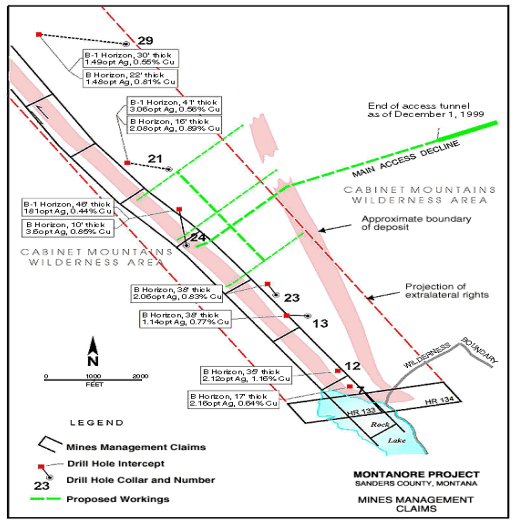
MONTANORE PROJECT

REVISED APPLICATION

HARD ROCK OPERATING PERMIT

PLAN OF OPERATIONS



Volume 1

April 2005 Revision

July 2005 Corrections

Mines Management, Inc.

ERRATA

Please remove and discard the previous versions of the following items, and replace with these updates.

- **Page 157, Section 12.2.1.** Last paragraph stated, *"Figure X provides the conceptual layout and location of the facility."* The correction to the text was made, and now reads, "Figures 51 and 52 provide the conceptual layout and location of the facility."

  Copies of pages 157 through 160 are included for replacement.

- **Table 12-1.** Several elements were added to Table 12-1, and copies of the revised table are enclosed.

- **Figure 32.** This figure was revised to better illustrate private, state, and National Forest lands as well as the permit boundary and transmission line route. Copies of the revised figure are enclosed.

1.0 INTRODUCTION

The application was revised to address USFS comments related to public scoping. Changes made to the text have been italicized. Mines Management is currently addressing agency comments and updating baseline data for the project.

1.1 APPLICANT'S PROPOSAL

Mines Management, Inc. (Mines Management), an Idaho Corporation, is submitting this revised permit application for the Montanore Project. Mines Management was formed in 1947 and has operated two zinc/lead mines and completed exploration throughout North and South America.

In 1988, Mines Management entered into a merger with Heidelberg Mining, owner of certain mining claims within the Montanore Project, and Mines Management became the surviving company. U.S. Borax assembled the original claim block including Heidelberg and other claims. A lease agreement was established between Noranda Mineral Corporation (Noranda) and U.S. Borax, and the claims were ultimately acquired by Noranda. *Noranda quit claimed HR 133 & 134, intellectual data, and unpatented mining claims to Mines Management which now controls the deposit.* Noranda submitted a Plan of Operation for the Montanore Project to the Federal and State approving agencies initiating an extensive review process. The Montanore Project was fully permitted with modifications and conditions established by the approving agencies as described in more detail below.

Other than initial exploration, Noranda did not pursue the Montanore Project for various reasons, and in 2000, Noranda decided to withdraw from the property. Under the agreement between Noranda and Mines Management, all unpatented mining and mill site claims, intellectual data, drill core, and other information that pertained to the Montanore Project was transferred to Mines Management.

Over the last several months, Mines Management evaluated the project in consideration of re-initiating the development and operation of the project. During this time period, Mines Management met with the various regulatory agencies to discuss submittal of the permit application, and in October 2004, a General Project Description was presented to the regulatory agencies to initiate formal re-authorization of the project.

As mentioned previously, the Montanore Project was fully permitted for construction and operation. The State of Montana issued Operating Permit No. 00150 on May 14, 1993. On September 28, 1993, the U.S. Forest Service issued a Record of Decision (ROD) that outlined and approved the preferred project alternative of the approving agencies. This preferred project alternative modified Noranda's submitted Plan of Operation. During the time period between project approval and 1996, Noranda worked further with the agencies to revise the approved modified Plan of Operation to incorporate additional mitigation and monitoring. This application constitutes Mines Management's re-submittal of the revised 1996 Noranda Plan of Operation that reflects the agency's preferred alternative with the additional mitigation and monitoring.

This application includes all the mitigation and project revisions required in the 1993 ROD and project revisions through 1996. The baseline data collected as part of the original application submittal is still valid and included in this application. Certain data has been or is being updated to reflect any additional information that may be available in the public domain. Further, the Montanore Project will undergo an additional National Environmental Policy Act/Montana Environmental Policy Act (NEPA/MEPA) analysis over the upcoming several months. This analysis will review all data and consider the adequacy of the baseline data to support the environmental review and re-authorization of the project. The baseline data will be used along with any supplemental data to address any regulatory changes since the 1993 approval and 1996 revision.

Because the original Noranda application went through an exhaustive public and agency review process, certain aspects of that application (alternatives) are not revisited in this application by Mines Management. Because Noranda originally included alternative

consideration, the 1993 NEPA/MEPA process developed and considered alternatives, and Mines Management has not changed the project; no additional alternatives have been included in this application. The proposed action submitted by Mines Management is the agency's preferred alternative that met the environmental review objectives in 1993 and includes additional mitigation and monitoring through 1996. The agencies will be updating the Environmental Impact Statement (EIS) and issuing a new ROD.
Mines Management is in the process of revising other applications submitted by Noranda, part of the overall project approval received at the time, and will include the transmission line, socioeconomic analyses, 404 Permit (Army Corps of Engineers), and other application permits for the project. *It is expected that permit applications for other associated authorizations will be completed as soon as practicable and concurrent with USFS and MDEQ review of this Hard Rock Application.*

The Montanore Project is located about 18 miles south of Libby in the Cabinet Mountains of Northwest Montana (Figures 1, 2, & 3). The ore body is located beneath the Cabinet Mountain Wilderness area. All access and surface facilities will be located outside of the wilderness boundary. The permit area is contained within sections 13, 14, 15, 23, 24, 26, 35, T 28N, R 31W and sections 1, 2, 3, 11, 14, 15, T 27N, R 31W in Lincoln County and sections 6, T 27N, R 31W in Sanders County.

The Montanore Project was originally permitted as a 20,000 ton per day underground mine accessed from twin portals in the Ramsey Creek drainage. Mines Management intends to initially start mine production at approximately 12,500 tons per day expanding to the 20,000 tons per day rate originally approved. Ore will be crushed underground and conveyed to a mill at the surface near the Ramsey Creek portals. Ore will be conveyed to the milling circuit where the crushed ore will be introduced to the mill grinding circuit where the size will be reduced to a fine grained sand particle size. Recovery of the silver and copper minerals will be accomplished using a conventional flotation process producing a silver/copper concentrate. Tailings, a fine grained quartz material, generated from the mill process will be conveyed through a pipeline to the tailing disposal impoundment approximately 4 miles from the mill in the Little Cherry Creek drainage.

Access to the mill and tailing facilities will be by the existing U.S. Forest Service Bear Creek road. The project will require construction of a 17 mile, 230 kV powerline from Pleasant Valley (Sedlak Park) along Highway U.S 2 following the North Miller Creek Alignment (Alternative #5 in the 1993 ROD).

Noranda constructed an evaluation adit from the Libby Creek area towards the orebody. Noranda discontinued the development of the adit, and the site has been reclaimed. Mines Management plans to use the Libby Creek Adit to continue the evaluation effort. *If the Libby Creek Adit is not used, the proposed Ramsey Creek production adit would be used for access to the orebody for evaluation purposes.* A ventilation raise may be required to provide air for underground workers after the initial construction and early operation. This ventilation raise would be positioned in the centroid of the orebody and driven up to the surface in the patented mining claims located near Rock *Lake*. The raise would serve as an in-take feature for ventilation. Current engineering studies underway will determine the time frame this will be required in the project schedule. The required disturbance would be quite small with no surface facilities required.

The Montanore Project would provide approximately 450 new jobs to the local economy of Lincoln County, at full production. Approximately 200-250 new jobs will be generated to support the initial production rate of 12,500 tons per day. This number could grow to 300-400 at 20,000 tons per day mine production. Construction employment will be approximately 350-500 depending on the stage of the construction activities. It is estimated that 80 percent of these positions would be filled by local workers. The mine is expected to operate between 15 to 20 years. At the present time, Lincoln County is in need of an economic stimulant with many people unemployed or under-employed. The increase taxable valuation from the Montanore Project would not solve all the budgetary problems experienced by Lincoln County local governmental units, but the increased revenue would help balance local governmental budgets. Social and economic impacts from the project are not expected to be severe. Fiscal impacts will be identified and addressed in the Hard-Rock Mining Impact Plan which will be submitted *concurrent with review by the USFS and MDEQ of this application.* Input and

assistance from local governmental units in the study area will be necessary to facilitate the preparation of the impact plan.

1.2 MONTANORE PROJECT ALTERNATIVES

As discussed previously, alternatives for the project were thoroughly evaluated and assessed during the previous project review and approval process. This application represents the agencies' preferred alternatives and mitigation, monitoring, and reporting requirements developed during the original approval process. For historical purposes, the following information is retained to provide the reader with the understanding of the alternative analyses that were previously completed for the project.

Considerable time and resources were spent in developing project components and alternatives for the original Montanore Project Hard Rock Operating Permit Application and Proposed Plan of Operation. The evaluation of project alternatives was initiated by U.S. Borax who sold their interests to the Montanore Project (Noranda Minerals Corp. and Montana Reserves). Noranda Minerals Corp., as the operating partner, continued the alternatives identification and selection process that led to the project previously submitted to the agencies and presented as Alternative 1 in the 1992 Final Environmental Impact Statement (FEIS) (USFS, 1992). The agencies developed additional alternatives as part of the environmental impact statement and described in the FEIS. The Alternative selected by the agencies, The Preferred Alternative, was documented in the Record of Decision (ROD) (USFS, 1993). Further, the ROD contained substantial mitigation, monitoring, and reporting requirements all of which are now considered part of the Montanore Project proposed by Mines Management.

In addition to the requirements developed and selected as the Preferred Alternative during the EIS process, the State of Montana issued Montanore Operating Permit #00150. This Operating Permit contains construction, operating, and reclamation conditions all of which are also now considered part of the Montanore Project proposed by Mines Management.

The primary objective for selecting locations for project components was minimization of impacts on the environment without severely impacting project economics. This objective was supported by the EIS and Record of Decision issued by the agencies.

Major consideration was given to finding suitable locations for adit portals for underground access and ventilation, mill site locations, tailings impoundment locations and powerline corridor alignments. Considered in the final analysis were three plant sites, three tailing disposal sites, two transportation routes and two powerline corridors. The alternative plant sites were: (1) Upper Libby Creek, (2) Ramsey Creek, and (3) Upper Rock Creek. The alternative tailing disposal sites were (1) Little Cherry located in the Little Cherry Creek drainage, (2) Poorman Creek located north and west of the Poorman Creek and Libby Creek confluence, and (3) Midas Creek located in the Midas Creek drainage. Alternatives examined for transportation to the site were: (1) the Libby Creek road from Highway 2 to the plant site, and (2) the Bear Creek road from Highway 2 to the plant site. Alternatives for powerlines include a northern alternative originating north of Libby, paralleling a private logging road south to either the Libby or Ramsey Creek plant sites, and two southern alternatives originating near Pleasant Valley which would connect northwest via Fisher River or Miller Creek to one of the plant site alternatives.

The approach was to identify all potential locations to access the deposit and develop various arrangements with alternative sites for the concentrator plant, tailing impoundment, transportation, powerline corridors, and ancillary facilities. Review of these arrangements allowed the immediate elimination of some sites due to obvious conflicts with the environment or because of excessive capital or operating costs. The remaining location alternatives were numerically rated relative to environmental and operating advantages. The selected project alternatives have low environmental impact yet have sound engineering and operating merit.

Selected components for the proposed Montanore Project include an adit constructed from Libby Creek, two portals (one for conveying ore and one for access/egress) and a

plant site on Ramsey Creek, a tailing impoundment facility at Little Cherry Creek, a power supply corridor from Pleasant Valley along North Miller Creek alignment to the Ramsey plant site, with the main transportation route along the Bear Creek road from Highway 2. The location of the facilities on the east side of the Cabinet Mountains was strongly influenced by the lack of suitable tailing disposal sites near the Rock Creek drainage. This, in turn, eliminated the placement of the plant and main portal in the Rock Creek drainage. The location of the main portal and plant in Libby Creek was disadvantaged by the high avalanche hazard and the distance to the ore body relative to the long-term mining program. The Midas Creek tailing impoundment site would require a major stream crossing for the tailing pipeline pipe and much more extensive drainage diversions above the facility and the Poorman tailings disposal site has poor efficiency (expensive construction) and artesian groundwater conditions. The northern powerline corridor (Libby Creek road) and the Fisher River road both have higher utilization for recreation than does the preferred alternative.

There are economic differences between the selected project components and the various alternatives; however environmental considerations were primary factors in site selection for the proposed Montanore Project. Evaluation of the alternatives and definition of the proposed project is well documented. It is believed the selected components for the Montanore Project are the best combination for the project environment and for the mineral development.

It is reasonable to assume the issues that drove the selection of the preferred alternative and project approval by the agencies throughout the approval process remain consistent today. Therefore, those alternatives eliminated during the extensive review and analysis period are anticipated to remain unfavorable in today's project area conditions.

1.3 APPLICATION FORMAT

The Montanore Project Application for a Hard Rock Operating Permit has been structured to meet all the regulatory requirements of the State of Montana, including the Montana Metal Mine Reclamation Act (Title 82, Chapter 4, Part 3). The application follows the same general format as the original permit application to provide continuity in the re-authorization review, and the application has been closely coordinated with the Montana Department of Environmental Quality (MDEQ) and with the U.S. Forest Service (USFS).

The format of this permit application includes four main sections plus appendices. These are:

Environmental Information
General Operating Plan
Reclamation Plan
References and Contributors

The original permit application was prepared and revised by Noranda Minerals Corp. with the assistance of Hydrometrics, Inc. and other professional consultants and is designed to be concise, readable, and understandable. Noranda worked with the various agencies modifying the original application through 1996, primarily by inserting the requirements specified in the agencies' Preferred Alternative and required mitigation, monitoring, and reporting. Mines Management revised the 1996 application to include all mitigation and project changes required by the 1993 Record of Decision and Montanore Operating Permit #00150 issued by the State of Montana. As part of the current agreement with MDEQ and the USFS, Mines Management has gathered updated information available through various agencies (i.e. USFS, MDFWP) and interim monitoring completed by Noranda after 1992 that wasn't incorporated into the application updates. The updated information is provided as separate reports and included in the appendices. Revision to the text has also been accomplished, where applicable.

Environmental and engineering reports are included as appendices in this application.

2.0 AIR RESOURCES AND CLIMATE

The Baseline Air Quality and Meteorology report is contained in Appendix A. The original baseline data was collected to meet state and federal regulations for air modeling purposes. Updates to this air resources and climate section required to reflect regulatory changes that have occurred since the project was approved will be prepared during the NEPA/MEPA analysis as part of the approval/permitting process.

2.1 CLIMATE

The climate of northwestern Montana is classified as *Modified Pacific Maritime*. Annual temperature variations are extreme, with summer highs in excess of 37ºC (99ºF) and winter lows below -25ºC (-13ºF). Precipitation is generally distributed evenly throughout the year with June and December receiving the greatest amounts of precipitation and August receiving the least amount. From the confluence of Libby Creek and Swamp Creek (down gradient from the project) to Elephant Peak (up gradient of the project) the average annual precipitation ranges from less than 20 inches to 100 inches (USDA/SCS, 1974). The SCS map values for the area differ from measured sites by approximately 10%. The Poorman Creek station, MT12, shows a 17-year average annual precipitation of 66 inches. The SCS map value for this site is approximately 75 inches. A linear relationship between elevation and precipitation was developed for the area (r = 0.85), using NOAA and NWS sites within a 30-mile radius. The estimated average annual precipitation at the tailings facility (3,760 feet) is 35 inches. *This data will be reviewed and updated with available published information.*

The mean annual precipitation at Libby is 48.4 cm (19.1 in). Prevailing winds are east to southeast with an average annual wind speed at Libby of 2.7 m/sec (6.0 miles per hour) (U.S. Dept. of Commerce, 1968). *This information will be reviewed and updated with available published information.*

The terrain in the immediate vicinity of the proposed facilities is mountainous with large changes in elevation occurring over short distances. Elevations range from 1,067 m (3,500 ft) in the valley floors to mountain peaks reaching 2,664 m (8,738 ft). Local climatic conditions are greatly influenced by the mountainous terrain.

Snowfall in the general project area (3,000 to 8,000 ft) accounts for 58% to 76% of the annual precipitation. A linear relationship was developed between elevation and snowfall using NOAA, NWS, and SNOTEL sites (r = 0.85). The estimated percentage of the annual precipitation that falls as snow at the tailings facility is 60%, ± 2% at the 90% confidence level (verified by Phil Farnes, SCS, personal communication, 1989).

Data from the Cedar Grove snow survey site shows that the average snow water equivalent of the snow pack ranges from 5 to 12 inches (January through June) with the maximum snowpack occurring in April.

Normal winter rainfall events generally do not cause flood conditions; *however rain on snow events can cause high surface flows. Rain on snow events will also be considered in final design of all appropriate facilities.* Rainfall either turns to snow before reaching the ground or is absorbed by the snowpack. Spring rainfall on snow is estimated to cause bank full streamflow two out of three years and runoff in excess of bank full event once in four years. USFS personnel report that flood causing winter rainfall events in excess of the 25-year, 24-hour storm have been observed every seven to ten years. Floods from these types of rainfall events were observed in 1974, 1975 and 1980 (Phil Farnes, SCS, and Steve Johnson, USFS, personal communications, 1989).

2.2 METEOROLOGY

The Montanore Project began monitoring meteorological parameters on July 1, 1988, at two locations (Figure 4). The Ramsey Creek meteorological station was located near the head of Ramsey Creek in the vicinity of the plant site. At the time, the Montana Air Quality Bureau participated in the monitoring site selection process, and verbal approval of the sites was granted at the time of selection (Driscoll, 1988).

2.2.1 Ramsey Creek Site

The Ramsey Creek site was located approximately 1.6 km (1.0 mi) from the head of Ramsey Creek (T27N, R31W), along the north side of the access road (Figure 4). The site was located on a gentle hillside where the forest had been clearcut allowing an unobstructed area for monitoring.

Parameters measured at the Ramsey Creek site included wind speed, wind direction, and atmospheric stability (sigma theta) at 10 m (32.8 ft) and temperature at four meters (13.1 ft).

Meteorological conditions were recorded at the Ramsey Creek site for a period of one year (July 1, 1988 – June 30, 1989). The average wind speed measured for the period was 2.2 m/sec (4.9 mph).

The most persistent wind directions were from the south-southeast through southwest with winds from these directions occurring 60.7 percent of the time. Maximum wind speeds were associated with south-southeast winds. Figure 5 presents the wind rose at the Ramsey Creek site for the 1988-1989 monitoring year. The wind rose depicts the percentage of time that the wind blows from a particular direction in a certain wind speed.

A summary of the percent occurrence of each stability class for the monitoring year is presented below for Ramsey Creek.

RAMSEY CREEK SITE PERCENT OCCURRENCE OF STABILITY CLASS

Stability Class	Percent Occurrence
A	12.5
B	9.9
C	8.9
D	24.1
E	16.7
F	27.9

Unstable atmospheric conditions (stability categories A, B and C) were recorded 31.3 percent of the time, neutral conditions (stability category D) 24.1 percent of the time, and stable conditions (stability categories E and F) 44.6 percent of the time during the monitoring year.

The average hourly temperature during the monitoring year at Ramsey Creek station was 4.3ºC (39.7ºF). The maximum temperature recorded during the period was 32.8ºC (91.0ºF) occurring on August 24, 1988. The minimum temperature recorded was -31.3ºC (-24.3ºF) on February 3, 1989.

2.2.2 Little Cherry Creek Site

The Little Cherry Creek site is located approximately 215 m (705 ft) north and 90 m (295 ft) east of the end of the road 6212H, T28N, R31W (Figure 4). The site is in a flat area where the forest has been clearcut, allowing an unobstructed area for monitoring. Parameters measured at the Little Cherry Creek site include wind speed, wind direction and sigma theta at 10 m (32.8 ft), relative humidity and solar radiation at 9.1 m (30 ft), and temperature at four meters (13.1 ft). In addition, precipitation is measured at approximately two meters (6.6 ft). The relative humidity, solar radiation, wind speed and temperature data are used to calculate daily evaporation (Penman, 1947).

Meteorological conditions were recorded at the Little Cherry Creek site during the 1988-1989 monitoring year (July 1, 1988 through June 30, 1989). The average wind speed for the period was 1.1 m/sec (2.4 mph) with a maximum hourly average of 8.8 m/sec (19.7 mph) recorded on July 5, 1988.

The most prominent wind directions, which occurred 45.0 percent of the time were from the south-southeast through southwest. Maximum wind speeds were associated with the south-southwest winds. Figure 6 presents the wind rose at the Little Cherry Creek site for the monitoring year.

Atmospheric stability, by percent occurrence, for each stability class is presented below for the Little Cherry Creek Site.

LITTLE CHERRY CREEK SITE

PERCENT OCCURRENCE OF STABILITY CLASS

Stability Class	Percent Occurrence
A	17.8
B	10.1
C	9.7
D	10.3
E	11.3
F	40.8

Unstable atmospheric conditions (stability categories A, B and C) were recorded 37.6 percent of the time, neutral conditions (stability category D) 10.3 percent of the time, and stable conditions (stability categories E and F) 52.1 percent of the time.

The average hourly temperature during the monitoring year was 4.7ºC (40.5ºF). The maximum temperature was 34.8ºC (94.6ºF) recorded on September 2, 1988. The minimum temperature was -32.3ºC (-26.1ºF) recorded on February 4, 1989.

The total precipitation recorded during the monitoring year was 9.56 inches. The largest monthly precipitation total was 3.25 inches, recorded in November. August was the driest month with 0.05 inches.

The average relative humidity for the monitoring year was 61.4 percent. The maximum humidity was 100 percent recorded in July and August and the minimum was 11.7 percent recorded in June, 1989.

The average solar radiation for the monitoring year was 0.16 Langleys per minute (LPM). The maximum hourly average solar radiation was 1.36 LPM. The mean daily solar radiation was calculated by multiplying the monthly average solar radiation (LPM) by 24 hours (1440 minutes). The mean daily solar radiation values for the monitoring year was 230 Langley.

Daily evaporation totals were calculated using concurrent wind speed, temperature, relative humidity and solar radiation data. Calculations are based on methods developed by Penman (1947). The total evaporation calculated for the monitoring year was 34.38 inches. The annual climatological normal Class A pan evaporation for northwestern Montana is 35 inches (U.S. Department of Commerce, 1968).

2.3 AIR QUALITY

The air quality parameters measured at the Montanore Project sites included particulate matter 10 microns or less in diameter (PM 10), total suspended particulate matter (TSP), antimony, arsenic, cadmium, chromium, copper, iron, lead, and zinc concentrations. Samplers were co-located with the meteorological monitoring equipment at the Ramsey Creek and Little Cherry Creek sites. Two co-located PM 10 samplers were located at the Ramsey Creek site. A PM 10 sampler and a TSP sampler were located at the Little Cherry Creek site. Samples from the TSP sampler were the only samples analyzed for trace elements.

The USFS has completed an air quality study of the Cabinet Mountains Wilderness (CMW) using the Magic Model as part of the Rock Creek EIS. This information may be used, as appropriate, for air quality modeling.

2.3.1 Ramsey Creek Site

The PM 10 concentrations measured at the Ramsey Creek site during the monitoring year are shown on the following page.

SUMMARY OF PARTICULATE CONCENTRATIONS

Sampler Location	Measured Concentrations (ug/m³) Maximum	Secondary Maximum	Arithmetic Mean	Geometric Mean
Ramsey No. 1	157	24	12	7
Ramsey No. 2	153	35	13	9
Little Cherry No. 3 (TSP)	267	197	44	33
Little Cherry No. 4	189	31	14	9

	National Standards (ug/m³) PM-10	TSP
Primary 24 hour Maximum	150[1]	260[1]
Secondary 24 hour Maximum	150[1]	150[1]
Primary Annual	50[2]	75[3]
Secondary Annual	50[2]	60[3]

[1] Not to be exceeded more than once per year
[2] Arithmetic mean
[3] Geometric mean not to be exceeded more than once per year.

