Expanded Site Inspection Report
on
Molycorp Inc, Questa Division
Taos County, New Mexico

(CERCLIS ID# NMD0022899094)

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Molycorp Inc., Questa Division
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I. INTRODUCTION

Molycorp Inc., Questa Division (or Molycorp Site) is a molybdenum mine and tailings disposal site in Northern New Mexico. It is currently under review by the New Mexico Environment Department (NMED), Superfund Program to determine whether the site is a potential candidate for inclusion on the National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980. To further evaluate the site, an Expanded Site Inspection (ESI) was conducted to obtain information critical for this assessment.

A. Expanded Site Inspection Objectives

This Expanded Site Inspection (ESI) was performed to obtain information relevant to the evaluation of the Molycorp Site using the Hazard Ranking System (ref. 1). The purpose of the ESI is to determine whether Molycorp Site poses a potential threat to human health and the environment. The information collected involved sampling various environmental media and review of records to more accurately determine the presence and distribution of CERCLA hazardous substances (listed in the Superfund Chemical Data Matrix, ref. 2) along the air, soil, surface water and groundwater migration/exposure pathways. Environmental media sampled included mining waste, soil, sediment and water. Air was not sampled during this investigation since recent monitoring data from NMED showed no exceedances of any ambient air quality standards.

B. Site Description

The Molycorp Site is situated in Taos County near Questa, New Mexico (Fig. 1) and consists of two separate areas: the mine and the tailings ponds (Fig. 2). The Molycorp Site and surrounding area are located on the following USGS 7½' quadrangle maps: Sunshine NM, Cerro NM, Latir Peak NM, Guadalupe Mountain NM, Questa NM and Red River NM (ref. 3). The mine, surrounded by Carson National Forest, occupies approximately three square miles on patented land owned by Molycorp, Inc. The mine, located at 36° 42' 30" N latitude and 105° 30' 30" W longitude (ref. 3), lies along the Red River and several side drainages including Sulphur Gulch, Spring Gulch, Goathill Gulch and Capulin Canyon (Fig. 2). The mine consists of both underground and open pit operations, a mill and two waste disposal areas (Fig. 3). Other features present in the mine area of the site are several groundwater seeps along the Red River, catchment basins to control run-off, a network of mining-related roads and several areas of erosion subsequently referred to as hydrothermal scars (ref. 4, photos 1, 3, 5). In the vicinity of the Molycorp mine, precipitation varies from about 16 inches per year at elevations of 8,000 feet to approximately 35 inches per year at elevations up to 11,000 feet (ref. 5, p. 33). Mean annual temperature near the mine is about 40° F.

Tailings ponds occupy approximately 1 square mile and consist of two large ponds (designated by Molycorp as Ponds 1 & 4) and two smaller ponds (Ponds 2 and 5A; Fig. 2). These tailings ponds are located 1-2 miles west of Questa, NM and 5-6 miles west of the mine on land owned by Molycorp, Inc. The coordinates of the tailings ponds are 36° 42' 30" N latitude and 105° 37' 0" W longitude. A series of pipelines transported the tailings from the mill site to the ponds until Molycorp became inactive in 1992. In the vicinity of the tailings ponds, annual precipitation is approximately 12.5 inches with average annual temperature of 45° F (ref. 6, p. III-8, 9).

The Red River is located immediately south of the Molycorp mine and tailings ponds and flows in a westerly direction (Fig. 2). The drainage area covers approximately 190 square miles and ranges in elevation from the top of Wheeler Peak (elev. 13,161 feet) to the confluence with the Rio Grande (elev. 6,500 feet) (ref. 7, p. 14, 15). Two tributaries to the Red River in the vicinity of the mine and tailings ponds are Columbine Creek and Cabresto Creek (Fig. 2). Four to five miles below the tailings ponds, the Red River enters the Rio Grande.

C. Operational History

Molybdenum Corporation of America (MCA) acquired mining rights to Sulphur Gulch, a side drainage to the Red River, in 1920. They conducted small-scale mining operations until 1923 when a mill was constructed. The old underground workings consisted of adits, winzes and raises which followed the irregular vein system. In 1941, a haulage adit approximately one mile long was constructed to facilitate ventilation and drainage (ref. 8, p. 8). By 1954 this underground complex contained over 35 miles of workings at 14 production levels ranging in elevation from 7764 to 8864 feet. By 1954 all but the lowest three working levels were designed to drain by gravity out a mile-long service portal (known as the Moly Tunnel) located above the elevation of the Red River. The lower three working levels gathered drainage in a sump and this water was pumped to the service portal where it was allowed to drain by gravity to the Red River. This original underground Molycorp mine continued to grow until the open pit mine was developed. In 1965, MCA switched to an open pit operation which required the transport of tailings via a pipeline approximately eight miles downstream to tailings ponds located 1-2 miles west of the town of Questa. Dam # 1 is located in Section 36 of T 29 N, R 12 E. Decant water from the associated pond was discharged to the Red River via culvert tunnels through the dam. To ensure integrity of Dam #1, a smaller dam was constructed in 1969 just north of Dam # 1 which contained overflow weir structures to keep waste water from the dam face (ref. 9, Table 1).

Waste water was conveyed to a small holding pond (called Pope Lake) for further settling before discharge to the Red River. Molycorp referred to this discharge point as outfall # 001 of their permit under the National Pollution Discharge Elimination System (NPDES) (ref. 10). In 1971, a second large dam (Dam # 4) was constructed southwest of Dam # 1 (in Section 35 of T 29 N, R 12 E) with an impermeable membrane on the dam face. Surface water diversion ditches were installed in 1974 on the north, east and west sides of the ponds to divert surface water run-on around the ponds (ref. 9). The following year, interceptor trenches (called seepage barriers) were constructed below Dam # 1 and east of Dam # 4 to collect leachate from the tailings ponds. This waste water is diverted around dwellings below the dams and discharged to the Red River through NPDES outfall # 002.

In 1978, Unocal 76 Corporation purchased Molybdenum Corporation of America and shortened the name to Molycorp, Inc. Molycorp constructed an ion exchange plant near Pope Lake in 1983 to treat the waste water prior to discharge. After extensive mineral exploration in Goathill Gulch during the 1970's and early 1980's, Molycorp ceased open pit operations in 1985 and reverted back to underground mining techniques. The recent mining activity is referred to as the new underground workings. Production declined significantly in 1989 due to decreased value of molybdenum. The number of employees at this time shrank from a maximum of over 1,000 to approximately 200. Low production continued until December 1991 when operations stopped (ref. 11, p. 3). There are currently only 16 employees who are preparing the mine for potential re-opening (ref. 11, p.2). In 1994 Molycorp began pumping the water that had been flooding the mine, and discharges this mine water via the tailings pipelines to the tailings ponds at Questa (ref. 12, p. 6).

D. Regulatory History

1. Other Agency Involvement

In 1966, the U.S. Department of Health, Education and Welfare (HEW), Federal Water Pollution Control Administration, conducted a baseline water quality survey of the Red River. A moderate increase of sulfate in the downstream direction was noted but metal concentrations varied little (ref. 13, p. V-1,2). The most significant effects observed were increased coliform counts from the town of Red River and the Red River Fish Hatchery (ref. 13, p. V-10). The overall quality of the river, including the segment adjacent to the Molycorp mine site, was determined to be high (ref. 13, p. II-1).

In November 1971, EPA conducted a study of the Red River in which they concluded that the chemical quality and biological conditions of the Red River water remained very good but that occasional breaks in the tailings pipeline resulted in some degradation of stream quality and biota (ref. 14, p. 4). During this same period of the late 1960s and early 1970s, however, the New Mexico Game and Fish Department discovered in the course of routine population studies that fish were conspicuously absent in the middle reach of the Red River where thriving populations had once existed (ref. 15). Fish census data of 1960 indicate that approximately 572 fish per mile were estimated in the river. The 1988 fish census found no fish in this same reach (ref. 16).

In 1982, EPA evaluated the Red River for potential impairment from metal loading (ref. 17). Among the findings were that concentrations of ambient total arsenic, cadmium, and silver exceeded EPA-recommended acute criteria; that 'Control' stations contained higher concentrations of all metals except zinc; and bioassay results from tests with Red River water suggested some biological toxic response may be occurring in the Red River (ref. 17, p. 35).

In 1983, the Red River and the Rio Grande in the vicinity of the confluence were designated a Wild and Scenic River (ref. 18, p. 49). In response to the designation the BLM published results of its study of water quality in the Red River and Rio Grande between 1978 and 1983. This study documented pollution sources and found a downstream increase in concentrations of various constituents, at times exceeding water quality standards, and found that the major impacts were due to mining and related activities. Nonpoint sources were found to be a major cause of elevated trace element concentrations (ref. 18, p. 49).

The U.S. EPA Superfund program (Region VI, Dallas, TX) conducted a Preliminary Assessment (PA) of the Molycorp site in May, 1980 and a Site Inspection (SI) in June, 1981. The conclusions of these reports, respectively, were for no further remedial action and placing the site at a lower priority (ref. 19). However, EPA funded field investigation teams (FIT) to investigate Molycorp in 1983 and 1985 (refs. 20, 21). Part of these investigations was an assessment of the Molycorp waste disposal area ("landfill") located near the head of Spring Gulch (above the mill area). This landfill was described as a mine rubble pile more than 100 feet thick that was also used as a disposal area for discarded equipment and parts. Some unrinsed reagent drums from the mill were the only "hazardous" wastes observed (ref. 20, p. 4). Soil samples were collected and analyzed for metals and organics in these EPA FIT investigations of the area, but were inconclusive, in part because appropriate background soil samples were not collected for comparison. The 1985 inspection observed a small oil spill (not sampled) and commented that the area was still active as a dump for empty drums and old equipment. Conclusions from the 1985 investigation included the recommendation for further study of this landfill under RCRA authority (ref. 21, p. 4). Molycorp has had two landfills (in Spring and Goathill Gulches) which are exempted from NM Solid Waste Management Regulations since they received only demolition and construction debris (ref. 22). The Spring Gulch site is inactive, having been covered with several hundred feet of overburden during subsequent mining operations that filled Spring Gulch.

In 1992, a report was submitted to the Congress of the United States by the New Mexico Water Quality Control Commission (WQCC) which reported an increase concentration in the Red River in the vicinity of the Molycorp Mine of several metals including cadmium, copper, lead, silver and zinc (ref. 23). Because these metals are listed CERCLA hazardous substances, the Molycorp Site was re-opened for investigation under CERCLA authority.

During 1994, another newly created state agency became involved in regulatory investigations at the Molycorp site. The NM Office of Natural Resource Trustee (ONRT) is investigating natural resource damages from Molycorp in the Red River area and has participated in sampling activities and review of Molycorp reports and workplans (ref. 24, p. 46, 47). A natural resource damage assessment (NRDA) is being conducted.

2. Involvement by New Mexico Environment Department (NMED)

Water quality concerns relating to the Molycorp site have been studied by several programs within NMED, predominantly by the Nonpoint Discharge Section of the Surface Water Quality Bureau and the Groundwater and Superfund Sections of the Ground Water Protection and Remediation Bureau. Point source discharges from the tailings ponds at Questa have been monitored through an NPDES permit issued by the U.S. Environmental Protection Agency. Renewal of the permit in 1993 (permit # NM0022360) included two additional discharge points for stormwater runoff from the mining site (ref. 10).

Groundwater monitoring data presented by Molycorp to NMED-Groundwater Section in April 1987 revealed contamination in one private well downgradient from the tailings ponds. The data, covering 1985 and 1986, showed an average lead concentration of 0.056 ppm (N = 8) in the water from this well (ref. 25). This level was greater than three times the reported background concentration of 0.016 ppm and above the WQCC standard of 0.05 ppm (ref. 25, p. 4). The maximum and minimum concentrations reported were 0.12 ppm and 0.01 ppm, respectively (ref. 25, p. 6). Comparing the results to the New Mexico State WQCC standards, Molycorp concluded the violation of the standard for lead on four different occasions (ref. 25 p. 12). Analytical results from seven private wells sampled in 1987 and 1988 by NMED, which included the well previously showing a violation, showed no detectable levels of lead or cadmium (Attachment A). Use of groundwater from this well for drinking had stopped by 1988 (ref. 24, p. 18).

Two studies conducted by the NMED-Surface Water Quality Bureau (SWQB) in 1986 and 1988 confirmed high metal loading of the Red River by periodic storm events, but found that metal concentrations in surface water and stream sediments were not elevated to the point of causing aquatic toxicity (refs. 26, 27). In these studies, the major elements which became elevated between the Red River Waste Water Treatment Plant and the Questa (USFS) Ranger Station were iron and aluminum. A portion of this segment abuts Molycorp property where mining operations have occurred. One conclusion drawn from these surface water surveys was that episodic run-off events may erode oxidized sulfide-rich soils from barren slopes and mining scars (ref. 26, p. 4; ref. 27, p. 3). This process generates acidic run-off, which mobilizes and transports trace elements, including heavy metals, to the Red River. The acidic run-off temporarily reduces the pH of the river. Metals precipitate out of solution downstream as the pH becomes more neutral. These surveys also concluded that biomonitoring in the Red River generally showed no chronic or acute toxicity but that biological indices were reduced in the area below the Molycorp mine (ref. 27, p. 3).

Groundwater seeps have been observed emerging and entering Red River in the vicinity of Molycorp Mine (ref. 24, p. 14-17; ref. 4, photo 3). Within this stretch of the Red River, the 1988 study by NMED-SWQB detected over a three-fold increase in manganese concentrations (ref. 27, p. 43, 51). Concentrations of zinc and total aluminum were elevated two to three times over this same reach of the river. Other reports have determined that there is a general increase in the loading of sulfate, manganese, iron, zinc and aluminum in the downstream direction, with those seeps located below Capulin Canyon being the major contributors (ref. 28, p. 31, 33).

A number of other investigations of Molycorp have been generated by the regulatory involvement of NMED-Groundwater Section. During 1987-90 Molycorp was proposing to build a new tailings impoundment area in the Guadalupe Mountain saddle area located on BLM lands several miles north of the existing ponds. Molycorp directed a number of hydrogeologic studies of the area as part of the requirements for an Environmental Impact Statement but never built the proposed new tailings facility because the mine operations ceased in 1992. In 1993, the GWPRB-Groundwater Section required Molycorp to submit an application for a Ground Water Discharge Plan for the tailings impoundments (application # 933). A similar request was made for the mine waste dumps in 1994 (application # 1055; ref. 29). While site investigation and monitoring processes are ongoing, approval of either Discharge Plan application is pending.

II. EXPANDED SITE INSPECTION

Molycorp was evaluated along four migration or exposure pathways: groundwater, surface water, air and soil. Environmental media sampled included the following: 1) waste samples from the mining waste rock piles and tailings ponds; 2) soil samples near the tailings ponds to identify the area of contamination; 3) groundwater samples from wells and seeps/springs to determine if a release from the waste sources has occurred; and 4) surface water and sediment samples from the Red River to identify a release of CERCLA hazardous substances and determine level of contamination.

A. Waste Source Characteristics

1. Source Identification and Quantity

Two areas of the Molycorp Site have been identified as potential waste sources for CERCLA hazardous substances: the mine waste dumps and the tailings ponds. While there are separate sub-units within each area (eg. multiple mine waste dumps and tailings ponds), these sub-units were considered collectively as mine waste dumps and tailings ponds due to their similarity of respective waste types.

The development of the open pit between 1965 and mid 1980's resulted in the deposition of mine waste rock in Capulin Canyon, Goathill, Sulphur and Spring Gulches and adjacent to the Red

River in areas referred to as Sugar Shack (Figs. 2, 3). A recent report has estimated the amount of waste material in each of the disposal areas (ref. 30, p. 45). The total amount of waste material at the mine waste dumps is 328 million tons (ref. 30, p. 45). While most of the dump material in Capulin Canyon and Goathill Gulch consists of altered volcanics, those dumps south and east of the pit consist primarily of andesite, aplite and granite (ref. 30, p. 7, 36). Prior to conducting the ESI and completion of a preliminary waste dump characterization study directed by Molycorp, little information was available regarding CERCLA constituents in the mine waste dumps. One field test performed by NMED-Surface Water Quality Bureau demonstrated the acid generating potential in several waste samples in which the pH of test water was reduced when samples of waste were shaken with water over a several minute period (ref. 31).

Tailings Ponds at Molycorp consist of fine-grained tailings and waste water located in a series of ponds west of Questa (Figures 2, 4). No bottom liner is present in any of four ponds (ref. 9, p. 3). Transmission of waste water from the tailings ponds to groundwater may be slowed by the deposition of fine-grained sediment on the bottom of the ponds. The amount of tailings in these ponds is estimated to be 95 million tons (ref. 30, p. 7). One split sample of the tailings analysis conducted by Molycorp and the Questa Board of Education in 1982 detected lead, copper and zinc at concentrations ranging from 90 ppm (lead) to 240 ppm (zinc) (ref. 32, p. B-13).

2. Waste Characteristics-Methods

Seven waste source samples were collected from the mine dumps during June 1994 to determine the presence of CERCLA hazardous substances. Sample locations were selected to evaluate the waste characteristics from each dump area (Fig. 3). Specific locations were initially intended to be selected based upon high relative readings of metal concentrations by x-ray fluorescence (XRF). Failure of the XRF resulted in visual selection of sampling points at more highly discolored locations (ref. 24, p. 51), which may be indicative of acid generation.

To assess whether the hydrothermal scar areas surrounding the mine waste dumps also could be a potential source of CERCLA hazardous substances, three composite soil samples (including one duplicate) were collected from the Eagle Rock and Hanson Creek scar areas (Fig. 3). Samples collected for analysis were homogenized in a designated plastic bag or in place prior to their transfer into two 4-oz. or one 8-oz. sample jar equipped with a Teflon-lined cap. All samples were split with Molycorp's consultant and analyzed for Target Analyte List metals under EPA's Contract Laboratory Program (CLP).

Collection of waste material in the tailings ponds occurred during April 1994 (Fig. 4). Eight waste samples from the four tailings ponds (including one duplicate sample) were collected and analyzed to identify the presence of CERCLA hazardous substances, with at least two samples from each of the two larger ponds (Ponds 1 and 4; Fig. 4). Because different tailings ponds were utilized at different times, samples from each pond, or various locations within a pond, may reflect changes in composition of the tailings over the period of operation.

At each sampling location within the tailings ponds, three waste locations 100 feet to 200 feet apart were screened for metal concentrations using x-ray fluorescence (Spectrace 9000). Selection of sampling location for waste source identification was based upon those screening locations which demonstrated higher XRF readings. Results for iron, barium and molybdenum were generally used as the basis for determining metal concentrations at each XRF screening location (ref. 24, p. 32-37). Results from the screening procedure are presented in Attachment B. Sample collection of the waste material from the tailings ponds involved the removal of the soil cap material (where present) with a hand auger, and collection of the upper 3 to 6 inches of tailings with a stainless steel hand auger (ref. 24, p. 32). Decontamination of the hand auger between waste samples was performed using deionized water. Samples collected for analysis were homogenized in a designated plastic bag prior to their transfer into two 4-oz. or one 8-oz. sample jar equipped with a Teflon-lined cap. All samples were split with Molycorp's consultant and analyzed for Target Analyte List metals under EPA's Contract Laboratory Program.

3. Waste Characteristics-Results

Analytical results of the average metal concentrations and the range of concentrations in the mine waste dumps are presented in Table 1 (ref. 65). Results indicate that most metals included in EPA's Target Analyte List were detected in the mine waste samples above the detection limits. Metals detected at the highest concentrations are those which are most abundant in the earth's crust including aluminum, calcium, iron, magnesium and potassium. Other metals ranged in concentrations from non-detectable levels (e.g. mercury) to over 1,000 mg/kg (e.g. manganese; Table 1). The large ranges of metal concentrations seen for most metals (e.g. cadmium, silver, zinc) demonstrates the heterogeneous nature of the mine waste dumps. This variation can be measured relative to the average concentration by calculating the coefficients of variation for each metal (Table 1). These values ranged between 50 and 245 % for all detected metals (Table 1).

Results of waste sampling at the tailings ponds is presented in Table 2 (ref. 65). Most metals on EPA's Target Analyte List were detected. Concentrations are fairly consistent as shown by coefficients of variation which are generally less than 50% (Table 2). Most metals demonstrating higher concentrations are those which are most abundant in the earth's crust such as aluminum, calcium, iron and magnesium.

Most metals on EPA's Target Analyte List were detected in the mine waste dumps and the tailings ponds with higher average concentrations generally noted in the tailings (iron, lead, zinc excluded; ca. Tables 1 and 2). While finding CERCLA hazardous substances in the waste sources does not require a comparison to background, evaluation of their potential to impact the surrounding environment should take into account effects from other potential sources. In the vicinity of the mine, hydrothermal scar areas represent another source of metal loading to groundwater and the Red River. Several composite soil samples from three of these scar areas (Eagle Rock, Goathill Gulch and Hanson Creek) were collected and analyzed for TAL metals. Results for the average concentration for each metal are presented in Table 3 (ref. 65). Variation in metal concentrations noted in the mine waste dumps is also apparent in the scar material.

4. Waste Characteristics-Discussion

Detecting differences between the mine waste dumps and hydrothermal scar areas is important in assigning attribution of any potential effects to groundwater and the Red River. To assist in detecting differences between the mine waste dump and scar material, ratios of average metal concentrations between the two sources were calculated (Table 4; ref. 65). Any dissimilarities in metal concentrations between the two areas are reflected in concentration ratios which deviate from unity. The mine waste dumps exhibited greater average concentrations (e.g. 2 to 5 times) of molybdenum, zinc, copper and manganese, while hydrothermal scar material had higher average levels of iron, alkali metals (potassium and sodium) and silver (Table 4).

Average metal concentrations of the tailings in the impoundments were also determined and compared to that of two surrounding soil types by calculating concentration ratios similar to those for the mine waste dumps (Table 4). Concentration ratios show that several metals exhibiting the highest average metal concentrations in tailings relative to surrounding soil are copper, calcium, magnesium, chromium and nickel (Table 4). Comparing these concentration ratios at the mine area and tailings ponds demonstrate that the tailings are more easily distinguishable from the surrounding soil (i.e. have higher ratios) than the mine waste dumps are from the hydrothermal scar areas (Tables 4).

B. Groundwater Migration Pathway

1. Geology and Aquifer Description

1.1 General Geology

The Molycorp mine is located along the Red River drainage in the Taos Range of the Sangre de Cristo Mountains where complex geologic history stems from Tertiary magmatism and regional block-faulting of the Rio Grande Rift (ref. 33, p. 3, 5, 7, 9). The Red River is located along a normal fault and is the southern boundary of a down-faulted area known as the Red River Graben (ref. 34, p. 94, 95, 99). North of the Red River fault but within the Red River drainage, there is a line of hydrothermal alteration scars marking a parallel fault (ref. 34, p. 95). A series of high angle normal faults which trend north has caused significant segmentation of this graben (ref. 34, p. 95).

The lithology in the vicinity of Molycorp mine is comprised of a Precambrian basement of igneous rock (granite) and metamorphic rock (amphibolites, quartzites and schists) which is overlain by Tertiary volcanics (ref. 8, p. 11). The volcanics consist of flows, breccias and tuffs of andesite, latite and rhyolite. These formations were intruded by a granitic stock of Miocene age (23 m.y.) and later by quartz and monzonite porphyries. Most of these intrusions, along with mineralizations associated with hydrothermal fluids, centered along the Red River Graben.

The town of Questa and the tailings ponds are located 5 miles to the west of the mine on the Taos Plain. This plain is situated within the Rio Grande Basin, a deep basin which was created through Miocene uplifting of the Taos Range (ref. 35, p. 12). This downfaulted area has received alluvial sediment from the Taos Range. Intermittent extrusion of basalt and andesite flows from ~~the~~ Guadalupe Mountains during late Pliocene and early Pleistocene (approximately 1.6 m.y.) resulted in interbedding of lava with alluvium. These lithologies, together with occasional lake deposits, comprise the Santa Fe Group (ref. 35, p. 15).

1.2 Hydrogeologic Setting

Mine Area

The principle aquifer in the vicinity of the mine is comprised of fractured igneous and volcanic bedrock (subsequently referred as Fractured-Bedrock Aquifer) and a second, overlying aquifer within the alluvium of the Red River channel and side channels (called Alluvial Aquifer) (ref. 12, p. 5). [For the purposes of this ESI, the "valley-fill mudflow and alluvial valley-fill aquifers" outlined in reference 12 were combined into the Alluvial Aquifer.] The depth of the alluvium within the Red River channel is as much as 150 feet thick (ref. 12, fig. 5). The placement of 12 new monitoring wells drilled in the Molycorp mine area in 1994 evaluated each of these aquifers (ref. 12, p. 3). Based upon pump tests of wells in the mine area, the aquifers are considered interconnected (ref. 12, p. 12). The hydraulic conductivity of the fractured bedrock was recently reported between 5.1 gallons/day/ft^2 and 629 gallons/day/ft^2 (.00024 cm/sec to .03 cm/sec; ref. 12, p. B-10); whereas that of the alluvium was 1,141 gallons/day/ft2 (.0539 cm/sec) (ref. 12, p. B-9). The variability seen in the fractured bedrock depends upon the degree of fracturing present at a given location.

A number of seepage studies have demonstrated that the Red River is a gaining stream in the vicinity of both the mine area and tailings area. In the middle reach of Red River (the reach from Red River to Questa, which includes the Molycorp mine area) seepage studies have documented accretion from groundwater into the Red River at average rates of 4 cubic feet per second (cfs) (ref. 36, p. 84, 85). As an approximation, this recharge rate could be assumed to be equally apportioned to each side of the river. Therefore, a portion of the 2 cfs from the north side originates from the drainage area of the Molycorp Mine. Other studies estimated groundwater recharge to the Red River from the Molycorp Mine drainage area to be between 1.45 and 2.56 cfs (ref. 12, p. B-6).

Tailings Ponds

The Santa Fe Group, underlying Questa and the tailings ponds, is the major water-bearing unit in the Rio Grande Basin of Taos County (ref. 35, p. 15). Depth to water in the Questa area is generally in the range of 60 to 160 feet (ref. 35, p. 22). The groundwater gradient in the vicinity of Questa is approximately 100 feet per mile (ref. 35, Plate 2). Groundwater flow near the town of Questa and the tailings ponds is generally southwest away from the mountains, and recharges the Red River and Rio Grande by numerous springs which generally emerge from a basalt layer. The lower reach of Red River (from Cabresto Creek to mouth of Red River, Fig. 2) has been measured as having an average accretion rate from groundwater of approximately 33 cfs (ref. 35, p. 40). Those springs which recharge the Red River are located southwest of the tailings ponds toward the confluence of the Red River and Rio Grande (ref. 37, p. 20, 23). Some of these springs are hydrologically connected to the waste water which leaches through the tailings ponds (ref. 37, p. 19, 24).

2. Groundwater Use

Mine Area

The Fagerquist's Cottonwood Park is a small, 12 unit resort approximately 1/3 mile south of the Molycorp mine and 100 feet below the confluence of Columbine Creek and the Red River (Fig. 3; ref. 65). The resort's well is the well nearest the mine which supplies drinking water. Other supply wells which provide drinking water in the vicinity of the mine are the U.S. Forest Service wells located in Columbine, Fawn Lakes, Elephant Rock and Junebug Campgrounds (Fig. 3). With a depth of 56 feet (ref. 65, p. 1), the Fagerquist well taps the Alluvial Aquifer which is in hydraulic communication with the Fractured-Bedrock Aquifer. With the Fagerquist well located on the south side of the Red River, much of the recharge may be from the Columbine Creek area. This is suggested by the low concentrations of metals and sulfate and high alkalinity detected in the well as compared to Molycorp monitoring wells north of the Red River (Table 5).

Drinking water wells in the vicinity of Questa include private wells and community wells (ref. 38). These wells are west of the regional blockfault which created the Taos Range. While on the opposite side of the fault from the mine, nothing is known to preclude inter-communication among the Santa Fe Group Aquifer and the Fractured-Bedrock and Alluvial Aquifers near the mine. Therefore, most of the wells west of the regional block fault, including the Questa community supply wells, are potentially impacted by groundwater in the vicinity of the mine. The population served by groundwater wells within four miles of the mine is presented below:

Distance from Mine (mi.)	# Private Wells (ref. 39)	Population Served by Private Wells	# Community Wells (ref. 38, 40)	Population Served by Community Wells	Total Population
0-1/4	0	0	0	0	0
1/4-1/2	1	2*	0	0	2
1/2-1.0	0	0	0	0	0
1.0-2.0	0	0	0	0	0
2.0-3.0	4	12	1	44	56
3.0-4.0	10	30	4	1733**	1763
	Total Population:				1,821

* Fagerquists (Nearest Well; ref. 65)
** Includes Questa population or 1,644 persons (ref. 38)

Tailings Ponds

Several private wells located below the tailings ponds were used by residents for drinking water purposes until Molycorp offered to switch their drinking water supply to the Questa community well system (ref. 41). The basis for this switch was due to elevated concentrations of Total Dissolved Solids (TDS) and sulfate (personal communication, Dave Shoemaker, Site Manager). The switch from private wells to the Questa community well system began in approximately 1976 (ref. 24, p. 19). Several families refused to have their water supply switched; by November 1993, all but three wells had been switched (ref. 42).

Groundwater analysis submitted September 1993 by Molycorp, Inc. used an off-gradient well to reflect background conditions. This well, labelled MW-CH, is screened in the middle to lower units of the Santa Fe Group Aquifer (ref. 43, p. 15). Results from this sampling event show elevated levels above background of iron, manganese and zinc in several monitoring wells and detected levels of chromium and lead in one monitoring well (ref. 43, p. 23). Three private wells were also sampled during September 1993 with results showing no exceedances of New Mexico WQCC Standards (ref. 44); however, comparison of the reported concentrations of zinc in the private wells to the background value reported in the September 1993 report demonstrates over a three-fold increase in zinc in each private well (ca. ref. 43, p. 23 and ref. 44). Upon presenting the results from the sampling of private wells to the owners, Molycorp continued to offer to switch residents below the tailings ponds to Questa community water supply (ref. 44, p. 2). The Feliciano Rael well (Fig. 4) is believed to be the only private well currently used for drinking purposes (ref. 45; ref. 24, p. 43).

The population served by groundwater was evaluated within 4 miles of the tailings ponds. Locations for the Questa Community Wells, other community wells and the Rael well are shown in Reference 3. Location of drinking water wells were determined using well information from the New Mexico State Engineer's Office (ref. 39) and information provided by the Superintendents of the towns of Questa (ref. 38) and Red River (ref. 40). The two community supply wells for the town of Questa, with roughly equal pumping rates, provide water for 1,644 persons (ref. 38). Three additional community wells identified near Questa are an unnamed well near the offices for the Town of Questa, Eagle Lake Trailer Park and Cerro de Oro (ref. 38). Each have 10 - 15 service connections. Population served by each well was calculated by multiplying the number of connections and the number of persons per household (i.e. 2.95; ref. 46, Questa Village). The population of Cerro was estimated to be 396 (ref. 46, 47) and was assumed to be serviced equally from each of two community supply wells (Cerro East and West, ref. 40). Total population served by groundwater within 4 miles of the tailings ponds is presented below:

Distance from Tailings Ponds (mi.)	# Private Wells (ref. 39)	Population Served by Private Wells	# Community Wells (ref. 38, 40)	Population Served by Community Wells	Total Population
0-1/4	1	1	0	0	1
1/4-1/2	0	0		0	0
1/2-1.0	2	6	3	882*	888
1.0-2.0	20	59	2	852*	911
2.0-3.0	5	15	1	198**	213
3.0-4.0	22	61	1	198**	259
	Total Population:				2,272

* Includes ½ of Questa population or 822 persons (ref. 38)

** Includes ½ of Cerro population or 198 persons (ref. 46, 47)

3. Groundwater Pathway-Methods

The purpose of evaluating groundwater in the mine area and tailings ponds is to determine whether a release of CERCLA hazardous substances from the site has occurred. A release is observed where contaminant concentrations in downgradient groundwater exceed three times the upgradient or background concentration for a particular analyte. An alternative definition for a release is the detection of an analyte in downgradient samples when undetected in the background sample(s). Therefore, field sampling focused upon the collection and analysis of groundwater from both background and downgradient locations within each aquifer.

In the area of the mine where elevated concentrations of metals in seeps, springs and the Red River have been previously noted (refs. 12, 24, 28), much attention focused upon the attribution of these elevated contaminants to Molycorp operations above any contribution from hydrothermal scar areas. During this ESI, attempts to distinguish site-related discharge from that of background conditions were used to identify and attribute the release of hazardous substances to the mining activities.

Much of the sampling for the groundwater pathway involved the sampling of seeps/springs. [For this ESI, these terms will be interchangeable]. Because the seeps and springs most likely reflect groundwater quality and ultimately reach a surface water body, they were also evaluated through the groundwater-to-surface water pathway. A release of any CERCLA hazardous substances from a seep or spring to surface water can only be achieved if a release to groundwater has first been established.

Mine Area: Alluvial Aquifer

In the vicinity of the mine, background groundwater quality is highly variable and likely depends, in part, on the degree to which it has been impacted by mineralized areas of the lithology. To address the variability of the Alluvial Aquifer, four groundwater sampling locations were chosen to reflect background conditions: one of the Molycorp Mill wells, U.S. Forest Service wells at Elephant Rock and Junebug Campgrounds and the wastewater treatment plant (WWTP) for the town of Red River (Fig. 3). The first three wells are screened in the alluvium of the Red River channel while the well at the WWTP is screened in a mudflow (alluvium) representing a fan delta from a side channel (Attachment C). For the purposes of this ESI, the highest reported concentration of each analyte from any of the four background wells was used to represent the background condition.

A release to the Alluvial Aquifer was determined by sampling six seeps along the Red River in the vicinity of Molycorp haulage adit, Goathill Gulch, Capulin Canyon and Old Eagle Rock Campground (called Cliff Seep) (Fig. 3; ref. 24, p. 46-47, 64). Collection included both filtered and unfiltered samples to distinguish between dissolved and total metals. Comparisons of metal concentrations in downgradient groundwater locations to background were restricted to samples of similar fractions (dissolved or total).

Mine Area: Fractured-Bedrock Aquifer

No background well for the Fractured-Bedrock Aquifer was located. Those wells screened in the alluvium (Red River channel or tributaries) are not representative of background for this aquifer. The only water which may serve this function is within the mine workings. Although the mine workings may be impacting the water quality, mine water provides the best available approximation for background water quality in the Fractured-Bedrock Aquifer. Numerous groundwater locations within the mine workings have been sampled by Molycorp (ref. 30, Table 1.4; ref. 12, Table D-4). While their data does not include all Target Analyte List metals, their data best addresses temporal and spatial representativeness of this aquifer and was used for background water quality within the Fractured-Bedrock Aquifer. Cabin Spring also represents fractured bedrock flow since it is located where mudflows from hydrothermal scars are absent (ref. 12, figure 4) and emerges directly from bedrock (ref. 24, p. 71). For the purposes of this ESI, the highest metal concentrations within the mine workings was used as background to identify releases of CERCLA hazardous substances to Cabin Spring and the 4 monitoring wells which are screened in the fractured bedrock.

Identifying a release to groundwater focused upon downgradient monitoring wells (which were installed after completion of the ESI workplan) and seeps/springs. A total of four monitoring wells and six seeps were sampled and analyzed for total and dissolved metal concentrations and general chemistry (Cabin Spring excluded). Location of all monitoring wells and seeps sampled are presented in Figure 3. Four 1-liter high density polyethylene (HDPE) bottles were needed at each sampling location for total (unfiltered) and dissolved (filtered) metals and general chemistry. The latter required both a preserved and unpreserved sample. Water samples requiring filtering were initially collected in 4-liter containers. Samples were acidified to pH 2 with nitric acid (sulfuric for general chemistry) and kept on ice until arrival at the analytical laboratory. Samples were split with Molycorp's consultant and analyzed for Target Analyte List (TAL) metals under EPA's Contract Laboratory Program (CLP). Selected samples were also analyzed for general chemistry parameters under either CLP or the program of the New Mexico State Laboratory Division (SLD). SLD was used for latter sampling events due to the discontinuation of the applicable contract under EPA. In accordance with SLD's operating procedures, general chemistry samples were not filtered.

Tailings Ponds

Ten monitoring wells located below (south - southwest) the tailings ponds were sampled to identify a release of CERCLA hazardous substances from the ponds to the Santa Fe Group Aquifer. Analyses conducted on samples from each well included total metals, dissolved metals and general chemistry parameters. Results from these downgradient wells were compared to that from the Change House well which represented background conditions. Locations of all wells sampled are presented in Figure 4.

Five seeps, labelled A through E, were identified between the tailings ponds and the Red River Fish Hatchery (Fig. 4). Those seeps which demonstrated higher relative readings of conductivity (eg. seeps A, D, E) were assumed to have a higher metal content and samples were collected for laboratory analysis (ref. 24, p. 40). Water from a seep identified along Embargo Road below tailings pond #1 and Molycorp's discharge (Outfall #002) was collected along with the warm and cold water springs which provide water to the Red River Fish Hatchery and the hatchery's abandoned cold water spring collection point (Fig. 4).

Four 1-liter HDPE bottles were needed at each sampling location for total (unfiltered) and dissolved (filtered) metals and general chemistry. The latter required both a preserved and unpreserved sample. Water samples requiring filtering were initially collected in 4-liter containers. Samples were acidified to pH 2 with nitric acid (sulfuric for general chemistry) and kept on ice until arrival at the analytical laboratory. Samples were split with Molycorp's consultant and analyzed for Target Analyte List (TAL) metals under EPA's Contract Laboratory Program (CLP) (ref. 24, p. 62).

4. Groundwater Pathway-Results

Mine: Alluvial Aquifer

Analytical results of the four background wells sampled during this ESI are presented in Table 6 (ref. 65). The metal concentration used as background groundwater quality to which downgradient seeps were compared is the highest concentration reported among the four wells. Results of metal analyses of various groundwater seeps and their comparison to background is presented in Table 7 (ref. 65). Results show that metal concentrations were generally the same for filtered (dissolved) and unfiltered (total) samples. Two CERCLA metals (beryllium and copper) were elevated above three times background in at least one downgradient seep of the Alluvial Aquifer (Table 7). Copper demonstrated a 7 to 30-fold increase over background whereas Be showed up to a 4-fold increase (Table 7). Also, the non-CERCLA metals aluminum and manganese were elevated in at least a single seep. The highest concentrations of all four metals were noted in the Capulin Channel Seep.

Mine: Fractured-Bedrock Aquifer

Analytical results of metal concentrations (total and dissolved) in downgradient monitoring wells and Cabin Spring are presented in Table 8 (ref. 65). Representing background for the Fractured-Bedrock Aquifer are the highest metal concentrations reported from Molycorp mine workings (Table 8). Data show that several metals were elevated in at least one downgradient well and/or Cabin Spring including three CERCLA metals--arsenic, cadmium and copper (Table 8). All metals reported were most elevated in MW-7. Cabin Spring, represented by an unfiltered sample only, demonstrated copper and aluminum concentrations which were elevated 14 and 28-fold, respectively.

Tailings Ponds: Santa Fe Group Aquifer

Groundwater from three private wells located south of the tailings ponds were sampled for metals and general chemistry parameters. Of the three wells, only one is currently used for drinking purposes (ref. 45). Analytical results of the groundwater in private wells near the tailings ponds is presented in Table 9 (ref. 65). The results show that arsenic, chromium and lead (CERCLA hazardous substances) were detected in either the filtered or unfiltered sample from one of the private wells while undetected in the background sample. Arsenic was detected in the filtered sample from the Duran well at 4.7 ug/L (Table 9). This level is below EPA's Maximum Contaminant Level (MCL) of 50 ug/L. Groundwater results from the Herrera well show detectable amounts of lead (estimated at 8.5 ug/L in the filtered sample only) and chromium (16.6 ug/L in the unfiltered sample only). The levels at which these metals were detected are also below their respective MCL (Table 9). Groundwater from the Rael well showed detectable levels of zinc in both the filtered and unfiltered samples (Table 9). The estimated zinc concentration of 260 ug/L observed in the unfiltered sample is over three times the background concentration of 75 ug/L but well below the MCL of 5,000 ug/L (Table 9). Concentrations of several non-CERCLA metals were elevated in both filtered and unfiltered samples from private wells (downgradient) at least three times the background concentration (at Change House Well; Table 9). Elevated concentrations of sulfate were noted in both the Rael and Herrera wells.

Analytical results of groundwater from the monitoring wells, presented in Tables 10 and 11, reveal that most of the elevated concentrations of metals were detected in unfiltered samples whereas only a few non-CERCLA metals (e.g. calcium, magnesium and manganese) were consistently elevated in filtered samples (Table 11). Two CERCLA metals were detected in both filtered and unfiltered samples but were not elevated above background in both fractions. These include lead in MW-3 and MW-4 and copper in MW-7b (Tables 10, 11). Lead was noted in the filtered samples from MW-3 and MW-4 at elevated concentrations of 8.3 ug/L and 4.2 ug/L, respectively (Table 11). The respective lead concentrations of 1.5 ug/L and 2.4 ug/L in the unfiltered samples were not elevated above the background concentration of 2.5 ug/L (Table 10). Lead concentrations in these wells are below EPA's Maximum Contaminant Level (MCL) of 15 ug/L. Copper was detected at 3.5 ug/L and 38.9 ug/L in the filtered and unfiltered samples from MW-7b while undetected in background samples (Tables 10, 11). The concentration of copper from both filtered and unfiltered samples is below the MCL of 1,300 ug/L (Tables 10, 11).

Analytical results of the seeps sampled near the tailings ponds are presented in Table 12 (ref. 65). Several seep samples along the Red River (e.g. Seeps A, D and E), the North Irrigation Ditch (near Embargo Road) and Outfall #002 were compared to background groundwater at the Change House Well to determine whether a release of CERCLA hazardous substances to groundwater had occurred. Results show elevated concentrations of arsenic in both filtered and unfiltered samples from the Warm Spring (Table 12). Several non-CERCLA hazardous substances were also elevated in at least one seep, including aluminum, manganese, sulfate and Total Dissolved Solids (TDS) (Table 12). Other than aluminum and sulfate, which were observed at the Embargo Road seep at the highest concentrations, all other parameters were most elevated in Outfall #002 (Table 12).

5. Groundwater Pathway-Discussion

<u>Mine Area</u>

One area of uncertainty when evaluating groundwater quality downgradient from the mine area is the selection of a background sample. Two different aquifer types can be distinguished at Molycorp Mine: Fractured-Bedrock and Alluvium. Seeps along Red River are likely influenced by both aquifers since nothing precludes hydrologic communication between the two aquifers. Since the seeps are located within the alluvium (Cabin Spring excepted), the selection of background focused within this aquifer. Water quality of the Alluvial Aquifer is highly variable as demonstrated by the analysis of groundwater from the WWTP and Molycorp Mill well (Table 6). The probable reason for this difference is that the Red River WWTP well is screened in the alluvium of a side channel (Hot-N-Tot Creek) which is more greatly influenced by drainage from a hydrothermal scar area. Because the WWTP well and portions of the Molycorp mine area are likely impacted by drainage from hydrothermal scars, the water quality observed from the WWTP well represents the most conservative selection of background water quality for the Alluvial Aquifer. Comparison of downgradient seeps to this background demonstrated a release of CERCLA hazardous metals (beryllium and copper) to this aquifer.

A second method of identifying a release to the seeps below the Molycorp Mine focused upon the comparison to an upgradient seep near Hanson Creek. This seep most probably drains Hanson Creek where one of the largest hydrothermal scars is located (ref. 28, figure A). Previously reported data show over a 3-fold increase between Hanson Creek Seep (or Spring) and downstream seeps in aluminum, copper, lead, manganese and zinc (ref. 28, Appendix 1). Except for beryllium which was not reported, the three metals defining a release to the seeps (aluminum, copper and manganese) during the ESI were also elevated in this previous report. Furthermore, aluminum, beryllium, copper and manganese were detected at greater concentrations in the leachate from mine waste than hydrothermal scars (Table 13; ref. 65). A similar result is seen with data from another study which used a greater number of samples (Table 14; ref. 30, Table 1.2). Copper and manganese were also detected at twice the concentrations in soil samples from the waste dumps than the scar areas (Table 4). The consistency with which increased concentrations of beryllium, copper and manganese were detected in the mine waste dumps, the leachate from the dumps and in the seeps provides sufficient evidence for partially attributing to Molycorp the release of CERCLA hazardous metals to the Alluvial Aquifer.

All downgradient monitoring wells sampled during this ESI are screened in bedrock and represent the Fractured-Bedrock Aquifer. Evaluation of data from this aquifer resulted in a release of CERCLA metals (arsenic, cadmium and copper) in at least a single monitoring wells and/or Cabin Spring (Table 8). Because cadmium and copper were detected at greater concentrations in the soil and leachate samples from mine waste dumps as compared to hydrothermal scars (Tables 4, 13, 14), the release of CERCLA hazardous metals to the Fractured-Bedrock aquifer is partially attributable to Molycorp. This conclusion is supported by another study which demonstrated, through tritium dating, similarities between the water from MW-11 and Cabin Spring and that from mine waste leachate (ref. 12, p. D-8).

Tailings Ponds

Increased metal concentrations were noted primarily in the unfiltered (total metals) samples of private wells located downgradient from the tailings ponds (Table 9). These elevated levels, however, may not be representative of the aquifer they tap (Santa Fe Group Aquifer). Unfiltered samples can be affected by well construction and are less likely to be representative of groundwater characteristics than filtered samples. Although purging of a well is supposed to alleviate problems from well construction and completion, the difference in metal concentrations between the filtered (dissolved fraction) and unfiltered (total metals) samples seen for aluminum, iron and manganese in the Herrera well (Table 9) suggests that the unfiltered sample may be incorporating particulates and may not be providing a true reflection of the aquifer. Contrarily, arsenic and lead were detected solely in the filtered (dissolved fraction) sample from the Duran and Herrera wells, respectively. If either metal truly exists at their reported level, one would expected similar results from the unfiltered samples. However, arsenic and lead were not detected in the unfiltered sample from the Duran and Herrera well, respectively. This inconsistency most likely reflects analytical variability. Further proof that As and Pb are not elevated in these wells is provided by Molycorp's data (from split sampling) which showed undetected levels of these metals in the Duran and Herrera wells (ref. 48, p. 2-4). For the purposes of this ESI, a release to groundwater required at least a three-fold increase of an analyte in both the filtered and unfiltered samples. Using this definition, no release of CERCLA hazardous substances to private wells was observed. While the concentration of zinc was elevated in the unfiltered sample from the Rael Well, it was not elevated above three times background for the filtered sample (Table 9). Therefore the Rael well, which remains as the only private well for drinking water purposes, is subject to potential contamination from the ponds rather than actual contamination.

Analytical results from the monitoring wells downgradient from the tailings ponds showed several metals including aluminum (Al), calcium (Ca), magnesium (Mg), manganese (Mn) and potassium (K) which are elevated in both filtered and unfiltered samples (Tables 10, 11). These metals, however, are not listed as CERCLA hazardous substances. Copper was detected in both filtered and unfiltered samples from MW-7b while remaining undetected in background samples (Tables 10, 11). The sample detection limit for copper in the background sample, however, is greater than the level detected in the filtered sample for MW-7b (6 ug/L vs. 3.5 ug/L, respectively). It is uncertain whether the level detected in MW-7b (dissolved fraction) is truly greater than the concentration (though undetected) in the background sample. Due to this uncertainty, copper is not considered elevated in MW-7b. No other metal listed as a CERCLA hazardous substance is elevated in both filtered (dissolved fraction) and unfiltered (total metals) samples in downgradient monitoring wells. Therefore, a release of CERCLA hazardous substances to monitoring wells has not been established in the vicinity of the tailings ponds.

