--	7.70	120	69	1,300	7,900	1.5	3.2	3,100	5.7	0.6
		9/2/99	NAW828	0.18	5.5	260	--	4.7	--	7.10	120	71	300	7,300	3.0	10	3,400	10	25
31	Mogul mine	8/31/99	NAW802	--	2.8	780	--	4.5	--	13.0	160	46,000	130,000	31,000	12,000	59	100,000	1,600	240
32	Mogul North mine	9/10/97	MS26	0.015	4.7	180	85	0.72	--	2.49	25	373	15	36	10	10	1,050	2.3	15
34	Queen Anne mine	9/6/97	MS50	0.05	7.0	367	344	1.5	--	3.94	61	116	77	1,680	98	10	2,430	11	15
35	Grand Mogul mine	8/15/97	NAW176	0.067	3.3	400	--	0.79	--	3.00	8.9	1,900	5,200	1,900	1,000	5.8	5,500	42	35
		9/10/97	MS16	0.003	3.4	488	190	1.0	--	6.05	17	9,170	1,470	7,110	3,240	24	15,800	89	44
		8/15/98	NAW530	0.045	2.9	630	--	<0.5	--	13.0	23	13,000	43,000	13,000	7,300	24	34,000	170	42
		8/31/99	NAW801	0.056	3.0	380	--	0.64	--	5.20	15	5,500	25,000	4,300	2,000	14	14,000	73	25
42	Mountain Queen mine	8/22/02	CGS-350	0.004	3.6	243	82		0.49	1.60	12	2,500	3,700	3,900	930	2.5	3,800	37	190
58	Evening Star mine	9/5/99	NAW860	0.011	4.6	92	--	1.2	--	4.30	16	12,000	21,000	7,200	3.0	15	4,400	14	300
62	Sandiago tunnel (Treasure Mountain mine)	9/8/98	MS54	0.433	7.0	590	203	2.0	1.44	5.76	77	20	15	717	2.0	10	27	1.0	15
		9/5/99	NAW854B	0.22	7.1	170	--	2.1	--	7.30	78	5.0	<50	490	0.7	5.0	5.0	0.04	25
70	Lower Bullion King mine	8/19/98	NAW592	0.011	4.6	140	--	< 0.5	--	1.00	30	450	--	1,100	28	2.5	1,600	10	12
		8/25/99	MS9	0.045	4.8	175	88	0.69	0.47	0.60	24	447	60	911	32	10	1,610	8.6	15
		9/7/99	NAW876	0.045	6.4	76	--	1.0	--	0.66	34	100	4,100	1,200	6.0	5.0	1,300	5.2	25
75	Koehler tunnel	9/25/95	MS81	0.02	2.5	3,520	2,720	19.4	0.70	26	111	71,400	686,000	23,700	98,600	300	228,000	780	235
		9/25/95	MS82	0.15	2.5	3,310	2,700	14.3	0.40	39	144	70,300	494,000	20,300	61,100	290	157,000	550	300
		8/18/98	NAW580	--	2.4	2,200	--	26.0	--	22	120	51,000	460,000	19,000	40,000		120,000	450	280
82	Galena Queen	9/9/97	MS59	--	2.6	1,060	368	0.67	--	1.36	7.2	7,180	60,100	603	3,920	57	44,700	183	417
83	Hercules mine	9/9/97	MS60	--	2.3	1,780	691	0.35	--	0.81	3.0	5,870	118,000	205	3,000	68	52,400	279	966
85	Henrietta mine, #7 level	8/17/97	NAW215	0.011	2.5	1,600	--	0.68	--	5.10	16	11,000	130,000	530	380	67	6,500	41	18
		6/30/99	H7A	--	2.6	530	--	0.23	--	1.09	3.5	1,914	27,696	78	50	10	296	1.0	15
		9/29/99	H7A	--	2.5	2,450	1,100	0.83	1.40	7.50	49	23,000	270,000	910	590	110	8,200	35	25
86	Lark mine	8/17/97	NAW204	0.011	3.2	380	--	0.62	--	1.00	4.6	1,300	760	120	420	5	3,300	21	320
		8/17/97	NAW212	--	4.2	50	--	0.54	--	2.90	14	820	1,500	210	100	6	490	3.0	28
		7/22/98	MS21	0.001	2.8	678	133	0.59	0.72	1.21	5.5	1,850	11,300	208	1,640	10	9,780	44	357
		8/31/99	NAW807	--	3.0	390	--	0.56	--	2.10	2.6	5,000	67,000	200	990	28	6,900	30	25
		9/29/99	L3A	--	4.1	228	53	2.6	2.20	0.90	16	350	24,000	220	160	11	2,200	9.2	25
		9/29/99	L3P	--	4.0	157	83	3.0	0.89	1.70	16	1,100	120	190	230	5	3,100	12	97

Table 6. Adit chemistry determined at low flow for selected sites sampled by U.S. Geological Survey.—Continued

AMLI_MINE_ID	Name	Date	Sample designation	Discharge ft³/s	pH	Specific conductance µS/cm	Sulfate mg/L	Na mg/L	K mg/L	Mg mg/L	Ca mg/L	Al µg/L	Fe µg/L	Mn µg/L	Cu µg/L	Ni µg/L	Zn µg/L	Cd µg/L	Pb µg/L
Detection limit —							*2*	*0.5*	*0.03*	*0.01*	*0.02*	*2*	*50*	*0.2*	*0.5*	*0.5*	*0.5*	*0.02*	*0.05*
87	Joe and Johns mine	8/17/97	NAW217	0.045	2.7	740	--	<0.5	--	1.20	2.2	6,400	29,000	180	400	20	7,100	54	1,200
		9/8/97	MS19	0.006	2.8	1,090	367	0.29	--	1.87	2.0	12,600	60,300	244	638	22	12,000	58	931
		6/30/99	JJA	--	--	--	--	0.36	--	0.30	1.6	317	244	28	22	10	216	1.0	15
		7/29/99	MS19	0.001	3.8	131	40	0.56	0.58	0.71	4.6	835	793	112	116	10	1,190	3.2	46
		9/29/99	JJP	--	2.7	1,010	290	0.39	1.60	1.60	2.7	13,000	62,000	190	640	28	11,000	54	1,400