The maximum PM 10 concentration reported for the period was 157 micrograms per cubic meter (ug/m³) in September 6, 1988. This concentration exceeds the 24 hour federal primary standard of 150 µg/m³ for PM 10 samplers (CFR 52, 1987). The 157 µg/m³ and 153 µg/m³ concentrations measured at the Ramsey Creek site on September 6, 1988 were reviewed (as part of the previous approval) and were believed to be valid. However, performance of a one-sided T-test on the annual data set indicates that these values are statistical outliers. Results of the T-test indicate that these values are representative of an anomalous event and not representative of background conditions. These values are believed to reflect particulate fallout from the numerous forest fires in the region. The annual arithmetic means for Sampler No. 1 and 2 were 12 µg/m³ and 13 µg/m³, respectively. These values are well below the annual primary standard of 50 µg/m³ for PM 10 samples (CFR 52, 1987).

2.3.2 Little Cherry Creek Site

Particulate Concentrations. The TSP and PM 10 concentrations measured at the Little Cherry Creek site during the monitoring year are presented in the *Summary of Particulate Concentrations* chart above. One PM 10 concentration exceeded the 24 hour state and federal secondary concentration of 150 µg/m³ for PM 10 (CFR 52, 1987). The maximum PM 10 concentration recorded for the period was 189 µg/m³ on September 6, 1988. TSP data are not available for September 6, 1988, thus a direct comparison of maximum PM 10 and TSP data cannot be made. The maximum TSP concentration was 267 µg/m³, recorded on October 6, 1988. The 189 µg/m³ and the 267 µg/m³ concentrations measured at the Little Cherry Creek site on September 6, 1988 and October 6, 1988, respectively, have been reviewed and are believed to be valid. However, performance of a one-sided T-test on the annual data set indicates that these values are statistical outliers. Results of the T-test indicate that these values are representative of an anomalous event and not representative of background conditions.

These values are believed to reflect particulate fallout from the numerous forest fires in the region. The 197 µg/m³ TSP concentration measured at Sampler No. 3 exceeds the federal secondary standard of 150 µg/m³. However, one exceedence per year is permitted. A comparison of the TSP to the PM 10 data reveals that the PM 10 concentrations are approximately 38 percent of the TSP concentrations. The annual arithmetic mean was 14 µg/m³ for the PM 10 sampler and the annual geometric mean was 33 µg/m³ for the TSP sampler. These values are well below the annual secondary standard of 60 ug/m³ for TSP samples (CFR 40, 1978) and the annual primary standard of 50 µg/m³ for PM 10 samples (CFR 52, 1987).

Trace Element Analysis. The maximum trace element concentrations from analysis of the TSP filters collected at the Little Cherry Creek site during the monitoring year, and the Montana state standards are presented below. All concentrations were well below the standards for metals in air.

SUMMARY OF TRACE ELEMENT CONCENTRATIONS
LITTLE CHERRY CREEK SITE
1 JULY 1988 THROUGH 30 JUNE 1989

	Measured Concentrations (ng/m^3)			**Montana Standards[1] (ng/m^3)**	
Reported Element	**Maximum 24-hour Concentration**	**Geometric Mean[2]**	**Arithmetic Mean**	**24 hour**	**Average**
Sb	3.27	0.3	0.5	3930	650
As	2.57	0.4	0.7	390	70
Cd	ND	ND	ND	390	70
Cr	6.63	3.1	3.2	390	70
Cu	138.36	64.5	79.5	1570	260
Fe	5646.77	42.3	204.3	7860	1310
Pb	28.87	4.3	5.6	1190	200
Zn	96.67	5.2	7.1	39290	6550

1 From IP sampler (2.5 um)
2 Half of the detection limit used for ND samples in the averaging calculations.

3.0 WATER RESOURCES

3.1 INTRODUCTION

The following is a summary of the Water Resources Baseline Investigation of the Montanore Project in Lincoln and Sanders Counties, Montana. The water resources baseline investigation was developed in conjunction with the Montana Department of State Lands, U.S. Forest Service – Kootenai Forest to obtain information on the quantity and quality of surface groundwater in the project area. The water resources investigation augments water quality information periodically collected by various agencies and organizations from 1979-1988. Previous information has been collected by the U.S. Forest Service, U.S. Geologic Survey, Montana Department of Health and Environmental Sciences (currently Montana Department of Environmental Quality), Montana Fish, Wildlife and Parks, ASARCO, U.S. Borax and Noranda. The Water Resources Baseline Investigation is contained in Appendix B.

3.2 STUDY AREA

The study area for the Montanore Project Water Resources Baseline Investigation is located on the east side of the Cabinet Mountain Wilderness Area, approximately 22 miles south of Libby, Montana and, to the west on Rock Creek, located 3.4 miles east of Noxon (Figure 7). The baseline investigation includes Libby Creek and its tributaries: Ramsey Creek, Poorman Creek, Little Cherry Creek and Bear Creek, all of which flow northeast to the Kootenai River, and Rock Creek which flows west to the Clark Fork River.

Proposed mine facilities will lie primarily in the Libby Creek drainage. The proposed production portal and mill site will be located in upper Ramsey Creek drainage which is tributary to Libby Creek. The proposed tailings disposal site will be located in the Little Cherry Creek drainage. Ventilation adits are proposed for the Ramsey Creek plant site area, upper Libby Creek, and in the East Fork Rock Creek drainage.

3.3 SURFACE WATER

3.3.1 Watershed Description and Streamflow

Snowmelt and high intensity precipitation are the primary contributors to streamflow in the study area. Groundwater discharge from bedrock and surface deposits account for a small amount of stream baseflow. Precipitation ranges from 100 inches per year at higher elevations in the Cabinet Mountains to about 35 inches per year at the tailings impoundment site. Mean monthly temperatures range from 7.3 degrees Fahrenheit (F) in January to 72.1 degrees F in July.

For the initial baseline monitoring period in 1988, streamflow was measured at all gauging sites, twice monthly from April through June, and monthly July through November 1988. In November 1988, a winter sampling program was initiated where sites continued to be sampled which were accessible and was pertinent to mine development.

Data from the USFS and the Montana Department of Fish, Wildlife and Parks (MDFWP) for total suspended sediment (TSS) and bedloading is available and will be reviewed and incorporated into a revised Water Resource Baseline Report.

Libby Creek, tributary to the Kootenai River, is the major stream located on the east side of the project area. Libby Creek drains the major mine facility sites. Within the project area, primary tributaries to Libby Creek are Ramsey, Poorman, Little Cherry, and Bear Creeks.

Major mine facilities will be located in the Libby, Ramsey, and Little Cherry Creek drainages. The west side of the project area is drained by East Fork of Rock Creek which is tributary to the Clark Fork River.

Libby Creek is a large stream (Strahler, 1957) which drains an area of approximately 68 square miles from a point just upstream of its crossing Highway 2. Libby Creek

originates in a steep, glacial-carved basin at an elevation of 5,600 feet and discharges to the Kootenai River 28 miles downstream at an elevation of 2,020 feet in Libby, Montana. The stream is primarily restricted to a narrow channel flowing through bedrock canyons; erodible valley fill composed of glacial, fluvial, and lacustrine sediments; and occasionally on aggraded floodplain surfaces. *Channelization has occurred in portions of the lower Libby Creek (personal communication J. Mackay USFS). A review of the project hydrology will be completed and will include a review of the Libby Creek classification to assure current nomenclature and data are used as appropriate.*

A continuous stage recorder was installed on Libby Creek in a downstream reach of the study area and collected daily stage data from April 1988 through 1989. An automatic water quality sampler was installed at the same site for collection of total suspended solids (TSS) samples. The automatic sampler operated in 1988 and 1989, excluding the winter months.

For the initial baseline monitoring period, six surface water monitoring stations were sampled and gauged on Libby Creek. From April 1988 through mid-April 1989, discharge ranged from 1.1 to 50.7 cubic feet per second (cfs) in the upper reach, and from 10.6 to 319.2 cfs in the lower reach of Libby Creek. The lower reach includes the combined flow from all tributaries in the study area. A perennial spring was located near upper Libby Creek and had a measured flow of approximately 9 gallons per minute (gpm) in August 1988.

Ramsey Creek is located north of and is tributary to Libby Creek (Figure 7). It originates in a glacial basin at an elevation of approximately 4, 400 feet and discharges to Libby Creek 5.3 miles downstream at an elevation of 3,425 feet. Ramsey Creek drains an area of 6.5 square miles. A marsh, approximately 7 acres in size, exists in the upper drainage near the wilderness boundary. A short distance downstream is Ramsey Lake which has a surface area of approximately 2 acres. Downstream from Ramsey Lake, Ramsey Creek flows as a high energy stream, similar to Libby Creek, through a series of narrow bedrock canyons and glacial moraine material. Three surface water stations were sampled and

gauged on Ramsey Creek during the baseline study. Discharge values ranged from 0.9 to 60.9 cfs at the upper site near the wilderness boundary, 1.1 to 62.8 cfs at midreach, and 1.2 to 66.0 cfs above the confluence with Libby Creek.

Poorman Creek is a perennial stream located north of Ramsey Creek (Figure 7). Its headwaters originate in a glacial basin at an elevation of approximately 5,400 feet. Poorman Creek converges with Libby Creek 5.3 miles downstream at an elevation of 3,315 feet and drains an area of approximately 6 square miles. During the baseline study period, discharge ranged from 0.5 to 53.0 cfs at the upstream site and 0.7 to 54.8 cfs at the downstream site. Poorman Creek flows in a constricted channel. Several small, intermittent tributaries also discharge to Poorman Creek but do not contribute significant flow to the stream. The lower reach of Poorman Creek drainage was one of the alternative tailing disposal sites which received consideration.

Little Cherry Creek is a perennial stream which originates at an elevation of approximately 4,000 feet and discharges 2.8 miles downstream to Libby Creek at an elevation of 3,100 feet. Little Cherry Creek drains an area of 1.9 square miles and flows through Kootenai National Forest and private lands. Streambanks in the lower reaches are sparsely vegetated and partially collapsed due to logging activity in the area. The stream is incised into interfingering glaciolacustrine and glaciofluvial sediments. The lower portion of the Little Cherry drainage is the proposed tailing disposal site.

Bear Creek is the most northern tributary to Libby Creek in the study area. Headwaters originate in a glacial basin at an elevation of 4,600 feet. The creek flows 8.5 miles before converging with Libby Creek at an elevation of 3,050 feet. Drainage basin size is approximately 15 square miles. Flowing springs were observed in the Bear Creek drainage during the inventory conducted in June 1988; however, most springs were dry by July 1988. Bear Creek is fed by surface runoff and several small intermittent drainages. The stream is incised into lake bed silts, although small exposed bedrock outcrops occur throughout the reach.

Rock Creek is formed by the convergence of the East and West Forks of Rock Creek. The two forks drain an area of approximately 33 square miles. Surface topography is steep, and exposed bedrock predominates forested slopes at high elevations. Precipitation averages 80 inches per year in the upper reaches. Temperatures are similar to those reported in the Libby Creek drainage.

The headwaters of East Fork Rock Creek include Rock Lake at an elevation of 4,958 feet. Rock Lake, with a surface are of 40.4 acres, is enclosed within a steep basin and is fed by snowmelt. A surface water monitoring site was established at the outflow of the lake. Discharge values ranged from 0 to 37.8 cfs in 1988. East Fork Rock Creek receives flow from the lake and from springs. Directly below Rock Lake, East Fork is quite steep, forming a 60-foot high waterfall in a reach near the Heidelberg Mine. A perennial spring, located east of the Heidelberg adit, was gauged at 4.5 gpm in August 1988. Stream discharge also was gauged at a surface water monitoring site located downstream from Heidelberg Mine on the East Fork. Flows at this site ranged from 0.4 to 47.8 cfs. Downstream of this site are a series of small ponds named Rock Creek Meadows. Flow was gauged below the meadows at 1.9 to 149 cfs.

Three additional surface water monitoring sites were established near the confluence of the East and West Forks of Rock Creek. Flow in West Fork Rock Creek is intermittent, and numerous small springs contribute to its flow. Discharges in the West Fork ranged from 0 to 21.7 cfs during the initial baseline study. The East Fork above the confluence could not be safely gauged during spring flow due to high velocities and discharges. Flows measured over the initial baseline period ranged from 0 to 69 cfs. Below the confluence, discharge ranged from 0 to 299 cfs. Immediately downstream of the confluence of East Fork and West Fork Rock Creek, water is lost to the alluvial groundwater system. The lowest reaches of Rock Creek are typically dry during summer and fall months.

Other surface water features in the study area include Libby Lakes and Isabella Lake. The three Libby Lakes occur at elevations of 6,920, 6,800 and 6600 feet. Their combined

area is approximately 8 acres. Isabella Lake lies at an elevation of 6,800 feet and is approximately 2 acres in surface area. *Although Libby Lake may have an outlet, n*o surface drainage *was* evident from either Libby Lakes or Isabella Lake.

3.3.2 Surface Water Quality

A project-specific surface water quality sampling program was initiated during late April 1988, and continued through March 1989 for the initial baseline monitoring period. Water quality samples were collected simultaneously with flow measurements at each station (Appendix B). For the first year of baseline monitoring, frequency of sampling was twice monthly during the spring runoff period (April through June) and monthly during non-runoff flow conditions. Water quality samples collected during the first year of baseline monitoring were analyzed for parameters presented in Table 3-1. Field measurements of specific conductance (SC), pH, and water temperature were also collected at each station at the time of sampling.

Subsequent to the first year of baseline monitoring (April 1988 through March 1989), an "interim" monitoring program was established to continue baseline monitoring of surface water from April 1989 through November 1997. Table 3-2 summarizes surface water sampling completed for the interim monitoring period. Also included on the table are four surface water samples that were collected in October 2004 to verify results of samples collected during previous sampling events in 1988 through 1997.

During the interim monitoring period, water samples were also collected of discharge from the Libby Creek Adit. These adit water sampling events in 1993 through 1998 are listed in Table 3-3.

Parameters analyzed in surface water samples collected during the interim period generally were similar to the list presented in Table 3-1. From 1992 through 1994, four additional metals (antimony, beryllium, nickel, and thallium) were added to the analytical parameter list. Beginning in 1995, surface water samples were only analyzed for nitrate+nitrite, ammonia, specific conductivity (SC), and pH. The Libby Creek Adit outfall samples collected in 1997 and 1998 as part of the MPDES permit were analyzed for nitrate+nitrite, ammonia, sulfate, cadmium, chromium, copper, iron, lead, manganese, mercury, and zinc.

Surface water sample collection and preparation were conducted using approved methods and practices described in (but not limited to), the Handbook for Sampling and Sample Preservation of Water and Wastewater (EPA, 1982). Sample collection incorporated quality assurance/quality control procedures. Surface water quality data for the initial baseline monitoring period are presented in the Water Resources Baseline Investigation Report, Appendix B. An Addendum is included with the Water Resources Baseline Investigation Report in Appendix B that presents surface water quality data for samples collected during the "interim" (1989-97) and "verification" (2004) monitoring events.

Table 3-4 presents the range of water quality concentrations from all surface water stations during the first ten sampling episodes (April 1988 through mid-April 1989). Minimum values are generally very near the laboratory detection limits. In order to compare results of water quality samples collected and analyzed during the first year baseline period and the interim monitoring period, four selected surface water stations were sampled and analyzed in October 2004 as "verification" samples. A summary of these results, along with the other "interim" samples, are presented in the Addendum to Appendix B.

Surface water in the Rock Creek and Libby Creek drainages is good quality. Based on the baseline monitoring results for April 1988 to April 1989, measured total dissolved solids (TDS) concentrations throughout the study area are less than 70 mg/L. Hardness values are low with approximately one-half of the sampling locations reporting <6.0 mg/L. No hardness values over 50 mg/L are reported for the remaining locations. Specific conductance (SC) field values are between 5 and 156 umhos/cm throughout the study area and field pH ranged between 5.8 and 8.4. Bicarbonate is the predominant anion. *Additional data is available for wilderness lakes from the Rock Creek EIS and will be incorporated into a revised Water Resource Baseline Report.*

Concentrations of nitrate+nitrite, fluoride, total phosphorous, and orthophosphate at all surface water stations sampled during the initial baseline period were present at higher

concentrations in samples collected during spring runoff, but declined to near or below detection limits by late summer.

Total recoverable metals occur at very low levels. Aluminum, arsenic, chromium, manganese, and molybdenum are consistently below their respective detection limits. Copper, iron, lead, mercury, silver, and zinc occurred at detectable concentrations during spring runoff sampling, but were near or below detection limits during summer and fall sampling episodes.

Evaluations of spatial water quality trends were completed using water quality data from sites within the same drainage.

Rock Creek Drainage Water Quality. The East Fork of Rock Creek drainage contains copper levels at Rock Lake that are slightly above the detection limit; however, copper concentrations appear to decrease in a downstream direction. For the initial baseline monitoring period, lead was detected in two sampling episodes at downstream sites but exhibits no significant trends. Total dissolved solids (TDS) gradually increase downstream. The West Fork of Rock Creek contributes hardness in the form of calcium and alkalinity as bicarbonate, slightly elevating specific conductivity. Nitrate+nitrite as N range from 0.01 to 0.49 mg/L on the East Fork of Rock Creek. The higher reported values are suspect due to probably nitrogen contamination. Values for April and May 1988 were higher than those reported during summer and fall sampling episodes. No significant trends occur in downstream directions and values from samples collected below Rock Creek Meadows show no significant increase in nutrients.

Rock Creek downstream from the confluence of the two forks shows continued increases in hardness and alkalinity.

Libby Creek Drainage Water Quality. Libby Creek receives flow from four tributaries. These tributaries account for a fourfold increase in hardness and alkalinity through the length of Libby Creek in the study area. The greatest increase appears to

occur below Ramsey Creek. For samples collected during the initial baseline period, hardness at the most downstream site in the study area averages 17 mg/L, with a maximum of 50 mg/L reported in September 1988. Alkalinity at this site averages 24 mg/L, with a maximum of 60 mg/L reported in September 1988.

Concentrations of nitrate+nitrite in Libby Creek decrease downstream until the Bear Creek confluence. Concentrations increase downstream from the confluence during higher flows. No increase was evident during low summer flow or winter flow.

For surface water samples collected during the initial baseline monitoring period, Bear Creek has the highest hardness (50 mg/L) and alkalinity (60 mg/L) values in the study area. An increase in these constituents in Libby Creek occurred downstream of the Bear Creek confluence.

For the initial baseline period, Ramsey Creek has a higher average total suspended solids (TSS) value (2.2 mg/L) due to organic debris contributed by the marsh environment during high flow. A decrease in nitrate+nitrite occurs downstream in upper Ramsey Creek similar to a noted decrease on upper Libby Creek. Common ions do not increase measurably in this stream and are not an important source of dissolved solids in Libby Creek.

Poorman Creek contributes hardness and alkalinity to Libby Creek. Average concentrations of hardness (6.5 mg/L) and alkalinity (14.0 mg/L) measured during the initial baseline period are higher in Poorman Creek than in Libby Creek. Nitrate+nitrite decreases downstream. No other significant changes occur in this short reach.

Using initial baseline monitoring data, Little Cherry Creek has relatively high average alkalinity (29.7 mg/L) and hardness (14.7 mg/L) values compared to all other creeks in the Libby Creek drainage except Bear Creek. These constituents increase downstream. Fluoride and nitrate+nitrite values were slightly above detection limits during spring, as were copper, iron, lead, mercury, and silver concentrations.

Particular constituents in surface waters are affected by seasonal flow variations. High spring flow is characterized by increased nitrate+nitrite apparently due to leaching of weathered soil during runoff periods. Total phosphorus and orthophosphate also show elevated values during spring runoff; concentrations decreased to near detection limits in late summer.

Values for hardness and TDS increased with a decrease in discharge, concentrating common ions and dissolved solids in the water. Total suspended solids (TSS) fluctuated during the study period, increasing slightly during runoff and decreasing during the steady flow of summer and winter. Slight increases in TSS concentrations were measured during extremely low flows probably due to sampling difficulties at low flow and increased algal growth with warmer water temperatures. Certain metals, such as silver and copper, were detected at higher levels during spring runoff events. These concentrations declined near or below detection limits during summer and winter flow conditions. The remaining constituent concentrations do not appear to vary measurably in response to seasonal flow variations.

3.4 GROUNDWATER RESOURCES

Groundwater in the proposed mine facility areas was investigated using both monitoring wells and geophysical methods. Nine monitoring wells were installed in the tailings impoundment area between Poorman and Little Cherry Creeks; resistivity surveys and seismic refraction also were conducted. Six geotechnical exploration boreholes, three of which were completed as observation wells, were installed at the alternative plant sites in Ramsey and Libby Creeks. Data from 15 exploration boreholes in bedrock also were available for use in the groundwater assessment. In addition, six springs were located within the project area; however, only two of the springs exhibited perennial flow during the study period.

The groundwater regime in the Libby Creek drainage may be divided between regional flow within the bedrock fracture system and local flow within the surficial deposits. The groundwater aspect of the project in the Rock Creek drainage is limited to the bedrock fracture system intersected by the proposed ventilation adit *shown on Figure 48, 49, and 50.*

Groundwater flow in both regimes is generally from areas of high elevation to lower elevation. Regional flow is characterized by a low permeability, deep, bedrock system in fractured quartzite and argillite of the Belt Supergroup. Local flow is characterized by a low permeability, shallow system in fine-grained lake beds and poorly sorted outwash deposit; both of glacial origin. The low permeability of the materials results in limited groundwater transmission through the project area.

Groundwater is of good quality primarily Ca-Mg bicarbonate water with low to moderate hardness, low ion concentration, low TDS, low sodium-adsorption ratios (SAR), and low SC. Dissolved metal concentrations are very low; near or below detection limits.

3.4.1 Regional Groundwater Flow

Regional groundwater flow is within the fracture controlled, bedrock system. The bedrock is comprised of metamorphosed sedimentary rock of the Wallace, Ravalli, and Prichard units of the Belt Supergroup. These brittle rocks, quartzite, siltite, and argillite, support a regional fracture system as indicated by well developed joint patterns visible on aerial photographs. These fractures and the northwest trending faults, appear to control regional groundwater flow.

As with most hardrock aquifers, the general rock-mass permeability is expected to be rather low. Fracture information logged during the exploration core drilling indicates a relatively tight rock mass with an estimated permeability of 10^{-4} to 10^{-7} cm/sec.

Depth to regional groundwater in the hardrock environment of the mine area was evaluated from exploration borehole information. Based on this information, it is possible that a regional water table parallels the existing topography at a depth of approximately 500 feet within this hardrock environment. However, there are no direct measurements of depth to groundwater in this area. *Groundwater elevations between the mine area and ore zone (based on exploration drilling) are likely to be contained in two separate hydrologic basins influenced by the mountain range between the two areas. Groundwater elevations will be discussed in an updated hydrologic review.*

Regional groundwater recharge occurs from the infiltration of precipitation, snowmelt, and streamflow in exposed bedrock of the Cabinet Mountains. Discharge areas for the regional groundwater system are not likely located within the project area. The lack of high flow springs and the relatively low base flow of the major streams indicate that regional flow in the bedrock is either deep or is limited by low permeabilities.

An update of the regional and local groundwater conditions will be completed that will include a recent study completed by Joe Gurrieri with the USFS.

Portal Sites. Production portal sites are located adjacent to the plant site in Ramsey Creek. *The use of the* Libby Creek Adit *may occur if an agreement is reached with the current owner of the property which is also located near Libby Creek.*

The Libby Creek portal site is located at an elevation of approximately 4,300 feet in the upper reaches of Libby Creek. *If this portal is used for early entry to the deposit, the existing portal will be used, and the current adit will be extended.* The Ramsey Creek portal site is located at an approximate elevation of 4,450 feet in the upper reaches of Ramsey Creek. The production portals would be situated on the south side of Ramsey Creek. *A ventilation raise will be driven to the patented HR 134 claim. The Libby Creek Adit may be used for ventilation purposes after its use in mine development is no longer required.*

Production portals and drifts at either site will be driven in bedrock; therefore, underground development will intersect groundwater flow in the bedrock fracture system. More detailed descriptions of the portal and plant sites are provided in the Geotechnical Reports (Appendix N).