Seeps and springs which were sampled during this ESI flow directly into the Red River (Seeps A, D, E, Old Cold Spring Collection), into the North Irrigation Ditch (Embargo Road Seep) or are collected by the Red River Fish Hatchery (Warm and Cold Springs). They represent locations where groundwater enters a surface water body. Arsenic was detected in both filtered and unfiltered samples from Warm Spring while remaining undetected in the background well (MW-CH; Table 12). However, arsenic was detected in only three of the eight tailings samples and at levels slightly greater than the detection limit (Table 2). With arsenic concentrations in background soil which equal or exceed those in the tailings (Table 4), the elevated level in Warm Spring cannot be attributed to the tailings ponds. The elevated concentrations of other metals noted in the seeps (e.g. Al, Ca, Mg, Mn and K) are restricted to parameters which are not defined as CERCLA hazardous substances.

Laboratory results of groundwater (from private wells, monitoring wells and seeps) near the tailings ponds demonstrated elevated concentrations of non-CERCLA hazardous substances such as aluminum, iron and manganese in both filtered and unfiltered samples from at least one downgradient groundwater sampling location (Tables 10-12). An elevated level of arsenic (a CERCLA metal) was detected at a single location, but is unlikely attributable to the tailings due to the virtual absence of As in the tailings. Therefore, a site-related release of CERCLA hazardous substances to groundwater in the vicinity of the tailings ponds has not been established.

C. Surface Water Migration Pathway

1. Surface Water Flow Characteristics

The Red River is located immediately south of the Molycorp mine and tailings ponds and flows in a westerly direction (Fig. 2). The average annual flow of the Red River at Questa Ranger Station (located between the mine and the tailings ponds) is approximately 41 cubic feet per second (cfs, ref. 28, Fig. B). Two tributaries to the Red River are Columbine and Cabresto Creeks which enter the Red River between the Molycorp mill area and the tailings ponds. Additional inflows to the Red River include seeps and springs, NPDES discharges from Molycorp, Inc. and return water from the Red River Fish Hatchery, which is located one-and-a quarter mile below Molycorp's most downstream NPDES discharge point (called outfall #001; ref. 10). Three miles below the hatchery, the Red River enters the Rio Grande (Fig. 2).

Drainage (via overland flow) from Molycorp first enters the Red River at the uppermost outfall of their NPDES permit (outfall #005) located near the mill area (Fig. 2). This location is the first probable point of entry (PPE-1). Approximately one-third mile below PPE-1, drainage from Molycorp's mine waste in Sulphur Gulch also enters the Red River through groundwater migration (ref. 4, photo 2). The bottom or toe of this dump was constructed in a manner which purposely conveys any collected water to the Red River via the alluvium of the river channel (ref. 24, p. 24). This location is the first where groundwater enters the Red River (called PPE-g). The furthest downstream location where drainage from Molycorp is known to enter the Red River (called PPE-2) occurs at outfall #001 (NPDES discharge point; ref. 10; Fig. 2). Between PPE-1 and PPE-2 are other known and potential drainage inputs from Molycorp to the Red River such as additional NPDES discharge points and seeps/springs (see Groundwater Pathway).

2. Surface Water Use

The Red River is a popular recreational area supporting activities such as skiing, hiking and fishing. The stream reach between the mine and State Highway 522 near Questa (a length of approximately 5 miles) is often referred to as the "Dead Zone" as it no longer supports a natural fishery (ref. 49). The last fish survey within this reach reported zero fish (ref. 16). Anecdotes persist regarding the presence of abundant fish in the Red River in the 1960's. This is substantiated by the decrease in fish counts in the Red River over time (ref. 15).

Although a self-supporting fishery is lacking, Eagle Rock Lake, which is within the "Dead Zone", is heavily stocked by the New Mexico Department of Game & Fish (ref. 49). Red River is stocked bi-weekly between May and September with fish which can be caught (> 9 inches). The annual production of fish stocked in this area is 11,000 pounds, all of which is assumed to be caught (ref. 50). Water from the Red River is used at the Red River Fish Hatchery where it provides about 40% of the water for the raising of fish (ref. 51). The supplement of water comes from the collection of groundwater at Warm and Cold Water Springs (ref. 51). The total fish production at the Red River Fish Hatchery is approximately 300,000 pounds (ref. 50).

Numerous wetlands have been delineated by the US Fish & Wildlife Service along the Red River (ref. 63). Below the uppermost probable point of entry (PPE-1) where Molycorp's Outfall #005 for their NPDES permit is located, at least ten wetlands have been identified (ref. 63). The length of these wetlands varies between 0.1 and 0.5 mile. The total length of all the wetlands along the Red River below Molycorp Mine was estimated to be 1.8 miles (ref. 63).

The Red River also provides water for irrigation purposes near the town of Questa. Four surface water diversions are located below the mine: Questa Forest Service Ranger Station (North Irrigation Ditch); near the Old Eagle Rock Campground area (South Irrigation Ditch); and two within the town of Questa (Middle and Molino Ditches; Fig. 2). These diversion structures provide water for approximately 700 acres of agriculture (ref. 52). Water in the ditches or in the Red River is not used for drinking purposes (ref. 53).

Two miles below Outfall #001, the Red River has been designated as a Wild and Scenic River (Fig. 2); This designation extends down the Red River and Rio Grande for at least 15 miles (Fig. 2). Included within the Wild and Scenic designation (approx. 12 miles below Outfall #001) is the Canon del Rio Grande Recreation Area which extends approximately two miles down the Rio Grande. (Fig. 2).

Several species may occur at the Molycorp Site which are either threatened or endangered (as designated by US Fish & Wildlife) (ref. 54). Species include the Bald Eagle, American Peregrine Falcon and Southwestern Willow Flycatcher (ref. 54). The list of state threatened or endangered species which may occur in the area also includes the Baird's Sparrow and Meadow Jumping Mouse (ref. 55). Only the Bald Eagle has been verified by New Mexico Department of Game & Fish within four miles of Molycorp and 12 miles downstream (ref. 55). A single sighting of a Southwestern Willow Flycatcher along the Red River has been recorded, but the Red River is generally considered poor habitat for this species as it requires slow meandering waters with willow overgrowth (ref. 49). While unverified by the New Mexico Department of Game & Fish, the American Peregrine Falcon represents a (State) threatened species whose range is known to include the Red River (ref. 49). American Peregrine Falcon has a foraging range of up to 20 miles, and may be present at either the mine area or the tailings ponds where its range overlaps that of the Prairie Falcon (ref. 49). With the American Peregrine Falcon having such a large range, the Molycorp site (mine and tailings ponds) may account for a small proportion of it; however, one was sighted on the mine waste dumps during ESI field activities (ref. 24, p. 52).

3. Surface Water Pathway-Methods

A release of CERCLA hazardous substances from waste sources to the Red River was evaluated by the collection and analysis of surface water and streambed sediment samples upstream and downstream from the mine area. Near the tailings ponds, a release to North Irrigation Ditch was also evaluated for potential impact to surface water. Discharges by Molycorp to the Red River which may have exceeded those permitted under NPDES were also examined by direct sampling (at outfall #002).

Mine Area

Twenty-one sampling locations along the Red River near the mine area were selected to determine whether CERCLA hazardous substances have migrated into the river from the mine site (Fig. 3). The selection of sampling locations were based upon the presence of various inputs to the Red River such as creeks, seeps and springs. Media sampled included surface water, seeps and streambed sediments. Samples taken within the Red River were generally collected in a progressively upstream direction to minimize the possibility of disturbance of previous sampling from upstream locations. Samples were collected on three separate sampling events and analyzed for Target Analyte List (TAL) metals under EPA's Contract Laboratory Program (CLP). Selected samples were also analyzed for general chemistry parameters under either CLP or the New Mexico State Laboratory Division (SLD). SLD was used for latter sampling events due to the discontinuation of general chemistry analyses under CLP.

Water samples were collected prior to sediment samples to prevent elevated amounts of suspended sediment in the water samples caused by sediment sampling. Four 1-liter HDPE bottles were needed for total and dissolved metals and general chemistry. A preserved and unpreserved sample of filtered water were needed for general chemistry. Water samples requiring filtering were initially collected in 4-liter containers. All water samples were collected upstream from where the sampler was standing. Samples were acidified to pH 2 with nitric acid (sulfuric for general chemistry) and kept on ice until arrival at the analytical laboratory. Sediment samples were collected with an individually wrapped (sterile) plastic scoop to a depth of 1 to 2 inches so as to collect the maximum precipitate which may have formed on the streambed. Samples were collected in a plastic bag and homogenized prior to their transfer to either one 8-oz. or two 4-oz. jars equipped with a Teflon-lined cap. All samples were split with Molycorp's consultant.

Tailings Ponds

Determining a release of CERCLA hazardous substances to surface water near the tailings ponds followed three lines of investigation: input of groundwater directly to the Red River by seeps and springs; input of a particular seep near the tailings ponds to the North Irrigation Ditch; and exceedances of Molycorp's NPDES permit at outfall #002 (Fig. 4). Media sampled included surface water and seeps.

Four 1-liter HDPE bottles were needed for total and dissolved metals and general chemistry. A preserved and unpreserved sample of filtered water were needed for general chemistry. Water samples requiring filtering were initially collected in 4-liter containers. Samples were acidified to pH 2 with nitric acid (sulfuric for general chemistry as appropriate) and kept on ice until arrival at the analytical laboratory. Samples were split with Molycorp personnel and were analyzed for Target Analyte List (TAL) metals and general chemistry parameters under EPA's Contract Laboratory Program (CLP).

4. Surface Water Pathway- Results

Mine Area

Results from the analyses of Red River water samples show a general downstream increase of both total and dissolved metals (Table 15, 16; ref. 65). Using a sampling location above Molycorp property as the background surface water quality (sampling location #16, Fig. 3), an increase of at least three-fold was observed for both manganese and zinc (Table 16). This 3-fold increase first occurred for zinc at Goathill Gulch whereas that for manganese occurred below Capulin Canyon Seeps (sampling locations #7 and #3, respectively; Fig. 3). The highest reported concentration of either occurred where the Molycorp tailings pipeline crosses the Red River (Old Eagle Rock Campground; sampling location #2, Fig. 3). Elevated concentrations of manganese and zinc were also noted in this reach of the Red River during an earlier ESI sampling event (Table 17; ref. 65).

A release of CERCLA hazardous substances to the river is also documented by streambed sediment samples. Analytical results of the metal contents for 13 sediment samples are presented in Table 18 (ref. 65). This contamination may be due to suspended sediment deposition or precipitation of metal oxides originating from groundwater seeps. Using the data from the Red River above Molycorp property as background condition, several metals were elevated at various locations along the 8 downstream sampling locations (Table 18). Beryllium (Be), copper (Cu), lead (Pb), manganese (Mn) and zinc (Zn) were elevated above three times the background concentration in at least one-half of these locations (locations A through D and I, Fig. 3). Except for Mn, these metals are listed as CERCLA hazardous substances. Be, Cu and Zn demonstrated at least a five-fold increase at the location reporting the highest concentration. While the elevated concentrations generally increased in a downstream direction, the highest value was not necessarily at the farthest downstream location (Red River above Pipeline Crossing).

Tailings Ponds

Results for all seeps which may affect the Red River and the North Irrigation Ditch near Embargo Road are presented in the Groundwater Migration Pathway (Table 12). Impacts from the Embargo Road Seep to the adjacent irrigation ditch was evaluated by the collection of surface water in the irrigation ditch both above and below the inflow of the seep (Fig. 4; Table 19; ref. 65). While the concentration of several parameters increased below the input of the seep, including aluminum, manganese, sulfate and TDS, none of the elevations resulted in at least a three-fold increase (Table 19). A third sample from this ditch was taken above its return to the Red River and incorporates field drainage between Embargo Road and the river (Fig. 4). Data from this sample show that several metals increased dramatically. Calcium was documented at a 3-fold increase and magnesium, at a 20-fold increase for this location. Aluminum and manganese decreased in this sample (Table 19).

5. Surface Water Pathway-Discussion

Mine Area

Two sets of surface water data obtained during the ESI show a general increase in metal concentrations below the mine (Tables 15-17). The first set of data (June 26, 1994) documents over a three-fold increase in Mn and Zn concentrations between Columbine Creek and the USGS gaging station at the US Forest Service Ranger station near Questa (locations #9 and #1, Fig. 3; Table 17). Although a background sample was collected above Hanson Creek during this sampling event (location #18, Fig. 3), it did not adequately characterize surface water quality at the Molycorp property boundary since contributions of metals from Hanson Creek are unknown. Analysis from the second sampling event (Nov. 1994) demonstrates at least a three-fold increase of Mn and Zn between Molycorp property boundary (representing background) and where the Molycorp pipeline crosses the river (locations #16 and #2, respectively, Fig. 3; Tables 15, 16). The concentration at which Zn was detected in the Red River above the pipeline crossing (159 ug/L at location #2; Table 16; Fig. 3) exceeds the Ambient Water Quality Standard of 110 ug/L (ref. 2, p. B-54). The dilution effect from Columbine Creek may preclude the three-fold increase of other metals between these two sampling locations.

Analytical results from sampling events prior to this ESI have also shown elevated concentrations of Zn in the Red River below the Molycorp Mine and in Eagle Rock Lake (ref. 28, Appendix 2, p. 1, 2). During both sampling events the concentration of Zn in Eagle Rock Lake exceeded the Ambient Water Quality Standard of 110 ug/L.

The increase in metal concentrations in surface water is not uniform throughout the Red River between Molycorp property boundary and the pipeline crossing (locations # 16 and #2, respectively, Fig. 3). The largest gain of sulfate, Mn and Zn during ESI sampling was generally between Columbine Creek and Goathill Gulch (Table 20). This finding is consistent with two other data sets which focused on sulfate gain (Table 21; ref. 28, Appendices 2, 3). The data set

C. Soil Exposure Pathway

Soil sampling surrounding the tailings ponds was conducted to identify any elevated concentrations of CERCLA hazardous substances in residential soils which are attributable to the site. Determining areas of soil contamination required the comparison of soil constituents in residential yards to that of background soil locations.

1. Soil Exposure Pathway- Methods

Eight waste samples, including one duplicate, were collected from the tailings ponds to identify the presence of CERCLA hazardous substances. Soil samples were collected from residential yards south, east and north of the ponds and from Questa Jr. High School to the north of the ponds (Fig. 4). Soils from these residential areas represent two soil classifications as determined by the U.S. Soil Conservation Service: Sedillo series (residences to the south) and Silva Series (residences and school to the east and north) (Fig. 6). Background soil sampling locations were chosen for similarity in soil type to residential sampling areas and were generally upwind (south) from the tailings ponds (Fig. 4). The Silva soil type present at the eastern and northern residences and the junior high school is not present south (i.e. upwind) of the ponds; a location representing background was chosen further downwind (north). Sampling locations for waste (i.e. tailings) and soil are shown on Figure 6.

Generally, soil samples at each sampling location were first screened using x-ray fluorescence (XRF) for metal concentrations (ref. 24, p. 36, 37; Attachment B). Those with the highest metal content were chosen for laboratory analysis. This screening was abandoned due to time constraints; no XRF screening was conducted at background sampling locations (ref. 24, p. 38). Soil samples were collected from the top 1 or 2 inches with emphasis toward finer grain-sized particles. Sieving of samples was not conducted. Samples were homogenized in a designated plastic bag prior to their transfer into two 4-oz. or one 8-oz. sample jar equipped with a Teflon-lined cap. All samples were split with Molycorp's contractor and were analyzed under EPA's Contract Laboratory Program for Target Analyte List (TAL) metals.

2. Soil Exposure Pathway-Results

Analytical data of the metal concentrations in residential soil and the comparison to background concentrations is presented in Tables 22 and 23 (ref. 65). Results from residential areas to the south of the ponds and near the Change House area east of the ponds show concentrations of three metals which exceed three times the highest background concentration, namely chromium (Cr), copper (Cu) and nickel (Ni; Table 23). Only Ni was elevated in each of soils from the residential and Change House areas. Two of the three metals have soil benchmarks associated with them: Cr at 2,900 mg/kg; and Ni at 12,000 mg/kg (Table 22, ref. 2, p. B-59, B-66). The concentrations seen in residential or Change House soils are at least two orders of magnitude less than their respective benchmarks.

A release of CERCLA hazardous substances to the soil involves the evaluation of the top 2 feet of potentially contaminated areas. Because the capped portions of the tailings ponds have only one foot of soil (ref. 57), the entire tailings ponds were included in the soil exposure pathway. Chromium, copper and nickel, which were elevated in residential areas south of the ponds, was also elevated in the tailings ponds. Average concentrations of Cr, Cu and Ni in the tailings ponds were 40 mg/kg, 188 mg/kg and 30 mg/kg, respectively (Table 2). These concentrations were 7 to 26 times greater than that seen in the highest background soil (Table 22).

Soils found at the Trujillo and Martinez residences were initially interpreted as the Fernando Series and several background soil samples from this soil type were collected. Further study of the U.S. Soil Conservation Service map correctly identified the soil type at these residences as the Silva Series. Soil samples from the Fernando Series likely would misrepresent background for these residential areas. Therefore, the one soil sample collected approximately 1/4-mile north of Questa Jr. High School, which was initially intended to represent background conditions for samples collected at the school, also would provide background conditions for the Trujillo and Martinez residences. Analytical results of the soil metal concentrations using this single sample for background is presented in Table 23. Results show a single incident of a metal concentration being elevated, namely zinc at the Martinez residence. To determine whether this single background sample was sufficiently far from the tailings ponds to be representative of background conditions of this soil type, three additional soil samples (including one duplicate) was collected further north (i.e. downwind) from the tailings ponds (Fig. 4). Results using the latter sampling locations as background (near the road to Cerro) failed to define any release to soil (Table 23).

3. Soil Exposure Pathway-Discussion

<u>Tailings Ponds</u>

A release of CERCLA hazardous substances to soils surrounding the tailings ponds is defined by any metal concentration which exceeds three times background and is attributable to the waste source (e.g. tailings ponds). Elevated metal concentrations have been determined; to prove likely attribution of these hazardous substances to the tailings ponds, metal concentrations from the tailings were compared to that in background soil for the same soil types sampled in residential yards. A ratio of average analyte concentrations in the tailings to the highest concentration in background soil was calculated (Table 22). With ratios exceeding one, the tailings were found to have higher concentrations of most metals than in the Sedillo soil type sampled in background locations. Three CERCLA hazardous metals demonstrated at least a seven-fold increase in the tailings: Cr, Cu and Ni (Table 22). Each of these metals was elevated in at least two of the four soil sampling locations within the Sedillo soil type and thus providing justification of attribution of the elevated metals concentrations to the tailings ponds (Table 22).

Zinc was elevated in the soil of the Martinez residence (Fig. 7) when compared to the initial background sample (location #23, Table 23). Using the highest background concentration from subsequent sampling failed to identify a release. Because the average and highest zinc concentrations in the tailings ponds (Table 23 and Table 4, respectively) are below the concentration noted at the Martinez residence, the elevated level of zinc noted at the Martinez residence is not likely attributable to the tailings and does not define an area of soil contamination.

The current extent of soil contamination has been shown to include the tailings ponds and several residential areas south of the tailings ponds (Fig. 7). No soil contamination to the east and north has been identified. Areas between residences which demonstrate an observed release are inferred to lie within the area of soil contamination. The total area of soil contamination is 20,635,000 ft^2 of which 35,000 ft^2 is beyond the extent of the tailings ponds (ref. 24, p. 5, 73). The number of persons residing within the area of soil contamination and the respective level of contamination is presented below:

Residence Sampled	Additional # of Residences w/in Obs. Release	# of Persons	CERCLA Substance Defining Release	Soil Benchmark Exceeded (metal)?
Herrera		2	Cr, Cu, Ni	No
	2 (ref. 24, p. 37, 72)	6*	Cr, Cu, Ni	No
Rael		1	Cr, Cu, Ni	No
Clines		1	Cr, Cu, Ni	No

* calculated from number of houses within area of soil contamination and number of persons per household (ref. 46)

The total number of persons residing in areas of soil contamination is 10. No schools or daycares are present within 200 feet of the area of contamination.

Mine Area

Soil contamination in the vicinity of the mine was not examined past the extent of the mine waste dumps. While physically accessible (i.e. no fence exists), the dumps are private property and provide no public recreational use. The owners of the Fagerquist Cottonwood Park (2 persons) are the nearest residents and live within a half-mile of the mine waste dumps at Sugar Shack South (Fig. 3). Molycorp workers and terrestrial sensitive environments are potentially exposed to the mine waste dumps. It is assumed that the 16 persons currently employed by Molycorp (ref. 11) work within 200 feet of the mine waste dumps.

During waste source sampling for this ESI, a Peregrine Falcon was seen perched on the waste dump near the open pit (ref. 24, p. 52). Conversation with the Wildlife Biologist for the Questa Ranger Station has confirmed that the Red River valley is included within the range of a nesting pair (ref. 49). The appearance of the Peregrine Falcon on the waste dumps suggests its range likely includes the entire mining site. Whether the waste dumps present a health risk to Peregrines

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20. Preliminary Report by Ecology and Environment on Sampling Inspection at Molycorp, Inc., Questa, NM. EPA Site Inspection Report, NM 00558, August 19, 1983. For U.S. EPA Region VI.

21. Preliminary Report by Ecology and Environment on Sampling Inspection at Molycorp, Inc., Questa, NM. June 4, 1986. For U.S. EPA Region VI.

22. NMED-Solid Waste Bureau correspondence to David Shoemaker, Molycorp Site Manager accepting exempted status for landfill permit requirements. June 1, 1993. Also included is Exemption request letter from David Shoemaker, Molycorp, Inc. Jan. 27, 1993.

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26. Intensive Survey of the Red River, Taos County, New Mexico. August 18-21, 1986. Smolka, L. R., Tague, D. F. NMED-Surface Water Quality Bureau, Surveillance and Standards Section. Oct. 1987.

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31. Results of Shake Flask Test performed by Bob Saltar, NMED-Surface Water Quality Bureau on Molycorp mine waste samples. 1993.

32. Molycorp, Inc. Response to "Summary Statement" Presented by Questa Board of Education. March 1982.

33. Geology of the Questa Quadrangle, Taos County, New Mexico. McKinlay, P. F. 1957. New Mexico Bureau of Mine and Mineral Resources, Bulletin 53.

34. Clark, K.F. and C.B. Read, 1972. Geology and Ore Deposits of Eagle Nest Area, NM. Bureau of Mines and Mineral Resources, Socorro, NM. Bulletin 94.

35. Ground-water Conditions and Geology of Sunshine Valley and Western Taos County, New Mexico. Winograd, I. J. New Mexico State Engineer Office. Technical Report No. 12. 1959.

36. Seepage Investigation-Rio Grande Basin, Red River. Oct. 25, 1988. USGS-Water Resources Division.

37. Analysis of Tailings Pond Seepage Flow to Red River at UNOCAL 76 Molycorp, Inc. - Questa Division. Vail Engineering, Inc. Sept. 24, 1993.

38. Record of Telephone Conversation: Ben Herrera, Village of Questa Superintendent. Date: 4/30/90 and Questa Water Supply System.

39. New Mexico State Engineer's Office: record of wells with information on well identification Number, location, usage and ownership.

40. Record of Telephone Conversation: Robert Parry, Town of Red River Superintendent. Date: 6/17/93. Cerro Water Supply System.

41. Letter from Molybdenum Corporation of America to local citizen of Questa regarding notice of potential contamination of private wells and an offer by MCA (former name of Molcycorp, Inc.) to switch water supplies to Questa Community System.

42. Record of Telephone Conversation: David Shoemaker, Site Manager, Molycorp, Inc. Date: 11/19/93.

43. Hydrogeologic Evaluation of Tailings Ponds: Molycorp, Questa Division - Questa, New Mexico. South Pass Resources, Inc. Sept. 23, 1993.

44. Groundwater Analytical Data of Private Wells # 4b, 5 and 9 near the Tailings Ponds. Submitted by Molycorp, Inc. on Nov. 2, 1993.

45. Records of Communication : Daniel Duran, Questa citizen; private well owner. 8/20/95.

46. 1990 Census of Population and Housing: Summary of population and Housing Characteristics-New Mexico. U.S. Dept. of Commerce. 1990 CPH-1-33.

47. Record of Telephone Conversation: Mrs. Parry, former US Postal worker in Cerro, NM. Date: 6/16/93.

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50. Record of Telephone Conversation: Gene Santistevin, Wildlife Culturist, Red River Fish Hatchery. Date: 7/10/93.

51. Record of Telephone Conversation: Victor Trujillo, Manager, Red River Fish Hatchery; New Mexico Game & Fish Dept. Date: 2/1/94.

52. Record of Telephone Conversation: Wilfred Rael, Questa Citizen. 10/2/95.

53 Record of Telephone Conversation: Ken McCallum, New Mexico Environment Department-Taos District Office. 7/7/93.

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57. Record of Telephone Conversation: Bill Renison, Molycorp, Inc. Date: 7/23/93

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63. Classification of and Deepwater Habitats of the United States. Cowardin, L. M. U.S. Fish and Wildlife Service. FWS/OBS-79/31. Included: National Wetlands Inventory Map for Wheeler Peak, New Mexico.

64. Expanded Site Inspection-Analytical Data using Contract Laboratory Program.

65. Record of Telephone Conversation: Billye Fagerquist, owner/operator of Fagerquist's Cottonwood Park. 5/7/93. Included is information regarding well and water schematic.

Table 1. Metal Concentrations in Mine Waste Dumps (mg/kg)

Map Location	P	Q	R	S	T	U	V	Average Waste Dump Concentration (# of samples=7)	Coefficient of Variation (%)
	Capulin Waste Dump #1	Capulin Waste Dump #2	Goathill Waste Dump	Sugar Shack West Dump	Sugar Shack South Dump	Along Truck Shop Road	Along Lower Bench Road		
Date Sampled	6/27/94	6/27/94	6/27/94	6/28/94	6/28/94	6/28/94	6/28/94		
Field ID #	SS-4	SS-5	SS-6	SS-7	SS-8*	SS-9	SS-10		
CLP #	SF5804	SF5805	SF5806	SF5816	SF5819	SF5817	SF5818		
Analyte (mg/Kg)									
Al	1910	2730	5860	6190	18900	9130	5810	7219	73
Sb	nd	nd	nd	nd	nd	nd	nd	nd	na
As	2.6Jv	2.5Jv	11.4Jv	1.6Jv	0.96Jv	na	1.1Jv	3	124
Ba	45.2	171	46.2	27.5	246	41.2	4	83	100
Be	0.25	0.27	0.27	0.59	0.63	0.89	1.3	1	60
Cd	nd	nd	nd	nd	nd	nd	3.9	1	245
Ca	195	1350	2280	8860	18400	8670	15100	7836	83
Cr	nd	4.6	17.5	10.4	81.7	17	nd	19	142
Co	nd	2.4	3.5	5.6	9	13.3	2.9	5	80
Cu	26.3	45.4	41.6	126	140	222	92.5	99	65
Fe	13800	16800	27700	22700	46000	25400	7830	22890	50
Pb	431	40.2	91	61	31.1	40.8	275	139	103
Mg	265	1800	3610	4300	18700	4700	1250	4946	118
Mn	64.5	155	473	432	362	293	1080	409	75
Hg	nd	nd	nd	nd	nd	nd	nd	nd	na
Ni	nd	5.5	12.7	12.2	26.9	21.7	3.7	12	76
K	1620	2180	2550	2540	12300	2550	1020	3537	102
Se	na	1.5J	0.43J	0.35J	nd	nd	nd	3	69
Ag	3.2J^	2.9J^	4	nd	4.6	3J^	nd	1	159
Na	27.5	40.5	67	99.9	183	56.1	43.8	74	67
Tl	na	na	na	na	2.4Jv	na	na	2	0
V	1.3	5.9	12.7	14.9	83.3	16.2	3.4	20	135
Zn	86.5	20.8	53.3	66.3	35.4	43.3	569	125	146
Mo	9.3	6.1	24	10.8	168	176	207	86	100

nd = not detected
J = estimated value;
^ = value biased high; v = value biased low
na = not available (data unusable or value cannot be calculated)
* Sample was labelled SS-11 on chain of custody

Table 2. Metal Concentrations in Tailings (mg/kg)

MapLocation	6	7	8	4	5	3	1	2		
Tailings Pond	TP-1	TP-1	TP-2	TP-5A	TP-5A(dupl)	TP-4	TP-4	TP-4	Average	Coefficient
Date Sampled	4/18/94	4/18/94	4/18/94	4/18/94	4/18/94	4/18/94	4/18/94	4/18/94		
Field Station	S-12	S-13	S-14	S-10	S-10A	S-11	S-8	S-9	Conc.	of Variation
CLP ID#	MFT923	MFT924	MFT925	MFT926	MFT927	MFT928	MFT929	MFT930	(mg/kg)	
Analyte (mg/Kg)										
Al	6190	16300	3850	5620	6220	11000	8150	7070	8050	45.7
Sb	nd	nd	nd	nd	nd	nd	nd	nd	nd	na
As	nd	nd	1.2^J	nd	1.4^J	nd	1.1^J	nd	0.78	46.9
Ba	70.4	153	29.9	73.9	90.6	125	78.1	74.8	87.0	40.1
Be	0.59	2.4	0.46	0.47	0.56	1.3	0.79	0.72	0.9	67.7
Cd	nd	nd	nd	nd	1.2	nd	nd	nd	0.2	265
Ca	14500	17900	10200	18800	19700	17700	15700	15500	16250	17.4
Cr	32.9	77.1	19.4	28.5	31	55.8	40.5	36.3	40.2	42.4
Co	8.1	7.9	3.6	14.7	16.2	7.4	12.9	12.4	10.4	38.6
Cu	136	169	37.7	262	274	324	196	109	188	47.2
Fe	13100	19700	8640	19400	20800	16600	18500	16800	16693	22.6
Pb	31.3	51.8	33.2	82.2	82.8	67.8	71.4	40.7	57.7	34.4
Mg	6300	14300	3870	5730	6180	10100	8330	7130	7743	39.0
Mn	352	692	515	386	413	546	461	406	471	21.9
Hg	nd	nd	nd	nd	nd	nd	nd	nd	nd	na
Ni	24.6	42	10.5	30.5	34.9	35.4	31.2	29.8	29.9	29.2
K	4010	8490	1910	3680	3970	6230	5340	4460	4761	38.6
Se	nd	nd	nd	nd	nd	nd	nd	nd	nd	na
Ag	nd	nd	nd	nd	nd	nd	nd	nd	nd	na
Na	118	222	78.6	119	117	173	130	140	137	29.5
Tl	0.42	0.82	ND	0.42	0.53	0.64	0.58	0.42	0.5	46.4
V	30.2	61.8	13.6	26.5	30.4	46.2	37.9	33.8	35.1	38.1
Zn	85.1J	115J	111J	156J	148J	140J	158J	104J	127	19.9

J - estimated value; ^ value biased high
nd - undetected; na - not available or calculable

Table 3. Metal Concentrations in Hydrothermal Scars (mg/kg)

Map Location	M Eagle Rock Scar Area	N Eagle Rock (duplicate)	O Goathill Scar	W Hanson Crk Scar	Average Scar Concentration (# of samples=4)	Coefficient of Variation (%)
Date Sampled	6/27/94	6/27/94	6/27/94	6/26/94		
Field ID#	SS-1	SS-2	SS-3	SS-12		
CLP ID#	SF5897	SF5899	SF1801	SF5860		
Analyte (mg/Kg)						
Al	10300	7770	2220	8210	7125	42
Sb	nd	nd	nd	nd	nd	na
As	na	na	21.2Jv	11.5Jv	16.4	30
Ba	147	131	106	248	158	34
Be	0.52	0.44	0.12J^	0.42	0.4	41
Cd	nd	nd	nd	nd	nd	na
Ca	5590	7680	81.9	8810	5540	61
Cr	47	44.8	nd	12.8	26	78
Co	2.4	2.4	3.7	4.6	3	28
Cu	31.4	31.3	52.4	35.1	38	23
Fe	40200	43500	156000	61500	75300	63
Pb	42.5	45.9	134	138	90	51
Mg	4140	3370	192	7100	3701	66
Mn	200	173	17.7	258	162	55
Hg	nd	nd	nd	nd	nd	na
Ni	12.6	9.1	nd	12.4	9	60
K	6250	5630	23700	3300	9720	84
Se	3.6J	3.7J	3.4J	2.2J	3	19
Ag	3.8J^	4.1	12.5	6	6	80
Na	908	1200	1200	689	999	22
Tl	2.1Jv	na	2.9Jv	na	3	16
V	43	37.7	16.2	18.6	29	40
Zn	31.4	27.5	23.9	55.9	35	36
Mo	7.5	9.6	35.6	16.6	17	64

nd = not detected
J = estimated value;
^ = value biased high; v = value biased low
na = not available (data unusable or value cannot be calculated)

Table 4. Ratio of Metal Concentrations between Waste Sources and Hydrothermal Scars or Background Soil

Analyte (mg/kg)	Average Metal Concentration: Waste Dumps (N=7)	Average Metal Concentration: Scars (N=4)	Ratio of Concentrations (waste dump/scar)	Average Metal Concentration: Tailings (N=8)	Average Metal Concentration: Background Soil Sedillo Soil Type* (N=3)	Ratio of Concentrations (tailings/backgroud) Sedillo Soil Type	Average Metal Concentration: Background Soil Silva Soil Type* (N=3)	Ratio of Concentrations (tailings/backgroud) Silva Soil Type
Al	7219	7125	1.0	8050	2887	2.8	10813	0.7
Sb	nd	nd	na	0	2.4	na	nd	na
As	3	16.4	0.2	0.78	0.78	1.0	4.9	0.2
Ba	83	158	0.5	87.0	48.7	1.8	167	0.5
Be	1	0.4	1.6	0.9	0.18	5.0	0.8	1.1
Cd	1	nd	na	0.2	nd	na	0.4	0.4
Ca	7836	5540	1.4	16250	1111	14.6	2477	6.6
Cr	19	26	0.7	40.2	3.5	11.5	14.8	2.7
Co	5	3	1.6	10.4	3.0	3.4	12.1	0.9
Cu	99	38	2.6	188	6.3	29.9	23.6	8.0
Fe	22890	75300	0.3	16693	7177	2.3	20633	0.8
Pb	139	90	1.5	57.7	12.6	4.6	22.9	2.5
Mg	4946	3701	1.3	7743	1051	7.4	2787	2.8
Mn	409	162	2.5	471	298	1.6	783	0.6
Hg	nd	nd	na	0.0	nd	na	nd	na
Ni	12	9	1.4	29.9	3.8	7.9	12.3	2.4
K	3537	9720	0.4	4761	1049	4.5	2330	2.0
Se	3	3	1.1	0.0	nd	na	1.1	0.0
Ag	1	6	0.2	0.0	nd	na	nd	na
Na	74	999	0.1	137	38.5	3.6	90	1.5
Tl	2	3	1.0	0.5	nd	na	nd	na
V	20	29	0.7	35.1	7.9	4.5	36.8	1.0
Zn	125	35	3.6	127	33.5	3.6	66.4	1.9

*ref. 5; nd - not detected; na - not available (cannot be calculated)
N = Number of Samples

Table 5. Metal Concentrations in Fagerquist Well (Nearest to Mine) and Surrounding Surface/Ground Waters

	Fagerquist Well*	Columbine Creek	Columbine C.G. Well*	Molycorp MW-8b**	Molycorp MW-10a**	Molycorp MW-10c**
Date Sampled	9/9/93	11/7/94	8/24/93	11/8/94	11/8/94	11/8/94
Side from Red River	south	south	south	north	north	north
Analyte (mg/L)						
Al	<0.1	0.05	<0.1	0.44	33.4	31.1
Sb	na	<0.003	na	<0.05	<0.05	<0.05
As	<0.005	<0.0012	<0.005	<0.05	<0.05	<0.05
Ba	<0.1	0.042	<0.1	0.016	<0.01	0.014
Be	<0.1	<0.0004	<0.1	0.008	0.008	0.007
Cd	<0.001	<0.004	<0.001	<0.0005	0.03	0.03
Ca	24	23	26	206	275	204
Cr	<0.005	<0.004	<0.005	<0.01	<0.01	<0.01
Co	<0.05	<0.005	<0.05	<0.01	0.15	0.11
Cu	<0.05	<0.003	<0.05	<0.01	0.56	0.38
Fe	<0.1	0.05	<0.1	<0.05	<0.05	<0.05
Pb	<0.005	<0.0009	0.01	<0.002	<0.002	<0.002
Mg	2	2.3	2.6	55.5	77.9	75.2
Mn	<0.05	<0.002	<0.05	0.2	13.8	16.3
Hg	<0.0005	<0.0002	<0.0005	<0.0002	<0.0002	<0.0002
Ni	<0.1	<0.017	<0.1	0.06	0.33	0.03
K	1	0.8	2	2.9	2.8	2.8
Se	<0.005	<0.001	<0.005	<0.005	<0.005	<0.005
Ag	<0.1	<0.004	<0.1	<0.1	<0.1	<0.1
Na	2	2.1	3	33.9	26.5	20.2
Tl	na	<0.004	na	<0.005	<0.005	<0.005
V	<0.1	<0.0009	<0.1	<0.01	<0.01	<0.01
Zn	<0.05	0.003	1.6	0.2	2.3	3.2
pH	8.15	7	7.51	6.4	5.8	4.7
Conductivity (umhos)	142	80	169	1780	2400	2000
Depth of Well (feet)	52	na	80	129	144	50

* unfiltered sample collected by NMED-Surface Water Quality Bureau

** filtered sample collected by South Pass Resources, Inc. (ref. 12)

Table 6. Background Metal Concentrations for Determining a Release to Alluvial Aquifer via Seeps

Map Location	21 Red River WWTP	15 Molycorp Mill Well	20 Elephant Rk Campground	22 Junebug Campground	Highest Conc. for Background Purposes	21 Red River WWTP	15 Molycorp Mill Well	20 Elephant Rk Campground	22 Junebug Campground	Highest Conc. for Background Purposes
CLP ID#	MFQ267	MFQ270	MFQ268	MFQ269		MFQ262	MFQ265	MFQ263	MFQ264	
Temp (C)						11	6	5.5	6	
pH						3.85**	6	5.5	6	
Cond. (umhos)						1200	202	150	163	
	Filtered	Filtered	Filtered	Filtered	Filtered	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered
Analyte (ug/L)										
Al	36500	144	nd	nd	36500	36700	716	nd	nd	36700
Sb	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
As	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ba	11.1	21	32.9	34.4	34.4	5.3	22.2	34.1	39	39
Be	5.1	nd	nd	nd	5.1	5.2	nd	nd	nd	5.2
Cd	6.1J	nd	nd	nd	6.1	7.8J	nd	nd	nd	7.8
Ca	151000	43700	33900	34200	151000	151000	45700	34300	36600	151000
Cr	5.8	nd	nd	nd	5.8	8.5	nd	nd	nd	8.5
Co	97.4	nd	nd	nd	97.4	101	nd	nd	nd	101
Cu	58.3	4.9	5		58.3	60.8	21.6	12.4	54.7	60.8
Fe	30100	nd	97.1J^	128	30100	30200	273	610	4850	30200
Pb	3.7J^	nd	nd	nd	3.7	3.6J^	3.1J^	1.5J^	5.6J^	5.6
Mg	51500	8880	6600	6920	51500	52200	9190	6710	7620	52200
Mn	5700	110	5.6	82.6	5700	5720	108	6.1	78.5	5720
Hg	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ni	227	nd	nd	nd	227	232	nd	nd	nd	232
K	2540	771	792	732	2540	2910	941	535	585	2910
Se	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ag	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Na	15100	5140	3870	4180	15100	14900	4810	3720	4060	14900
Tl	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
V	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Zn	2090	41	107	252	2090	2090	46.1	109	404	2090

nd - not detected
*ref. 12
J^ - estimated value biased high

Table 7. Release of CERCLA Hazardous Substances to Downgradient Seeps of Alluvial Aquifer

Map Location	Background Concentrations for Determining a Release in Alluvial Aquifer		S-1 Cliff Seep (Old Eagle Rock CG)		S-2 Capulin Channel Seep		S-3 Capulin Canyon Seep: Lower		S-3 (Duplicate) Capulin Canyon Seep: Lower		S-4 Capulin Canyon Seep: Upper		S-5 Goathill Seep		S-7 Adit Seep	
	filtered	unfiltered	filtered	unfiltered	filtered	unfiltered	filtered	unfiltered	filtered	unfiltered	filtered	unfiltered	filtered	unfiltered	filtered	unfiltered
Date Sampled			6/26/94	6/26/94	6/26/94	6/26/94	6/26/94	6/26/94	6/26/94	6/26/94	6/26/94	6/26/94	6/26/94	6/26/94	6/26/94	6/26/94
CLP ID#			SF5831	SF5832	SF5823	SF5827	SF5824	SF5828	SF5825	SF5829	SF5826	SF5830	SF5839	SF5842	SF5840	SF5843
Analyte (ug/L)																
Al	36500	36700	43100	43500	127000	120000	104000	108000	105000	105000	113000	114000	28500	28800	13700	17500
Sb	nd	nd	nd	nd	nd	nd	32.1	nd	nd	nd	nd	nd	nd	nd	nd	nd
As	nd	nd	nd	nd	1.8J	1.0J	1.1J	nd	1.1J	1.3J	2.1J	1J	nd	nd	nd	nd
Ba	34.4	39	12.8	13.5	8.1	7.9	9.8	12.2	13.6	13.9	8.2	8.1	20.1	25	82.6	58.1
Be	5.1	5.2	13.1	13.1	25.6	21.3	19.6	20.4	20	19.9	17.6	17.6	5.5	5.5	3.6	4.2
Cd	6.1	7.8	17.7J	23J	nd	5.7	9.2J	12.1J	13.1J	15.2J	6.8J	nd	11.1J	15.1J	13J	51.4J
Ca	151000	151000	79800	79500	224000	218000	199000	206000	201000	202000	216000	216000	275000	273000	206000	210000
Cr	5.8	8.5	2.9	nd	3.3	3.8	4	3.4	3.8	3.9	5	3.9	nd	4.6	nd	nd
Co	97.4	101	127	125	216	202	179	185	183	183	195	194	113	115	nd	nd
Cu	58.3	60.8	361	363	1010	916	741	775	755	753	1130	1140	233	234	22	37.9
Fe	30100	30200	47	146	4730	6010	7550	7860	7430	7900	14600	17500	27.9	602	18.4	59.1
Pb	3.7	5.6	2.1J	2.5J	4.0J	4.9J	4.4J	3.8J	5J	5.1J	3.6J	4.4J	3.4J	6.8J	1.7J	1.4J
Mg	51500	52200	44100	44000	63000	58100	50800	53000	51500	51900	55500	55900	104000	103000	80300	87000
Mn	5700	5720	19000	18900	19200	17000	14700	15200	14800	14900	15900	16000	4270	4250	6350	9450
Hg	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ni	227	232	368	353	430	409	357	373	367	364	393	412	412	414	342	413
K	2540	2910	1650	1980	2770	3000	3290	3000	3210	3220	2460	3200	3270	3360	3150	3000
Se	nd	nd	na	na	na	na	na	na	na	na	na	na	1.3J	na	1.4J	1.5J
Ag	nd	nd	nd	nd	nd	nd	3.9	3.6	nd	3.2	nd	5.4	nd	nd	nd	nd
Na	15100	14900	10700	10500	26500	25500	22200	23000	22500	22300	27100	27100	32200	31600	22200	22400
Tl	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
V	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Zn	2090	2090	4560	4570	4890	4370	3790	3940	3840	3880	4230	4290	1650	1650	2470	3100

J - estimated value; nd - not detected; na - not available
Shaded data indicate concentrations which exceed 3 x background.
Note: Only Be and Cu represent CERCLA Hazardous Substances

Table 8. Release of CERCLA Hazardous Substances to Fractured Rock Aquifer at Molycorp Mine

	Highest Background Concentration*	Capulin Canyon (MW-3)**	Sugar Shack West (MW-7)**	Sugar Shack South (MW-10b)**	Sugar Shack South (MW-11)**	Sugar Shack South (MW-11 dup.)**	Cabin Spring**
CLP ID#		MFQ252	MFQ251	MFQ250	MFQ249	MFQ248	MFQ266
	F	F	F	F	F	F	UF
Analyte (ug/L)							
Al	1200	876	777000	6720	48800	45300	34500
As	<10	1.4J^	48.2J	nd	nd	nd	nd
Cd	19	nd	97.4	23.3J	30.3J	32.3	28.8
Cu	30	16.7	4220	111	832	787	424
Fe	39000	121J^	329000	227	nd	nd	nd
Mn	43600	28400	54700	7640	24900	23600	20100
Zn	25600	1190	8750	1120	4330	4090	3540

* ref.12, Table D4; ref. 30, Table 1.4 (highest reported value)
** ref. ~~65~~ 64
F = filtered; UF = unfiltered
J - estimated value; ^ - datum biased high; nd - not detected
Shaded data indicate concentrations which exceed 3 x background.
Note: Only As, Cd and Cu represent CERCLA Hazardous Substances which have been released.