91	Eveline mine	11/6/96	MS13	0.01	3.3	472	178	2.4	--	10.2	4.6	10,600	15,500	843	55	10	858	5.2	15
		8/16/97	NAW201	0.022	3.1	370	--	2.2	--	8.20	4.8	6,500	8,800	600	91	14	640	10	3.8
		8/19/97	MS13	0.01	3.1	468	175	2.5	--	10.2	4.7	11,100	17,900	859	100	10	892	4.3	15
100	Adams mine	10/1/99	MS38	0.01	4.2	498	169	3.8	0.76	4.85	60	3,180	11,500	2,670	81	10	3,880	51	60
125	Silver Wing mine	9/5/97	NAW355	0.22	6.2	620	--	3.2	--	3.40	36	210	740	1,400	410	8.0	2,000	14	0.2
		9/30/98	MS53	0.06	6.5	679	307	2.7	1.26	3.89	96	20	4,750	3,130	14	10	2,460	11	15
132	Potomac mine	9/13/98	NAW721	0.011	5.2	120	--	<0.5	--	0.87	28	140	340	230	27	<0.5	1,900	15	170
133	Silver Crown mine	8/18/98	NAW577	0.022	5.5	360	--	8.2	--	5.50	100	--	1,600	100	5.0	8.9	160	<0.02	<0.05
		8/25/99	MS51	0.164	7.6	481	156	6.0	0.38	3.76	80	20	15	69	2.0	10	34	1.0	15
135	Chattanooga Curve mine	8/18/98	NAW579	0.022	4.9	280	--	8.5	--	9.60	78	460	2,500	1,400	5.0	9.1	390	<0.02	<0.05
		8/27/99	MS42	0.095	5.8	456	218	6.3	0.51	6.83	64	656	1,870	1,200	2.0	10	171	1.0	15
136	Imogene mine	9/11/97	NAW427	0.067	5.8	280	--	4.4	--	2.40	14	300	3,200	360	0.7	2.2	110	0.07	0.2
		8/14/98	NAW511	0.067	5.4	260	--	6.1	--	4.10	54	410	5,900	1,000	7.3	3.6	130	<0.02	6.1
		9/1/99	NAW814	0.11	5.1	120	--	5.6	--	3.40	48	440	6,000	920	3.0	5.0	130	1.0	25
		9/15/99	MS17	0.174	5.9	334	123	5.4	0.43	3.23	46	445	5,230	884	2.0	10	118	1.0	15
137	Ferricrete mine	8/14/98	NAW512	0.045	5.1	380	--	6.4	--	7.90	74	840	11,000	2,600	2.2	10	370	0.6	0.5
		9/15/99	MS14	0.52	6.0	480	193	5.7	0.60	6.72	66	962	11,300	2,540	2.0	10	380	2.7	15
140	Gold Finch group	8/26/99	MS28	0.035	6.7	1,080	480	12.3	1.34	9.26	197	221	3,610	1,730	2.0	10	106	1.0	15
141	Brooklyn mine	8/13/98	NAW508	0.045	4.8	610	--	4.2	--	24	120	810	3,000	8,100	99	25	5,300	14	11
		8/18/98	NAW589	0.045	2.9	880	--	2.8	--	22	130	4,200	16,000	9,400	380	27	6,500	27	64
		7/18/99	MS8	0.08	3.7	802	311	1.8	0.77	16.0	84	2,250	17,300	6,750	338	10	5,560	18	15
		9/1/99	NAW817	0.045	2.9	280	--	1.7	--	16.0	62	3,700	33,000	5,800	280	22	5,900	23	52
		9/1/99	NAW819	0.045	3.0	350	--	1.9	--	17.0	72	5,500	28,000	6,400	430	31	6,500	30	50
142	Upper Browns Gulch mine	9/18/99	MS37	0.003	2.9	859	240	1.3	0.37	7.80	52	4,220	27,600	4,490	490	10	2,810	28	168
143	U.S. Basin mine	8/18/98	NAW586	--	2.8	670	--	1.4	--	6.60	40	4,100	15,000	1,500	370	11	1,100	7.7	180
145	Kansas City mine #1	8/22/98	NAW630	0.011	2.9	810	--	2.2	--	18.0	150	10,000	28,000	32,000	1,600	45	7,100	28	110
147	Elk tunnel	8/21/97	NAW311	0.22	6.4	1,100	--	6.7	--	5.00	190	47	4,100	1,400	1.3	19	160	<0.02	33
		10/10/97	MS11	--	7.1	1,280	815	7.8	--	6.00	342	20	3,060	1,750	2.0	10	225	1.0	15
		8/17/98	NAW575	0.22	4.9	1,200	--	9.3	--	7.50	370	15	11,000	2,000	2.9	26	210	0.2	5.0
		10/14/98	MS11	0.338	6.8	1,450	867	7.9	0.92	6.07	322	123	3,540	1,720	2.0	10	187	1.0	15
		9/8/99	NAW882	0.22	6.8	520	--	7.2	--	5.70	270	11	3,100	1,600	2.0	5	170	0.1	25
148	Mammoth tunnel	8/17/97	NAW227	0.089	4.8	990	--	4.1	--	13.0	120	1,000	26,000	3,200	5.2	25	730	1.8	0.6
		10/10/97	MS24	--	--	--	636	4.3	--	15.8	201	1,470	21,700	5,020	39	10	1,260	1.0	15
		8/7/98	MS24	0.005	5.1	1,520	700	5.4	2.65	18.4	215	2,010	52,400	4,810	13	10	1,090	12	15
		8/16/98	NAW554	0.089	4.5	980	--	5.9	--	20	230	2,000	51,000	4,900	27	32	1,000	2.0	<0.05
149	Avalanche mine	8/21/97	NAW309	0.022	3.8	480	--	2.1	--	7.40	31	5,300	22,000	530	75	17	170	1.1	1.3
		9/5/97	MS2	0.009	3.9	614	308	2.8	--	9.82	58	9,360	48,500	812	69	30	219	1.0	15
		8/17/98	NAW555	0.022	3.7	440	--	2.8	--	9.40	64	6,900	35,000	870	54	18	200	0.8	<0.05
		8/19/98	MS2	0.015	3.9	565	286	2.7	1.59	8.42	54	7,130	36,700	748	44	10	195	5.3	15

Table 6. Adit chemistry determined at low flow for selected sites sampled by U.S. Geological Survey.—Continued