3.4.2 Local Groundwater Flow

Local groundwater flow is primarily within the glacial deposits along the eastern mountain front. These glacial deposits form a wedge at an approximate elevation of 4,000 feet along the mountain front and thicken away from the mountains. These deposits are dominated by poorly-sorted, glacial outwash and glacial lakebed sediments. The poorly-sorted glacial outwash is deposited directly on ice-scoured bedrock and interfingers with the generally overlying glacial lakebed sediments. Interfingering occurred as the paleo-lakeshore advanced up the mountain front. The uppermost elevation of the paleo-lakeshore in the study area is evidenced by the existence of lakebed silt above approximately 3,550 feet. Other local groundwater systems of very limited extent exist within localized morainal, colluvial, and talus deposits within the upper stream valleys. These systems directly discharge to adjacent streams.

Glacial deposits comprise the mountain front hydrogeologic units and exhibit low to very low permeabilities. Thirteen aquifer tests within poorly-sorted glacial outwash material exhibited a range of permeability or hydraulic conductivity of 7 x 10^{-3} to 2 x 10^{-6} cm/sec (0.05 to 145 gpd/ft^2) with an average value of 2 x 10^{-3} cm/sec (50 gpd/ft^2). Aquifer tests were not conducted in the lakebed silt because, although saturated, the silt did not yield measurable water to the boreholes. Therefore, the lakebed deposits are estimated to have a horizontal permeability of 10^{-6} cm/sec or less.

The local groundwater system is recharged by infiltration of precipitation, snowmelt, and streamflow, primarily along the mountain front. Groundwater flow is along the bedrock contact to the few springs located in the lower elevations of the project site, directly to local streams, or other locations beyond the study area.

In the vicinity of lower Poorman Creek, an artesian condition exists where lakebed silt caps the underlying glacial outwash material. Farther to the north, near Little Cherry Creek, this artesian condition does not exist presumably due to breaching of the silt cap by an infilled paleo-channel.

Tailings Sites. Tailings facility is proposed at the Little Cherry Creek area. *The 1992 EIS analyzed alternative tailings facility and selected a preferred alternative; which was the Little Cherry Creek location proposed in this application.* The site is located on a substantial thickness of glacial outwash and lakebed material deposited on bedrock along the eastern mountain front. The thickness of the outwash, lakebed, and local colluvial material in the tailings area ranges from 0 feet at a few exposures of bedrock to over 200 feet at the Poorman site.

The artesian conditions *were monitored in certain zones and wells during the geotechnical investigations completed by Noranda* in the vicinity of Little Cherry Creek. Material in the investigated area is low permeability, with measured values of 1 x 10^{-4} to 2 x 10^{-5} cm/sec (0.5 to 2.7 gpd/ft^2) in two aquifer tests, the permeability difference as compared to the silt is significant.

Measured depth to local groundwater at the Little Cherry site ranges from 6 to 11 feet below the surface. The low permeability of both the glacial outwash and the lakebed silt limits groundwater transmission through this area.

Three springs are located within the proposed tailings impoundment areas. One of these is immediately downgradient from the Little Cherry location, while the other two springs are located upgradient. All springs have relatively low flows and were observed to dry up during late summer.

Plant Sites

Alternative plant sites *were considered in the previous environmental review and were removed for various reasons and are not included in this application.*

The Ramsey Creek plant site is located in an area of morainal material deposited by alpine glaciation. Geotechnical exploration drilling at the plant site revealed 41 to over 50 feet of silt, sand, and gravel. One borehole intercepted groundwater at 39 feet below ground surface, with a static water level recorded at 22 feet below ground surface. The remaining boreholes at this site were dry. This localized groundwater system is apparently flowing on the steeply-dipping bedrock surface within glacial material and is of very limited extent. Groundwater discharges to the stream immediately downhill from the site.

Geotechnical drilling at Libby Creek encountered 30 to 46 feet of silt, sand, and gravel. Two boreholes recorded water depths of 12 and 16 feet below ground surface and a third borehole was dry. This shallow groundwater system apparently occurs in granular material on the underlying bedrock, is very localized, and discharges to the stream immediately downhill from the site.

3.4.3 Groundwater Quality

Groundwater is a good quality soft to moderately hard calcium-magnesium bicarbonate type, with low concentrations of TDS and metals. Spring water samples are very similar to surface waters, and probably represent local reemergence of infiltrated runoff. Ranges of groundwater quality parameters for samples collected during the initial baseline monitoring period (April 1988 to April 1989) are given in Table 3-5. Groundwater quality data for the initial baseline monitoring period are presented in the Water Resources Baseline Investigation Report, Appendix B. An Addendum is included with Appendix B that presents groundwater quality data for samples collected during the "interim" monitoring events from late-1989 through 1995. A summary of interim sampling events for groundwater is presented in Table 3-6.

Parameters analyzed in groundwater samples collected during the interim period generally were similar to the list presented in Table 3-1, except that TSS, turbidity, orthophosphate, total phosphorous, ammonia, and total Kjeldahl nitrogen were not analyzed. From 1993 through 1995, ammonia and total Kjeldahl nitrogen were added to the analytical parameter list.

3.4.4 Well, Spring and Adit Inventory

No existing wells were identified within close proximity to the project study area. Several minor, ephemeral springs and seeps were observed in the Poorman and Little Cherry tailing disposal areas and are associated with surface exposures of lakebed materials.

Four springs were inventories in the eastern portion of the study area; three of these are in alternate tailing disposal areas and one is near the Libby Creek portal site. Those in the tailing disposal areas ranged in flow from 1 to 5 gpm in early summer, but dried up as the season progressed. The Libby Creek spring flowed at approximately 9 gpm.

Two springs were inventoried along Rock Creek in the western part of the study area. One of these is seepage entering the Heidelberg adit that was observed to flow in the

springtime but, by summer only standing water was observed in the adit. The other spring flowed at approximately 5 gpm.

4.0 WILDLIFE

4.1 INTRODUCTION

A four-season wildlife baseline study was conducted between May 4, 1988 and April 20, 1989 to meet permitting requirements associated with the Montanore Project (MP) proposal in the Cabinet Mountains. Supplemental Coeur d'Alene salamander surveys were conducted from September 17-20, 1989. The wildlife study plan was reviewed by personnel representing U.S. Forest Service (USFS), Montana Department of State Lands, Montana Department of Fish, Wildlife, and Parks (MDFWP), and the proponent. The finalized study plan, which incorporated reviewers' suggestions, was then endorsed by the Kootenai National Forest. *A review of the wildlife information, including threatened and endangered species, will be completed and updated as required to support* the NEPA/MEPA analysis as part of the approval/permitting process *as some changes may have occurred in the project area since 1989*. The baseline wildlife report is in Appendix C.

Major objectives of the MP baseline study were to:

1) develop a list of wildlife species observed and which potentially occur in the proposed project area;

2) evaluate the types, distribution, and relative importance of local habitats to various wildlife taxa;

3) assess the seasonal distribution of important wildlife species (e.g., elk, grizzly bears, eagles, etc.) on and adjacent to the project area;

4) estimate relative numbers of important wildlife species on and adjacent to the project area; and

5) document the occurrence of state and federal threatened, endangered, and candidate species and habitat suitability for such species in the project area.

4.2 STUDY AREA

The MP wildlife study area is located in northwest Montana, south-southwest of Libby and northeast of Noxon in the Kootenai National Forest. The majority of the study area lies on the east side of the Cabinet Mountains, on the southwest edge of Lincoln County. The Rock Creek portion of the study area, west of the divide, is in the northern tip of Sanders County.

The Cabinet Mountains, straddled by the study area, are characterized by high glaciated peaks along a north-northwest/south-southeast divide, a series of parallel sharp spur ridges running northeast off the main divide, and topography shaped by glaciation and fluvial processes. Study area elevations range from 3, 040 ft. along Libby Creek to 7,938 ft. at Elephant Peak.

When the wildlife study plan was developed, the proponent was evaluating facilities sitting in three alternative areas adjacent to the ore deposit: upper East Fork of Rock Creek, Libby Creek, and Ramsey Creek. Impact assessment required that wildlife data be collected in each of these areas, in adjacent areas where ancillary facilities will be located, and in a surrounding area of potential influence.

The 49.2 square mile MP wildlife study area was stratified into intensive and extensive study areas based on proximity to potential impact areas, the relative distance that different wildlife taxa react to impacts, and the intensity of data required for impact analyses. An intensive study area (potential impact area) (30.8 square miles) encompassed all project-related facilities and activities associated with the development alternatives including mine facilities, mill, tailings disposal areas, road, pipeline and power transmission line corridors, and other ancillary facilities.

This intensive study area extended beyond actual disturbance sites to topographic barriers which would contain the obtrusive visual and acoustic impacts emanating from project-related operations. Specific field surveys were conducted in this area because of the

relative magnitude of potential impacts. Breeding birds and small mammals were sampled in a 12.1 square mile subset of the intensity study area which included all potential disturbance areas and a 0.25 mile buffer zone. The size and location of this bird and small mammal study area was designed to detect impacts on these communities with the potential development areas. Additionally, occupied habitats beyond this zone were similar enough to those in the sample area to allow valid data extrapolation, if desired. The experimental design of the bird and small mammal study incorporated spatial and temporal controls so that the influence of any combination of development alternatives on these wildlife communities could be assessed by comparison with similar post-development data.

An extensive study area (18.4 square mile buffer) surrounded the intensive development area. Wildlife surveys conducted in this zone were intensive and oriented towards identifying the ecological setting in which the proposed project area was located. Potential wildlife impacts resulting from the proposed development could not be adequately assessed unless the relative importance of project area habitats could be placed in perspective with seasonal wildlife use and importance of surrounding habitats. The size of the extensive study area varied between wildlife groups, depending on the type and magnitude of anticipated impact and the extent of seasonal wildlife movements.

4.3 TERRESTRIAL WILDLIFE

4.3.1 Habitats

Wildlife habitats in the MP wildlife study area, divided into three sub-study areas, were mapped by existing habitat components (USFS et al, 1988) functional to the entire wildlife community. The study area contained ten terrestrial and one aquatic habitat types. Distribution of these types varied throughout the three sub-study areas in relation to elevation, aspect, slope, substrate, and forest management practices. Forest types dominate the study area except for exposed bedrock areas high along the main divide and its spur ridges. In the entire study area (31,481 acres) the mixed conifer type dominates (9.819 acres; 31%), followed by spruce-fir (6,469 acres; 21%), rock (4,362 acres; 14%), shrubfield (4,285 acres; 14%); clearcuts (3,256 acres; 10%), grassland (1,365 acres; 4%), western hemlock (725 acres; 2%), riparian (711 acres; 2%), lodgepole pine (232 acres; 1%), forbfield (152 acres; <1%), and aquatic (105 acres; <1%). *It is anticipated that certain habitat types may have changed, and habitat types will be reviewed and updated where appropriate.*

4.3.2 Species of Special Concern

Wildlife species identified as species of special concern through federal, state, forest, and/or Montana Natural Heritage Program sources as potentially present in the MP study area were particularly considered.

Four federally listed threatened or endangered species, the grizzly bear, bald eagle Canada lynx, and gray wolf, are present on or near the MP study area or its transmission line corridors.

A low number of grizzly bears exist as a stagnant/declining population in the Cabinet Mountains. Results of ongoing studies, which began in 1983, indicate that the seasonal ranges of a few grizzlies overlap the MP study area and that the Rock, Libby, and Ramsey Creek drainages are specifically used by those bears. The MP project area is located within the Cabinet-Yaak Grizzly Bear Ecosystem, one of *four* ecosystems

selected as priorities for grizzly bear recovery after the Grizzly Bear Recovery Plan (U.S. Fish and Wildlife Service, 1993).

While Libby, Ramsey, and the upper elevations in the East Fork of Rock Creek are all important fall feeding areas, because of preferred berry concentrations, the east side of the divide, specifically Libby Creek also provides important spring grizzly habitat. In this respect Libby Creek provides better spring habitat than Ramsey Creek because of its larger area, greater number of avalanche chutes supporting feeding areas, its graminoid-sidehill parks, and its riparian areas, which in June support cow parsnip and other succulent forbs (W. Kasworm, MDFWP, personal communication.).

Bald eagles are non-breeding winter visitors or winter residents on the west side of the Cabinet Mountains, in the vicinity of Rock Creek. They were not observed in Rock Creek Meadows and it is unlikely that this area is used by them, especially during winter. However, bald eagles are breeders, residents, transients, and winter residents on the east side of the Cabinets and their breeding and wintering numbers are increasing. Although most eagle use occurs along the Kootenai River in winter, they have been observed as far up Libby Creek as the lower bridge during fall whitefish runs and they may use the creek during fall until it freezes. Bald eagles do not inhabit the potential facility or tailings areas, but are present in the transmission line corridors, particularly the lower portion of the Libby-Plant Site corridor where it crosses the Kootenai River.

The Canada lynx and gray wolf occur or have historically occurred on or near the MP study area (personal communication with Jerry Brown, MDFWP, November 19, 2004).

Coeur d'Alene salamanders, a USFS species of special concern, were located in tributaries along the Bear Creek and Libby Creek access roads during September, 1989 surveys. Potential salamander habitat is widespread throughout the Libby and Big Cherry Creek drainages. It is likely that additional sites in these drainages are also occupied by the Coeur d'Alene salamander; however, salamander presence throughout the MP study area could not be identified in the scope of the study.

Other terrestrial wildlife species of special concern which may be in the project area include the peregrine falcon, North American wolverine, western toad, and northern leopard frog, flammulated owl, northern bog lemming, fisher, Townsend's big-eared bat (Kootenai NF sensitive species); and the northern goshawk, black-backed woodpecker, boreal owl, and pileated woodpecker (Kootenai NF species with a high level of management interest) (Al Bratkovich, KNF, via e-mail December 15, 2004). *This list of species of concern which may occur in the project area will be reviewed with the agencies and updated to ensure inclusion of all required species.*

4.3.3 Big Game

Seven big game species, including black bears, mountain lion, and five ungulates, inhabit the MP study area. Black bears are common and their seasonal use of the area is oriented toward low elevation, herbaceous meadows in spring and toward summer/fall berry concentrations. Mountain lions are hunted in the area, but the harvest is closely monitored by the MDFWP.

Five species of ungulates seasonally utilize habitats in the study area. Depending upon snow depth, virtually all individuals migrate in December-January to lower elevation winter ranges. As in most other mountainous areas of Montana, white-tailed deer occur in lower elevations of the study area within approximately one-half to one mile of stream bottoms; however, during spring and early fall they often extend their ranges to mid- and upper elevations as well. Mule deer also occur along bottomlands and extend their summer distribution into the alpine. Elk display a spotty distribution in the Cabinet Mountains and appear to be the least common ungulate in the study area. Like whitetails, moose are most common at lower elevations along streambottoms and around ponds and marshes; however, they too extend their summer and fall distributions to the upper limits of treeline. Mountain goats summer on alpine and subalpine cliffs and ridges, and most migrate to slightly lower elevations in the winter. They occur primarily along the main divide and up to several miles out on the spur ridges. Caribou do not inhabit the Cabinet Mountains and mountain sheep occur further north in the ridge.

4.3.4 Breeding Birds

Breeding birds were sampled with replication on 4.94 acre plots stratified by major habitat type in June during the peak of the 1988 breeding season. A total of 1,711 birds, representing 92 breeding species were observed during plot counts. The greatest number of breeding species occurred in riparian habitats (63), followed by spruce-fir habitats (58), shrubfields (57), mixed conifer stands (50), clearcuts (48), and western hemlock stands (37). Breeding species observed on potential impact areas appeared to be representative of the area's avifauna. Only nine additional breeding species were observed in the rest of the MP study area during the baseline study.

Avian species richness differed significantly between and within major habitat types. However, test results also indicated that only the riparian and clearcut bird diversities differed significantly from each other; all other bird richness comparisons between habitats were statistically similar. This appeared to be due to a high degree of variability within habitats and a high degree of similarity between habitat types.

Density of breeding birds did not differ significantly between habitats, but did significantly differ between plots. This former result suggested that the habitat productivity of the six habitats was so similar that it supported numerically similar bird communities.

4.3.5 Small Mammals

Small mammals were trapped in potential impact area habitats, on a proportional allocation basis, to document species occurrence and relative abundance. Eleven species of small mammals were captured in the 2,383 available traps established throughout six habitat types between August 17-24, 1988. The most species (8) were captured in mixed conifer habitats, followed by spruce-fir (7), riparian and shrubland (6), and hemlock and clearcut (5) habitats. However, there was no statistical difference in species richness between habitat types, in part due to the large variation in richness between individual plots composing each habitat type.

The most individual small mammals of all species were captured in shrubfields (26), followed by spruce-fir (53), mixed conifer (51), clearcut (50), riparian (29), and hemlock (26) habitats, although these relationships were somewhat confused by the number of traps available. Test results indicated that there was no difference in mammal abundance between the six habitats, also due to the wide variation in trap success between plots composing habitats. These results statistically indicate that the six habitats supported numerically similar small mammal communities. Deer mice were the most common small mammal captured in the study area and represented 66 percent of all mammals captured.

4.3.6 Raptors

Twelve species of raptors were observed in the MP study area. Eight species, including the sharp-shinned hawk, northern goshawk, red-tailed hawk, American kestrel, great horned owl, barred owl, northern pygmy owl, and common raven nested, or probably nest, on the MP study area.

4.3.7 Waterfowl and Shorebirds

Habitat for waterfowl and shorebirds is available, but extremely limited in area, on the MP study area. On the intensive study area, the best habitats included Rock Creek Meadows, the fen along Libby Creek below its confluence with Howard Creek, and the small pond on the west side of the Little Cherry Creek Look Road. While some production occurred at all these sites in 1988, it was low. Only two mallard broods and one spotted sandpiper brood were noted in these areas.

In the extensive study area, water bird habitat is restricted to Howard Lake. This relatively good habitat is somewhat degraded by high summer levels of human activity, although some waterfowl production still occurs. The lake is moderately to heavily used by geese and ducks during spring and fall migration.

4.3.8 Upland Game Birds

Two species of upland game birds were recorded on the study area. Ruffed grouse were common to abundant in riparian habitats, but were detected in all six major types except clearcuts. Blue grouse were common in spruce-fir stands on top of the eastern spur ridges. Spruce grouse were not detected on the study area during the field studies, but are known to occur in the Libby Creek drainage (personal communication with Jerry Brown, MDFWP, November 19, 2004)

4.3.9 Predators

The study area contains an excellent diversity and number of predators. Predators, such as coyotes, bobcats, martens, weasels, and wolverine were quantified in the intensive study area via winter track counts.

4.3.10 Herpetofauna

Three reptiles and five amphibians have been recorded in the study area *as described in Appendix C.* Coeur d'Alene salamanders, a USFS sensitive species, exist in tributaries along the Libby and Bear Creek access roads and may occupy other sites within drainages affected by the Montanore Project. The tailed frog was noted in five study area streams and was considered locally absent to abundant in the study area.

4.4 AQUATIC HABITAT AND BIOLOGY (MACROINVERTEBRATES, PERIPHYTON AND FISHERIES)

The bull trout has been listed under the Endangered Species Act and it is known to exist within the Project Area. MMI will comply with provisions within Inland Native Fisheries Strategies (INFISH) dealing with stream protection. Certain portions of the project facilities, as proposed and selected by the agencies in the 1992 EIS, fall within Riparian Habitat Conservation Areas (RHCA). Facility locations shown in the application require that certain RHCA boundaries be encroached upon to meet operational and construction requirements. Locations of certain features (e.g. tailings dam, mill facilities, bridges) are dictated by topography and other environmental considerations and cannot be relocated outside of the RHCA. Therefore, MMI will pursue waivers for these limited areas.

4.4.1 Introduction

Numerous documented fish, invertebrate, periphyton and stream habitat surveys have been conducted in the Montanore Project (MP) area, beginning with fish surveys in the 1970's. Much of this information was in raw form and has recently been summarized in a report on stream biology and habitat in the MP area included as (Appendix D). Some of the information is also summarized in the MDFWP MFISH database (http://maps2.nris.state.mt.us/scripts/esrimap.dll?name=MFISH&Cmd=INST).

Information that was collected during the late 1980's and early 1990's was summarized in the 1992 EIS. Much of this information was gained during a one-year aquatic biology baseline study that was initiated in May 1988 to meet permitting requirements associated with the MP. The goals of the aquatic program were to assemble a database for physical habitat, benthic macroinvertebrates and periphyton, and fisheries in streams within and adjacent to potential development areas. The recently summarized data is consistent with the findings presented in the 1992 EIS and supplemental data referred to in the 1993 Record of Decision.

A draft aquatic biology study plan was reviewed and revised several times by personnel representing the U.S. Forest Service (FS), Montana Department of State Lands (MDSL), Montana Department of Fish, Wildlife, and Parks (MDFWP), the Montana Department of Health and Environmental Sciences, Water Quality Board, and Noranda. *MDSL and the Department of Health and Environmental Science jurisdiction for the Hard Rock Operating Permit, now lie within Montana Department of Environmental Quality (MDEQ).* The finalized aquatic biology study plan was then endorsed by the Kootenai National Forest.

A draft fisheries study plan was developed based on site visits and discussions with representatives of the MDFWP, FS, and Noranda. This plan was then modified following reviews from these agencies and subsequent field meetings. Fieldwork for the baseline study was initiated in August 1988 to meet permitting requirements associated with the MP. Fieldwork was completed by mid-November 1988, except for a bull trout redd survey that was conducted in October 1989 because the 1988 survey was cancelled due to scouring streamflows preceding the survey. All fieldwork was conducted under the supervision of the MDFWP. Objectives of the fisheries program were to determine species composition, age structure, relative numbers, population estimates by age group, approximate level of bull trout and whitefish spawning, and baseline heavy metals content of fish tissues in Libby Creek. Other objectives were to characterize habitat, macroinvertebrates, and periphyton in MP area streams. The aquatic biology report is contained in Appendix D.

Since the 1992 EIS, additional fish, invertebrate, periphyton, and habitat surveys have been conducted in MP area streams, fish genetic analyses have been performed, and a reach of Libby Creek in the Montanore Project area has been restored. The summary and update report on stream biology and habitat in the Montanore Project area (Appendix D) summarizes all available information on fish, invertebrate, periphyton, and stream habitat in the MP area.

4.4.2 Study Area

The MP aquatic biology and fisheries study area is located in northwest Montana, south-southwest of Libby and northeast of Noxon in the Kootenai National Forest. When the 1988-89 study plans were developed, the proponent was evaluating facility siting in three drainages, East Fork of Rock Creek, Libby Creek, and Ramsey Creek; and tailings sites in adjacent areas. Impact assessment required that appropriate data be collected in each of these three drainages plus adjacent reaches of Poorman, Little Cherry, and Bear Creeks. The current proposal calls for evaluation of Libby, Ramsey, Poorman, and Little Cherry Creeks. None of these streams are listed as Critical Habitat for bull trout*; however they are identified as priority watersheds for bull trout recovery*. The only stream that will be substantially impacted by the MP is Little Cherry Creek.

4.4.3 Methods

Stream habitat surveys have been conducted in the MP area streams. General descriptions of Little Cherry, Poorman, and Ramsey Creeks were made in the late 1970's. Riparian vegetation and erodible reaches may have changed substantially in the 27 years since these surveys, but the surveys still offer useful data. From the late 1980's to the present, stream reaches in the MP area have been classified using the Rosgen technique. Reaches are categorized using this technique based on various measurements of entrenchment, width to depth ratio, sinuosity, substrate, and stream slope.

For the 1992 EIS, aquatic biology data were collected from 18 reaches in the six study area streams. Locations of sample reaches were based on their relative location to disturbance sites and their suitability as spatial control or treatment reaches. When possible, biological and physical sampling sites were located near hydrology and water quality stations to obtain multiple discipline data for most sites. The updated MP database (Appendix D) includes sampling for stream macroinvertebrates and periphyton from 21 locations in the MP area streams, mainly between 1988 and 1994. Some of these locations have been sampled on 16 occasions. Macroinvertebrate sampling methodology differed between some of the sampling periods, which restricts the ability to interpret the data over the entire time period.

For the 1992 EIS, fish populations in Libby, Ramsey, Poorman, Little Cherry, and the East Fork of Rock Creeks and Rock Lake were sampled using backpack electroshockers; and electrofishing boat, gill netting, and hook and line. Spawning was assessed from electroshocking results and from visual searches along Libby Creek. Heavy metals analyses of rainbow trout collected from Libby Creek were conducted at Montana State University, Bozeman, and the Department of Health and Environmental Sciences, Helena. The updated MP database (Appendix D) includes fish survey data from the 1970's through 2004.