Table 9. Metal Concentrations and General Chemistry Parameters in Private Wells below the Tailings Ponds

Map Location / Field Station	A CHANGE HOUSE WELL* W-1 (Background)		C DURAN WELL* W-5		D Duplicate W-5.5	E RAEL WELL* W-5**		N HERRERA WELL* W-6.5		MCL
CLP ID#	MFT996	MFT995	MFQ072	MFQ071	MFQ073	MFQ998	MFQ997	MFQ982	MFQ981	
	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	
Date Sampled	4/18/94		4/18/94			~~4/18/94~~ 4-21		4/19/94		
Used for Drinking?			No			Yes		No		
Analyte (ug/L)										
Al	<34	108	nd	nd	nd	nd	55.8	nd	3210	50-200
Sb	<50	<50	nd	nd	nd	nd	nd	nd	nd	6
As	<1.0	<1.0	[redacted]	nd	nd	nd	nd	nd	1.4J	50
Ba	44.1	44.7	54	54.9	54.9	65.7	70	34.5	295	2000
Be	<1.0	<1.0	nd	nd	nd	nd	nd	nd	nd	4
Cd	<5.0	<5.0	nd	nd	nd	nd	nd	nd	nd	5
Ca	28200	28000	47400	46100	46000	80800	84000	231000	232000	
Cr	<9.0	<9.0	nd	nd	nd	nd	nd	nd	[redacted]	100
Co	<9.0	<9.0	nd	nd	nd	nd	nd	nd	nd	
Cu	<6.0J	<6.0J	nd	nd	nd	nd	nd	nd	7.2J	1300al
Fe	19	360	nd	1220	1420	13.5	849	184	17900	300
Pb	<1.0	2.5	nd	ND	3.1	nd	ND	[redacted]	2.5	15al
Mg	5260	5180	10400	10100	9970	14600	15600	44300	44400	
Mn	3.1	6.8	146	158	157	3.3	4.1	22	215	50a
Hg	<0.2	<0.2	nd	nd	nd	nd	nd	nd	nd	2
Ni	<11	<11	nd	nd	nd	nd	nd	nd	nd	100
K	<667	<667	867	877	873	<667	766	2840	2940	
Se	<2.0	2.6	nd	nd	nd	nd	nd	nd	nd	50
Ag	<5.0	<5.0	nd	nd	nd	nd	nd	nd	nd	50
Na	66300	66400	15800	15100	14900	26100	26900	71400	69900	
Tl	<2.0J	<2.0J	nd	nd	nd	nd	nd	nd	nd	2
V	<7.0	<7.0	nd	nd	nd	nd	nd	nd	[redacted]	
Zn	75.4J	75.1J	101J	150	165	206J	[redacted]	nd	8.5J	5000a
	SF1386		SF1389		SF1390	SF1387		SF1385		
Gen. Chem. (ug/L)					(filtered)					
Alk	190000		103000		104000	112000		154000		
COD	ND		nd		nd	nd		nd		
TDS	292000		288000		277000	454000		1290000		500000a
TSS	ND		nd		nd	nd		nd		
NH3	ND		nd		nd	nd		nd		
Cl	<2000		6140		6140	8420		18300		250000a
NOX	400		260		280	400		1040		
TOC	5340J		nd		nd	2460J		5820J		
TPO4	120		nd		nd	120		170		
SO4	58000		72000		84000	209000		752000		250a

* ref. 65; ** Sample inadvertently labelled as W-5; nd - not detected; J - estimated value; ^ - value biased high

MCL - EPA Maximum Contaminant Level; a - aesthetic standard; i - irrigation standard

Stippled data are > 3 x background (or detected when undetected in background); additional shading for CERCLA Hazardous Substances

Table 10. Total Metal Concentrations in Selected Monitoring Wells near Tailings Ponds (ref. 65)

Map Location	A Change House Well (Background)	B MW-4	F MW-9a	K MW-3	L MW-1	M MW-1 (Duplicate)	G MW-2	H MW-C	I MW-7b	J MW-7c	MCL
Date Sampled	4/21/94	4/21/94	4/25/94	4/21/94	4/21/94	4/21/94	4/21/94	4/21/94	4/25/94	4/25/94	
pH (paper)	6.5	6.5	7.7*	6.5	6.5	6.5	6.5	6.5	7.6*	7.3*	
Conductivity (umhos)	328	1280	710	1120	1190	-	1340	1390	1180	1080	
Field ID#	W-1	W-2	W-4	W-6	W-7	W-7.5	W-8	W-9	W-11	W-12	
CLP ID#	MFT995 UF	MFT969 UF	MFQ076 UF	MFQ979 UF	MFT975 UF	MFT977 UF	MFT971 UF	MFT973 UF	MFQ074 UF	MFQ069 UF	
Analyte (ug/L)											
Al	108	36	78800	115	179	161	3690	94.3	53200J	2540J	50-200
Sb	<50	nd	nd	nd	nd	nd	nd	nd	nd	nd	6
As	<1J	nd	23.7	nd	nd	nd	nd	nd	15.2	nd	50
Ba	44.7	36.1	570	35.8	40	26.4	152	35	514	53.7	2000
Be	<1.0	nd	14.7	nd	nd	nd	nd	nd	4.0	nd	4
Cd	<5.0	nd	nd	nd	nd	nd	nd	5.1	nd	nd	5
Ca	28000	157000	197000	256000	224000	195000	222000	311000	274000	248000	
Cr	<9.0	nd	109	13.1	nd	nd	22	nd	88.1	nd	100
Co	<9.0	nd	92.1	nd	nd	nd	nd	nd	15.8	3.7	
Cu	<6J	nd	65.7	nd	nd	nd	nd	nd	38.9	7.9	1300al
Fe	360	643	69500	455	612	562	25200	170	38600	1900	300
Pb	2.5	2.4	65.6	1.5	nd	nd	4.4vJ	nd	44.9	5.3	15al
Mg	5180	31800	49900	46500	46000	40500	50000	53200	60500	45700	
Mn	6.8	43.5	1880	14.9	24.2	19	774	2420	743	37.3	50a
Hg	<0.2	nd	nd	nd	nd	nd	nd	nd	nd	nd	2
Ni	<11	nd	82.2	nd	nd	nd	22.7	nd	65.8	nd	100
K	<667	nd	11000	1240	2770	2470	3150	3420	13800	3250	
Se	2.6	nd	nd	nd	nd	nd	nd	nd	nd	2.6	50
Ag	<5.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	50
Na	66400	65700	41100	67600	61100	52300	92100	87900	42300	39600	
Tl	<2J	nd	nd	nd	nd	nd	nd	nd	nd	nd	2
V	<7.0	nd	91.7	nd	nd	nd	nd	nd	48.8	3.9	
Zn	75.1J	nd	288	nd	nd	nd	nd	nd	177	16.4	5000a

* pH measured by laboratory

UF - unfiltered sample; nd - not detected; J - estimated value; v - value biased low

MCL - EPA Maximum Contaminant Level; a - aesthetic std.; l - irrigation std.

Stippled data are > 3 x background (or detected when undetected in background); additional shading for metals representing CERCLA hazardous substances

Table 11. Dissolved Metal Concentrations and General Chemistry Parameters in Selected Monitoring Wells near Tailings Ponds (ref. 64)

Map Location	A	B	F	K	L	M	G	H	I	J	MCL
	Change House Well (Background)	MW-4	MW-9a	MW-3	MW-1	MW-1 (Duplicate)	MW-2	MW-C	MW-7b	MW-7c	MCL
Field ID#	W-1	W-2	W-4	W-6	W-7	W-7.5	W-8	W-9	W-11	W-12	
CLP ID #	MFT996	MFT970	MFQ077	MFQ980	MFT976	MFT978	MFT972	MFT974	MFQ075	MFQ070	
	F	F	F	F	F	F	F	F	F	F	
Analyte (ug/L)											
Al	<34	55.7	nd	nd	nd	48	128	135	nd	nd	50-200
Sb	<50	nd	nd	nd	nd	nd	nd	nd	nd	nd	6
As	<1J	nd	nd	nd	nd	nd	nd	nd	nd	16	50
Ba	44.1	36	92.7	31.4	26.2	ND	22.4	35.4	57.5	34	2000
Be	<1.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	4
Cd	<5.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	5
Ca	28200	158000	144000	243000	225000	222000	204000	307000	231000	237000	
Cr	<9.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	100
Co	<9.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	
Cu	<6J	nd	nd	nd	nd	nd	nd	nd	3.5	nd	1300al
Fe	19	31.3	ND	40.1	nd	nd	290	nd	nd	nd	300
Pb	<1.0	4.2	ND	6.3^J	nd	nd	nd	nd	nd	nd	15al
Mg	5260	30900	28100J	45000	46900	45800	45200	53800	43600	43400	
Mn	3.1	1.7	573J	1.9	3.2^J	3^J	550	2400	12	ND	50a
Hg	<0.2	nd	nd	nd	nd	nd	nd	nd	nd	nd	2
Ni	<11	nd	nd	nd	nd	nd	nd	nd	nd	nd	100
K	<667	945	1420J	973	2630	2690	2900	3620	5770	2670	
Se	<2.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	50
Ag	<5.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	50
Na	66300	66600	40700J	65900	61300	59800	89200	89300	40600	38200	
Tl	<2J	nd	nd	nd	nd	nd	nd	nd	nd	nd	2
V	<7.0	nd	nd	nd	nd	nd	nd	nd	nd	2.6	
Zn	75.4J	nd	37J	nd	nd	nd	nd	nd	26.1J	7.8J	5000a
Gen. Chem.											
CLP ID#	SF1386	SF1368	SF1392	SF1384	SF1382	SF1383	SF1380	SF1381	SF1391	SF1388	
Alk	190000	188000	162000	179000	152000J	150000J	67500J	179000J	134000	131000	
COD	nd	nd	nd	nd	nd	7200	nd	5860	6600	nd	
TDS	292000	928000	81400	1340000	1162000	1313000	1314000	1690000	1330000	1280000	
TSS	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
NH3	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
Cl	1000	8340	23500	18400	18300	18300	15600	17900	15200	16200	
NOX	400	320	360	370	710	710	nd	nd	330	340	
TOC	5340J	7370J	2150	5970J	3030J	4770J	1990J	5310J	2280	1390	
TPO4	120	120	nd	120	150	160	nd	120	nd	nd	
SO4	58000	521000	384000	779000	701000	749000	825000	1013000	818000	740000	

F - filtered sample; nd - not detected; J - estimated value; ^ - value biased high; v - value biased low
MCL - EPA Maximum Contaminant Level
Stippled data are > 3 x background (or detected when undetected in background); additional shading for metals representing CERCLA hazardous substances

Table 12. Total and Dissolved Metal Concentrations in Discharges below Tailings Ponds (ref. 64)

Map Location	A Change House Well (Background)		W Seep A		V Seep D		U Seep E		O Embargo Rd. Seep		R Outfall #002		X Warm Spring		Y Cold Spring		T Old Coldwater Spring Collection	
CLP ID#	MFT996 F	MFT995 UF	MFT955 F	MFT954 UF	MFT953 F	MFT952 UF	MFT952 F	MFT951 UF	MFT959 F	MFT958 UF	MFT963 F	MFT962 UF	MFT947 F	MFT946 UF	MFT949 F	MFT948 UF	MFT967 F	MFT966 UF
Analyte (ug/L)																		
Al	<34	108	nd	480	nd	658	50.3	66.9	119	248	148	135	35.5	nd	nd	nd	nd	44.5
Sb	<50	<50	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
As	<1J	<1J	1.2vJ	2.2vJ	1.3vJ	2.1vJ	2.1vJ	2.7vJ	nd	nd	nd	nd	[illegible]	[illegible]	[illegible]	nd	nd	nd
Ba	44.1	44.7	66.4	73.8	27.7	41.8	28.1	27.6	13.5	16.2	27.1	27.3	20.1	18.3	45.1	44.8	52.6	54.3
Be	<1.0	<1.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cd	<5.0	<5.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ca	28200	28000	33600	33100	30800	30800	31200	31200	265000	269000	277000	291000	22200	21600	50900	50400	101000	105000
Cr	<9.0	<9.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Co	<9.0	<9.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cu	<6J	<6J	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Fe	19	360	nd	494	nd	900	nd	nd	nd	nd	nd	19.9	nd	nd	nd	nd	nd	nd
Pb	<1.0	2.5	nd	6	nd	2.7	nd	nd	[illegible]	1.7	nd	nd	nd	nd	nd	nd	nd	nd
Mg	5260	5180	10800	10700	9770	10000	9960	9850	46400	47200	46400	47400	6830	6730	8790	9120	16700	17400
Mn	3.1	6.8	3.7vJ	8.6	nd	56.8	2.8vJ	4.8vJ	569	650	1820	1860	1vJ	nd	nd	nd	nd	nd
Hg	<0.2	<0.2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ni	<11	<11	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
K	<667	<667	3670	3490	2740	3140	2960	2690	4140	4350	3520	4010	2390	2280	1120	1210	1860	2130
Se	<2.0	2.6	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ag	<5.0	<5.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Na	66300	66400	41200	41100	33000	33800	31800	31700	90100	92000	91700	91600	24900	24300	25100	24700	46000	48000
Tl	<2J	<2J	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
V	<7.0	<7.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Zn	75.4J	75.1J	nd	nd	nd	11.8	nd	nd	nd	8.3	nd	nd	nd	nd	nd	nd	nd	nd
Gen. Chem.																		
	SF1386		SF1373		SF1371		SF1372		SF1375		SF1377		SF1369		SF1370		SF1379	
Alk	190000		92900J		80200J		80200J		160000		158000J		84400J		158000J		184000J	
COD	nd		nd		nd		nd		nd		nd		nd		nd		nd	
TDS	292000		320000		287000		281000		1633000		1580000		199000		268000		583000	
TSS	nd		nd		nd		nd		nd		nd		nd		nd		nd	
NH3	nd		nd		nd		nd		nd		nd		nd		nd		nd	
Cl	<2000		12000		10300		9610		16000		15600		8880		6080		9530	
NOX	400		210		300		390		nd		nd		350		630		370	
TOC	5340J		1780J		1090J		nd		3430J		2560J		nd		1660J		2780J	
TPO4	120		170		170		170		130		160		160		100		nd	
SO4	58000		127000		68000		105000		1005000		973000		54000		67000		254000	

F - filtered sample; UF - unfiltered sample
nd - not detected; J - estimated value; v - value biased low
Stippled data are > 3 x background (or detected when undetected in background); additional shading for metals representing CERCLA hazardous substances

Table 13. Ratio of Metal Concentrations in Leachate or Drainage from Mine Dumps to Hydrothermal Scars

Analyte (ug/L)	Average Mine Leachate Concentration (# of Samples=2)	Average Scar Leachate Concentration (Goathill & Hanson Crk) (# of Samples=2)	Ratio Mine Dump/Hydrothermal Scar
Al	1245000	162850	7.6
Sb	nd	24	na
As	51	11	4.8
Ba	na	na	na
Be	439	57	7.7
Cd	490	11	43.8
Ca	383500	234500	1.6
Cr	320	11	29.0
Co	2910	286	10.2
Cu	12150	2445	5.0
Fe	663500	484435	1.4
Pb	10	4	2.7
Mg	952500	57900	16.5
Mn	603500	41905	14.4
Hg	nd	0.2	na
Ni	6550	559	11.7
K	801	3605	0.2
Se	7	8	1.0
Ag	80	35	2.3
Na	25150	8915	2.8
Tl	3	3	1.1
V	8	16	0.5
Zn	133000	8835	15.1
Mo	34	16	2.1

nd - not detected; na - not available or not calculable
Note: one half detection limit was used in calculating average when detected in the other sample.

Table 14. Ratio of Metal Concentrations in Leachate from Mine Waste Dumps and Hydrothermal Scars*

Analyte (mg/L)	Mine Waste Mean (n=9)	Scar Mean (n=8)	Ratio
Al	471	230	2.1
Cd	0.14	0.03	5.4
Cr	1.24	0.48	2.6
Co	0.16	0.08	2.1
Cu	3.89	2.19	1.8
Fe	230	317	0.7
Mn	210	31	6.7
Ni	2.54	1.20	2.1
Pb	0.18	0.10	1.8
Zn	36.0	7.2	5.0

* ref.30, Table 1.2

Table 15. Total Metal Concentrations in Surface Water near Molycorp Mine (ug/L)

Map Location	18 Red River above Hanson Creek	17 Red River below Hanson Creek	16 Red River above Molycorp (Background)	12 Red River below (30') Adit Seep	11 Red River above Columbine Creek	10 Columbine Creek	9 Red River below Columbine Creek	7 Red River @ Goathill Gulch Seep	6 Red River above Capulin Seeps	5 Red River between Capulin Seeps	3 Red River below (20') Capulin Seeps	3 (duplicate) Red River below (20') Capulin Seeps	2 Red River above Pipeline Crossing
Station	RR-12	RR-11	RR-10	RR-9	RR-8	RR-7	RR-6	RR-5	RR-4a	RR-4	RR-3	RR-2	RR-1
CLP ID#	MFQ393	MFQ392	MFQ272	MFQ271	MFQ243	MFQ199	MFQ198	MFQ197	MFQ196	MFQ195	MFQ194	MFQ193	MFQ192
Date Sampled	11/8/94	11/8/94	11/8/94	11/8/94	11/7/94	11/7/94	11/7/94	11/7/94	11/7/94	11/7/94	11/7/94	11/7/94	11/7/94
Temp (C)	na	4.5	5	5	6	4.5	5.5	6	4.5	6	6	6	7
pH	6	6	6	6.5	6.5	7	7	7	6.5	6.5	7	6.5	6.5
Cond. (umhos)	na	160	178	190	195	80	172	230	222	235	250	250	261
	UF	UF	UF	UF	UF	UF	UF	UF	UF	UF	UF	UF	UF
Analyte (ug/L)													
Al	347	612	1070	1290	1080	49.7	856	1270	1540	1690	2050	2050	2590
Sb	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
As	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ba	40.9	40.5	41.1	39.6	36.5	41.8	37.4	37.1	36.7	36.1	36.5	36.7	36.9
Be	0.35	0.35	0.34	nd	0.35	nd	0.45	0.59	0.45	0.54	0.45	0.55	0.7
Cd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ca	33300	34200	36900	40700	39800	23000	36600	44600	46000	46100	46900	46600	47000
Cr	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Co	nd	nd	nd	nd	nd	nd	nd	6.8	nd	nd	nd	7.9	7.4
Cu	13.1	11.2	14.3	15.9	15.6		10	16.2	21.8	20.5	24.3	26.1	29.8
Fe	294	376	394	557	320	49.7	263	265	269	279	386	355	407
Pb	-	-	1.1	-	0.93	-	-	1.1	1	nd	nd	nd	1.3
Mg	7090	7240	8220	9200	9070	2290	7670	10100	10500	10500	10700	10600	11000
Mn	109	138	208	299	267	-	208	495	531	553	607	603	651
Hg	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ni	nd	nd	nd	nd	nd	nd	nd	nd	nd	18.7	nd	23	nd
K	1200	1140	1030	999	1210	810	983	1320	-	1090	668	1130	971
Se	nd	nd	nd	nd	nd	nd	nd	nd	873	nd	nd	nd	nd
Ag	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Na	5260	5120	5430	5230	5530	21000	4830	5250	5620	5610	5660	5550	5490
Tl	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
V	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Zn	32.1	48.7	60.9	92.8	75.3	3.3	56.5	123	132	136	153	149	205

nd - not detected
Shaded data is > 3 x background; only Zn is a listed CERCLA hazardous substance

Table 16. Dissolved Metal Concentrations and General Chemistry Parameters in Surface Water near Molycorp Mine

Map Location	18 Red River above Hanson Creek	17 Red River below Hanson Creek	16 Red River above Molycorp (Background)	12 Red River below (30') Adit Seep	11 Red River above Columbine Creek	10 Columbine Creek	9 Red River below Columbine Creek	7 Red River @ Goathill Gulch Seep	6 Red River above Capulin Seeps	5 Red River between Capulin Seeps	3 Red River below (20') Capulin Seeps	3 (duplicate) Red River below (20') Capulin Seeps	2 Red River above Pipeline Crossing
Station	RR-12	RR-11	RR-10	RR-9	RR-8	RR-7	RR-6	RR-5	RR-4a	RR-4	RR-3	RR-2	RR-1
CLP ID#	MFQ397	MFQ396	MFQ395	MFQ394	MFQ253	MFQ254	MFQ255	MFQ256	MFQ257	MFQ258	MFQ259	MFQ260	MFQ261
	F	F	F	F	F	F	F	F	F	F	F	F	F
Analyte (ug/L)													
Al	115	48.4	115	51.5	nd	nd	nd	nd	nd	nd	nd	nd	nd
Sb	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
As	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ba	44.2	40.2	36.7	33.6	37	43.4	37	36.1	35.4	35	36.3	35.2	36.5
Be	nd	0.3	nd	0.3	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ca	33400	34300	36900	38800	42200	24600	38400	46500	48600	48800	49200	49000	49900
Cr	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Co	nd	nd	nd	nd	nd	nd	nd	nd	nd	5.1	nd	nd	6.7
Cu	6.8	3.7	3.7	4.4	4.3	nd	3.1	3.7	3.1	5.6	4.9	6.2	6.8
Fe	29.5	12.7	19.3	29	nd	nd	nd	211	nd	nd	nd	nd	nd
Pb	nd	nd	1.9	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Mg	7050	7260	8140	8760	9540	2540	8080	10800	11200	11100	11200	11200	11600
Mn	106	130	195	250	275	-	216	513	550	573	**630**	**628**	**876**
Hg	nd	nd	nd	nd	0.22J^	0.2J^	nd	nd	nd	nd	nd	nd	nd
Ni	nd	nd	nd	nd	nd	nd	nd	nd	22.1	19.5	28.7	20.4	33
K	868	775	1320	1220	720	697	1170	613	1020	1110	1080	1190	1070
Se	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ag	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Na	5400	5270	5640	5750	5250	2160	4660	5290	5560	5480	5480	5410	5600
Tl	nd	nd	nd	nd	nd	nd	nd	nd	nd	1.4	nd	nd	nd
V	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Zn	22.1	28.8	29.9	62	49.4	6.6	45.1	**103**	**103**	**110**	**125**	**126**	**159**
Gen. Chem.													
(mg/L)*													
Ca	41	42	45	48	49	26	40	49	51	50	52	53	54
Mg	7	7	8	9	9	3	8	11	11	11	12	12	12
K	4	4	4	4	4	4	4	4	4	4	4	4	4
Na	5	5	6	6	6	-	5	6	6	6	6	6	6
Hardness	131	134	145	154	157	74	135	166	175	171	176	179	184
Alkalinity	64	62	58	56	56	64	58	52	50	49	47	46	42
HCO3	78	76	72	69	68	78	71	64	61	60	57	57	52
Cl	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
SO4	55	59	74	88	89	10	71	106	112	114	117	118	122
TDS	200	206	220	246	234	98	224	256	262	266	282	284	283
TSS	4	6	9	9	10	-	5	9	8	10	10	13	8

F = filtered sample
- not detected; J^ - estimated value which is biased high
* New Mexico State Laboratory Division data
Shaded data is > 3 x background of which only Zn is a listed CERCLA hazardous substance

Table 17. Metal Concentrations and General Chemistry Parameters in the Red River near Molycorp Mine: 6/26/94

	Red River above Hanson Creek		Red River below Columbine Creek		Red River at USFS Ranger Station	
Date Sampled CLP ID#	6/26/94 SF5850 F	6/26/94 SF5852 UF	6/26/94 SF5841 F	6/26/94 SF5844 UF	6/26/94 SF5861 F	6/26/94 SF5862 UF
Analyte (ug/L)						
Al	73.3	286	84.1	284J^	nd	1360
Sb	nd	nd	31.7	nd	nd	nd
As	nd	nd	nd	na	na	na
Ba	25.6	29.4	32.3	38J	26.9J	39.8J
Be	nd	nd	nd	nd	nd	nd
Cd	nd	nd	nd	nd	nd	nd
Ca	21500	21200	21200	21700J	29000J	29800J
Cr	nd	nd	nd	nd	nd	nd
Co	nd	nd	nd	nd	5.4J	5.9J
Cu	nd	nd	nd	nd	nd	nd
Fe	40.3	331	15.3	nd	nd	nd
Pb	nd	nd	nd	2.5J	na	2J
Mg	3520	3510	2850	2960	5890	6210
Mn	29.4	37.1	33.3	55.8	369	407
Hg	0.2	nd	nd	nd	nd	0.22
Ni	nd	nd	nd	nd	nd	nd
K	796	nd	nd	nd	nd	nd
Se	na	na	na	nd	nd	nd
Ag	nd	nd	nd	nd	nd	nd
Na	2210	2070	1900	nd	nd	nd
Tl	nd	nd	nd	nd	nd	nd
V	nd	nd	nd	nd	nd	nd
Zn	18.3	10.1	10.1	25.7	62.8	95.2
Gen. Chem.						
	SF5854		SF5848		SF5863	
Alk	57000		63300		45400	
COD	nd		nd		nd	
TDS	102000		92000		156000	
TSS	10000		12000		14000	
NH3	nd		nd		nd	
Cl	nd		nd		nd	
NOX	150		100		160	
TOC	2650		2550		2700	
TPO4	240		140		nd	
SO4	21000		12600		53700	

Shaded data are > 3 x concentration below Columbine Creek

Note: of the elevated parameters, only Zn is a CERCLA Hazardous Substance

nd - not detected; na - not usable; F - filtered sampled; UF - unfiltered sample

J - estimated value; ^ - value biased high

Table 18. Metal Concentrations in Sediments from the Red River near Molycorp Mine Area

Map Location	L	K	J	I	H	G	F	E	D	C	B	B	A
	Red River above Hanson Crk.	Red River below Hanson Crk.	Red River above Molycorp Property (Background)	Red River below (30') Adit Seep	Red River above Columbine Creek	Columbine Creek	Red River below Columbine Creek	Red River below Goathill Seep	Red River above Capulin Seeps	Red River between per and low Capulin Seeps	Red River below (20') Capulin Seeps (duplicate)	Red River below (20') Capulin Seeps	Red River above Pipeline Crossing
Date Sampled:	11/8/94	11/8/94	11/8/94	11/8/94	11/7/94	11/7/94	11/7/94	11/7/94	11/7/94	11/7/94	11/7/94	11/7/94	11/7/94
Field ID #	S-12	S-11	S-10	S-9	S-8	S-7	S-6	S-5	S-4a	S-4	S-3	S-2	S-1
CLP ID#	MFQ696	MFQ695	MFQ399	MFQ398	MFQ191	MFQ190	MFQ189	MFQ187	MFQ188	MFQ186	MFQ185	MFQ184	MFQ182
Analyte (mg/kg)													
Al	15000	4510	5250	12200	12600	10500	10500	10900	13900	24200	19500	16000	12600
Sb	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
As	10Jv	5.6Jv	4Jv	8.5Jv	11.2Jv	1.2Jv	8.4Jv	6.1Jv	7.4Jv	9.2Jv	8.8Jv	6.1Jv	11Jv
Ba	787	262	439	694	601	78.5	567	406	537	578	569	508	499
Be	1.1	0.34	0.43	1.3	1.2	0.46	1.1	1.1	[illegible]	2.4	[illegible]	[illegible]	[illegible]
Cd	nd	nd	nd	nd	nd	nd	nd	nd	[illegible]	nd	nd	nd	nd
Ca	3690	1190	1470	2340	2900	2490	3020	2210	3230	1860	2150	1980	2990
Cr	23.5	6.5	8.8	22.1	20.5	12.5	16.8	20.3	18.7	22.3	23.9	20.7	18.5
Co	12.9	4	6.9	13.2	14.1	13.1	12.7	13.3	19	13.5	14.6	12.2	[illegible]
Cu	142	22	25.1	135	78.9	21.2	71.1	104	120	152	116	99.9	[illegible]
Fe	45800	14800	17600	40600	38400	26700	33600	31300	33700	47600	41800	38000	34400
Pb	163	21.4	29.3	[illegible]	139	118	106	[illegible]	[illegible]	142	119	102	[illegible]
Mg	6110	1700	2210	5310	5300	7420	4560	5090	4640	5400	5680	4970	4670
Mn	636	115	165	534	538	701	550	466	1080	553	501	468	1310
Hg	nd	nd	nd	nd	nd	0.13	nd	nd	0.29	nd	nd	nd	nd
Ni	23.2	8.6	13.9	24	31.2	7.4	30.9	18.1	31.7	29.4	32.5	27.3	53.6
K	5290	1980	1700	3640	3980	1030	3130	2540	3080	4330	3960	3390	2890
Se	1.8	0.44	nd	[illegible]	1.6	nd	1.1	[illegible]	[illegible]	[illegible]	1.3	0.94	[illegible]
Ag	3.3	nd	nd	nd	nd	1.9	1.9	2.3	2.5	nd	nd	[illegible]	[illegible]
Na	292	76.5	122	297	277	54.4	238	245	254	326	290	241	232
Tl	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.69	nd	nd	nd
V	24.8	6.5	7.9	20.5	20.6	48.6	16.8	22.2	18.9	21.2	24.7	21.6	18.6
Zn	274	44.5	93.9	190	237	136	221	182	548	298	250	220	[illegible]

nd - not detected; Jv - estimated value is biased low

Stippled data are > 3 x background concentration (or detected when undetected at background location)

Additional shading for those metals representing CERCLA hazardous substances

Table 19. Metal Concentrations in Selected Seeps and Surface Water Bodies near the Tailings Ponds

Map Location	~~18~~ O Embargo Rd. Seep		~~19~~ P Irrigation Ditch above Seep		~~20~~ Q Irrigation Ditch below Seep		~~21~~ R #002 OUTFALL		~~22~~ S 50' W of 002 OUTFALL	
CLP ID#	MFT959 F	MFT958 UF	MFT961 F	MFT960 UF	MFT957 F	MFT956 UF	MFT963 F	MFT962 UF	MFT965 F	MFT964 UF
Analyte (ug/L)										
Al	119	248	111	971	136	1050	148	135	40	149
Sb	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
As	nd	nd	nd	nd	1.2	nd	nd	nd	nd	nd
Ba	13.5	16.2	27.4	32	26	37.7	27.1	27.3	57.5	60.8
Be	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ca	265000	269000	49100	46800	45700	52900	277000	291000	123000	119000
Cr	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Co	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cu	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Fe	nd	nd	109	963	116	1160	nd	19.9	33.4	251
Pb	1	1.7	nd	nd	nd	1.4vJ	nd	nd	nd	nd
Mg	45400	47200	9190	8970	8500	9910	46400	47400	20700	20800
Mn	569	650	6.8vJ	36.4	15.8	65	1820	1860	11	10.9vJ
Hg	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ni	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
K	4140	4350	863	1110	791	1390	3520	4010	1060	1370
Se	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ag	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Na	90100	92000	15400	ND	14700	ND	91700	91600	48000	46700
Tl	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
V	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Zn	nd	8.3	nd	nd	nd	nd	nd	nd	nd	nd
Gen. Chem. (ug/L)										
CLP ID#	SF1375		SF1376		SF1374		SF1377		SF1378	
Alk	160000		71800J		71800J		158000J		167000J	
COD	nd		8410		6840		nd		nd	
TDS	1633000		273000		304000		1580000		679000	
TSS	nd		nd		nd		nd		nd	
NH3	nd		nd		nd		nd		nd	
Cl	16000		3630		3860		15600		12300	
NOX	nd		130		130		nd		nd	
TOC	3430J		3000J		2890J		2560J		2840J	
TPO4	130		nd		110		160		100	
SO4	1005000		121000		127000		973000		290000	

F - filtered sample; UF - unfiltered sample

nd - not detected; J - estimated value; v - value is biased low

Table 20. Loading of Sulfate and Selected Metals into the Red River by Stream Segment during ESI Sampling

Location:	Flow (cfs)*	SO4 conc.	SO4 gain	Mass gain	% of total gain	
		mg/l	(flow x conc)			
Abv. Molycorp Mill	18	74	1332	499.8	31.8	Moly Mill to Columbine Ck.
Below Columbine Crk.	25.8	71	1832	1030.2	65.6	Columbine to Goathill Gulch
Goathill Gulch	27	106	2862	418.4	26.6	Goathill to Blw Capulin Cyn
Blw Capulin Canyon	27.8	118	3280	196.6	12.5	Blw Capulin Cyn to Eagle Rk CG
Eagle Rock CG	28.5	122	3477			
FS Ranger St.	29					
			Total Gain =	2145		
Location:	Flow (cfs)	Al conc.	Al gain	Mass gain	% of total gain	
		mg/l	(flow x conc)			
Abv. Molycorp Mill	18	1.07	19.3	2.8	5.2	Moly Mill to Columbine Ck.
Below Columbine Crk.	25.8	0.856	22.1	12.2	22.4	Columbine to Goathill Gulch
Goathill Gulch	27	1.27	34.3	22.7	41.6	Goathill to Blw Capulin Cyn
Blw Capulin Canyon	27.8	2.05	57.0	16.8	30.8	Blw Capulin Cyn to Eagle Rk CG
Eagle Rock CG	28.5	2.59	73.8			
FS Ranger St.	29					
			Total Gain =	54.6		
Location:	Flow (cfs)	Mn conc.	Mn gain	Mass gain	% of total gain	
		mg/l	(flow x conc)			
Abv. Molycorp Mill	18	0.195	3.5	1.9	8.9	Moly Mill to Columbine Ck.
Below Columbine Crk.	25.8	0.208	5.4	8.0	38.6	Columbine to Goathill Gulch
Goathill Gulch	27	0.495	13.4	3.4	16.4	Goathill to Blw Capulin Cyn
Blw Capulin Canyon	27.8	0.603	16.8	7.5	36.1	Blw Capulin Cyn to Eagle Rk CG
Eagle Rock CG	28.5	0.851	24.3			
FS Ranger St.	29					
			Total Gain =	20.7		
Location:	Flow (cfs)	Zn conc.	Zn gain	Mass gain	% of total gain	
		mg/l	(flow x conc)			
Abv. Molycorp Mill	18	0.061	1.098	0.4	7.9	Moly Mill to Columbine Ck.
Below Columbine Crk.	25.8	0.057	1.4706	1.9	39.0	Columbine to Goathill Gulch
Goathill Gulch	27	0.123	3.321	0.9	19.7	Goathill to Blw Capulin Cyn
Blw Capulin Canyon	27.8	0.153	4.2534	1.6	33.5	Blw Capulin Cyn to Eagle Rk CG
Eagle Rock CG	28.5	0.205	5.8425			
FS Ranger St.	29					
			Total Gain =	4.7		

* Flow was estimated by applying flow rates from Vail 1993 to gauged flow of 29 cfs.

Shaded data represents reach of Red River demonstrating highest gain

Table 22. Metal Concentrations in Residentials Areas near Tailings Ponds: South

Map Location CLP ID# Soil Type* Analyte (mg/kg)	Average Metal Conc. in Tailings (N=8)	Highest Metal Conc. in Background Soil Sedillo Soil Type*	Ratio of Conc. (tailings/bckgrd)	17 Change House MFT934 Sedillo	15 Feliciano Rael MFT937 Sedillo	14 Roger Herrera MFT938 Sedillo	16 Cecil Clines MFT939 Sedillo	Benchmark (ref. 2)
Al	8050	3180	2.5	8290	7140	7070	8300	
Sb	nd	7.3	na	nd	nd	nd	nd	
As	0.78	0.84	0.9	1.9	1.5	1.3	1.4	
Ba	87	54.1	1.6	157	108	156	121	
Be	1	0.21	4.3	0.63	0.56	0.58	0.49	
Cd	0.2	nd	na	nd	nd	nd	nd	
Ca	16250	1230	13.2	5360.0	2490.0	8670.0	3060	
Cr	40	4.2	9.6	12.8	16.4	14	17.5	2900
Co	10	3.3	3.2	7.3	9.1	7.1	8.7	
Cu	188	7.0	26.9	31.7	20.1	20.3	22.7	na
Fe	16693	7780	2.1	11700	14200	11300	15400	
Pb	58	13.5	4.3	33.7	17.3	21.7	15.7	
Mg	7743	1120	6.9	3520.0	3350.0	3710.0	3830.0	
Mn	471	317	1.5	527	541	548	469	
Hg	nd	nd	na	nd	nd	nd	nd	
Ni	30	4.0	7.5	13.6	15.5	15.4	15.6	12000
K	4761	1100	4.3	1650	1650	2960	1650	
Se	nd	nd	na	nd	nd	nd	nd	
Ag	nd	nd	na	nd	nd	nd	nd	
Na	137	45.8	3.0	56.7	49.4	97.8	89.9	
Tl	0.5	nd	na	nd	nd	nd	nd	
V	35	8.7	4.0	18.6	19.3	14.8	21.9	
Zn	121	38.4	3.1	63.7J	57.8J	80.8J	52.4J	

* ref.5

** Cancer Risk Screening Concentration (ref. 2)

Shaded data are CERCLA hazardous substances which are > 3 x background concentrations.

J - estimated value; nd - not detected; na - not available or calculable

Table 23. Metal Concentrations in Residentials Areas near Tailings Ponds: North

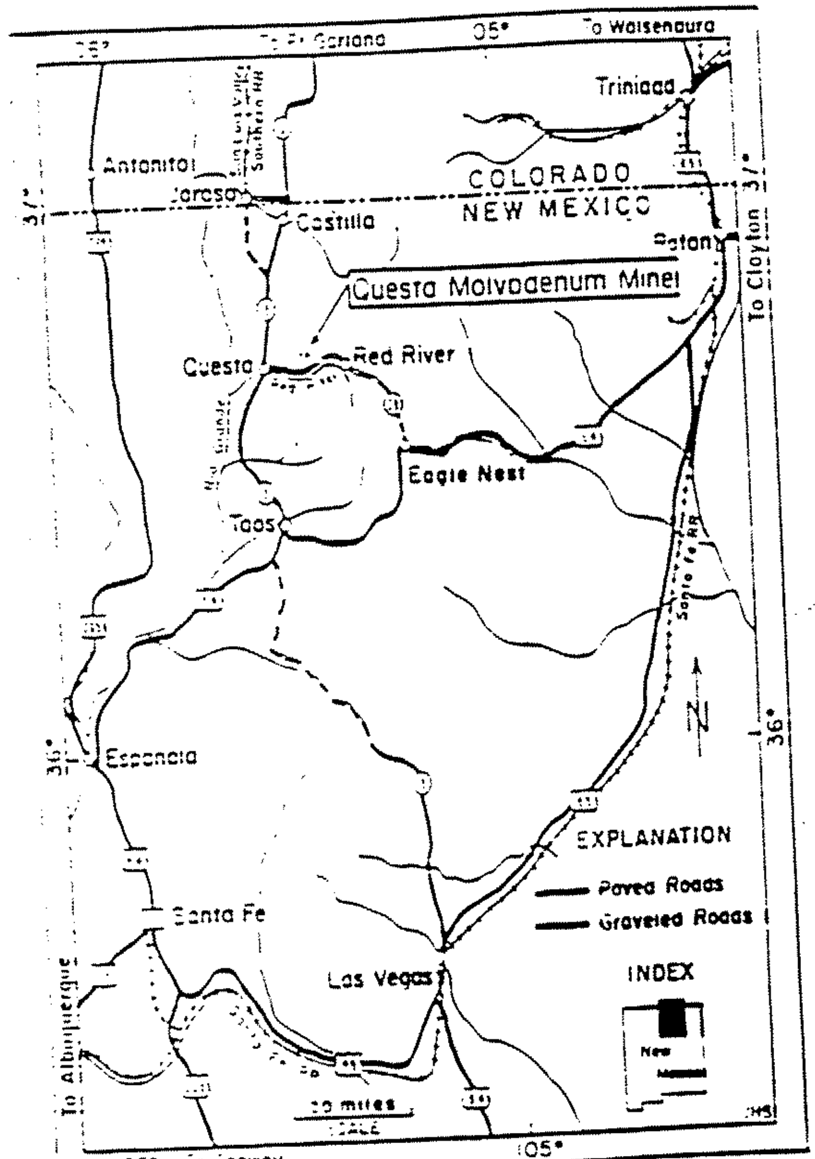
Map Location	Average Metal Concentration in Tailings	23 1/4-mile north of Questa Jr. High (initial background)	24 Cerro Rd. # 1 (background)	25 Cerro Rd. # 2 (background)	26 Cerro Rd. # 2 (duplicate)	Average Background Concentration	Ratio of Concentrations (tailings/bckgrd)	22 Questa Jr. High School-2	20 Questa Jr. High School-3	21 Questa Jr. High School-3 (duplicate)	18 Arch Trujillo	19 Romolo Martinez
CLP ID#	(N=8)	MFT945	MFQ-082	MFQ-083	MFQ-084			MFT931	MFT932	MFT933	MFT935	MFT936
Soil Type*		Silva	Silva	Silva	Silva	Silva Soil Type		Silva	Silva	Silva	Silva	Silva
Analyte (mg/kg)												
Al	8050	13600	9790	8950	13700	11510	0.7	12300	8000	10900	8710	8650
Sb	nd	nd	nd	nd	nd	nd	na	nd	nd	nd	nd	nd
As	0.78	nd	4.7	4.4	5.5	3.7	0.2	2.3	2	nd	2.5	1.5
Ba	87	187	156	159	185	172	0.5	218	196	195	167	192
Be	1	0.75	0.72	0.79	0.97	0.81	1.1	0.88	0.67	0.69	0.62	0.62
Cd	0.2	0.98	nd	0.57	0.65	0.55	0.4	nd	nd	1.2	nd	nd
Ca	16250	4670	2570	2280	2580	3025	5.4	9970	7680	7010	13700	14000
Cr	40	13.2	13.1	13.7	17.7	14.4	2.8	11.8	8.2	11.5	9	14.5
Co	10	7.1	10	12	14.3	10.9	1.0	8.7	7.7	6.7	6.6	7.8
Cu	188	14.4	17.4	24.3	29.2	21.3	8.8	19.5	16.9	16	16.4	30.2
Fe	16693	17200	17500	19400	25000	19775	0.8	15000	10700	14300	13200	12500
Pb	58	16.2vJ	20.3	23.5	24.9	21.2	2.7	18.7	15.8	3.3vJ	16.4	48.4
Mg	7743	4100	2550	2590	3220	3115	2.5	4100	3100	3700	3980	4280
Mn	471	493	655	789	904	710	0.7	589	504	518	457	542
Hg	nd	nd	nd	nd	nd	nd	na	nd	nd	nd	nd	nd
Ni	30	12.4	11	11.6	14.3	12.3	2.4	12.6	9.2	11.2	11.5	14.3
K	4761	2650	1850	2230	2910	2410	2.0	3040	1700	2070	2090	2630
Se	nd	0.21J	1.1J	0.92	1.4J	0.23	0.0	nd	nd	nd	nd	nd
Ag	nd	nd	nd	nd	nd	nd	na	nd	nd	nd	nd	0.81
Na	137	86.9	86.2	79.6	105	89.4	1.5	104	61.6	73.5	93.7	85.6
Tl	nd	nd	nd	nd	nd	nd	na	nd	nd	nd	nd	nd
V	35	24.8	36.1	33	41.3	33.8	1.0	19.8	19.9	22.4	24.5	21
Zn	121	49.3	48.5	65.3	85.3	62.1	1.9	60.7J	42.1J	44.1	52.6J	[redacted]

* ref. 5

J = estimated value; v - value biased low

nd = not detected; na = not available or calculable

Note: Shaded datum is > 3 x background but also > average concentration in tailings



INDEX MAP SHOWING THE LOCATION OF THE QUESTA MOLYBDENUM MINE.

