MINE SITE VISIT:

CYPRUS THOMPSON CREEK

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U.S. Environmental Protection Agency
Office of Solid Waste
Special Waste Branch
401 M Street, SW
Washington, DC 20460

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This section of the Technical Resource Document consists of a report on a site visit conducted by EPA to Cyprus Minerals Corporation's Thompson Creek Molybdenum Mine near Challis, Idaho during 1991. A draft of this report was provided to representatives of Cyprus Minerals Corporation, the U.S. Forest Service, and the U.S. Bureau of Land Management. Cyprus Minerals Corporation provided comments, which are presented in Appendix B. The Forest Service and the Bureau of Land Management did not provide comments. EPA's responses to Cyprus' comments are summarized in Appendix C.

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INTRODUCTION

Background

EPA has initiated several information gathering activities to characterize mining wastes and waste management practices. As part of these ongoing efforts, EPA is gathering data by conducting visits to mine sites to study waste generation and management practices. As one of several site visits, EPA visited Cyprus Minerals Corporation's Thompson Creek Mine near Challis, Idaho on August 28 and 29, 1991. This report discusses the extraction and beneficiation activities at the site.

The sites to be visited were selected by EPA to represent both an array of mining industry sectors and different regional geographies. All site visits are conducted pursuant to the Resource Conservation and Recovery Act (RCRA), Sections 3001 and 3007 information collection authorities. For those sites located on Federal land, EPA has invited representatives of the appropriate land management agency (U.S. Forest Service and Bureau of Land Management). State agency representatives and EPA regional personnel also have been invited to participate in each site visit.

For each site, EPA has collected waste generation and management information using a three-step approach: (1) contacting the facility by telephone to obtain initial information, (2) contacting state regulatory agencies by telephone to obtain additional information, and (3) conducting the actual site visit. Information collected prior to each visit is then reviewed and confirmed at the site.

The site visit reports describe mine operations, mine waste generation and management practices, and the regulatory status on a site-specific basis; the information is based on information gathered from State and Federal agency files as well as observations made during the site visit. In preparing this report, EPA collected information from a variety of sources, including the Cyprus Thompson Creek facility, the Idaho Department of Lands (IDL), the U.S. Forest Service (USFS), and other published information. The following individuals participated in the Cyprus Thompson Creek site visit on August 28 and 29, 1991.

Cyprus Minerals Corporation
Les Darling, Director, Environmental Affairs (303) 643-5325

Cyprus Copper Company
Jamie Sturgess, Manager, Environmental Affairs (303) 643-5782

Cyprus Thompson Creek
Bert Doughty, Supervisor, Environmental Affairs (208) 838-2200
Don Hilleary, Chief Engineer
Jim Kopp, Operations Supervisor

Marvin Harmer, Chief Metallurgist
Turk Terrill, Mine Superintendent

U.S. EPA
Van Housman, Chemical Engineer (703) 308-8419

Science Applications International Corporation
Ingrid Rosencrantz, Environmental Scientist (703) 734-2508
Ron Rimelman, Chemical Engineer (703) 821-4861

U.S. Forest Service
Greg Johnson (208) 838-2201
Pete Peters (208) 838-2201

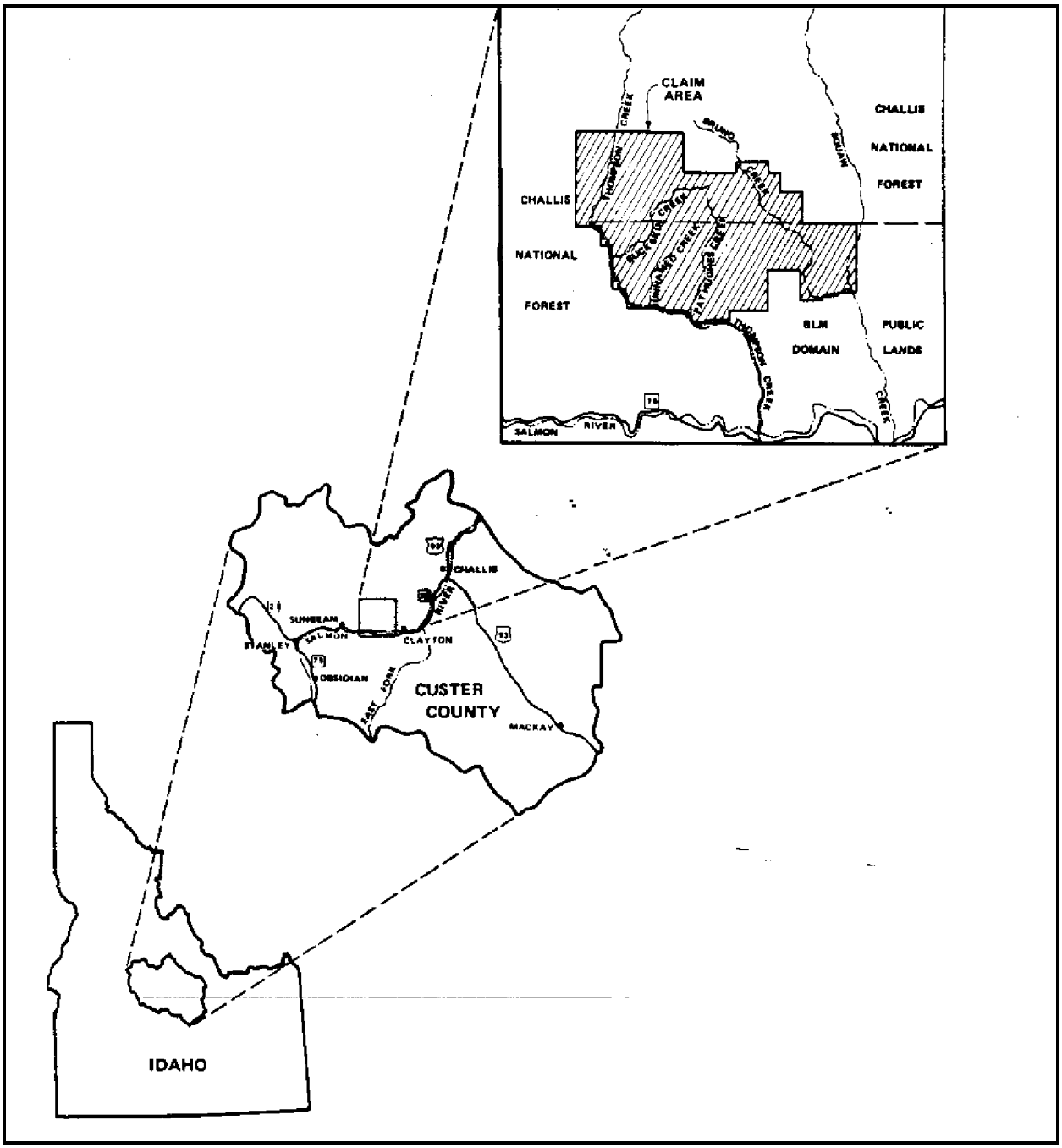
U.S. Bureau of Land Management
Dan Bartholme (208) 756-5400

General Facility Description

Cyprus Minerals Corporation (Cyprus) mines molybdenite (molybdenum disulfide, MoS_2) from an open pit mine near Challis in central Idaho (see Figure 1). The mine site is located in an area of high mountain ranges, and numerous lakes, streams, and valleys near the Salmon River and its tributaries, which flow through the lower elevations. Elevations range from 5,500 feet at the Salmon River to 9,487 feet near the mine site. The active facility is located on nearly 1,935 acres of mixed ownership including: private lands (521 acres), Bureau of Land Management (BLM) administered Federal land (781 acres), and USFS administered Federal land (633 acres of the Challis National Forest). Cyprus also controls a mineral claim block of about 16,000 acres around the Thompson Creek Mine.

The mine is located in Custer County, approximately 35 miles southwest of Challis, the county seat of Custer County. The nearest town is Clayton, which has a population of 42 and is approximately 12 miles from the site. Access to the mine site is from State Highway 75, along an unpaved county road that generally parallels Squaw Creek. The road crosses Squaw Creek, first west to east about 1.5 miles from its intersection with State Highway 75 and from east to west about 4 miles from the intersection.

Figure 1: Location of Thompson Creek Molybdenum Project
(Source: USFS 1980)



Several historic mining operations are located in the vicinity of the Cyprus Thompson Creek site. An old tungsten mine is buried under the Buckskin waste rock dump. The remains of the mill associated with this mine are located along Thompson Creek downstream of the site (see later discussion of ongoing joint Cyprus/USFS remediation activities on tailings generated by the mill). A small gold mine (circa 1929) was located north of the tailings pond (not on Cyprus property). Finally, an old silver/zinc mine (1930s-1940s) was operated in the area (also not on the Cyprus property).

Cyprus staked its first mineral claims at Thompson Creek in 1967. During 1974 and 1975, a preliminary feasibility study for a large open pit and concentrator was prepared. Based on the results of this study, Cyprus Minerals initiated additional technical studies to better define the potential project. On May 25, 1979, Cyprus Minerals submitted its Notice of Intent to Operate and Initial Plan of Operations to the Challis National Forest. In 1981, mining operations began and the first concentrates were produced in 1983.

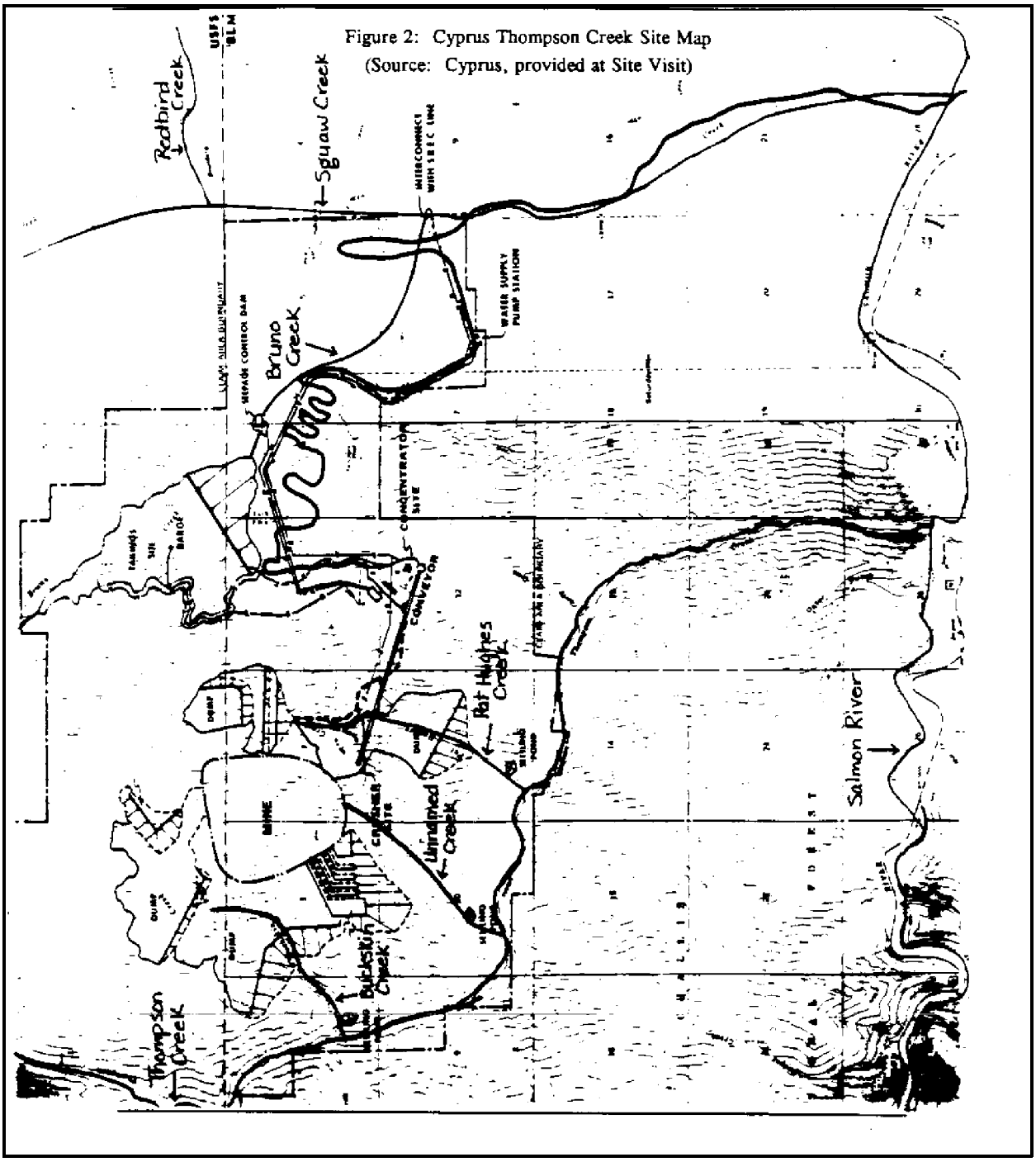
The Cyprus Thompson Creek Mine site currently consists of (1) an open pit mine and two associated waste rock dumps; (2) a primary in-pit crusher; (3) a mill that includes grinding and concentration by flotation, and (4) a tailings impoundment. These units, as well as various support and maintenance facilities, are shown in Figure 2. During the site visit, the facility was only conducting stripping operations (i.e., removing overburden and waste rock to access the orebody). As a result, the mill was temporarily inactive.

Environmental Setting

Climate. The Thompson Creek Project is located in a fairly rugged mountainous region of central Idaho. This region is west of the Continental Divide and approximately 525 miles east of the Pacific Ocean. The prevailing air flow over the local area near the project is from the west; however, local topographic features considerably influence surface wind velocity and direction. The canyons and ridges probably cause channeling and lee eddies. The maximum sustained wind velocity recorded by an on-site weather station (in operation since 1972) has been 15 mph. Wind gusts have not been measured; however, strong gusts estimated to be in the range of 40-60 mph have occurred. On-site wind direction tends to be north-south approximately 50 percent of the time and variable the remainder of the time. The average annual precipitation at the project site is estimated to be 10 to 20 inches or greater, depending on the altitude. The maximum and minimum recorded temperatures have been 93^{o}F and -25^{o}F, respectively (USFS 1980).