4.4.4 Results and Discussion

Physical Habitat

Stream habitat types on reaches of Libby, Ramsey, Poorman, and Little Cherry Creeks have been described *from the 1980s to the present. The stream reaches in the Project area have been classified using the USFS General Aquatic Wildlife System (GAWS) Level III assessment (USDA 1989) which incorporates the Rosgen (1985) system, and more recently using watershed field data sheets that incorporate updates to the Rosgen system mainly during 1988 and 2004 (Appendix D).*

From its origin in a steep, glacial cirque, Libby Creek flows to the northeast, intermittently, through a narrow canyon over bedrock and coarse deposits in steep and wooded terrain. A fifty-foot waterfall near the junction of FS roads 6210 and 2316 forms a barrier to upstream fish migration. Below the falls, the stream merges with its first major tributary, Howard Creek, which originates in Howard Lake. Below the Howard Creek confluence, MDFWP completed a project during 2002 that restored approximately 3,200 feet of the Libby Creek stream channel to the proper dimension, pattern, and profile.

Little Cherry Creek is a first and second order, low velocity stream in a small, low gradient watershed. The stream is approximately 3 miles long. Substrate in the upper third of the stream, from the headwaters to a tributary from the south, is a mix of rubble, gravel, and sand. Spawning gravel comprises 15% of the substrate, but rearing habitat is

marginal. The middle reaches of the stream have debris jams, overhanging devil's club, and undercut banks. The lower reach has thick, overhanging alder, and shallow riffles between shallow pools. The lower reach also has a gravel and small cobble substrate, good fish cover, and good spawning habitat. Possible fish barriers are common throughout much of the stream. A significant fish barrier was documented 0.25 miles upstream of the Libby Creek confluence. Below the lower barrier, there is no spawning habitat and a portion of the lower reach is subsurface.

Poorman Creek originates in a steep, glacial cirque and flows 5 to 6 miles before entering Libby Creek downstream of Ramsey Creek. The transition from the steep, bedrock controlled, upper reach to the lower gradient, depositional, lower reach is abrupt. Avalanche activity in the upper reach maintains riparian vegetation in a shrub stage. As such, recruitment of large woody debris is low. Riparian vegetation in the lower reach is dominated by mature timber. The lower 2.5 miles of Poorman Creek is destabilized. The banks are eroded, timber recruitment is excessive, and bedload transport is high. The lower half of Poorman Creek is characterized as having cobble substrate, stream braiding, fair to good fish cover, poor spawning habitat, and partial barriers to fish in the form of debris jams. One steep falls was noted near river mile 2 to 2.5.

Ramsey Creek originates in a steep, glacial cirque and flows 5 to 6 miles before entering Libby Creek. Several regularly spaced tributaries draining wooded slopes join Ramsey Creek in its upper reach. Near its headwaters and the Cabinet Wilderness Boundary, the stream runs though a wetland. The stream bottom in this reach is deep silt with large numbers of caddisfly larvae. The stream banks are undercut. Below the wetland, the stream gradient is gentle and the substrate is a mix of bedrock and gravel. The banks are vegetated with overhanging alders. The stream then steepens to a 15% gradient in places, cascading over bedrock with deep bedrock pools below the cascades. Potential fish barriers occur in this reach of Ramsey Creek. The lower half of Ramsey Creek is dominated by riffle and pool complexes, until nearing the confluence with Libby Creek, where glides predominate and pools are lacking. The substrate is comprised of bedrock,

boulders, and large cobble. Spawning habitat is poor throughout the lower half of Ramsey Creek.

Aquatic Macroinvertebrates

EPT species (ephemeroptera [mayflies], plecoptera [stoneflies], trichoptera [caddisflies] are generally intolerant to pollutants, low oxygen, high silt loads, and high temperatures; whereas chironomids (C) are generally tolerant. Thus, the EPT/C quotient can be indicative of water quality. EPT/C should also be less influenced by sampling methods than other community attributes, such as total abundance.

Few patterns are apparent in the 1988 through 1994 EPT/C data. Values during 1988-89 were low, which could reflect the relative condition of invertebrate communities during that time period, or could reflect methods differences. Average values were calculated for 1991 and 1992, the only years where the same methods were used and all of the same sites were sampled. No spatial, seasonal, or annual trend was apparent.

These results illustrate the general finding that macroinvertebrate communities in the MP area streams are highly variable and influenced by factors other than water quality. The MP area streams generally support a sparse but diverse macroinvertebrate fauna. Macroinvertebrate abundance usually reflects the recent flow regime with repeated spates resetting densities at low levels. The natural flow regime is dictated by drainage basin characteristics and precipitation events, such as rain on snow.

Periphyton

Periphyton sampled in study area streams during August and October 1988, and April 1989 was sparse, but characteristic of high-elevation mountain streams. Chlorophyta and Cyanophyta algae occurred throughout the study area where *Zygnema* and *Oscillatoria* were the most abundant and widespread genera.

Diatoms were present in all periphyton samples, but were relatively sparse. Total species richness for all streams was 49, 44, and 39 taxa in August, October, and April samples,

respectively. *Achnanthes minutissima* was the most abundant taxon at most stations on each date. Species richness was low, particularly in headwater reaches. In general, diatom taxa were typical of clean, soft-water Montana streams.

Conclusions from 1991 and 1992 periphyton sampling were that Little Cherry Creek was enriched with nutrients and had a high diversity of algae species, whereas Poorman and Ramsey Creeks were nutrient-poor and had limited algal diversity. Conclusions from Libby Creek for 1991 through 1994 were that biological integrity upstream and the nearest station downstream of mining activities was excellent and aquatic life was not impaired.

Fisheries Species Composition

Only bull trout occur upstream of the falls on upper Libby Creek. Below the falls, rainbow trout, Columbia basin redband trout, westslope cutthroat trout, bull trout, brook trout, torrent sculpin, slimy sculpin, mountain whitefish, and salmonid hybrids have been reported. In Ramsey, Poorman, and Little Cherry Creeks; reported trout species occurrence has varied over time and between streams. Purebred Columbia basin redband trout, redband/rainbow, redband/cutthroat, and rainbow/cutthroat hybrids have been identified using genetic analysis.

Four fish species that occur in upper Libby Creek or its tributaries have state or federal designations (Appendix D):

- bull trout (*Salvelinus confluentus*)
  Montana Species of Concern, BLM Special Status, USFWS Listed Threatened (removed as proposed Critical Habitat during September 2004);
- Columbia basin redband trout (*Oncorhynchus mykiss gairdneri*)
  Montana Species of Concern;

- westslope cutthroat trout (*Oncorhynchus clarki lewisi*)
  Montana Species of Concern;
- torrent sculpin (*Cottus rhotheus*)
  Montana Species of Concern.

The U.S. Fish and Wildlife Service's Bull Trout Recovery Plan formerly designated Libby Creek, Poorman Creek, and Ramsey Creek as part of the Kootenai River and Bull Lake Proposed Critical Habitat Sub-Unit. Final designation of bull trout Critical Habitat on September 22, 2004, did not include streams in the MP area, or any streams in Montana. *The aquatic resources information will be updated to reflect bull trout and other species that may occur in Rock Lake and the East Fork of Rock Creek.*

Fish Populations, Age, and Growth

Study area creeks are primarily first or second order, high mountain streams with characteristically low productivity. Resulting fish populations are composed of moderate densities of small, young fish. Densities, sizes, and age classes of fish have been reported by species for several reaches of the MP area streams. The largest rainbow trout and bull trout captured during surveys have typically been seven to nine inches in length. This small fish size reflects low stream productivity and sparse invertebrate population.

Spawning

Nearly 22 miles of Libby, Ramsey, and Poorman Creeks were surveyed for bull trout redds in October, 1989. No redds were observed in Ramsey or Poorman Creek. Two redds were located in Libby Creek below the falls and ten were located above the falls. No spawning or spent bull trout were observed in the 11.5 mile portion of Lower Libby Creek during the mid-November 1988 mountain whitefish survey, nor were any schools of spawning mountain whitefish located. Redd surveys conducted during October 1995 and October 1996 in Libby, Ramsey, Poorman, and Little Cherry Creeks revealed a total of four possible redds.

Estimated percent spawning area was typically 20 to 40% in all of the MP area streams. Cobble, boulder, and bedrock substrate predominated in characterized reaches, thus limiting potential spawning habitat. Potential rearing habitat was more variable and was nearly absent in some of the surveyed reaches that had abundant spawning habitat.

Heavy Metals

Twenty-four rainbow trout collected from the Libby Creek cumulative effects sampling reach (LB-1) were analyzed to establish baseline heavy metals content. Muscle or liver tissue was analyzed at Montana State University, or the Montana Department of Health and Environmental Sciences for mercury, zinc, cobalt, copper, and lead levels. Mean metal levels for all 24 fish were 0.19, 30.1, 1.9, 6.5, and <0.5 ppm, respectively. Metal levels were generally similar to those reported from fish in other Montana streams.

5.0 VEGETATION

5.1 INTRODUCTION

Baseline vegetation inventories were conducted by Western Resource Development (WRD) during the 1988 and 1989 growing seasons for the Montanore Project. In 1988, quantitative data was collected on vegetation of the plant site, tailings area, and evaluation adit study area alternatives; and qualitative observations were collected on the alternative transmission line study area. Following completion of the initial study, the planning process identified developments for areas not studied in 1988, expanded some of the 1988 development sites, and eliminated some development sites. The 1989 study inventoried these new areas. The baseline vegetation study is in Appendix E.

Prior to the initiation of the 1988 study, a detailed Plan of Study was developed based upon the Montana Metal Mines Reclamation Act, NEPA, and guidelines to these acts. The Plan of Study was presented to personnel at the U.S. Forest Service, Kootenai National Forest, and Montana Department of State Lands and modified to reflect their concerns. *It is anticipated that some changes in vegetative types may have occurred in the project area since the completion of the vegetation baseline. This will be reviewed and* updated during the NEPA/MEPA analysis as part of the approval/permitting process.

5.2 METHODS

The vegetation of the tailings impoundment, land application sites, surface facilities, plant, mine, and mill sites was mapped per existing and potential vegetation type (forest habitat type). Existing vegetation types were segregated according to vegetation structure and species dominance. The forest habitat type mapping was based upon a refinement of the U.S. Forest Service, Kootenai National Forest Habitat Type Map according to systems of Pfister et al. (1977) and Cooper et al. (1987). Quantitative sample sites were selectively located in representative existing vegetation and forest habitat types. Vegetation cover; tree density, reproduction, diameter, basal area, volume and age; shrub density; and herbaceous production were quantified. Existing vegetation types and forest habitats were described based upon the quantitative data and published literature.

Vegetation in the transmission line and road access study areas was mapped according to existing vegetation type and forest habitat type, and described according to published literature and qualitative observations. The small, isolated wetlands area have been mapped and qualitatively described.

All quantitative sampling for cover, density, height, diameter, age, and production occurred at the same sample sites. All sampling was within a 5 m by 25 m rectangular shaped quadrat. A point-intercept method was used for cover sampling and quadrat methods for density and herbaceous production.

5.3 RESULTS AND DISCUSSION

5.3.1 Existing Vegetation – Intensive Study Area

The intensive study area which includes surface facilities in Libby Creek, the mine/mill site in Ramsey Creek, water disposal sites between Ramsey and Poorman Creeks and alternatives along Little Cherry Creek is characterized by three major vegetation types, one minor vegetation type, disturbances, and talus slopes. Vegetation types are as follows: coniferous forest (1,444.8 acres), clearcuts (1,133.2 acres), shrubland (19.6 acres), and wetlands (19.9). Each of these types is briefly described below from quantitative data collected in 1988. *Changes many have occurred since 1988 and vegetation types will be validated/updated as part of the review process.*

Coniferous Forest. Coniferous forests with a total of ten tree species are common to about half of the intensive study area. Past fires and a logging history have created numerous different aged seral stands to the climax forest habitat types. To a lesser degree, timbering and avalanches have reduced the extent of coniferous forests.

Major trees in the coniferous forest type include western hemlock (*Tsuga heterophylla*), grand fir (*Abies grandis*), western red cedar (*Thuga plicata*), and Engelmann spruce (*Picea engelmannii*). Western hemlock has the highest cover, but grand fir the highest density. Western hemlock, however, accounts for about three-fourths of the tree reproduction. Less abundant tress include Douglas-fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), subalpine fir (*Abies lasiocarpa*), lodgepole pine (*Pinus contorta*), ponderosa (*Pinus ponderosa),* and black cottonwood (*Populus trichocarpa*).

Common shrubs in the understory include Rocky Mountain maple (*Acer glabrum*), Pacific yew (*Taxus brevifolia*), Sitka alder (*Alnus sinuate*), devil's club (*Oplopanax horridum*), huckleberry (*Vaccinium globulare*), pachistima (*Pachistima myrsinites*), and white spirea (*Spirea betulifolia*).

Nineteen graminoids are present, but provide little cover. The most common graminoids include reed mannagrass (*Glyceria grandis*), pinegrass (*Calamagrostis canadensis*), and northwest sedge (*Carex concinnoides*).

Tiarella (*Tiarella trifoliate*), queencup beadlily (*Clintonia uniflora*), heartleaf arnica (*Arnica cordifolia*), western goldthread (*Coptis occidentalis*), beargrass (Xerophyllum *tenax*), stream violet (*Viola glabella*), and roundleaf violet (*Viola orbiculata*) are respectively the most abundant of the 52 forbs present. Cryptogams are more common than forbs. Lady fern (*Athyrium filix-femina*), oak fern (*Gymnocarpium dryopteris*), and bracken fern (*Pteridium aquilinum*) are, respectively, the most abundant cryptogams.

Clearcuts. Based on results of tree core analysis, most of the clearcuts were logged 20-30 years ago. These clearcuts are located primarily in the tailings study area. Considering cover and density, western larch, western red cedar, Douglas-fir, lodgepole pine, and Engelmann spruce are the most abundant of the tree species present. Engelmann spruce, black cottonwood, and western white pine (*Pinus monticola*) have the highest reproduction rates, respectively.

Shrub cover and density is high in the clearcuts. The most abundant shrubs include white spirea, pachistima, Sitka alder, huckleberry, snowberry (*Symphoricarpos alba*), dwarf bilberry (*Vaccinium myrtillus*) and baldcup rose (*Rosa gymnocarpa*).

Herbaceous cover of graminoids and forbs is high and includes 23 perennial graminoids and 51 perennial forbs. Pinegrass, northwest sedge, western fescus (*Festuca occidentalis*) and purple reedgrass (*Calamagrostis purpurascens*) are the most dominant graminoids. Major forbs respectively include Virginia strawberry (*Fragaria virginiana*), fireweed (*Epilobium angustifolium*), orange hawkweed (*Hieracium aurantiacum*), beargrass, Canada goldenrod (*Solidago canadensis*), and white clover (*Trifolium repens*).

Shrublands. Shrublands, located in the avalanche chutes in Libby, Ramsey, and Rock Creek, are dominated by a complex association of 26 shrubs. Major species of the cover and density are thimbleberry (*Rubus parviflorus*), pachistima, red raspberry (*Rubus idaeus*), white spirea, Rocky Mountain maple, Sitka alder, and rusty menziesia (*Menziesia ferruginea*). Major tree species colonizing the shrublands include subalpine fir, aspen (*Populus tremuloides*), and grand fir.

Herbaceous understory cover is dominated by perennial forbs, but includes numerous perennial graminoids. Beargrass is the major perennial forb, while bluejoint reedgrass is the most abundant perennial graminoid. Other common forbs include green false hellebore (*Veratrum viride*), hooker fairybell (*Disporum hookeri*), starry Solomon's seal (*Smilacina stellata*), cow parsnip (*Heracleum lanatum*), bedstraw (*Galium triflorum*), and western meadowrue (*Thalictrum occidentale*). Less abundant perennial graminoids include blue wildrye (*Elymus glaucus*), Columbia brome (*Bromus vulgaris*), and bearded fescue (*Festuca subulata*).

Wetlands. Wetlands delineated using the 1987 delineation manual are shown in Figure 8. Three types of wetland settings were delineated and mapped:

- Distinct areas comprised entirely of wetlands (W);
- Complexes of wetland and non-wetland areas (WC);
- Seep areas with less than 5 to 10 percent wetlands (S).

Most wetlands occur within the proposed Little Cherry Creek impoundment area. Other wetlands along the proposed access road and transmission line alternatives are not shown because of their small size (less than one acre). Wetlands for the Montanore Project area occur within riparian areas of perennial streams, at seeps and springs, and on poorly drained depressions which collect and retain surface runoff. Beaver dams and logging activities have influenced the distribution, structure, and species composition of wetlands of the project area. Three wetland types were identified based on canopy structure and

dominant vegetation: conifer-dominated wetlands, shrub-dominated wetlands, and sedge-dominated wetlands.

Conifer-dominated Wetlands

Approximately 0.2 acres of conifer-dominated wetlands grow at springs and seeps which have not had the overstory canopy removed. Dominant overstory species include western red cedar, western hemlock, Engelmann spruce, and black cottonwood. Shrubs include Sitka alder, devil's club, and red osier dogwood. Dominant herbaceous plants include lady fern, oak fern, Columbia monkshood, reed mannagrass, bluejoint reedgrass, arrowleaf groundsel, and common horsetail.

Typic Humaquepts components of the complex, a hydric soil, are deep, somewhat poorly drained, and formed in alluvium, slopewash, and eolian materials. Soil characteristics are as follows: 0 horizon (3-0 inches) of decomposed plant material; A horizon (0-6 inches) of loam (10YR 3/3); BW horizon (6-15 inches) of silty clay loam (10YR 4/3) and with mottles; Ogl horizon (15-26 inches) of silt loam (5Y 7/1); and Og2 horizon (26-50 inches) of clay loam (95YR 7/1) and with mottles.

Shrub-dominated Wetlands

Shrub-dominated wetlands (approximately 12.9 acres in the tailings area plus 0.4 acres in the Bear Creek road reconstruction area) typically are present at springs and seeps and at the margins of poorly drained depressions where the forest overstory has been removed by logging. Dominant shrubs are Douglas spirea, alderleaf buckthorn, and Sitka alder. Common understory species are bluejoint reedgrass, beaked sedge, starry Solomon's seal, and stream violet. This type was most common on the proposed tailings impoundment at Little Cherry Creek where surface flows of springs and seeps appear to have increased due to removal of the forest overstory. Soils of this wetland type are Typic Haplaquept, Typic Dystrochrept, Typic Humaquept, and Typic Fluvageuent.

A Wetlands Identification, Delineation Mititigation and Monitoring Plan was submitted in March 1992 for the Corps of Engineers 404 application and is on file at the KNF and

DSL. Using the currently accepted techniques, Mines Management will conduct the proper field inventory of wetlands in the MP area and prepare an application to the Corps of Engineers for a 404 permit in 2005.

Flowing Water Wetlands (5.8 acres) in Little Cherry Creek will be filled or dewatered by the Little Cherry Creek tailings impoundment and diversion channel. Road reconstruction will affect flowing water wetlands along Bear Creek Road (0.1 acres).

Sedge-dominated Wetlands

Sedge-dominated wetlands (approximately 0.5 acre) grow in poorly drained depressions at the proposed Little Cherry Creek tailing impoundment site. Sedge-dominated wetlands occupy sites where water collects during the early part of the growing season and soils remain water saturated for all or most of the growing season. Dominant species are beaked sedge, water sedge, knot-sheath sedge, and inflated sedge.

Wetlands in depressions have a Cumulic Humaquept (ThA) soil which is classified as hydric by the U.S. Soil Conservation Service (SCS) (1987). These soils are deep, somewhat poorly drained, and formed in glacial drift lake deposits and alluvium. The soils have an A/O horizon (0-9 inches) of loam (10YR 3/2); a Bwg horizon (9-39 inches) of silty clay loam (10YR 3/2); and a Og horizon (39-60+ inches) of silt loam (5YR 5/6) with mottles, and are hydric.

The Sensitive Wetland Species Northern beechfern (*Thelypteris phegopteris*) is a widely distributed circumboreal species, ranging in distribution in North America from North Carolina, Alaska, to northern California. Its centers of greatest occurrence are on the East and West coasts and inland where precipitation is relatively high. In Montana, this species is known from one location in Glacier National Park and from two sites in Lincoln County - Little Cherry Creek and Bear Creek. *Additional sensitive wetland plant surveys completed since 1992 have given better definition of populations in the project area resulting in the conclusion that the project would have no overall impact on the Northern beechfern.* The Glacier Park population grows on moist, organic soil over

rock; whereas the population in Lincoln County grows in riparian areas usually on decomposed logs and moist soil, close to streams, and under a closed conifer overstory of old-growth cedar and hemlock.

5.3.2 Existing Vegetation – Transmission Line Corridor and Access Roads

The transmission line corridors and access roads include areas of native vegetation, agricultural lands, industrial sites, residential areas, talus slopes, water, and disturbances. The native communities are in various stages of ecological succession as a past history of logging, fire, agricultural, or other disturbances has arrested the progress toward the climax. Major native communities mapped include coniferous forest, clearcut, riparian, shrubland, and wetlands. These communities are similar to those described for the intensive study area.

5.3.3 Forest Habitat Types – Intensive Study Area and Transmission Line Alternatives and Access Roads

Twelve forest habitat types in seven climax series occur in the intensive study area and along the transmission line alternatives and access roads. Table 5-1 identifies these habitat types by climax series.

Western hemlock/queencup beadlily is ubiquitous to the tailings areas and also occurs at each of the plant sites, the exploration adit area, and is common along the upper elevations of both transmission line alternatives. This habitat type is composed of young seral stands dominated respectively by grand fir, western hemlock, western red cedar, Douglas-fir, western larch, Engelmann spruce, lodgepole pine, and white pine.

Western hemlock/oak fern occurs at the upper Libby plant site along Libby Creek and is associated with the Engelmann spruce/common horsetail habitat type which is also present in Ramsey Creek. Western hemlock, the climax tree, dominates the study area sample stands. Major seral trees present include grand fir, Engelmann spruce, and white pine.

Other habitat types of drainages include the western red cedar/lady fern, which occurs on the moist draw at the tailings sites, and the western red cedar/devil's club which is present along Ramsey Creek. The western red cedar/lady fern habitat type is dominated by western red cedar and western hemlock, the climax codominants. Engelmann spruce

and black cottonwood are common in the habitat type. The western red cedar/devil's club habitat type is characterized by grand fir and Engelmann spruce, seral components of the climax, and western hemlock, the climax codominant. Western red cedar is not present.

Mountain hemlock/queencup beadlily and mountain hemlock/beargrass are high elevation habitat types found only in the Rock Creek exploration adit study area. These two habitat types are represented in the study area as seral brush fields. Although, the mountain hemlock/beargrass habitat type is characterized by a sparse density of mountain hemlock and Douglas-fir amid a dense cover of shrubs.

The two habitat types of the subalpine fir series (subalpine fir/queencup beadlily and subalpine fir/menziesia) characterize the upper elevation slopes of Libby and Ramsey Creeks. The subalpine fir/queencup beadlily habitat type is characterized by a dense cover of grand fir and a sparse representation of six seral tree species. The subalpine fir/menziesia habitat type occurs only as a seral brush field on steep, north-facing slopes in the Ramsey Creek drainage.

The grand fir/queencup beadlily habitat type is present only along intermediate elevations of the Miller Creek transmission line alternative.

The Engelmann spruce/common horsetail habitat type is present in the transmission line alternatives along sections of Libby and Miller creeks and the Fisher River. Due to the historical disturbance along these streams the vegetation includes many diverse seral communities.

Lower elevation habitat types of dry sites include Douglas-fir/common snowberry and Douglas-fir/pinegrass. These habitat types occur commonly throughout the area including the town of Libby and the alternative transmission line routes, and they were not quantitatively sampled.

5.3.4 Threatened and Endangered Species

The U.S. Fish and Wildlife Service has not listed any federally classified threatened or endangered plant species for Lincoln County, Montana pursuant to the Endangered Species Act. There are, however, two species considered sensitive by the Kootenai National Forest – woolgrass and northern beechfern. *A review of threatened and endangered species will be completed with the agencies and updated as necessary for project review.*

A small population of woolgrass, *Scirpus cyperinus,* was found at the Little Cherry Creek tailing study area in a wetlands habitat and in an adjacent ditch along the Forest Service road. A larger population was found in a wetlands habitat outside the intensive study area along Libby Creek.