Figure 1 (from Ref. 8)

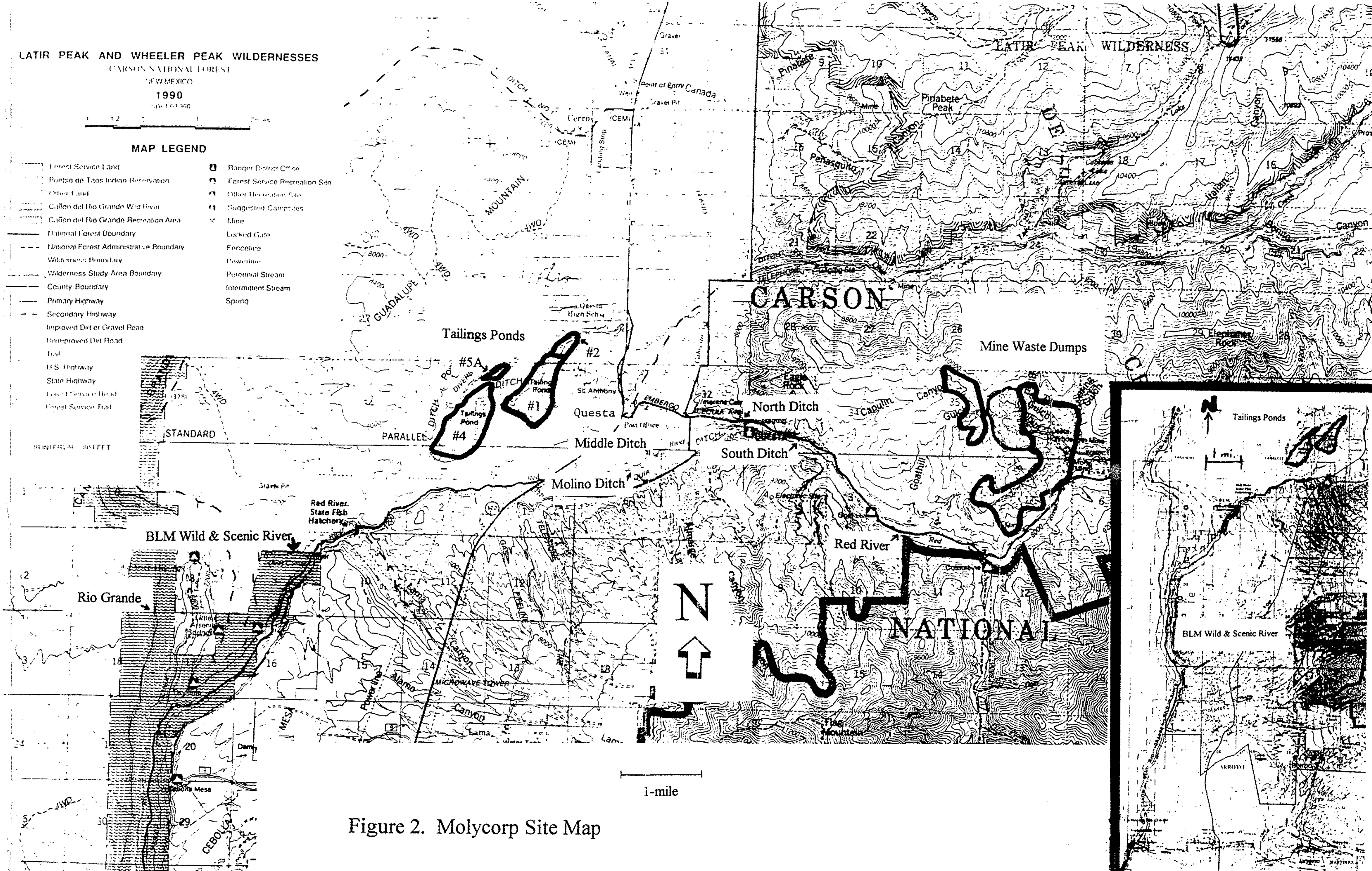


Figure 2. Molycorp Site Map

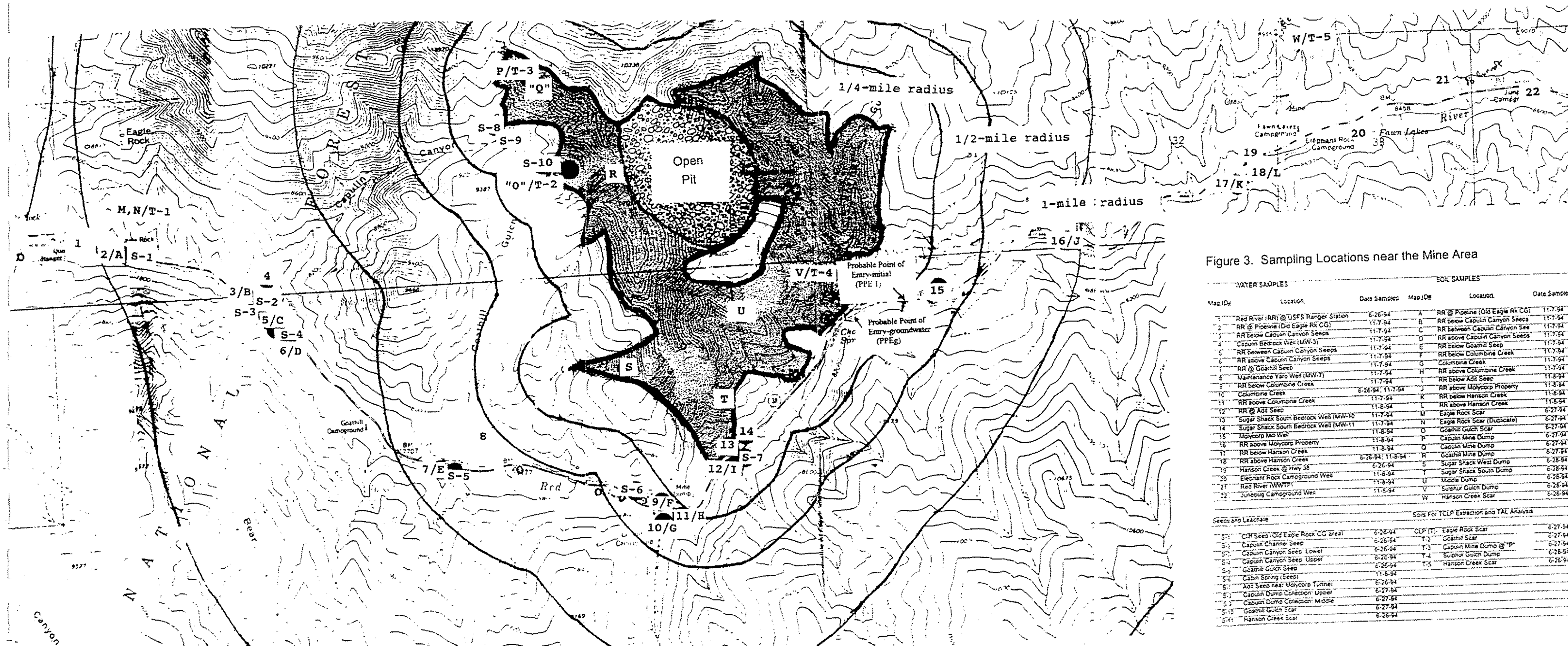


Figure 3. Sampling Locations near the Mine Area

WATER SAMPLES			SOIL SAMPLES		
Map ID#	Location	Date Sampled	Map ID#	Location	Date Sampled
1	Red River (RR) @ USFS Ranger Station	6-26-94	A	RR @ Pipeline (Old Eagle Rk CG)	11-7-94
2	RR @ Pipeline (Old Eagle Rk CG)	11-7-94	B	RR below Capulin Canyon Seeps	11-7-94
3	RR below Capulin Canyon Seeps	11-7-94	C	RR between Capulin Canyon See	11-7-94
4	Capulin Bedrock Well (MW-3)	11-7-94	D	RR above Capulin Canyon Seeps	11-7-94
5	RR between Capulin Canyon Seeps	11-7-94	E	RR below Goathill Seep	11-7-94
6	RR above Capulin Canyon Seeps	11-7-94	F	RR below Columbine Creek	11-7-94
7	RR @ Goathill Seep	11-7-94	G	Columbine Creek	11-7-94
8	Maintenance Yard Well (MW-7)	11-7-94	H	RR above Columbine Creek	11-7-94
9	RR below Columbine Creek	11-7-94	I	RR below Adit Seep	11-8-94
10	Columbine Creek	6-26-94; 11-7-94	J	RR above Molycorp Property	11-8-94
11	RR above Columbine Creek	11-7-94	K	RR below Hanson Creek	11-8-94
12	RR @ Adit Seep	11-8-94	L	RR above Hanson Creek	11-8-94
13	Sugar Shack South Bedrock Well (MW-10	11-7-94	M	Eagle Rock Scar	6-27-94
14	Sugar Shack South Bedrock Well (MW-11	11-7-94	N	Eagle Rock Scar (Duplicate)	6-27-94
15	Molycorp Mill Well	11-8-94	O	Goathill Gulch Scar	6-27-94
16	RR above Molycorp Property	11-8-94	P	Capulin Mine Dump	6-27-94
17	RR below Hanson Creek	11-8-94	Q	Capulin Mine Dump	6-27-94
18	RR above Hanson Creek	6-26-94; 11-8-94	R	Goathill Mine Dump	6-27-94
19	Hanson Creek @ Hwy 38	6-26-94	S	Sugar Shack West Dump	6-28-94
20	Elephant Rock Campground Well	11-8-94	T	Sugar Shack South Dump	6-28-94
21	Red River (WWTP)	11-8-94	U	Middle Dump	6-28-94
22	Junebug Campground Well	11-8-94	V	Sulphur Gulch Dump	6-28-94
			W	Hanson Creek Scar	6-28-94

Seeps and Leachate			Soils For TCLP Extraction and TAL Analysis		
S-1	Cliff Seep (Old Eagle Rock CG area)	6-28-94	CLP (T)-1	Eagle Rock Scar	6-27-94
S-2	Capulin Channel Seep	6-26-94	T-2	Goathill Scar	6-27-94
S-3	Capulin Canyon Seep: Lower	6-26-94	T-3	Capulin Mine Dump @ "P"	6-27-94
S-4	Capulin Canyon Seep: Upper	6-26-94	T-4	Sulphur Gulch Dump	6-28-94
S-5	Goathill Gulch Seep	6-26-94	T-5	Hanson Creek Scar	6-28-94
S-6	Cabin Spring (Seep)	11-8-94			
S-7	Adit Seep near Molycorp Tunnel	6-26-94			
S-8	Capulin Dump Collection: Upper	6-27-94			
S-9	Capulin Dump Collection: Middle	6-27-94			
S-10	Goathill Gulch Scar	6-27-94			
S-11	Hanson Creek Scar	6-26-94			

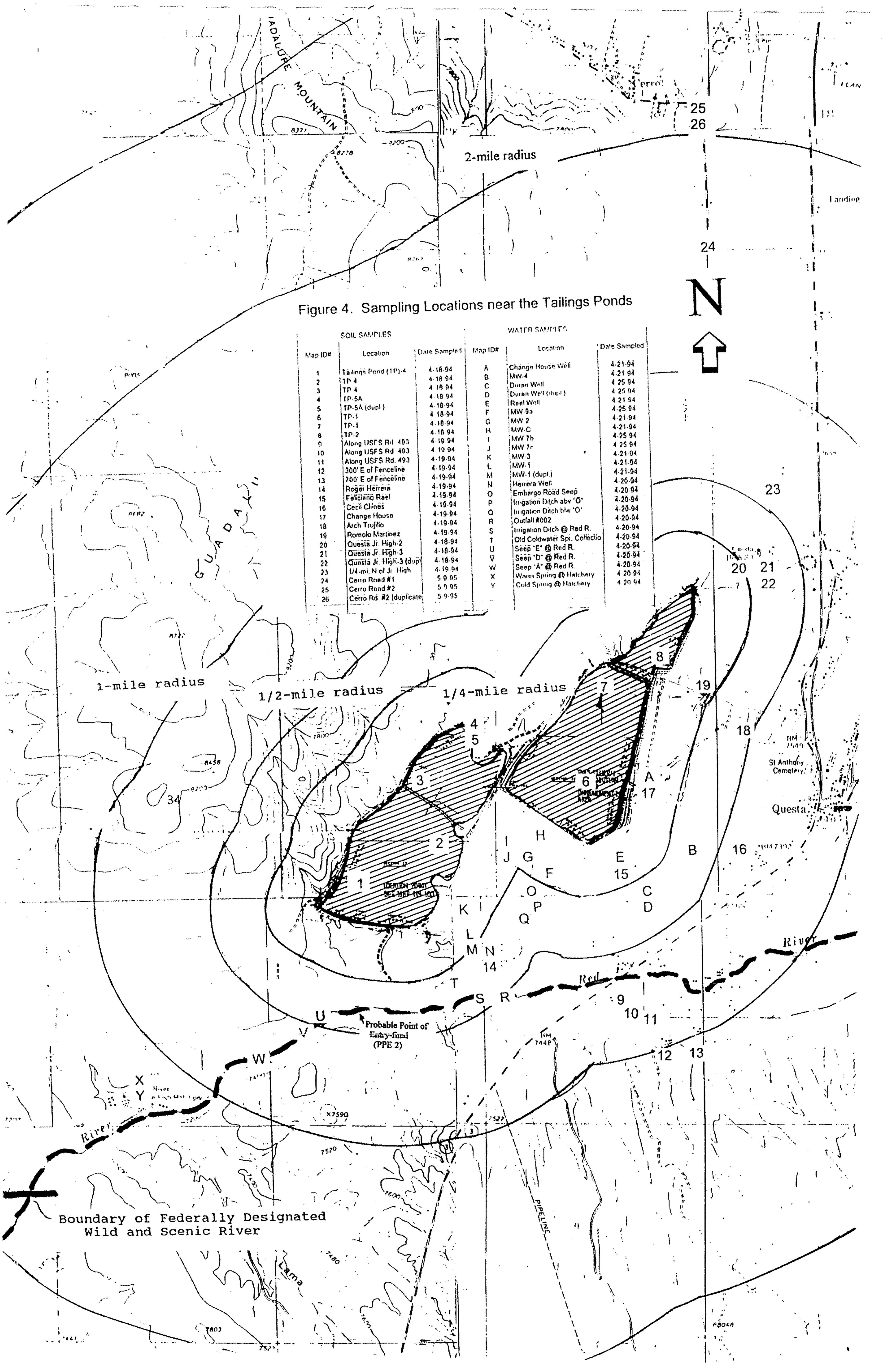


Figure 4. Sampling Locations near the Tailings Ponds

SOIL SAMPLES

Map ID#	Location	Date Sampled
1	Tailings Pond (TP)-4	4-18-94
2	TP 4	4-18 94
3	TP 4	4 18 94
4	TP-5A	4-18 94
5	TP-5A (dupl.)	4-18-94
6	TP-1	4-18-94
7	TP-1	4-18-94
8	TP-2	4-18 94
9	Along USFS Rd 493	4-19 94
10	Along USFS Rd 493	4 19 94
11	Along USFS Rd. 493	4-19-94
12	300' E of Fenceline	4-19-94
13	700' E of Fenceline	4-19-94
14	Roger Herrera	4-19-94
15	Feliciano Rael	4-19-94
16	Cecil Clines	4-19-94
17	Change House	4-19-94
18	Arch Trujillo	4-19-94
19	Romolo Martinez	4-19-94
20	Questa Jr. High-2	4-18-94
21	Questa Jr. High-3	4-18-94
22	Questa Jr. High-3 (dupl	4-18-94
23	1/4-mi. N of Jr. High	4-19-94
24	Cerro Road #1	5 9 95
25	Cerro Road #2	5 9 95
26	Cerro Rd. #2 (duplicate	5-9-95

WATER SAMPLES

Map ID#	Location	Date Sampled
A	Change House Well	4-21-94
B	MW-4	4-21-94
C	Duran Well	4 25 94
D	Duran Well (dupl.)	4 25 94
E	Rael Well	4 21 94
F	MW-9a	4-25 94
G	MW 2	4-21-94
H	MW-C	4-21-94
I	MW-7b	4-25 94
J	MW 7c	4 25 94
K	MW-3	4-21-94
L	MW-1	4-21-94
M	MW-1 (dupl.)	4-21-94
N	Herrera Well	4-20-94
O	Embargo Road Seep	4-20-94
P	Irrigation Ditch abv "O"	4-20-94
Q	Irrigation Ditch blw "O"	4-20-94
R	Outfall #002	4-20-94
S	Irrigation Ditch @ Red R.	4-20-94
T	Old Coldwater Spr. Collectio	4-20-94
U	Seep "E" @ Red R.	4-20-94
V	Seep "D" @ Red R.	4-20-94
W	Seep "A" @ Red R.	4-20-94
X	Warm Spring @ Hatchery	4 20 94
Y	Cold Spring @ Hatchery	4 20 94

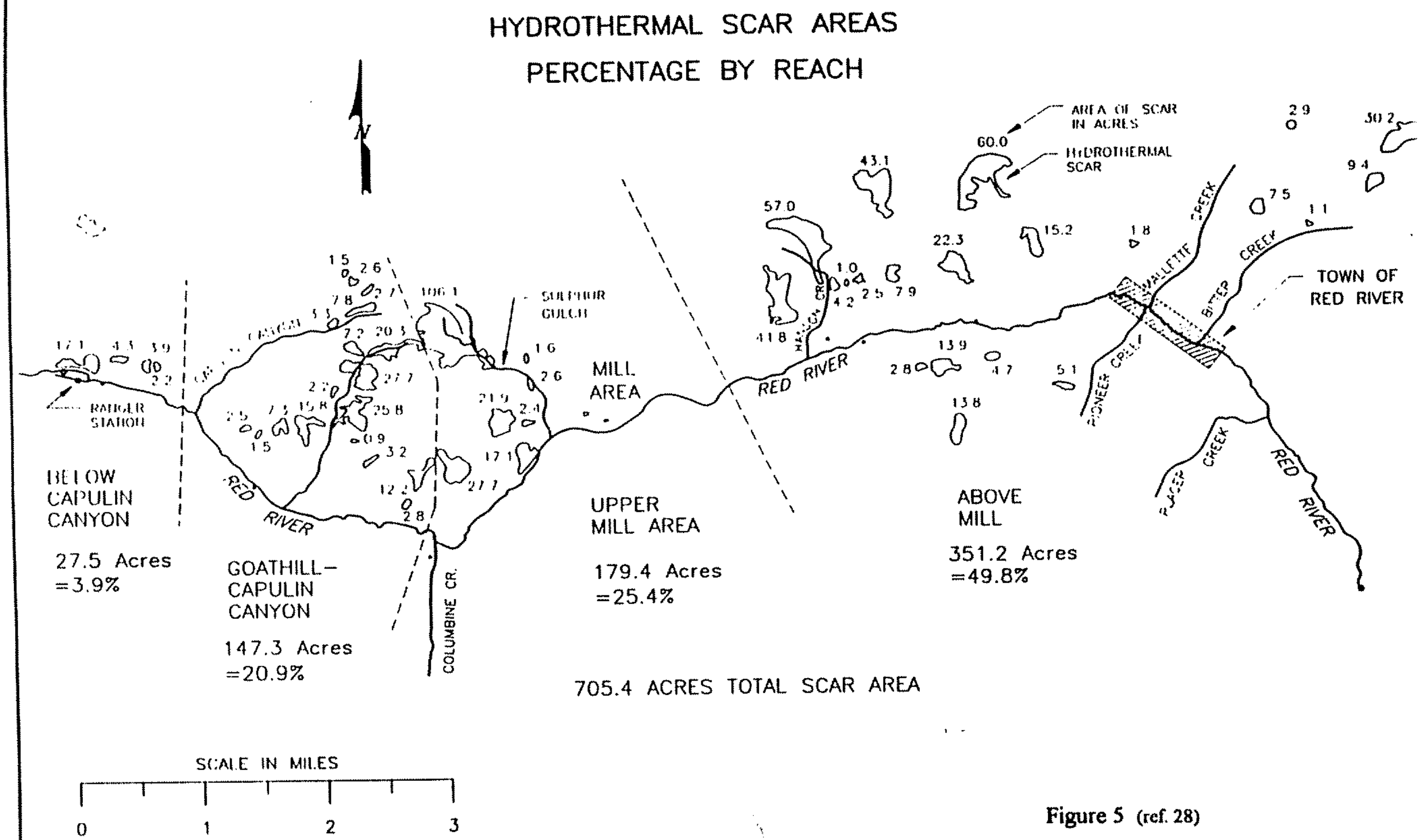


Figure 5 (ref. 28)

HYDROTHERMAL SCAR AREAS

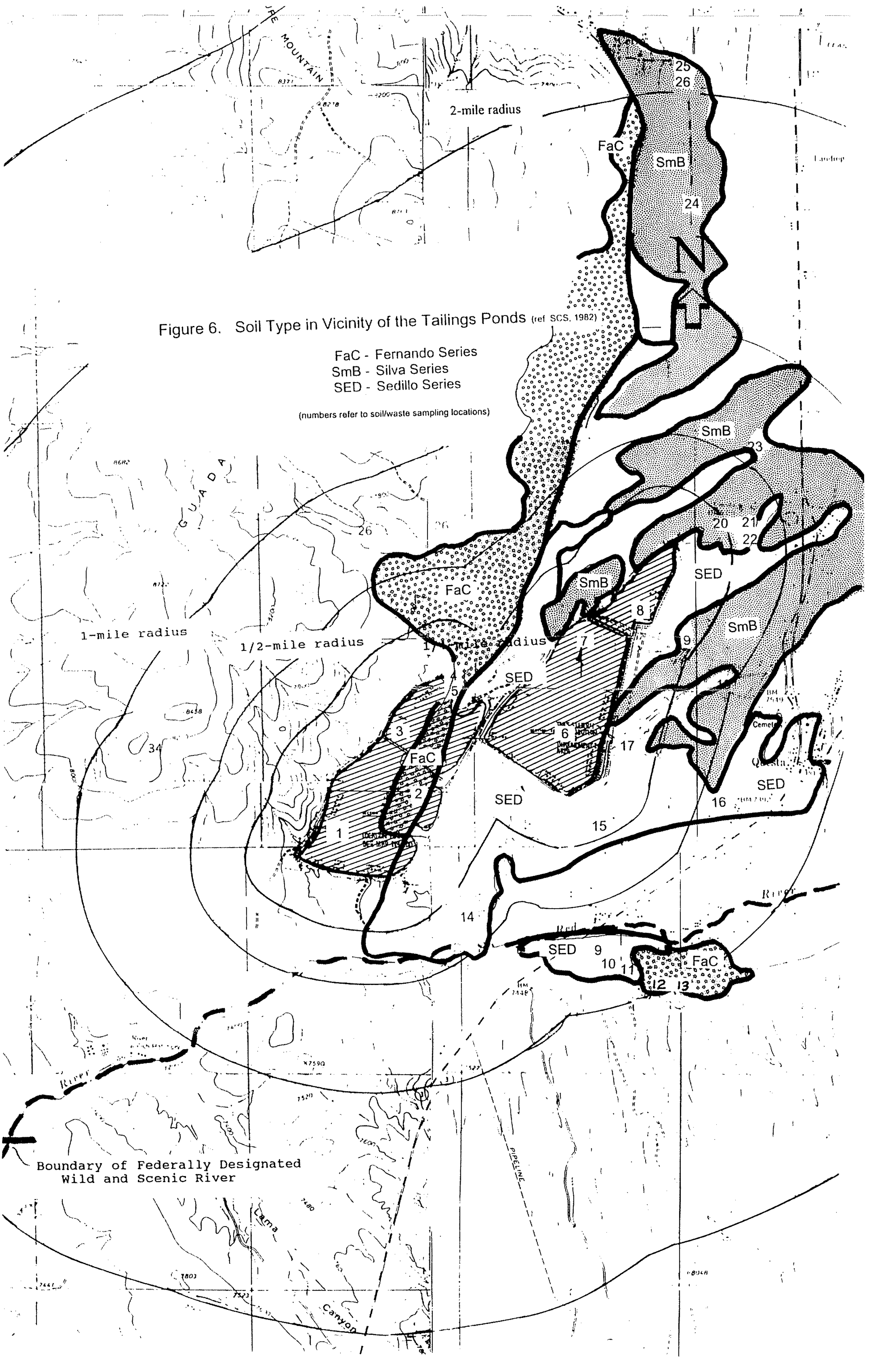


Figure 6. Soil Type in Vicinity of the Tailings Ponds (ref SCS, 1982)
FaC - Fernando Series
SmB - Silva Series
SED - Sedillo Series
(numbers refer to soil/waste sampling locations)
2-mile radius
1-mile radius
1/2-mile radius
1/4-mile radius
FaC
SmB
SED
Boundary of Federally Designated Wild and Scenic River
MOUNTAIN
GUADA
River
Red
Lama
Canyon
PIPELINE
Cemet
Questa
1
2
3
4
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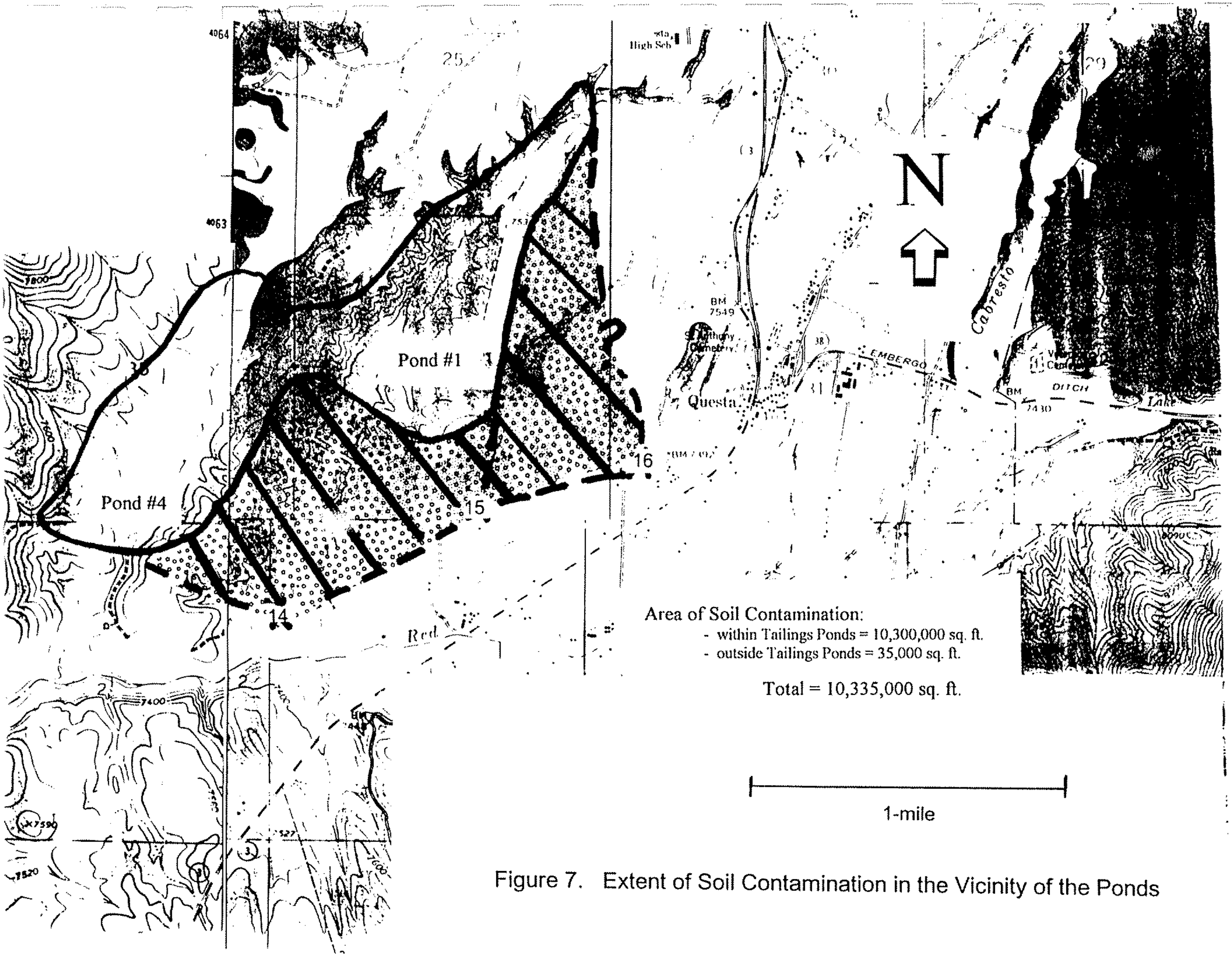
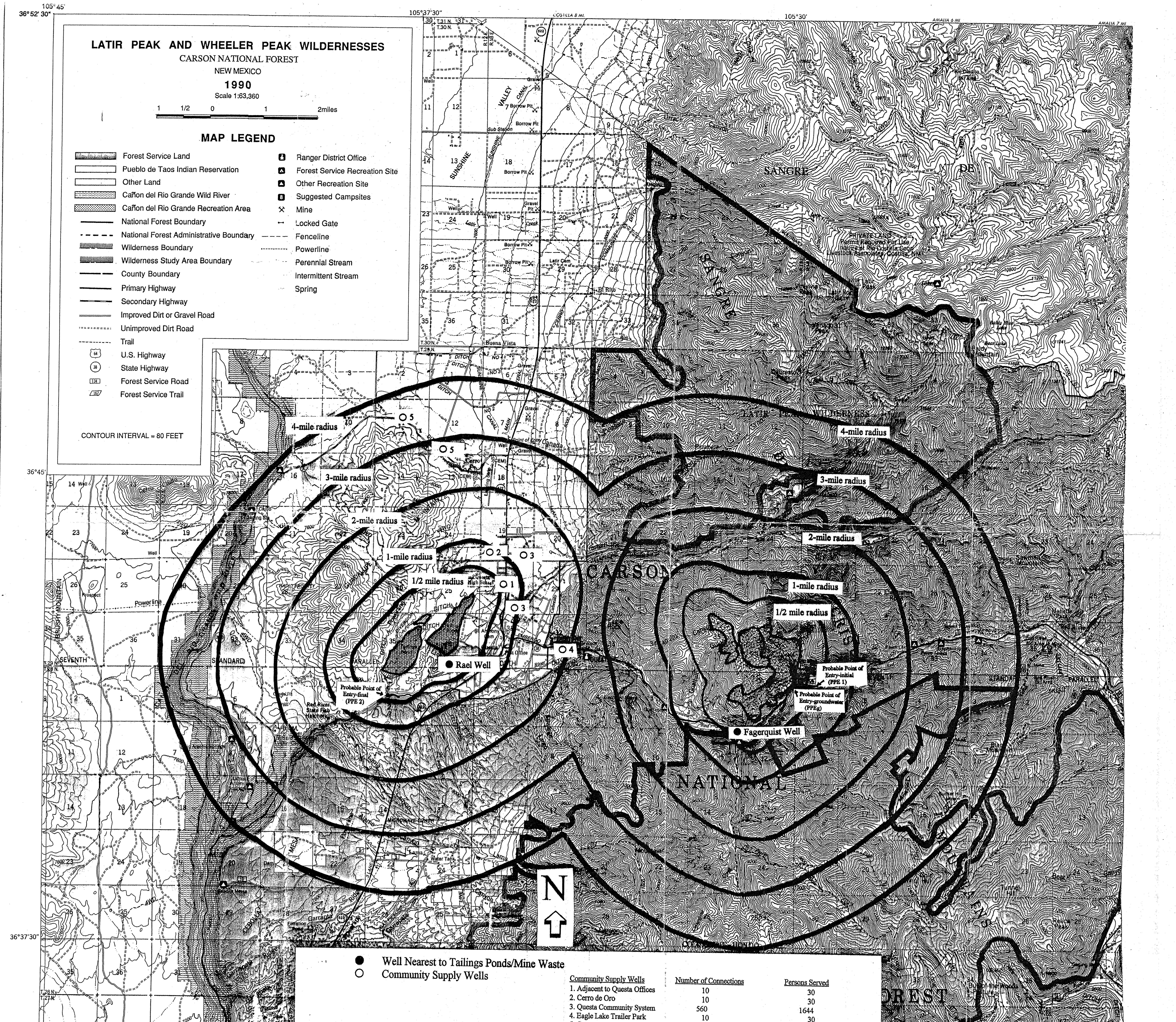


Figure 7. Extent of Soil Contamination in the Vicinity of the Ponds



Community Supply Wells	Number of Connections	Persons Served
1. Adjacent to Questa Offices	10	30
2. Cerro de Oro	10	30
3. Questa Community System	560	1644
4. Eagle Lake Trailer Park	10	30
5. Cerro	144	396

Reference 3. Site Map with 4-mile Radii and Drinking Water Wells

Reference 1

(Not Included)

HRS Manual

SUPERFUND CHEMICAL DATA MATRIX

9 March 1993

Chemical Name (CAS) /	Data Element /	Next	Current
Maleic anhydride (000108-31-6)	Substance Synonym (primary)	Furandione, 2,5-	
Maleic hydrazide (000123-33-1)	Substance Synonym (primary)	Dihydro-3,6-pyridazinedione, 1,2-	
Maleic hydrazide (000123-33-1)	Air Gas Mobility	1.0000	0.2000
Maleic hydrazide (000123-33-1)	Vapor Pressure (Torr)	46900.0000000000000	0.0740000000000
Maleic hydrazide (000123-33-1)	Particulate Substance (VP <= 0.1)	F	T
Manganese (007439-96-5)	MCL / MCLG (mg/L) [pCi/L for radionuclides]	-1.00000000000	0.20000000000
Manganese (007439-96-5)	Drinking Water (GW & SW) Reference Dose Screening Concentration (mg/L)	0.1750000000	3.5000000000
Manganese (007439-96-5)	Surface Water Food Chain Reference Dose Screening Concentration (mg/kg)	6.5000000000	130.0000000000
Manganese (007439-96-5)	Soil Exposure Reference Dose Screening Concentration (mg/kg)	2915.0000000000	58300.0000000000

Date: 03/08/93
Chemical: Barium

SUPERFUND CHEMICAL DATA MATRIX

SCDM Version: MAR93
CAS Number: 007440-39-3

TOXICITY

Parameter	Value	Unit	Source
Oral RfD:	7.0E-02	mg/kg/day	IRIS
Inhal RfD:		mg/kg/day	
Oral Slope:		(mg/kg/day)^-1	
Oral Wt-of-Evid:			
Inhal Slope:		(mg/kg/day)^-1	
Inhal Wt-of-Evid:			
Oral ED10:		mg/kg/day	
Oral ED10 Wgt:			
Inhal ED10:		mg/kg/day	
Inhal ED10 Wgt:			
Oral LD50:	2.0E+03	mg/kg	ACGIH
Dermal LD50:		mg/kg	
Gas Inhal LC50:		ppm	
Dust Inhal LC50:		mg/L	
ACUTE			
Fresh AWQC:		ug/L	
Salt AWQC:		ug/L	
Fresh AALAC:		ug/L	
Salt AALAC:		ug/L	
CHRONIC			
Fresh AWQC:		ug/L	
Salt AWQC:		ug/L	
Fresh AALAC:		ug/L	
Salt AALAC:		ug/L	
Fresh Ecol LC50:	4.1E+05	ug/L	ACQUIRE
Salt Ecol LC50:		ug/L	

PERSISTENCE

Parameter	Value	Unit	Source
LAKE - Halflives			
Hydrolysis:		days	
Volatility:	**	days	
Photolysis:		days	
Biodeg:		days	
Radio:		days	
RIVER - Halflives			
Hydrolysis:		days	
Volatility:	**	days	
Photolysis:		days	
Biodeg:		days	
Radio:		days	
Log Kow:			

PHYSICAL CHARACTERISTICS

Parameter	Value
Metal Contain:	Yes
Organic:	No
Inorganic:	Yes
Gas:	No
Particulate:	Yes
Radionuclide:	No
Rad. Element:	No
Molecular Wgt:	1.4E+02
Density:	

MOBILITY

Parameter	Value	Unit	Source
Vapor Press:		Torr	
Henry's Law:		atm-m3/mol	
Water Solub:		mg/L	
Distrib Coef:	6.0E+01	ml/g	CH2M_KD
Geo. Mean Sol.:	3.0E+03	mg/L	WEAST

BIOACCUMULATION

Parameter	Value	Unit	Source
FOOD CHAIN			
Fresh BCF:			
Salt BCF:			
ENVIRONMENTAL			
Fresh BCF:			
Salt BCF:			
Log Kow:			
Water Solub:		mg/L	

CLASS INFORMATION

Class	Parent Substance
Toxicity:	NA
GW Mob:	NA
Other:	NA

** This substance should be considered essentially non-volatile.

ASSIGNED FACTOR VALUES

AIR PATHWAY

Parameter	Value
Toxicity:	10
Gas Mobility:	0.0000
Gas Migration:	0

GROUND WATER PATHWAY

Parameter	Value
Toxicity:	10
Water Solub:	3.0E+03
Distrib:	6.0E+01

SOIL EXPOSURE PATHWAY

Parameter	Value
Toxicity:	10

SURFACE WATER PATHWAY

Drinking Water

Parameter	Value
Toxicity:	10
Persistence	
River:	1.0000
Lake:	1.0000

Human Food Chain

Parameter	Value
Toxicity:	10
Persistence	
River:	1.0000
Lake:	1.0000
Bioaccumulation	
Fresh:	0.5
Salt:	0.5

Environmental

Parameter	Value
Fresh Tox:	1
Salt Tox:	1
Persistence	
River:	1.0000
Lake:	1.0000
Bioaccumulation	
Fresh:	0.5
Salt:	0.5

BENCHMARKS

AIR PATHWAY

Parameter	Value	Unit
NAAQS/NESHAPS:		ug/m3
Cancer Risk:		mg/m3
Reference Dose:		mg/m3

GROUND WATER PATHWAY

Parameter	Value	Unit
MCL/MCLG:	2.0E+00	mg/L
Cancer Risk:		mg/L
Reference Dose:	2.5E+00	mg/L

SOIL EXPOSURE PATHWAY

Parameter	Value	Unit
Cancer Risk:		mg/kg
Reference Dose:	4.1E+04	mg/kg

RADIONUCLIDE

Parameter	Value	Unit
MCL:	2.0E+00	pCi/L
UMTRCA:		pCi/kg
Cancer Risk:		
Air:	5.4E-01	pCi/m3
DW:	1.6E+01	pCi/L
FC:	6.0E+02	pCi/kg
Soil Ing:	3.1E+05	pCi/kg
Soil Gam:		pCi/kg

SURFACE WATER PATHWAY

Drinking Water

Parameter	Value	Unit
MCL/MCLG:	2.0E+00	mg/L
Cancer Risk:		mg/L
Reference Dose:	2.5E+00	mg/L

Human Food Chain

Parameter	Value	Unit
FDAAL:		ppm
Cancer Risk:		mg/kg
Reference Dose:	9.1E+01	mg/kg

Environmental

Parameter	Value	Unit
ACUTE		
Fresh AWQC:		ug/L
Salt AWQC:		ug/L
Fresh AALAC:		ug/L
Salt AALAC:		ug/L
CHRONIC		
Fresh AWQC:		ug/L
Salt AWQC:		
Fresh AALAC:		ug/L
Salt AALAC:		ug/L

Date: 03/08/93
Chemical: Beryllium

SUPERFUND CHEMICAL DATA MATRIX

SCDM Version: MAR93
CAS Number: 007440-41-7

TOXICITY

Parameter	Value	Unit	Source
Oral RfD:	5.0E-03	mg/kg/day	IRIS
Inhal RfD:		mg/kg/day	
Oral Slope:	4.3E+00	(mg/kg/day)^-1	IRIS
Oral Wt-of-Evid:	B2		IRIS
Inhal Slope:	8.4E+00	(mg/kg/day)^-1	IRIS
Inhal Wt-of-Evid:	B2		IRIS
Oral ED10:	1.3E-02	mg/kg/day	EPA_ED10
Oral ED10 Wgt:	B2		EPA_ED10
Inhal ED10:	1.3E-02	mg/kg/day	EPA_ED10
Inhal ED10 Wgt:	B2		EPA_ED10
Oral LD50:		mg/kg	
Dermal LD50:		mg/kg	
Gas Inhal LC50:		ppm	
Dust Inhal LC50:		mg/L	
ACUTE			
Fresh AWQC:		ug/L	
Salt AWQC:		ug/L	
Fresh AALAC:		ug/L	
Salt AALAC:		ug/L	
CHRONIC			
Fresh AWQC:		ug/L	
Salt AWQC:		ug/L	
Fresh AALAC:		ug/L	
Salt AALAC:		ug/L	
Fresh Ecol LC50:		ug/L	
Salt Ecol LC50:		ug/L	

PERSISTENCE

Parameter	Value	Unit	Source
LAKE - Halflives			
Hydrolysis:		days	
Volatility:	**	days	
Photolysis:		days	
Biodeg:		days	
Radio:		days	
RIVER - Halflives			
Hydrolysis:		days	
Volatility:	**	days	
Photolysis:		days	
Biodeg:		days	
Radio:		days	

Log Kow:

PHYSICAL CHARACTERISTICS

Parameter	Value
Metal Contain:	Yes
Organic:	No
Inorganic:	Yes
Gas:	No
Particulate:	Yes
Radionuclide:	No
Rad. Element:	No
Molecular Wgt:	9.0E+00
Density:	

MOBILITY

Parameter	Value	Unit	Source
Vapor Press:		Torr	
Henry's Law:		atm-m3/mol	
Water Solub:		mg/L	
Distrib Coef:	6.5E+02	ml/g	CH2M_KD
Geo. Mean Sol.:	3.4E+02	mg/L	WEAST

BIOACCUMULATION

Parameter	Value	Unit	Source
FOOD CHAIN			
Fresh BCF:	1.9E+01		VER_BCF
Salt BCF:			
ENVIRONMENTAL			
Fresh BCF:	1.9E+01		VER_BCF
Salt BCF:			
Log Kow:			
Water Solub:		mg/L	

CLASS INFORMATION

Class	Parent Substance
Toxicity:	NA
GW Mob:	NA
Other:	NA

** This substance should be considered essentially non-volatile.

Date: 03/08/93
Chemical: Beryllium

SUPERFUND CHEMICAL DATA MATRIX

SCDM Version: MAR93
CAS Number: 007440-41-7

ASSIGNED FACTOR VALUES

AIR PATHWAY

Parameter	Value
Toxicity:	10000
Gas Mobility:	0.0000
Gas Migration:	0

GROUND WATER PATHWAY

Parameter	Value
Toxicity:	10000
Water Solub:	3.4E+02
Distrib:	6.5E+02

SOIL EXPOSURE PATHWAY

Parameter	Value
Toxicity:	10000

SURFACE WATER PATHWAY

Drinking Water

Parameter	Value
Toxicity:	10000
Persistence	
River:	1.0000
Lake:	1.0000

Human Food Chain

Parameter	Value
Toxicity:	10000
Persistence	
River:	1.0000
Lake:	1.0000
Bioaccumulation	
Fresh:	50.0
Salt:	50.0

Environmental

Parameter	Value
Fresh Tox:	0
Salt Tox:	0
Persistence	
River:	1.0000
Lake:	1.0000
Bioaccumulation	
Fresh:	50.0
Salt:	50.0

BENCHMARKS

AIR PATHWAY

Parameter	Value	Unit
NAAQS/NESHAPS:	1.0E-02	ug/m3
Cancer Risk:	4.2E-07	mg/m3
Reference Dose:		mg/m3

GROUND WATER PATHWAY

Parameter	Value	Unit
MCL/MCLG:	1.0E-03	mg/L
Cancer Risk:	8.1E-06	mg/L
Reference Dose:	1.8E-01	mg/L

SOIL EXPOSURE PATHWAY

Parameter	Value	Unit
Cancer Risk:	1.4E-01	mg/kg
Reference Dose:	2.9E+03	mg/kg

RADIONUCLIDE

Parameter	Value	Unit
MCL:	1.0E-03	pCi/L
UMTRCA:		pCi/kg
Cancer Risk:		
Air:	7.2E+00	pCi/m3
DW:	6.5E+02	pCi/L
FC:	2.4E+04	pCi/kg
Soil Ing:	1.2E+07	pCi/kg
Soil Gam:		pCi/kg

SURFACE WATER PATHWAY

Drinking Water

Parameter	Value	Unit
MCL/MCLG:	1.0E-03	mg/L
Cancer Risk:	8.1E-06	mg/L
Reference Dose:	1.8E-01	mg/L

Human Food Chain

Parameter	Value	Unit
FDAAL:		ppm
Cancer Risk:	3.0E-04	mg/kg
Reference Dose:	6.5E+00	mg/kg

Environmental

Parameter	Value	Unit
ACUTE		
Fresh AWQC:		ug/L
Salt AWQC:		ug/L
Fresh AALAC:		ug/L
Salt AALAC:		ug/L
CHRONIC		
Fresh AWQC:		ug/L
Salt AWQC:		
Fresh AALAC:		ug/L
Salt AALAC:		ug/L

Date: 03/08/93 SUPERFUND CHEMICAL DATA MATRIX SCDM Version: MAR93
Chemical: Chromium CAS Number: 007440-47-3

TOXICITY

Parameter	Value	Unit	Source
Oral RfD:	5.0E-03	mg/kg/day	IRIS
Inhal RfD:		mg/kg/day	
Oral Slope:		(mg/kg/day)^-1	
Oral Wt-of-Evid:			
Inhal Slope:		(mg/kg/day)^-1	
Inhal Wt-of-Evid:			
Oral ED10:		mg/kg/day	
Oral ED10 Wgt:			
Inhal ED10:	2.6E-03	mg/kg/day	SPHEM
Inhal ED10 Wgt:	A		SPHEM
Oral LD50:		mg/kg	
Dermal LD50:		mg/kg	
Gas Inhal LC50:		ppm	
Dust Inhal LC50:		mg/L	
ACUTE			
Fresh AWQC:		ug/L	
Salt AWQC:		ug/L	
Fresh AALAC:		ug/L	
Salt AALAC:		ug/L	
CHRONIC			
Fresh AWQC:		ug/L	
Salt AWQC:		ug/L	
Fresh AALAC:		ug/L	
Salt AALAC:		ug/L	
Fresh Ecol LC50:	2.2E+01	ug/L	ACQUIRE
Salt Ecol LC50:		ug/L	

PERSISTENCE

Parameter	Value	Unit	Source
LAKE - Halflives			
Hydrolysis:		days	
Volatility:	**	days	
Photolysis:		days	
Biodeg:		days	
Radio:		days	
RIVER - Halflives			
Hydrolysis:		days	
Volatility:	**	days	
Photolysis:		days	
Biodeg:		days	
Radio:		days	
Log Kow:			

PHYSICAL CHARACTERISTICS

Parameter	Value
Metal Contain:	Yes
Organic:	No
Inorganic:	Yes
Gas:	No
Particulate:	Yes
Radionuclide:	No
Rad. Element:	No
Molecular Wgt:	5.2E+01
Density:	

MOBILITY

Parameter	Value	Unit	Source
Vapor Press:	0.0E+01	Torr	RAGS
Henry's Law:		atm-m3/mol	
Water Solub:		mg/L	
Distrib Coef:	8.5E+02	ml/g	CH2M_KD
Geo. Mean Sol.:	7.9E+04	mg/L	WEAST

BIOACCUMULATION

Parameter	Value	Unit	Source
FOOD CHAIN			
Fresh BCF:	1.0E+00		VER_BCF
Salt BCF:	1.9E+02		VER_BCF
ENVIRONMENTAL			
Fresh BCF:	1.0E+00		VER_BCF
Salt BCF:	1.9E+02		VER_BCF
Log Kow:			
Water Solub:		mg/L	

CLASS INFORMATION

Class	Parent Substance
Toxicity:	NA
GW Mob:	NA
Other:	NA

** This substance should be considered essentially non-volatile.

ASSIGNED FACTOR VALUES

AIR PATHWAY

Parameter	Value
Toxicity:	10000
Gas Mobility:	0.0000
Gas Migration:	0

GROUND WATER PATHWAY

Parameter	Value
Toxicity:	10000
Water Solub:	7.9E+04
Distrib:	8.5E+02

SOIL EXPOSURE PATHWAY

Parameter	Value
Toxicity:	10000

SURFACE WATER PATHWAY

Drinking Water

Parameter	Value
Toxicity:	10000
Persistence	
River:	1.0000
Lake:	1.0000

Human Food Chain

Parameter	Value
Toxicity:	10000
Persistence	
River:	1.0000
Lake:	1.0000
Bioaccumulation	
Fresh:	5.0
Salt:	500.0

Environmental

Parameter	Value
Fresh Tox:	10000
Salt Tox:	10000
Persistence	
River:	1.0000
Lake:	1.0000
Bioaccumulation	
Fresh:	5.0
Salt:	500.0

BENCHMARKS

AIR PATHWAY

Parameter	Value	Unit
NAAQS/NESHAPS:		ug/m3
Cancer Risk:		mg/m3
Reference Dose:		mg/m3

GROUND WATER PATHWAY

Parameter	Value	Unit
MCL/MCLG:	1.0E-01	mg/L
Cancer Risk:		mg/L
Reference Dose:	1.8E-01	mg/L

SOIL EXPOSURE PATHWAY

Parameter	Value	Unit
Cancer Risk:		mg/kg
Reference Dose:	2.9E+03	mg/kg

RADIONUCLIDE

Parameter	Value	Unit
MCL:	1.0E-01	pCi/L
UMTRCA:		pCi/kg
Cancer Risk:		
Air:	6.5E+00	pCi/m3
DW:	4.6E+02	pCi/L
FC:	1.7E+04	pCi/kg
Soil Ing:	8.6E+06	pCi/kg
Soil Gam:		pCi/kg

SURFACE WATER PATHWAY

Drinking Water

Parameter	Value	Unit
MCL/MCLG:	1.0E-01	mg/L
Cancer Risk:		mg/L
Reference Dose:	1.8E-01	mg/L

Human Food Chain

Parameter	Value	Unit
FDAAL:		ppm
Cancer Risk:		mg/kg
Reference Dose:	6.5E+00	mg/kg

Environmental

Parameter	Value	Unit
ACUTE		
Fresh AWQC:		ug/L
Salt AWQC:		ug/L
Fresh AALAC:		ug/L
Salt AALAC:		ug/L
CHRONIC		
Fresh AWQC:		ug/L
Salt AWQC:		
Fresh AALAC:		ug/L
Salt AALAC:		ug/L

TOXICITY

Parameter	Value	Unit	Source
Oral RfD:	2.0E-02	mg/kg/day	IRIS
Inhal RfD:		mg/kg/day	
Oral Slope:		(mg/kg/day)^-1	
Oral Wt-of-Evid:			
Inhal Slope:		(mg/kg/day)^-1	
Inhal Wt-of-Evid:			
Oral ED10:		mg/kg/day	
Oral ED10 Wgt:			
Inhal ED10:	1.0E-01	mg/kg/day	SPHEM
Inhal ED10 Wgt:	A		SPHEM
Oral LD50:	5.0E+00	mg/kg	RTECS
Dermal LD50:		mg/kg	
Gas Inhal LC50:		ppm	
Dust Inhal LC50:		mg/L	
ACUTE			
Fresh AWQC:	1.4E+03	ug/L	WATCRIT
Salt AWQC:	7.5E+01	ug/L	WATCRIT
Fresh AALAC:		ug/L	
Salt AALAC:		ug/L	
CHRONIC			
Fresh AWQC:	1.6E+02	ug/L	WATCRIT
Salt AWQC:	8.3E+00	ug/L	WATCRIT
Fresh AALAC:		ug/L	
Salt AALAC:		ug/L	
Fresh Ecol LC50:	2.6E+05	ug/L	ACQUIRE
Salt Ecol LC50:		ug/L	

PERSISTENCE

Parameter	Value	Unit	Source
LAKE - Halflives			
Hydrolysis:		days	
Volatility:	**	days	
Photolysis:		days	
Biodeg:		days	
Radio:		days	
RIVER - Halflives			
Hydrolysis:		days	
Volatility:	**	days	
Photolysis:		days	
Biodeg:		days	
Radio:		days	
Log Kow:			

PHYSICAL CHARACTERISTICS

Parameter	Value
Metal Contain:	Yes
Organic:	No
Inorganic:	Yes
Gas:	No
Particulate:	Yes
Radionuclide:	No
Rad. Element:	No
Molecular Wgt:	5.9E+01
Density:	

MOBILITY

Parameter	Value	Unit	Source
Vapor Press:	0.0E+01	Torr	RAGS
Henry's Law:		atm-m3/mol	
Water Solub:		mg/L	
Distrib Coef:	1.5E+02	ml/g	CH2M_KD
Geo. Mean Sol.:	5.2E-01	mg/L	WEAST ; LANGE