AMLI_MINE_ID	Name	Date	Sample designation	Discharge ft³/s	pH	Specific conductance µS/cm	Sulfate mg/L	Na mg/L	K mg/L	Mg mg/L	Ca mg/L	Al µg/L	Fe µg/L	Mn µg/L	Cu µg/L	Ni µg/L	Zn µg/L	Cd µg/L	Pb µg/L
Detection limit —							*2*	*0.5*	*0.03*	*0.01*	*0.02*	*2*	*50*	*0.2*	*0.5*	*0.5*	*0.5*	*0.02*	*0.05*
150	Big Colorado mine	8/16/98	NAW552	0.22	3.6	960	--	4.8	--	14.0	130	6,800	42,000	2,400	31	45	1,100	4.6	19
		8/20/98	MS5	--	4.7	1,090	500	3.9	3.27	12.2	109	6,610	64,500	2,170	18	10	1,020	11	15
153	Natalie/Occidental (Silver Ledge) mine	10/18/96	MS52	0.75	5.7	1,090	518	3.9	--	8.99	211	879	12,300	2,430	11	10	701	6.3	15
		11/4/97	MS52	--	6.8	1,000	527	3.2	--	8.73	200	1,040	12,700	2,710	2.0	10	805	10	15
		8/5/98	MS52	--	6.3	910	490	3.9	0.88	8.76	187	1,430	13,700	2,470	17	10	895	6.2	15
		8/16/98	NAW551	0.89	5.3	670	--	4.2	--	9.90	220	1,300	16,000	2,700	23	23	820	2.2	1.3
		8/31/99	NAW808	0.89	5.1	330	--	3.7	--	8.70	150	1,300	14,000	2,400	19	15	940	3.4	25
155	Black Hawk mine	10/1/97	MS6	0.6	6.9	1,020	600	4.2	--	12.9	259	123	1,220	4,300	2.0	10	1,130	2.4	15
156	South Fork mine	8/28/98	MS29	0.3	6.5	652	253	2.1	0.67	5.42	117	20	4,490	1,980	2.0	10	304	1.0	15
168	Paradise mine	9/28/95	MS77	0.6	5.7	1,962	1,200	7.8	0.80	33	400	8,600	67,000	5,100	13	25	530	0.5	0.5
		8/14/98	NAW520	0.22	4.5	1,300	--	8.9	--	49	430	22,000	77,000	6,600	1.4	52	660	0.3	0.5
		8/14/98	NAW521	0.22	4.6	1,200	--	9.8	--	47	440	19,000	75,000	6,400	3.0	51	640	0.7	1.5
		8/27/98	MS34	0.009	5.0	2,140	1,300	8.0	0.90	42	359	21,200	73,000	5,920	2.0	10	620	1.0	15
		9/6/99	NAW870	0.45	5.1	610	--	8.2	--	38	350	27,000	69,000	5,100	3.0	29	570	0.4	25
169	Ruby Trust mine	9/18/95	MS76	1.03	6.4	560	200	3.6	0.50	3.90	110	0.5	470	530	3.0	3.0	39	0.5	0.5
		8/14/98	NAW524	0.45	6.4	360	--	4.8	--	4.40	120	38	2,400	550	3.3	10	66	0.2	2.7
		9/1/99	NAW816	0.89	5.5	180	--	3.6	--	3.40	90	5.0	440	470	1.0	5.0	55	0.1	25
171	Independence mine (Silverton quadrangle)	9/26/95	MS80	0.04	3.2	667		6.8	0.50	5.80	65	4,410	12,600	1,250	0.5	0.5	243	14	0.5
		6/10/98	MS18	0.04	3.2	634	263	6.1	0.64	4.83	64	4,140	11,400	1,090	51	10	225	1.0	15
172	Bonner mine upper adit	8/14/98	NAW516	0.022	3.1	530	--	6.7	--	7.70	90	7,000	15,000	3,800	86	14	3,000	14	17
		8/14/98	NAW517	0.022	2.9	730	--	8.3	--	8.80	120	6,800	11,000	3,800	83	16	2,700	14	13
172	Bonner mine, lower adit	9/26/95	MS79	0.06	3.1	1,225		7.7		7.30	107	8,300	10,500	4,100	0.5	0.5	4,090	20	0.5
		9/1/99	NAW815	0.045	2.8	380	--	7.0	--	7.40	81	8,300	11,000	4,400	120	11	4,900	25	25
173	Molly Gulch mine	8/24/99	MS43	0.004	3.1	560	177	4.7	0.84	8.77	34	5,560	4,770	1,140	629	10	224	1.0	15
174	Magnet mine	8/23/99	MS48	0.014	7.5	980	501	11.3	0.97	7.33	186	147	88	829	11	10	106	1.0	15
181	May Day mine	5/15/97	MS61	0.03	2.6	1,810	1,060	--	--	--	--	--	--	--	--	--	--	--	--
183	Anglo Saxon mine	10/10/97	MS1	--	--	--	827	9.6	--	20	339	970	550	9,490	2.0	10	3,060	17	15
		8/7/98	MS1	0.05	6.5	1,870	867	8.8	2.61	18.8	286	484	28,800	9,320	2.0	10	3,050	10	15
		8/17/98	NAW574	0.11	5.7	1,100	--	13.0	--	27	360	530	33,000	11,000	28	49	3,400	4.0	<0.05
186	Yukon tunnel (Gold Hub)	9/11/97	NAW415	0.089	5.9	1,100	--	5.2	--	4.50	70	65	1,500	510	6.4	9.1	130	1.2	1.0
		8/17/98	NAW573	0.089	5.6	900	--	8.6	--	9.00	260	150	5,000	970	15	20	270	1.2	<0.05
189	Legal Tender mine (Howardsville quadrangle)	9/8/97	NAW396	0.045	7.0	480	--	3.0	--	2.50	29	10	700	130	1.5	3.9	220	0.9	0.6
		9/3/99	NAW845	0.045	5.4	180	--	3.8	--	3.50	88	11	420	310	1.0	5.0	390	2.0	25
195	Forest Queen mine (preremediation)	11/6/96	MS15	0.036	4.7	856	433	8.8	--	13.9	137	2,150	25,300	2,460	2.0	10	641	8.3	44
		8/18/97	NAW231	0.045	5.1	830	--	6.6	--	9.60	80	1,000	13,000	1,600	n.d.	15	440	8.9	7.5
		9/11/97	MS15	0.036	4.6	770	475	8.9	--	13.1	133	1,960	24,400	2,330	2.0	10	605	8.0	15