A large population of northern beechfern grows in the riparian zone of Little Cherry Creek, downstream from where Little Cherry Creek road crosses Cherry Creek. The population occurs on both USFS and private land downstream to the confluence of Little Cherry Creek with Libby Creek. The largest portion of the population appears to be in the 25-acre parcel of old growth forest on USFS land. A small population of northern beechfern was found on Bear Creek. The northern beechfern grows in close proximity to water on moist organic stream banks and on decomposed logs in late stages of decay.

5.3.5 Noxious Weeds

The following weeds are known to exist within the project area: orange hawkweed, common St. Johns-wort, knapweed, oxeye daisy, and perhaps other new invaders. Weed management on the public lands is a recognized concern, and MMI will develop a weed management control plan with the agencies input and Lincoln County approval.

6.0 GEOLOGY

The Montanore Project orebody is located in western Montana near Noxon. Access can be gained by driving east from the Noxon bridge for two miles to the Rock Creek road, which can be driven for about 5 miles to where the east and west forks of Rock Creek divide. At this point, it is about a 4 mile hike to the outcrop.

6.1 REGIONAL GEOLOGY

Rocks of the Belt Supergroup, a thick section of predominantly clastic sedimentary rocks, is contained within the Rocky Mountain Physiographic Province. In northwestern Montana, major north to northwest trending collinear folds with subparallel faults formed as (Laramine Orogeny) mountain building activity ceased. The Belt sedimentary basin, which formed over a time span of 600 million years (1450 to 850 million years ago), experienced horizontal shortening and vertical thickening in part as a results of this, along with development of regional jointing, cleavage and foliation.

The Montanore Project deposit is located to the north of the major Osburn and Hope Faults. These major strike-slip faults cut west-northwesterly across the 40 mile wide "Western Montana Copper Belt". The Western Montana Copper Belt trends north/south, starting near the Coeur d'Alene Silver District on the south and parallels the Idaho border over western Montana terrain to the north to cover the Troy Mine, Rock Creek and Montanore Project Orebodies. Anomalous copper and silver values are scattered throughout thousands of square miles of Belt terrain. Copper commonly occurs in the green-beds of the sediments from Lincoln, Montana on the east to near Sandpoint, Idaho on the west, and from Salmon, Idaho on the south to and beyond the Canadian border on the north.

A geological map of the area above and peripheral to the planned underground workings is in Figure 9. Also included in this figure is an approximate outline of the Montanore Project ore deposit. A cross-section along the Libby Creek Adit is in Figure 10. This

shows the geological formations that will be encountered by the adit. Figure 11 is a regional geologic map of the project area showing the location of the proposed tailing disposal area and the hydrogeologic cross-sections. The relation of the Montanore Project ore body and Asarco's Rock Creek deposit is shown on Figure 9.

The Montanore Project ore deposit has been examined by means of exploration boreholes. These holes yielded little information on the groundwater table, however, available information from the drilling program indicates a depth to groundwater of about 500 feet. Due to the low permeability of the Precambrian geological formations in the area and the geological structure, the characteristics of or even the presence of a regional groundwater system has not been confirmed.

The groundwater table in the area probably is a subdued reflection of surface topography. Streams in the area have large flows during spring runoff but flows greatly decline or cease in the summer and fall. The presence of very few springs together with the lack of stream baseflow in the area suggests a groundwater system with a limited flow rate and a poor interconnection with streams. In the proposed mine area, based on exploration drilling data and information from ASARCO's permit application, it is assumed that regional groundwater levels are well above the proposed underground workings and groundwater will flow into these workings.

Groundwater recharge probably occurs along higher elevation stream channels and from infiltration of precipitation into rock fracture zones. Regional groundwater discharge zones have not been identified but presumably the lower segments of streams in the area receive groundwater recharge as do the few springs in the study area.

Rock Lake, St. Paul Lake, Libby Lakes and Isabella Lakes appear to be the result of glacial activity. Rock Lake may be a glacial hanging valley lake and St. Paul Lake appears to be dammed by a glacial moraine. Isabella Lakes appear to be cirque lakes and Libby Lakes may be in morainal deposits. Both Rock Lake and St. Paul Lake are within the trend of the Rock Lake fault.

Mine development will remove some groundwater from Precambrian bedrock formations, however, the low bedrock permeability and depth to proposed underground workings will significantly limit the impact of mining on groundwater levels. If, during underground mining, large groundwater inflows are encountered then, as a matter of operational necessity, these inflows will be grouted to reduce or eliminate the inflows.

After mining is completed, if water flowing from the adits is considered a problem due to quantity or quality, the adits can be plugged. Long-term monitoring of any plugs would be required. In the unlikely event these plugs show evidence of failure, the plugs can be repaired or the adit can be replugged. The mine development and subsequent closure should have little long-term impact on water balances. Equilibrium outflow from the adits after mining has ended is expected to be similar to the regional contributions of springs and stream baseflow. The openings can be plugged, if needed, to restore hydrostatic heads in the groundwater system.

During mine development, the subsurface geology and hydrogeology will be evaluated in detail and the potential relationship to water levels in lakes assessed as mining progresses. Evaluation of means to prevent any adverse impacts will proceed in conjunction with mine development as inflows occur and grouting techniques are brought into practice.

6.2 LITHOLOGY

The formations exposed in the project area include, from oldest to youngest, the Burke, Revett, St. Regis, and Wallace. The Burke, Revett and St. Regis Formations belong to the Ravalli Group, and the Wallace Formation belongs to the Middle Belt Carbonate Sequence. Figure 45 is a map showing the geology of the surface in the project area. Figure 46 shows geologic longitudinal and cross-sections AA-AA′, BB-BB′ and CC-CC′ through the project area.

The Burke Formation is composed mainly of dark-gray, slabby siltite with greenish-gray argillite and silty argillite. Purplish tints in the coarser-grained layers are fairly common. The contact (according to Jack Harrison of the USGS) between the Burke and Revett is considered one of the most gradiational of the Belt Series. The lower Revett and Burke contact was never penetrated at the Montanore Project.

The Revett Formation is characterized by blocky, thinly cross-bedded, clean, white quartzite in layers from 2 to 100 feet thick, with buff colored, silty quartzite, light gray to green siltite and some greenish argillite that alternates with quartzite layers. It is common for this fine-grained quartzite unit to be more heavily jointed than the thin-bedded siltite sequence. The blocky quartzites commonly outcrop as cliffs, which can often be visually traced around canyons, on foot or from an airplane.

The St. Regis Formation is composed of gray to green thin-bedded and commonly interlaminated siltites and argillites which are often slightly carbonatic, alternative with gray to white quartzites. The slits occasionally have anomalous patches of ferroan carbonate. In some areas the St. Regis displays a distinctive purple cast, which is probably caused by oxidation of sulfides.

The Wallace Formation consists of lithogic types listed (in order of decreasing abundance): 1. black and white or green interlaminated argillite and siltite; 2. green to gray carbonatic siltite commonly thinly interbedded with argillitic siltite; 3. blue-gray

laminated, limestone that commonly has an irregular cellular weathering habit (molar tooth structure); 4. white laminated dolomitic quartzite and 5. dense green argillite having conchoidal fracture and waxy appearance.

6.3 REVETT FORMATION

The Revett Formation, which hosts the Montanore Project deposit has been subdivided into three members based on the amount of quartzite, silty quartzite, and siltite. The upper Revett is dominated by clean, fine-grained quartzite with minor, thin siltite and silty quartzite interbeds. The middle Revett is a thick sequence of siltite and silty quartzite interbeds. The lower Revett is composed primarily of quartzite with packages of siltite and silty quartzite beds.

The average thickness of the Revett Formation in the Rock Lake area is 2,500 feet. The upper Revett averages 215 feet in thickness compared to 245 feet at Troy and 180 feet at Copper Gulch. The middle Revett ranges in thickness from 300 feet to the east near the Libby Lake Fault to over 600 feet thick near the Rock Lake Fault. The average thickness of the middle Revett above the deposit is 600 feet. This is the thickest reported section of middle Revett in the Belt Basin. It compares to 289 feet at Troy and 404 feet at Copper Gulch. The dramatic increase in thickness of the middle Revett near the Rock Lake Fault suggests that this area was a topographic low during sedimentation and may indicate that the Rock Lake Fault was vertically active during sedimentation. The entire section of lower Revett is exposed on the east side of Rock Peak. Here it averages 1,700 feet in thickness. The thickness of the lower Revett beneath the Rock Lake Deposit has not been determined. To date the deepest drill hole penetration has been to a stratigraphic depth of 459 feet below the middle Revett.

The vast majority of the silver/copper mineralization at the Montanore Project is located in the upper portion of the lower Revett. The lower Revett has been divided into sub-units based on lithologic guidelines devised by ASARCO geologists and reported by Hayes and Einaudi (1986). The subdivisions range from the A Bed quartzites at the top to the I Bed quartzite on the bottom. Drilling of the Montanore Project orebody has not penetrated beyond the F Beds. The A Beds consist primarily of thick sets of vitreous quartzite with thin siltite and silty quartzite interbeds. The unit averages 183 feet in thickness and ranges between 141 and 210 feet thick with the thickest sections being

located within a few hundred feet of the Rock Lake Fault to the south near the apex of the mineralized zones. The B Beds are dominated by siltite and silty quartzite which are commonly separated by two thin vitreous quartzite beds. They average 62 feet in thickness and range between 31 and 80 feet. The thickest section is located in the St. Paul Pass area whereas the thinnest section appears to be near the apex of the mineralized zones. The C Beds consist of vitreous quartzite sets with few thin siltite interbeds. The unit averages 47 feet in thickness and ranges from 36 to 74 feet thick. The D Bed consists of interbedded siltite, silty quartzite, and thin quartzite beds. The unit averages 63 feet in thickness and ranges from 56 to 69 feet thick. The E Beds consist primarily of thick sets of vitreous quartzite with local thin siltite and silty quartzite interbeds. Only one drill hole has completely penetrated the E Beds in which the intercept thickness was 28 feet. Each of these subunits have been found to contain significant silver/copper mineralization (greater than 0.75 oz. silver/ton).

The mineralization at the Montanore Project orebody lies on the lower limb of a breached overturned syncline (Figure 12 and 13). The syncline is an inclined, plunging, asymmetric fold that is dominated by planar limbs and is overturned to the west. The fold axis of the overturned syncline diverges slightly from the Rock Lake Fault to the northwest. This geometry creates a much wider lower limb progressively northwestward. The overturned syncline at the Montanore Project orebody is bounded on the west by the Rock Lake Fault which has a down-dropped eastside, the Libby Lake Fault bounds the syncline on the east.

6.4 MINERALIZATION

The following descriptions of the orebody are based on more than 70,000 feet of core drilling in the years 1983 through 1987.

The mineralization at the Montanore Project orebody is dominated by sulfide mineral assemblages containing one or more of the following minerals: bornite, chalcocite, chalcopyrite, native silver, galena, pyrite, and pyrrhotite. Zones that contain an average of greater than 1.00 oz Ag/ton are dominated by the bornite-chalcocite, and bornite-chalcopyrite – chalcocite assemblages. Sulfides in the system occur primarily within pore spaces between sand grains and also as grain coatings. Sulfide concentrations disseminated along bedding planes (sometimes they cross) and heavy mineral laminations are common, especially within siltite intervals. Almost without exception the higher grade intervals within a particular zone will be located in fine-grained rocks (but note: the total mineral package or ore zone is within the coarser-grained upper Revett quartzites; not fine grained middle Revett siltites). Mineralization preferring the finer-grained rocks is probably due to both a physical and chemical change across lithologic boundaries. The fine-grained sediments act as a trap to mineralized solutions passing through coarser-grained quartzites. Further sulfides are concentrated along contacts, which also have higher organic contents than do coarser facies sediments, thereby providing a very efficient precipitation mechanism. At Troy, a mine geologist earlier reported that, "Copper sulfides which were observed adhering to bedding plane concentrations have been followed for several tens of feet along any given trace". Polished sections indicate such occurrences are generally associated with carbonate-rich, coarse-grained phases of Montanore Project orebody, except in close proximity to premineral faults. The best mineralized intercept of the entire orebody is in hole HR-16, having 33 feet of 5.93 oz. Ag and 1.13 percent Cu/ton, and consists of disseminated grains of copper sulfides peppering a white quartzite, with no remobilized or gobby-mineral present.

Andrew McNeil, a Noranda mineralogist in Toronto, described the textures he observed in 106 doubly polished thin sections collected from the ore intercepts in U.S. Borax drill

holes. He noted that copper sulfides +/- native silver occur principally as intergranular disseminations in the host clastics where the concentrations are variable. The occurrences vary from patches or clusters within rocks to concentrations along bedding planes at lithologic changes. Some samples showed higher values in coarser grained rocks, some the opposite. Copper sulfides also occur in heavy mineral laminations with zircon, rutile and pyrrhotite. He noted that grain sizes are directly proportional to the classic grain size of the host. Vein copper sulfides, reported in variable amounts by U.S. Borax and Noranda, are generally coarser grained than their disseminated counterparts.

The average grade, based on U.S. Borax drilling is approximately 2.0 opt Ag and .80% Cu. Mineralization lies on the lower limb of a breached, overturned syncline and is truncated on the west by the Rock Lake Fault (Figure 12 and 13). The deposit remains open to the north and east. Two distinct subparallel ore zones, the B-1 (upper) and B (lower) averaging 30 feet and 34 feet thick, respectively, are present. The B zone is generally higher in grade, although the Ag:Cu ratio is higher in the B-1 zone. The B-1 zone is not as extensive as the B zone, having been encountered in only 17 of 27 drill holes.

Mineralization narrows to the east in B-1; the B horizon exhibits variable thicknesses. Higher grades are generally found to the west. Vertical separation between the B-1 and B horizons increases from east to west. A low grade zone which contains disseminated and vein related galena, forms an interlayer in most areas between the B-1 and B horizons.

The stratigraphic separation between the upper Ag-Cu (B-1) and lower Ag/Cu (B) zones by the barren zone may be more than 200 feet on the west and as thin as 18 feet on the east, and the two zones may converge to the northeast.

Due to the mineralogic (zoning) and stratigraphic similarities of these two zones they can be correlated with a high degree of confidence. It appears that the lead-bearing waste is located similarly to the peripheral lead zone at the Troy deposit, where it is above and later to the Ag-Cu mineral lode. The “JF” protorebody at Ross Creek (near the Troy

deposit) also has a similar peripheral zone. The chemistry of the shallow seas not only changed from lead-rich to silver-copper rich over time, but also laterally over distance with little apparent facies change. The assay data at the Montanore Project orebody shows that there is minimal overlap of the mineral zones.

6.5 GENESIS

At Spar Lake (Troy), the data suggests that ore fluids were diagenetic, guided by permeable sandstones which contained pre-ore reactant, which were then replaced by ore minerals. It is reasonable to expect the same controls at Montanore, however, more data is necessary to verify this assumption. The evaluation program should provide more data on textures and relative ages of ore minerals, in addition to the age of mineralization with respect to folding.

7.0 SOILS

7.1 INTRODUCTION

A soils investigation of the Montanore Project site was conducted in the summer of 1988 and 1989 by Western Resource Development Corporation. Soils of the area were mapped, described and sampled using methods detailed in the Baseline Soils Study (WRDC 1988) and Addendum (WRDC, 1989). Nomenclature follows guidelines in place in 1988 and 1989. Names of some soils may be different today; however, characteristics of the soils remain the same (personal communication with Lou Kuennen, Kootenai National Forest November 16, 2004, and with Neil Svendsen USDA Natural Resources Conservation Service Missoula, MT, November 17, 2004.) Any required updates to this soils section will be prepared during the NEPA/MEPA analysis as part of the approval/permitting process.

The Baseline Soils Studies are in Appendix F of this permit application. Objectives of the soils study included:

1) Description and characterization of the landscape, including the physical and chemical attributes of the soils.

2) Evaluation of basic soil and landscape data to provide interpretations important to use, management and reclamation.

3) Determination and mapping of the distribution of the soils in the intensive study areas.

The baseline soils report presents soil information for the intensive and extensive study areas and the transmission line corridors. The intensive study area focused on the tailings disposal area, plant sites and adit sites. The Land System Inventory of the Kootenai National Forest (Kuennen and Gerhardt, 1984) was the primary source for the extensive study area and the transmission corridors.

A detailed soil survey was performed in the intensive study area. Fourteen (14) map units occur in the intensive area.

Soil information for the transmission line corridors were derived from the Land System Inventory and additional field investigations. There are eight (8) map units on the Bear Creek Road and other line corridors to plant sites.

7.2 SOILS FORMING FACTORS

7.2.1 Geology and Parent Materials

The project area is underlain by a great thickness of Precambrian metasedimentary rocks of the Belt series, composed of hard, fine-grained clastic rocks, which are generally resistant to weathering (Veseth and Montagne, 1980). Most of the soils formed in deposits derived from Belt series rocks that were transported by water, ice and slope processes. Wind-deposited materials containing volcanic ash mantle much of the project area (Nimlos 1980).

The soils formed in the water deposited materials are weakly to moderately developed. Soils formed on fluvial deposits are well-sorted, coarse to medium textured and stony. Soils formed on lacustrine deposits are medium to fine textured with few coarse fragments.

Soils formed on alpine glacial deposits exhibit only minimal weathering and development and are medium textured with abundant angular coarse fragments. Soils formed on continental glacial deposits in the tailings are extensively weathered and have translocated clay, strong soil structure and thick weathering rinds on rocks. These soils are fine textured and vary widely in coarse fragment contents.

Soils formed in conjunction with soil creep and snow avalanche processes are medium textured and weakly developed with abundant coarse fragments.

7.2.2 Physiography

The landforms of the project area have been shaped by fluvial and glacial processes acting within the structural constraints of the bedrock. Alluvial processes have produced nearly level to gently sloping flood plains, terraces and terrace escarpments.

Alpine glacial features occur high in the Cabinet Mountains. Landforms include sloping marginal and recessional moraines and gently sloping valley bottoms. The valley

bottoms are dissected by streams with associated flood plains, small terraces and ravines. Debris fans are associated with snow avalanche chutes.

Landforms in the tailings area are of structurally controlled hills and ridges with a veneer of glacial drift. The slopes are moderately to very steep, convex and slightly dissected. Areas of glacial drift have hummocky topography suggesting a water-reworked glacial plain with a poorly integrated drainage network.

7.2.3 Time

The youngest soils in the study area are associated with recent fluvial and colluvial activity. They have surface horizons with organic accumulation and little development in the subsurface. Soil age ranges from less than a hundred to several thousand years old.

Intermediate aged soils have surface horizons affected by volcanic ash where most of the weather occurred. These soils range in age from at least 6,600 years old to early Wisconsin age.

The oldest soils in the intensive study area occur in the tailings area on deposits related to one of the pre-Wisconsin glacial advances which occurred in the Pleistocene over the last 2 million years.

7.2.4 Climate

From the confluence of Libby Creek and Swamp Creek (below the project area) to Elephant Peak (above the project area), the annual precipitation ranges from less than 20 inches to 100 inches (USDA/SCS, 1974). Mean annual precipitation in the vicinity of the project area varies from 20 to 100 inches (Montagne et al, 1982). Low intensity, long duration storms are common with the most of the precipitation falling as snow in the higher elevations.

The mean annual temperature of the surrounding valley stations is near 45ºF (Kuennen and Gerhardt, 1984). The frost free period is around 30 to 50 days (Montange et al, 1982).

The soil moisture regime of the well drained soils was assumed to be udic. Inadequately drained soils have aquic moisture regimes. Lower elevation soils have frigid soil temperature regimes and higher soils and those in cold air drainages were assumed to be cryic.

7.2.5 Biologic Influences

The dominant vegetation in the project area is coniferous forest. Shrubfields occur in areas of repeated disturbance, such as avalanche chutes. Small areas of hydric vegetation dominated by sedges, rushes and shrubs occur in bogs. The forest vegetation, with closed canopies and sparse understories, results in soils with thin A horizons. Thick dark colored surface horizons occur under grass and shrub vegetation.

7.3 SOILS OF THE INTENSIVE STUDY AREA

The intensive study area includes the Little Cherry Creek tailings impoundment (1,818 acres), the Libby Creek Surface Facility (202 acres), Ramsey Creek mine/mill site (164 acres) and two water disposal sites on a gentle east-sloping ridge between Poorman and Ramsey Creeks. Water disposal site No.1 (218 acres) is west of the transportation corridor and Water disposal site No.2 (199 acres) is to the east.

The Baseline Soil Study contains maps showing the distribution of the fourteen (14) map units in the intensive study area. Table 7-1 is a list of the soil map units which occur in the intensive study areas.

7.3.1 Soil Suitability

The suitability of the soils in the areas to be disturbed for topsoil salvage was evaluated for each map unit. Table 7-2 contains information about topsoil suitability and limitations and salvage volumes for each of the intensive study areas.

7.3.2 Soil Chemical and Physical Properties

The soils of the intensive study area range from extremely acid to moderately alkaline. The saturated soil paste pH ranged from 4.3 to 7.5. Surface soils were in the 4.9 to 6.6 pH range.

All the soils were non-saline. The electrical conductivity (EC) of the saturated soil paste extract ranged from 0.1 to 0.4 mmhos/cm. The soils are almost certainly non-sodic as well.

The soils had relatively high organic matter contents. This may be accounted for by the presence of volcanic ash (Nimlos, 1980; Fosberg et al, 1979a) and relatively low ambient air and soil temperatures reducing the rate of decomposition. The surface soils ranged from 1.2 to greater than 7.0 percent organic matter.

The soils were predominately medium textured with silt loam being the most common texture, though both coarse and fine textured soils occurred. The surface horizons were mostly silt loam in texture. Most of the soils contained rock fragments greater than 2mm in mean diameter and many contained significant amounts.

The saturation percent and 15 bar water content of the soils were abnormally high in the surface soils indicating the presence of volcanic ash and in some cases high levels of organic matter. The subsoil horizons fell within the normal range for mineral soils.

Soil fertilizer elements (N, P, K) are expected to occur in less than adequate amounts in most soils. Phosphorous fixation is a particular problem on volcanic ash influenced soils (Fosberg, et al, 1979b).

7.4 SOILS OF ANCILLARY FACILITIES

The land type map units that occur along the corridor and interpretations relevant to environmental assessment are presented for Bear Creek Road and other line corridors in Tables 7-3, 7-4 and 7-5, respectively.

8.0 LAND USE, AESTHETICS AND NOISE

8.1 LAND USE

The U.S. Forest Service is responsible for maintaining the national forests under a multiple-use concept. *Current land uses and ownership likely have changed since the original submittal. A review of land use and ownership will be accomplished and updated as necessary for project review.* The Montanore Project will be developed on unpatented mining claims located on federal lands under the jurisdiction of the U.S. Forest Service. Some private land will also be included in the overall development scheme.

Existing pertinent documents which may be used to describe the affected environment are Forest Land Use Report, Special Use Permit folders, Range Permit folders Plans of Operation and Notices of Intent (mineral operations), Oil and Gas leases, and interviews with permitees.

The Cabinet Mountains separate the Montanore Project into:

- A study area on the east side, which is accessed from the town of Libby; and
- A study area on the west side, which is accessed from the town of Noxon.

The study area on the east side was proposed by the U.S. Forest Service for review and evaluation of existing land uses. The study area extended from Bear Creek in the north to West Fisher Creek Canyon in the south. This included all areas proposed for disturbance plus a buffer area. New data concerning land use for all affected areas will be obtained from all appropriate sources during the NEPA/MEPA analysis to be conducted in the near future.

The proposed west side study area extended from the East Fork of the Bull River in the north to Big Cedar Gulch in the south.

The study areas on the east and west sides are within the area shown on Figures 1 and 2.

8.1.1 EXISTING LAND USE – EAST SIDE

There are two types of land in the east study areas:

- Public lands administered by the U.S. Forest Service; and
- Private lands consisting of patented mining claims.

The majority of the land surface is controlled by the U.S. Forest Service. The patented claims are generally along Libby Creek, with a few scattered claims at the upper portion of the drainage.

Public land, administered from the Libby Ranger District, Kootenai National Forest, is used for logging, grazing, recreation, watershed, wildlife management, and mineral exploration. Recreational uses of forest lands include hunting, fishing, huckleberry harvesting, firewood collection, snowmobiling, sightseeing, and hiking.

Timber

Timber harvesting has been an important economic resource in the area. The timber harvest along lower Libby Creek adjacent to the private land was completed in the late 1960's. The Libby Creek road was extended to upper Libby and Ramsey Creeks, where the timber harvest was completed in the mid 1970's. These clearcut areas were studied as possible alternative plant sites.