BIOACCUMULATION

Parameter	Value	Unit	Source
FOOD CHAIN			
Fresh BCF:	8.0E-01		VER_BCF
Salt BCF:	4.7E+02		VER_BCF
ENVIRONMENTAL			
Fresh BCF:	1.1E+02		VER_BCF
Salt BCF:	4.7E+02		VER_BCF
Log Kow:			
Water Solub:		mg/L	

CLASS INFORMATION

Class	Parent Substance
Toxicity:	NA
GW Mob:	NA
Other:	NA

** This substance should be considered essentially non-volatile.

Date: 03/08/93
Chemical: Nickel

SUPERFUND CHEMICAL DATA MATRIX

SCDM Version: MAR93
CAS Number: 007440-02-0

ASSIGNED FACTOR VALUES

AIR PATHWAY

Parameter	Value
Toxicity:	10000
Gas Mobility:	0.0000
Gas Migration:	0

GROUND WATER PATHWAY

Parameter	Value
Toxicity:	10000
Water Solub:	5.2E-01
Distrib:	1.5E+02

SOIL EXPOSURE PATHWAY

Parameter	Value
Toxicity:	10000

SURFACE WATER PATHWAY

Drinking Water

Parameter	Value
Toxicity:	10000
Persistence	
River:	1.0000
Lake:	1.0000

Human Food Chain

Parameter	Value
Toxicity:	10000
Persistence	
River:	1.0000
Lake:	1.0000
Bioaccumulation	
Fresh:	0.5
Salt:	500.0

Environmental

Parameter	Value
Fresh Tox:	10
Salt Tox:	1000
Persistence	
River:	1.0000
Lake:	1.0000
Bioaccumulation	
Fresh:	500.0
Salt:	500.0

BENCHMARKS

AIR PATHWAY

Parameter	Value	Unit
NAAQS/NESHAPS:		ug/m3
Cancer Risk:		mg/m3
Reference Dose:		mg/m3

GROUND WATER PATHWAY

Parameter	Value	Unit
MCL/MCLG:	1.0E-01	mg/L
Cancer Risk:		mg/L
Reference Dose:	7.0E-01	mg/L

SOIL EXPOSURE PATHWAY

Parameter	Value	Unit
Cancer Risk:		mg/kg
Reference Dose:	1.2E+04	mg/kg

RADIONUCLIDE

Parameter	Value	Unit
MCL:	1.0E-01	pCi/L
UMTRCA:		pCi/kg
Cancer Risk:		
Air:	2.8E+00	pCi/m3
DW:	2.2E+02	pCi/L
FC:	8.0E+03	pCi/kg
Soil Ing:	4.1E+06	pCi/kg
Soil Gam:		pCi/kg

SURFACE WATER PATHWAY

Drinking Water

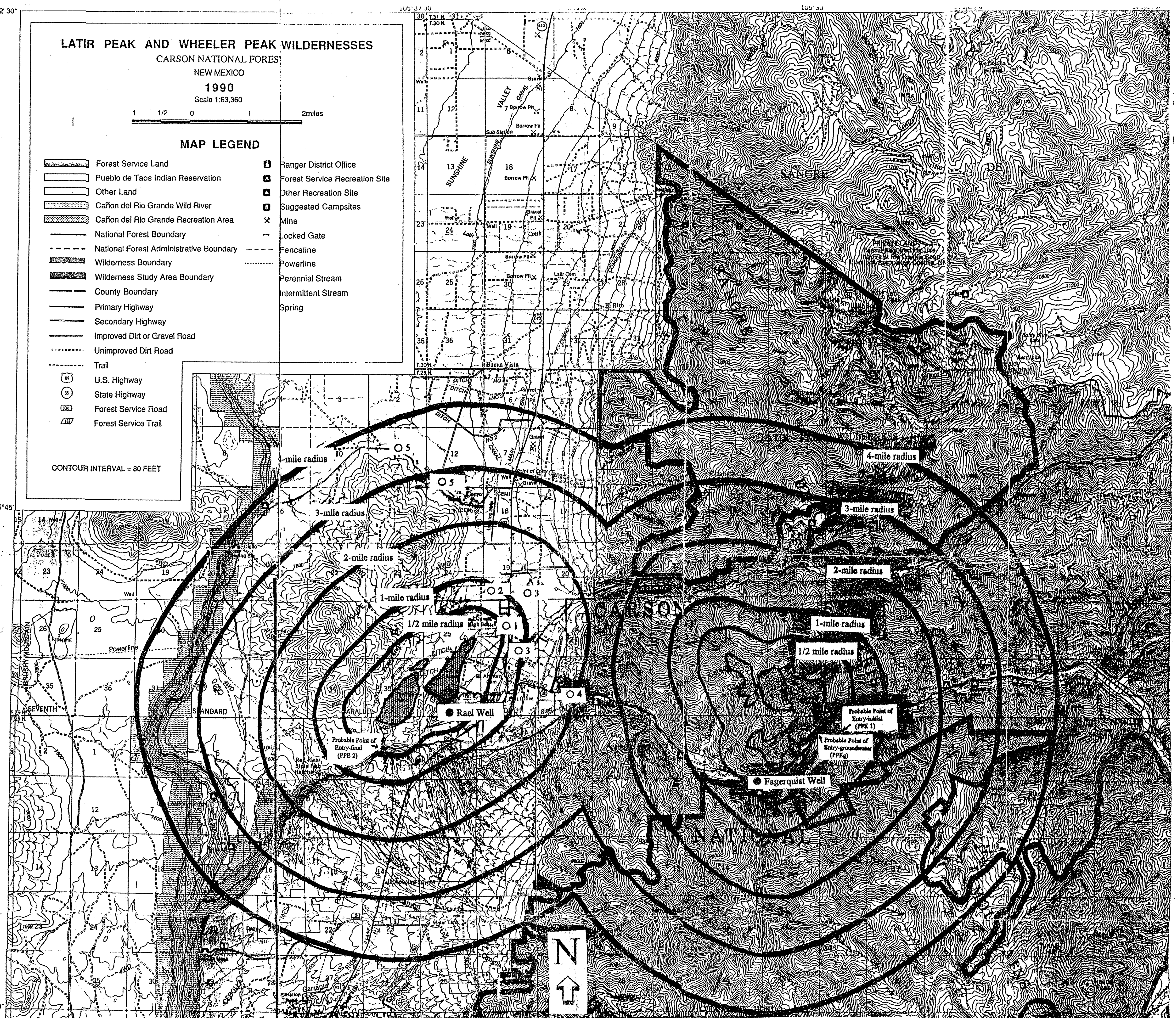
Parameter	Value	Unit
MCL/MCLG:	1.0E-01	mg/L
Cancer Risk:		mg/L
Reference Dose:	7.0E-01	mg/L

Human Food Chain

Parameter	Value	Unit
FDAAL:		ppm
Cancer Risk:		mg/kg
Reference Dose:	2.6E+01	mg/kg

Environmental

Parameter	Value	Unit
ACUTE		
Fresh AWQC:	1.4E+03	ug/L
Salt AWQC:	7.5E+01	ug/L
Fresh AALAC:		ug/L
Salt AALAC:		ug/L
CHRONIC		
Fresh AWQC:	1.6E+02	ug/L
Salt AWQC:	8.3E+00	
Fresh AALAC:		ug/L
Salt AALAC:		ug/L



● Well Nearest to Tailings Ponds/Mine Waste
○ Community Supply Wells

Reference 3. Site Map with 4-mile Radii and Drinking Water Wells

Community Supply Wells	Number of Connections	Persons Served
1. Adjacent to Questa Offices	10	30
2. Cerro de Oro	10	30
3. Questa Community System	560	1644
4. Eagle Lake Trailer Park	10	30

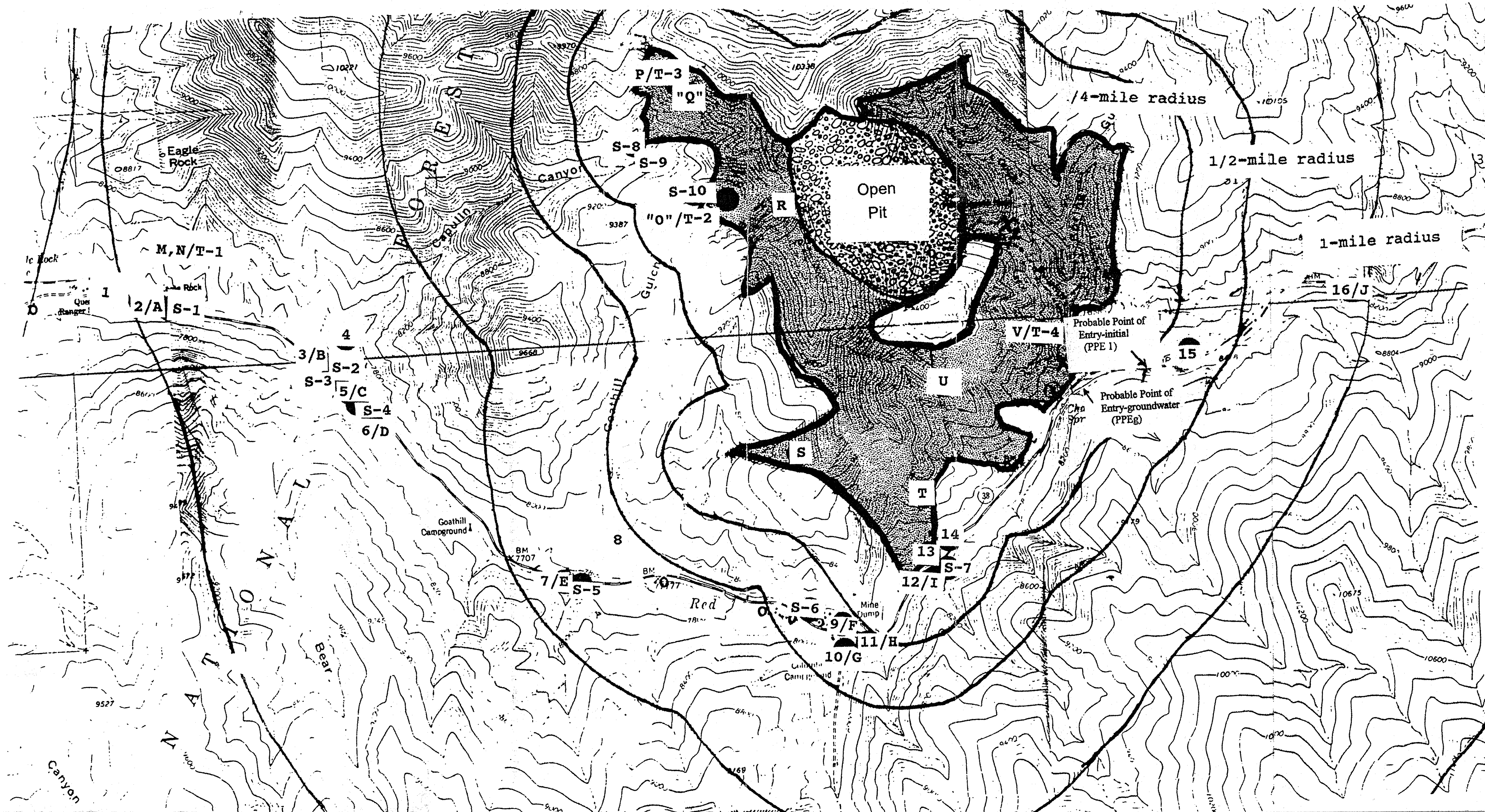


Figure 3. Sampling Locations near the Mine Area

WATER SAMPLES			SOIL SAMPLES		
Map ID#	Location	Date Sampled	Map ID#	Location	Date Sampled
1	Red River (RR) @ USFS Ranger Station	6-26-94	A	RR @ Pipeline (Old Eagle Rk CG)	11-7-94
2	RR @ Pipeline (Old Eagle Rk CG)	11-7-94	B	RR below Capulin Canyon Seeps	11-7-94
3	RR below Capulin Canyon Seeps	11-7-94	C	RR between Capulin Canyon See	11-7-94
4	Capulin Bedrock Well (MW-3)	11-7-94	D	RR above Capulin Canyon Seeps	11-7-94
5	RR between Capulin Canyon Seeps	11-7-94	E	RR below Goathill Seep	11-7-94
6	RR above Capulin Canyon Seeps	11-7-94	F	RR below Columbine Creek	11-7-94
7	RR @ Goathill Seep	11-7-94	G	Columbine Creek	11-7-94
8	Maintenance Yard Well (MW-7)	11-7-94	H	RR above Columbine Creek	11-7-94
9	RR below Columbine Creek	11-7-94	I	RR below Adit Seep	11-8-94
10	Columbine Creek	6-26-94; 11-7-94	J	RR above Molycorp Property	11-8-94
11	RR above Columbine Creek	11-7-94	K	RR below Hanson Creek	11-8-94
12	RR @ Adit Seep	11-8-94	L	RR above Hanson Creek	11-8-94
13	Sugar Shack South Bedrock Well (MW-10	11-7-94	M	Eagle Rock Scar	6-27-94
14	Sugar Shack South Bedrock Well (MW-11	11-7-94	N	Eagle Rock Scar (Duplicate)	6-27-94
15	Molycorp Mill Well	11-8-94	O	Goathill Gulch Scar	6-27-94
16	RR above Molycorp Property	11-8-94	P	Capulin Mine Dump	6-27-94
17	RR below Hanson Creek	11-8-94	Q	Capulin Mine Dump	6-27-94
18	RR above Hanson Creek	6-26-94; 11-8-94	R	Goathill Mine Dump	6-27-94
19	Hanson Creek @ Hwy 38	6-26-94	S	Sugar Shack West Dump	6-28-94
20	Elephant Rock Campground Well	11-8-94	T	Sugar Shack South Dump	6-28-94
21	Red River (WWTP)	11-8-94	U	Middle Dump	6-28-94
22	Junebug Campground Well	11-8-94	V	Sulphur Gulch Dump	6-28-94
			W	Hanson Creek Scar	6-26-94
			Soils For TCLP Extraction and TAL Analysis		
Seeps and Leachate					
S-1	Cliff Seep (Old Eagle Rock CG area)	6-26-94	CLP (T)-	Eagle Rock Scar	6-27-94
S-2	Capulin Channel Seep	6-26-94	T-2	Goathill Scar	6-27-94
S-3	Capulin Canyon Seep: Lower	6-26-94	T-3	Capulin Mine Dump @ "P"	6-27-94
S-4	Capulin Canyon Seep: Upper	6-26-94	T-4	Sulphur Gulch Dump	6-28-94
S-5	Goathill Gulch Seep	6-26-94	T-5	Hanson Creek Scar	6-26-94
S-6	Cabin Spring (Seep)	11-8-94			
S-7	Adit Seep near Molycorp Tunnel	6-26-94			
S-8	Capulin Dump Collection: Upper	6-27-94			
S-9	Capulin Dump Collection: Middle	6-27-94			
S-10	Goathill Gulch Scar	6-27-94			
S-11	Hanson Creek Scar	6-26-94			

Photo 1. Mine Waste Dumps (foreground) and hydrothermal Scar at head of Goathill Gulch. View to south. Photo by Stuart Kent.

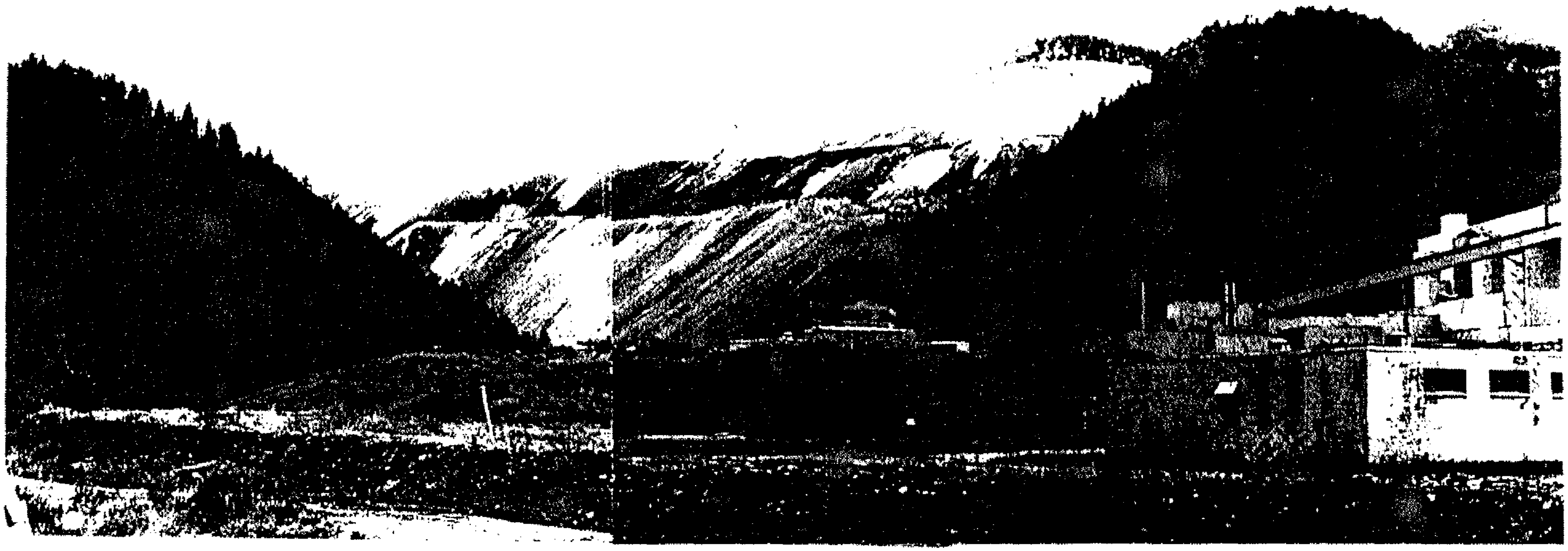


Photo 2. Molycorp Mill Area and Mine Waste Dumps in Sulphur Gulch
View to west. Photo by James MacDonald.

Photo 3. Seep at mouth of Capulin Canyon along old Channel of Red River. Bob Saltar, NMED-Surface Water Quality Bureau pictured. View to east. Photo by Stuart Kent.

Photo 4. Capping of Tailings Ponds with Soil. (Notice airborne soil; tailings not airborne.) View to southwest. Photo by Stuart Kent.

Photo 5. Hydrothermal Scar area (with snow) at head of Hanson Creek.
View to northeast. Photo by Stuart Kent.

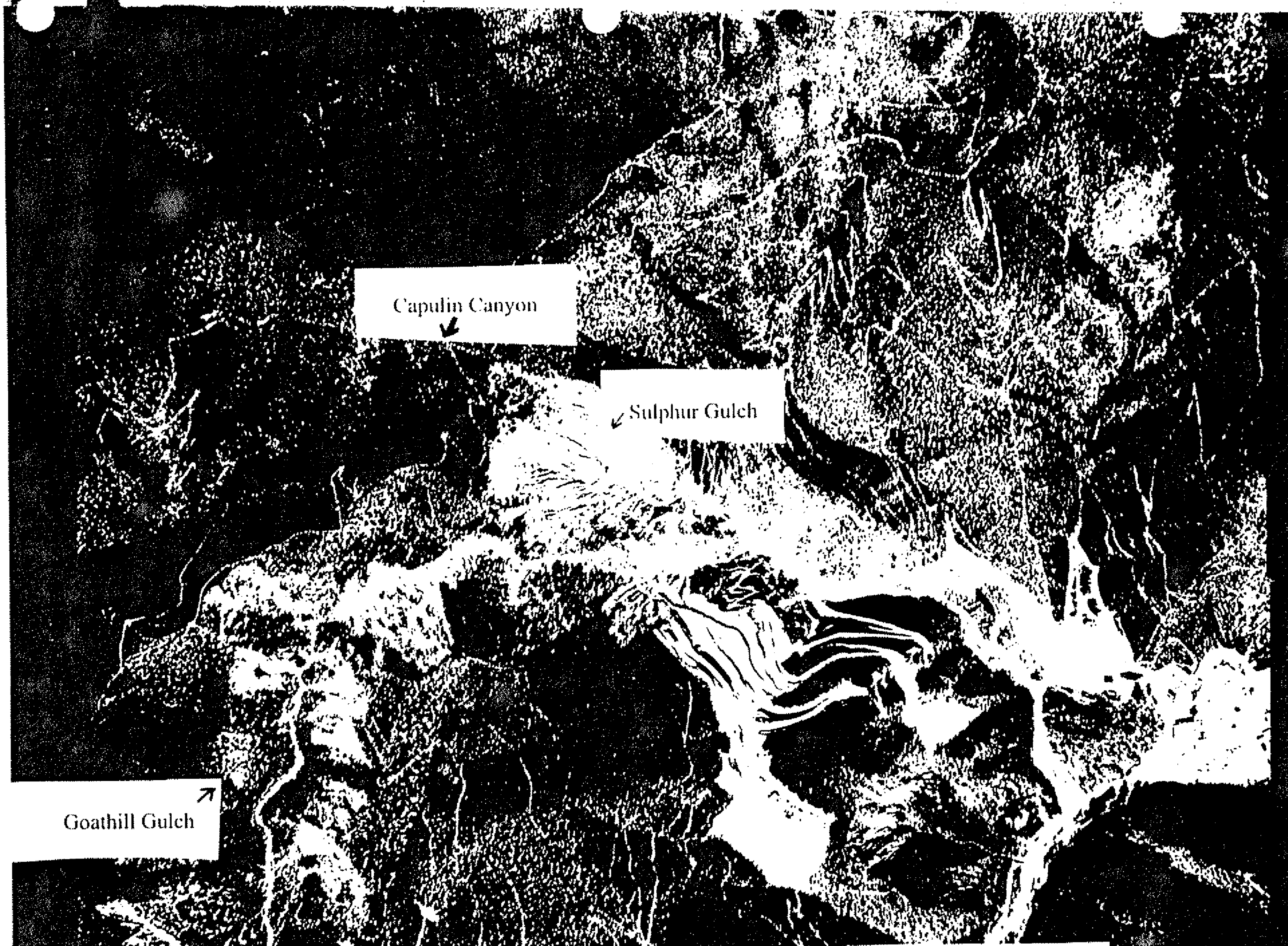


Photo 6. Extent of Mine Waste Dumps in Sulphur Gulch and to the South. (Notice lack of dump material in Goathill Gulch and Capulin Canyon; and degree of road development in Goathill Gulch.) Photo by US Forest Service. 9/15/65.

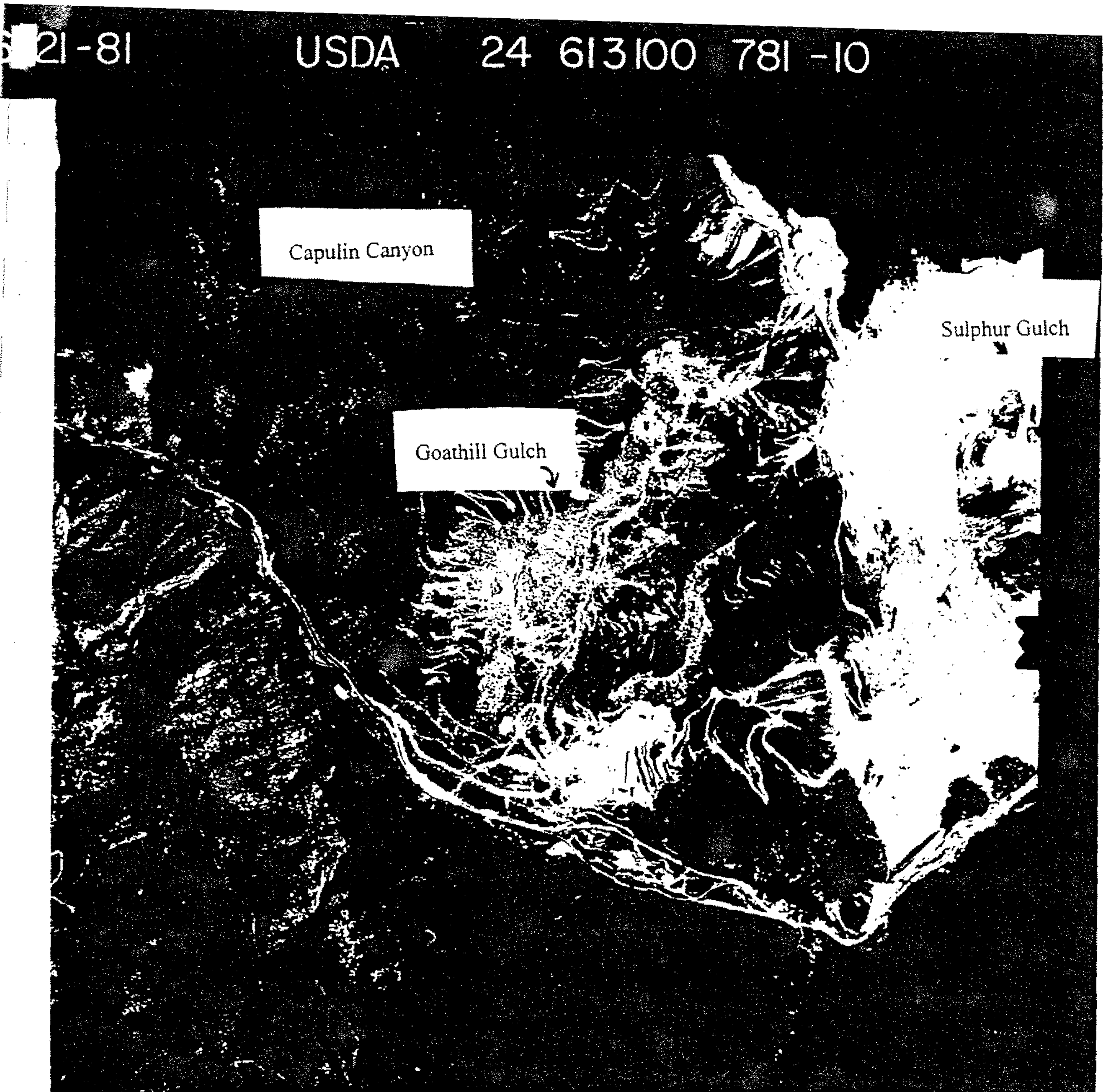
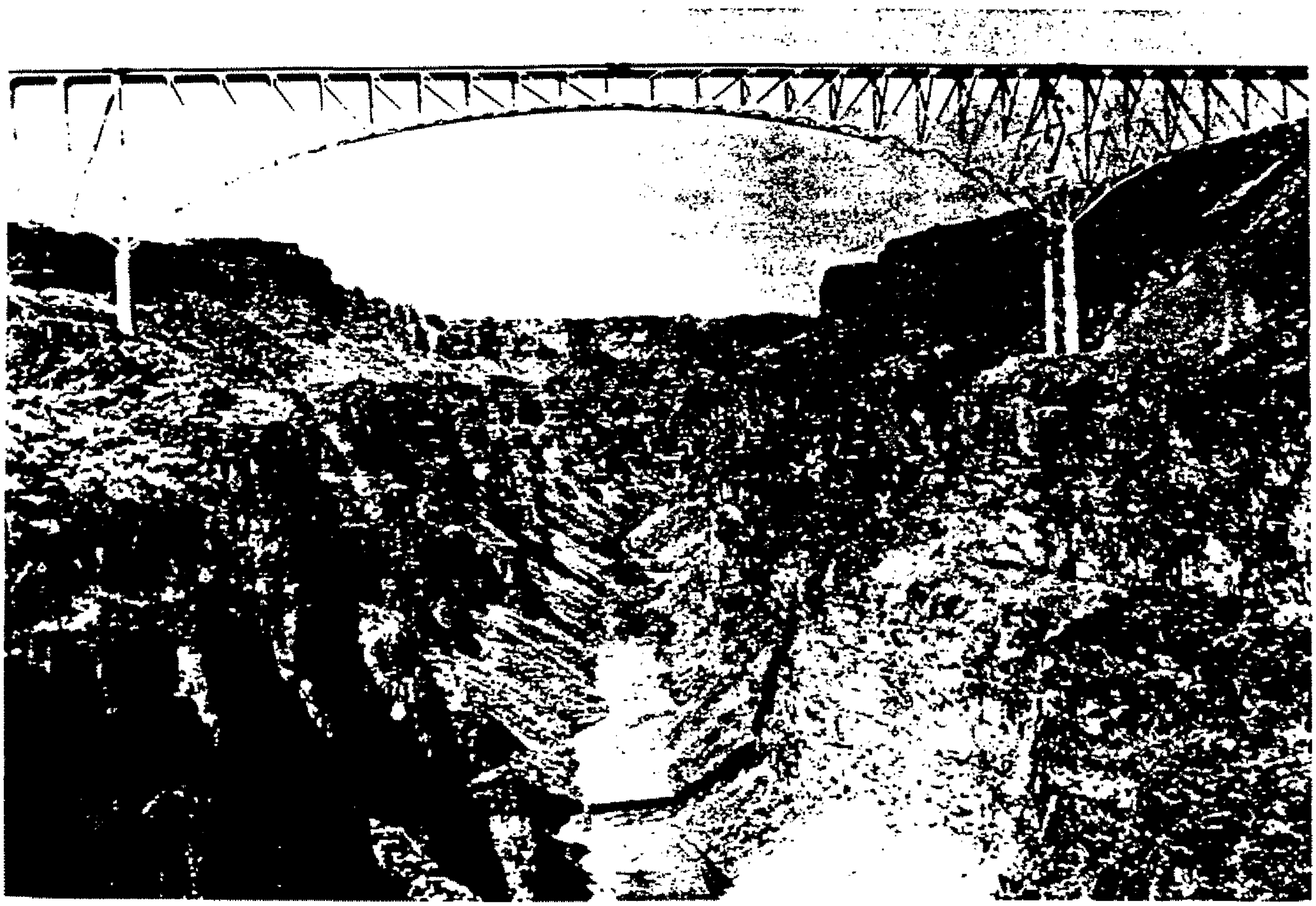


Photo 7. Extent of Mine Waste Dumps. (Notice dump material at head of Goathill Gulch and Capulin Canyon; and enhanced road development in Goathill Gulch.) Photo by US Forest Service 6/21/81.

Soil Survey of Taos County
and parts of
Rio Arriba and Mora Counties
New Mexico



United States Department of Agriculture
Soil Conservation Service and Forest Service and
United States Department of the Interior
Bureau of Indian Affairs and
Bureau of Land Management
in cooperation with the
New Mexico Agricultural Experiment Station

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summary of tables

very steep soils and Rock outcrop at an elevation of 7,500 to 10,500 feet. The mean annual precipitation is 20 inches for Eutroboralfs and 30 inches for Glossoboralfs. The mean annual temperature is 42 degrees F for Eutroboralfs and 40 degrees F for Glossoboralfs soils. The frost-free season is 80 to 100 days. This association is about 40 percent Eutroboralfs, 40 to 80 percent slopes; 30 percent Glossoboralfs, 40 to 80 percent slopes, and 20 percent Rock outcrop. Much of the Rock outcrop is scattered throughout the association as nearly vertical escarpments.

Included in mapping are areas of Etoe and Jaroso soils, which make up about 10 percent of this association.

Eutroboralfs are deep, well drained soils on mountain and canyon slopes. They formed in colluvium and residuum of sandstone and shale. The surface layer is cobbly loam or cobbly sandy loam. The subsoil is very cobbly clay loam or very cobbly clay. The substratum is stony silty clay to a depth of 60 inches or more.

Permeability is very slow to moderately slow. The effective rooting depth is 60 inches or more. The available water capacity is moderate. Runoff is medium, and the hazard of water erosion is high.

Glossoboralfs are deep, well drained soils on mountain and canyon slopes. They formed in colluvium and residuum of sandstone and shale. The surface layer is cobbly loam or cobbly sandy loam. The subsoil is very cobbly sandy clay or very cobbly clay that extends to a depth of 60 inches or more.

Permeability is very slow to moderately slow. The effective rooting depth is more than 60 inches, and the available water capacity is moderate. Runoff is moderate, and the hazard of water erosion is high.

Rock outcrop consists of interbedded shale and sandstone and in some areas, limestone.

The dominant vegetation on the Eutroboralfs is ponderosa pine and some scattered Gambel oak. The understory consists mainly of kinnikinnick, prairie junegrass, and mountain muhly.

The dominant vegetation on the Glossoboralfs is Douglas-fir and ponderosa pine, and there are scattered white fir, limber pine, and Gambel oak. The understory consists mainly of Kentucky bluegrass, prairie junegrass, mountain brome, and kinnikinnick.

These soils are mainly used for wildlife habitat. The very steep slopes, high erosion hazard, and rock outcrops preclude most other uses. The potential is low for the production of ponderosa pine, Douglas-fir, white fir, and aspen.

This association has medium potential for use as habitat for woodland wildlife.

FaC—Fernando cobbly loam, 1 to 7 percent slopes. This is a deep, well drained, nearly level to moderately sloping soil on alluvial fans at the base of mountains and cones. It formed in mixed alluvium. Slopes are smooth and convex. The areas are 100 to 640 acres. The elevation is 6,500 to 7,500 feet. The mean annual precipitation is 12 inches, and the mean annual temperature is 49 degrees F. The frost-free season is 125 to 135 days.

Included in mapping are Fernando loam, which makes up about 10 percent of the map unit; Hernandez soils, which makes up 15 percent; and Rock outcrop, which makes up 5 percent.

Typically, the surface layer is brown cobbly loam about 3 inches thick. The subsoil is brown and light brown loam and clay loam about 20 inches thick. The substratum is light brown loam to a depth of 60 inches or more. Cobbles and gravel cover 15 to 35 percent of the surface.

Permeability is moderately slow. The effective rooting depth is 60 inches or more. The available water capacity is high. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of wind erosion is slight.

This soil is suitable for use as native grazing land for domestic livestock. Proper grazing use improves the plant cover, results in the accumulation of residue, and helps prevent erosion.

A management system that provides definite periods of deferment and grazing use results in a balanced plant community of vigorous and productive forage plants such as western wheatgrass, blue grama, and bottlebrush squirreltail.

When in excellent condition, the vegetation on this soil is western wheatgrass, big sagebrush, galleta, blue grama, and bottlebrush squirreltail. If the condition of the plant community deteriorates, the proportion of desirable forage plants and the plant cover decrease. These plants are replaced by shrubby plants such as rubber rabbitbrush and big sagebrush, and pinyon pine and Rocky Mountain juniper invade the plant community. This deterioration generally results in accelerated wind and water erosion.

The use of machinery in areas of this soil is restricted because of the cobbly surface layer. Constructing earthen ponds, installing pipelines, and managing brush, however, are feasible.

This soil has medium potential for use as habitat for rangeland wildlife.

FbC—Fernando silt loam, 0 to 7 percent slopes. This is a deep, well drained, level to moderately sloping soil on alluvial fans. It formed in mixed alluvium. The areas mainly are rounded and range from 200 to 1,000 acres in size. The elevation is 6,500 to 7,500 feet. The mean annual precipitation is 12 inches, and the average annual temperature is 49 degrees F. The frost-free season is 125 to 135 days.

Included with this soil in mapping are Petaca, Prieta, Servilleta, and Sedillo soils and Orthents, each making up about 5 percent of the map unit.

Typically, the surface layer is light brown silt loam about 2 inches thick. The subsoil is about 34 inches

inches thick. The substratum to a depth of 60 inches or more consists of mixed cobbles, gravel, and stones, and a small amount of sandy clay loam.

Permeability is moderate. The available water capacity is low. Runoff is medium, and the hazard of water erosion is moderate.

The dominant vegetation is Douglas-fir and Engelmann spruce and some scattered white fir, subalpine fir, and aspen. The understory is mainly Kentucky bluegrass, kinnikinnick, grouse whortleberry, Arizona fescue, and mountain brome.

This soil is used mainly for timber production and for wildlife habitat. It has medium potential for the production of Douglas-fir, Engelmann spruce, white fir, and aspen. Conventional methods cannot be used to harvest trees. The steep to very steep slopes severely restrict the mobility of most equipment. Soil disturbance and erosion should be kept to a minimum during harvest. Managing this soil to favor aspen increases timber production and improves the habitat for wildlife.

MSG—Marosa-Rock outcrop complex, very steep. This complex consists of small areas of Marosa very cobbly sandy loam and Rock outcrop that are so intermingled that they could not be mapped separately at the scale selected. The areas are on mountain slopes at an elevation of 9,000 to 11,000 feet. Most areas are associated with rhyolite rock. The mean annual precipitation is 35 inches, and the mean annual temperature is 40 degrees F. The frost-free season is less than 60 days. This complex is about 50 percent Marosa very cobbly sandy loam and 30 percent Rock outcrop.

Included in mapping are areas of Nambe soils, which make up about 20 percent of this complex.

The Marosa soil is deep and well drained. It formed in colluvium and residuum of acid igneous rock. Typically, the surface layer is light brownish gray very cobbly sandy loam about 3 inches thick. The subsurface layer is white and very pale brown very gravelly loamy sand about 31 inches thick. The subsoil is light yellowish brown very cobbly sandy clay loam about 10 inches thick. The substratum to a depth of 60 inches or more consists of mixed cobbles, gravel, and stones, and a small amount of sandy clay loam.

Permeability is moderate. The available water capacity is low. Runoff is medium, and the hazard of water erosion is high.

The dominant vegetation is Douglas-fir and Engelmann spruce and some scattered white fir, subalpine fir, and aspen. The understory is mainly Kentucky bluegrass, kinnikinnick, grouse whortleberry, Arizona fescue, and mountain brome.

The Marosa soil is used mainly for timber production and for wildlife habitat. It has medium potential for the production of Douglas-fir, Engelmann spruce, white fir, and aspen. Conventional methods cannot be used to harvest trees. The very steep slopes, the high erosion hazard, and the rock outcrops preclude most uses. Managing the Marosa soil to favor aspen increases timber production and improves the habitat for wildlife.

This complex has low potential for the development of habitat for openland and woodland wildlife.

MSG2—Marosa-Rock outcrop complex, very steep, eroded. This complex consists of small areas of Marosa very cobbly sandy loam and Rock outcrop that are so intermingled that they could not be mapped separately at the scale selected. The areas are on mountain slopes at an elevation of 9,000 to 11,000 feet. Most areas are associated with rhyolite rock. The mean annual precipitation is 35 inches, and the mean annual temperature is 40 degrees F. The frost-free season is less than 60 days. This complex is about 50 percent eroded Marosa soils and 30 percent Rock outcrop.

Included in mapping are areas of Nambe soils, which make up about 20 percent of this complex.

The Marosa soil is deep and well drained. It formed in colluvium and residuum of acid igneous rock. Typically, the surface layer is about 12 inches thick. It is light brownish gray very cobbly sandy loam over white and very pale brown very gravelly loamy sand. The subsoil is light yellowish brown very cobbly sandy clay loam about 10 inches thick. The substratum to a depth of 60 inches or more consists of mixed cobbles, gravel, and stones, and a small amount of sandy clay loam. The surface layer ranges from 6 to 25 inches in thickness depending on the degree of erosion.

Permeability is moderate. The available water capacity is low. Runoff is rapid, and the hazard of water erosion is very high.

The dominant vegetation is aspen and some scattered Douglas-fir, Engelmann spruce, white fir, and subalpine fir. The understory is mainly kinnikinnick, grouse whortleberry, Arizona fescue, and mountain brome.

The Marosa soil is used mainly for timber production and for wildlife habitat. It has low potential for the production of Douglas-fir, Engelmann spruce, white fir, and aspen. Conventional methods cannot be used to harvest trees. Managing the Marosa soil to favor aspen increases timber production and improves the habitat for wildlife.

This complex has low potential for use as habitat for openland and woodland wildlife.

MTE—Marosa-Nambe association, moderately steep. This association consists of moderately steep soils on north-facing mountain side slopes in the northern part of the survey area. The elevation is 9,000 to 11,000 feet. The mean annual precipitation is 35 inches, and the mean annual temperature is 40 degrees F. The frost-free season is less than 60 days. This association is about 45 percent Marosa gravelly sandy loam and 30 percent Nambe gravelly sandy loam. The Marosa soil is at the lower elevations, and the Nambe soil is at the higher elevations.

A management system is needed in which the seasons of grazing and resting of pasture vary in successive years. This system results in a balanced plant community of vigorous and productive forage plants such as bottlebrush squirreltail, western wheatgrass, blue grama, and winterfat. If the condition of the plant community deteriorates, the desirable forage plants decrease in number and are replaced by broom snakeweed, rubber rabbitbrush, and big sagebrush. This deterioration generally results in accelerated soil erosion. Fences, access roads, and stock trails are needed for livestock distribution.

The Raton soil has medium potential for use as habitat for woodland and rangeland wildlife, and the Stunner soil has medium potential for use as habitat for rangeland wildlife.

The Raton soil has medium potential for the production of wood crops for firewood and fenceposts.

RcG—Rock outcrop, very steep. This miscellaneous area is mainly along the sides of the Rio Grande Gorge. It consists mainly of escarpments of basalt that have some layers of terrace sediment. Slopes are very steep. The elevation is 6,000 to 7,000 feet. The mean annual precipitation is 12 inches, and the mean annual temperature is 48 degrees F. The frost-free season is '20 to 130 days.

Local relief is 50 to 600 feet. Runoff is very rapid, and the erosion hazard is slight. This miscellaneous area is used for wildlife habitat. It has low potential for this use.

RdG—Rock outcrop-Badland complex, very steep. This complex consists of Rock outcrop and Badland in small areas that are so intermingled that they could not be mapped separately at the scale selected. Rock outcrop and Badland are on steep to very steep mountain slopes. Badland formed through hydrothermal activity. This complex is almost bare of vegetation.

There are three distinct climatic regimes. The first climatic regime is at an elevation of 8,000 to 9,000 feet. The mean annual precipitation is 16 inches. A few oneseed junipers and pinyon pines are scattered along the edge of this area.

The second climatic regime is at an elevation of 8,000 to 10,500 feet. The mean annual precipitation is 25 inches. A few Douglas-firs, white firs, and ponderosa pines are scattered along the edge of this area.

The third climatic regime is at an elevation of 9,000 to 11,000 feet. The mean annual precipitation is 30 inches. A few Douglas-firs, Engelmann spruces, and subalpine firs are scattered along the edge of this area.

The sediment generated from this complex needs to be stabilized and contained. However, the extremely acid soil material and the unstable nature of Badland severely restrict the establishment of vegetation for stabilization. The amount of sediment generated increases with an increase in precipitation.

This complex has low potential for most uses.

High erosion + runoff

RPG—Rock outcrop-Penitente complex, very steep. This complex is about 60 percent Rock outcrop and 30 percent Penitente cobbly loam. The Penitente soil is in widely scattered pockets surrounded by areas of Rock outcrop. The mean annual precipitation is 35 inches, and the mean annual temperature is 30 degrees F. The elevation is 12,000 to 13,000 feet.

Included in mapping and making up about 10 percent of this map unit are Nambe and Presa soils and soils that are similar to the Penitente soil but are shallow to bedrock. These make up about 10 percent of the complex.

Rock outcrop consists mainly of acid igneous or metamorphic rock. Slopes are steep to very steep.

The Penitente soil is deep and well drained. It formed in colluvium and residuum of acid igneous or metamorphic rock. Typically, the surface layer is dark brown cobbly loam about 10 inches thick. The subsoil is brown very cobbly sandy loam about 14 inches thick. The substratum is brown very cobbly loam to a depth of 60 inches or more.

Permeability is moderately rapid. The effective rooting depth is 60 inches or more. The available water capacity is low. Runoff is medium, and the hazard of water erosion is severe.

The dominant vegetation is sheep fescue, Thurber fescue, clovers, kobresia, and dwarf goldenrod.

The Penitente soil is used for wildlife habitat. The very steep slopes and precipitous rock outcrops preclude most other uses.

This complex has medium potential for use as habitat for woodland and rangeland wildlife.

RRE—Rock outcrop-Raton complex, moderately steep. This complex consists of areas of Rock outcrop and Raton very stony silt loam that are so intermingled that they could not be mapped separately at the scale selected. The Raton soil is strongly sloping to moderately steep. Rock outcrop is steep to very steep. The elevation is 8,000 to 9,000 feet. The mean annual precipitation is 15 inches, and the mean annual temperature is 41 degrees F. The frost-free season is 90 to 110 days. Rock outcrop makes up about 45 percent of this complex, and the Raton soil makes up about 40 percent.

Included in mapping are Orthents and Stunner soils, which make up about 15 percent of this complex.

Rock outcrop consists of folded, broken, and exposed basalt flows. Runoff is rapid, and the erosion hazard is slight.

The Raton soil is shallow and well drained. It formed in residuum of basalt and in mixed eolian sediment. Typically, the surface layer is dark brown very stony silt loam about 4 inches thick. The subsoil is dark brown very stony clay about 14 inches thick. Basalt bedrock is at a depth of 18 inches.

The Raton soil is slowly permeable. The effective rooting depth is 10 to 20 inches. The available water capacity is very low. Runoff is rapid. The hazard of water erosion is moderate, and the wind erosion hazard is slight.

The Raton soil is suitable for use as woodland and for grazing use for domestic livestock and wildlife. It produces pinyon pine, Rocky Mountain juniper, oneseed juniper, and understory vegetation consisting of mountain muhly, muttongrass, Arizona fescue, and western wheatgrass. Proper grazing of the understory vegetation maintains the woodland, improves the plant cover, results in the accumulation of plant residue, and helps prevent soil erosion.

A management system is needed that provides periods of resting from grazing so that the key management plants can complete their growth cycle. The result will be a balanced plant community of productive forage that helps to maintain the woodland.

Access roads and trails are needed for livestock distribution. The use of machinery for other purposes is not feasible because of the shallow, stony soil and the many rock outcrops.

This complex has medium potential for use as habitat for rangeland wildlife and for the production of wood crops for firewood and fenceposts.

RUG—Rock outcrop-Ustorthents complex, very steep. This complex consists of small areas of Rock outcrop and Ustorthents that are so intermingled that they could not be mapped separately at the scale selected. The areas are on mountain slopes at an elevation of 8,000 to 10,000 feet. The mean annual precipitation is 20 inches, and the mean annual temperature is 42 degrees F. The frost-free season is 60 to 80 days. Rock outcrop makes up about 50 percent of this complex, and Ustorthents make up about 30 percent.

Included in mapping are areas of Mirabal and Marosa soils, which make up about 20 percent of this complex.

Rock outcrop consists of igneous and metamorphic rock, including granite, gneiss, schist, and rhyolite.

Ustorthents are deep and well drained. They consist of gravelly loam, very gravelly loam, or very gravelly clay loam to a depth of 60 inches or more. The content of rock fragments ranges from 25 to 60 percent.

Permeability is moderate to moderately rapid. The effective rooting depth is 60 inches or more. The available water capacity is very low. Runoff is rapid, and the hazard of water erosion is severe.

The dominant vegetation is Douglas-fir and ponderosa pine. The understory is mainly Gambel oak, mountain brome, and kinnikinnick.

This complex is used for wildlife habitat. It has medium potential for the development of habitat for woodland wildlife.

RvC—Royosa loamy sand, 1 to 8 percent slopes. This is a deep, somewhat excessively drained, gently undulating to gently rolling soil. It formed in eolian material on old dunes. Slopes are complex. The elevation is 6,800 to 7,200 feet. The mean annual precipitation is 13 inches, and the mean annual temperature is 43 degrees F. The frost-free season is 130 to 140 days.