Surface Water. The mine site is located in the drainage systems of Bruno Creek, Thompson Creek, Squaw Creek, Buckskin Creek, and Pat Hughes Creek, all of which are tributaries of the Salmon River. The waste rock dumps overlie Buckskin Creek and Pat Hughes Creek, which flow into Thompson Creek. Cyprus' tailings impoundment overlies Bruno Creek, which can be diverted

Figure 2: Cyprus Thompson Creek Site Map
(Source: Cyprus, provided at Site Visit)



around the impoundment, as necessary. Bruno Creek feeds Squaw Creek. Both Thompson Creek and Squaw Creek flow directly into the Salmon River, approximately five miles from the site. All of these waterbodies are classified by the State as Class II waters and must be protected for the following general uses: (1) agricultural water supply, (2) cold water biota, (3) salmonid spawning, and (4) secondary contact recreation (State of Idaho 1989). In addition, the Salmon River downstream of the facility is further designated as a domestic water supply and for primary contact recreation. The Salmon River south of the mine site is designated as a Special Resource Water, because of salmonid spawning grounds. According to Cyprus personnel, surface water in the vicinity of the facility is only used as a drinking water supply for animals on nearby ranches. In addition, Cyprus obtains makeup water from the Salmon River for use in the mill (when the mill is operating).

Geology. The bedrock geology of the region is a sequence of Paleozoic sedimentary rocks intruded by Cretaceous igneous rocks known as the Idaho batholith. A large portion of the area is overlain by a series of Tertiary volcanic rocks called the Challis volcanics (USFS 1980).

The Paleozoic sedimentary rocks range in age from the Cambrian to Pennsylvanian geologic periods, and vary in sequences of argillite, quartzite, limestone, dolomite, and shale, some several thousand feet thick. The primary sedimentary rocks from the oldest to youngest are the Saturday Mountain, Copper Basin, and Wood River formations. These sedimentary rocks have been intruded by a biotite granodiorite-quartz monzonite stock known as the Idaho batholith. In some areas of intrusion, contact metamorphism has occurred, creating silicification and hornfelsing of the argillite. Intrusive rocks can be exposed on the ground surface at the mine site but are generally overlain with volcanics at the site (USFS 1980).

Complex folding and faulting exists in the Paleozoic sedimentary units of the claim area. A thrust fault is thought to exist near Bruno Creek. The thrust plane is at a low angle and the effect has been to thrust younger Mississippian rocks on top of the older Ordovician sequence at this location. A variety of other faults including bedding plane slippage have been noted in the Bruno Creek area. The age of folding and faulting in the project area remains uncertain. The deformation clearly took place before the extrusion of the Challis volcanics (38-49 million years) and may have been completed by stresses related to the intrusion of the nearby plutonic rocks during mid-Cretaceous time (85-100 million years). There is no known evidence to indicate that faults in this area have been recently active (no specific timeframes were provided in the reference) (USFS 1980).

The site is located in the USGS Class II Intermountain Seismic Zone. In the vicinity of the mine site, there were a total of 56 earthquakes from 1935 to 1980 with Richter magnitudes of 4.0 or greater. The majority of earthquake epicenters in the study area are located about 12 miles west of the project area. This region of seismic activity is referred to as the Sunbeam District. There are, however, no major faults within 12 miles of the project area. Therefore, it is unlikely that a fault structure exists in the project vicinity that could produce an earthquake event exceeding a 7.6 magnitude (USFS 1980).

Of particular note, in 1983, a major earthquake (7.3 on the Richter scale) was centered approximately 40 miles from the mine site. This earthquake caused property damage and two fatalities in Challis. Cyprus personnel who were present at the site at that time noted severe tremors in the vicinity of the tailings impoundment.

Hydrogeology. The occurrence and distribution of ground water within the project area is determined by the complex hydrogeology of the region. The area is mountainous with steep slopes along drainages. The primary sources of ground water include: (1) infiltration of runoff into surface soils, (2) stream channel underflow within alluvial deposits, and (3) water in fracture and fault zones of bedrock formations.

Relatively small quantities of ground water are contained within the surface soils and decomposed bedrock comprising the soil mantle. Alluvial deposits occur in stream channel bottoms; ground water in the alluvium is in direct connection with surface water within the stream courses. The major stream channels in the project area are Squaw and Thompson Creeks, which are tributaries of the Salmon River. The direction of surface water flow is generally to the south. The mine site is characterized by narrow, steep-sided and v-shaped valleys. Based on existing information, alluvial deposits are probably less than 100 feet in thickness and 300 feet in width along the stream courses (USFS 1980). According to Cyprus, an alluvial aquifer is found at depths ranging from 0 to 20 feet below ground in the vicinity of the creekbeds.

Argillaceous sediments of the Copper Basin and Saturday Mountain formations are the primary sedimentary bedrock aquifers in the mine site area. The lithology of these units is largely argillite, bedded limestones, and dolomite. The well-consolidated, and in some locations metamorphosed, nature of these rocks creates low porosity, preventing the production of significant amounts of ground water from pore spaces. However, these formations are extremely folded and at some locations are nearly vertical (USFS 1980).

In general, there is a continuous supply of baseflow to the streams throughout the year from the alluvial and bedrock aquifers. Larger quantities of baseflow occur during periods of high precipitation and snow melt; however, this contributes a smaller percentage to total surface water runoff. Baseflow may constitute 90 percent or more of the total stream flow during dry periods of the year (USFS 1980).

The shallow alluvial aquifer is used for livestock drinking water on nearby ranches. The uppermost bedrock aquifer is encountered at a depth of 150 feet. Cyprus has two potable water wells on the site at a depth of 250 feet. These wells are approximately one mile apart and produce 15 and 20-25 gallons per minute (gpm), respectively. According to Cyprus personnel, there are no other uses of the aquifers in the immediate vicinity of the site. Other than the on-site wells, the nearest drinking water well is at the Red Bird Mine three miles from the mine site.

Air Quality. The mine site is located in an undeveloped area in Custer County, Idaho. The air quality at the site is characterized as excellent because of the remoteness of the area and the absence of sources of pollutant

emissions. There are no ambient air quality monitoring stations in the vicinity of the mine site. However, the baseline air quality was expected to be typical of a remote area. The primary pollutant was expected to be total suspended particulates because of mining operations. Hydrocarbons, carbon monoxide, and nitrogen oxides would not be expected to be appreciable because of the lack of significant motor vehicle traffic (USFS 1980).

FACILITY OPERATIONS

Cyprus staked its first mineral claims at Thompson Creek in 1967. Prior to the commencement of mining operations, Cyprus drilled more than 160,000 feet of exploration holes from surface and underground locations and outlined a significant molybdenum deposit containing at least 200 million tons of ore averaging 0.18 percent molybdenite (MoS_2) (USFS 1980). Mining began in 1981 and the first concentrates were produced from the mill in 1983. In 1986, the mill was shutdown for one month. The mill was also inactive from October 1987 to March 1988, when only minor stripping operations (i.e., removal of overburden and waste rock) were underway. At the time of the site visit, the mill was inactive, although waste rock and overburden stripping operations in the mine continued to access additional ore. (According to Cyprus, milling operations resumed after the site visit in November 1991.) Assuming continuous operation of the mine and mill, the operation was originally planned to be active for 20 years. With the periods of inactivity discussed above, the operation has approximately 13 years from the date of the site visit of operation remaining.

Mining Operations

Along a ridge in the Salmon Mountains, Cyprus operates a large open pit where molybdenite (MoS_2) ore is mined from quartz monzonite. The top of the open pit is at an elevation of approximately 8,400 feet above sea level with the orebody encountered at 7,300-7,400 feet (or at a depth of approximately 1,000 feet). The pit currently extends down to the 7,050 foot level, with plans to expand down to an elevation of 6,400 feet (i.e., to a depth of 2,000 feet). The mine operates continuously 24 hours per day, seven days per week, 365 days per year.

When mining began in 1981, approximately 130 million tons of overburden were initially removed as "preproduction stripping" concurrent with the construction of project facilities. Most of the overburden was placed in the two waste rock dumps (the Buckskin and Pat Hughes dumps) located adjacent to the pit, although some overburden was used as fill for construction purposes (USFS 1980).

Mining operations generally follow those described in the 1982 Plan of Operations approved by USFS. The ore is accessed by drilling and blasting along 50 foot benches. Drilling is accomplished using Marian electric drills and a typical blast pattern consists of between 30-40 holes. ANFO, a blend of ammonium nitrate and

diesel fuel, is used as the blasting agent (10,000 tons of ANFO are used annually). Waste oil has previously been substituted for diesel fuel in the ANFO mixture, however, it is not being used pending MSHA approval. On average, one blast occurs every other day. After fragmentation, ore and waste rock are excavated using P & H electric shovels. Cyprus has two 28 cubic yard shovels, one 17 cubic yard shovel, and two 15 cubic yard shovels. The shovels place the ore and waste rock in 170 ton diesel haul trucks. The ore is then transported to the primary crusher, while the waste rock goes to either the Buckskin or Pat Hughes dump. Information on the specific cutoff grade between waste rock and ore was not obtained.

In 1990, approximately 16.2 million cubic yards of waste rock and 4.5 million tons or ore were generated, a stripping ratio of 4:1 (waste rock:ore). However, over the life of the mine, Cyprus personnel indicated that the average stripping ratio would be closer to 2:1. At the time of the site visit, Cyprus was stripping away waste rock to access additional areas of the orebody and the mill was inactive. As a result, only waste rock was being generated and disposed of.

Milling Operations

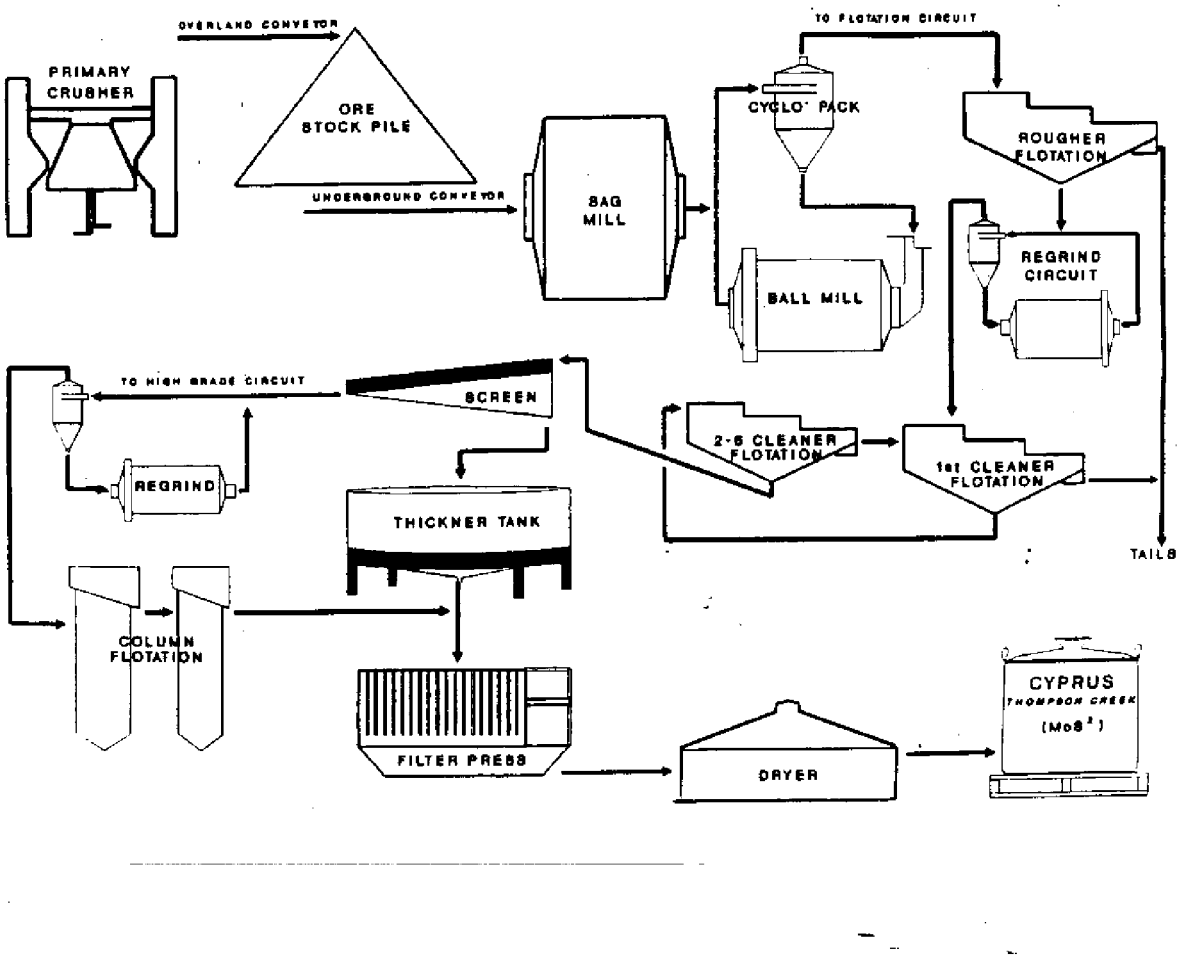
A flow diagram of the milling operations at the site is presented in Figure 3. Mined ore is first sent through a 60 x 89 inch gyratory primary crusher located near the mine, where the ore is crushed to minus 8 inches. The gyratory crusher is equipped with a baghouse for particulate emissions control.