The Horse Cable timber sale is the most recent harvest in the project area. It commenced in the early 1980's, with the most recent portion of the cut being completed on lower Ramsey Creek in the fall of 1988. The sale has been extended to 1991. (personal communication, Charlie Howard, USFS, 1988).

Several private tracts of land occur in the project area, and these tracts generally have been clearcut.

Grazing

Currently, no grazing allotment exists in the area. The Libby Creek grazing allotment *had* been used by John L. Beebe *beginning in* 1947. The *past* grazing use *was* for 30 cows for a period of May 16 to October 15. The cows *previously had* access to approximately 5,000 acres on Libby Creek and Midas Creek.

Use Permits

There are several special uses permitted within the general area of the proposed project for private and government benefit. *The following land use authorizations have been issued in the project area (Mark Petersen, USFS, 2005):*

- *Two irrigation water ditches,*
- *One domestic water transmission line,*
- *One Federal Land Policy and Management Act road users association (Libby Cr. Rd),*
- *Two Road Use Permits authorizing commercial log haul (annual permits),*

Currently there are approximately 15 active small mining operations within the Project Area (Lynn Hagarty, USFS, 2005).

Hunting

Big game hunting season opens with archery (generally in early September through mid October), followed by a general rifle season (generally late October through late November). There is also a spring bear season in the project area (generally mid April through mid May). Fishing is a popular and often pursued recreation activity on Libby Creek and its drainage. Howard Lake appears to be a major fishing destination. The proposed mining project is located in deer, bear, elk, and mountain lion hunting district #104 and in mountain goat district #100.

Hunting generates substantial income for the area, and the latest harvest statistics available from MDFWP will be presented in the NEPA/MEPA analysis to be conducted in the near future.

Recreation

During the summer months, local residents and tourists can be observed sightseeing on the general Forest Service system roads. Hiking, backpacking, and camping in the area, other than Howard Lake, is limited. There are no trails which provide access into and over the top of the Cabinet Mountain Wilderness. Consequently, only the most advanced backpackers and those seeking solitude attempt to scale the Libby Creek and Ramsey Creek access to the wilderness. Canyon *roads* approaching the Cabinet Mountains Wilderness offer highly scenic views and are popular for summer hikes and fall hunting.

Several outfitters are permitted in the Libby Ranger District, with *some* operating in the southern end of the District, where the project is proposed.

Locked gates control vehicle traffic to the head of Libby, Ramsey, Poorman, and Cable Creeks all year round and to upper Bear Creek October 15 to June 30 for grizzly bear and wildlife habitat protections.

In the wintertime, the area is blanketed with snow, and the county plows only the Libby Creek road about ½ mile off of Highway 2. Snowmobiles use the area and are allowed access to most roads December 1 to April 30 (Libby Ranger District Travel Access Map, June 1, 2004). Cross-country skiing is also an important wintertime activity in the Bear Creek Canyon area to Poorman Creek Canyon area. (Personal communication, Jon Jeresek, USFS, 1988).

In 1996, a ski area proposal for Treasure Mountain was submitted to the US Forest Service. The Treasure Mountain Ski Area was proposed to be located approximately five miles west of US Highway 2 and one mile south of Libby. Some studies have been performed, and an Administrative Draft Environmental Impact Statement was prepared in June 1998. If the ski area project is to continue, the proponent must finance the additional studies and continue preparation of the Environmental Impact Statement.

Residences

Although there is private property along Libby Creek, the only homes are within ½ mile of Highway 2. No other private homes are encountered along the approach to the project. Other homes in the area are at least 4 miles away, on the Bear Creek access.

8.1.2 Existing Land Use – West Side

There are three types of land in the west study area:

- Public land administered by the U.S. Forest Service;
- Private land owned by individuals, lumber companies, and mining companies; and
- One partial section of State land.

The majority of the surface is controlled by the Forest Service and administered from the Cabinet Ranger District.

The area is used for logging, recreation, watershed, wildlife management, mineral exploration, and placer mining.

The private land holdings constitute a smaller portion of the land ownership in the area. Private lands include ASARCO fee land, residential land, other land company holdings, and limited agricultural land used as hayland.

Timber

Timber harvesting has been an important economic resource in the area. *Planned timber harvests on public land have changed since 1989. Small timber harvests on private lands near the project area have occurred recently. This data will be updated and considered in the agency review and NEPA/MEPA process.* Methods of logging and sizes of cuts are determined by several environmental and economic considerations (ASARCO permit application, May 1987).

Land Use Authorizations

The Forest Service issues Special Land Use Authorizations to individuals and companies that need access across the National Forest for activities not related to mining. The Forest Service issues approvals for Notices of Intent and Plans of Operation for mineral exploration, development, mining, and processing activities. Exploration activities are continuing outside the wilderness. *Additional information is available through the Special Use Database System (SUDS).*

The area along the East Fork of Rock Creek is covered by unpatented mining claims, one patented claim, and a Recreational Withdrawal. *Revette Mining Company has obtained approval for the Rock Creek Project but no permits, licenses, or authorizations have been issued.* Noranda obtained approval for Plans of Operation to continue development work on their project *but has since closed the Libby Creek Adit.*.

Recreation

Several access points to the Cabinet Mountains and wilderness provide routes to the top of the range, where there are several fishing lakes. The main access points are the West Fork of the Bull River, Government Mountain Road, West Fork of Rock Creek Road, and the East Fork of Rock Creek Road. The most heavily used trail is from the East Fork of Bull River to St. Paul Lake. The East Fork of Rock Creek has a locked gate, which requires a longer walk to Rock Lake. In 1988, Rock Lake received 2,450 recreational visitors, 58 percent of which were from out of state (Personal communication, George Bain, USFS, 1989).

There are numerous outfitters on the west side, which generate additional visitor days.

Additional activities which take place are huckleberry harvesting and firewood collection. Huckleberry picking is considered by the USFS to be an important economic and recreational use of the area, although no information is available concerning the number of individuals who visit the area for this purpose, or the economic values that may result. Huckleberry season (late summer through early autumn) brings many people to the area to take part in the berry harvest. The USFS estimates that about 80 percent of

the pickers are local residents. Firewood is collected primarily in the spring and fall, but with the large number of wood burning stoves in the area, firewood collection is constant. Firewood collection permits in 1988 resulted in $4,292.50 in district-wide revenue to the Libby Ranger District (Personal communication, Charlie Howard, USFS, 1989). *It is anticipated that very little change in firewood collection permits have occurred since 1989 but it will be reviewed and updated as appropriate.*

Hunting

The hunting season on the west side is the same as the east side. A larger elk population on the west side seems to increase the number of elk hunters on the west side, where the Montana Department of Fish, Wildlife and Parks (MDFWP) records indicate that more hunting activity occurs. The proposed mining project is located in deer, bear, elk, and mountain lion hunting district #*121* and in mountain goat district #100.

Hunting generates substantial income for the area, and the latest harvest statistics available from MDFWP will be presented in the NEPA/MEPA analysis to be conducted in the near future.

Residences

There are at least two homes along the Rock Creek Road access to the project site.

8.2 VISUAL RESOURCES

8.2.1 Introduction

The visual resources investigation addressed an area of visual influence containing the proposed project facilities and activities associated with the construction and operation of the mine plant site, tailing disposal site, portal locations, and linear facilities including transmission powerline, slurry pipeline, and access roads. This report specifically addresses the Ramsey Creek plant site, Little Cherry Creek tailing disposal site; portals located in Ramsey and Libby Creeks; transmission powerline from Pleasant Valley to

Ramsey Creek; and slurry pipeline and access from Ramsey Creek to Little Cherry Creek. In addition to these facilities, Appendix G includes results from baseline studies conducted for alternative facilities including the Libby Creek plant site, Poorman Creek tailing site, and northern transmission line corridor. *An updated visual analysis will be completed for the project to support the NEPA/MEPA process.*

8.2.2 Methods

Inventory of visual resources was compiled from existing baseline data available from the United States Forest Service (USFS). Kootenai National Forest and Kaniksu National Forest conducted in 1981 a visual resource inventory which includes the study area. The approach used for describing the visual resource baseline information was developed by the USFS and known as the Visual Management System (VMS). The USFS VMS included inventories of variety classes, sensitivity levels for travel routes, visual quality objectives (VQO) and visual absorption capability (VAC).

8.2.3 Results

The study area is located in the Columbia Rockies section of the Northern Rocky Mountain Physiographic Province. Four landscape character subtypes were identified in the study area including 1) Cabinet Mountain Valleys, 2) Intermountain Valley, 3) Mountain terrain, and 4) Valley Plain. The first subtype is the deeply dissected Cabinet Mountain valleys and uplands comprised mainly of quartzitic rock and some granite rocks. The visual character of the Cabinet Mountains, particularly the much higher peaks, have been sculpted by glacial activity which resulting in narrow ridges and steep slopes. Much of this subtype is visually unmodified and protected as wilderness. The locations of the Ramsey Creek plant site and the Ramsey and Libby Creek portals are located at the base of the Cabinet Mountains.

The intermountain basin or valley subtype contains numerous and visually evident modifications consisting of clearcut harvesting and roads. Riparian stands are lined along drainage bottoms. The Little Cherry Creek tailing disposal site and portions of the transmission corridor, slurry pipeline, and access road are located in this landscape

subtype. Adjacent to the intermountain valley lies the rolling mountain terrain subtype. The mountain terrain supports both open and vegetated faces. The open faces include grasses and rock outcrops. The vegetated faces include nearly homogeneous stands of lodge pole/hemlock/Douglas-fir forest. Clearcut harvesting dominates some mountain faces. Horse Mountain is located in this subtype. A portion of the transmission line corridor is found here. The valley plain landscape subtype consists of the Libby and Miller Creek drainages and the Fisher River. This area ranges from narrow to broad flat bottoms with side drainages and separated by steep rolling ridges. Numerous modifications are evident including clearcut harvesting, pasture lands, residential areas, roads, and overhead electrical and telephone lines. A portion of the transmission line corridor is located here.

Most of the project facilities are located in primarily the middleground distance zone. The transmission corridor is located in foreground, as well as middleground zones.

Visual Quality Objectives

Visual Quality Objectives (VQO) are the guidelines established by the U.S. Forest Service for managing scenic quality of lands under their jurisdiction. Private lands are typically not rated. All Visual Quality Objectives classes are represented in the study area and are displayed on Figure 14 and The *Visual Resource Inventory Summary* below. The Cabinet Mountains Wilderness is located in Preservation. The Ramsey Creek plant site and Ramsey and Libby Creek portals are located in Retention. The Little Cherry Creek tailing site is located in Partial Retention. The slurry pipeline and access road are located mostly in Retention and some in Partial Retention. The transmission line corridor contains segments in Retention, Partial Retention and Modification-Maximum Modification.

Visual Absorption Capability

Visual Absorption Capability is the inherent capability of the characteristic landscape to absorb visual change or landscape modification. VAC levels range from high, areas most capable to absorb visual change; to moderate; to low, areas least capable to absorb

modification to the landscape. The results of the VAC inventory are displayed on Figure 15 and the following table. Below is a brief description of the physical characteristics including topography, vegetation and soils and perceptual characteristics of the viewer used to compile each VAC rating. With the assistance of the Forest Service, VAC ratings are identified for each of the project facilities.

VISUAL RESOURCE INVENTORY SUMMARY

Project Facilities	Variety Class	Sensitivity Level of Travel Route	Distance Zone	Visual Quality Objective	Visual Absorption Capability
Plant Site Ramsey Creek	A	1/3	MG/BG	Retention	High
Tailing Disposal Site Little Cherry Creek	B/C	2	MG	Partial Retention	Moderate to High
Transmission Line Miller Creek Alternative	B/A	1/3/2	FG, MG	Retention Partial Retention Modification	Moderate to High

FG = Foreground MG = Middleground

Note:
Portions of some facilities may cross or be located on private lands and therefore may not be included in the Forest Service Inventory.

Cabinet Canyons – High VAC

Project facilities located in this unit include the Ramsey Creek plant site, all portal sites and portions of the access road, slurry pipeline, and transmission line. Topography consists of high diversity. There is a high diversity of vegetation types or classes. Soils provide for a moderate productivity and relatively short term vegetation recovery period. Viewer position is inferior; focal points are strongly oriented toward the Cabinet Mountains Wilderness. The foreground is screened to the uphill side.

Intermountain Valley Floor – Moderate to High VAC

Little Cherry Creek disposal site, portions of the slurry pipeline and access road, and a portion of the transmission line corridor is located in this VAC unit. Topography consists of gentle slopes. There is a diversity of vegetation classes, colors, and heights caused by timber harvesting activities. Soils are very productive and offer rapid revegetation potential. Viewer position is normal. Generally, vegetative screening is in the foreground. Views are parallel to the slope. Strong adjacent scenery dominates visual interest.

Open Mountain Faces – Moderate to High VAC

A portion of the transmission line corridor is located here. Topography is steep and contains well dissected slopes. Vegetation diversity is evident in class and color. Soil productivity is lower with slow vegetation recovery. Soil color surface to subsurface is darker to lighter. Viewer position is inferior, and views are perpendicular to the slope. This VAC unit contains secondary focal points.

Riparian Valley- High VAC

A portion of the transmission line corridor is found here. Topography is characteristic of gentle slopes, low diversity and poorly dissected. Diversity of vegetation is displayed in class, color, and variety of pattern. Soils are productive with rapid vegetation recovery. Viewer position is normal. Foreground vegetation screening is common. Manmade modification dominates many areas of the foreground view.

Vegetated Mountain Faces – Moderate VAC

A portion of the transmission line corridor is located in this VAC unit. Topography is generally steep sloped. There are scattered pockets of dissected slopes. Vegetation contains a low diversity of classes and heights. Soils are productive with good vegetation recovery. Viewer position is inferior with views perpendicular to slope. Northern portions of VAC unit contain dominant man made modifications.

Valley Plain – Moderate to High VAC

A portion of the transmission line corridor is located in this VAC unit. Topography is gentle to flat. Vegetation contains a diversity of classes, classes, and pattern which is largely manmade. Soils are very productive with rapid vegetation recovery. Observer position is normal. Some foreground screening does breakup viewer duration. Views are parallel to the slope. Foreground focal points include occasional rural settings and scattered dwellings.

8.2.4 Computer Generated Visibility

The final component of the Visual Absorption Capability inventory is identification of seen and unseen areas as viewed from representative viewpoints. For the study area viewer locations were identified, with the assistance of the Forest Service which included travel routes, residential, and recreation areas. Twelve critical viewpoints were selected, and a computer visibility analysis was compiled to determine seen and unseen locations for each selected viewpoint.

Viewpoints were ranked according to data provided from the sensitivity levels (one of the component inventories for compiling VQOs). A composite overlay was made for all eleven viewpoints to determine the overall visibility levels for the project facilities. Six designative high level sensitivity viewpoints included four viewpoints from the Cabinet Mountains Wilderness (Snowshoe Peak, Bald Eagle Peak, Elephant Peak, and Libby Lakes), and Great Northern Mountain and Howard Lake campground. Five moderate level viewpoints included Libby Creek and Ramsey Creek roads, two points along USFS

Road 231, (Mileposts 5 and 6 approximately) and one point along USFS Road 278. One low level sensitivity point included the USFS Road 4776 at Horse Mountain Saddle.

The composite visibility map showed the visibility of the Ramsey Creek plant site was low, and visible only from Elephant Peak and Horse Mountain. Little Cherry Creek tailing disposal site, overall, was rated moderate with portions of the site seen from Snowshoe Peak, Great Northern Mountain, Bald Eagle Peak, Horse Mountain Saddle, and USFS Roads 278 and 231. The three portal locations were rated low. The linear facilities of the transmission line corridor were low to moderate, and the slurry pipeline and access road were rated low. Located in Appendix G is a table which displays a summary of the visibility inventory. The composite visibility map is also located in Appendix G, Visual Resource Baseline Study.

8.3 AMBIENT NOISE STUDY

8.3.1 Monitoring Program

A baseline noise study was conducted during Sept 8-10, 1988. The objective of the study was to establish baseline noise levels in the study area. Ambient noise levels were measured near the two meteorological monitoring stations located at the head of Ramsey Creek, and at the Little Cherry Creek Tailings disposal area, the same site used for air monitoring and shown on Figure 4. Noise measuring equipment was calibrated with a B&K 4230 acoustic calibrator. The baseline noise study is contained in Appendix H. Any required updates to the noise baseline data will be done during the NEPA/MEPA analysis conducted in the near future.

The sampling program consisted half-hour averages of A-weighted equivalent sound levels (L_{eq}) and calculating statistical properties of the noise data (L(N)). L(N) values represent the percentage of the measurement time during which a certain sound level is always exceeded. For example, the L(90) value is the sound level that is exceeded 90 percent of the time. In addition, an octave filter was used to collect instantaneous A-weighted sound levels at 10 frequency bands. The octave band data consists of instantaneous readings as observed from the sound meter for the frequency level being monitored. Ambient noise data were collected during the daytime and nighttime hours for both weekday and weekend periods. The sampling for the L_{eq} and L(N) averages were a half-hour.

8.3.2 Ambient Noise Levels at the Ramsey Creek Site

The weekday equivalent sound levels measured during the daytime (L_d) and nighttime (L_n) at the Ramsey Creek site were 41.3 dBA and 28.8 dBA, respectively. The L_{dn} value was 40.5 dBA. The weekend L_d and L_n values were 40.1 dBA and 31.3 dBA, respectively, and the L_{dn} was 40.6 dBA.

A yearly average equivalent sound level of 55 dB will generally interfere with most outside activities (EPA, 1974).

The majority of the weekday daytime sound levels ranged from 31.3 dBA to 45.1 dBA, while the weekday nighttime values ranged from 23.7 dBA to 27.9 dBA. During the weekend, the sound levels ranged from 33.7 dBA to 42.9 dBA during the daytime and from 27.1 dBA to 33.0 dBA during the nighttime. These values represent the range in which most (80 percent) of the sound levels occur (Dept. of Housing and Urban Development, 1972).

The median or average weekday daytime and nighttime sound levels (L(50)) for the Ramsey Creek were 36.3 dBA and 25.1 dBA, respectively. The median weekend daytime and nighttime sound levels were 39.1 dBA and 29.1 dBA, respectively.

Examination of the octave band analysis indicates that the noise levels are higher in the middle of the audible frequency range. The observers noted that noise levels at the Ramsey Creek site consisted mainly of rustling leaves and the sound of Ramsey Creek.

8.3.3 Ambient Noise Levels at the Little Cherry Creek Site

The weekday L_d and L_n equivalent sound levels recorded at the Little Cherry Creek site were 39.0 dBA and 35.5 dBA, respectively, and the L_{dn} was 42.6 dBA. The weekend L_d and L_n equivalent sound levels were 28.6 dBA and 22.7 dBA, respectively, and the L_{dn} was 30.6 dBA.

The majority of the weekday sound levels ranged from 30.3 dBA to 39.5 dBA, while the weekday nighttime values were all at the level of detection (20 dBA) for the noise analyzer. During the weekend conditions, the majority of the daytime sound levels ranged from 21.5 dBA to 31.7 dBA. The nighttime sound levels ranged from near the detection limit of the instrument to 21.1 dBA.

The median weekday daytime and nighttime sound levels for the Little Cherry Creek site were 34.7 dBA and 20.7 dBA, respectively. The median weekend daytime and nighttime sound levels were 23.3 dBA and 20.7 dBA, respectively. The octave band analysis at the

Little Cherry Creek site is similar to the Ramsey Creek site, with the majority of the sound levels occurring in the middle of the audible frequency range.

8.3.4 Summary

Baseline noise levels measured at the Ramsey Creek and Little Cherry Creek sites are typical of those that might be found in unpopulated or rural residential areas. These levels are noted in the table below. Additionally, these data are consistent with the baseline noise levels recorded in the Rock Creek Study Area. The daytime baseline noise levels in the Ramsey and Little Cherry Creek Study Area range was 29 to 41 dBA and the baseline noise levels measured in the Rock Creek Study Area range from 25 to 35 dBA. Therefore, the noise levels measured in the Ramsey Creek and Little Cherry Creek sites are believed to be representative of noise levels throughout the area. By comparison, the noise levels measured in the vicinity of the mining activities at Asarco's Troy mine range from 45 dBA to 97 dBA (Parker, 1987).

EXAMPLES OF OUTDOOR DAY-NIGHT AVERAGE SOUND LEVELS IN Dba MEASURED AT VARIOUS LOCATIONS

L_{dn} in dBA	Outdoor Location
135	Construction blasting
115	Solids conveyance equipment (at 3 ft)
110	Mining rock crusher (at 3 ft)
95	Earth moving equipment (at 50 ft)
80-90	Diesel locomotive (at 50 ft) Heavy trucks (at 50 ft)
60-80	Automobile (at 50 ft) Urban residential area
50-60	Suburban residential area
40-50	Agricultural cropland
30-40	Rural residential area Wilderness area

Sources: Adapted from EPA, 1977; Supplemented by Bechtel, 1981

9.0 TRANSPORTATION AND ENERGY

9.1 TRANSPORTATION

The U.S. Forest Service determined that transportation should be addressed in the Plan of Study for the Montanore Project. Existing highways and access roads in the vicinity of the project area are shown on Figure 2. The following information *from 1988 and 1989* will be updated during the NEPA/MEPA analysis.

9.1.1 Site Access Alternatives

Highways

In Lincoln County, Montana, Highway 2 is the primary transportation route. This is the highway connecting Libby with Kalispell, and would be used by employees, service vehicles, and vendors to access the project site located in the Libby Creek area. Major roads which are north of the town of Libby all feed to Highway 2.

The following information identifies traffic levels for selected sections of Highway 2 between Libby and the Libby Creek road. The traffic count information is for all lanes. Vehicle mix is generally configured as follows: passenger vehicles – 40 to 50 percent, passenger trucks – 25 to 30 percent, trucks – about 8 percent, single unit trucks – 5 to 8 percent, other vehicles – about 4 percent (personal communication, John Wright, Montana Department of Highways, 1989).

Highway 2 Milepost	2002 Traffic Daily Traffic *
32.7	6,869
35.7	2,082
41.1	1,354

* Information from Montana Department of Transportation.

Information summarizing the 1988 average annual daily traffic volume time of day volume patterns for Highway 2 is presented below.

Highway 2 Milepost	Midnight - 5AM	5AM - Noon	Noon - 5PM	5 PM - Midnight
35	2.3%	31.2%	37.2% *	29.5%
* highest daily percent of use occurs from 3 to 5PM (17.1%)				
48	3.2%	33.7%	37.8% *	24.6%
* highest daily percent of use occurs from 1 to 4PM (23.8%)				

Accident rate data and potential safety problems *from 1988/1989* are presented on Table 9-1.

Roads

The follow descriptions were current as of 1989 and included in the 1996 revised application document to the agencies. There are two main Forest Service system roads that access the Libby Creek and Ramsey Creek area from Highway 2. The Bear Creek road 278 joins Highway 2 approximately 7 miles south of Libby, and its length to the project site is approximately 15 miles.

The first section of the Bear Creek road is from Highway 2 to milepost 9.5 at the bridge over Bear Creek. It is a single-lane asphalt road which is 18 feet wide. The speed limit is 25 mph, and the degree of intervisible turnouts is 50 percent.

The second section of the Bear Creek road is from milepost 9.5 to the intersection with the Libby Creek Road #231. This section is 4.5 miles of native, single-lane road, 18 feet wide. The speed limit is 25 mph, and the degree of intervisible turnouts is also 50 percent.

A traffic counter was installed on the Bear Creek road at milepost 2.7 from highway 2 during 1986, 1987, and 1988. The average daily traffic (ADT) is given below:

4/9 – 12/1, 1986 = 72 ADT

5/5 – 12/7, 1987	=	87 ADT
5/10 – 12/15, 1988	=	64 ADT

The Bear Creek road is not an all-weather road and is closed during frost break-up for vehicles weighing over 10,000 lbs. The peak season of use is June through September (Personal communication, Dave Erwin, USFS, 1989). The Bear Creek road can generally be traveled by all types of vehicles unless mud and snow conditions require 4-wheel drive.

The majority of the roads are not plowed, and when the roads are closed due to snow, snowmobiles use the roads for access to Poorman, Cable, Bear, and Ramsey Creeks and other recreation sites in the area.