Included with this soil in mapping are areas of Vibo, Petaca, and Manzano soils. Also included are a few small areas of barren sand dunes. Included in the Ojo Caliente area are some small areas of stratified sand and some areas that have a flood hazard. The soils th are included in mapping make up about 20 percent of this map unit, but the areas of these soils generally ar less than 5 acres in size.

Typically, the surface layer is brown loamy sand abc 8 inches thick. The underlying material is brown loamy sand to a depth of 60 inches or more.

Permeability is very rapid. The available water capac is low. The effective rooting depth is 60 inches or mor Runoff is very slow. The hazard of water erosion is slight, and the wind erosion hazard is high.

This soil is suitable for use as woodland and for grazing by domestic livestock and by wildlife. It produc pinyon pine, oneseed juniper, and understory vegetatic consisting of blue grama and Indian ricegrass. In the C Caliente area, some small areas of this soil are used f farming.

Proper grazing of the understory vegetation improve the plant cover, results in the accumulation of plant residue, and helps prevent soil erosion.

A management system is needed that provides periods of resting from grazing so that the key management plants can complete their growth cycle. The result will be a balanced plant community of productive forage that helps to maintain the woodland

Installing pipelines and constructing fences to facilit grazing management are feasible.

This soil has medium potential for use as habitat for openland and rangeland wildlife.

RWE—Royosa-Orthents association, moderately steep. This association consists of moderately sloping moderately steep, eroded soils along mesa and canyo breaks and on highly dissected hills. The elevation is 6,500 to 7,100 feet. The mean annual precipitation is inches, and the mean annual temperature is 50 degre F. The frost-free season is 125 to 135 days. The Roy soil makes up about 55 percent of this association, ar Orthents make up about 30 percent.

Included in mapping are areas of Montecito and Sil soils, which make up about 15 percent of this association.

The Royosa soil is deep and somewhat excessivel drained. It formed in eolian material. Typically, the original surface layer has been lost through erosion. exposed underlying material is brown loamy sand to depth of more than 60 inches.

Permeability is very rapid. The effective rooting dep is 60 inches or more. The available water capacity is

The dominant vegetation is ponderosa pine. The understory is mainly Gambel oak, mountainmahogany, and mountain muhly.

These soils are used mainly for timber and for wildlife habitat.

The Sabe soil has low potential for the production of ponderosa pine, and the Mirand soil has medium potential. On slopes of more than 40 percent, conventional methods cannot be used to harvest trees. The low available water capacity of the Sabe soil restricts seedling survival and reduces the production of ponderosa pine.

This complex has medium potential for use as habitat for woodland wildlife.

SbD—Sedillo cobbly loam, 3 to 12 percent slopes. This is a deep, well drained, gently sloping to strongly sloping soil. It formed in gravelly alluvium on alluvial fans along the western front of the Sangre de Cristo Mountains. Slopes are smooth and convex. The elevation is 7,000 to 8,000 feet. The mean annual precipitation is 12 inches, and the mean annual temperature is 49 degrees F. The frost-free season is 125 to 135 days. Drainage from this soil contributes to the Rio Grande watershed.

Included in mapping are Tenorio soils, which make up about 15 percent of this unit, and Fernando soils, which make up 10 percent.

Typically, the surface layer is brown cobbly loam about 10 inches thick. The subsoil is brown very cobbly loam about 15 inches thick. The substratum, to a depth of 60 inches or more, is pink and brown very cobbly sandy loam.

Permeability is moderately slow. The effective rooting depth is 60 inches or more. The available water capacity is low to moderate. Runoff is medium. The hazards of water and wind erosion are slight.

This soil is suited to use as native grazing land for domestic livestock and wildlife. Proper grazing use improves the plant cover, results in the accumulation of residue, and helps prevent soil erosion.

A resource management system is needed that can control the brush species, allow variation in seasons of use, and provide for resting the forage species in successive years. The result will be a balanced plant community of vigorous and productive forage plants such as western wheatgrass, Indian ricegrass, and blue grama. If the condition of the plant community deteriorates, the desirable forage plants decrease in number and are replaced by big sagebrush, rabbitbrush, and broom snakeweed. This deterioration generally results in accelerated soil erosion.

Practices to facilitate range management are restricted because of the cobbles.

This soil has medium potential for the development of wildlife habitat.

SDD—Sedillo-Orthents association, strongly sloping. This association consists of soils on the sides of major drains. Sedillo gravelly loam that has slopes of 9 to 15 percent makes up about 45 percent of the association. It is on narrow ridgetops and on the upper part of the slopes of narrow, extremely dissected ridges. Orthents that have slopes of 30 to 45 percent make up about 35 percent of the association. These soils are in extremely dissected areas. The elevation is 6,800 to 8,000 feet. The mean annual precipitation is 12 inches. The mean annual temperature is 49 degrees F, and the frost-free season is 125 to 135 days.

Included in mapping are Silva, Manzano, Fernando, and Hernandez soils, each making up about 5 percent of the association.

The Sedillo soil is deep and well drained. It formed in gravelly alluvium. Typically, the surface layer is brown gravelly loam about 3 inches thick. The subsoil is reddish brown and brown very gravelly clay loam about 8 inches thick. The substratum is pink and brown very gravelly sandy loam to a depth of 60 inches or more. The soil, below a depth of 11 inches, is slightly calcareous to strongly calcareous.

The Sedillo soil is moderately slowly permeable. The effective rooting depth is 60 inches or more. The available water capacity is low to moderate. Runoff is medium to rapid, and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

Orthents are deep, gravelly, and well drained. Typically, they have a very gravelly loam surface layer. The underlying material is very gravelly clay loam.

Permeability is moderate to moderately rapid. The effective rooting depth is 60 inches or more. The available water capacity is low. Runoff is rapid, and the hazard of water erosion is high. The hazard of wind erosion is slight.

This association is suited to use as native grazing land for domestic livestock and for wildlife. Proper grazing use improves the plant cover, results in the accumulation of residue, and helps prevent soil erosion.

A resource management system is needed that can control the brush species, allow variation in seasons of use, and provide for resting the forage species in successive years. The result will be a balanced plant community of vigorous and productive forage plants such as western wheatgrass, blue grama, galleta, and Indian ricegrass. If the condition of the plant community deteriorates, the desirable forage plants decrease in number and are replaced by ring muhly, broom snakeweed, and big sagebrush. This deterioration generally results in accelerated soil erosion.

In managing range, brush management, range seeding, constructing fences and livestock and wildlife trails, and installing pipelines are feasible.

These soils have medium potential for the development of habitat for rangeland wildlife.

SED—Sedillo-Silva association, strongly sloping. This association consists of soils on uplands that are mainly east of the Rio Grande. The elevation is 6,500 to

7,500 feet. The mean annual precipitation is 11 inches, and the mean annual temperature is 47 degrees F. The frost-free season is 125 to 135 days. Sedillo very gravelly loam makes up about 55 percent of this association, and Silva loam makes up about 25 percent. The strongly sloping Sedillo soil is on side slopes of narrow ridges. The nearly level to gently sloping Silva soil is on narrow ridge crests and on the adjacent breaks of upper slopes.

Included in mapping are Orthents and Manzano, Fernando, and Hernandez soils, each making up 5 percent of the association.

The Sedillo soil is deep and well drained. It formed in gravelly alluvium. Typically, the surface layer is brown very gravelly loam about 3 inches thick. The subsoil is reddish brown and brown very gravelly clay loam about 8 inches thick. The substratum is light brown and brown, very gravelly sandy loam to a depth of 60 inches or more. The soil in the upper 11 inches is noncalcareous to slightly calcareous, and it is strongly calcareous below that.

The Sedillo soil is moderately slowly permeable in the subsoil and moderately rapidly permeable in the substratum. The effective rooting depth is 60 inches or more. The available water capacity is low to moderate. Runoff is rapid, and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

The Silva soil is deep and well drained. It formed in mixed alluvium and eolian sediment. Typically, the surface layer is brown loam about 3 inches thick. The subsoil is reddish brown clay loam about 26 inches thick. The substratum is pinkish white clay loam to a depth of 60 inches or more.

The Silva soil is slowly permeable. The effective rooting depth is 60 inches or more. The available water capacity is high. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of wind erosion is slight.

These soils are suited to use as native grazing land for domestic livestock and for wildlife.

Proper grazing use improves the plant cover, results in the accumulation of residue, and helps prevent erosion.

A resource management system is needed that can control brush species, allow variation in seasons of use, and provide for resting the forage species in successive years. The result will be a balanced plant community of vigorous and productive forage plants such as western wheatgrass, blue grama, and galleta. If the condition of the plant community deteriorates, the desirable forage plants decrease in number and are replaced by big sagebrush, broom snakeweed, threeawn, and cacti. This deterioration generally results in accelerated soil erosion.

Range seeding and constructing trails to facilitate range management are feasible. Care should be taken in using machinery in the areas of more sloping soils.

This association has medium potential for the development of habitat for rangeland wildlife.

SgC—Servilleta-Prieta complex, 1 to 5 percent slopes. This complex consists of small areas of Servilleta and Prieta soils that are so intermingled that they could not be separated in mapping at the scale selected. These soils are nearly level and gently sloping and are shallow and moderately deep. They are on basalt flows. The elevation is 7,000 to 8,000 feet. The mean annual precipitation is 12 inches. The mean annual temperature is 49 degrees F. The frost-free season is 125 to 145 days. Servilleta silty clay loam makes up about 50 percent of the complex, and Prieta stony silty clay loam makes up about 30 percent. The Servilleta soil is in the more nearly level areas and on the more gentle slopes. The Prieta soil is in the more sloping areas and on ridge crests.

Included in mapping and making up about 10 percent of the complex are areas of Petaca soils near ridgetops and basalt outcrops. Also included are Hernandez, Fernando, and Manzano soils and areas of basalt outcrops, each making up about 5 percent of this complex.

The Servilleta soil is moderately deep and well drained. It formed in material that weathered from basalt and in eolian material. Typically, the surface layer is brown silty clay loam about 3 inches thick. The subsoil is reddish brown and light brown silty clay loam about 22 inches thick. The substratum is light brown silty clay loam about 9 inches thick. Fractured, caliche-coated basalt bedrock is at a depth of about 34 inches. The soil is moderately calcareous to strongly calcareous below a depth of 16 inches.

The Servilleta soil is slowly permeable. The effective rooting depth is 20 to 40 inches. The available water capacity is mainly moderate. Runoff is medium to slow. The hazard of water erosion is moderate, and the hazard of wind erosion is slight.

The Prieta soil is shallow and well drained. It formed in residuum in mixed eolian sediment. Typically, the surface layer is brown stony silty clay loam about 2 inches thick. The subsoil is brown and light brown stony silty clay loam about 8 inches thick. The substratum is pink very stony silty clay loam about 4 inches thick. Fractured, caliche-coated basalt bedrock is at a depth of about 14 inches. The soil material is noncalcareous in the surface layer and grades to strongly calcareous in the substratum.

The Prieta soil is slowly permeable. The effective rooting depth is 10 to 20 inches. The available water capacity is very low. Runoff is medium. The hazard of water erosion is moderate, and the wind erosion hazard is slight.

These soils are suited to use as native grazing land for domestic livestock and for wildlife. Proper grazing use improves the plant cover, results in the accumulation of plant residue, and helps prevent soil erosion.

A management system is needed in which the seasons of grazing and resting of pasture vary in successive years. This system results in a balanced plant community of vigorous and productive forage plants such as western wheatgrass and blue grama. If the condition of the plant community deteriorates, the desirable plants decrease in number and are replaced by big sagebrush, broom snakeweed, and cacti. This deterioration generally results in accelerated soil erosion.

In managing range, installing pipelines, constructing fences, brush management, and range seeding are feasible on the Servilleta soil. The use of machinery, except in constructing trails, is not feasible on the Prieta soil.

This complex has medium potential for the development of habitat for rangeland wildlife.

ShB—Shawa clay loam, 0 to 3 percent slopes. This is a deep, well drained, level and nearly level soil. It formed in alluvium on playa bottoms along the Rio de los Pinos. Slopes are smooth and concave. The elevation is 7,500 to 8,500 feet. The mean annual precipitation is 11 inches, and the mean annual temperature is 43 degrees F. The frost-free season is 80 to 110 days.

Included with this soil in mapping are Luhon and Stunner soils, each making up about 5 percent of the map unit.

Typically, the upper part of the surface layer is dark grayish brown clay loam and very dark grayish brown silty clay loam about 16 inches thick, and the lower part is dark brown clay loam about 14 inches thick. The underlying material is brown, light brown, and pink clay loam to a depth of 60 inches or more.

Permeability is moderate. The effective rooting depth is 60 inches or more. The available water capacity is high. Runoff is very slow, and the hazard of water erosion is slight.

This soil is suited to irrigated hay and pasture, to use as native grazing land, and to the development of wildlife habitat. It provides forage for domestic livestock and wildlife. Proper grazing use improves the plant cover, results in the accumulation of residue, and helps prevent erosion.

A management system is needed in which the seasons of grazing and resting of pasture vary in successive years. This system results in a balanced plant community of vigorous and productive forage plants such as western wheatgrass, blue grama, and fourwing saltbush. If the condition of the plant community deteriorates, the desirable forage plants decrease in number and are replaced by rubber rabbitbrush, annual grasses and forbs, and cacti. This deterioration generally results in accelerated soil erosion.

In managing range, constructing earthen ponds and fences, seeding, controlling noxious plants, and installing pipelines are feasible.

This soil is used for irrigated hay and pasture. It has high potential for these uses. Management concerns include the planting of adapted species, fertilization, and timely harvesting.

This soil can produce high quality range plants to support habitat for the pronghorn antelope and other rangeland wildlife.

SmB—Silva loam, 0 to 2 percent slopes. This is a deep, well drained, level to nearly level soil. It formed in mixed alluvium and eolian sediment on upland fans and ridges throughout the survey area. Slopes are smooth and convex. The elevation is 6,500 to 7,500 feet. The mean annual precipitation is 12 inches, and the mean annual temperature is 49 degrees F. The frost-free season is 125 to 135 days.

Included with this soil in mapping are Fernando and Sedillo soils, which make up about 10 percent of this map unit.

Typically, the surface layer is brown loam about 5 inches thick. The subsoil is brown clay loam about 25 inches thick. The substratum is pink clay loam to a depth of 60 inches or more.

Permeability is slow. The effective rooting depth is 60 inches or more. The available water capacity is high. Runoff is slow. The hazard of water erosion is slight, and the hazard of wind erosion is moderate.

The major limitations to growing cultivated crops are the short growing season and cool nights, which limit the choice of crops and reduce crop yields. This soil is suitable for alfalfa, small grains, and cool-season grasses. Potatoes and vegetables that are adapted to the short growing season and cool nights also can be grown.

Growing mainly grasses or legumes or other high residue-producing crops helps to prevent water and wind erosion to maintain soil tilth. Fertilization and improved water-management practices help to maintain or increase yields. Generally, all crops except legumes respond to nitrogen, and all legumes respond to phosphate fertilizer. Border, furrow, corrugation, and sprinkler irrigation systems are suitable. Rotation grazing increases the yield and quality of pasture. Timely harvesting improves the quality of crops.

This soil has medium potential for most urban uses. Low strength and the high shrink-swell potential and slow permeability in the subsoil are limitations. The shrinking and swelling and the low strength can be overcome by good design and careful installation. The slow permeability, which is a limitation to the use of this soil for septic tank absorption fields, can be overcome by increasing the size of the absorption area or by modifying the filter field.

If this soil is irrigated, it can produce grains, grasses, legumes, and shrubs that provide a good habitat for ring-necked pheasant, cottontail rabbit, and other farmland wildlife.

SmD—Silva loam, 2 to 10 percent slopes. This is a deep, well drained, nearly level to strongly sloping soil. It formed in mixed alluvium and eolian sediment on upland fans. The elevation is 6,500 to 7,500 feet. The mean


Scale 1:24 000
Cabresto Creek
Guadalupe Mountain
Questa
RED RIVER
Red River Fish Hatchery
CARSON NATIONAL
NATIONAL FOREST
MOLYBDENUM MINE
FHB
PGC
RUG
RdG
CHG
SED
FeC
FeB
TeB
SmB

Water Availability & Water Quality

Taos County, New Mexico

Phase A Report: Basic Data on
Geography, Climate, Geology, Surface Water
Ground Water, Water Rights, Water Use,
Water Supply and Water Quality

by

Lee Wilson
Stevan T. Anderson
David Jenkins
Phil Lovato

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P.O. Box 931
Santa Fe, New Mexico 87501

13 September 1978

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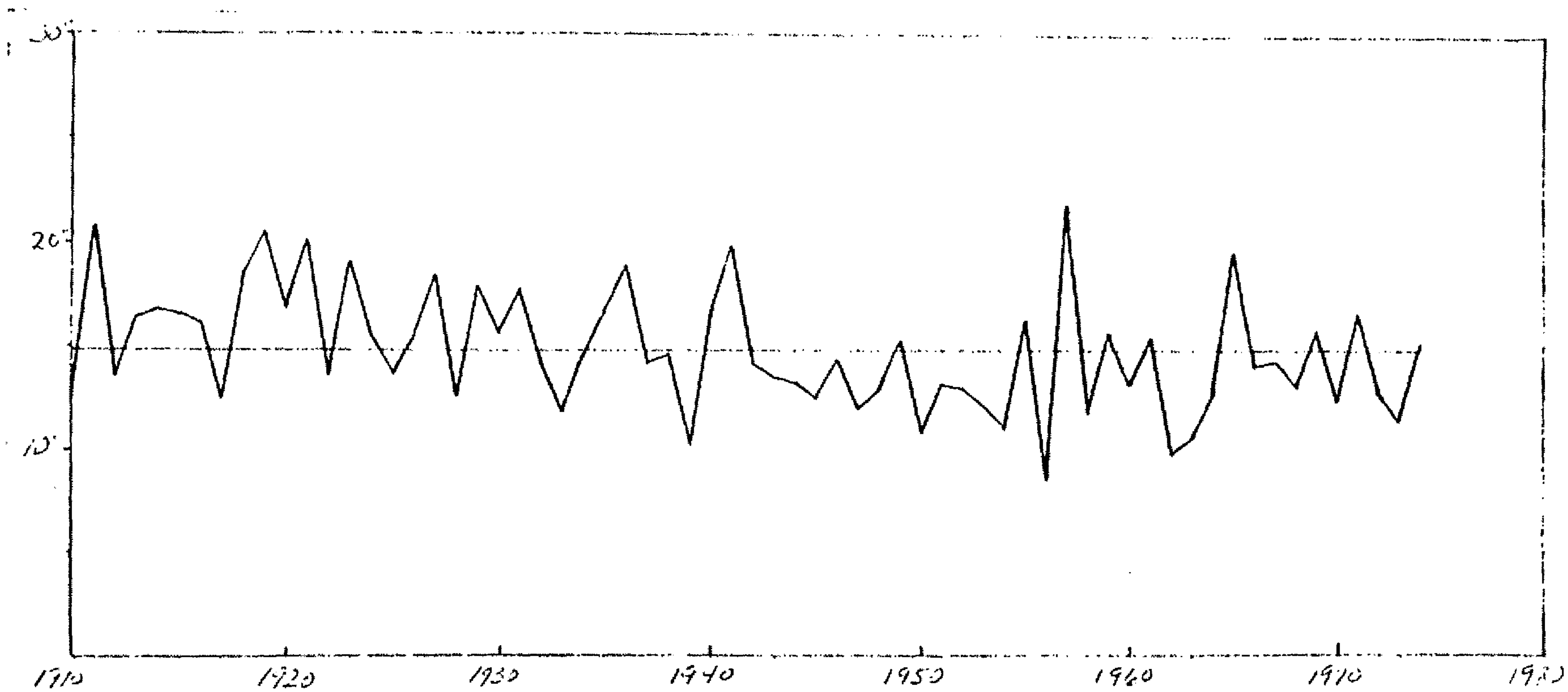
Table 8. Storm rainfall estimates, Taos County.

These values are the maximum rainfalls expected to occur in Taos County over a typical period of time. Return period indicates the frequency with which a given storm rainfall is likely to occur. Column 1A gives the 6-hour duration rainfalls for Taos. For example, the 5-year storm (which will occur on the average 20 times every century) brings with it 1.25 inches of rain in six hours. Column 1B gives the range in 6-hour rainfalls for the County, with low values generally occurring in the southwest part of the County, and highs in the northeast corner. Column 2A = 24-hour rainfalls, Taos; Column 2B = 24-hour rainfalls, Countywide. Based on maps, SCS, 1967.

Duration:	1B	1A	2B	2A
Return Period				
2 years	.85 - 1.8	.96	[1.[illegible] - 2.2]	1.20
5 years	1.15 - 2.2	1.25	1.5 - 2.6	1.62
10 years	1.35 - 2.6	1.49	1.7 - 3.0	1.84
25 years	1.55 - 3.0	1.80	1.9 - 3.8	2.28
50 years	1.75 - 3.2	2.00	2.3 - 4.2	2.44
100 years	1.95 - 3.4	2.25	2.5 - [illegible]	2.[illegible]

Figure 5a.
Average annual precipitation, Taos County*, N.M., 1910-1974.

LEGEND: [zigzag line] average annual precipitation
——— mean precipitation for the period (14.79")



* Average of Cerro, Red River, Taos, and Tres Piedras for entire period

cubic feet per second (c.f.s.) - unit used to measure water flow (i.e. at a gaging station); equals the rate of flow in a channel with a one square-foot cross-section and velocity of one foot per second. One c.f.s. for a 24-hour period equals 86,400 cubic feet or 1.98 acre-feet. Then 1 CFS/yr = 722.7 acre-feet/yr

1.98 ac-ft/day × 365 day/yr = 722.7 a.f./yr

inch - a depth of runoff which produces a certain amount of water per unit of land area; for example, twelve inches of water on one acre equals one acre-foot.

Average Flows. Based on Figure 13 and on the data tables it is evident that almost all runoff in Taos County occurs in mountain streams. For most of the large upland basins the average flow is 3-10 inches/year, measured near the point where the stream enters the Piedmont area. In the Piedmont proper runoff is normally 0.5-2.0 inches/year while in the Taos Plains it is less than 0.5 inches/year. The following list indicates how much water would be produced from one square mile in each of the three natural units:

Mountains:	160-600 acre-feet/year
Piedmont:	25-100 acre-feet/year
Plains:	5- 25 acre-feet/year

The major factor controlling runoff is precipitation, which as discussed previously is closely related to elevation. The following equation permits prediction of average runoff, if average basin elevation is known:

$$Q = \text{Antilog}\left(\frac{0.72E}{1,000} - 6.19\right)$$

where Q is runoff in inches/year, and E is elevation in feet. This equation does not apply if average elevation is above about 10,500 feet.

For the major streams gaged in Taos County, average elevation decreases markedly as basin area increases; therefore discharge can also be predicted as a function of area, a value which is easier to measure than average elevation. The appropriate equation is:

$$Q = 1,580A^{0.64}$$

where Q is runoff in acre-feet/year, and A is basin area in square miles. This applies only to mountain drainages, not lowland arroyos.

The effect of elevation is especially noticeable for the Rio Fernando de Taos. According to Bureau of Reclamation data (Bureau of Reclamation, 1971), above the gaging station this drainage has an average elevation of 9151 feet, and a unit discharge of 54 acre-feet per square mile. The nearby Rio Grande del Rancho is approximately 264 feet higher in average elevation, and has nearly four times the water yield - 204 acre-feet per square mile.

Much of the average flow of the Taos County streams is discharged to the Rio Grande either directly or after recharge to ground water and subsequent ground water inflow to the River. At the point it enters Taos County the Rio Grande carries mostly return flow from irrigation in the San Luis Valley of southern Colorado. This flow is approximately doubled by the time it leaves the County, through the addition of 250,000 - 300,000 acre-feet in a "typical" year, and

Miscellaneous cont.

Number Assigned	Name and Location of Station	Period of Record	Footnotes
*08-2595	New Mexico Branch Cerro Canal near Jaroso, Colorado (from Cerro Canal)	1944-Present	C
*08-2596	*Cerro Canal at State Line near Jaroso, Colorado	1973-1974	
*08-2600	Penasquito Ditch at Costilla, New Mexico (from Costilla Creek)	1955-1961	C
*08-2615	*Alire Ditch at Garcia, Colorado (from Costilla Creek)	1944-1959	C
*08-2620	*Eastdale No.1 Intake Canal (from Costilla Creek)	1944-Present	H
*08-2655	Llano Ditch near Questa, (from Cabresto Creek)	1943-1968	C
	Acequia Madre at Taos, New Mexico (from Rio Pueblo de Taos)	1940-1941	C,H
	Tenorio Ditch near Arroyo Seco, New Mexico (from Rio Lucero)	1935-1950	H
	Indian Ditch near Arroyo Seco, New Mexico (from Rio Lucero)	1934-1950	H
	Seco Ditch near Arroyo Seco, New Mexico (from Rio Lucero)	1934-1950	H
	Juan Manuel Ditch near Arroyo Seco, New Mexico (from Rio Lucero)	1935-1950	H
	Prado Ditch near Arroyo Seco, New Mexico (from Rio Lucero)	1934-1950	H
	Picuris Ditch near Penasco, New Mexico	1936-1941	
*08-2688	tributary of Rio Grande near Arroyo Hondo, New Mexico	1968-Present	P
*08-2774	tributary of Rio Grande at Rinconada, New Mexico	1952-Present	P

*irrigation in Colorado

Table 14. Gaging station records, Taos County, "Major Stations". Information obtained from U. S. Geological Survey.

Number Assigned (by U.S.G.S.)	Name and Location of Station	Area (sq.mi.)	Period of Record (water year)	Average Flow Records (acre-feet/year)	1955-1974 (acre-feet/year)	1955-1974 (inches)	Footnotes
*2515	Rio Grande near Lobatos, Co.	4,760[a]	1889-Present	431,100 [CFS/yr]	242,000	.96	A,B,C,D,E,I
*2525	Costilla Creek above Costilla Dam, N. M.	25.1	1937-Present	N/A	N/A	N/A	A,D,G
*2555	Costilla Creek near Costilla, N. M.	195	1936-Present	30,430	26,730	2.57	C,H
*2630	Latir Creek near Cerro, N.M.	10.5	1937-1970	4,820	N/A	N/A	I
[Above Red River] *2635	Rio Grande near Cerro, N.M.	5,500[a]	1948-Present	275,900 [379]	268,800	.92	C
*2650	Red River near Questa, N.M.	113	1910-Present[b]	38,250 [52.9]	26,150	4.33	C,F,I
*2660	Cabresto Creek near Questa, N. M.	36.7	1943-Present	6,950	6,540	3.34	C
*2670	Red River at Mouth near Questa, N. M.	190	1950-Present	56,220 [77.8]	54,770	5.40	C
*2675	Rio Hondo near Valdez, N.M.	36.2	1934-Present	25,650	22,240	11.51	I
*2685	Arroyo Hondo at Arroyo Hondo, N. M.	65.6	1910-Present[b]	20,000	14,130	4.03	C
*2690	Rio Pueblo de Taos near Taos, N. M.	66.6	1911-Present[b]	20,350	N/A	N/A	H,D
*2710	Rio Lucero near Arroyo Seco, N. M.	16.6	1910-Present[b]	16,080	N/A	N/A	H,I
*2750	Rio Fernando de Taos near Taos, N. M.	71.7	1910-Present[b]	4,780	N/A	N/A	C
*2755	Rio Grande del Rancho near Talpa, N. M.	83	1952-Present[b]	14,270	14,560	3.28	C
*2756	Rio Chiquito near Talpa, N. M.	37	1957-Present	5,850	N/A	N/A	
*2763	Rio Pueblo de Taos below Los Cordovas, N. M.	380	1957-Present	34,920	N/A	N/A	C,I
[Below 15-mile Target Dist. Limit] *2765	Rio Grande below Taos Jct. Bridge, near Taos, N. M.	6,730[a]	1925-Present	527,400 [730]	431,300	1.20	C
*2790	Embudo Creek at Dixon, N. M.	305	1923-Present[b]	57,090	N/A	N/A	C,H
*2795	Rio Grande at Embudo, N. M.	7,460[a]	1889-Present	728,100	481,100	1.22	C
*2890	Rio Ojo Caliente at La Madera, N. M.	419	1932-Present	49,050	40,140	1.30	C

[a] area does not include 2,940 square miles in a closed basin
[b] earlier records partial

Table 27. (continued)

LOCATION	OWNER OF RECORD: RG PERMIT NUMBER AND YEAR COMPLETED	WELL DEPTH	WATER LEVELS	OTHER
27.12 Tr	John Davidson Ranchos de Taos RG27809, 1976	D=75	25' 10/76	Y=4
27.13.13.000 (p)	Robert Peet RG26282, 1972	D=57		
27.13.31.130	Lower Des Montes HDhCA RG16107		180' 1/68	Y=20 C
27.13.31.213	Fritz Law ooc RG18190, 1970	D=55	20' 11/70	
27.13.31.214	Fritz Law ooc RG21163, 1972	D=87	40' 7/72	C
27.13.32 Tr	Alejandro R. Valdez Valdez RG9681, 1964	D=36	26' 1/64	
27.13.32.213	Jose Garcia ooc RG17995, 1970	D=70	40' 9/70	C
27.13.32.212	Joseph R. Apodaca Valdez RG18052, 1970	D=92	39' 10/70	
27.13.32.142	Charles R. Pfeiffer Valdez RG18053, 1970	D=55	20' 10/70	
27.13.32.212	Eva Martinez Valdez RG20535, 1972	D=95	45' 7/72	F
27.13.32 Tr	Peter Blake Arroyo Seco RG26143, 1975	D=165	69' 10/75	Y=10
27.13.33 Tr	Paul C. Hunner ooc RG13539, 1966	D=60	40'	
27.13.33.122	Mr. & Mrs. Gordon Wagner, ooc RG18051, 1970	D=100	70' 10/70	F

Table 27. (continued)

LOCATION	OWNER OF RECORD:* RG PERMIT NUMBER AND YEAR COMPLETED	WELL DEPTH	WATER LEVELS	OTHER
27.13.33.111	Tony P. Valdez Valdèz RG18120, 1970	D=81	27' 10/70	
27.13.3312	P. Martinez* Taos Cerro Project DH-TII RG20046, 1972	D=500	60.56' 3/72	S C
28.12.1.000	Manuel Ortega Questa RG123, 1956	D=65	43' 12/56	
28.12.1.100	Feliciano Rael Questa RG10696, 1965	D=175	84'	F
28.12.1.220	Felipe S. Ortega Questa RG11021, 1964	D=52	6' 8/64	U=C C
28.12.1.220	John W. Coward Questa RG17088, 1969	D=115	40' 11/69	C
28.12.1.420	Feliciano Vigil Questa RG17352, 1970	D=200	40' 5/70	F
28.12. 2.422**	Louis B. Ortiz[1] Questa RG10584, 1964	D=71	45' 6/64	C S
28.12. 2.422**	Louis B. Ortiz Questa RG10585, 1964	D=60	35' 6/64	C S
28.12.5.442	Alfredo Duran Questa RG13698, 1968	D=43	21' 4/66	C
28.12.24.144	Abran Ortega Questa RG149, 1957	D=300	Dry	
28.12.28.400	U. S. Forest Service Region #3, ooc RG22147, 1973	D=1183	887' 10/73	Y=2 (860-885) Y=1 (885-895) Y=15 (906-1008) Y=10 (1065-1183) F,S

*Data obtained from special SEO file.
**Location based on field check.
[1]In addition, SEO files show two springs with water level at 7400'.

Those sections are immediately south of those with tailings ponds

Table 37. (continued)

LOCATION	OWNER OF RECORD: RG PERMIT NUMBER AND YEAR COMPLETED	WELL DEPTH	WATER LEVELS	OTHER
29.13.29 Tr	Felomeno Vigil Questa RG15727, 1968	D=50	5' 6/68	
29.13.29 Tr	Agustin Rael Questa RG16937, 1970	D=60	8' 9/70	
29.13.30.341	*	D=130	70'	
29.13.30.140	State Highway Dept. Questa RG6128, 1961	D=198	98' 10/64	F
29.13.30.333	Manuel B. Ortega Questa [illegible]9262, 1961	D=52	10' 7/64	
29.13.30.100	Taos County Board of Education Taos [illegible]10732, 1964	D=210	127' 9/64	F C
29.13.30.110	Questa Baptist Mission Questa RG12762, 1965	D=200	128' 7/65	
29.13.30.1211	Village of Questa RG10641-S	D=200	85' 7/64	Y=237 C U=M
29.13.30.124	Robert C. Bryant Questa RG10479, 1969	D=250	165' 1/69	Y=30 U=C C, F
29.13.31.114	*	D=55	45'	
29.13.31.320	John H. Yaple Questa RG1107, 1960	D=103	80' 5/60	

*Data obtained from special SEO file.

Table 37. (continued)

LOCATION	OWNER OF RECORD: RG PERMIT NUMBER AND YEAR COMPLETED	WELL DEPTH	WATER LEVELS	OTHER
29.13.31.323	*	D=180-200		
29.13.31.341	*	D=267	20'?	
29.13.31.343	*	D=35	33'	
29.13.31.410	*	D=35	16'	
29.13.31.411	Antonio J. Trujillo Questa RG4784, 1960	D=30	6' 6/60	
29.13.31.111	Selimo Rael Questa RG147, 1957	D=136	95' 3/57	F
29.13.31.422	E. J. Valasquez Questa RG4784, 1960	D=30	6' 6/60	
29.13.31.233	Malaquias Rael Questa RG10707, 1964	D=50	6' 6/64	C
29.13.31.422	Charles Gonzales Questa RG10722, 1964	D=50	7' 7/64	
29.13.31.410	Eloisa V. Cisneros Questa RG11271, 1964	D=55	10' 6/64	
29.13.31 Tr	Carlos Martinez Cerro RG11552, 1964	D=50	8' 10/64	
29.13.31.400	Santiago Ortega Questa RG11156, 1964	D=51	10' 6/64	U=C
29.13.31. Tr	Claudio Rael Questa RG13037, 1966	D=62	35' 5/66	F

*Data obtained from special SEO file.

Town of Questa located in 29.13.31

CATALOG

OF

INFORMATION

ON

WATER DATA

U. S. Department of the Interior
Geological Survey
Office of Water Data Coordination

Edition 1972

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EXHIBITS

AGENCY CODE	LETTER	STATE NUMBER	AGENCY STATION NUMBER	STATION NAME	LATITUDE	LONGITUDE	STATE	COUNTY	TYPE	BEGAN	DISCONTINUED	INTERRUPTED RECORD	PUBLISHED	NOT PUBLISHED	DATA VIA PUNCHCARD	DATA VIA MAG. TAPE	OTHER
49	Q	04252	08248500	SAN ANTONIO R AT M NR MANASSA COLO	371046	1055236	CO	021	STREAM	1923		*	*	*		*	*
49	N	04253	08249000	CONEJOS R NR LA SAUSES COLO	371801	1054447	CO	021	STREAM	1921			*	*		*	*
49	N	21339	08249400	CULEBRA C NR CHAMA COLO	371037	1051918	CO	023	STREAM	1967	1970		*	*		*	
49	N	04254	08250000	CULEBRA C AT SAN LUIS COLO	371101	1052531	CO	021	STREAM	1927			*	*		*	*
49	N	04255	08251500	RIO GRANDE NR LOBATOS COLO	370442	1054522	CO	021	STREAM	1899			*	*		*	*
49	N	20334	C6-5074-5	LOBATOS BR COLO ON RIO GRANDE R	3705	10545	CO	023	STREAM	1941		*	*				*
49	N	04256	08252000	RIO GRANDE AT COLO N MEX STATE LINE	370014	1054312	CO	023	STREAM	1953			*	*		*	*
49	N	04570	08252500	COSTILLA C AB COSTILLA DAM NM	365352	1051516	NM	055	STREAM	1937			*				
49	N	04571	08253000	CASIAS C NR COSTILLA N MEX	365348	1051535	NM	055	STREAM	1937			*				
49	N	04572	08253500	SANTISTEVAN C NR COSTILLA N MEX	365303	1051650	NM	055	STREAM	1937			*				
49	N	04707	08253900	COSTILLA RE NR COSTILLA N MEX	365232	1051645	NM	055	RESER	1922			*				
49	N	04573	08254000	COSTILLA C BL COSTILLA DAM N MEX	365226	1051647	NM	055	STREAM	1937			*				
49	N	04574	08254500	COSTILLA C NR AMALIA N MEX	365233	1052322	NM	055	STREAM	1949			*				
49	N	04575	08255500	COSTILLA NR COSTILLA N MEX	365801	1053023	NM	055	STREAM	1936			*				
49	N	[illegible]	[illegible]	ACEQUIA MADRE AT COSTILLA N MEX	365803	1053057	NM	055	CANAL	1944			*				
49	N	04702	08256500	MESA F NR GARCIA COLO	365950	1053049	CO	023	CANAL	1944		*	*				
49	N	04703	08257500	CORDILLERA D AT GARCIA COLO	365941	1053139	NM	055	CANAL	1944			*				
49	N	04577	08259000	CERRO CA AT COSTILLA N MEX	365756	1053107	NM	055	CANAL	1944			*				
49	N	[illegible]	[illegible]	ASSOCIATION D AT COSTILLA N MEX	365738	1053203	NM	055	OTHER	1955	1971		*				
49	N	[illegible]	[illegible]	CERRO CA NR JAROSO COLO	365941	1053436	NM	055	CANAL	1944			*				
49	N	04579	08259500	N MEX B CERRO CA NR JAROSO COLO	365943	1053447	NM	055	CANAL	1944			*				
49	N	21117	08260500	COSTILLA C BL DIV D A COST N M	365833	1053100	NM	055	STREAM	1952			*				
49	N	04701	08261000	COSTILLA C AT GARCIA COLO	365921	1053154	CO	023	STREAM	1944			*				
49	N	04580	08262000	EASTDALE NO 1 INTAK CA N JAR COLO	370225	1053615	CO	023	CANAL	1944			*				
49	Q	04581	08263000	LATIR C NR CERRO N MEX	364945	1053250	NM	055	STREAM	1937	1970		*			*	
49	Q	04582	08263500	RIO GRANDE NR CERRO N MEX	364424	1054059	NM	055	STREAM	1948			*			*	
49	Q	04583	08264500	RED R BL ZWERGLE DAMSI NR RE R N M	364025	1052245	NM	055	STREAM	1963			*			*	
49	Q	04584	08265000	RED R NR QUESTA N MEX	364212	1053404	NM	055	STREAM	1910			*			*	
49	Q	04585	08265500	LLANO D NR QUESTA N MEX	364350	1053300	NM	055	STREAM	1943			*				
49	Q	04586	08266000	CABRESTO C NR QUESTA N MEX	364350	1053312	NM	055	STREAM	1943			*			*	
49	Q	04587	08267000	RED R AT MOUTH NR QUESTA N MEX	363853	1054134	NM	055	STREAM	1950			*			*	
49	Q	04588	08267500	RIO HONDO NR VALDEZ N MEX	363230	1053321	NM	055	STREAM	1934			*			*	
49	Q	04589	08268200	RIO HONDO AT DAMSI AT VALDEZ N MEX	363207	1053607	NM	055	STREAM	1963	1966		*				
49	Q	04590	08268500	ARR HONDO AT ARROYO HONDO N MEX	363156	1054106	NM	055	STREAM	1910		*	*			*	
49	Q	04591	08268700	RIO GRANDE NR ARROYO HONDO N MEX	363704	1054234	NM	055	STREAM	1962			*			*	
49	Q	25369	08268800	RIO GRANDE TR NR ARROYO HONDO NM	362829	1054305	NM	055	STREAM	1968			*				
49	Q	04592	08269000	RIO PUEBLO DE TAOS NR TAOS N MEX	362622	1053011	NM	055	STREAM	1910		*	*			*	
49	Q	04593	08271000	RIO LUCERO NR ARROYO SECO N MEX	363030	1053149	NM	055	STREAM	1910		*	*			*	
49	Q	04594	08276000	RIO FERNANDO DE TAOS NR TAOS N M	362242	1053255	NM	055	STREAM	1910		*	*			*	
49	Q	[illegible]	[illegible]	RIO PUEBLO DE TAOS N RANCHITO N M	[illegible]	[illegible]	NM	055	STREAM	1957			*			*	

→ to p. 15

OWDC NUMBER	DRAINAGE AREA (SQUARE MILES)	TYPES OF FIELD MEASUREMENT: STAGE: FREQUENCY	RECORDED	TELEMETERED	DISCHARGE (FREQUENCY)	TYPES OF DATA: DAILY DISCHARGE	PEAK STAGE OR DISCHARGE	LOW FLOW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	AGENCY REPORTING
04252	157	1	*		5	*			*		*													GS
04253	887	1	*		5	*			*		*								*					GS
21339	73.1	1	*		5	*			*				*											GS
04254	220	1	*		5	*			*															GS
04255	7700	1	*		5	*			*		*		*						*					GS
20334		2																	*					NWS
04256		1	*		5	*			*															GS
04570	25.1	2	*		2	*	*												*					GS
04571	16.6	2	*		2	*	*												*					GS
04572	2.15	2	*		2	*	*												*					GS
04707	54.6	8																	*		*		*	GS
04573	54.6	1	*		5	*	*												*					GS
04574	152	2	*		2	*	*												*					GS
04575	135	1	*		5	*	*						*						*					GS
04576		2	*		2		*																	GS
04702		2	*		2	*	*																	GS
04703		2	*		2	*	*																	GS
04577		2	*		2	*																		GS
04578		2	*		2	*																		GS
04709		2	*		2	*																		GS
04579		2	*		2	*																		GS
21117	197	2	*		2	*													*					GS
04701	200	2	*		2	*	*												*					GS
04580		1	*		5	*													*					GS
04581	10.5	1	*		5	*	*												*					GS
04582	8440	1	*		5	*	*												*					GS
04583	25.7	1	*		5	*	*												*					GS
04584	113	1	*		5	*	*												*					GS
04585		1	*		5	*	*												*					GS
04586	36.7	1	*		5	*	*												*					GS
04587	190	1	*		5	*	*						*						*					GS
04588	[illegible]	1	*		5	*	*												*					GS
04589	40.3	1	*		5	*	*												*					GS
04590	65.6	1	*		5	*	*												*					GS
04591	8760	1	*		5	*	*												*					GS
25399	1.16	1	*		9		*				*					*								GS
04592	66.6	1	*		5	*	*												*					GS
04593	16.6	1	*		5	*	*												*					GS
04594	71.7	1	*		5	*	*												*					GS
04595	199	1	*		5	*	*												*					GS

Table 4. Temperature - Taos County
(In °F.)

	Cerro Mean Max	Cerro Mean Min	Cerro Mean	Red River Mean Max	Red River Mean Min	Red River Mean	Taos Mean Max	Taos Mean Min	Taos Mean	Tres Piedras Mean Max	Tres Piedras Mean Min	Tres Piedras Mean
JANUARY	17	6	[illegible]	[illegible]	3	19	40	10	25	35	[illegible]	20
FEBRUARY	41	13	27	38	[illegible]	22	47	15	30	39	11	25
MARCH	49	20	35	43	13	28	53	21	37	46	19	32
APRIL	59	28	43	53	22	38	64	29	46	56	26	41
MAY	67	36	52	62	28	45	73	37	55	65	33	49
JUNE	78	44	61	73	34	54	84	44	64	76	41	58
JULY	81	49	65	76	40	58	87	50	68	79	47	63
AUGUST	80	48	64	75	40	57	85	50	67	78	46	62
SEPTEMBER	75	41	58	70	33	52	79	42	60	72	38	55
OCTOBER	64	30	47	59	25	42	67	32	49	61	28	45
NOVEMBER	50	19	35	46	12	29	52	18	35	48	17	32
DECEMBER	38	8	23	38	5	22	43	12	27	37	9	[illegible]
ANNUAL	60	29	45	56	22	39	64	30	47	58	26	[illegible]
RECORD HIGH		100(Jun)			94(Aug)			101(Jun,Jul)			93(Jul)	
RECORD LOW		-34(Jan)			-40(Jan)			-27(Feb)			-35(Feb)	
# DAYS MIN. LESS THAN 0		---			46			11			--	
DEGREE HEATING DAYS (measure of need to heat a home)		7559			9530			6770			8280	

Min. = minimum
Max. = maximum

3 miles North of Questa, NM

Table 5. Mean monthly and annual precipitation, Taos County.
(all data in inches; summer = May-October; winter = November-April)

Station Period	Ojo Caliente (1950-74)	Taos (1931-60)	Cerro (1931-60)	Penasco RS (1931-60)	Tres Piedras (1931-60)	Red River (1931-60)	Anchor Mine (1911-20)
January	0.59	0.82	0.64	1.06	0.85	1.07	1.91
February	0.34	0.72	0.60	1.02	0.86	1.10	2.53
March	0.56	0.79	0.58	1.20	0.76	1.35	3.27
April	0.37	0.92	0.97	1.14	0.85	1.60	3.91
May	0.70	1.20	1.34	1.37	1.11	1.80	2.75
June	0.52	0.76	0.97	0.99	0.69	1.24	1.97
July	1.68	1.58	1.70	1.98	1.93	2.56	5.78
August	1.98	1.77	1.92	2.10	2.32	3.07	3.84
September	1.00	1.11	1.41	1.34	1.36	1.49	2.14
October	1.11	1.13	1.19	1.32	1.05	1.47	2.30
November	0.59	0.71	0.61	0.87	0.59	0.98	1.44
December	0.48	0.57	0.61	0.82	0.80	0.93	2.32
Annual	9.70	12.08	12.46	15.19	13.17	18.66	34.16
Summer	6.79	7.55	8.45	9.10	8.46	11.63	18.78
As a %	70	62	68	60	64	62	55
Winter	2.91	4.53	4.01	6.09	4.71	7.03	15.38
As a %	30	38	32	40	36	38	45
Elevation	6,250'	6,945'	7,685'	7,900'	8,110'	8,676'	10,600'

3 miles North of Questa, NM

BULLETIN 51

Geology of the Questa Molybdenum (Moly) Mine Area, Taos County, New Mexico

BY JOHN H. SCHILLING

Local structure and stratigraphy, and detailed description of mineral deposits as related to regional geology, with guides to ore exploration in the surrounding area

1956

STATE BUREAU OF MINES AND MINERAL RESOURCES
NEW MEXICO INSTITUTE OF MINING & TECHNOLOGY
CAMPUS STATION SOCORRO, NEW MEXICO

Illustrations

PLATES

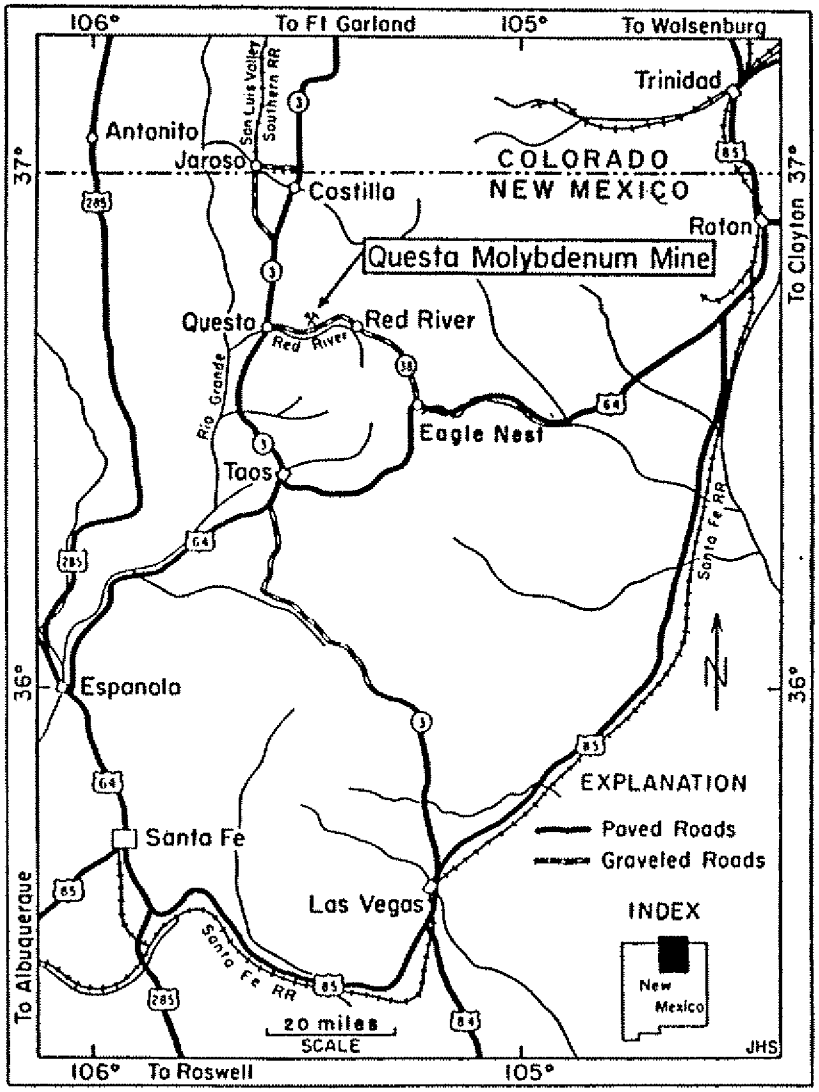
Abstract

The Questa molybdenum mine (known locally as the Moly mine), 6 miles east of Questa, in the Taos Range of the Sangre de Cristo Mountains, Taos County, New Mexico, is unique in containing high-grade molybdenite ore in fissure veins, whereas in most other mines production is from low-grade, disseminated deposits. The true nature of the veins first was recognized in 1916. In 1920 the Molybdenum Corporation of America acquired the property, and the mine has been in almost continuous production since then. Total production to Jan. 1, 1956, was 18,095,000 pounds of molybdenite. Mining is by overhand, horizontal slicing in stull-supported stopes; concentration is by flotation.