From the primary crusher, the ore is transported by conveyor to a surge pile, located near the mill. The conveyor belt is 2,350 feet long and 60 inches wide. The surge pile contains approximately 300,000 tons of ore. However, Cyprus personnel indicated that only 75,000 tons of ore comprise the "active" portion of the pile. The remainder of the ore in the pile is stored semi-permanently for beneficiation if conveyor problems disrupt the feed to the pile. Ore is removed from the surge pile by 8 feeders underneath the pile. The ore is then transported to two parallel grinding circuits. In each circuit, the ore initially enters a 32 foot diameter semi-autogenous grinding (SAG) mill. The outputs from the SAG mills are passed over 0.75 inch screens and flow into cyclone separators. The overflows from the cyclones go directly to flotation, while the underflows go to 16.5 foot by 26 foot ball mills for further grinding prior to flotation. Grinding is a wet process and burned lime is added for pH control. In 1990, Cyprus used an average of 0.132 pounds of lime per ton of ore. The grinding circuit product is 35 percent solids.

In the flotation process, the slurry from the grinding circuits is passed into flotation cells (or tanks). Flotation is accomplished by bubbling air through the slurry in a series of mechanically agitated cells. Fuel oil is used as the collector, alcohol is used as the frother, and a Nokes reagent (P_2S_5 and NaOH) is added in the cleaner stages to depress copper and lead. In 1990, Cyprus used an average of 0.117 pounds of fuel oil, 0.025 pounds of alcohol, and 0.011 pounds of Nokes reagent per ton of ore. No cyanide is used in the process. The flotation operation is conducted in several stages (rougher and cleaner). The first rougher stage produces concentrate overflow (approximately 10 percent molybdenum disulfide) that is then reground in a small ball

mill. The underflow from the first rougher stage goes directly to the tailings impoundment by pipeline. The effluent from the small ball mill is then subjected to ten additional stages of flotation, called "cleaner" stages, to progressively

Figure 3: Cyprus Thompson Creek Mill Flow Chart



(Source: Cyprus, provided during site visit)

upgrade the concentrate. The overflow from each successive cleaner stage flows to the next cleaner stage. The underflow from the first of the ten cleaner stages (identified by Cyprus as "scavenger" flotation) goes directly to the tailings impoundment. The underflows from subsequent cleaner stages are returned to first cleaner/scavenger stage. The final cleaner cells produce crystalline MoS_2 concentrate. The MoS_2 crystals are passed over a screen. The smaller, lower grade particles from cleaner flotation are sent to a holoflyte dryer/"screw conveyor." Heated oil is circulated through the hollow sections of the screw conveyor to provide enough heat to evaporate additional water in the concentrate. The dried concentrate (identified by Cyprus as technical grade concentrate) is 54 to 59 percent molybdenum disulfide with less than 9.0 percent water and 1.0 percent fuel oil. The technical grade concentrate is packaged in 4,000 pound bags and sent by truck to deep water ports or the Cyprus Sierrita facility in Arizona for roasting.

Depending on market conditions, the larger, higher grade particles (those that do not pass through the screen) are either sent to drying and packaging or to Cyprus' High Performance Molybdenum (HPM) plant. In the HPM plant, the crystals are reground and then subjected to either one or two stages of column flotation, again depending upon market requirements. The concentrate, which is 15-18 percent water, is then passed through a filter plate. The filtrate is recycled as process water. The filtered crystals are sent to a separate holoflyte dryer/screw conveyor in the HPM plant.

The dried HPM concentrate is a very fine powder, about 59 percent molybdenum disulfide with less than one percent water and 0.1 percent fuel oil. The HPM concentrate is packaged in 55-gallon drums or other suitable containers for shipment off-site as product.

WASTE AND MATERIALS MANAGEMENT

Types of Waste and Materials

This section describes several of the wastes and materials that are generated and/or managed at the Cyprus Thompson Creek facility and the means by which they are managed. It should be noted that a variety of wastes and other materials are generated and managed by molybdenum extraction and beneficiation operations.

Some, such as waste rock and tailings, are generally considered to be wastes and are managed as such, typically in on-site management units. Even these materials, however, may be used for various purposes (either on- or off-site) in lieu of disposal. Some quantities of tailings, for example, may be used as construction or foundation materials at times during a mine's life. Many other materials that are generated and/or used at mine sites may only occasionally or periodically be managed as wastes. Some materials are not considered wastes at all until a particular time in their life cycles.

The issue of whether a particular material is a waste clearly depends on the specific circumstances surrounding its generation and management at the time. In addition, some materials that are wastes within the plain meaning of the word are not "solid wastes" as defined under RCRA and thus are not subject to regulation under RCRA. These include, for example, mine water or process wastewater that is discharged pursuant to an NPDES permit. It is emphasized that any questions as to whether a particular material is a waste at a given time should be directed to the appropriate EPA Regional office.

The following subsections describe several of the more important wastes (as defined under RCRA or otherwise) and nonwastes alike, since either can have important implications for environmental performance of a facility. Wastes and materials generated at Cyprus Thompson Creek include waste rock, tailings, mine water, and other wastes and materials (e.g., waste oil, grease, spent solvents, sanitary waste, capacitors, and haul road runoff).

Waste Rock

As noted in the previous chapter, approximately 16.2 million cubic yards of waste rock were generated in 1990. During the site visit, when only accelerated stripping operations were underway, Cyprus was generating approximately 2 million cubic yards of waste rock per month. Four types of materials are found in the waste rock. These materials include: metasediment, quartz monzonite, challis volcanics, and clayey rock (i.e., decomposed volcanics). Waste rock is initially classified and segregated by type of material. Types of waste rock are then separately end-dumped in the two on-site waste rock dumps, the Buckskin and Pat Hughes waste dumps (named to correspond with the drainages in which they are located). Cyprus currently determines where to place specific types of materials based on stability requirements (see discussion of stability issues below).

The Buckskin dump is considerably larger than the Pat Hughes dump and designed to contain 480 million tons of waste material. No information was obtained for the Buckskin dump on the annual quantity of waste rock disposed or the total amount of material currently contained in the dump. The slope of the Buckskin dump is at the angle of repose of the waste rock (slopes range from 33º to 38º). The dump at the time of the site visit was 1,300 feet high extending from an elevation of 8,100 feet to 6,800 feet. Two 300-foot-wide benches, which enhance stability, are currently situated at the 7,600 foot and 7,900 foot levels, respectively. The maximum depth of material in the dump is planned to be approximately 950 feet (Golder Associates 1980).

The Pat Hughes dump is designed to contain approximately 130 million tons of waste material. No information was obtained for the Pat Hughes dump on the annual quantity of waste rock disposed or the total amount of material currently contained in the dump. The waste material has been placed in the dump progressively from north to south. The slope of the Pat Hughes dump is also at the angle of repose of the waste rock with slopes ranging from 33º to 38º. The dump at the time of the site visit was 800 feet high and

will eventually extend from 7,150 to the toe of the dump at elevation 6,300. The maximum depth of material in the dump is planned to be 700 feet (Golder Associates 1980).

In September 1984, the first documented failure of waste rock in the Buckskin dump occurred. The failure involved several hundred feet of slope crest, with a 100 foot wide section sliding up to 100 feet. It was reported that a reason for the failure was excessive dumping of volcanic rock (>100 million cubic yards) between August and mid-September of 1984. Following the dump failure, relatively little waste material was disposed of between October 1984 and June 1986. However, in July 1986, dumping commenced from the 7,750 level. As a result of the continued dumping, the dump again failed on November 11, 1986. A section approximately 80 to 90 feet high along a crest length of 800 to 900 feet failed. Cyprus soon started dumping again but at a different location in the dump. A third large failure occurred on August 27, 1988, which raised serious concerns of the dump's stability (Piteau Associates 1989).

To address these stability problems, Cyprus modified its waste rock dumping practices and began segregating materials. The facility now tries to place the quartz monzonite (intrusive rock) on the outer surfaces of the dumps to "armor" the faces and increase stability.

Facility personnel indicated that the intrusive rocks have high sulfur content (up to 1.13 percent). Therefore, since 1990, Cyprus has been conducting a study of the potential for acid rock drainage (ARD) generation from the waste rock and tailings. (For a more complete discussion of ARD, see U.S. EPA Office of Solid Waste, 1994, *Acid Mine Drainage Prediction*.) According to USFS personnel, the Thompson Creek mine is the only active mine in the area that has had to address ARD rock generation. Static testing has been performed on eight intrusive rock samples collected from the lower benches of the pit. For each sample, Cyprus determined the net neutralization potential (NNP) and the neutralization potential/acid generation potential (NP/AP) ratio. The NNP represents the neutralization potential (the tons of calcium carbonate required to neutralize 1,000 tons of waste rock) minus acid generation potential (calculated based on the total sulfur content). Analyses of the eight samples showed an average NNP of 0.053 with values ranging from -6.26 to 7.31. The NP/AP ratio for these samples was 1.88:1 with values ranging from 0.63:1 to 6.85:1. According to Cyprus personnel, waste rock with an NP/AP ratio in excess of 3:1 may be considered non-acid generating (Steffen Robertson & Kirsten 1991a). According to USFS personnel, a NP/AP ratio of at least 5:1 should be required before a material is determined to be non-acid forming. Thirteen samples of intrusive rock collected from the upper benches of the pit showed an average NNP of 4.93 with values ranging from -0.65 to 11.35, and an average NP/AP ratio of 3.80:1 with values ranging from 0.90:1 to 15.92:1. The difference between intrusive rock samples collected from the upper and lower benches is believed to be caused by a relatively predictable pattern of mineralization and alteration zoning about the ore body. According to Cyprus, the metasedimentary and volcanic rocks do not appear to be sources of ARD. Cyprus has performed static testing on the metasedimentary rock and found average NNP and NP/AP values of 24.95 and 3.11:1, respectively (Steffen Robertson & Kirsten 1991a). It should be noted that, while the metasedimentary rocks are considered non-acid forming by Cyprus (NP/AP greater than 3:1), the average

NP/AP ratio is less than the minimum ratio suggested by the USFS (5:1). According to Cyprus, seventy-six samples of the volcanic rocks have also been analyzed for acid base accounting. All samples showed NP/AP ratios of greater than 31:1.

Prior to commencement of dumping in 1981, Cyprus installed a culvert and drain system in both valley bottoms to convey the creeks underneath the dumps. The underdrain systems are further designed to collect infiltration through dump materials. These systems drain into sediment ponds, which also collect surface runoff from the dump areas. The sediments ponds discharge through NPDES outfalls to Buckskin and Pat Hughes Creeks. The discharge from the Buckskin dump sediment pond is identified as National Pollutant Discharge Elimination System (NPDES) outfall 001, while the discharge from the Pat Hughes dump sediment pond is NPDES outfall 002. During 1989-1990, pH levels in the discharges from outfalls 001 and 002 ranged from 7.0 to 9.2 s.u. and 6.4 to 8.9, respectively. (A complete summary of monitoring results for outfalls 001 and 002 is included in Appendix A) (Cyprus 1991a). As indicated by Cyprus personnel, no evidence of ARD has yet been found in these discharges. A NALCO coagulant is added to the sediment ponds during the spring to help control total suspended solids levels in the discharges (the amount of coagulant added was not obtained). According to Cyprus personnel, no other treatment is required to meet NPDES permit limits.

Tailings

When the mill is operating at full production, tailings are generated at a rate of approximately 7.5 million cubic yards per year. On Cyprus' 10/4 mill operating schedule (10 consecutive days operating/4 days shutdown), about 5.5 million cubic yards of tailings are produced each year. Cyprus continuously monitors the composition of concentrates and tailings generated by each flotation stage to assess mill performance. Samples are collected every 15 minutes and composited for analysis every 24 hours. The results of one recent analysis of a 24-hour composite sample are presented in Table 1. As indicated in the previous section, only the rougher and scavenger tails are sent to the tailings impoundment.

Table 1: Cyprus Thompson Creek Mining Company
Daily Tailings and Concentrate Composite Assays

Report Date: 28/Jan/91

Sample	Molybdenum Percent	Copper Percent	Lead Percent
Rougher Tails	0.009	0.002	0.002
Combined Tails	0.009	0.004	0.003
Scavenger Tails	0.073	0.150	0.051
Rougher Concentrate	8.11	0.130	0.060

1st Cleaner Concentrate	43.40	0.620	0.180
2nd Cleaner Tails	34.10	1.300	0.240

Tailings flow from the mill in a 30-inch diameter high density polyethylene (HDPE) pipeline that extends 7,000 feet north-northeast to the tailings impoundment in the Bruno Creek drainage. The tailings discharged from the mill are approximately 39 percent solids and the pipeline flow is about 10,000 gpm. The pipeline is situated in an unlined ditch along its entire length to provide for secondary containment.

The tailings impoundment covers a total of approximately 150 acres with the embankment covering about 60-70 acres and the tailings pond behind the embankment approximately 90 acres. The embankment is currently about 400 feet high with an eventual planned final height of 600 feet. The impoundment is designed to contain the surface water runoff from a 500-year storm event. In addition, the impoundment was designed with a runoff interceptor system (RIS). When Cyprus determines that it is necessary to reduce the upstream flow of Bruno Creek into the tailings impoundment, the RIS can be used to divert Bruno Creek around the impoundment. The diverted flow is discharged to lower Bruno Creek below the final seepage collection sump described below.

The "centerline" method is the chosen technique for tailings embankment construction. The starter dam was a 35-foot earthen embankment. Tailings fractions are classified by cycloning (as sands or slimes) and distributed to the impoundment by spigotting. The coarse fraction (sands) forms the embankment that retains the slimes. The slimes have formed a "beach" that slopes upstream away from the embankment. Tailings water is kept at the upstream end of the impoundment by the addition of tailings to the upstream face of the dam. Eighty percent of the tailings water is reclaimed by a pumping barge and reused in the mill. The flow of reclaim water to the mill averages 7,000 gallons per minute (gpm). Additional fresh water may be pumped from the Salmon River as needed (this is not continuous, but typically averages 1,000 gpm). Under their water quality monitoring program, Cyprus collects and analyzes tailings pond water at the inflow to the barge pump. At the time of the site visit, Cyprus personnel indicated that the pH of the tailings water was 6.5 to 7.0 s.u. Results of analyses for 1989-1990 are included in Appendix A (see monitoring location TP).