The Libby Creek road joins Highway 2, 12 miles south of the town of Libby. The first section of the road from Highway 2 to milepost 9.2 is a single-lane, 14-foot wide, aggregate surface. The speed limit is 25 mph, and the degree of intervisible turnouts is 75 percent.

The second section of the Libby Creek road is from milepost 9.2 (or the Bear Creek Road intersection) to milepost 10.6 at the bridge to Howard Lake. The road is a single-lane, 12-foot wide, aggregate surface with a designed speed of 20 mph. The degree of intervisible turnouts is 50 percent.

The third section of the Libby Creek road is from the Howard Lake Bridge to the end of the road on Libby Creek. The surface is native, and it is a single lane road with a width of 12 feet. The designed speed is 15 mph, and there are no intervisible turnouts.

Traffic counts for the Libby Creek road were initiated in 1988 and reported a cumulative total of 447 vehicles for the period of July 13th through July 21st. Average daily traffic for the Libby Creek road is expected to be greater than for the Bear Creek road. Allowing 15 percent (estimate from USFS) more, the average daily traffic is estimated to be 85.

The Libby Creek road is not an all-weather road, and is closed during spring break-up to vehicles weighing over 10,000 lbs. The peak season of use is June through August (personal communication, Dave Erwin, USFS, 1989). The Libby Creek road can generally be traveled by all types of vehicles unless mud and snow conditions require 4-wheel drive. The majority of the road is not plowed, and when snow becomes deep enough that the road is impassible, it remains closed until spring melt.

Access from Highway 200 to Rock Creek is on Forest Service System Road 150; the road up the East Fork is designated 150A.

Rail, Bus and Air Service

The Burlington Northern Railroad passes through Libby. There is daily train service east and west, with major destinations being Chicago and Seattle. Amtrak also has a depot in Libby.

There is no national bus service to Libby. No national car rental service is available; however, cars can be rented in Libby.

United Parcel Service and Federal Express provide freight transportation.

The closest major airports are located in Spokane and Kalispell. Driving time between Kalispell and Libby (90 miles) is approximately 1½ hours. The Spokane airport is approximately 3 hours away (160 miles) and offers several major airlines with multiple schedules.

The runway at the Libby Municipal Airport is 5,000 feet long and 75 feet wide. The airport's elevation is 2, 600 feet, and it is open 24 hours per day, under visual flight rules.

Existing Condition of Bridges

The bridges on Highway 2 from the town of Libby to the Fisher River are all concrete bridges. These bridges are designed for legal highway loads. The bridges over Libby Creek and the Fisher River were built in the summer of 1988 to replace old wood structures (personal communication, James Hill, USFS, 1989).

There are two single lane bridges over Libby Creek on the road along Libby Creek, which is Forest Service Road 231. These bridges are designed for legal highway loads. The first bridge is concrete, and was constructed in 1981 with a load rating of HS 30-44. The second bridge, near the Old Town site, is a new concrete structure constructed in 1984, after a major flood removed the old bridge. The rating on this bridge is HS 20-44 (personal communication, Charlie Howard, USFS, 1988).

The preferred access route along the Bear Creek Road does not have any bridges between Highway 2 and Bear Creek. The first bridge is at Bear Creek and is a wooden structure. The second bridge crossing is at Poorman Creek. Both bridges will accept legal highway loads.

The bridges on Highway 200 between Highway 56 and Trout Creek are concrete bridges designed to withstand legal highway loads. The bridges on the Rock Creek Roads 150 and 150A are wooden structures, which are designed to support legal highway loads (personal communication, Floyd Bain, USFS, 1988).

9.2 ENERGY

Currently there is no electric power available at the site. The nearest major power lines are a 230 kV line along Highway 200 near Pleasant Valley, operated by the Bonneville Power Administration (BPA) and the Noxon Rapids Dam substation near Noxon. The Noxon Dam is operated by Washington Water and Power (Avista Utilities). Two electrical cooperatives have a special agreement with BPA to tap power off of their grid for distribution to industrial customers. Mines Management has contacted BPA and they indicated Flathead Electrical Cooperative would be the distributor of the power for the project.

10.0 EXISTING SOCOIOECONOMIC SETTING

The existing socioeconomic setting was updated to present available data from the public sector. Mines Management is currently developing all the information necessary to submit a revised Hard Rock Mining Impact Plan to the State. Certain data are available and are included and noted. Appendix I contains the baseline data, along with the original Hard Rock Mining Impact Plan. This data and the Hard Rock Mining Impact Plan will be updated. *Certain data provided in this section was updated in 2004 by contacting various local government sources. The updated socioeconomic baseline data will document those sources. The application will provide citations where updated data is not found in the appendices.*

10.1 ECONOMIC ENVIRONMENT

10.1.1 Lincoln County

Employment Conditions

Over the last thirty-three years, the labor force in Lincoln County, defined as persons working or seeking work, has declined from 7,275 in 1970 to 7,018 by 2003. This is a decline of 0.1 percent per year. The number of employed decreased by 0.4 percent per year from 6,628 to 5,901 over the same period. The unemployment rate in Lincoln County has varied from 8.9 percent in 1970 to a high of 19.4 percent in 1982, reaching 15.9 percent in 2003. Since 1990, the unemployment rate in Lincoln County has averaged about 13.5 percent of the labor force.

Another way to measure employment is to count the number of full and part-time jobs, rather than the number of people working. Over the last thirty-two years, employment in Lincoln County has increased at an annual rate of 0.7 percent, rising from 7,130 in 1970 to 8,935 in 2002.

The government enterprises sector with 16.5 percent of total employment was the largest employer in Lincoln County in 2002. The retail trade sector was the next largest with 11.7 percent jobs. The manufacturing sector accounted for 9.5 percent.

The manufacturing sector, which includes timber and harvesting and wood products manufacturing, represents 16 percent of all businesses in the county. *Rosauer's Grocery Store, St. John's Lutheran Hospital, Plum Creek Timber, Semi-Tool are major private sector employers in Lincoln County.*

The mining sector represents 0.3 percent of all businesses in the county. Genesis Inc. is currently hiring staff to support the mining operations. This number should be available in early 2005. In 1979, the Troy Mine (now Genesis, Inc.) and W.R. Grace, Inc were the two dominant mine operators in the area. At that time, this accounted for approximately 7 percent of all employment in the county. Currently mine employment, even with Genesis, Inc. at full production is significantly below the 7 percent figure in 1979.

Total employment in Lincoln County is projected to increase to 12,503 by the year 2030. This increase represents an annual growth rate of 1.21 percent, which is higher than the historical 1970-2002 growth rate of 0.7 percent.

Income Conditions

Real per capita income in Lincoln County has been increasing at a rate of 1.4 percent per year, rising from $12,178 to $18,790 in 2002. This compares to an annual growth rate of 1.9 percent real per capita income statewide. Although increasing each year, per capita income is much lower than the statewide average real per capita income of $23,855.

Total earnings in real 2002 dollars declined at a rate of 0.2 percent per year between 1970 and 2002. Total earnings in the state, however has been increasing at a rate of 2.30 percent per year.

Total earnings to Lincoln County in 2000 real dollars are projected to increase from $208.7 million in 2002 to $488.16 million by 2030, representing an annual rate of increase of 3.1 percent.

Fiscal Conditions

Total taxable valuation in Lincoln County declined from $28.46 million in fiscal year (FY) 1996 to $25.25 million in 2002. This is a decline of 11.3 percent with no accompanying decrease in population.

Between 1996 and 2002, revenues from property taxes increased by 15 percent from $10,585,506 to $12,171,099.The major revenue source to Lincoln County government was intergovernmental transfers during 2002.

Total expenditures for Lincoln County during FY 2002 were budgeted at $14.3 million. In FY 2002, 21.2 percent of the budget was spent on general government, 21.61 percent on public safety, and 12 percent on public works.

Municipalities

Taxable valuation for Libby declined from $3,298,085 in FY 1996 to $2,529,771 by FY 2002, representing a 23.3 percent decline in the tax base. In 1990 data, total revenues for Libby had decreased 5 percent since 1980. It is expected that a similar trend is likely with current data.

Taxable valuation in Troy decreased by 24.1 percent between FY 1996 and FY 2002 from $953,157 to $723,332. Since the closure of the Troy Mine, it is expected that Troy has had a similar condition and will be verified with the Hard Rock Mining Impact Plan.

School Districts

The taxable valuation for all the school districts in Lincoln County increased slightly from $25.25 million in FY 2002 to $25.36 million in FY 2003.

Taxable valuation for the Libby School District decreased slightly from $11.61 million to $11.2 million between FY 2002 and 2003. Total revenues increased slightly from $13 million in FY 2002 to $13.7 million in FY 2003. Expenditures at the Libby School District increased from $11.2 million to $11.8 million over the same time period.

Taxable valuation for the Troy School District increased from $8.7 million to $9.1 million between FY 2002 and 2003. Total revenues remained the same at $5.85 million between FY 2002 and 2003. Expenditures at the Troy School District decreased slightly from $4.34 million to $4.32 between FY 2002 and 2003.

Taxable valuation for the Eureka School District increased from $15 million to $15.4 million between FY 2002 and 2003. Total revenues for the Eureka School District increased by 114.6 percent between FY 2002 and 2003, increasing from $7.5 million to $16 million. Expenditures increased from $5.6 million to $6.6 million over the same time period.

10.1.2 Sanders County

Employment Conditions

The available civilian labor force in Sanders County increased by 1.6 percent or by 1,778 persons between 1970 and 2003. The number of employed also increased by 1.5 percent over the period. The unemployment rate in Sanders County has varied from 6 percent in 1970 to over 15 percent during the mid-80s, to 8.2 percent in 2003.

The government enterprises sector accounted for 14 percent of all jobs in 2002, the largest employer in Sanders County. Farming-related employment with 9.9 percent of total jobs, was the next largest employer. Employment in retail trade accounted for 9.2 percent, and construction and manufacturing jobs comprised about 7 percent of total jobs in 2002.

Total employment in Sanders County, the number of full and part-time jobs, more than doubled from 2,743 in 1970 to 5,400 in 2002. Total employment is projected to increase to 7,025 by the year 2030. This represents an annual increase of 0.94 percent over the 2002-2030 period.

Income Conditions

Real per capita income in Sanders County has been increasing at a rate of 1.8 percent per year, rising from $10,238 in 1970 to $17,945 in 2002. This compares to an annual growth rate of 1.9 percent real per capita income statewide. Although increasing each year, per capita income is much lower than the statewide average real per capita income of $23,855.

Total earnings in real 2002 dollars increased at a rate of 2 percent per year between 1970 and 2002. This compares to a growth rate of 2.30 percent per year statewide. Total earnings to Sanders County in 2000 real dollars are projected to increase from $101.82 million in 2002 to $234.2 million by 2030, representing an annual rate of increase of 3 percent.

Fiscal conditions

Total taxable valuation in Sanders County decreased from $35.52 million in FY 1996 to $27.42 million by FY 2002. Between 1996 and 2002, revenues from property taxes declined by 3.6 percent from $11,572,530 in 1996 to $11,155,034 in 2002. The major revenue source to Sanders County government was intergovernmental transfers during 2002.

Municipalities

The taxable valuation for Thompson Falls declined from $1.7 million in FY 1996 to $1.4 million by FY 2002. Total revenues for Thompson Falls were not available and will be updated with the Hard Rock Mining Impact Plan. In 1988, revenues were approximately $274,000. At that time, property taxes comprised about 50 percent of all revenues. It is expected that that has not changed significantly. Per capita expenditures (in real terms) in 1986 were $243 per person. Spending for general government operations usually amounts to about 15-20 percent of the budget.

School Districts

The taxable valuation in the Noxon school district has increased from $3.98 million in $4.07 million in 2004.

The taxable valuation for Trout Creek Elementary School increased from $4.07 million in 2002 to $4.23 million in 2004. Noxon High School information was not available but will be included in the Hard Rock Mining Impact Plan.

Taxable valuation for the Thompson Falls School District declined slightly from $10.76 million in 2002 to $10.70 million in 2004

10.2 DEMOGRAPHIC AND POPULATION CONDITIONS

10.2.1 Lincoln County

Demographic Conditions

The population growth in Lincoln County has more than doubled since 1940. The largest increase in population occurred between 1960 and 1970 due to the construction of the Libby Dam. There was a slight decline in population between 1970 and 1990. There has been a recovery since, with the population increasing by almost 8 percent, from 17,481 in 1990 to 18,837 in 2000. The Census Bureau's most recent population estimate of 18,835 indicates almost no growth between 2000 and 2003.

The natural increase (births over deaths) for Lincoln County from 2000 through 2003 declined slightly by 0.5 percent, however net migration (internal and international) increased by 0.8 percent over the same period. The population of Lincoln County is projected to increase by 0.7 percent per year over the next 27 years, reaching 22,700 by the year 2030.

The median age for Lincoln County was 42 years compared to 37.5 years in the state for both males and females. In 2000, the median family income in Lincoln County was at $31,784 about 21.5 percent lower than the state figure of $40,487. In Lincoln County, nearly 80.2 percent of the population 25 years and over had completed 12 years or more of school as compared to 87.2 percent at the state level.

The birth rate per 1,000 in Lincoln County was 10.4 percent, compared to 12.5 percent in the state. Lincoln County had a death rate of 10.6 per 1,000 population in 2002. This is 1 percentage point higher than the rate of deaths in the state. Cancer, heart disease, and cerebrovascular diseases were the 3 leading causes of death recorded at both the state and county levels.

10.2.2 Sanders County

Demographic Conditions

The population of Sanders County increased nearly 48 percent between 1940 and 2000. The largest increase in population occurred between 1970 and 1980. There was a slight decline in population between 1980 and 1990. There has been a significant recovery since, with the population increasing by almost 18 percent, from 8,669 in 1990 to 10,227 in 2000. The Census Bureau's most recent population estimate of 10,455 in 2003 indicates a population growth of 2.2 percent since 2000.

The natural increase (births over deaths) for Sanders County from 2000 through 2003 declined slightly by 0.8 percent, however net migration (internal and international) increased by 7.6 percent over the same period. The population of Sanders County is projected to increase by 1.24 percent per year over the next 27 years, reaching 14,751 by the year 2030.

The median age for Sanders County was 44.2 years compared to 37.5 years in the state for both males and females. In 2000, the median family income in Sanders County was at $31,340 about 22.6 percent lower than the state figure of $40,487. In Sanders County, nearly 81.2 percent of the population 25 years and over had completed 12 years or more of school as compared to 87.2 percent at the state level.

The birth rate per 1,000 in Sanders County was 9.7 percent, compared to 12.5 percent in the state. Sanders County had a death rate of 10.6 per 1,000 population in 2002. This is 1 percentage point higher than the rate of deaths in the state. Cancer, heart disease, and accidents were the 3 leading causes of death recorded in the county.

10.3 SOCIAL ENVIRONMENT

10.3.1 Lincoln County

Social Life

The history of northwestern Montana has greatly influenced the social character, human interactions, and life-styles of current residents in the Libby area. Settlement of the region began with gold mining and a resource extractive economy has prevailed since that time with cyclical periods of high employment followed by periods of recession. In addition to the economic factors, ethnic heritage, occupations requiring strenuous physical labor, and the geographic isolation have directed the social evolution of residents of the Kootenai Valley.

Libby area residents have adapted to the cyclic nature of the economy by living off the land (i.e., hunting, fishing, gardening, firewood gathering, and berry picking). Local residents tend to acquire vehicles, homes, and other possessions which are functional rather than ostentatious. Residents of Lincoln County, because of their livelihoods, are closely linked to the natural environment, have a conservation ethic, but do not favor preservation that would prohibit development of natural resources.

Community Services

There are 5.5 elementary schools, 2 middle schools, and 3 high schools in Lincoln County. Schools in Lincoln County are:

City	*Elementary Schools*	*Middle Schools*	*High Schools*
Libby	*1.5*	*1*	*1*
Troy	*1*	*0*	*1 (inc. Middle School)*
Eureka	*1*	*1*	*1*
Fortine	*1*	*0*	*0*
Trego	*1*	*0*	*0*

Law enforcement services in the Lincoln County study area are provided by the Lincoln County Sheriff's Office, Montana Highway Patrol, Eureka Police Department, Troy Police Department, and Libby Police Department. The Sheriff's Office, has a total of 14 deputies. There are 2 jail facilities in the study area – a 24-cell adult jail in Libby and a 2-cell juvenile holding facility in Troy.

Fire protection is provided by 9 fire departments in Lincoln County. The fire departments, include the Bull Lake, Eureka, Fisher River, Libby, McCormick, Ranchers, Trego/Fortine/Stryker, Troy, and Yaak fire departments. The Libby and Troy Fire Departments (both rural and city) are volunteer departments. The rural/city Libby Fire Department has 28 volunteers and the Troy rural/city Fire Department has 25 volunteers.

The Lincoln County health care facilities include the St. John's Lutheran Hospital, Prompt Care – a rural health clinic in Eureka and Libby, Lincoln Community Health Center in Libby. The other health care facilities in the area include, the Center for Asbestos Related Diseases (CARD), Libby Care Center for the elderly, Libby Clinic, Neuman Foot & Ankle Clinic and Lincoln County Radiology. The Troy area medical facilities include the Medicine Tree Primary Care and the Troy Medical Center. Lincoln County is served by approximately 20 licensed physicians, 6 dentists.

More than 50 percent of the households in Lincoln County use a well for water supply. In Libby, approximately 2,000 households are served by the municipal water system which obtains water from Flower Creek. The town of Troy receives its municipal water supply from 2 wells and O'Brien Creek.

Approximately 76 percent of the households in Lincoln County, including the town of Troy utilize septic tanks for wastewater disposal. The city of Libby has operated a public wastewater treatment facility since 1964, and in 1985, converted from a primary to a secondary treatment facility (i.e., an activated sludge oxidation ditch system).
The Human Services Office is located in Libby. Funding for the social welfare program comes from state, federal, and county sources; however, the state administers the

program. Services include aid to families with dependent children, food stamps, medical services, general assistance, and fuel assistance.

10.3.2 Sanders County

Social Life

Sanders County, like Lincoln County, was first explored by David Thompson in the early 1800s. Thompson Falls, the county seat of Sanders County, came into existence with construction of the Northern Pacific Railroad in 1881. Although Thompson Falls did not experience a "boom" associated with mining, mines in Sanders County have produced gold, silver, copper, lead and zinc. Metal production in Sanders County in 1939 was greater than metal production in any other northwestern Montana county.

The population of Sanders is relatively sparse and dependent upon the natural resources of the area for employment, recreation, and in some cases subsistence. The limited possibilities for diversity of employment and life-styles have limited contact between the local population and significant numbers of different types of people from outside the area. The relative isolation of the population is Sanders County tends to have a homogenizing effect, resulting in the sharing of common life experiences and the development of similar perspectives toward life. Generally, the people of Sanders County are similar to Lincoln County residents in their social values and world view.

Community Services

There are 8 elementary schools, 6 middle schools, and 4 high schools in Sanders County. The Plains School District has the most schools in the County. Schools in Sanders County are:

City	*Elementary Schools*	*Middle Schools*	*High School*
Thompson Falls	*1*	*1*	*1*
Plains	*2*	*1*	*1*
Noxon	*1*	*1*	*1*
Trout Creek	*1*	*1*	*0*
Hot Springs	*1*	*1*	*1*
Dixon	*1*	*1*	*0*
Paradise	*1*	*0*	*0*

Law enforcement services in the Sanders County study area are provided by the Hot Springs Police Department, Montana Highway Patrol, the Sanders County Sheriff's Department, and the Thompson Falls Police Department. The Sheriff's Department is headquartered in Thompson Falls and is staffed by a sheriff, undersheriff, 5 deputies, and 7 support personnel; whereas the Thompson Falls Police Department employs 2 full-time officers.

Fire protection is provided by 4 rural fire districts (Thompson Falls Rural, Trout Creek, Noxon Rural, and Heron), Thompson Falls City Fire Department, DSL and USFS. The fire departments are staffed by volunteer firefighters.

There are 14 health care facilities in Sanders County. Clark Folk Valley Hospital in Plains is a nonprofit 16-bed critical access hospital. The hospital offers 24-hour emergency care and has a helipad for ambulance service. The Hot Springs Medical Clinic, and Thompson Falls Clinic are two federally qualified rural health clinics. Sanders County is served by 5 licensed physicians, 2 nursing practitioners, 4 physician's assistants, 2 dentists, and 2 dental hygienists.

Rural households within the Sanders County study area, not within the water service areas of Thompson Falls, Trout Creek, and Noxon, rely upon wells for water supply. The sources for the municipal water supply in Thompson Falls are Ashley Creek and 2 wells. In Trout Creek and Noxon, wells are the primary sources for the municipal water system.

There is no countywide solid water district in Sanders County, rather each local community has a refuse board responsible for overseeing solid waste operations in their area. Private contractors provide refuse collection and disposal services. There is a 10-acre landfill site about 11 miles west of Thompson Falls and an 80-acre site near Trout Creek.

The social welfare program through the Human Services Office in Thompson Falls receives funding from county, state, and federal sources. The county-administered

program provides services for aid to families with dependent children, food stamps, Medicaid, and general assistance.

There is no formal planning board or planner, rather the county commissioners make the planning decisions on an as-needed basis. Air pollution is a problem in the Thompson Falls area and is being monitored daily. It is anticipated that the air quality will exceed EPA standards and, as a result, an Air Quality Control Compliance Plan would need to be prepared.

10.4 HOUSING

10.4.1 Lincoln County

In 2000, the U.S. Bureau of the Census reported that Lincoln County had 9,319 year-round housing units. Of the 7,764 occupied housing units, 76.6 percent were occupied by owners. The percent of owner-occupied housing units was much higher than the state percent of 69.1 percent in 2000.

There were 67 realtors operating in Libby, Troy, and, Eureka, listed with the Montana Association of Realtors. On December 14, 2004, the Montana Association of Realtors had 99 residential listings for sale and 87 parcels of land for sale (62 with less than 6 acres, 16 with 6 to 25 acres, and 9 with more than 25 acres).

10.4.2 Sanders County

Sanders County had 5,271 year-round housing units in 2000, with 4,273 occupied dwellings. About 76.4 percent of the occupied dwellings were owner-occupied as compared to 69.1 percent for the state.

There were 26 realtors operating in Thompson Falls, and Plains, listed with the Montana Association of Realtors. On December 14, 2004, the Montana Association of Realtors had 59 residential listings for sale, 7 farm/ranches for sale, and 69 parcels of land for sale (26 with less than 6 acres, 25 with 6 to 25 acres, and 18 with more than 25 acres).

10.5 RECREATION

The proposed Montanore Project is located in both the Cabinet and Libby Ranger Districts of the Kootenai National Forest on National Forest Land. Recreational activities include hiking, picnicking, camping, snowmobiling, cross-country skiing, fishing, hunting, rafting, kayaking, trail rides, berry picking, wilderness experiences, and general use of the forest. *Changes in the previous recreation description have likely occurred. Any changes will be updated as part of the NEPA/MEPA process.*

The Cabinet Ranger District regulates the activities of 21 outfitters, who act as guides for hunting and fishing. The Libby Ranger District has five permitted outfitters with three operating in the south end. 1988 actual, and 1989 planned service days for the outfitters in the Libby Ranger District are 145 and 265, respectively. Two outfitter and guides (permitted for service days by both districts) operate in an area that is within the vicinity of the proposed mining project (personal communication with Charlie Howard and Bill Rockwell, USDA Forest Service, October, 1989). Both outfitters and guides use the Barree Lakes are (south of the project area). Forest Service receipts for these outfitters in 1988 were $225. The Forest Service has developed guidelines for outfitters as part of the Kootenai National Forest's Forest Plan.

10.5.1 Traffic Count

Traffic counters have been used to evaluate road use and intensity of forest use.

<u>Cabinet Ranger District</u>

The district has 24 traffic counters located as follows.

1. Beaver Creek
2. White Pine
3. Martin Creek
4. Pilgrim Creek
5. South Fork of the Bull
6. East Fork of the Bull
7. Chicago Peak
8. Snort Creek
9. Rock Creek
10. McKay Creek

11. Vermilion
12. Willow Pass
13. Graves Upper Vermilion
14. Lyons Creek

Several of the counters are located in one drainage. Consequently, the actual number of major counters was reduced to 8. After deducting logging traffic and as estimated 20 Forest Service vehicles from the counters, the following estimate of recreation visitors was developed.