The Taos Range is made up chiefly of Precambrian metamorphic rocks overlain by Tertiary volcanic rocks. In the vicinity of the mine, Precambrian amphibolites and quartz-biotite schist of the amphibolite complex are overlain by Cabresto metaquartzite, and all these units are intruded by Precambrian granite. Late Paleozoic and Mesozoic sediments crop out along the eastern edge of the range and in small scattered areas elsewhere in the range. At the mine, conglomerates, arkosic graywackes, siltstones, and limestones overlie the Precambrian and are correlated tentatively with the Pennsylvanian-Permian Sangre de Cristo formation. A thick sequence of Miocene (?) volcanics (the volcanic complex) overlies the older rocks. The lower series of this complex includes andesite and quartz latite flows, breccias, and tuffs (the andesitic series); these in turn are overlain by an upper series of rhyolite flows, breccias, and tuffs (the rhyolite series). Numerous dikes, sills, and small plugs of rhyolite and andesite may be the intrusive equivalents of this volcanic complex. Late Tertiary soda granite stocks and dikes intrude the older rocks. Quaternary alluvial gravels cover the valley bottoms and terraces, and mud-flows form fans in Red River Canyon at the mouths of some of the side gulches.

Folding is not an important structural feature of the Taos Range. Faults are common, the majority being divisible into three systems: (1) north trending thrust faults along the east edge of the range, active during late Cretaceous and early Tertiary time, with thrusting toward the east; (2) north to northwest trending high-angle frontal faults along the west edge of the range and associated parallel faults throughout the range, active during late Tertiary and early Quaternary time; and (3) east to northeast trending high-angle faults throughout the range, active during the Precambrian or Paleozoic, with later Tertiary and Quaternary movement along some faults. Fractures parallel the east to northeast trending fault system. The Precambrian rocks show foliation, which most commonly strikes N. 50° E. to N. 70° E. and dips vertically.

Important local structures are superimposed on the regional structures of the Taos Range, forming the structural pattern in which the ore deposits occur. The mine is located in a downfaulted zone several



NDEX MAP SHOWING THE LOCATION OF THE QUESTA MOLYBDENUM MINE.

Figure 1

Introduction

PURPOSE AND SCOPE

The Questa molybdenum mine, known locally as the Moly mine, is unique in containing high-grade molybdenite ore in large veins, whereas nearly all other production is from low-grade, disseminated deposits. This report describes the geology of the Questa molybdenum mine and the other nearby prospects in detail, relates this detailed picture to the regional geology, and discusses the possibilities of future mineral production in the surrounding area, offering practical guides thereto. It is hoped that the ideas presented here will be useful also in locating and evaluating other mineral deposits with similar features.

METHODS OF INVESTIGATION

The writer first became interested in the mine during the summer of 1950 while serving as an assistant to Philip McKinlay, of the New Mexico Bureau of Mines and Mineral Resources, who was mapping the Taos Range of the Sangre de Cristo Mountains.

A total of 14 months was spent during the years 1951-55 examining the mine and surrounding area. Accessible workings were mapped on a scale of 1 inch to 20 feet; the surface over the mine (area of pl 2) was mapped on a scale of 1 inch to 500 feet. Maps of Molybdenum Corporation of America were used as bases.

For the detailed surface mapping, a dividing line between outcrop and cover was set up arbitrarily. The following rules were made and followed as closely as possible during mapping. All outcrops over 50 by 50 feet in size were delineated. All dikes over 1 foot wide also were mapped. Smaller isolated outcrops that could not be shown on the map were included with the cover. Locally small, isolated outcrops surrounded by a large area of cover (soil, talus, etc.) or other rock types, but important to the overall geologic picture, are shown on the map and are exaggerated slightly in size. A number of smaller outcrops spread over an area larger than 50 by 50 feet, but not more than 20 feet apart or covering less than 25 percent of the area, were mapped as one outcrop.

An area of approximately 20 square miles in the vicinity of the mine (area of fig 26) was mapped on a scale of 1 inch to 1 mile by a series of reconnaissance traverses designed to outline the important geologic features. Most of the prospects in the area were mapped by Brunton compass and tape.

A large number of specimens of the different rock types and vein materials were collected, from which over 150 thinsections and 7 polished sections were made and examined. The laboratory work, drafting, and writing were done in Socorro, with the aid of the facilities of the New Mexico Bureau of Mines and Mineral Resources.

PREVIOUS WORK

The deposit was described initially in a brief paper by Larsen and Ross (1920). A more detailed study was made by Vanderwilt (1938), who spent 4 months at the mine, mostly in underground studies. McKinlay (1956) mapped the geology of the Taos Range, in which the mine is located. Vanderwilt's paper and McKinlay's work were the foundation for the more detailed investigation made for this report.

ACKNOWLEDGMENTS

The writer is indebted to members of the Questa molybdenum mine staff who helped in so many ways to make this report possible, including Mr. J. B. Carman, former general manager; Mr. A. L. Greslin, general manager; Mr. E. William O'Toole, mine clerk; Mr. Francis C. Rowe, mining engineer; Mr. Ben Horner, former mine foreman; and Mr. Jose Varela, mine foreman.

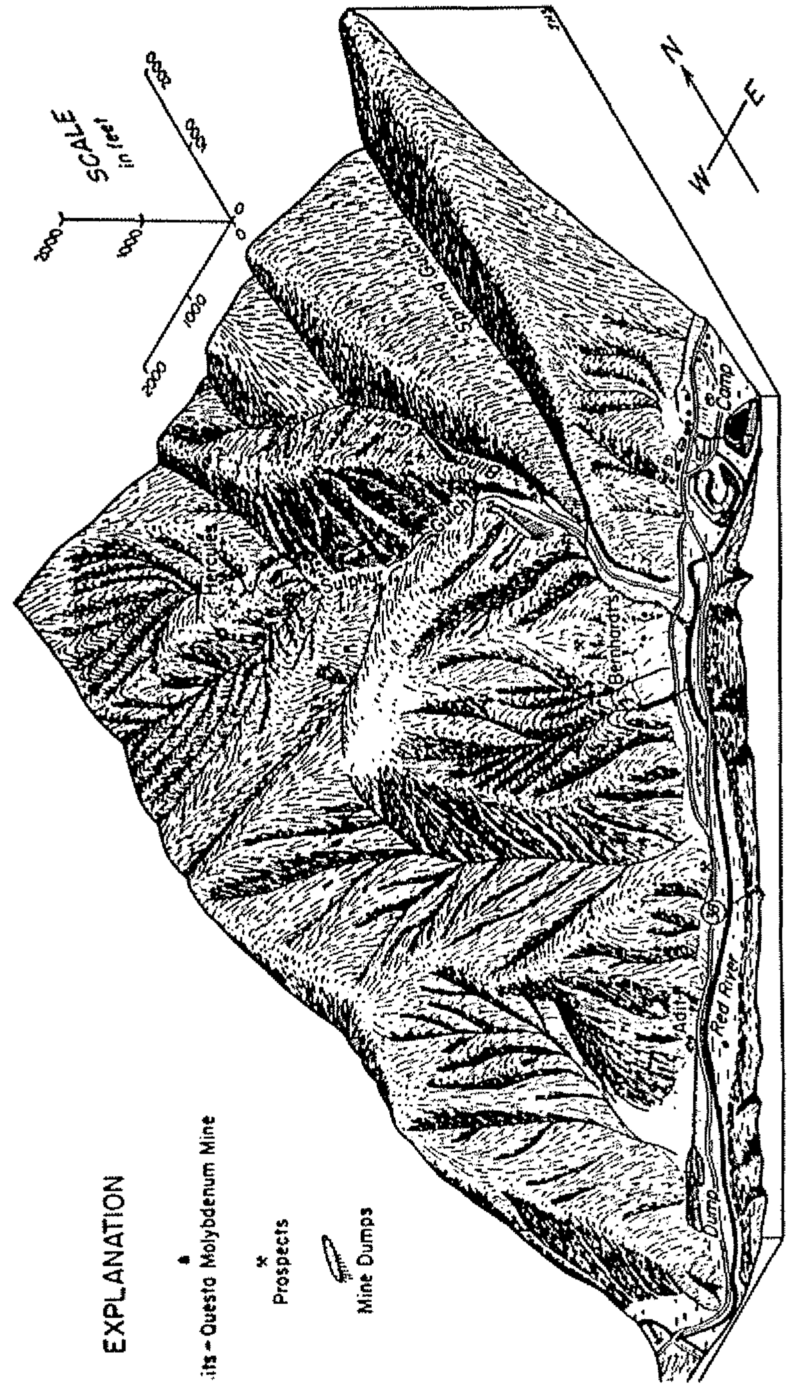
Sincere appreciation is due Dr. Eugene Callaghan, director of the New Mexico Bureau of Mines and Mineral Resources, for his guidance and support, to Dr. Edmund H. Kase, Jr., Dr. Robert H. Weber, and Mr. Max E. Willard for critically reading the manuscript and making many helpful suggestions, and to Dr. Brewster Baldwin for critically checking and making suggestions for Plate 2. Other members of the Bureau staff have checked various parts of the report and helped in many other ways.

Mr. Charles Treseder did all the photography necessary in preparing the figures and plates.

Field expenses for two summers were paid by the Field Assistance Fellowship Fund of the New Mexico Bureau of Mines and Mineral Resources. A grant from the Isadore Aaron Ettlinger Memorial Fund of Harvard University provided miscellaneous expenses for one summer.

A special word of acknowledgment is due my wife Constance. She was my field assistant, did all the necessary secretarial work, and has helped in so many other ways to make the completion of this study easier and more enjoyable.

Space will not permit the mention by name of the many other individuals who helped make this report possible. Their help is gratefully acknowledged.



ISOMETRIC DIAGRAM OF THE QUESTA MOLYBDENUM MINE AREA.
The main haulage adit (Moly tunnel) is labeled "adit."

GEOGRAPHIC FEATURES

Location and Accessibility

The Questa molybdenum mine is located on the western slope of the Taos Range of the Sangre de Cristo Mountains, Taos County, New Mexico (see fig 1). The various mine portals range in altitude from 8,000 to 9,000 feet. The mill, camp, haulage adit, and dump are distributed along Red River Canyon, 5-6 miles east of Questa. The adits to the older workings are along Sulphur Gulch, an intermittent tributary of the Red River (see fig 2).

State Highway 38, a graded gravel road, passes the mine and camp. It follows Red River Canyon and connects the mine with Questa, 6 miles to the west, and with the town of Red River, 6 miles to the east (see fig 1). Paved highways lead from Questa to Taos, New Mexico (to the south), and Fort Garland, Colorado (to the north). East of Red River, State Highway 38 crosses Red River Pass and continues to Eagle Nest, a distance of 19 miles. From Eagle Nest, paved highways lead to Taos and Raton, New Mexico (see fig 1). All other roads are primitive and in many places ungraded and badly washed.

The nearest railroad is at Jarosa, Colorado, 25 miles north of Questa. Jarosa is the southern terminal of the San Luis Valley Southern Railway, which connects with the Denver and Rio Grande Western Railroad at Blanca, Colorado (see fig 1). Only freight service is available.

Physical Features

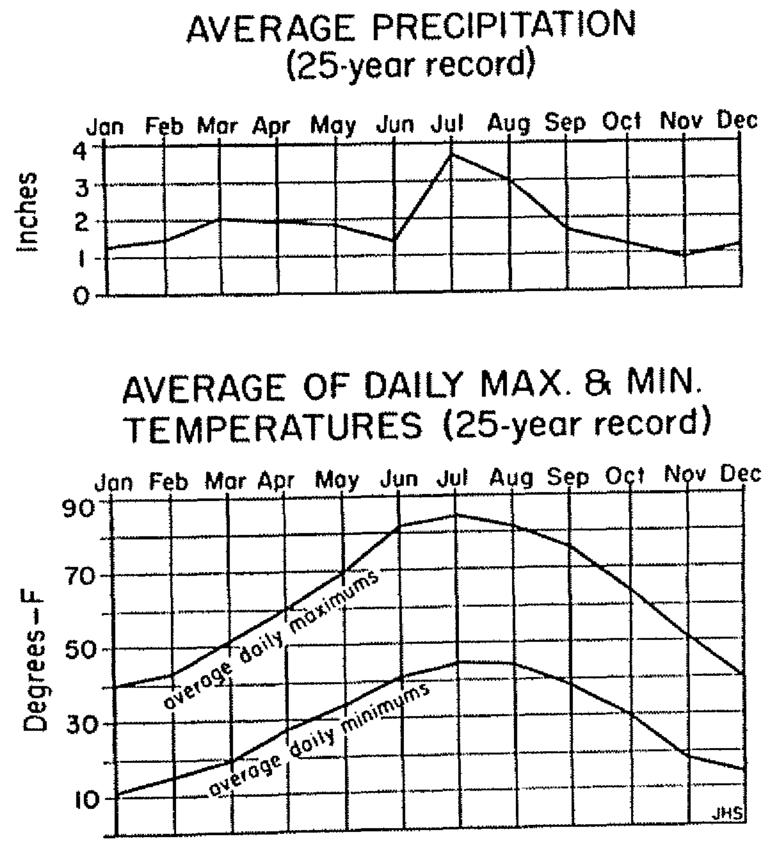
The Sangre de Cristo Mountains, in which the mine is located, are part of the Southern Rocky Mountains physiographic province. The maximum relief in the Taos Range of these mountains is over 6,000 feet; local relief at the mine is over 3,500 feet. Wheeler Peak (elevation 13,155 ft), which lies 10 miles southeast of the mine, is the highest point in New Mexico.

The surface over the mine is drained by intermittent tributaries of the Red River (see fig 2); the largest of these is Sulphur Gulch. The Red River (called the Rio Colorado or Colorado Creek in old reports) flows westward into the Rio Grande, 4 miles west of Questa. Where the Red River passes the mine, it has an average gradient of 2.0 percent. In comparison, the lower mile of Sulphur Gulch has an average gradient of 11 percent.

Climate

The climate at the mine is similar to that of the Rocky Mountains of Colorado, but is modified by the semiarid plateau to the west (see fig 3).

Summer is characterized by hot days and cool nights. The rainy season is during July and August, some rain occurring also in May and June. Heavy, but localized, rains during July and August cause flash



Climatic data for the Questa molybdenum mine area.

(Rainfall from *Climate and Man*, 1941 Yearbook of Agriculture, U. S. Dept. of Agriculture; temperatures from Molybdenum Corporation of America records.)

Figure 3

floods and mud-flows which often block the highway and occasionally damage the mine plant.

Fall is a period of warm days and cold nights. The first killing frost usually is in mid-September, and occasional snows can be expected.

Winters are mild, and the roads seldom are blocked by snow. The heaviest snowfall is limited to the higher parts of the mountains. Although the winters are long, protracted periods of freezing weather are limited to December through February. There are many sunny days, and the ground is often bare in areas exposed to the sun.

Spring arrives in late May with warmer, windy weather. Dust storms are common. The last killing frost is in mid-June. The aspen, willow, and cottonwood trees leaf out in late May or early June.

HISTORY AND PRODUCTION

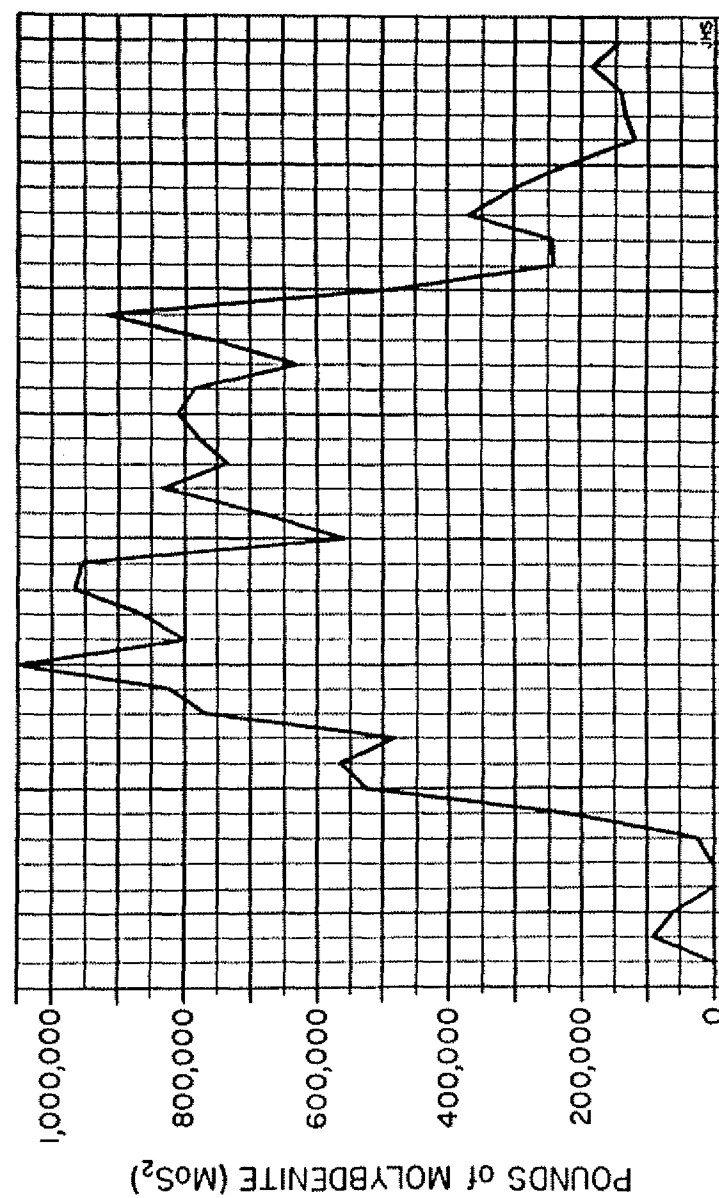
Prior to 1916 the bright-yellow molybdic gossan at the outcrops of the veins was thought to be sulfur, giving the name Sulphur Gulch to the valley in which the outcrops occur. The black molybdenite was mistaken for graphite, and the mineral was mixed with grease and used locally to lubricate wagon wheels. It also served as a shiny shoe polish, which unfortunately rubbed off on everything.

In 1916 or 1917 Jimmy Fay, a prospector having claims along Sulphur Gulch, sent a specimen of ore containing molybdenite to San Francisco to be assayed for gold and silver. The beginning of World War I had greatly increased the demand for molybdenum, and assayers were becoming aware of the value of the mineral molybdenite. When the assayer returned his report, he mentioned the presence of molybdenite and its value.

Some claims were located during the war. The Western Molybdenum Company, of La Jara, Colorado, was organized but did little to develop the claims. In November 1918, the R and S (Rapp and Savery) Molybdenum Company, of Denver, was formed and took over seven claims of the Western Molybdenum Company, filing additional claims. Development work was done throughout the winter of 1918-1919; production began in the spring. The ore was treated at a converted gold mill on the Red River, about 4 miles above the mine.

The Molybdenum Corporation of America was incorporated in 1920, in the same year acquiring the property of the R and S Molybdenum Company. Mining was discontinued during the depression of 1921; however, development work was continued. Operations were on a small scale until 1923, when a mill was built on the present mill site. In 1929, this mill was rebuilt. Because of the inaccessible location of the workings, burros were used to haul the ore from the portals to the bottom of Sulphur Gulch.

By 1941 mining and exploratory work had extended to such distances below and to the west of the lowest adit, Z tunnel level, that the present haulage adit (Moly tunnel) was driven to facilitate transporta-



Molybdenite concentrates produced from the Questa molybdenum mine. (Data from Vanderwilt, 1938; Annual Reports of the State Inspector of Mines; and Mineral Yearbooks of the U. S. Bureau of Mines.)

Figure 4

tion, ventilation, and drainage. This adit was driven north from the Red River for 1 mile, where it joined the lowest level in the mine (8,000 ft elevation). The mill was rebuilt again at about the same time. By 1955 the workings had reached a point 240 feet below the haulage adit.

Total production to January 1, 1956, was 18,095,000 pounds of molybdenite (MoS_2). See Figure 4 for production by years.

Other companies have attempted to mine molybdenite in the surrounding area, but with little success. In 1924, the Hercules Molybdenum Corporation built a camp at the head of Sulphur Gulch. Some development work was done, but apparently little ore was found; the company abandoned the camp the following year.

More recently several adits, the BJB prospects, were driven by Bill Wilde along Goat Hill Gulch, 3 miles west of the mine. Some ore was mined, but the prospects no longer are being worked.

Dan Cisneros and Juan Aragon, of Questa, worked a group of claims, known as the Horseshoe or Bear Creek claims, for many years. These claims are located along the south side of Red River Canyon where it meets Bear Canyon, 4 miles west of the Questa molybdenum mine. No ore has been milled, although a few tons have been stockpiled.

The late Leroy Bernhardt had a group of claims along the lower part of Sulphur Gulch. A good vein of silver ore was found, but proved to be limited in extent. Only traces of molybdenite were present.

SURFACE PLANT AND MINE

The present camp consists of an office building, which also contains the warehouse and commissary, a mill, assay laboratory, cookhouse, bunkhouse, school, and houses for employees (see fig 2).

At the haulage-adit portal, 1 mile west of the camp, there is a building containing a lamp room, change room, blacksmith shop, and the compressor and generating equipment. Another small building is used for cutting mine timber. Surface track from the adit continues a quarter of a mile down the canyon to the mine ore bins and dump (see fig 2).

The mine has over 35 miles of workings, with a vertical extent of 1,200 feet. The mine is divided into three parts: (1) the Sulphur Gulch north workings, located north of Sulphur Gulch; (2) the Sulphur Gulch south workings, which include all workings south of Sulphur Gulch mined through adits on the gulch; and (3) the Tunnel shaft workings, which include all workings mined through the Tunnel shaft (a vertical winze) and the Moly tunnel. The relationship of the levels to each other and to the geology is shown by Plate 1 (in pocket).

MINING METHODS

Prospecting and Exploration

The veins do not form bold outcrops but are easily located by the bright canary-yellow color of the ferrimolybdite in the gossan. Underground exploration is carried on by drifting or raising along veins that have known ore shoots or appear favorable, and by crosscutting and raising to intersect known veins or explore new areas. Diamond drilling is not used.

These factors are used as guides: (1) Most of the ore shoots are near or on the contact of the granite with the altered rocks. (2) Ore-grade mineralization is usually weak in the "tight" altered rocks and strong in the more "open" granite near the contact. (3) Veins are usually thicker where the contact dips steeply. (4) Most of the ore is found where the contact has an east-west trend and a south dip. (5) Dikes of granite near the main granite mass often have good ore shoots.

Electrical prospecting (Sunberg and Nordstrom) was tried in 1917. Good ore was found in several places indicated by the survey, but many of the indications turned out to be gouge zones containing water.

Development

The mine is developed by adits, drifts, crosscuts, raises, and winzes at intervals of 15-100 feet vertically. There is no standard pattern because of the irregular vein systems. Exploration openings are used wherever possible.

Drifters are used to drill a 15-hole, bottom V-cut round; this is loaded with a total of 45 sticks of 40-percent gelatin dynamite, and normally breaks 4½ feet. Stopers are used to drill center V-cuts when raising; there is no standard drilling pattern for a round. Machine mucking is used in all easily accessible drifts; hand mucking is employed in drifts on intermediate levels inaccessible to mucking machines. The rock, when granite, is moderately hard and usually stands well without timbering; the altered volcanics are usually soft and broken and require considerable timber.

Stoping

Stoping methods are adapted to local conditions. Most of the ore shoots are mined by overhand methods in open, stull-supported stopes. Where the hanging wall is weak, back filling or pillars are used for support. Much of the stoping is done by hand drilling, which is possible because of the soft vein material. This permits highly selective mining. The ore occurs so irregularly in the veins that stoping practices often must be changed every round. In narrow veins, the foot wall is broken away from the ore, and the ore shot down separately. In wide veins, no breaking of the wall rock is needed, and light shooting or picking is used. If the vein splits, the waste in between often is removed first. There are numerous other variations. Where the veins are more regular machine drilling is used.

Reserves cannot be estimated, since mining closely follows exploration and development. Only the Tunnel shaft workings are being mined actively.

Transportation

The ore and waste are hand-trammed to the Tunnel shaft in 1-ton end-dump cars, hoisted, and dumped into 3-ton rocker-dump cars. A storage-battery engine pulls these larger cars out the mile-long haulage adit and over the surface track to the dump and ore bins.

Drainage and Ventilation

Water from the levels above the haulage adit drains by gravity out the various adits. Water from the workings below the haulage adit drains into a sump at the bottom of the Tunnel shaft; then it is pumped up the shaft and flows out the adit. Ventilation is natural.

MILLING METHODS

The present mill has a capacity of 50 tons of ore per day. Two types of material are milled: (1) ore from the mine, and (2) tailings from the older of two tailing ponds. Ore is trucked to the mill and stored in bins which feed through a crusher into a ball mill. The tailings are loaded into trucks by a shovel, and then hauled a short distance to bins which feed directly into the ball mill. The ball mill is run in a closed circuit with a classifier; the overflow goes to the rougher flotation cells, which remove most of the waste as tailings. The concentrates from the roughers go to the regrind mill, which is in a closed circuit with a classifier; the overflow goes to the cleaner flotation cells, which remove most of the remaining waste. The concentrates, averaging 85 percent MoS_2, are dewatered by a thickener tank, filter, and dryer, and then sacked and shipped to the company plant at Washington, Pennsylvania, where they are made into ferromolybdenum or calcium molybdate for use in alloys.

Geologic Setting

DESCRIPTIVE GEOLOGY

Introduction

The Taos Range of the Sangre de Cristo Mountains is made up chiefly of Precambrian metamorphic (amphibolites, schists, and quartzites) and intrusive (granite) igneous rocks overlain by late Tertiary volcanic rocks (andesite, quartz latite, and rhyolite flows, breccias, and tuffs) and interbedded sediments. Permian and Pennsylvanian sediments (arkosic sandstone and conglomerate, shale, and limestone) occur along the eastern edge of the range; also, a few poorly exposed outcrops of sedimentary rocks in other areas probably are late Paleozoic in age. Tertiary granitic rocks intrude the older rocks (see figs 5 and 6).

All the rock types, except the sediments, are well represented in the vicinity of the Questa molybdenum mine (see fig 5). Sediments, probably of late Paleozoic age, are present, although evidence for their correlation and dating is poor. None of the other rock units could be dated accurately because of the lack of fossil or other direct evidence of their age.

Precambrian

Because of the poor exposures and complex relationships of the Precambrian rocks, only the granite and quartzite were mapped as separate units; the other Precambrian rocks are predominantly amphibolites, and were mapped as a single unit, the amphibolite complex. The metamorphic rocks are assigned tentatively to the Precambrian, but only because of their position below late Paleozoic (?) rocks, their metamorphic character, and their similarity to more accurately dated Precambrian rocks elsewhere in the Rocky Mountains. It must be emphasized that metamorphism alone is not a good criterion for Precambrian age.

Amphibolite Complex

The amphibolite complex covers large areas along the south side of Red River Canyon, both east and west of the mine camp (see pl 2). North of the Red River, these rocks are more limited in extent. One area of outcrop, approximately 100 feet above the canyon floor, extends west from the mouth of Sulphur Gulch to the main haulage adit (Moly tunnel). In the mine, quartz-biotite schist of the amphibolite complex is exposed in the main haulage adit (Moly tunnel). Rocks of this complex are found also in the long crosscuts extending south from the main drift of Z tunnel level, although here alteration by the Tertiary soda granite makes identification difficult (see pl 1). Vanderwilt (1938, p 610) reports that these rocks are exposed also above Z tunnel level in the east ends of No. 3 and W levels, where the workings are now caved.

The base of the complex is not exposed. The total exposed thickness in the vicinity of the mine is probably several thousand feet, although no accurate measurements could be made.

The amphibolite complex includes many varieties of amphibolite and interlayered quartz-biotite schists. The complex is not resistant to weathering, and areas underlain by these rocks usually are covered with rocky soil or talus. At a distance, the few outcrops appear darker gray than any of the other rock types, except some of the andesitic volcanics. Outcrops commonly are stained brown. A few outcrops contain alternating layers of quartz-biotite schist and amphibolite; these layers may represent bedding. No other primary structures were noted.

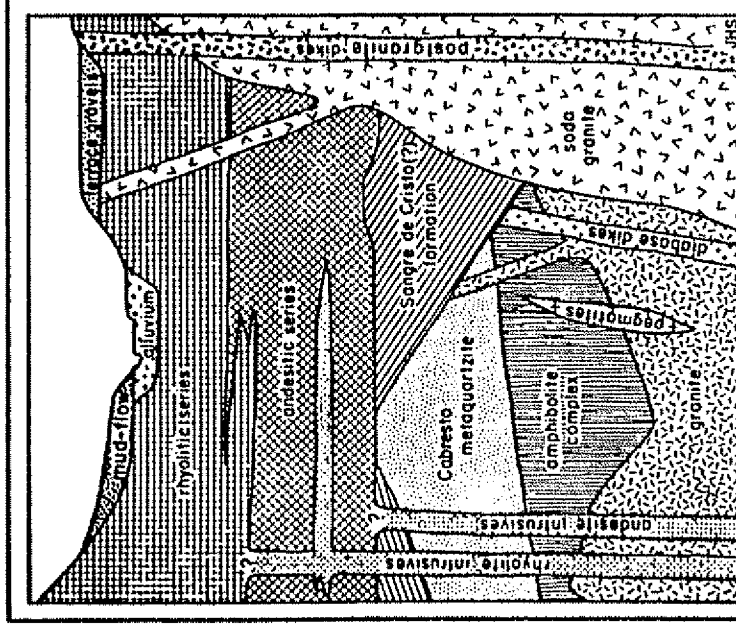
In hand specimen the rocks which have been grouped together in the amphibolite complex are massive to foliated, range from black to dark green, usually with specks or bands of white, and can be separated roughly into four varieties: (1) massive, coarse-grained; (2) massive, medium-grained; (3) gneiss; and (4) coarse-grained schist.

The massive, coarse-grained amphibolites contain large, black hornblende crystals up to 3 cm across in a fine-grained phaneritic groundmass of hornblende and andesine (?). In thinsection large, green, subhedral crystals of hornblende, with no preferred orientation, are set in a groundmass of smaller hornblende crystals, cloudy andesine (?), and minor quartz. Epidote, in clumps of small anhedral grains, replaces the hornblende; many of the larger hornblende crystals are poikiloblastic, with inclusions of epidote and magnetite. The andesine (?) is highly altered to clay and sericite. A typical thinsection contains 70 percent hornblende, 15 percent andesine (?), 10 percent epidote, 3 percent quartz, and 2 percent magnetite, by volume.

The massive, medium-grained amphibolites are equigranular aggregates (average grain size: 3 mm) of black hornblende and white plagioclase, closely resembling a diorite in appearance. In thinsection (see fig 7) large, ragged, unoriented, green hornblende in groups or individual crystals is set in a groundmass of cloudy, lathlike to irregular aggregates of twinned andesine and small, irregular quartz grains. Magnetite is scattered through the hornblende, commonly along the hornblende cleavage. In some specimens, the hornblende is altered to chlorite and is accompanied by more abundant magnetite. In some sections the hornblende is poikiloblastic, with inclusions of quartz (?) or plagioclase (?). The andesine is altered to clay and sericite. Thinsections examined contain 45-60 percent hornblende, 30-40 percent andesine, 5 percent quartz, and 5-10 percent magnetite, by volume. Epidote probably occurs in rock of this variety, but was not noted in the sections examined.

The amphibolite gneisses are coarsely foliated with oriented trains of black hornblende and white plagioclase. If the hornblende and plagioclase were not oriented, this rock type would resemble closely the massive, medium-grained amphibolite. In thinsection, small to medium-sized, green, subhedral hornblende, paralleling the plane of foliation, is set in a cloudy, granular aggregate of smaller anhedral andesine (?). Quartz grains are scattered through the andesine (?). Although the

AGE	UNIT		LITHOLOGY
Quaternary	alluvium		gravel, sand, silt — valley fill
	mud-flow		unsorted gravel, sand, silt
	terrace gravels		gravel
Tertiary	postgranite dikes		porphyritic quartz monzonite to monzonite
	soda granite		mostly porphyritic to inequigranular quartz-orthoclase-albite-biotite granite, some aplitic and pegmatitic granite
	andesite and rhyolite intrusives		andesite and rhyolite of varying composition and texture
	volcanic complex	rhyolitic series	light-colored rhyolite flows, breccias, and tuffs
		andesitic series	dark-colored andesite flows, breccias, and tuffs
Pennsylvanian—Permian (?)	Sangre de Cristo (?) formation		massive, gray to grayish-red conglomerate, sandstone (arkosic graywacke), and siltstone usually gradational with one another; thin limestone lenses
Precambrian	diabase dikes		black with aphanitic walls and phaneritic centers of plagioclase and augite having an ophitic texture
	pegmatite dikes		coarse quartz, albite, and muscovite
	granite		gneiss, gneissic, or massive medium-grained quartz-microcline-plagioclase-biotite granite
	Cabresto metaquartzite		massive coarsely crystalline glassy to milky quartz
	amphibolite complex		amphibolite gneiss and schist of hornblende, andesine, quartz, and epidote; and quartz-biotite schist



Generalized rock section of the Questa molybdenum mine area.

Mineral Deposits

INTRODUCTION

The Questa molybdenum mine is the only mine in the area. Many other small deposits in the surrounding area have been prospected for molybdenum, gold, silver, copper, lead, or zinc, but always with unfavorable results. Nearly all these deposits, including that of the Questa molybdenum mine, apparently are late Tertiary in age and were formed by hydrothermal solutions emanating from the soda granite intrusives.

Oxidation and enrichment of the disseminated sulfides in the hydrothermal pipes may have formed minable copper deposits at depth, although the present scanty evidence is unfavorable. More detailed study is needed.

QUESTA MOLYBDENUM MINE DEPOSIT

Introduction

A group of molybdenite-bearing veins form the mineral deposit in which the Questa molybdenum mine is located. This deposit is unique in containing high-grade molybdenite ore in fissure veins, whereas most other production is from low-grade disseminated deposits. The ore occurs in the Sulphur Gulch soda granite stock along a locally east striking, south dipping part of the contact with propylitized rocks. Most veins parallel the contact, range from less than 1 inch to over 7 feet in thickness, and are largely quartz and molybdenite, with locally abundant biotite, fluorite, pyrite, chalcopyrite, calcite, and rhodochrosite. The veins were deposited as cavity fillings during late Tertiary time soon after the soda granite was intruded. The upward force of intrusion apparently sheeted the granite along the contact, and hydrothermal solutions from the granite entered the sheeting to form the veins.

Spacial Relation of Veins to Rock Units and Structure

The veins of the ore deposit occur along the western side of the Sulphur Gulch soda granite stock where the north trending contact locally strikes east and dips to the south. To the east and west, where the contact swings north-south, very few veins are found. At the surface the east-west portion of the contact is over 1,500 feet long. The propylitized Tertiary andesitic series is in contact with the soda granite over much of the area where the veins occur. On the upper levels, at the east end of the deposit, the propylitized Pennsylvanian-Permian (?) sediments, dipping steeply to the west and striking northwest, are in contact with the soda granite. East of these sediments Precambrian quartz-biotite schist is in contact with the soda granite where the contact begins to swing south. The Sulphur Gulch soda granite stock, in which the deposit is found, is in the downfaulted zone and near several hydrothermal pipes.

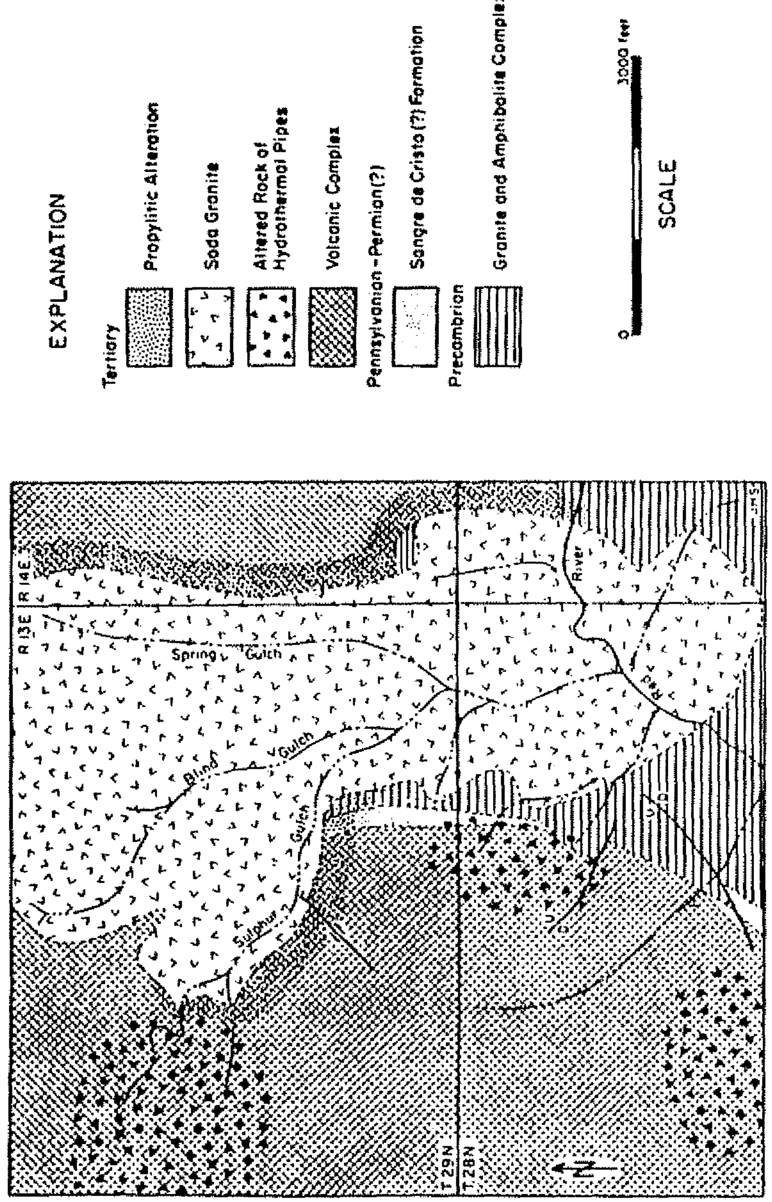


Figure 10

Generalized geologic map of the Questa Molybdenum mine area.

(8)

ATTACHMENT I, PARAGRAPH 3
TAILS AREA GROUND WATER DISCHARGE PLAN APPLICATION
Item 16

MOLYCORP, INC.
QUESTA DIVISION

EXISTING TAILINGS DISPOSAL AREA

PLAN OF OPERATIONS

1. INTRODUCTION:

This Plan of Operations covers the operation and maintenance of Molycorp's Questa mine existing tailings facilities located in Sections 2/35/26 and 36/25, approximately one mile west of Questa, New Mexico.

2. LOCATION:

The attached Map No's 100 & 200 outlines the existing impoundment area.

The site covering 2,132 acres, is located in Township 29N, Range 12E, Sections 2/25, 26/35 and 36. The property is made up of patented and fee simple land owned by Molycorp. A location map, patented and fee simple land recordation information are available at the BLM State office in Santa Fe and at the Taos County courthouse.

Approximately 555 acres of the site are covered with tailings of which 390 acres of tails have been temporarily capped with a topsoil cover and reseeded. Another 150 acres of tailings will be temporarily capped by July, 1993. Soil stabilizer has and will be sprayed on the remaining small area of tails sand.

3. HISTORY:

A brief history of the development of the Questa mine tails storage area from the 1965 start of open-pit mining to placing the underground mine on standby in 1992 is as follows:

. Table I chronologically lists the construction sequences of dams shown on Map No.'s 100 & 200.

. In 1965, tails disposal was started by constructing starter Dam #1 in a large arroyo at the south end of Section 36. This dam was constructed of earthfill and incorporated an internal drain system. The upstream face of the dam was sealed with the slime fraction of the tailings. The water clarification pond was at the dam face. Clarified water was piped via decant structures raised on the upstream dam face through culvert tunnels under the dam and then by ditch to the Red River.

MOLYCORP, INC.
Questa Mine

TABLE I

TAILS STORAGE DEVELOPMENT
(Chronologically Listed)

YEAR	SECTION 36	SECTION 35
1964/65	Dam 1 to 7425' elevation (starter dam)	---
1966	Dam 1 to 7560' elevation	---
1967	Dam 1 to 7484' elevation	---
1968	Dam 1 to 7500' elevation	---
1969	Dam 1 to 7520' elevation Dam 2 to 7520' elevation	---
1970	-----	---
1971	Dam 1 to 7525' elevation	Dam 4 to 7440' elevation (starter dam)
1972	-----	Dam 4 to 7460' elevation
1973	-----	Dam 4 to 7478' elevation Dam 3A to 7532' elevation avg.
1974	East diversion ditch	West diversion ditch
1975	Dam 1C to 7560' elevation by cyclones Dam 1B, 2A to 7560' elev. Seepage barrier #1 below Dam 1	Dam 4 to 7505' elevation Seepage barrier #2 east of Dam 4
1976/79	-----	---
1980	Dam 2B to 7580' elevation by cyclones	Dam 4 to 7512' elevation
1981/82	Dam 1C, 1B, 2A, separator dike to 7584' elevation	Dam 4 to 7517' elevation
1983	-----	Ion exchange water treatment plant
1990	-----	Dam 5A to 7525' elevation

3. HISTORY (continued)

Dam #1 raises and operation continued in this fashion until 1969, when a small Dam #2 was constructed at the north end of Section 36. The clarification pond was then shifted to the north and the existing decant structures abandoned for a new overflow weir structure constructed in the bank along side the new Dam #2. Clarified water overflowed the weir and traveled down a decant ditch cut around the west side of Section 35 to a small holding pond named Pope Lake located at the south end of Section 35. From Pope Lake, the water flowed over a Parshall flume (later called Outfall 001) and on to the Red River.

The final 7520 ft. and 7525 ft. elevation raises in 1969 and 1971, on Dam #1, were shifted upstream of the existing dam west and constructed on tailings. These lifts were of compacted earthfill.

. In 1971, additional tails storage was created by constructing starter Dam #4 in the Section 35 arroyo, parallel to and just south of Section 36 and Dam #1. This dam and all its subsequent lifts were constructed of earthfill with internal drain systems. The upstream dam face was also covered with an asphalt or plastic membrane to ensure that the upstream face was impermeable. A decant weir was built to the north of the dam so that the clarification pond could be kept away from the dam face. Clarified water was released over the weir structure into the west ditch to Pope Lake and the Red River.

. In 1973, Dam #3A was constructed north of Dam #4, inside the west ditch, in order to close off the north end of Section 35 for additional tails storage.

. In 1974, east and west diversion ditches were constructed around both tails storage areas in order to divert all natural drainage away from the impounded tailings. Diverted water re-entered the watershed below the Dams 1 and 4.

. In 1975, seepage barriers were constructed below Dam #1, and to the east of the ridge separating Dam #4 and Dam #1 areas. These barriers were excavated to clay and sealed on the downstream side and filled with suitable drain material so that ground water from the tails storage ponds could be collected and diverted around the dwellings situated downstream of the tails storage area. This water was then piped to the Red River through Outfall 002.

HISTORY (Continued)

. In the 1975 time period, new dam construction in Section 36 consisted of constructing a new structure approximately 1200 feet upstream of Dam #1. This dam was labeled Dam #1C and was constructed of cycloned tailings. Dams #1B & 2A, were also constructed of earthfill and extended north from the east abutment of Dam #1C, to the far end of Section 36. These structures did not have internal drains and were sealed with tails slimes.

In 1980, a cyclone berm was raised several hundred feet upstream of Dam #2A, and in 1981, new Dams #'s 1C, 1B & 2A, were raised to their present 7584 ft. elevation.

These structures were constructed of earthfill [redacted] and upstream face plastic membranes. All structures were constructed downstream of their earlier counterparts. A separator dike was also constructed on the the ridge between Sections 35 & 36, extending north from the west abutment of Dan #1C.

. In 1983, an ion exchange water treatment plant was constructed alongside Pope Lake. This plant processed all tails decant water before it was discharged into the Red River.

. In 1990, Dam 5A was constructed in the old west decant channel on the north side of Dam 3A to an 7525 ft. elevation. The dam is designed to be raised to 7540 ft. elevation at a later date.

4. DAM DESIGN PARAMETERS

The dams impounding the tailings are hydraulic structures of compacted earth fill [redacted]. Dams 1C and 4, have impermeable membranes installed on their upstream faces. Existing Dams 1C, 1B, 2A in Sections 36/25, have a common crest elevation of 7585 ft. with design approval by the State Engineer to 7610 ft. elevation. Existing Dam 4, in Section 35, has a crest elevation of 7520 ft. with State Engineer approval to 7537 elevation. Dam 5A was designed with a rock downstream core in order to store water on both sides. State Engineer approval is to the 7540 ft. elevation. The existing dam crest is at 7525 ft. elevation.