Consolidation of the tailings in the impoundment is promoted by controlled seepage through the dam. Piezometers and open-ended standpipes are used to monitor stability in the impoundment. French drains located under and within the impoundment direct the flow of seepage through the permeable embankment.

The tailings disposal system has been designed to be a zero discharge unit. A seepage return pond was constructed below the embankment to collect the seepage from the tailings impoundment. The clay-lined seepage pond typically contains approximately 20 acre feet of seepage with the capacity to contain up to 100 acre feet (the current area and depth of the pond, and average seepage rates were not determined). The downstream end of the return pond (approximately 850 feet from the tailings embankment) is an earth and rock fill dam, identified by Cyprus as the Seepage Return Dam (SRD). The maximum height of the SRD is

75 feet with an impervious upstream zone and a rock fill downstream zone. The SRD incorporates a positive seepage cutoff by use of a grout curtain in the foundation bedrock. At the time of the site visit, the pH of seepage pond water was 6.2 to 6.5 s.u.

While the SRD was originally planned to contain all seepage from the tailings impoundment, Cyprus personnel subsequently identified seepage downstream of the SRD. Therefore, to ensure no discharge of seepage to Bruno Creek, a lined sump was installed further downstream in Bruno Creek drainage (information on the specific type of liner was not obtained). Under their water quality monitoring program, Cyprus collects and analyzes samples from the inlet to this sump. Results of analyses for 1989-1990 are included in Appendix A (see monitoring location PBS). Seepage collected in both the seepage return pond and the downstream sump is pumped back to the mill for reuse. In 1990, the monthly average pumping rate from the return pond to the mill ranged from 791 gpm (August) to 1352 gpm (November and December) (Cyprus 1991b). The quantity of seepage returned to the mill from the sump was not obtained.

During the ongoing acid drainage study, indications of acid generation have been found in the tailings. According to Cyprus personnel, tailings oxidation has been evident for over two years. In October 1990, ten hollow stem auger borings were completed in the tailings embankment. Samples collected from the these borings showed that the average sulfur content of the tailings sands was 0.79 percent and the pH ranged from 3.5 to 7.3 s.u. (Steffen Robertson & Kirsten 1991b). During the site visit, Cyprus personnel further indicated that analyses of tailings sands have shown pH levels as low as 3.0 s.u. According to Cyprus personnel, the tailings pond and the seepage return pond are not currently a problem (pH > 5.7 s.u.). However, in 1991, Cyprus conducted a water quality trend analysis for six surface water quality monitoring locations in the tailings impoundment area. These locations included the main drain of the rock toe, springs located on the left and right abutments of the rock toe, the discharge from the rock toe, the sump below the SRD, and Bruno Creek (immediately downstream of the sump). This analysis found that during the period 1981-1990, pH decreased at four locations (not at the left and right abutment springs), (2) sulfate had increased at all locations, (3) iron had increased at four locations (not at the left and right abutment springs), and (4) no trends in zinc, copper, or arsenic were recognized. The increase in sulfate concentrations was attributed to tailings oxidation and acid generation (Steffen Robertson & Kirsten 1991b).

Cyprus' original plan for reclamation of the tailings impoundment (submitted to the State in 1982) provides for restoration of the Bruno Creek drainage through the impoundment in compliance with State water quality standards. The plan indicates that Cyprus initially anticipated that water quality standards could be met by diluting impoundment seepage with natural runoff. No water treatment beyond sediment control was expected to be required (Steffen Robertson & Kirsten 1982). However, the original reclamation plan did not consider the ARD issue.

According to Cyprus personnel, the ARD problem could extend well beyond the life of the mine and perpetual care/treatment may be necessary. Therefore, Cyprus is currently evaluating remedial alternatives

(other than perpetual care) and is preparing to submit a revised tailings pond reclamation plan (as a modification to their operating plan). Alternatives may include installing an additional flotation unit to remove pyrite and/or in-place treatment of tailings with trisodium phosphate as a buffer.

Preliminary flotation tests have been conducted to investigate the possibility of removing sulfides from the tailings prior to disposal in the impoundment. Test results indicate that a high percentage of pyrite may be recovered. Limited static testing performed on a whole tailings sample from which pyrite was recovered indicated a NP/AP ratio in excess of 4:1 compared to an average value of 0.84:1 for all tailings analyses (Steffen Robertson & Kirsten 1991a).

Cyprus also has been testing the spray application of trisodium phosphate (2 percent solution) to buffer tailings sands. The facility has been analyzing the buffered sands and collected leachate. Based on preliminary test results, the trisodium phosphate has been successful in elevating pH levels and reducing iron concentrations in leachate samples. However, because the tailings impoundment unit has no discharge and water from the impoundment, seepage return pond, and pump back system is returned to the mill, the TSP application will cause elevated phosphorus levels in the reclaim water. Cyprus personnel indicated these levels may adversely affect flotation operations and that this issue is being studied (Steffen Robertson & Kirsten 1991a).

According to Cyprus personnel, oxidation has only been found to occur in the top two to three feet of tailings (despite the results of analyses of the 1990 borehole samples that showed oxidation at all depths down to 150 feet, see Steffen Robertson & Kirsten, 1991a). Therefore, an additional alternative under consideration is to encapsulate the tailings. Information on specific types of cover materials was not provided. Additionally, Cyprus is investigating the potential use of wetlands treatment.

Mine Water

Until early 1988, little or no mine water accumulated in the pit except seasonal runon. However, ground water seepage to the pit began in 1988 when the pit reached the 7,300 foot elevation (a depth of about 1,000 feet below the surface). As a result, a collection sump and pumpback system were installed with a capacity to remove 1,200 gpm of mine water. According to Cyprus personnel, an average of 200 gpm of mine water is pumped out of the pit to a booster station and then pumped to the tailings impoundment. Because the mill was shutdown during 1991 spring runoff, mine water was combined with underflow collected from the Pat Hughes dump and discharged through NPDES outfall 002 (after receiving approval from EPA). Under their water quality monitoring program, Cyprus collects and analyzes samples of mine water from the collection sump. The results of mine water analyses for 1989-1990 are presented in Table 2.

Other Materials and Wastes

Other wastes generated at the Cyprus Thompson Creek site include solid waste (i.e., trash), waste oil, grease, and spent solvents). Each of these and their management practices are discussed below. Other materials managed at the facility are also described.

Waste Oil/Grease/Fuel. Diesel fuel usage is approximately 220,000-230,000 gallons per month in the mine trucks and 9,000 gallons per month in the mill. The primary fuel storage tank is a 400,000 gallon tank located north of the machine shop near the pit. There are also a 6,000 gallon tank for auto transmission fluid and a 6,000 gallon tank for antifreeze storage located north of a gas shop, also near the pit. Two 13,000 gallon underground tanks are used for gasoline storage (the locations of these tanks were not obtained). Waste oil is collected in two aboveground 10,000 gallon tanks near the shops. Vehicles generate 90 percent of the waste oil at the site. When vehicle waste oil was used in blasting, all of the vehicle waste oil generated at Cyprus Thompson Creek was recycled on-site (the amount was not determined). Forty percent of the vehicle waste oil was used in blasting and 60 percent was used in the facility's space heating furnaces. Because vehicle waste oil is no longer being used in blasting pending MSHA approval, the management of waste oil not used in Cyprus' space heating furnaces is unknown. The shop generates the remaining 10 percent of the facility's waste oil. Shop waste oil is shipped off-site after analysis for chlorinated hydrocarbons. Grease is manifested and also shipped off-site.

As noted in the facility's SPCC plan (see the following chapter), all of the tanks listed in the preceding paragraph, except the two underground gasoline tanks, have secondary containment (i.e., liners surrounded by berms). None of these tanks have leak detection systems (Cyprus 1990). No information was obtained on whether the two underground gasoline tanks have been leak tested. Cyprus personnel visually inspect all tanks at the site at least monthly.

Solid waste. Solid waste generated at the site is disposed with waste rock materials in the Buckskin dump. The quantity of solid waste generated and disposed was not obtained.

Solvents. In 1989, more than 12,000 pounds of naptha were generated and manifested for off-site management. In 1989, 1,250 pounds of waste chlorinated cleaning solvents were generated and sent to the State of Washington for disposal.

Capacitors. All PCB-contaminated capacitors were manifested and removed from the site in one shipment (information on the removal date and quantity shipped was not obtained). According to Cyprus, there is no remaining PCB-contaminated electrical equipment on the Thompson Creek property.

Facility Runoff. All runoff from disturbed areas at the site (except for runoff from the mine, waste dumps, and tailings impoundment) is collected in ditches, which drain to a sediment control pond adjacent to Squaw Creek below the confluence with Bruno Creek. The site visit team observed a significant algal bloom and aquatic plant life in the sediment pond. The discharge from the pond is NPDES outfall 003.

Table 2. General Surface Water Parameter Concentrations
for Pit Sump (PIT 1, PIT 2, and PIT 3)

Year	Parameter Range Concentrations												
	pH	Arsenic Total µg/l	Barium Total µg/l	Cadmium Total µg/l	Lead Total µg/l	Mercury Total µg/l	Selenium Total µg/l	Silver Total µg/l	Copper Total µg/l	Iron Total µg/l	Manganese Total µg/l	Zinc Total µg/l	Aluminum Total µg/l
PIT 1													
1989	6.8-7.0	10-36	NR	<5.0-27.0	50.0	<0.50	NR	NR	10	2,500	NR	20-27	NR
1990	6.3-6.7	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
PIT 2													
1989	6.5-7.4	<5.0-77.0	NR	<5.0-68.0	<50.0-150.0	<0.50-19.20[1]	NR	NR	<10-90	460-1,900	NR	<5-302	NR
1990	3.6-6.5	<5.0-19.0	NR	5.0-14.0	60.0	<0.50	NR	NR	50-210	NR	NR	337-1,080	NR
PIT 3													
1989	6.5-7.3	<5.0-129.0	NR	<5.0-5.0	<50.0-80.0	<0.50-50.00[2]	NR	NR	10-30	NR	NR	6-67	NR
1990	5.9-7.0	167	<100	<5.0	<50.0	<0.50	<20.0	<5.00	<10	700	1,300	<5	570

NR = Not Reported

(Source: Cyprus 1991a)

[1]Six of 39 samples showed detectable levels of mercury. Other detected levels ranged from 0.50 µg/l to 1.60 µg/l. According to Cyprus, laboratory contamination is suspected as the source for the anomalous mercury values

[2]Three of six samples showed detected levels of mercury. The other detected levels were 0.50 µg/l and 0.60 µg/l.

REGULATORY REQUIREMENTS AND COMPLIANCE

Cyprus Thompson Creek operates under several permits and/or plans issued by the State of Idaho Departments of Lands and Water Resources and Division of Environmental Quality, as well as approvals from the U.S. Forest Service (USFS) and EPA Region X. In addition, the State of Idaho has established an interagency task force that coordinates regulatory activities related to each major mine site. The interagency task force for the Thompson Creek site meets quarterly and includes representatives of the State Departments of Lands, Water Resources, and Fish and Game; the State Division of Environmental Quality; USFS; and BLM. USFS is the lead agency for the Cyprus task force. Each of Cyprus' major permits and/or plans is discussed in the following sections.

Plan of Operations

Background. Cyprus submitted their initial Plan of Operations to USFS for the Thompson Creek mine on May 25, 1979. This plan, which was approved by USFS and has been modified throughout the life of the mine, describes how the mine is to be operated and the specific activities to be performed at mine closure. A part of the Plan of Operations is the reclamation plan for the site. In addition to USFS approval, the reclamation plan and subsequent modifications are subject to review by the Idaho Department of Lands under the Idaho Surface Mining Act.

Cyprus submits annual reports to the Idaho Department of Lands and USFS on reclamation and tailings impoundment related activities. Cyprus also submits to the State, USFS, and EPA Region X the results of all ground and surface water monitoring. Under the authority of the Surface Mining Act, the Department of Lands coordinates with USFS to enforce the requirements of Cyprus' Plan of Operations. Generally, the Department of Lands and USFS work with Cyprus to address any problems that arise. If formal enforcement action is required, the Idaho Division of Environmental Quality (DEQ) can issue a consent decree. The DEQ also reviews ground water and surface water monitoring data to ensure compliance with State ground and surface water quality standards. BLM's role at the site is limited to participation in the interagency task force.

The Forest Service inspects the site monthly. As noted above, staff from the State Departments of Lands, Water Resources and Fish Game, and the Division of Environmental Quality participate in the Thompson Creek interagency task force, which meets at the site quarterly.

Water Quality Monitoring. As part of their Plan of Operations, Cyprus is required to perform ground and surface water monitoring in the Buckskin, Pat Hughes, Squaw, Bruno, and Thompson Creek drainages, as well as the Salmon River drainage. The ground and surface water monitoring locations (among which are the NPDES permitted outfalls described below) are identified in Table 3 and on the maps presented in Figures 4

and 5. Parameters and monitoring frequencies vary between locations (Cyprus 1991c). Information on the construction and depths of the ground-water monitoring wells was not obtained.

A summary of the 1989 and 1990 monitoring data for each monitoring location is included in Appendix A. Monitoring for pH and metals is required to ensure no degradation of surface and ground water in the Salmon River basin (Cyprus 1991c).

Acid Rock Drainage Study. As noted in the previous chapter, Cyprus has been conducting a study to investigate the potential for the waste dumps and the tailings impoundment to generate ARD. The results of the ARD study of the waste rock and tailings were to be provided to USFS by March 1, 1992. Proposed revisions to the facility's reclamation plan were also to be submitted to USFS. According to USFS personnel who participated in the site visit, the revisions to the Plan of Operations will be subjected to the environmental review requirements of National Environmental Policy Act (NEPA). This review may include preparation of a supplemental Environmental Impact Statement.