		8/11/98	MS15	0.083	6.7	1,390	787	8.7	1.44	11.0	272	305	10,900	2,240	2.0	10	349	1.0	15
195	Forest Queen mine (postremediation)	9/16/99	MS15	--	5.9	1,510	577	9.6	1.10	11.2	334	601	10,400	2,590	2.0	10	393	39	15
		9/20/00	MS15	0.0007	6.1	733	345	8.4	1.55	10.8	124	70	8,240	2,200	0.8	1.5	79	9.0	11

Table 6. Adit chemistry determined at low flow for selected sites sampled by U.S. Geological Survey.—Continued

AMLI_MINE_ID	Name	Date	Sample designation	Discharge ft³/s	pH	Specific conductance µS/cm	Sulfate mg/L	Na mg/L	K mg/L	Mg mg/L	Ca mg/L	Al µg/L	Fe µg/L	Mn µg/L	Cu µg/L	Ni µg/L	Zn µg/L	Cd µg/L	Pb µg/L
Detection limit —							*2*	*0.5*	*0.03*	*0.01*	*0.02*	*2*	*50*	*0.2*	*0.5*	*0.5*	*0.5*	*0.02*	*0.05*
201	Kittimack mine	8/18/97	NAW235	0.067	6.3	270	--	4.1	--	4.90	33	17	360	200	110	3.7	1,000	7.0	5
		8/5/98	MS20	--	7.8	392	115	5.9	0.95	6.15	59	42	15	256	160	10	1,440	4.6	15
		9/13/98	NAW717	0.045	5.5	320	--	7.3	--	8.50	71	67	570	390	250	<0.5	1,500	7.3	21
		9/3/99	NAW835	0.045	5.6	120	--	4.0	--	5.30	58	15	<50	220	130	5.0	1,200	6.4	25
203	Esmeralda mine, lower adit	10/3/98	MS12	0.05	7.0	252	56	3.2	0.69	3.19	41	20	15	7.0	2.0	10	10	1.0	15
207	Burbank mine	8/20/98	NAW603	0.11	5.7	530	--	5.0	--	18.0	150	--	6,200	1,400	3.2	10	52	1.8	<0.05
		8/24/98	MS10	0.087	6.3	898	327	4.3	0.72	16.7	135	20	2,810	1,310	2.0	10	47	1.0	15
		9/9/99	NAW890	0.45	7.4	250	--	4.4	--	15.0	98	5.0	2,600	1,100	1.0	5.0	38	0.2	25
239	Old Hundred mine, lower adit	8/19/97	NAW271	0.11	7.1	450	--	3.5	--	3.00	58	8.4	500	1.4	3.2	6.1	130	1.3	1.9
		10/17/97	MS49	--	7.5	520	205	3.8	--	3.44	109	229	15	1.5	2.0	10	127	1.0	15
260	Columbine mine	8/19/98	MS57	0.011	3.0	715	240	3.9	3.43	5.32	28	10,700	4,560	445	12	10	137	1.0	15
		9/24/98	MS57	0.01	2.9	694	207	4.1	2.77	4.97	20	10,800	4,060	339	21	10	102	1.0	15
263	North Star mine	12/17/97	MS63	0.632	6.8	716	363	4.8	0.92	17.1	132	101	1,820	2,560	2.0	10	619	1.0	15
		7/23/98	MS63	1.18	7.2	726	327	4.1	0.87	16.3	117	20	1,590	2,520	11	10	667	1.0	15
		10/13/98	MS63	0.935	6.8	756	340	4.9	0.77	17.0	131	197	1,600	2,600	2.0	10	621	1.0	15
266	Sultan tunnel	8/21/97	NAW298	0.056	6.9	600	--	4.0	--	7.70	56	30	540	580	8.1	7.1	52	0.3	0.6
		8/19/98	NAW601	0.056	5.5	390	--	5.3	--	11.0	120	57	3,000	580	4.0	7.7	49	0.3	<0.05
		9/14/98	NAW733	--	3.0	760	--	3.8	--	7.70	35	17,000	29,000	580	10	31	200	0.4	4.1
285	Mighty Monarch mine	9/24/98	MS25	0.041	6.8	359	122	3.9	0.39	4.58	63	20	33	881	2.0	10	484	1.0	15
287	Lackawanna mill tailings	8/21/98	NATW622	--	5.9	1,800	--	<0.5	--	11.0	580	59	21,000	31,000	42	69	63,000	150	190
289	Last Chance mine	9/6/97	NAW364	0.13	7.2	230	--	2.5	--	1.90	16	10	390	160	< 0.5	2.2	15	0.1	0.2
		9/15/98	NAW735	0.11	5.2	180	--	3.1	--	2.60	48	18	400	410	1.1	<0.5	25	0.04	0.2
306	King Soloman mine	9/8/99	NAW883	0.022	7.3	40	--	1.3	--	1.40	24	52	64	20	32	5	140	1	25
332	Bandora mine	9/9/97	NAW399	0.045	6.6	540	--	2.9	--	5.80	32	4.7	4,800	3,200	35	19	8,300	65	1.9
		8/23/98	NAW648	0.056	5.6	410	--	3.8	--	8.50	100	24	9,300	6,800	63	23	12,000	51	1.6
		10/13/98	MS4	0.09	6.1	556	260	2.8	0.29	6.46	84	55	6,770	5,780	39	20	10,500	43	15
		9/9/99	NAW887	0.22	6.4	250	--	2.5	--	7.20	79	19	11,000	7,200	120	21	16,000	80	25
360	Highland Mary mine, #8 level	9/16/98	NAW741	0.022	5.8	240	--	3.7	--	3.40	62	7.6	300	2.6	3.5	<0.5	60	0.4	0.9
505	Henrietta mine, #8 level	8/17/97	NAW213	0.011	2.6	1,100	--	0.52	--	1.90	2.9	2,800	21,000	190	830	18	4,400	31	43
		8/17/98	NAW570	0.013	2.3	2,200	--	1.5	--	11.0	9.1	22,000	29,000	1,100	5,900	110	27,000	130	18
511	unnamed adit, Porcupine Gulch	9/29/97	MS62	0.01	3.7	395	138	1.1	--	4.90	19	4,700	12,200	882	522	10	2,160	13	47
		9/24/98	MS62	0.002	3.8	234	99	1.4	0.68	4.98	23	2,120	874	377	242	10	1,360	6	15

Table 7. Time-series data from adit flow from seven mine sites.