5. BASIC OPERATING SCHEME

Tailings are transported from the mill to the tails pond in two, 50,000 foot long, rubber lined tails lines in a slurry at 38% by weight solids.

The tailings are discharged from spigot points located around the tails disposal area. After the tailings are discharged into the disposal area, the tails water is retained for a long enough period to allow the solids to settle out. This retention time is governed by overflow weirs constructed at strategic points in the impoundment area. Water flow from the impoundment area is controlled by adding weir boards to the structures.

After water overflows the final weir, west and north of the No. 4 dam, the tails water is conveyed by ditch and pipeline to the water treatment plant located below Dam No. 4. After water treatment, the tails water is discharged into the Red River at Pope Lake (Outfall 001).

6. OPERATING PARAMETERS

The following tailings disposal operating philosophy is used.

a) Utilize pond areas efficiently in order to eliminate mill disruptions.

b) Control tails disposal areas so that areas are either wet with tailings, under water in clarification phase, or tails sand covered with chemical stabilizer for short term dust control, or soil top cover for long term dust control.

c) Keep clarification ponds away from dam faces.

d) When introducing tailings into new areas not covered with tailings, initially establish tails beach against structure, or over natural ground to seal area against seepage.

e) Where feasible, minimize exposed tails sand areas by berming area with tails sand or controlling spigotting of tails to form ridges to attempt to isolate tails into cells.

f) Adjust decant overflow weirs to maximize water clarification.

7. FACILITIES MAINTENANCE AND INSPECTION

The following maintenance and inspection procedures are used.

a) When the mill is operating, Tails patrol over lines, pond areas and dams, 24 hours/day.

b) Daily recording of #002 seepage outflow and inspection of seep barrier No. 2 pipeline.

c) Monthly readings of piezometers in dam structures and visual inspection of all structures.

d) Continuous monitoring in mill control room of tails lines flow rates, pressure and sampling of tails to check density of slurry.

8. ENVIRONMENTAL

The following environmental controls are utilized.

a) Rainwater and snow melt diversion ditches have been constructed around the area in order to divert all material runoff away from the tails containment ponds.

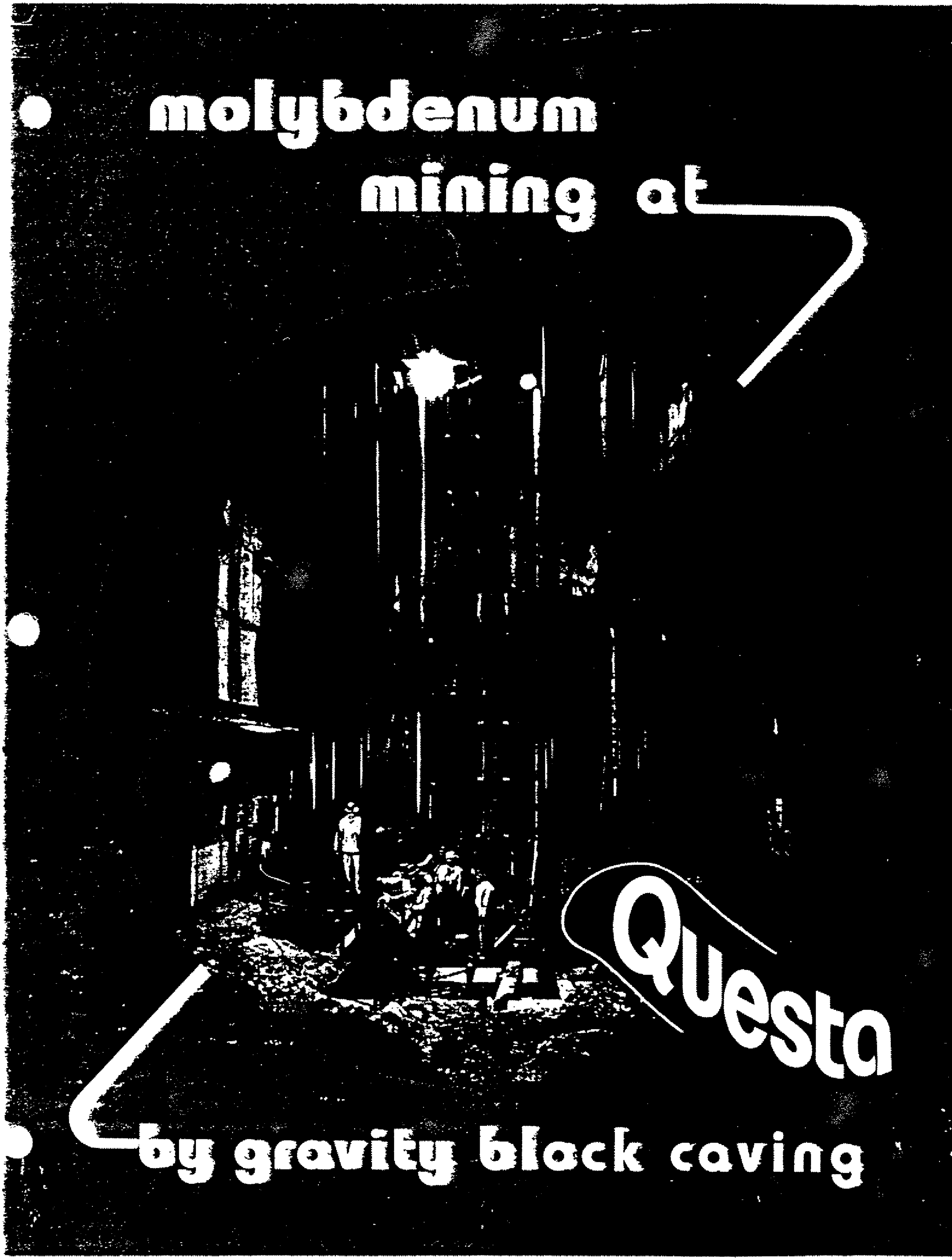
b) Two seepage barriers and drain systems have been constructed below No. 1 Dam and adjacent ot No. 4 Dam to collect and divert seepage water to #002 Outfall.

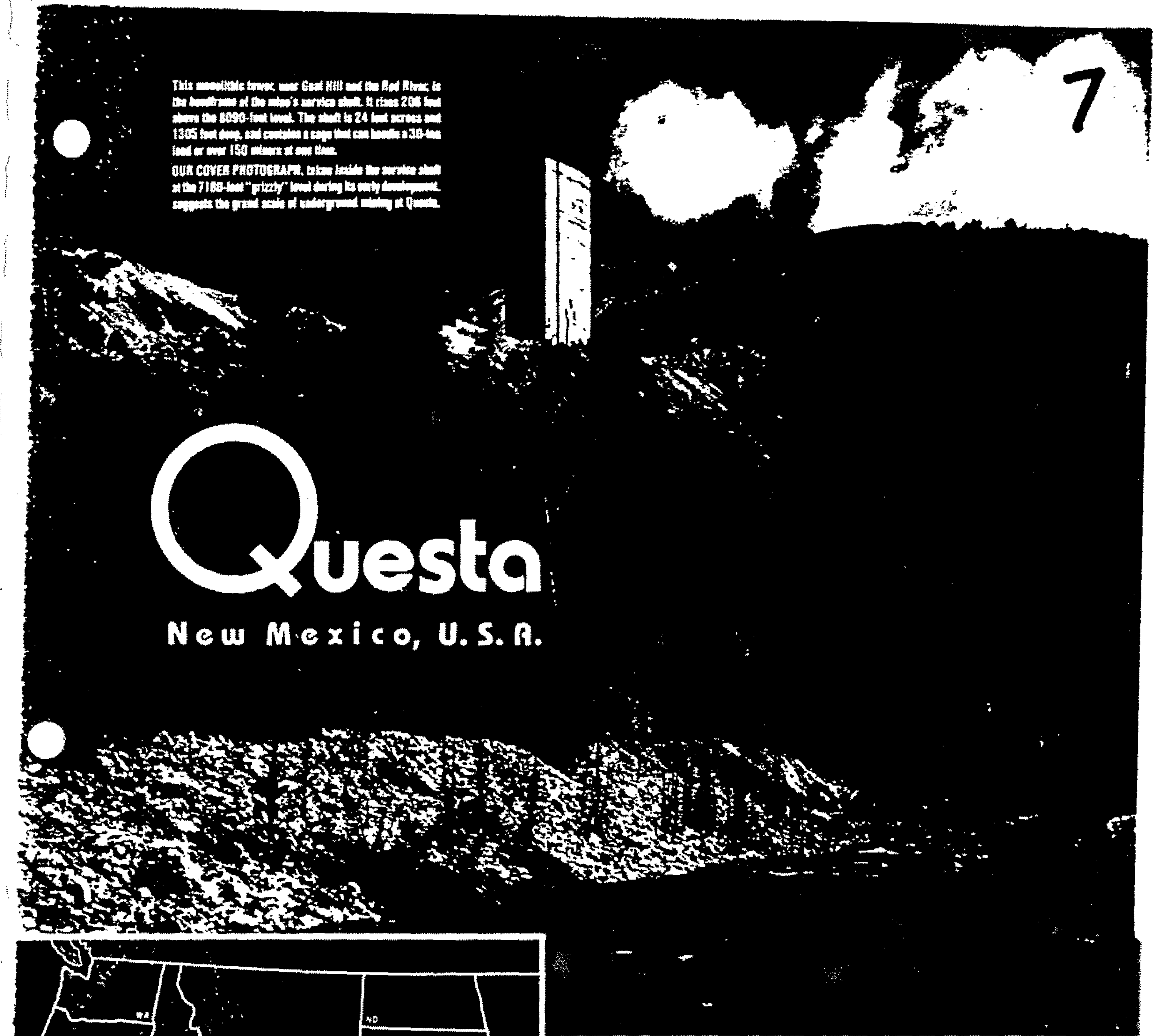
c) Tails Dust Control: Either by soil top cover and revegetation for long-term stabilization; or by coating exposed dry sand with chemical soil stabilizer for short-term.

d) Tails Decant Water Treatment: All clarified water from ponds is conveyed to a water treatment plant before final discharge into the Red River.

e) Tails lines are rubber lined for their entire length in order to reduce pipeline wear.

molybdenum mining at Questa by gravity black caving



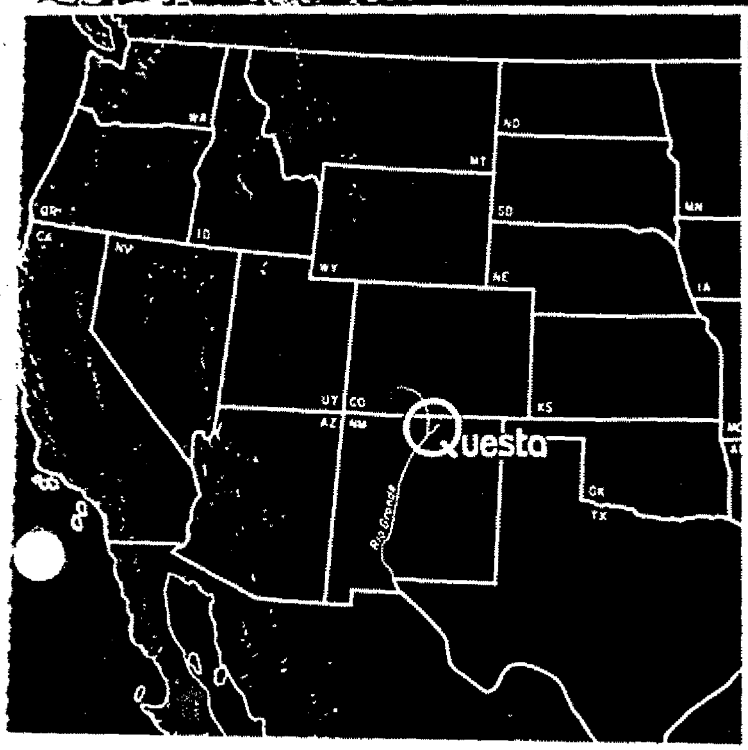


This monolithic tower, near Goat Hill and the Red River, is the headframe of the mine's service shaft. It rises 206 feet above the 8090-foot level. The shaft is 24 feet across and 1305 feet deep, and contains a cage that can handle a 38-ton load or over 150 miners at one time.

OUR COVER PHOTOGRAPH, taken inside the service shaft at the 7180-foot "grizzly" level during its early development, suggests the grand scale of underground mining at Questa.

Questa

New Mexico, U.S.A.



Questa is a town in the mountains of the great North American Southwest — halfway across the state of New Mexico, in Taos County just below the Colorado line. It lies on the Red River between the Rio Grande and the Sangre de Cristo Mountain Range.

Questa is mineralogically special because deep under nearby Goat Hill and Sulfur Gulch lie enormous quantities of molybdenite ore that will supply molybdenum alloying ingredients to the iron and steelmakers of the world.

Questa is economically important because the new mine and mill, which these pages describe, is creating 1,000 jobs and $35 million in payroll. The mill can process 18,000 tons of ore daily to produce 20 million lb/yr of molybdenum in concentrate. The operation comprises one of the great resources of

UNION 76
MOLYCORP

molybdenum was Molycorp's original product

These snapshots recall the days when mules, muscle and water power were the only means of mining and milling molybdenum ore at Questa — before commercial electricity arrived in 1935.

Into the hills around Sulfur Gulch our miners followed greasy, gray molybdenite veins wherever they led. No test drillings or mineral surveys guided them. Originally, mules packed the ore to a converted gold mill five miles up the canyon for molybdenite extraction.

But in 1923 belt-driven mills and flotation cells were built at the mine site — and we began producing our own concentrate. Even so, the fickle flow of the Red River was our only power source, and 50 tons of ore per day was capacity.

It was a romantic period, but the small, underground mine was unable to keep pace with new and growing markets for molybdenum metal to strengthen steel.

Metallurgy had brought "moly" to commodity status, which demanded new mining and milling technology.

1923

1935

PERMIT NO. NM0022306 COVER PAGE

AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Clean Water Act, as amended, (33 U.S.C. 1251 et. seq; the "Act"),

Molycorp, Inc.
P. O. Box 469
Questa, New Mexico 87556

is authorized to discharge from a facility located at Questa, Taos County, New Mexico

to receiving waters named Red River, Waterbody Segment Code No. 2-119 of the Rio Grande Basin, from

Outfall 001: Latitude - N36°41'49"; Longitude - W105°37'53"
Outfall 002: Latitude - N36°41'29"; Longitude - W105°37'53"
Outfall 004: Latitude - N36°41'08"; Longitude - W105°31'51"
Outfall 005: Latitude - N36°41'41"; Longitude - W105°31'48"

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I (11 pages), II (8 pages), and III (7 pages) hereof.

This permit supersedes and replaces NPDES Permit No. NM0022306 issued May 20, 1988.

This permit shall become effective on October 15, 1993.

This permit and the authorization to discharge shall expire at midnight, October 14, 1998

Prepared by:

Signed this 10thday of September 1993

Frederick O. Humke, P.E.
Environmental Engineer
Industrial Permits Section (6W-PI)

Myron O. Knudson, P.E.
Director
Water Management Division (6W)

PART I
REQUIREMENTS FOR NPDES PERMITS

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

OUTFALL 001

During the period beginning the effective date and lasting through the expiration date, the permittee is authorized to discharge from Outfalls 001 - process water from milling operations and tailings disposal.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS			
	MASS (LBS/DAY)		OTHER UNITS (mg/L UNLESS STATED)	
	DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX
Flow (MGD)	N/A	N/A	(*1)	(*1)
Chemical Oxygen Demand	(*1)	(*1)	60	90
Total Suspended Solids	(*1)	(*1)	20	30
Total Arsenic	(*1)	(*1)	0.5	1.0
Total Cadmium	(*1)	(*1)	0.05	0.05
Total Copper	(*1)	(*1)	0.15	0.30
Total Cyanide	(*1)	(*1)	0.025	0.05
Fluoride	(*1)	(*1)	3.0	3.0
Total Iron	(*1)	(*1)	0.6	0.6
Total Lead	(*1)	(*1)	0.3	0.6
Total Manganese	(*1)	(*1)	1.0	1.5
Total Mercury	(*1)	(*1)	0.001	0.002
Total Molybdenum	(*1)	(*1)	1.0	2.0
Total Zinc	(*1)	(*1)	0.2	0.2
Total Aluminum	(*1)	(*1)	(*1)	(*1)
Total Cobalt	(*1)	(*1)	(*1)	(*1)
Total Selenium	(*1)	(*1)	(*1)	(*1)
Total Vanadium	(*1)	(*1)	(*1)	(*1)
Total Beryllium	(*1)	(*1)	(*1)	(*1)
Total Silver	(*1)	(*1)	(*1)	(*1)
Chlordane	(*1)	(*1)	(*1)	(*1)
Total Residual Chlorine	(*1)	(*1)	(*1)	(*1)
Temperature	N/A	N/A	(*1)°F	(*1)°F
Biomonitoring	N/A	N/A	N/A	N/A

EFFLUENT CHARACTERISTIC	MONITORING REQUIREMENTS	
	MEASUREMENT FREQUENCY	SAMPLE TYPE
Flow (MGD)	(*2)	Record
Chemical Oxygen Demand	1/Week	Composite(*3)
Total Suspended Solids	1/Week	Composite(*3)
Total Arsenic(*5)	1/Week	Composite(*3)
Total Cadmium(*5)	1/Week	Composite(*3)
Total Copper(*5)	1/Week	Composite(*3)
Total Cyanide(*5)	1/Week	Composite(*3)
Fluoride	1/Week	Composite(*3)
Total Iron	1/Week	Composite(*3)
Total Lead(*5)	1/Week	Composite(*3)
Total Manganese	1/Week	Composite(*3)
Total Mercury(*5)	1/Week	Composite(*3)
Total Molybdenum	1/Week	Composite(*3)

Total Zinc(*5)	1/Week	Composite(*3)
Total Aluminum	1/Month	Composite(*3)
Total Cobalt	1/Month	Composite(*3)
Total Selenium(*5)	1/Month	Composite(*3)
Total Vanadium	1/Month	Composite(*3)
Total Beryllium(*5)	1/Month	Composite(*3)
Total Silver(*5)	1/Month	Composite(*3)
Chlordane(*5)	1/Month	Composite(*3)
Total Residual Chlorine(*5)	1/Month	Composite(*3)
Temperature	1/Week	Grab
Biomonitoring	1/Quarter	(*4)

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/Week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Outfall 001, which is the discharge spillway from Pope Lake.

FOOTNOTES

(*1) Report.
(*2) Continuous and totalized monitoring.
(*3) See Part II, Paragraph A.
(*4) See Part II, Paragraph E.
(*5) See Part II, Paragraph D.

OUTFALLS 002

During the period beginning the effective date and lasting through the expiration date, the permittee is authorized to discharge from Outfall 002 - seepage from tailings impoundment.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS			
	MASS (LBS/DAY)		OTHER UNITS (mg/L UNLESS STATED)	
	DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX
Flow (MGD)	N/A	N/A	(*1)	(*1)
Chemical Oxygen Demand	(*1)	(*1)	60	90
Total Suspended Solids	(*1)	(*1)	20	30
Total Arsenic	(*1)	(*1)	0.5	1.0
Total Cadmium	(*1)	(*1)	0.05	0.05
Total Copper	(*1)	(*1)	0.15	0.30
Total Cyanide	(*1)	(*1)	0.025	0.05
Fluoride	(*1)	(*1)	3.0	3.0
Total Iron	(*1)	(*1)	0.6	0.6
Total Lead	(*1)	(*1)	0.3	0.6
Total Manganese	(*1)	(*1)	(*1)	(*1)
Total Mercury	(*1)	(*1)	0.001	0.002
Total Molybdenum	(*1)	(*1)	(*1)	(*1)
Total Zinc	(*1)	(*1)	0.2	0.2
Total Aluminum	(*1)	(*1)	(*1)	(*1)
Total Cobalt	(*1)	(*1)	(*1)	(*1)
Total Selenium	(*1)	(*1)	(*1)	(*1)
Total Vanadium	(*1)	(*1)	(*1)	(*1)
Total Beryllium	(*1)	(*1)	(*1)	(*1)
Total Silver	(*1)	(*1)	(*1)	(*1)
Chlordane	(*1)	(*1)	(*1)	(*1)
Total Residual Chlorine	(*1)	(*1)	(*1)	(*1)
Temperature	N/A	N/A	(*1)°F	(*1)°F
Biomonitoring	N/A	N/A	N/A	N/A

EFFLUENT CHARACTERISTIC	MONITORING REQUIREMENTS	
	MEASUREMENT FREQUENCY	SAMPLE TYPE
Flow (MGD)	(*2)	Record
Chemical Oxygen Demand	1/Week	Composite(*3)
Total Suspended Solids	1/Week	Composite(*3)
Total Arsenic(*5)	1/Week	Composite(*3)
Total Cadmium(*5)	1/Week	Composite(*3)
Total Copper(*5)	1/Week	Composite(*3)
Total Cyanide(*5)	1/Week	Composite(*3)
Fluoride	1/Week	Composite(*3)
Total Iron	1/Week	Composite(*3)
Total Lead(*5)	1/Week	Composite(*3)
Total Manganese	1/Week	Composite(*3)
Total Mercury(*5)	1/Week	Composite(*3)
Total Molybdenum	1/Week	Composite(*3)
Total Zinc(*5)	1/Week	Composite(*3)
Total Aluminum	1/Month	Composite(*3)
Total Cobalt	1/Month	Composite(*3)
Total Selenium(*5)	1/Month	Composite(*3)
Total Vanadium	1/Month	Composite(*3)

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Prior to discharge from the settling basins.

FOOTNOTES

(*1) Report
(*2) Daily discharges averaged over the number of days in the monthly period.
(*3) During periods of discharge.
(*4) See Part II, Paragraph E.
(*5) See Part II, Paragraph D.
(*6) See Part II, Paragraph A.
(*7) By calibrated weir.

B. SCHEDULE OF COMPLIANCE

The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

Mass limitations for SUM1 and SUM2

Status Report	12/31/93
Status Report	3/31/94
Status Report	6/30/94
Status Report	9/30/94
Status Report	12/31/94
Status Report	3/31/95
Status Report	6/30/95
Status Report	9/30/95
Status Report	12/31/95
Status Report	3/31/96
Achieve Compliance	7/01/96

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date. Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

C. REPORTING OF MONITORING RESULTS

Monitoring results shall be reported in accordance with the provisions of Part III.D.4 of the permit. Monitoring results obtained during the previous month shall be summarized and reported on a Discharge Monitoring Report form postmarked no later than the 15th day of the month following the completed reporting period.

The first report is due on November 15, 1993 .

The results of the analysis shall be submitted to the EPA Water Division Enforcement Branch (6W-EA) and the NMED within 30 days following a tailings spill.

Consistent with the procedures described in the Preventative Maintenance and Surveillance Plan and the Contingency Action and Reporting Plan (June 1975), a written report containing the following information will be sent to the EPA (6E) and the NMED within ten (10) days following any spill:

(1) Date of Spill.

(2) Time when the spill was observed and time when tailings flow into the river was stopped.

(3) Location (pipe or coupling number).

(4) Estimated amount of tailings that entered the river.

(5) Sketch and dimension of size of hole or failure that caused the spill.

(6) Position of failure in the pipe or coupling.

(7) Copy of the latest computer printout covering the pipe or coupling which failed.

(8) Comments, if required for clarification.

D. MINIMUM QUANTIFICATION LEVELS

If any individual analytical test result is less than the minimum quantification level (MQL), a value of zero (0) may be reported for that individual result for the Discharge Monitoring Report (DMR) calculation and reporting requirements.

PARAMETER	MQL
Total Arsenic	0.01 mg/l
Total Beryllium	0.005 mg/l
Total Cadmium	0.001 mg/l
Total Chromium	0.01 mg/l
Total Copper	0.01 mg/l
Total Lead	0.005 mg/l
Total Mercury	0.0002 mg/l
Total Selenium	0.005 mg/l
Total Zinc	0.02 mg/l
Total Cyanide	0.01 mg/l
Total Nickel	0.04 mg/l
Total Silver	0.002 mg/l
Chlordane	0.0002 mg/l
Total Residual Chlorine	0.011 mg/l

This permit may be reopened if MQLs change during the term of the permit.

E. WHOLE EFFLUENT TOXICITY TESTING REQUIREMENTS (Chronic, Freshwater)

1. SCOPE, FREQUENCY AND METHODOLOGY

a. The provisions of this section are individually applicable to Outfall(s) 001, 002, 004 and 005 for whole effluent toxicity.

b. The permittee shall test the effluent for toxicity in accordance with the provisions in this section. This testing will determine if an appropriately dilute effluent sample adversely affects the survival, reproduction or growth of the test organism.

c. The permittee shall complete the first toxicity test for each species within sixty (60) days of the effective date of the permit.

d. The permittee shall implement all toxicity tests utilizing the test organisms, procedures and quality assurance requirements specified in this section of the permit and in accordance with the EPA manual, "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms", EPA/600/4-89/001, or the most recent update thereof. The permittee shall repeat a test, including the control and all effluent dilutions, if the procedures and quality assurance requirements defined in the test methods or in this permit are not satisfied. A repeat test shall be conducted within the required reporting period of any test determined to be invalid.

e. The permittee shall utilize the _Ceriodaphnia_ _dubia_ chronic static renewal survival and reproduction test (Method 1002.0 or the most recent publication). This test should be terminated when 60% of the surviving females in the control produce three broods. The permittee shall conduct the _Ceriodaphnia_ _dubia_ toxicity test at a frequency of once per quarter.

f. The permittee shall utilize the fathead minnow (_Pimephales_ _promelas_) chronic static renewal 7-day larval survival and growth test (Method 1000.0 or the most recent publication). A minimum of five (5) replicates with eight (8) organisms per replicate must be used for this test. The permittee shall conduct the fathead minnow toxicity test at a frequency of once per quarter.

g. The permittee shall use five effluent dilution concentrations in addition to a control (0% effluent) in each toxicity test. These additional effluent concentrations shall be 9%, 12%, 17%, 22%, and 29%. The low-flow effluent concentration (critical dilution) is defined as the 22% effluent.

h. The NOEC (No Observed Effect Concentration) is defined as the greatest effluent dilution which does not elicit lethality that is statistically different from the control (0% effluent) at the 95% confidence level.

i. This permit may be reopened to require whole effluent toxicity limits, chemical specific effluent limits, additional testing, and/or other appropriate actions to address toxicity.

2. PERSISTENT LETHALITY

If the testing frequency in item 1 is monthly for a species, the permittee shall initiate the Toxicity Reduction Evaluation requirements as specified under Part II, Section F of this permit when any two of three consecutive monthly toxicity tests exhibit significant lethal effects at the 22% effluent concentration.

3. REQUIRED TOXICITY TESTING CONDITIONS

a. Test Acceptance

The permittee shall repeat any toxicity test, including the control and all effluent dilutions, which fails to meet any of the following criteria:

i. The toxicity test control (0% effluent) must have survival equal to or greater than 80%.

ii. The mean number of Ceriodaphnia dubia neonates produced per surviving female in the control (0% effluent) must be 15 or more.

iii. The minimum mean dry weight of surviving fathead minnow larvae at the end of the 7 days in the control (0% effluent) must be 0.25 mg per larva or greater.

iv. The percent coefficient of variation between replicates shall be 40% or less in the control (0% effluent) for: the young of surviving females in the Ceriodaphnia dubia reproduction test; fathead minnow growth test; and fathead minnow survival test.

v. The percent coefficient of variation between replicates shall be 40% or less in the 22% effluent concentration, unless significant lethal or nonlethal effects are exhibited for the young of surviving females in the Ceriodaphnia dubia reproduction test; fathead minnow growth test; and fathead minnow survival test.

b. Statistical Interpretation

i. For the Ceriodaphnia dubia survival test, the statistical analyses used to determine if there is a significant difference between the control and the low flow (critical dilution) shall be Fisher's Exact Test as described in the "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms", EPA/600/4-89/001, or the most recent update thereof.

ii. For the Ceriodaphnia dubia reproduction test and the fathead minnow larval survival and growth test, the statistical analyses used to determine if there is a significant difference between the control and the low flow (critical dilution) effluent concentration shall be in accordance with the methods for determining the No Observed Effect Concentration (NOEC) as described in the "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms", EPA/600/4-89/001, or the most recent update thereof.

c. Dilution Water

i. Dilution water used in the toxicity tests will be receiving water from the Red River collected as close to the point of discharge as possible but unaffected by the discharge. The permittee shall substitute synthetic dilution water of similar pH, hardness and alkalinity to the closest downstream perennial water for;

A. toxicity tests conducted on effluent discharges to receiving water classified as intermittent streams; and

B. toxicity tests conducted on effluent discharges where no receiving water is available due to zero flow conditions.

ii. If the receiving water is unsatisfactory as a result of preexisting instream toxicity (fails to fulfill the test acceptance criteria of item 3.a.), the permittee may substitute synthetic dilution water for the receiving water in all subsequent tests provided the unacceptable receiving water test met the following stipulations:

A. a synthetic dilution water control which fulfills the test acceptance requirements of item 3.a. was run in addition to the receiving water control;

B. the test indicating receiving water toxicity has been carried out to completion (i.e., 7 days);

C. the permittee includes all test results indicating receiving water toxicity with the full report and information required by item 4. below; and

D. the synthetic dilution water shall have a pH, hardness and alkalinity similar to that of the receiving water or closest downstream perennial water not adversely affected by the discharge, provided the magnitude of these parameters will not cause toxicity in the synthetic dilution water.

d. Samples and Composites

i. The permittee shall collect a minimum of three flow-weighted 24-hour composite samples each from Outfall(s) **001, 002, 004 and 005**. A 24-hour composite sample consists of a minimum of four effluent portions collected at equal time intervals representative of a 24-hour operating day and combined proportional to flow or a sample continuously collected proportional to flow over a 24-hour operating day.

ii. The permittee shall collect second and third 24-hour composite samples for use during 24-hour renewals of each dilution concentration for each test. The permittee must collect the 24-hour composite samples such that the effluent samples are representative of any periodic episode of chlorination, biocide usage or other potentially toxic substance discharged on an intermittent basis.

iii. The permittee must collect the 24-hour composite samples so that the maximum holding time for any effluent sample shall not exceed 72 hours. The permittee must have initiated the toxicity test within 36 hours after the collection of the last portion of the first 24-hour composite sample. Samples shall be chilled to 4 degrees Centigrade during collection, shipping and/or storage.

iv. If the flow from the outfall(s) being tested ceases during the collection of effluent samples, the requirements for the minimum number of effluent samples, the minimum number of effluent portions and the sample holding time are waived during that sampling period. However, the permittee must collect an effluent composite sample volume during the period of discharge that is sufficient to complete the required toxicity tests with daily renewal of effluent. When possible, the effluent samples used for the toxicity tests shall be collected on separate days if the discharge occurs over multiple days. The effluent composite sample collection duration and the static renewal protocol associated with the abbreviated sample collection must be documented in the full report required in item 4. of this section.

4. REPORTING

a. The permittee shall prepare a full report of the results of all tests conducted pursuant to this section in accordance with the Report Preparation Section of "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms", EPA/600/4-89/001, or the most current publication, for every valid or invalid toxicity test initiated whether carried to completion or not. The permittee shall retain each full report pursuant to the provisions of Part III.C. of this permit. The permittee shall submit full reports only upon the specific request of the Agency.

b. The permittee shall submit the results of each valid toxicity test on the subsequent monthly DMR for that reporting period in accordance with Part III. D. of this permit, as follows:

Pimephales promelas (Fathead Minnow)

i. If the Fathead minnow No Observed Effect Concentration (NOEC) for survival is less than the 22% effluent dilution, enter a "1"; otherwise, enter a "0". Parameter No. TLP6C.

ii. Report the Fathead minnow NOEC value for survival, Parameter No. TOP6C.

iii. Report the Fathead minnow NOEC value for growth, Parameter No. TPP6C.

iv. Report the % coefficient of variation (Largest of low flow and control dilutions), Parameter No. TQP6C.

Ceriodaphnia dubia

i. If the *Ceriodaphnia dubia* NOEC for survival is less than the 22% effluent dilution, enter a "1"; otherwise, enter a "0". Parameter No. TLP3B.

ii. Report the *Ceriodaphnia dubia* NOEC value for survival, Parameter No. TOP3B.

iii. Report the *Ceriodaphnia dubia* NOEC value for reproduction, Parameter No. TPP3B.

iv. Report the % coefficient of variation (Largest of low flow and control dilutions), Parameter No. TQP3B.

F. TOXICITY REDUCTION EVALUATION

1. Within ninety (90) days OF CONFIRMING LETHALITY IN THE RETESTS, the permittee shall submit a **TRE Action Plan and Schedule** for conducting a Toxicity Reduction Evaluation (TRE). The **TRE Action Plan** shall specify the approach and methodology to be used in performing the TRE. A

Toxicity Reduction Evaluation is an investigation intended to determine those actions necessary to achieve compliance with water quality-based effluent limits by reducing an effluent's toxicity to an acceptable level. A TRE is defined as a step-wise process which combines toxicity testing and analyses of the physical and chemical characteristics of a toxic effluent to identify the constituents causing effluent toxicity and/or treatment methods which will reduce the effluent toxicity. The TRE Action Plan shall lead to the successful elimination of effluent toxicity at the low flow dilution and include the following:

a. Specific Activities. The plan shall detail the specific approach the permittee intends to utilize in conducting the TRE. The approach may include toxicity characterizations, identifications and confirmation activities, source evaluation, treatability studies, or alternative approaches. When the permittee conducts Toxicity Characterization Procedures the permittee shall perform multiple characterizations and follow the procedures specified in the documents "Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures" (EPA-600/6-91/003) and "Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I" (EPA-600/6-91/005), or alternate procedures. When the permittee conducts Toxicity Identification Evaluations and Confirmations, the permittee shall perform multiple identifications and follow the methods specified in the documents "Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures" (EPA/600/3-88/035) and "Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures" (EPA/600/3-88/036), as appropriate;
The documents referenced above may be obtained through the <u>National Technical Information Service</u> (NTIS) by phone at (703) 487-4650, or by writing:

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, Va. 22161

b. Sampling Plan (e.g., locations, methods, holding times, chain of custody, preservation, etc.). The effluent sample volume collected for all tests shall be adequate to perform the toxicity test, toxicity characterization, identification and confirmation procedures, and conduct chemical specific analyses when a probable toxicant has been identified;

Where the permittee has identified or suspects specific pollutant(s) and/or source(s) of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical specific analyses for the identified and/or suspected pollutant(s) and/or source(s) of effluent toxicity. Where lethality was demonstrated within 48 hours of test initiation, each 24 hour composite sample shall be analyzed independently. Otherwise the permittee may substitute a composite sample, comprised of equal portions of the individual 24 hour composite samples, for the chemical specific analysis;

c. Quality Assurance Plan (e.g., QA/QC implementation, corrective actions, etc.); and

d. Project Organization (e.g., project staff, project manager, consulting services, etc.).

The permittee shall initiate the TRE Action Plan within thirty (30) days of plan and schedule submittal. The permittee shall assume all risks for failure to achieve the required toxicity reduction.

The permittee shall submit a quarterly <u>TRE Activities Report</u>, with the Discharge Monitoring Report in the months of January, April, July and October, containing information on toxicity reduction evaluation activities including:

a. any data and/or substantiating documentation which identifies the pollutant(s) and/or source(s) of effluent toxicity;

b. any studies/evaluations and results on the treatability of the facility's effluent toxicity; and

c. any data which identifies effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to meet no lethality at the critical low flow effluent concentration.

A copy of the <u>TRE Activities Report</u> shall be also be submitted to the New Mexico Environment Department.

The permittee shall submit a <u>Final Report on Toxicity Reduction Evaluation Activities</u> no later than twenty-eight (28) months from confirming lethality in the retests, which provides information pertaining to the specific control mechanism selected that will, when implemented, result in reduction of effluent toxicity to no lethality at the critical low flow effluent concentration. The report will also provide a specific corrective action schedule for implementing the selected control mechanism.

A copy of the <u>Final Report on Toxicity Reduction Evaluation Activities</u> shall also be submitted to the New Mexico Environment Department.

...pitol marred with graffiti

...overed the graffiti with a white ...er Wednesday morning and will ap... ...ew stucco.

...e graffiti included obscenities and ...es denouncing Gov. Gary Johnson; ...awing of a mushroom and the ...e "Legalize hemp;" and the phrase ... La Fiesta."

...e Capitol normally has security of... ...s on duty through mid-evening and ... is a maintenance worker in the ...ing through the night. Stuart Bluestone of the Legislative Council Service, which runs the building, said that in response to the graffiti, the Capitol will be protected with around-the-clock security at least through this weekend's Fiesta de Santa Fe celebration.

"And we're going to continue to assess what to do from here on out," Bluestone said.

One of the phrases sprayed on the building was, "Death to the gov. Ha ha." A state police spokesman said investigators take all possible threats against the governor seriously and that the graffiti incident will be investigated, but that there would be no change in operations of the governor's security detail.

The anti-Johnson slogans coupled with the reference to Fiesta produced speculation around the Roundhouse that the vandalism may have been a reaction to Johnson's decision to break tradition and not allow state workers the afternoon off on Friday, the first day of Fiesta weekend, or complaints that he is not attending enough Fiesta events.

A spokeswoman for Johnson said the governor was appalled by the graffiti but "doesn't believe in any way that a state employee would be responsible." Johnson did not see the graffiti before it was covered, his staff said. The governor's office has received a few calls on his cancellation of state workers' time off for Fiesta, with most of them against Johnson's move, the staff said.

...URCE OF GLOOM

U.S. agency eased policy to OK bridge

By KEITH EASTHOUSE
The New Mexican

this month. A hearing is sched... uled before Judge M...rtha Vasquez today in Santa Fe.

The coalition believes the 8...

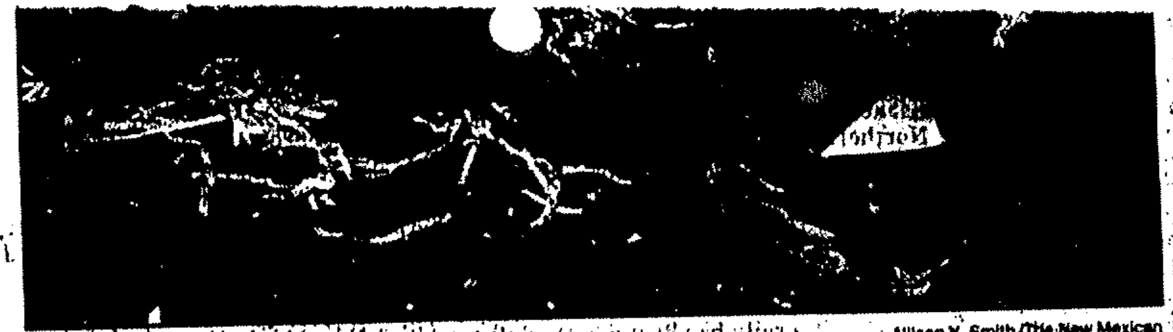
all the [illegible], gloom, doom and misery went into one man, Dr. Vincent Zozobra.

His hair turned orange, he grew as tall as a 10-story building, and when he spoke, his voice was deafening.

Wherever he went he spread gloom and doom, there was panic in the streets.

Finally they forced him out of town. So Dr. Zozobra went away to Santa Fe, New Mexico. What he didn't know was that his "friends" had warned the New Mexicans that he was coming. They hid with their torches and all manner of weaponry. When he entered the town they ambushed him from every side. He was tied, staked, and burned to the ground. All gloom and doom left them for that year!

So now, every year we make a replica of Zozobra and burn it to celebrate the end of Dr. Vincent Zozobra.



Allison V. Smith/The New Mexican

Jim Iplotis spray paints the 1995 Zozobra's lips Wednesday night at the 4-H warehouse. Zozobra will be burned Friday at dusk in a celebration at Ft. Marcy Park.

By Amy Applewhite

Long ago, at the beginning of this century, a child was born. He was cheerful, quick and constantly laughing. His face was framed with auburn curls and his deep blue eyes were always twinkling. It was said there was never such a beautiful baby. His parents loved him dearly and provided for him well. He grew up to be a delightful child. He worked hard in school and was loved by both his teachers and classmates.

One day the boy was seen sitting in a tree talking to a woman below. It as said that she suffered from leprosy underneath the heavy veil around her head. No one knows quite what she told the boy, but some say she cast an evil spell on him. Others say she told him a dreadful story. Some people deny they even spoke and uphold the theory that she

Please see **ZOZOBRA**, Page B-3

Julie Graber/The New Mexican

Ray Valdez, left, president of Zozobra Inc., works earlier this week with Karla Niemi to stuff the body of this year's Old Man Gloom.

charg
motel

[illegible]

A San Juan Pueblo r
Tuesday night from a si
shot wound to the ches
Española man was bein
Santa Fe County Deten
ter, charged with his mu

Ted Martinez, 28,
Tuesday at the Wester
Motel on U.S. 84-285 in
Police say Gilbert Ohle
Martinez when he an
others attacked motel
Kenneth Sharp.

The criminal complai
the case states that C
police the incident bega
bunch of guys jumpe
guy on the north side
tel." It goes on to say
male, who said the ma
boyfriend, ran to the d
motel office and yelle
to call the police.

Sharp went outside a
group to leave, the re
and several of the men
him.

At that point, Ohlen,
motel employee wh
room there with his
and son, came out of
with Sharp's .357-M
volver. He told the as
leave Sharp alone, and
didn't, he fired a sh
Martinez in the left up

Sharp concurred w
account, and added t
struck with a beer
then heard the shot
Martinez.

According to the
Ohlen "came out of

Questa molybdenum mine may reopen

By CATHERINE WALSH
For The New Mexican

TAOS — By mid-1996, Molycorp Inc. in Questa could be employing 225 to 250 people and meeting an annual payroll of $10 million, according to David Shoemaker, the company's line manager.

Sixteen Molycorp employees and 40 contract workers are currently working at the molybdenum mine "to gain access to underground mining areas and do repairs," Shoemaker said Wednesday. Molybdenum is an alloy used for hardening steel.

Molycorp's plans for reopening the mine and reclaiming the land around it will be discussed during a public hearing at the Questa Village Council Chambers, at 5:30 p.m. today. The purpose of the hearing is to allow public comment on Molycorp's request for an operating permit. But an environmental group dedicated to protecting New Mexico's rivers said it will challenge Molycorp's plans. Amigos Bravos blames Molycorp for turning the Red River into "a dead river."

"The Red River was once a blue ribbon trout fishery," said Brian Shields, co-director of Amigos Bravos. "The fish disappeared during the same 10 years that the mine ex-

Please see **MINE**, Page B-3

[illegible] was completely empty of his belongings. He had run away.

Two years later, he appeared in the small town of Santa Fe. When questioned about his background he answered only that his name was Zozobra.

He walked the streets of Santa Fe at night, wailing with sorrow. When the sun rose, he would retreat to his small house to hide from the people of the town. Some curious children would peek through the shutters of the house but there wasn't much to see. The rooms were empty and dusty. There were streaks on the

[illegible] ming pool and swam for hours. He went and showered at the swimming pool, put shampoo in his hair and put what he thought was conditioner. When he looked at the bottle it said chlorine.

His mother picked him up and said, "what happened to your hair?" He said, "nothing, why?" She said "look in the mirror."

When he got home he looked in the mirror and his hair had turned green. He did not want to go to school because he knew that the kids would make fun of him, but his mother made him go to school. So he took a hat to wear

years out almost every year his hair would turn a diff[illegible]olor;

He finally came o[illegible] rity and started cha[illegible] by [illegible]ning and jumping all ove[illegible] Santa [illegible] Almost everything [illegible] on fire. With every step he took, the earth would shake, and suddenly he started on fire. He moaned and groaned and screamed until he fell to pieces. There were only about 100 people to tell the tale.

MINE

Continued from Page B-1

panded — between the late '60s and the late '70s."

Without pressure put on Molycorp, the mine "could weasel out of the reclamation required by New Mexico's mining law," said Sawnie Morris, co-director of Amigos Bravos.

The mine which once employed 800 people at its peak could now use its resources to reclaim 3,200 acres of disturbed land, Morris said. "A lot of jobs could be provided if Molycorp would employ people to clean up its mess," she said.

But Shoemaker said problems with the Red River have existed for "thousands and millions of years.

"They're not just attributable to the mine," he said.

Molycorp will work with the local community and the environmental community on these issues, Shoemaker said.

The closing of Molycorp mine in December 1991 was devastating to the Taos County economy. The skeleton crew that worked at the closed mine could do little to prevent the flooding that occurred in the mine over the last few years. In December Molycorp announced that it had installed additional pumping equipment underground.

"We wanted to hasten the removal of water in case we decided to re-open the mine," said Art Bentley, a spokesperson for Unocal, the Los Angeles-based parent company of Molycorp.

In early August, Unocal confirmed that it was continuing start-up activities at Molycorp and that it hoped to reopen the mine sometime in 1996.

THURSDAY EVENING TE[illegible]

	5:00	5:30	6[illegible]
2	Fam. Mat. 9674	Full House 248	Rose[illegible]
4	News 1842	NBC News 194	New[illegible]
5	Bill Nye 1620	Business 1194	Mac[illegible]
7	News 9216	News 6262	New[illegible]
11	700 Club 1849		A[illegible]
19	News 3262	News 4620	Jeop[illegible]
41	Noticias 17216	Noticiero Univ.	C[illegible]
62	Para Sangre 50945		P[illegible]

	5:00	5:30	6[illegible]
[illegible]	Movie (Cont'd)	Sing a Song	Mov[illegible]
[illegible]	Rockford Files 779228		[illegible]
[illegible]	Penny Heaven (Cont'd) 359200		Ang[illegible]
[illegible]	Moneyline	Crossfire	New[illegible]
[illegible]	House of Rep. (Cont'd) 289736		Prim[illegible]
[illegible]	Beyond 2000	Next Step	Myst[illegible]
[illegible]	Faerie Tale Theatre 289200		Aven[illegible]
[illegible]	Movie "Obsession" (1976) Cliff Robertson		
[illegible]	O.J. Simpson Trial (Live) (Cont'd) 843623		
[illegible]	Sportsctr	Kickoff 239303	Coll[illegible]
[illegible]	Talking 491216	Masters-Moza	My [illegible]
[illegible]	Wonder Woman 6365378		Batm[illegible]
[illegible]	Amor en Silencio 3945129		Dos [illegible]
[illegible]	(4:30) Movie "Silverado" (1985) (Cont'd)		
[illegible]	Spenser: For Hire 310367		Cagn[illegible]
[illegible]	Movie (Cont'd)	Movie "Harmony Cats"	
[illegible]	Nick Afternoon (Cont'd) 274636		Loor[illegible]
[illegible]	Football Wkly.	Press Box	This[illegible]
[illegible]	(4:30) Movie (Cont'd) 34770571		Mov[illegible]
[illegible]	Follies 4702303	Follies 9383571	Goo[illegible]
[illegible]	Dance (Cont'd)	News 158007	Way[illegible]
[illegible]	In the Heat of the Night 439484		Mo[illegible]
[illegible]	On Target 7282	Flight Path 842	Pri[illegible]
[illegible]	Dad 775200	U.S. Open Tennis: M[illegible]	
[illegible]	Love Connect.	Jeffersons	Ma[illegible]
[illegible]	Streets of San Francisco 604736		[illegible]
[illegible]	Major League Baseball: Atlanta Brave[illegible]		