Reclamation. As required under their Plan of Operations, Cyprus submits an annual report describing reclamation activities undertaken during the previous year and proposed activities for the following year. The 1990 annual report, for example, described each specific project undertaken (e.g., stabilizing and fertilizing areas of the Buckskin and Pat Hughes dumps, seeding road cuts, and weed control). Overall, Cyprus reported final reclamation of 30.8 acres in 1990 (compared to 6.5 acres originally planned) (Cyprus 1991d).

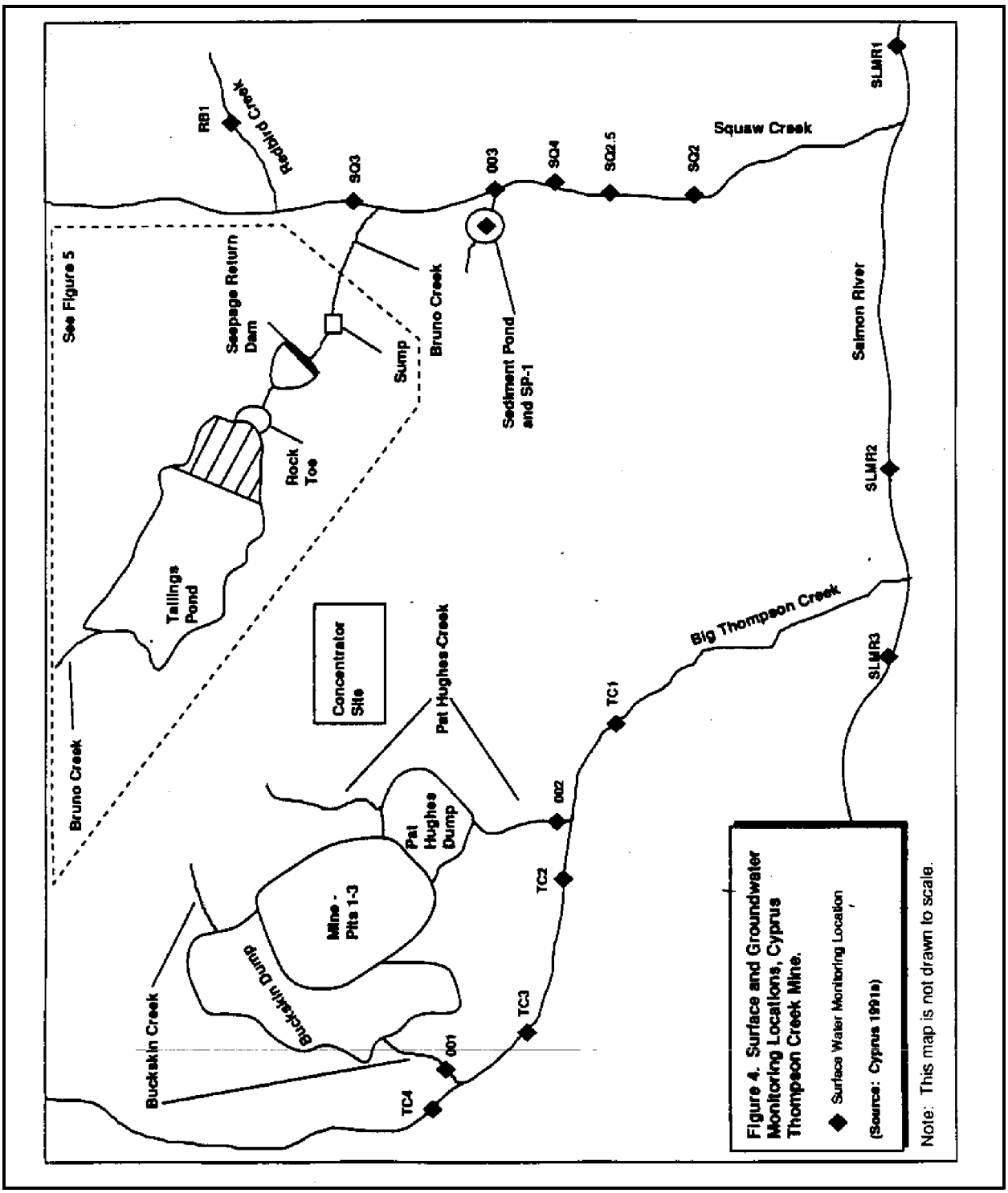
Bonding. Because of the various agencies responsible for oversight of activities at the Thompson Creek facility, coordinated bonding (including Memoranda of Understanding) has been required to avoid duplication of requirements. Table 4 summarizes the agencies holding bonds, the bond values, and the types of disturbances addressed. Overall, approximately $10,000,000 of bonds are held by the USFS, BLM and the Idaho Departments of Lands and Water Resources for the Thompson Creek Mine.

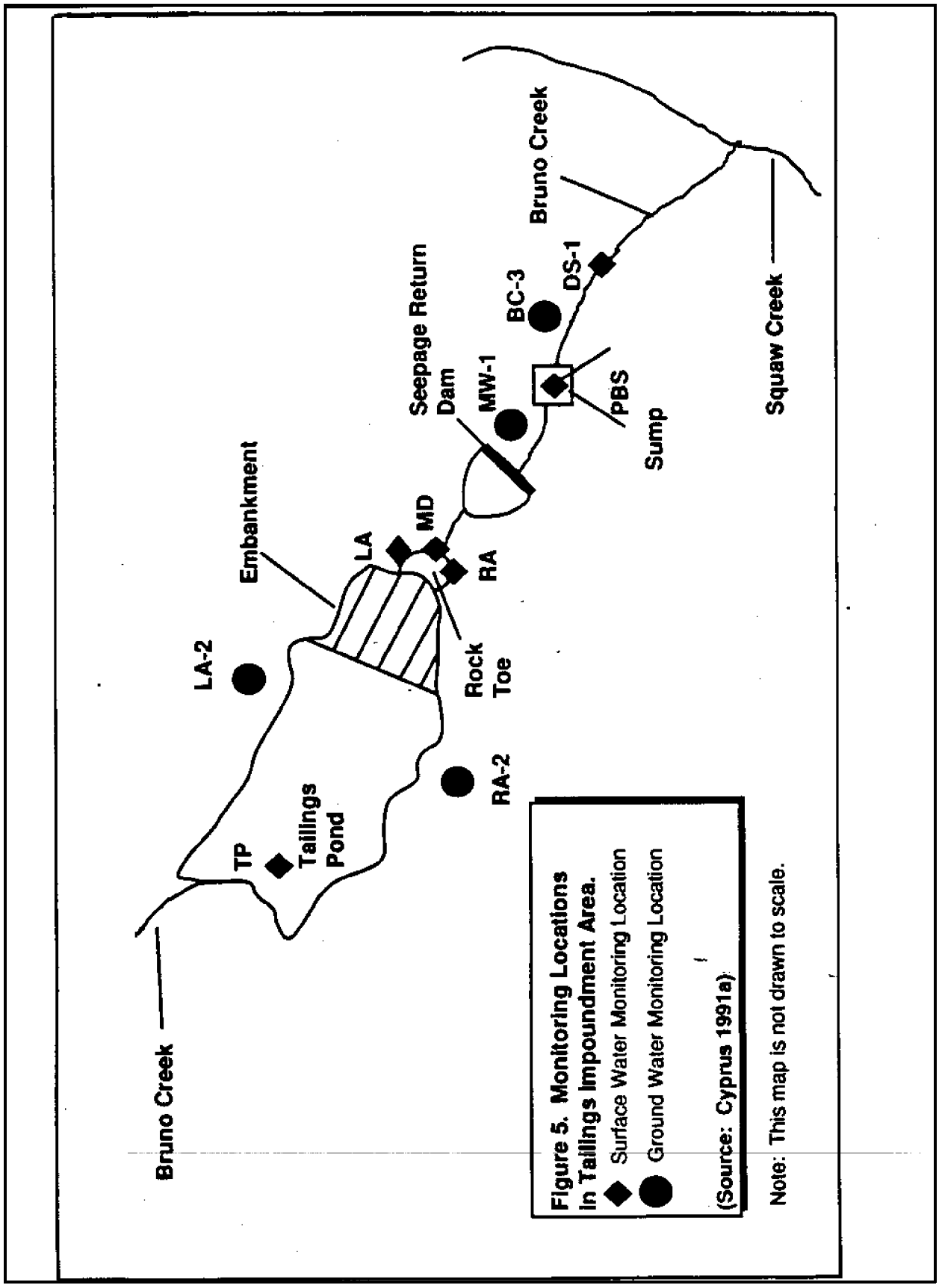
Table 3: Surface and Ground Water Monitoring Locations

Surface Water Monitoring Locations	
SQ-2	Squaw Creek below confluence with Bruno Creek and 25 feet above second bridge above gate.
SQ-2.5	Squaw Creek 250 feet below confluence with Bruno Creek (at boulder).
SQ-3	Squaw Creek above confluence with Bruno Creek and 100 feet below Redbird mine.
SQ-4	Bruno Creek at the U.S. Gauging Station (USGS) and above guard gate.
TC-1	Thompson Creek 250 feet below confluence with Pat Hughes Creek and one mile above Transfer Pump Sump.
TC-2	Thompson Creek one-fourth mile above confluence with Pat Hughes Creek and below confluence with Unnamed Creek.
TC-3	Thompson Creek above confluence with Unnamed Creek and below confluence with Buckskin Creek.
TC-4	Thompson Creek above confluence with Buckskin Creek and below confluence with Alder Creek.
001	Buckskin Creek sediment dam discharge point.
002	Pat Hughes Creek sediment dam discharge point.
003	Beaver Pond sediment control structure - storm water discharge point on Squaw Creek.
PITS 1-3	Locations in pit sump used for dewatering.
SLMR1	Salmon River, 50 feet below steel ladder bridge (access road). South bank.
SLMR2	Salmon River, at parking flat directly above concrete bridge. South bank.
SLMR3	Salmon River, 50 feet above mouth of Thompson Creek.
TP	Tailings pond (barge).
MD	Main drain (lower center) of rock toe.
LA	Left abutment of rock toe.
RA	Right abutment of rock toe.
PBS	Pumpback system, inlet to sump on lower tailings road south of Seepage Return Dam.
DS-1	First downstream spring 100 feet below pumpback system and 25 feet below monitoring well on Bruno Creek (east bank).
SP-1	Sediment pond at elevation 6,640 feet on Squaw Creek
RB-1	Redbird Creek tributary to Squaw Creek one mile above Redbird Mine.
Ground Water Monitoring Locations	
MW-1	Monitoring well located approximately 100 feet below Seepage Return Dam.
BC-3	Former production well on lower Bruno Creek at Pope John Boulevard.
LA-2	Monitoring well located on left abutment above centerline of tailings impoundment.
RA-2	Monitoring well located on right abutment (west edge) of tailings impoundment and one-half mile off of upper mine (motivator) road.

Table 4: Bond Amounts Required of Cyprus Thompson Creek
Through December 31, 1993

Agency Holding Bond	Disturbance Type	Area	Base Rate	Portion Covered by Other Bonds				Adj. Rate	Total ($)
		Acres	Cost/Acre	Lands	Water	USFS	BLM	Cost/Acre	
Dept. of Water Resources	Tailings Deposition	219.2	28,800	750				28,050	7,517,455
Dept. of Lands Total Bonds = $1,393,150	Dumps	8	2,000	1,800				--	$14,400
	Roads & Utilities	23	1,500					--	34,500
	Laydown & Shops	112	1,000					--	112,000
	Remaining	1,643	750					--	1,232,250
USFS Total Bonding = $468,125	Mine	37.5	250	750				(500)	--
	Dumps	343	2,000	750				1,250	$428,750
	Tails - Deposition	199.5	28,800	750	28,050			--	--
	Tails - Nondeposition	41	1,500	750				750	30,750
	Borrow	--	750	750				--	--
	Roads & Utilities	11.5	1,500	750				750	8,625
	Laydown & Shops	--	1,000	750				250	--
BLM Total Bonding = $549,300	Mine	173	250	750				(500)	
	Dumps	308.5	2,000	750				1,250	385,625
	Tails - Deposition	19.2	28,800	750	28,050			--	--
	Tails - Nondeposition	30.3	1,500	750				750	22,725
	Borrow	17	750	750				--	--
	Roads & Utilities	165	1,500	750				750	123,750
	Laydown & Shops	68.8	1,000	750				250	17,200
Total									9,928,030





Old Tungsten Mill Tailings Remediation. As indicated previously, an abandoned mill associated with an old tungsten mine is located beside Thompson Creek 10 miles downstream of the mine site (not on Cyprus' property). The tailings from the mill were disposed in and around the creek drainage. These tailings have been shown to have acid generation potential (pH approximately 2.9 s.u.) and high metals concentrations which could affect Thompson Creek. Although the abandoned mill tailings are not on Cyprus' property, their potential impact on the Creek affects Cyprus' nearby operations. Therefore, it is to Cyprus' benefit to assist in remediation of the site. In a joint effort, Cyprus has been working with the USFS to remediate problems associated with the tailings. Tailings are being removed from the Creek and placed on other tailings away from the drainage. They are then covered from top to bottom with layers of lime, topsoil, sewage sludge, and additional topsoil. Cyprus is providing the equipment and operators, while USFS is providing funding, expertise, and additional manpower.

NPDES Permit

The State of Idaho has not been delegated NPDES permitting authority under the Clean Water Act. Therefore, the five-year NPDES permit for the Cyprus Thompson Creek site was issued by EPA Region X on August 1, 1988. The permit specifically addresses the discharges from NPDES outfalls 001 (the discharge from the Buckskin dump) and outfall 002 (the discharge from the Pat Hughes dump). For these outfalls, the permit establishes limits and monitoring requirements for: pH (monitored weekly), total suspended solids (weekly), arsenic (monthly), cadmium (monthly), lead (monthly), mercury (monthly), copper, (monthly) and zinc (monthly). Permit limits are based on ensuring compliance with the applicable State water quality standards. However, the permit provides alternative limitations for the metals (except arsenic) to allow for elevated levels of pollutants in background water quality (USEPA 1988).