[Discharge in ft^3/s (cfs); total concentrations are from unfiltered sample; dissolved (diss.) concentrations are from 0.45 µm filtered sample; µS/cm, microsiemens per centimeter at 25°C; mg/L, milligrams per liter; µg/L, micrograms per liter; --, not determined; n.d., not detected; < detection limit, not detected; detection limits are for instrumental methods used in the analyses. Data for 1996–99 are from Mast and others (2000). Statistical data rounded to three significant figures]

Mine	Sample date	Discharge ft³/s	Field pH	Dissolved oxygen mg/L	Specific conductance µS/cm	Sulfate total mg/L	Na diss. mg/L	K diss. mg/L	Mg diss. mg/L	Ca diss. mg/L	Sr diss. µg/L	Ba diss. µg/L	Al diss. µg/L	Al total µg/L	Silica diss. µg/L	Silica total µg/L	Fe diss. µg/L	Fe total µg/L	Mn diss. µg/L	Cu diss. µg/L	Cu total µg/L	Zn diss. µg/L	Cd diss. µg/L	Pb diss. µg/L
Detection limit--						*1*	*0.1*	*0.01*	*0.01*	*0.15*	*3*	*2*	*40*	*40*	*0.2*	*0.2*	*30*	*30*	*10*	*4*	*4*	*20*	*2.0*	*30*
Avalanche mine	9/5/97	0.009	3.92	3.9	614	308	2.75	--	9.82	57.5	717	6.0	9,360	--	63.2	--	48,500	--	812	69	--	219	< 2.0	< 30
(AML_MINE_ID # 149)	3/26/98	0.015	3.69	7.4	563	237	2.74	1.32	7.16	55.3	466	7.0	4,150	5,000	49.5	53.9	27,900	31,200	716	45	46	166	< 2.0	< 30
	4/22/98	0.016	3.40	6.5	449	205	2.69	1.32	6.93	54.7	448	7.0	3,920	4,650	47.4	51.6	26,000	31,000	699	40	44	179	< 2.0	< 30
	5/6/98	0.022	3.99	8.1	542	237	2.55	1.34	7.59	52.6	463	10	5,230	6,310	48.0	55.9	31,000	34,000	720	42	51	177	4.1	< 30
	5/21/98	0.028	3.92	8.0	654	293	3.24	1.43	11.5	60.0	752	6.0	10,500	9,250	64.9	56.8	62,100	53,600	864	63	55	241	6.6	< 30
	6/10/98	0.024	3.85	6.7	628	330	2.32	1.56	9.93	50.5	723	5.0	9,650	10,300	57.1	65.6	54,200	53,700	712	57	70	193	4.7	< 30
	7/1/98	0.008	3.80	6.0	627	300	2.06	1.60	8.31	46.1	597	3.0	7,690	8,580	49.7	58.2	41,000	44,200	670	49	58	190	3.1	< 30
	7/23/98	0.011	3.99	8.8	601	290	2.02	1.63	8.01	47.7	539	4.0	6,820	7,230	49.9	55.8	36,200	37,100	696	43	48	172	< 2.0	< 30
	7/30/98	0.014	3.85	7.9	598	267	2.09	1.61	8.52	52.3	569	< 2	7,040	7,160	50.5	49.6	37,900	36,100	741	41	42	180	8.0	< 30
	8/19/98	0.015	3.91	8.1	565	286	2.66	1.59	8.42	54.4	554	5.0	7,130	7,530	53.1	52.4	36,700	38,400	748	44	44	195	5.3	< 30
	9/24/98	0.010	3.93	5.8	546	270	2.82	1.38	8.40	57.4	542	4.0	6,250	6,600	54.3	52.6	34,000	34,100	755	42	40	189	2.2	< 30
	10/14/98	0.003	3.92	4.6	534	260	2.42	1.28	7.64	53.6	488	4.0	5,170	5,790	49.7	51.3	31,000	31,300	721	40	42	171	5.3	< 30
	11/5/98	0.017	4.04	--	535	252	2.43	1.30	7.64	54.1	481	4.0	5,020	--	49.5	--	30,300	--	722	39	--	162	2.8	< 30
	12/18/98	0.031	4.02	--	551	259	2.05	1.47	8.27	55.2	527	< 2	5,920	--	49.3	--	34,700	--	753	38	--	177	< 2.0	< 30
Minimum		0.003	3.40	3.9	449	205	2.02	1.28	6.93	46.1	448	3.0	3,920	4,650	47.4	49.6	26,000	31,000	670	38	40	162	2.2	< 30
Median		0.015	3.92	7.0	564	269	2.49	1.43	8.29	54.3	541	5.0	6,535	7,160	49.8	53.9	35,450	36,100	722	43	46	180	4.7	< 30
Mean (n = 14)					572	271	2.49	1.45	8.44	53.7	562	5.4	6,704	7,127	52.6	54.9	37,964	38,609	738	47	49	187	4.7	< 30
Standard Deviation				1.5	53	33	0.36	0.13	1.23	3.74	101	1.9	2,036	1,739	5.5	4.4	10,369	8,367	50	10	9	21	1.9	--
Maximum		0.031	4.04	8.8	654	330	3.24	1.63	11.5	60.0	752	10	10,500	10,300	64.9	65.6	62,100	53,700	864	69	70	241	8.0	< 30
Bandora mine	5/28/98	0.10	6.04	2.8	624	260	3.45	0.33	7.82	95	587	18	86	179	13.7	14.6	8,260	17,300	8,230	55	231	15,700	55.1	< 30
(AML_MINE_ID # 332)	7/22/98	0.11	6.25	2.4	588	238	3.00	0.34	7.02	87	533	12	< 40	1,110	12.8	17.4	7,290	18,000	6,680	79	302	13,100	54.6	< 30
	10/13/98	0.09	6.06	0.9	556	260	2.79	0.29	6.46	84	554	14	55	119	11.9	12.7	6,770	14,200	5,780	39	169	10,500	42.9	< 30
	12/17/98	0.03	5.95	--	545	219	2.96	0.32	6.53	89	597	15	< 40	--	12.6	--	6,670	--	5,720	30	--	10,100	39.9	< 30
	5/27/99	0.09	5.36	0.6	628	192	2.84	0.30	7.15	87	529	28	320	--	12.1	--	8,130	--	7,610	72	--	15,400	60.7	153
	7/17/99	0.13	6.04	0.8	591	240	2.90	0.34	7.21	84	528	15	94	--	13.1	--	7,750	--	7,030	121	--	14,400	65.4	< 30
	8/25/99	0.14	5.72	0.9	618	325	3.07	--	7.72	91	538	14	232	--	13.2	--	8,480	--	8,120	143	--	17,400	77.8	< 30