As noted previously, Cyprus collects runoff from all areas (other than the pit, waste dumps, and tailings impoundment) in unlined channels that convey runoff to a sediment pond located adjacent to Squaw Creek downstream of the confluence with Bruno Creek. This pond discharges to Squaw Creek at NPDES outfall 003. Cyprus is required to monitor Squaw Creek upstream and downstream of this outfall for turbidity. Weekly monitoring is required between February 1 and June 30 and monthly during other months. The permit only requires turbidity monitoring, no limits are provided (USEPA 1988).

The NPDES permit also requires Cyprus to continue to implement the comprehensive water quality monitoring program described under the operating plan above. Cyprus submits quarterly reports on water quality monitoring to both EPA Region X and DEQ. EPA Region X's Water Quality Branch conducts a compliance inspection at the facility once per year.

Cyprus personnel indicated that the water quality in the receiving waters was generally "very good," including pH levels (see Appendix A). To further determine whether mining activities have impacted surface waters,

Cyprus conducted an aquatic biological survey of Thompson and Squaw Creeks. The results of this 1988 study indicated that mining was having no discernable effect on aquatic life in Thompson Creek. The invertebrate populations in Squaw Creek were shown to have experienced changes in species composition and relative density. However, the cause of these changes was unknown and continued monitoring was recommended (Chadwick & Associates 1989). Annual aquatic life monitoring is now required under Cyprus' water quality monitoring program (no additional data was obtained). During the site visit, Cyprus personnel noted that in 1986, one of the waste dump ponds stratified, confining higher temperature (lower oxygen) water at depths in the pond. Because of this effect, the decreasing level of oxygen caused fishkills.

Air Permit

The State of Idaho has issued an air emissions permit for the Thompson Creek site that addresses the following sources:

- Baghouses located at the crusher, at the turning point of the conveyor, at the lime bin, at the product package area, and at the HPM plant,
- Discharges from the two boilers in the mill,
- Portable crusher used to generate gravel for roads; water is sprayed at the base of this crusher to control particulate emissions,
- Technical grade concentrate holoflyte dryer/rotary kiln stack,
- HPM plant holoflyte dryer/rotary kiln stack.

Dust collected from the baghouses is recycled to the mill. All of the above sources are required to meet 20 percent opacity limits and the particulate size limit for each source is either 0.02 or 0.5 grains/dry cubic foot. In addition, the fuel feed to the mill boilers must be less than one percent sulfur. The State conducts air permit compliance inspections once per year. Magnesium chloride is used for dust suppression on haul roads.

Dam Safety Permit

As required under Idaho State law, Cyprus Thompson Creek has a dam safety permit issued by the Department of Waste Resources for the main tailings embankment and the SRD. This permit was not reviewed by the site visit team.

Other Regulatory Requirements

In accordance with 40 CFR Part 112 of the Clean Water Act, Cyprus has implemented a spill prevention control and countermeasure (SPCC) plan for the Thompson Creek mine site, primarily because of the project's location adjacent to and near a number of tributaries to the Salmon River. The SPCC plan is designed to help prevent spills and to minimize the risk of injury to human health and the environment in the event that a spill should occur. Cyprus's SPCC plan specifically: (1) provides the locations of all aboveground storage tanks at the site, (2) describes their contents and volumes, and (3) identifies spill prevention and control measures. As noted previously, all of the aboveground tanks at the site have secondary containment and are visually inspected monthly. According to Cyprus personnel, the two underground gasoline storage tanks at the site are in full compliance with Underground Storage Tank program requirements.

REFERENCES

Chadwick & Associates, 1989. *Draft Aquatic Biological Survey of Thompson Creek and Squaw Creek*. Prepared for Cyprus Minerals Corporation. March 1989.

Cyprus Minerals Corporation, 1990. *Spill Prevention Control and Countermeasure Plan*, December 12, 1990.

Cyprus Minerals Corporation, 1991a. *Water Quality Monitoring Program Results for 1989-1990*.

Cyprus Minerals Corporation, 1991b. *Cyprus Thompson Creek Annual Tailings Report, 1990*. Submitted to the Idaho Department of Water Resources. March 25, 1991.

Cyprus Minerals Corporation, 1991c. *Cyprus Thompson Creek: 1991 Water Quality Monitoring Program*.

Cyprus Minerals Corporation, 1991d. *Cyprus Thompson Creek Molybdenum Mine, Reclamation and Planned Renewal Activities, 1990 Annual Report.* Prepared for the Idaho Department of Lands. March 27, 1991.

Piteau Associates, 1989. *Geotechnical Review of Buckskin Creek Waste Dump*. Prepared for Cyprus Minerals Corporation. January 25, 1989.

State of Idaho. *Water Quality Standards*. Revised as of 1989.

Steffen Robertson & Kirsten, 1982. *Conceptual Reclamation Plan and Cost Estimate,Thompson Creek Project, Tailings Impoundment*. Prepared for Cyprus Minerals Corporation. December 1982.

Steffen Robertson & Kirsten, 1991a. *Memo to Bert Doughty of Cyprus Thompson Creek on the Status of the Thompson Creek ARD Investigation*. August 19, 1991.

Steffen Robertson & Kirsten, 1991b. *Memo to Bert Doughty of Cyprus Thompson Creek on the ARD Investigation of Cyprus Thompson Creek's Tailings Impoundment*. April 9, 1991.

U.S. Environmental Protection Agency, Region X, 1988. *NPDES Permit No. ID0025402*. Issued on June 30, 1988.

U.S. Forest Service, 1980. *Final Environmental Impact Statement, Thompson Creek Molybdenum Project, Challis, Idaho*.

APPENDIX A

WATER QUALITY MONITORING DATA

Monitoring Results for Surface Water Stations in Squaw Creek (SQ-2, SQ-2.5, SQ-3, and SQ-4)

Year	Concentration Ranges												
	pH	As Total µg/l	Ba Total µg/l	Cd Total µg/l	Pb Total µg/l	Hg Total µg/l	Se Total µg/l	Ag Total µg/l	Cu Total µg/l	Fe Total µg/l	Mn Total µg/l	Zn Total µg/l	Al Total µg/l
SQ-2													
1989	6.9-8.5	<5.0	<100	<5.0	<50.0	<0.50	<2.0	<5.00	<10-10	<10-120	<10-10	<5-15	<100
1990	6.1-8.0	<5.0	<100	<5.0	<50.0	<0.50	<5.0	<5.00	<10	90-190	<50	<5-13	<100
SQ-2.5													
1989	6.9-8.1	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1990	7.8	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
SQ-3													
1989	6.8-8.3	<5.0	<100	12.0	<50.0	<0.50	<2.0	<5.00	<10	50-140	<10-10	20	<100
1990	6.4-8.1	<5.0	<100	<5.0	<50.0	<0.50	<5.0	<5.00	20	100-150	<50-50	<5	<100
SQ-4													
1989	6.6-8.6	<5.0	<100	<5.0	<50.0	<0.50	<2.0	<5.00	10	<10-80	<10	13	100
1990	7.5-8.3	<5.0	200	<5.0	140.0	0.50	<5.0	<5.00	NR	50-110	<50	12-15	270

NR = Nonreporting

Monitoring Results for Surface Water Stations: Downstream Spring (DS-1), Left Abutment (LA), Pumpback System Inflow (PBS), Right Abutment (RA), Redbird Creek (RB-1), and Sediment Pond (SP-1)

	Concentration Ranges												
Year	pH	As Total µg/l	Ba Total µg/l	Cd Total µg/l	Pb Total µg/l	Hg Total µg/l	Se Total µg/l	Ag Total µg/l	Cu Total µg/l	Fe Total µg/l	Mn Total µg/l	Zn Total µg/l	Al Total µg/l
DS-1													
1989	6.4-8.0	<5	<100	<5.0	<5	<.5	<2	<50	<10	20-290	<10-10	<5-12	200
1990	5.3-7.9	<5	<100	<5.0	60	<.5	<5	<5	NR	60-170	<50	<5-11	400
LA													
1989	6.4-7.1	<5-6	170-700	5-9	<50-110	<.5-2.4	<2	<5-10	<10-30	200-820	260-770	11-65	<100-490
1990	6.7-6.8	<5	<100-150	<5-10	60-70	<.5	<5	6-8	20-30	150-210	140-310	14-71	<100-110
PBS													
1989	6.5-7.0	<5-6	100-1,900	5-28	60-90	<1	<2	<5-8	<10-10	40-180	<10-20	12-64	<100
1990	6.2-7.2	<5-19	<100-130	6-11	50-110	<.5-.6	<5	7-11	<10-10	50-130	<50	9-49	<100-300
RA													
1989	4.2-8.2	<5	<100-1,100	<5-15	<50-80	<1	<2-4	<5-6	<10-50	550-58,000	20-10,700	21-360	300-15,600
1990	6.9-7.8	<5	<100	<5-10	<50-110	<.5-.5	<5	<5-10	<10-10	190-1,100	<50-8,000	21-50	<100-550
RB-1													
1989	8.5	<5	<100	<5	<50.0	<.5	<2	<5.00	<10	80	<10	9	200
1990	6.8-8.1	<5	<100	<5	<50.0	<.5	<5	<5.00	10	50	<50	<5	430
SP-1													
1989	7.1-8.8	<5	<100	<5	<50.0	<.5	<2	<5.00	<10	10-80	<10	44	<100
1990	6.2-8.6	<5	<100	<5	70.0	<.5	<5	<5.00	NR	50-70	<50	34-37	250

NR = Nonreporting

Monitoring Results for Surface Water Stations
Tailings Pond (TP) and Main Drain (MD)

Year	Concentration Ranges												
	pH	As Total µg/l	Ba Total µg/l	Cd Total µg/l	Pb Total µg/l	Hg Total µg/l	Se Total µg/l	Ag Total µg/l	Cu Total µg/l	Fe Total µg/l	Mn Total µg/l	Zinc Total µg/l	Al Total µg/l
TP													
1989	6.4-8.7	<5.0	200-400	<5.0-12.0	90.0-160	<0.50-1.00	4.0-7.0	<5.0-9.0	<10-60	240-2,000	410-3,400	11-34	480-1,220
1990	5.7-7.1	<5.0	<100-120	<5.0-14.0	<50.0-70.0	<0.50-0.50	4.0-9.0	<5.0-6.0	10-20	170-400	270-950	<5-112	<100-550
MD													
1989	5.8-7.1	<5.0	200-800	5.0-8.0	70.0-100.0	<0.50-1.00	<2.0	6.00-9.00	10-20	3,500-5,000	1,200-1,600	9-124	<100-880
1990	5.2-7.7	<5.0	<100-460	5.0-10.0	<50.0-130.0	<0.50-0.80	<2.0-<5.0	<5.00-10.00	10-20	2,700-9,400	910-9,600	26-42	<100-650

NR = Nonreporting

Monitoring Results for Surface Water Station in Salmon River (SLMR 1, SLMR 2, and SLMR 3)

Year	Concentration Ranges												
	pH	As Total µg/l	Ba Total µg/l	Cd Total µg/l	Pb Total µg/l	Hg Total µg/l	Se Total µg/l	Ag Total µg/l	Cu Total µg/l	Fe Total µg/l	Mn Total µg/l	Zn Total µg/l	Al Total µg/l
SLMR 1													
1989	6.5-8.2	<5.0	<100	<5.0	<50.0	<0.50-0.70	<2.0	<5.00	<10-10	40-470	<10-20	11-22	<100-510
1990	7.3	<5.0	110	<5.0	<50.0	0.60	<5.0	<5.00	20	<50	<50	<5	100
SLMR 2													
1989	6.5-8.1	<5.0	<100	<5.0	<50.0	<0.50	<2.0	<5.00	<10	20-520	<10-20	10-11	<100-550
1990	7.0	<50	110	<5.0	<50.0	<0.50	<5.0	<5.00	<10	50	<50	<5	<100
SLMR 3													
1989	6.8-7.6	<5.0	<100	<5.0	<50.0	<0.50	<2.0	<5.00	<10	90-350	10-20	5-14	<100-410
1990	6.7	<5.0	<100	<5.0	<50.0	<0.50	<5.0	<5.00	<10	2,000	<50	<5	210

NR = Nonreporting

Monitoring Results for NPDES Permitted Discharges to Buckskin Creek (001), Pat Hughes Creek (002), and Bruno Creek (003)

Year	Concentration Ranges												
	pH	As Total µg/l	Ba Total µg/l	Cd Total µg/l	Pb Total µg/l	Hg Total µg/l	Se Total µg/l	Ag Total µg/l	Cu Total µg/l	Fe Total µg/l	Mn Total µg/l	Zn Total µg/l	Al Total µg/l
001													
1989	7.0-9.2	<5.0	NR	4.0-<5.0	<50.0	<0.20-24.00	NR	NR	<10-<20	60	NR	4-27	NR
1990	7.1-8.9	<5.0	NR	<5.0	50.0	0.40-0.80	NR	NR	<10	NR	NR	8-19	NR
002													
1989	6.6-8.9	<5.0	NR	<5.0-9.0	<50.0-44,000[3]	<0.20-10.90	NR	NR	<10-20	50-80	NR	<5-172	NR
1990	6.4-8.9	<5.0	<100	<5.0-8.0	<50.0-70.0	<0.20-5.00	<5.0	<5.00	<10-20	70	<50	<5-65	300
003													
1989	6.6-8.3	<5.0	<100	<5.0	<50.0	<0.50	<2.0	5.00	10	50	30	20	<100
1990	6.3-8.1	<5.0	<100	<5.0	60.0	2.00	<5.0	<5.00	<10	110	70	10	130

NR = Nonreporting

[3]This value may be inaccurate because the results of analysis of all other samples collected from outfall 002 showed lead levels of 90 µg/l or less. No other information was available.

Monitoring Results for Surface Water Stations in Thompson Creek (TC-1, TC-2, TC-3, and TC-4)

Year	Concentration Ranges												
	pH	As Total µg/l	Ba Total µg/l	Cd Total µg/l	Pb Total µg/l	Hg Total µg/l	Se Total µg/l	Ag Total µg/l	Cu Total µg/l	Fe Total µg/l	Mn Total µg/l	Zn Total µg/l	Al Total µg/l
TC-1													
1989	6.6-8.1	<5.0-6.0	<100	<5.0-27.0	<50.0	<0.50-2.60	<2.0	<5.00	<10-20	20-30	10	<5-21	<100
1990	6.2-7.8	<5.0	<100	<5.0	<50.0	<0.50	<5.0	<5.00	<10	100	<50	<5	380
TC-2													
1989	6.7-7.7	<5-11	<100	<5.0	<50.0	<0.50	<2.0	<5.00	<10-<20	130	10	11-25	<100
1990	6.3-7.9	NR	NR	NR	<50.0	<0.50	<5.0	<5.00	<10	<50	<50	NR	NR
TC-3													
1989	6.8-7.8	<5.0	<100	<5.0	<50.0	<0.50	<2.0	<5.00	<10-<20	40	<10	6-18	<100
1990	6.1-8.0	NR	NR	NR	<50.0	<0.50	<5.0	46.00	<10	230	<50	NR	NR
TC-4													
1989	5.9-7.9	<5.0	<100	<5.0-9.0	<50.0	<0.50-6.80	<2.0	46.00	<10-20	20-400	<10	<5-166	<100
1990	6.2-7.9	<5.0	<100	<5.0-6.0	<50.0-70.0	<0.20-2.90	<5.0	<5.00	<10-20	140	<50	<5-18	190

NR = Nonreporting

General Surface Water Parameter Concentrations for Pit Sump (PIT 1, PIT 2, and PIT 3)

Year	Parameter Range Concentrations												
	pH FLD	Arsenic Total µg/l	Barium Total µg/l	Cadmium Total µg/l	Lead Total µg/l	Mercury Total µg/l	Selenium Total µg/l	Silver Total µg/l	Copper Total µg/l	Iron Total µg/l	Mangns Total µg/l	Zinc Total µg/l	Aluminum Total µg/l
PIT 1													
1989	6.8-7.0	10-36	NR	<5.0-27.0	50.0	<0.50	NR	NR	10	2,500	NR	20-27	NR
1990	6.3-6.7	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
PIT 2													
1989	6.5-7.4	<5.0-77.0	NR	<5.0-68.0	<50.0-150.0	<0.50-19.20	NR	NR	<10-90	460-1,900	NR	<5-302	NR
1990	3.6-6.5	<5.0-19.0	NR	5.0-14.0	60.0	<0.50	NR	NR	50-210	NR	NR	337-1,080	NR
PIT 3													
1989	6.5-7.3	<5.0-129.0	NR	<5.0-5.0	<50.0-80.0	<0.50-50.00	NR	NR	10-30	NR	NR	6-67	NR
1990	5.9-7.0	167	<100	<5.0	<50.0	<0.50	<20.0	<5.00	<10	700	1,300	<5	570

NR = Nonreporting

Cyprus Thompson Creek Mining Company
Concentrator Daily Tailings Composit Assays

Report Date: 28/Jan/91

Sample	Molybdenum Percent	Copper Percent	Lead Percent
Rougher Tails	0.009	0.002	0.002
Combined Tails	0.009	0.004	0.003
Scavenger Tails	0.073	0.150	0.051
Rougher Concentrate	8.11	0.130	0.060
1st Cleaner Concentrate	43.40	0.620	0.180
2nd Cleaner Tails	34.10	1.300	0.240

Surface Water Monitoring Locations:

SQ-2:
Squaw Creek below the confluence with Bruno Creek and 25 feet above the second bridge above the gate.
SQ-2.5:
Squaw Creek 250 feet below the confluence with Bruno Creek (at boulder).
SQ-3:
Squaw Creek above the confluence with Bruno Creek and 100 feet below Redbird mine.
SQ-4:

Bruno Creek at the U.S. Gauging Station (USGS) and above the guard gate.
TC-1:
Thompson Creek 250 feet below the confluence with Pat Hughes Creek and one mile above the Transfer Pump Sump.
TC-2:
Thompson Creek one-fourth mile above the confluence with Pat Hughes Creek and below the confluence with Unnamed Creek.
TC-3:

Thompson Creek above the confluence with Unnamed Creek and below the confluence with Buckskin Creek.
TC-4:
Thompson Creek above the confluence with Buckskin Creek and below the confluence with Alder Creek.
001:
Buckskin Creek sediment dam discharge point.
002:
Pat Hughes Creek sediment dam discharge point.
003:

Beaver Pond sediment control structure - storm water discharge point on Bruno Creek.
PITS 1-3:
Locations in pit sump used for dewatering.
SLMR1:
Salmon River, 50 feet below steel ladder bridge (access road). South bank.
SLMR2:
Salmon River, at parking flat directly above concrete bridge. South bank.
SLMR3:
Salmon River, 50 feet above mouth of Thompson Creek.
TP:
Tailings pond (barge).

MD:

Main drain (lower center) of the rock toe.

LA:

Left abutment of the rock toe.

RA:

Right abutment of the rock toe.

PBS:

Pumpback system, inlet to sump on lower tailings road south of the Seepage Return Dam.

DS-1:

First downstream spring 100 feet below pumpback system and 25 feet below the monitoring well on Bruno Creek (east bank).

SP-1:

Sediment pond at elevation 6,640 feet on Bruno Creek, one-half mile below pumpback system.

RB-1:

Redbird Creek tributary to Squaw Creek one mile above Redbird Mine.

Ground Water Monitoring Locations:

MW-1:

Monitoring well located approximately 100 feet below the Seepage Return Dam.

BC-3:

Former production well on lower Bruno Creek at Pope John Boulevard.

LA-2:

Monitoring well located on the left abutment above the centerline of the tailings impoundment.

RA-2:

Monitoring well located on the right abutment (west edge) of the tailings impoundment and one-half mile off of the upper mine (motivator) road.

Ground Water Monitoring Results for Bruno Creek Artesian Well (BC-3), Tailings Left Abutment Well (LA-2), SRD Monitoring Well (MW-1), and Tailings Right Abutment Well (RA-2)

Year	Concentration Ranges												
	pH	As Total µg/l	Ba Total µg/l	Cd Total µg/l	Pb Total µg/l	Hg Total µg/l	Se Total µg/l	Ag Total µg/l	Cu Total µg/l	Fe Total µg/l	Mn Total µg/l	Zn Total µg/l	Al Total µg/l
BC-3													
1989	6.9-7.9	<5.0	<100	<5.0	<50.0	<0.50	<2.0	<5.00	<10	6,500-7,400	140-170	80	<100
1990	6.6-7.6	<5.0	<100	<5.0	<50.0	<0.50	<5.0	<5.00	NR	4,200-7,200	100-130	<5-34	<100
LA-2													
1989	6.7-7.2	<5.0	<100	<5.0	<50.0	<0.50	<2.0	<5.00	<10-10	350-530	60-100	8-18	150-300
1990	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
MW-1													
1989	6.6-7.7	<5.0-23.0	300	<5.0-32.0	<50.0-190.0	<0.50-3.30	<2.0	<5.00	<10-120	2,100-14,000	100-890	20-11,800	44,000
1990	6.7-8.0	<5.0	<100	7.0	60.0	<0.50	<5.0	<5.00	NR	1,800-2,000	70-90	68-137	420
RA-2													
1989	6.4-6.8	8.0-17.0	<100	<5.0	<50.0	<0.50	<2.0	<5.00	<10-<20	1,400-5,300	150-440	<5-36	600-1,400
1990	5.8	<5.0	130	<5.0	<50.0	<0.50	<5.0	<5.00	<10	210	<50	17	600

NR = Nonreporting

APPENDIX B

CYPRUS MINERALS COMPANY COMMENTS

Cyprus Comments on EPA's Thompson Creek Mine Report

June 5, 1992

The following comments on EPA's MINE SITE VISIT: CYPRUS THOMPSON CREEK (draft) dated April 1992 are presented in accordance with the reports organization.

INTRODUCTION

Background

Page 1, at the bottom of the page, the correct titles and company names are:

Cyprus Minerals Company

Les Darling, Director, Environmental Affairs *(303) 643-5325*

Cyprus Copper Company

Jamie Sturgess, Manager, Environmental Affairs, *(303) 643-5782*

Page 2, at the top of the page, the correct titles and company names are:

Cyprus Thompson Creek *(208) 838-2200*
Bert Doughty, Supervisor, Environmental Affairs
Don Hilleary, Chief Engineer
Jim Kopp, Operations Supervisor
Marvin Harmer, Chief Metallurgist
Turk Terrill, Mine Superintendent

Dave Bergby

General Facility Description

Page 2, first paragraph, last sentence should read:

> *The active facility is located on nearly 1,935 acres of mixed ownership including: private lands (521 acres), Bureau of Land Management administered federal land (781 acres), and USFS administered federal land (633 acres of the Challis National Forest).*

Page 2, first paragraph, the following sentence should be added to the end of the paragraph (above):

> *Cyprus controls a mineral claim block of about 16,000 acres around the Thompson Creek Mine.*

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June 5, 1992
page 2

Page 2, second paragraph, first sentence should read:

The mine is located in Custer County, approximately 35 miles southwest of Challis, the county seat of Custer County.

Page 4, second full paragraph, first sentence should read:

The Cyprus Thompson Creek Mine site currently consists of (1) an open pit mine and two associated waste rock dumps, (2) a primary crusher, (3) a mill that includes grinding, concentration by flotation, and (4) a tailings impoundment.

Environmental Setting

Page 5, Figure 2.: The figure shows a non-existing "unnamed creek" flowing from the pit to the Salmon River between Pat Hughes Creek and Buckskin Creek. It also shows a settling pond on this unnamed and non-existing drainage. This Figure should be corrected.

Page 7, third paragraph: Delete the last sentence as it duplicates the penultimate sentence.

Page 8, first incomplete paragraph, last sentence should read:

Other than the on-site wells, the nearest drinking water well is at the Red Bird Mine three miles from the mine site.

Facility Operations

Page 9, first paragraph, fourth, fifth and sixth sentences should read:

In 1986, the mill was shut down for one month. The mill was also inactive from October 1987 to March 1988, when only minor stripping operations (i.e., removal of overburden and waste rock) were underway. Again, from May 1991 to November 1991 the mill was not operated but waste rock and overburden stripping operations in the mine continued to access additional ore.

Mining Operations

Page 9, second paragraph, second to the last sentence should read:

The pit currently extends down to the 7,050 foot level, with plans to expand down to an elevation of 6,400 feet (i.e., to a depth of 2,000 feet).

Page 9, third paragraph, second to the seventh sentence should read:

The ore is accessed by drilling and blasting along 50 foot benches. Drilling is accomplished using Marion electric drills and a typical blast pattern consists of

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between 30-40 holes. ANFO, a blend of ammonium nitrate and diesel fuel, is used as the blasting agent (10,000 tons of ANFO is used annually). (Waste oil has been substituted for diesel fuel in the ANFO mixture, however, it is currently not being used pending MSHA approval.) On average, one blast occurs every other day. After fragmentation, ore and waste rock are excavated using P & H electric shovels. Cyprus currently has two 28 cubic yard shovels, one 17 cubic yard shovel, and two 15 cubic yard shovels.

Page 10, continuation of previous page paragraph, first sentence should read:

The stripping ratio is approximately 2:1 (waste rock:ore).

Milling Operations

Page 10, second paragraph, third and fourth sentence should be replaced with:

The gyratory crusher is equipped with a bag house for controlling particulate emissions.

The water sprays are on the portable crusher which is intermittently used for gravel production.

Page 10, third paragraph, second sentence should read:

The conveyor belt is 2,350 feet long and 60 inches wide.

Page 10, third paragraph, fourth sentence should read:

2 Separate days

However, Cyprus personnel indicated that 75,000 tons of ore comprise the "active" portion of the pile.

Page 10, third paragraph, sixth sentence to the end of the paragraph should read:

Ore is removed from the surge pile by eight feeders underneath the pile. The ore is then transported to two parallel grinding circuits. In each circuit, the ore initially enters a 32 foot diameter semi-autogenous grinding (SAG) mill. The outputs from the SAG mills is passed over 0.75 inch screens and flows into cyclone separators. The overflow from the cyclones goes directly to flotation, while the underflows go to 16.5 foot by 26 foot ball mills for further grinding prior to flotation. Grinding is a wet process and burned lime is added for pH control. In 1990, Cyprus used an average of 0.132 pounds of lime per ton of ore. The grinding circuit product is 35 percent solids.

Page 10, last paragraph, third and fourth sentences should read:

Fuel oil is used as the collector, alcohol is used as the frother, while a Nokes

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reagent (P_2S_5 & NaOH) is added in the cleaner stages to depress copper and lead. In 1990, Cyprus used an average of 0.117 pounds of fuel oil, .025 pounds of alcohol, and 0.011 pounds of Nokes reagent per ton of ore.

Page 10, last paragraph, last sentence should read:

The effluent from the small ball mill is then subjected to ten additional stages of flotation, called "cleaner" stages, to progressively upgrade the concentrate.

Page 12, first paragraph, third sentence should read:

The larger particles (those that don't pass through the screen) are sent to Cyprus' High Performance Molybdenum (HPM) plant.

Page 12, first paragraph, after the fourth sentence the following should be added:

The higher grade (screen oversize) reports to either the high grade flotation plant or the drying and packaging plant, depending upon market requirements. In the high grade plant the moly is reground and subjected to either one or two stages of column flotation, again dependent upon market conditions.