Minimum		0.03	5.36	0.6	545	192	2.79	0.29	6.46	84	528	12	55	119	11.9	12.7	6,670	14,200	5,720	30	169	10,100	39.9	< 30
Median		0.10	6.04	0.9	591	240	2.96	0.33	7.15	87	538	15	94	179	12.8	14.6	7,750	17,300	7,030	72	231	14,400	55.1	< 30
Mean (n = 7)				1.4	593	248	3.00	0.32	7.13	88	552	17	157	469	12.8	14.9	7,621	16,500	7,024	77	234	13,800	56.6	< 30
Standard Deviation				0.9	33	42	0.22	0.02	0.52	4.1	29	5.3	114	556	0.6	2.4	726	2,022	1,030	42	67	2,725	13.0	--
Maximum		0.14	6.25	2.8	628	325	3.45	0.34	7.82	95	597	28	320	1,110	13.7	17.4	8,480	18,000	8,230	143	302	17,400	77.8	153
Bonner mine	12/17/97	0.07	3.16	9.2	795	346	6.18	0.66	6.16	89	381	10	7,450	7,520	49.1	48.8	3,900	3,950	2,590	106	91	1,830	12.3	< 30
(AML_MINE_ID # 172)	3/25/98	0.06	2.74	9.5	938	356	7.11	0.64	6.39	92	420	12	7,490	6,680	50.2	49.1	4,130	3,740	2,490	94	88	1,490	3.4	< 30
	5/22/98	0.04	3.00	3.1	1,220	510	10.3	0.67	8.98	155	539	7	6,620	6,000	47.2	47.7	17,700	16,500	3,650	59	62	1,840	10.9	< 30
	7/22/98	0.05	3.28	10.5	895	350	5.94	0.51	5.97	88	393	14	6,460	5,730	48.5	50.1	3,990	4,580	2,560	100	102	2,140	13.6	< 30
	10/13/98	0.03	3.09	10.3	874	360	6.01	0.51	6.32	91	395	12	7,390	7,170	48.9	49.7	4,100	4,110	2,940	97	96	2,330	13.0	< 30
	7/16/99	0.07	3.23	8.0	807	291	5.74	0.46	5.22	77	348	16	6,120	--	44.9	--	3,540	--	2,440	96	--	2,610	7.0	< 30
	8/25/99	0.05	3.35	8.5	770	325	5.82	--	5.72	76	349	22	7,270	--	46.3	--	3,630	--	3,430	121	--	3,730	33.5	< 30
Minimum		0.03	2.74	3.1	770	291	5.74	0.46	5.22	76	348	7	6,120	5,730	44.9	47.7	3,540	3,740	2,440	59	62	1,490	3.4	< 30

Table 7. Time-series data from adit flow from seven mine sites.—Continued

Mine	Sample date	Discharge ft³/s	Field pH	Dissolved oxygen mg/L	Specific conductance µS/cm	Sulfate total mg/L	Na diss. mg/L	K diss. mg/L	Mg diss. mg/L	Ca diss. mg/L	Sr diss. µg/L	Ba diss. µg/L	Al diss. µg/L	Al total µg/L	Silica diss. µg/L	Silica total µg/L	Fe diss. µg/L	Fe total µg/L	Mn diss. µg/L	Cu diss. µg/L	Cu total µg/L	Zn diss. µg/L	Cd diss. µg/L	Pb diss. µg/L
Detection limit--						*1*	*0.1*	*0.01*	*0.01*	*0.15*	*3*	*2*	*40*	*40*	*0.2*	*0.2*	*30*	*30*	*10*	*4*	*4*	*20*	*2.0*	*30*
Bonner mine (continued)																								
Median		0.05	3.16	9.2	874	350	6.01	0.57	6.16	89	393	12	7,270	6,680	48.5	49.1	3,990	4,110	2,590	97	91	2,140	12.3	< 30
Mean (n = 7)					900	363	6.73	0.58	6.39	95	404	13	6,971	6,620	47.9	49.1	5,856	6,576	2,871	96	88	2,281	13.4	< 30
Standard Deviation				2.5	153	69	1.64	0.09	1.21	27	65	4.8	559	757	1.8	0.9	5,228	5,556	488	19	15	736	9.6	--
Maximum		0.07	3.35	10.5	1,220	510	10.3	0.67	8.98	155	539	22	7,490	7,520	50.2	50.1	17,700	16,500	3,650	121	102	3,730	33.5	< 30
Elk tunnel	10/10/97	--	7.10	--	1,280	815	7.85	--	6.00	342	4,790	14	< 40	--	26.9	--	3,060	--	1,750	< 4	--	225	< 2.0	< 30
(AML_MINE_ID # 147)	12/29/97	0.40	6.14	--	1,460	790	8.39	1.15	6.09	305	4,880	10	< 40	n.d.	28.2	28.3	3,080	3,440	1,730	< 4	< 4	152	< 2.0	< 30
	2/12/98	0.30	6.20	0.6	1,480	796	7.81	1.13	6.03	300	4,790	12	< 40	n.d.	27.4	28.4	3,280	3,600	1,690	< 4	< 4	164	< 2.0	< 30
	3/24/98	0.57	6.79	0.0	1,510	800	9.25	1.03	6.25	270	5,160	11	125	n.d.	28.6	32.2	3,380	3,540	1,740	< 4	< 4	168	< 2.0	< 30
	4/21/98	0.43	6.54	0.2	1,480	817	8.71	0.98	6.06	277	4,930	11	66	n.d.	27.2	31.3	3,450	8,960	1,680	< 4	< 4	168	< 2.0	< 30
	5/5/98	0.55	7.04	0.1	1,510	820	8.08	0.96	6.41	300	5,140	10	49	249	28.4	35.3	3,630	15,400	1,800	< 4	< 4	174	< 2.0	< 30
	5/21/98	0.45	7.18	0.1	1,480	793	8.56	0.93	6.13	286	4,910	11	48	n.d.	28.1	29.1	3,580	3,890	1,760	< 4	< 4	215	< 2.0	< 30
	6/24/98	0.34	6.50	0.3	1,410	800	7.26	0.96	5.71	252	4,490	11	< 40	241	26.9	29.6	3,480	3,840	1,900	< 4	< 4	201	2.3	38
	7/23/98	0.34	6.93	1.2	1,460	780	7.31	1.12	5.92	307	4,590	< 2	< 40	239	27.1	31.6	3,560	5,280	1,710	< 4	< 4	164	< 2.0	< 30
	10/14/98	0.34	6.79	0.3	1,450	867	7.93	0.92	6.07	322	5,020	10	123	123	28.0	26.9	3,540	4,880	1,720	< 4	< 4	187	< 2.0	< 30
Minimum		0.30	6.14	0.0	1,280	780	7.26	0.92	5.71	252	4,490	10	48	123	26.9	26.9	3,060	3,440	1,680	--	--	152	2.3	< 30
Median		0.40	6.79	0.3	1,470	800	8.00	0.98	6.07	300	4,895	11	66	240	27.7	29.6	3,465	3,890	1,735	--	--	171	2.3	< 30
Mean (n = 10)					1,452	808	8.12	1.02	6.07	296	4,870	11	82	213	27.7	30.3	3,404	5,870	1,748	--	--	182	2.3	17
Standard Deviation				0.4	67	24	0.62	0.09	0.19	26	216	1.3	39	60	0.65	2.6	203	3,972	64	--	--	24	--	--
Maximum		0.57	7.18	1.2	1,510	867	9.25	1.15	6.41	342	5,160	14	125	249	28.6	35.3	3,630	15,400	1,900	--	--	225	2.3	38
Eveline mine	11/6/96	0.010	3.31	--	472	178	2.36	--	10.2	4.60	77	< 2	10,600	10,700	57.5	49.3	15,500	17,700	843	55	51	858	5.2	< 30
(AML_MINE_ID # 91)	12/11/96	0.030	3.29	1.9	490	162	2.48	--	10.6	5.03	81	< 2	11,000	11,000	58.8	49.8	15,600	17,700	881	54	48	885	6.4	< 30
	1/22/97	0.016	3.20	2.3	500	156	2.42	--	10.3	4.71	79	< 2	10,800	10,700	57.0	49.0	15,100	17,300	860	53	47	826	4.0	< 30
	2/13/97	0.014	2.81	3.0	493	153	2.28	--	9.97	4.48	74	< 2	10,300	10,300	55.5	46.7	14,700	16,900	829	43	47	837	4.9	< 30
	3/14/97	0.023	3.18	4.9	502	161	2.43	--	11.1	5.08	87	< 2	11,100	10,600	52.4	47.0	14,700	14,700	889	49	46	904	6.7	< 30
	4/25/97	0.012	3.00	--	510	171	2.21	--	10.4	4.67	81	< 2	11,000	10,700	49.1	47.2	13,700	15,200	836	41	47	851	2.5	< 30
	5/22/97	0.018	3.16	3.2	502	170	2.47	--	10.6	4.88	79	< 2	11,100	12,300	50.4	51.4	17,400	26,300	878	67	292	895	4.3	< 30
	6/5/97	0.026	3.15	2.4	494	183	2.25		10.8	4.72	76	< 2	11,800	11,400	49.9	50.2	24,600	26,000	911	283	268	1,240	8.9	< 30
	7/17/97	0.017	3.19	2.1	470	173	2.41	--	10.1	4.62	75	< 2	11,300	11,100	59.5	59.0	20,900	23,200	853	206	202	949	3.4	< 30
	8/19/97	0.010	3.11	2.6	468	175	2.50	--	10.2	4.70	78	< 2	11,100	10,200	60.5	55.9	17,900	18,800	859	100	88	892	4.3	< 30
	9/11/97	0.022	3.04	1.4	457	180	2.49	--	10.2	4.68	76	< 2	10,900	10,600	59.9	57.8	16,600	18,000	859	88	82	885	2.7	< 30
Minimum		0.010	2.81	1.4	457	153	2.21	--	10.0	4.48	74	--	10,300	10,200	49.1	46.7	13,700	14,700	829	41	46	826	2.5	< 30
Median		0.017	3.16	2.4	493	171	2.42	--	10.3	4.70	78	--	11,000	10,700	57.0	49.8	15,600	17,700	859	55	51	885	4.3	< 30
Mean (n = 11)		0.018		2.6	487	169	2.39	--	10.4	4.74	78	--	11,000	10,873	55.5	51.2	16,973	19,255	863	94	111	911	4.8	< 30
Standard Deviation		0.007		1.0	17	10.0	0.10	--	0.34	0.18	3.6	--	382	583	4.3	4.4	3,215	4,048	24	78	95	114	1.9	--
Maximum		0.030	3.31	4.9	510	183	2.50	--	11.1	5.08	87	--	11,800	12,300	60.5	59.0	24,600	26,300	911	283	292	1,240	8.9	< 30
Forest Queen	11/6/96	0.036	4.68	0.5	856	433	8.84	--	13.9	137	1,270	7	2,150	1,900	57.0	45.4	25,300	24,300	2,460	< 4	< 4	641	8.3	44
(AML_MINE_ID # 195)	12/11/96	0.039	4.69	0.4	865	446	8.54	--	13.5	132	1,220	7	2,070	1,840	55.5	44.2	24,500	23,600	2,390	< 4	< 4	599	5.4	40
	1/22/97	0.058	4.80	0.2	870	442	9.90	--	15.5	153	1,420	7	2,380	1,980	62.2	46.5	28,100	24,900	2,740	< 4	< 4	709	3.3	< 30
	2/12/97	0.036	4.44	0.4	883	450	8.49	--	13.5	133	1,220	7	2,050	2,370	54.5	44.8	24,300	24,000	2,390	< 4	4	604	8.4	< 30
	3/13/97	0.036	4.76	0.0	872	425	7.87	--	13.3	128	1,150	5	2,060	1,970	45.7	44.9	23,200	24,000	2,270	< 4	< 4	569	5.4	< 30
	4/24/97	0.022	4.57	--	895	461	9.48	--	14.7	144	1,320	6	2,060	--	50.4	--	25,500	--	2,500	< 4	--	634	2.9	< 30
	5/22/97	0.044	4.49	0.0	854	477	9.31	--	14.1	141	1,390	5	2,130	2,010	60.0	47.2	25,200	25,100	2,510	< 4	< 4	613	< 2.0	< 30

Table 7. Time-series data from adit flow from seven mine sites.—Continued

Mine	Sample date	Discharge ft³/s	Field pH	Dissolved oxygen mg/L	Specific conductance µS/cm	Sulfate total mg/L	Na diss. mg/L	K diss. mg/L	Mg diss. mg/L	Ca diss. mg/L	Sr diss. µg/L	Ba diss. µg/L	Al diss. µg/L	Al total µg/L	Silica diss. µg/L	Silica total µg/L	Fe diss. µg/L	Fe total µg/L	Mn diss. µg/L	Cu diss. µg/L	Cu total µg/L	Zn diss. µg/L	Cd diss. µg/L	Pb diss. µg/L
Detection limit--						*1*	*0.1*	*0.01*	*0.01*	*0.15*	*3*	*2*	*40*	*40*	*0.2*	*0.2*	*30*	*30*	*10*	*4*	*4*	*20*	*2.0*	*30*
Forest Queen (continued)																								
	6/5/97	0.052	3.72	0.0	920	472	8.36	--	13.6	141	1,430	5	1,890	1,840	56.7	45.3	24,000	24,300	2,420	< 4	< 4	598	4.3	< 30
	6/19/97	0.077	5.06	0.0	969	456	6.72	--	11.9	125	1,260	7	1,580	2,020	48.8	57.2	21,100	25,600	2,120	< 4	< 4	538	< 2.0	< 30
	7/18/97	0.070	4.92	0.4	934	449	8.89	--	13.3	141	1,450	6	1,920	1,870	57.9	55.2	24,300	24,300	2,350	< 4	< 4	588	3.8	< 30
	8/18/97	0.050	5.05	0.0	872	481	8.28	--	12.8	133	1,340	6	1,820	1,810	55.5	53.5	23,700	22,900	2,260	< 4	< 4	567	8.7	< 30