Page 12, first paragraph, the sentence after the addition directly above should read:

The concentrate, which is 15-18 percent water, is then passed through a filter press. The filtrate....

Page 12, second paragraph, beginning with the second sentence to the end of the paragraph should read:

When dry, the concentrate is a very fine powder, about 54 to 59 percent molybdenum disulfide with less than 9.0 percent water and 1.0 percent fuel oil. The concentrate is packaged in 4,000 pound bags and sent by truck to deep water ports or the Cyprus Sierrita facility in Arizona for roasting.

Page 12, last paragraph, first and second sentences should read:

The "higher grade" larger crystals from the final cleaner stages go to a filter. They are then separately filtered and dried in the holoflyte dryer/rotary kiln.

Page 12, last paragraph, a sentence should be added at the end that reads:

This product is ≈ 59 percent Mo with less than one percent water and 0.1 percent fuel oil.

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Waste Management - Waste Rock

Page 13, second paragraph, first sentence should read:

As noted in the previous chapter, approximately 16.2 million cubic yards of waste rock were generated in 1990, with the stripping ratio typically about 2:1 (waste:ore).

Page 13, third paragraph, fourth and fifth sentences should read:

The dump is currently ~~800~~ 1306 feet high and is planned to eventually extend from an elevation of 8,100 feet to 7,600 feet. A 300-foot-wide bench, which enhances stability, is currently situated at the 7,600 elevation.

Page 14, last paragraph, delete the last sentence and replace it with the following:

Seventy-six volcanic samples were run for acid base accounting with NP/AP ratios of over 31:1.

Page 15, first paragraph, penultimate sentence should read:

A NALCO coagulant is added to the sediment ponds during the spring to help control total suspended solids levels in the pond discharges.

Tailings

Page 15, second paragraph, the paragraph section above the table should read:

When the mill is operating at full production, tailings are generated at a rate of approximately 7.5 million cubic yards per year. On a 10/4 mill operating schedule, about 5.5 million cubic yards of tailings are produced each year. Cyprus continuously monitors the composition of concentrates and tailings generated by each flotation stage to assess mill performance. Samples are collected every 15 minutes and composited for analysis every 24 hours. The results of one recent analysis of a 24-hour composite are presented in Table 1. As indicated in the previous section, only the rougher and scavenger tails are sent to the tailing impoundment.

Page 16, first paragraph, first sentence should read:

Tailings flow from the mill in a 30-inch diameter high density polyethylene (HDPE) pipeline that extends 7,000 feet north-northeast to the tailings impoundment located in the Bruno Creek drainage.

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Page 16, first paragraph, last sentence should read:

The pipeline is placed in a ditch along its entire length to provide secondary containment.

Page 16, third paragraph: Strike the tenth sentence: "Cyprus personnel indicated that approximately 120 gpm of tailings water is lost to infiltration." We are unsure of the meaning of this sentence. Infiltration to what? Water that seeps through the tailing impoundment is captured in the seepage collection ponds below the impoundment. We have no evidence that there is any tailing water lost to groundwater flows out of the drainage area.

Page 16, fourth paragraph, second sentence should read:

Piezometers and open-ended standpipes are used to monitor stability in the impoundment.

Page 17, second paragraph, second sentence should read:

Therefore, to ensure no discharge of seepage to Bruno Creek, a lined sump was installed further downstream in the Bruno Creek drainage.

Page 17, second paragraph, fifth sentence should read:

Seepage collected in both the seepage return pond and the downstream sump is pumped back to the reclaim water head tank at the mill.

Page 18, second paragraph, last sentence should read:

Limited static testing performed on a whole tailings sample from which pyrite was recovered indicated a NP/AP ratio in excess of 4:1 compared to an average value of 0.84:1 for all tailings analyses (Steffen Robertson & Kirsten 1991a).

Mine Water

Page 18, last paragraph, second sentence should read:

However, groundwater seepage to the pit began in 1988 when the pit reached the 7,300 foot elevation (a depth of about 1,000 feet below the surface).

Page 18, last paragraph, fourth sentence should read:

According to Cyprus personnel, an average of 200 gpm of mine water is pumped out of the pit to a booster station and pumped to the tailings pond.

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Page 18, last paragraph, after above fourth sentence the following sentence should be added:

Because the mill was down during spring runoff of 1991, mine water was combined with underflow collected from Pat Hughes Waste Rock dump and discharged through NPDES outfall 002 after receiving approval from EPA.

Page 19, second footnote at the bottom of the page, the following sentence should be added:

Laboratory contamination of the sample bottles is suspected as a source for the anomalous mercury values.

Other Materials and Wastes--Waste Oil/Grease/Fuel

Page 20, second paragraph, fourth sentence should read:

Two 13,000 underground tanks are used for gasoline storage. Waste oil is collected in two above ground 10,000 gallon tanks near the shops.

Capacitors

Page 20, last paragraph, should read:

Capacitors. Only one shipment of PCB contaminated capacitors was manifested and shipped off-site since startup of the mine. According to Cyprus there is no remaining PCB- contaminated electrical equipment on the Thompson Creek Mine property.

Regulatory Requirements and Compliance

Page 22, first paragraph, first sentence should read:

Cyprus Thompson Creek operates under several permits and/or approvals issued by the State of Idaho Department of Lands, Division of Environmental Quality, and Water Resources as well as approvals from the U.S. Forest Service (USFS) and EPA Region X.

Page 22, first paragraph, third sentence should read:

The interagency task force for the Thompson Creek site meets quarterly and includes representatives of the State Departments of Lands, Fish and Game, Department of Water Resources, and Divison of Environmental Quality, USFS, and BLM.

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Page 22, fourth paragraph, delete the second sentence that states:

> *However, because of the proximity of their offices, USFS personnel are at the site almost daily.*

Water Quality Monitoring

Page 23, second paragraph, second sentence should read:

> *Monitoring for pH and metals is required to ensure no degradation of surface and ground water in the Salmon River basin (Cyprus 1991c).*

Acid Rock Drainage Study

Page 23, third paragraph, last sentence should be replaced with the following two sentences:

> *According to USFS personnel who participated in the site visit, the revisions to the Plan of Operations will be subjected to the environmental review requirements of the National Environmental Policy Act (NEPA). This review may include the preparation of a supplemental Environmental Impact Statement.*

Bonding

Page 23, fifth paragraph, last sentence: Delete "and insurance." Cyprus has met its bonding requirements through the posting of an appropriate surety bond. Our insurance status has nothing to do with bonding.

NPDES Permit

Page 28, third paragraph, the second and third sentences should read:

> *This pond discharges to Squaw Creek at NPDES outfall 003. Cyprus is required to monitor Squaw Creek upstream and downstream of this outfall for turbidity.*

Air Permit

Page 29, first bullet under Air Permit section should read:

> *Baghouses are located at the crusher, at the turning point of the conveyor, at the lime bin, at the product package area, and at the HPM plant,*

Page 29, fourth bullet, change the period at the end of the bullet to a comma.

Page 29, after fourth bullet, add fifth bullet stating:

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Holoflyte/Rotary kiln stack on HPM plant.

Dam Safety Permit

Page 29, third paragraph, first sentence should read:

As required under Idaho State law, Cyprus Thompson Creek has a dam safety permit issued by the Department of Water Resources for the main tailings embankment and the SRD.

APPENDIX C

EPA RESPONSES TO CYPRUS MINERALS COMPANY COMMENTS ON DRAFT SITE VISIT REPORT

EPA RESPONSES TO CYPRUS MINERALS COMPANY JUNE 5, 1992, COMMENTS ON DRAFT MINE SITE VISIT REPORT: CYPRUS THOMPSON CREEK MINE

A copy of the draft *Mine Site Visit: Cyprus Thompson Creek Mine* was provided to Cyprus Minerals Corporation for their review. EPA has addressed the comments submitted by Cyprus Thompson Creek (See Appendix C) in the revised report as described below:

Comment 1:Cyprus provided clarifications of the titles and corrected telephone numbers for several of the individuals who participated in the site visit.

Response:The text has been changed accordingly.

Comment 2:Cyprus clarified the ownership of specific areas of the property and indicated that the mine is 35 miles from Challis, ID.

Response:The text has been changed accordingly.

Comment 3:Cyprus clarified the general descriptions of the operations at the site.

Response:The text has been changed accordingly.

Comment 4:Cyprus indicated that the draft report described a surface water body, Unnamed Creek, that is not found at the site.

Response:References to Unnamed Creek have been deleted from the text and figures.

Comment 5:Cyprus indicated that the nearest drinking well is located at the Redbird Mine (3 miles from the site) not at the Ranger Station (6 miles from the site).

Response:The text has been changed accordingly.

Comment 6:Cyprus clarified the history of operations including indicating that milling operations resumed in November 1991.

Response:The report has been edited to reflect these change, including a parenthetical reference to the restart of milling operations after the site visit in November 1991.

Comment 7:Cyprus provided a corrected elevations for the current and planned depths of the pit.

Response:The text has been changed accordingly.

Comment 8:Cyprus clarified the description of mining operations, indicating that waste oil was no longer being used in the ANFO mixture (pending MSHA approval).

Response:

The text has been changed accordingly.

Comment 9:

Cyprus commented that while the stripping ratio was 4:1 in 1990, the average stripping ratio over the life the time is expected to be closer to 2:1.

Response:

The report has been edited to indicate an average stripping ratio of 2:1 over life of the mine.

Comment 10:

Cyprus provided clarification of the description of milling operations, including specific information about the HPM plant and the compositions of the high and lower, technical grade products. Cyprus further indicated that there are two separate dryers (a dryer for the HPM concentrate and a dryer for the technical grade concentrate). Cyprus noted that the gyratory crusher is equipped with a baghouse to control dust emissions (not water sprays). Water sprays are used to control dust emission from the portable crusher used to produce gravel.

Response:

The text has been changed accordingly.

Comment 11:

For the Buckskin dump, Cyprus provided corrected elevations for the top and bottom of the dump. In their written comments, the elevation of the bottom of the Buckskin was inadvertently listed as 7,600 feet. Cyprus was subsequently contacted telephone to clarify this information. Cyprus personnel indicated that the Buckskin dump currently extends from 8,100 feet down to 6,800 feet. In addition, Cyprus personnel noted that the has a second 300 foot wide bench at the 7,900 foot level. Cyprus further indicated that the NALCO coagulant is added to the sedimentation ponds located downstream of the waste rock piles to control TSS (not TDS).

Response:

The text has been changed accordingly.

Comment 12:

Cyprus summarized available acid base accounting data for the volcanic rocks.

Response:

The text has been changed accordingly.

Comment 13:

Cyprus clarified the annual quantity of tailings generated (based on full production and the current 10/4 mill operating schedule). Cyprus also corrected the frequency of concentrate and tailings analyses.

Response:

The text has been changed accordingly.

Comment 14:

Cyprus commented that the tailings pipeline is located in a ditch along it entire length to provide for secondary containment.

Response:

The report has been edited to reflect this comment. The revised report continues to indicate that the ditch is unlined.

Comment 15:

Cyprus requested deletion of the sentence "Cyprus personnel indicated that approximately 120 gpm of tailings water is lost to infiltration."

Response:

This sentence has been deleted from the report.

Comment 16:

Cyprus indicated that open-ended standpipes are used along with piezometers to monitor stability in the tailings impoundment.

Response:

The report has been edited to include this information.

Comment 17:

Cyprus indicated that the pumpback sump is lined (but not concrete) and that seepage collected in the SRD and the sump are returned directly to the mill (not the tailings impoundment).

Response:

The text has been changed accordingly.

Comment 18:

Cyprus provided corrected data on acid base accounting of tailings from which pyrite was recovered.

Response:

The text has been changed accordingly.

Comment 19:

Cyprus clarified mine water generation and management, specifically indicating that mine water is generally pumped to the tailings impoundment. Only during Spring 1991 (when the mill was shutdown), mine water was combined with the underflow from the Pat Hughes Dump and discharge through outfall 002 (with EPA's prior approval).

Response:

The text has been changed accordingly.

Comment 20:

Cyprus requested that the Footnote 1 in Table 2 indicate that Cyprus suspects that the "anomalous" mercury values were caused by laboratory contamination.

Response:

The footnote now reflects Cyprus' suggestion that the elevated levels were caused by laboratory contamination.

Comment 21:

Cyprus provided corrected volumes for several tanks. Cyprus further indicated that, during the life of the mine, there has been only one shipment of PCBs manifested and disposed off-site. According to Cyprus, there is no longer any PCB-contaminated electrical equipment at the site.

Response:

The text has been changed accordingly.

Comment 22:

Cyprus clarified the names of several State agencies that participate in the interagency Task Force, and requested deletion of the reference to USFS personnel visiting the site "almost daily."

Response:

The report has been edited to include the correct agency names and the reference to almost daily visits by USFS personnel has been deleted.

Comment 23:

Cyprus changed a reference from the Salmon Creek basin to the Salmon River basin.

Response:

The text has been changed accordingly.

Comment 24:

Cyprus indicated that the revisions to the Plan of Operations to address acid rock drainage will require NEPA review and may require a supplemental EIS.

Response:

The text has been changed accordingly.

Comment 25:

Cyprus indicated that their insurance status has no relation to their bonding.

Response:

The text has been changed accordingly.

Comment 26:

Cyprus clarified that the storm water sediment pond discharges to Squaw Creek, not Bruno Creek, and that monitoring is required above and below the pond discharge in Squaw Creek.

Response:

The text has been changed accordingly.

Comment 27:

Cyprus indicated that their air permit addresses a total of five emission sources, including the stacks of both holoflyte dryers/rotary kilns.

Response:

Both dryers have been identified as separate emission sources in the report. In addition, the section now indicates that water sprays are used to control emissions from the portable crusher.

Comment 28:

Cyprus clarified that the Department of Water Resources is the issuing agency for their dam safety permit.

Response:

The text has been changed accordingly.