	9/11/97	0.036	4.64	0.0	770	475	8.86	--	13.1	133	1,320	5	1,960	1,650	58.3	49.8	24,400	22,300	2,330	< 4	< 4	605	8.0	< 30
	8/11/98	0.083	6.65	--	1,390	787	8.71	1.44	11.0	272	3,760	13	305	5,360	39.1	57.8	10,900	42,700	2,240	< 4	20	349	< 2.0	< 30
	7/29/99	0.005	5.83	3.7	1,220	746	9.53	3.09	12.2	250	2,970	19	1,450	--	42.6	--	2,380	--	2,410	< 4	--	828	112.0	< 30
	8/3/99	--	6.27	--	1,640	1,250	9.56	1.56	11.1	359	4,710	14	540	--	36.7	--	10,200	--	2,550	< 4	--	485	84.8	< 30
	8/13/99	--	6.20	3.8	1,590	1,190	11.9	1.75	12.8	409	5,360	12	705	--	44.1	--	12,100	--	2,830	< 4	--	477	86.0	< 30
	8/20/99	--	6.07	6.1	1,710	1,110	8.99	1.45	10.6	378	5,150	15	241	--	35.4	--	11,500	--	2,710	< 4	--	355	37.1	< 30
	8/25/99	--	5.65	7.5	1,770	1,010	9.56	--	10.9	393	5,500	19	244	--	36.0	--	11,400	--	2,860	< 4	--	386	32.2	< 30
	9/1/99	--	5.69	7.2	1,320	756	10.3	1.60	10.9	349	4,550	13	523	--	37.8	--	10,500	--	2,600	< 4	--	337	23.7	< 30
	9/9/99	--	5.80	9.0	1,380	746	9.99	1.45	11.7	294	3,620	10	1,120	--	41.8	--	8,610	--	2,450	14	--	545	70.7	< 30
	9/16/99	--	5.92	6.9	1,510	577	9.59	1.10	11.2	334	4,350	13	601	--	38.8	--	10,400	--	2,590	< 4	--	393	39.2	< 30
	3/30/00	0.003	5.07	8.5	622	--	7.70	1.61	11.9	93	714	17	974	--	--	--	13,400	--	2,310	14	--	559	5.4	< 30
	4/26/00	0.003	5.97	6.1	617	--	7.70	1.50	12.1	95	707	11	953	--	21.3	--	15,900	--	2,340	< 4	--	614	17.2	< 30
	6/2/00	--	5.72	3.1	685	--	7.80	1.50	12.8	106	872	9.9	1,770	--	48.6	--	19,700	--	2,270	< 4	--	679	19.5	< 30
	7/19/00	0.105	5.58	--	783	--	8.70	1.58	12.8	162	1,640	15	1,480	--	48.2	--	20,200	--	2,360	< 4	--	616	19.2	< 30
	9/20/00	0.001	6.09	4.7	733	--	8.40	1.55	10.8	124	1,130	21	70	--	44.4	--	8,240	--	2,200	< 4	--	79	9.0	< 30
Minimum		0.001	3.72	0.0	617	425	6.72	1.10	10.6	93	707	5.0	70	1,650	21.3	44.2	2,380	22,300	2,120	14	4	79	2.9	< 30
Median		0.037	5.33	1.8	889	477	8.85	1.55	12.8	141	1,405	9.9	1,530	1,935	48.2	46.9	19,950	24,300	2,400	14	12	579	9.0	< 30
Mean (n = 26)					1,059	649	8.92	1.63	12.5	202	2,339	10.6	1,348	2,218	47.1	49.3	17,655	25,667	2,441	14	12	537	26.7	< 30
Standard Deviation				3.3	357	274	1.03	0.46	1.3	106	1,646	5.0	739	1,004	9.9	5.2	7,306	5,439	191	0	11	150	31.5	--
Maximum		0.105	6.65	9.0	1,770	1,250	11.9	3.09	15.5	409	5,500	21	2,380	5,360	62.2	57.8	28,100	42,700	2,860	14	20	828	112.0	44
Mighty Monarch	3/5/98	0.044	6.43	8.1	376	124	3.58	0.53	4.34	60.7	548	23	< 40	114	13.4	14.8	102	686	786	< 4	10	458	6.0	< 30
(AML_MINE_ID # 285)	4/21/98	0.076	6.35	8.5	375	118	4.20	0.39	4.63	64.9	606	19	96	72	14.2	16.8	31	545	793	< 4	< 4	449	< 2.0	< 30
	5/6/98	0.049	7.17	8.7	373	115	3.89	0.40	4.51	62.7	581	17	90	103	13.8	16.1	64	393	803	< 4	< 4	466	< 2.0	< 30
	5/21/98	0.053	7.52	7.0	371	120	2.77	0.37	3.67	49.0	449	15	< 40	99	11.1	14.6	34	451	678	< 4	9	376	< 2.0	31
	6/8/98	0.078	6.70	8.7	376	120	3.79	0.41	4.45	60.6	566	22	< 40	141	13.5	15.4	58	471	985	< 4	6	519	3.0	< 30
	7/2/98	0.058	6.50	8.4	376	123	3.66	0.41	4.19	57.0	533	19	< 40	62	12.8	14.6	57	468	837	4	9	469	< 2.0	< 30
	7/22/98	0.081	6.60	8.6	377	120	3.45	0.43	4.53	61.2	568	18	< 40	88	13.7	15.6	44	429	869	< 4	7	447	< 2.0	< 30
	8/19/98	0.047	7.20	8.6	360	115	3.76	0.43	4.43	60.7	562	19	54	137	13.8	15.5	46	393	860	< 4	8	464	2.0	< 30
	9/24/98	0.041	6.80	6.4	359	122	3.93	0.39	4.58	63.1	584	18	< 40	77	14.2	14.7	33	364	881	< 4	5	484	< 2.0	< 30
	10/14/98	0.074	6.60	6.4	359	120	3.61	0.38	4.52	62.1	585	18	55	182	13.9	15.6	< 30	578	895	< 4	11	473	< 2.0	< 30
	11/2/98	0.044	6.18	7.1	358	123	3.35	0.38	4.39	59.2	553	16	< 40	--	13.3	--	< 30	--	906	< 4	--	483	2.2	< 30
	12/29/98	0.018	7.27	--	356	91	4.17	0.44	4.53	63.2	595	15	< 40	--	14.3	--	< 30	--	676	< 4	--	426	2.4	< 30
Minimum		0.018	6.18	6.4	356	91	2.77	0.37	3.67	49.0	449	15	54	62	11.1	14.6	31	364	676	4	5	376	2.0	< 30
Median		0.051	6.65	8.4	372	120	3.71	0.41	4.48	61.0	567	18	73	101	13.8	15.4	46	460	849	4	9	465	2.4	< 30
Mean (n = 12)					368	118	3.68	0.41	4.40	60.4	561	18	74	108	13.5	15.4	52	478	831	4	8	460	3.1	< 30
Standard Deviation				0.9	8.7	8.9	0.39	0.04	0.26	4.1	41	2.5	22	37	0.87	0.72	22	99	90	--	2	35	1.7	--
Maximum		0.081	7.52	8.7	377	124	4.20	0.53	4.63	64.9	606	23	96	182	14.3	16.8	102	686	985	4	11	519	6.0	31