Location	Vehicles [(a)]	Visitors [(b)]
South Fork Bull	11,474	34,422
Vermilion Drainage	7,643	22,929
Pilgrim Creek	2,405	7,215
McKay Creek	2,701	8,103
Martin Creek	2,026	6,078
White Pine Creek	1,379	4,137
Rock Creek Drainage	1,162	3,486
Beaver Creek	948	2,844
	29,738	89,214

(a) This data was collected from June through November 1987 and would cover the major activities of summer camping, fall berry picking, and hunting.

(b) Three persons per vehicle.

Limited data is available on winter activities, which would include cross-country skiing and snowmobiling. However, access and amount of use would depend on the snow conditions more than any other factor.

The traffic count data shows there are two major areas of high use – the Vermilion Drainage and the South Fork of the Bull River. These two areas account for 64 percent of the recreation visitors.

The Vermilion Drainage is approximately 12 miles south of the Rock Creek Drainage. The South Fork of the Bull River is approximately 14 miles north of the Rock Creek

Drainage. As a percent of total traffic count, the Rock Creek Drainage represents 4 percent.

The Cabinet Ranger District traffic count survey covered approximately 418,000 acres.

Libby Ranger District

In 1987, traffic count data was obtained on Bear Creek Road, 2.7 miles from the junction with Highway 2. This is a paved road, and logs were hauled on it for at least three separate time periods (noted on the traffic count records). Log hauling may occur any time of the year except during spring breakup. The total number of counts was 18,773. If logging activities are deleted, the count would be 9,857. If a three person per vehicle estimate is applied, then the Bear Creek road had approximately 29,571 recreation visitors for the period between May 5 and December 7, 1987.

There are private residences on the Bear Creek Road, and the Bear Creek fisheries are also located less than a mile from the highway such that traffic to these sites would not be counted. Traffic counts for the Libby Creek road initiated in 1988 indicate a cumulative total of 447 vehicles for the period of July 13th through July 21st. The annual number of recreation visitors on the Libby Creek Road is estimated to be greater than the Bear Creek Road (personal communication, Charlie Howard, USFS, 1989).

The area south of the town of Libby, within the Libby Ranger District, is approximately 200,000 acres. In the area of the proposed mine development there are a range of potential recreational activities which might draw visitors to the upper reaches of Libby and Ramsey Creeks including people seeking solitude.

10.5.2 Trail Head Counts

Cabinet Ranger District

Trail head counts on designated tail heads in the Cabinet Ranger District were compiled for 1986 and 1987. Field verification of the 1987 data has resulted in a more accurate estimate of the number of people registering and actually using the trails in the Cabinet Mountain Wilderness. Registration accounts for an estimated 10 to 30 percent of the

people using the trails. The following trails have registration boards and were field verified in 1987.

Trail No.		% Registering	Estimated Total Use
924	Wanless Lake	10%	400
646	St. Paul Lake	25%	628
932	Engle Lake	10%	180
978	Middle Fork Bull	10%	630
935	Rock Lake	30%	630
972	North Fork Bull	25%	280
993	Moran Basin	10%	50
912	Buck Lake	10%	270
		Total	3,068 *

* Rounded to 5,000 in the Kootenai National Forest Inventory Management Report.

These trails and destinations cover most of the wilderness portion of the Cabinet Ranger District.

Libby Ranger District

Recreational use of the Libby Ranger District is highest in the summer, with camping, hiking, and fishing being the major activities. Autumn use of the area includes the above activities as well as berry picking and hunting. The winter activities include cross-country skiing and snowmobiling. Winter activities are highest near Bear Creek and Poorman Creek, which provide good areas for skiing and snowmobiling. The Bear Creek road is plowed all winter long to the Priester Ranch, and the Libby Creek road is plowed to the state section at Hoodoo Creek.

Ramsey and Libby Creeks are used by local residents for skiing and snowmobiling in the winter.

The Libby Ranger District has two type of trails identified as “managed” and “unmanaged”. The managed trailheads have parking areas, and registration boxes. The unmanaged routes can be either trails, old roads, roads or roads with gates, and usually do

not have parking facilities. Forest Service personnel check and record the activities at the managed trailheads, and only have opportunistic sitings at the unmanaged routes.

The Libby Ranger District maintains registration boxes at 12 managed trailheads. These are listed below with summer use figures.

Managed *Trailheads*	Visitors	June 1 – Aug 31 Visitor Days *
Williams Creek	24	25
Scenery Mountain	102	275
Cedar Creek	540	1,125
Parmenter Creek	128	350
Flower Creek	314	1,275
Granite Creek	394	1,650
Leigh Creek	1,335	2,475
Bramlet Creek	369	700
4th July Creek	52	175
Lake Creek	996	2,150
Bear Lake	114	325
Baree Creek	228	575
Totals	4,596	11,100

* The Libby Ranger District has a verification program and considers their numbers as reliable.

The Libby Ranger District also has 19 "unmanaged trailheads". These are listed below with summer use *based on limited public participation at the trailhead box*.

Unmanaged *Trailheads*	Visitors	June 1 – Aug 31 Visitor Days
Norman Mountain	10	10
Parmenter (horse)	50	150
Indianhead	25	25
Horse Creek	10	25
Horse Ridge	10	25
Deep Creek	10	25
Snowshoe Creek	10	25
Big Cherry Creek	10	10
Bear Creek	100	100
Cable Creek	25	25
Poorman Creek	25	50
Ramsey Creek	25	25
Libby Creek	25	50
Great Northern	10	25
Gloria	10	25
Wayup	10	25
Mill Creek	25	75
Silver Dollar	25	75
Powerline	50	135
Totals	465	895

Summer use for the managed trailheads account for nearly 80 percent of the total use. The data for other seasons was tabulated conservatively. The following table summarizes use estimates.

Season		Estimated Visitor Days/year
Summer Use		
Managed Trailheads		11,100
Unmanaged Routes		895
Fall Use		
Managed Trailheads		1,100
Unmanaged Routes		575
Winter Use		
Managed Trailheads		300
Unmanaged Routes		230
	Total	14,200

10.5.3 Recreation Inventory Management Report Evaluation

A Recreation Inventory Management (RIM) Report is prepared by each district of the Kootenai National Forest (NF) and then summarized in the overall Kootenai Recreation Inventory Management Report. *The RIM report is no longer used and has been replaced using the Infra Structure Data base (INFRA). Information will be updated as appropriate in the NEPA/MEPA analysis.*

The following 1987 information is from the 1988 Kootenai National Forest Summary:

Activity Grouping	RVD* (thousands)	RVD Per Acre**
Camping & Picnicing	332.9	.15
Travel & Viewing	600.2	.27
Hiking & Horseback Riding	104.7	.05
Winter Sports	20.2	.008
Resorts & Cabins	20.8	.009
Wilderness	7.7	.003
Hunting	93.2	.04
Fishing	224.6	.10
Nature Studies	20.6	.009
Other Recreation	93.1	.04
Total	1,508.5	.67

* Annual Recreation Visitor Days

** The Kootenai National Forest consists of 6 districts, totaling 2,245,000 acres.

Cabinet Ranger District

The RIM Report for the Cabinet District evaluates several areas such as fee campgrounds, developed sites, semi-primitive non-motorized, scenic, wilderness, undeveloped recreation, and Highways 56 and 200. The entire district's recreation activities are listed in the table below:

Activity Grouping	RVD (thousands)	RVD Per Acre*
Camping & Picnicing	21.5	.05
Travel & Viewing	74.9	.18
Hiking & Horseback Riding	29.5	.07
Winter Sports	1.7	.004
Resorts & Cabins	--	--
Wilderness	3.0	.007
Hunting	20.3	.05
Fishing	10.9	.03
Nature Studies	--	--
Other Recreation	--	--
Total	161.8	.39

* Area of the Cabinet Ranger District is approximately 418,000 acres.

A comparison of RVD/acre for the Cabinet Ranger District to the entire Kootenai National Forest indicates that the District is used much the same as the entire Forest for only hiking, horseback riding and hunting.

Libby Ranger District

The RIM Report for the Libby Ranger District is similar in format to the Cabinet Ranger District. Activities for the District are listed below:

Activity Grouping	RVD (thousands)	RVD Per Acre*
Camping & Picnicing	10	.03
Travel & Viewing	116	.33
Hiking & Horseback Riding	10.7	.03
Winter Sports	2.8	.008
Resorts & Cabins	.4	.001
Wilderness	11.0	.03
Hunting	4.5	.01
Fishing	7.4	.02
Nature Studies	6.8	.02
Other Recreation	4	.01
Total	173.6	.50

* Area of the Libby Ranger District is approximately 350,000 acres.

The total RVD's and RVD's per acre are higher for the Libby Ranger District than for the Cabinet Ranger District, the Clark Fork River may be providing increased fishing activities in the Cabinet Ranger District. Also, the Libby Ranger District has 5 permit outfitters, whereas the Cabinet Ranger District has 21 outfitters which would stimulate the hunting and fishing activities.

10.5.4 Recreation Interviews

The Recreation Report is a broad overview of recreation activities in the Cabinet Mountains. Because the mountains create a physical divide to the project area, the recreation activities have been discussed as they relate to the east side (Libby) and the west side (Noxon).

The Montanore Project's preferred alternative is to develop from the east (Libby) side. The production facilities, ventilation adits and tailings impoundments are proposed in the vicinities of Libby Creek, Poorman Creek and Little Cherry Creek.

The U.S. Forest Service requested that an additional aspect of the recreation experience which is unique to the Cabinet Mountains be addressed; the unique recreation experience is solitude.

The U.S. Forest Service furnished a list of individuals to contact, representing a wide range of recreational uses of the east face of the Cabinet Mountains. The individuals expressed interest in hunting, fishing, backpacking, climbing, cross-country skiing, and snowmobiling. The one common attribute which made the area appealing was solitude.

Both summer and winter recreation allowed individuals to find areas where no other individuals or groups were encountered for a day or days at a time. The peaceful serenity of sitting in an open park or mountain pass without the distraction of civilization was described as being very appealing. One interviewee stated that her entire family chooses not to wear bear bells.

There are few areas remaining in the continental United States which offer the solitude opportunities provided by the Cabinet Mountains. (personal communications with B. Black, J. Brown, C. Clough, W. Kasworm, J. Myer, M. Randall and G. Rice, 1989).

PERSONAL COMMUNICATIONS

USDA Forest Service, Cabinet Ranger District, 1988

George Bain

Jim Mershon

Rocky Rockwell

USDA Forest Service, Libby Ranger District, 1988

Charlie Howard

Jon Jeresek

Gary Rahm

USDA Forest Service, Supervisor's Office, Libby, 1988

Ron Erickson

Individuals interviewed regarding recreational solitude, 1989

B. Black

J. Brown

C. Clough

W. Kasworm

J. Myer

M. Randall

G. Rice

10.6 WILDERNESS

The United States Department of Agriculture, Forest Service prepared an Environmental Impact Statement (EIS) and Forest Plan for the Kootenai National Forest. The Final EIS and Record of Decision for the Kootenai National Forest Plan was issued September 14, 1987.

Wilderness is considered an important issue to be addressed in the Montanore Project Operating Permit Application. The Forest Service Cabinet Mountain Wilderness Management Action Plan, Appendix Twenty-three, Volume 2, of the Kootenai National Forest Plan is attached to this application as Appendix L.

The Wilderness Management Action Plan is a comprehensive analysis, review, and decision for management of the wilderness.

11.0 CULTURAL RESOURCES

11.1 INTRODUCTION

Historical Research Associates (HRA) of Missoula, Montana, conducted cultural resource inventories on behalf of Noranda Minerals Corp. The approved plan of study entailed 1) a literature review and search of cultural resource site files housed at the Montana State Historic Preservation Office (SHPO) in Helena, and 2) an intensive pedestrian survey of all Forest Service lands to identify cultural resource sites which may be affected by project related activities. HRA also conducted a limited reconnaissance of private lands to identify the potential for cultural resource sites. More detailed discussions of the methodology are presented in HRA's baseline report (Appendix J), the Lower Libby Evaluation Site report, the Bear Creek Road/ Water Disposal Sites report, and the Final Environmental Impact Statement.

11.2 PHYSICAL SETTING

The Montanore Project is located in the Cabinet Mountain Range in northwestern Montana. Libby Creek and its tributary Ramsey Creek drain the east slopes of the project area, while Rock Creek drains the project's west slopes. Pleistocene glaciation by the Cordilleran ice sheet influenced the project area's topography, geology, and soil development. The surficial geology of the area includes solid rock, loose rock, talus, gravel, sand, clay, and glacial silt. The mountainous soils are stony clay loams, originating from metamorphic rocks of the Belt Supergroup or colluvium. The valley and foothill glacial moraine soils along rivers and creeks are characterized as gravelly, stony or cobbly clay or sandy loams of alluvial or colluvial origin (Montagne et al. 1982).

11.3 LITERATURE REVIEW

11.3.1 Paleontology

The project area is located in very old Precambrian sediments of the Belt Supergroup, containing algal stromotolites fossils.

11.3.2 Prehistory and Ethnography

Although the prehistory of the "Intermountain Region" is not nearly as well understood as the adjacent regions of the Northwestern Plains and the Columbia Plateau, general patterns are beginning to emerge as a result of research primarily conducted during the last two decades. Especially pertinent are the chronologies of Choquette (Choquettte and Holstien, 1980, 1982; Choquette, 1984) for the region and Roll (1982) and Thoms and Burtchard (1987) for the Kootenai River area.

The Early Prehistoric Period (10,000+ to 7-8,000 B.P.), defined in the western United States on the basis of lanceolate spear points, is likely restricted to upper elevation (montane) land surfaces.

The Middle Prehistoric Period (8,000 or 5,000 – 1,500 B.P.), defined broadly on the basis of dart points, experienced substantial climatic change. The first half of this period was characterized by a warmer and drier climate than that of today. Local populations were oriented to the mountains, which provided refuge for humans and the animals upon which they depended. The second half of this period is characterized by expansion of dense forests and reduction of habitat for herd game. Human populations likely responded by relocating out of the area to exploit anadromous fish or camas from riverine settlements or to low elevation, long-term camps to exploit multiple resources (Thoms and Burtchard, 1987).

At least two cultural complexes or phases are defined in both chronologies for the Lake Prehistoric Period (1,500 to 150 B.P.). The earlier complex, recognized on the basis of the Avonlea arrow point type, is identified by the settlement pattern of winter camps on

large alluvial terraces and bison hunting during the rest of the year. Choquette associates these archaeological remains with the Libby-Jennings band of the Kutenai (Choquette and Holstine, 1980). Sometime between 500-750 years ago the dominant ethnic group in the area changed to the Tobacco Plains band of Kutenai (Choquette and Holstine, 1980; Reeves, 1972, 1983). Unlike their immediate predecessors, the focus and seasonal use of these hunter-gatherers in the Kootenai area was spring and fall (Choquette and Holstine, 1980). More recently, Thoms and Burtchard (1987) have suggested that settlement pattern in the area generally remained the same as the preceding period, with some increase in riverine residence. They suggest testing a model involving the trade of non-local goods versus ethnic affiliation or population movement, thus explaining the presence of exotic raw materials in the area.

At the time of Euro-American contact, two major ethnic groups occupied and utilized the current project area, the Lower Pend d'Oreille, and the Kootenai (Teit, 1930; Turney-High, 1941). Salishan speakers, the Pend d'Oreille were similar in many ways to the Flathead Indians of the Bitterroot Valley. They may have migrated from the northwest in response to pressure from southbound Athabascan speakers. Hudson et al. (1981) suggest that the Pend d'Oreille practiced centrally based hunting and gather, locating semi-permanent winter encampments in nuclear area. Outside these areas they seasonally exploited other resource and task specific sites.

The Kootenai have used the project area for the last three to five centuries (Malouf and White, 1952; Smith, 1984). At least 150 to 200 years prior to the wide traders, one or more bands of Kootenai were Plains dwellers (Johnson, 1969; White, n.d.). White argues that they migrated from the plains northwest of Calgary, west over the Continental Divide into the upper Columbia River drainages. However, Curtis (1911) and Malouf (1952) believe the Kootenai, originally located west of the Continental Divide, were drawn to the Plains for seasonal bison hunts. With acquisition of the horse, some Kootenai may have remained east of the Divide (Curtis, 1911). Although anthropologists disagree regarding Kootenai origins, they agree that the Kootenai had a hunting-gathering economy (Turney-High, 1941; Smith, 1984).

11.3.3 History

White contact with the Native inhabitants was initiated by European fur traders. Probably the first white men to enter the project area were two employees of the Northwest Company, Le Blanc and Le Gasse who were sent into the region by David Thompson in 1801 (Choquette and Holstine, 1980). In April 1808, Thompson himself traveled up the Kootenai River to the Kootenai Falls Portage and connecting trails (Davis and Vinson, 1980). Thompson then sent Finan McDonald to establish a trading post among the Indians living along the Kootenai River. In 1809, another Northwest Company post, known as "Salish house", was established near Thompson Falls (Whilte, 1942:255).

Travel routes, such as the "Kootenai Road" following the Kootenai River and the trail paralleling the Bull River, were established to connect the Kootenai River region with trading posts (Davis and Vinson, 1980). The routes continued to be of importance in subsequent settlement and economic development of the region.

In 1841, the Jesuit missionaries, under Father Pierre Jean DeSmet, arrived in western Montana, establishing first St. Mary's mission among the Flathead Indians of the Bitterroot Valley and then the St. Ignatius Mission in the Flathead River Valley. Although these missions did not significantly increase the non-Native population of the area, they, together with the fur trade, drastically altered the Native life style.

More permanent settlements were established with the gold strikes of the 1860s and the construction of the transcontinental railroads through the Clarks Fork Valley in 1883 and the Kootenai Valley in 1892. Placer mining was underway north of the project area as early as 1864 and along Libby Creek by 1867 and 1868. Settlement along the Kootenai River was limited to Tobacco Plains until the late 1880s when Old Town was established near Howard Creek's confluence with Libby Creek. Old Town was abandoned in 1889 with the establishment of Old Libby, south of Libby Creek's confluence with the Kootenai River. This site was established closer to the Kootenai (Johnson, 1958; Roeder and Heath, 1981).

Placer mining in the Libby Creek drainage peaked in the early 1900s. However, settlements along the Kootenai and Clarks Fork Rivers prospered, for several reasons: 1) the activity associated with the gold rush in the Coeur d'Alene Mountains and the completion of the Northern Pacific and Great Northern Railroad 2) the location of other mines in the area; and 3) the development of the timber industry (Choquette and Holstine, 1980). Quartz mines were located on Snowshoe Creek to the north and West Fisher Creek to the south of upper Libby Creek. Mines also were developed in the mountains east of the towns of Noxon and Trout Creek.

The coming of the railroads and the regional mining boom contributed to development of the timber industry which then became the economic base of communities in both Lincoln and Sanders Counties. The railroads in particular contributed to the development of the timber industry by requiring timber for ties and lumber for bridges and trestles and by providing outlets to large distribution centers.

Some homesteads were established along the major bottoms of the Kootenai, Tobacco, Clarks Fork, and Bull Rivers. Able to produce only garden products on these small farms, homesteaders supplemented their income with outside jobs or the sale of timber on their holdings.

A major change came to the region with the establishment of the Federal Government's Forest Reserves. Parts of the land within the project area were included in the Cabinet Forest Reserve, now part of the Libby and Cabinet Ranger Districts of the Kootenai National Forest.

11.4 RESULTS OF THE INVENTORIES

The pedestrian surveys located three historical sites. A review of land records, mineral entry surveys, and published material was undertaken to document these sites. A narrative has been prepared for each site, describing the physical characteristics and historical development of the site, presenting an evaluation of significance and management recommendations, and analyzing the impacts of the project to the site.

11.4.1 Site 24LN942

Located on a bench above Libby Creek, this site is a collapsed log cabin with remnants of a shed-style roof. Partially dug out, the cabin has only one log of each wall in place to form an outline, with parts of logs located inside and outside the feature. Associated with this cabin is a trail connecting it to a two-track road; large stumps and cut logs; and a fill depression of unknown function. Limited debris is scattered inside and outside the cabin.

The historic record does not indicate any type of withdrawal of this site from the public domain. Local histories of Lincoln County provide no information on the possible historic use of this portion of the Upper Libby Creek drainage.

The site is in poor condition, comprised of a collapsed cabin and unidentifiable features. The region in which the site is located has a long mining history. Cabins built and used by miners and loggers were common and often were built near trails or roads. Due to a lack of documentation for sites associated with unpatented mining claims and short term logging camps, no information can be gained from this site beyond that obtained during its initial recording and photographic documentation. This site is recommended as ineligible for the National Register of Historic Places. No further work is recommended.

The site has been substantially impacted by natural deterioration. It is located within the boundaries of the *previously* proposed Libby Creek plant site, although specific impacts will depend upon final project design.

11.4.2 Site 24LN943

Located above Libby Creek, the site consists of four features: a collapsed, wood frame residence, a collapsed pole frame shed, a collapsed outhouse, and a dump of undetermined age. Based on what artifacts present at the site, it appears to be a logging camp last used in the 1950s. There is an abandoned two-track road just to the north.

The site is located within Mineral Survey Number 8797, the Ceader (sic) and Upper Cut Lodes and Johnstone Placer, surveyed in 1908 and patented in 1909 (Patent No. 95595). The site is interpreted as a logging camp post-dating historic mining on the basis that all of the mining activity shown on the Mineral Survey Plat is either upstream from the current site or south of Libby Creek, and given the items discarded at the site.

The site is in poor condition with all the structures in a state of collapse. The region in which the site is located has a long mining history. Shacks built and used by miners and loggers were common and often were built near trails or roads. Due to a lack of documentation for short term logging camps, no information can be gained from this site in addition to that obtained during initial recording and photographic documentation of the site. The site is recommended as ineligible for the National Register of Historic Places. No further work is recommended.

The site has been substantially impacted by natural deterioration. The site is located in the vicinity of a proposed transmission line to the Libby Plant site, although specific impacts will depend upon final project design.

11.4.3 Site 24SA254

This site, known as the Heidelberg Mine, is located in upper Rock Creek drainage. It consists of six areas containing three structures; three adits; three features, an outhouse, and a wood-lined storage box; plus various tools and machinery associated with the mine. Mining claims associated with the site were first explored by the R.J. Price Mining Co. in the 1920s. In 1936, the Heidelberg Mining Company was formed and production peaked

in the late 1930s and early 1940s, with exploration and development continuing to the present.

Located at the south end of Rock Lake, Area 1 contains three features probably associated with early mining or exploration: a prospect pit with associated rock dumps north and downslope; a cleared and leveled area with four evenly spaced rotted logs that may represent the base of a cabin or shack; and an elliptical shaped alignment of rocks and boulders in a partially leveled area cleared of vegetation. The second feature contains most of the artifactual material.

Area 2, which contains Feature 4, a portal and tunnel, and numerous mining related items, is located south of the end of a mine road constructed in 1960. The portal has a roof of 4 x 6's braced by recycled railroad ties. The tunnel contains a track for an interior tram that branches outside the portal. Two electric powered ore cars, one still on and the other off the track, remain at the waste dump.

Located below the mine road at the end of an access road, Area 3 contains a vertical and horizontal portal into Feature 5, a second adit, plus a tailings dump. Partially collapsed, the horizontal portal is braced with railroad ties and dimensional timbers. A pipe runs into the portal. The caved-in upper portal and vertical shaft contain lumber, which may represent a crude headframe, and a small tailings dump. Mining paraphernalia is located in the area.

Area 4, located at the end of an access road off the main mine road and adjacent to the base of Rock Creek Falls, contains Feature 6, the principal producing adit of the Heildelberg Mine. The associated tunnel was cut into solid bedrock, requiring no bracing for at least the first 30 meters. Numerous mining related items are present in the area, including a double Pelton water wheel mounted in concrete and a large drive wheel and fly wheel.

Located north of the east end of Rock Creek Meadows, contains two structures: Structure 2, a single story, gable-roofed log and frame cabin with corrugated metal roof; Feature 7, a large wood-lined box; Feature 8, a single-seat, shed-roofed, outhouse with 1 x 12 inch horizontal sheathing and corrugated metal roof. It is assumed that this is the area referred to in 1963 as the main camp for the Heidelberg Mine (Crowley, 1963). Parked next to the house is a 1-1/2 or 2 ton, flatbed, U.S. Army surplus, truck last registered in 1973.

Area 6, located at the west end of Rock Creek Meadows, contains two structures: Structure 2, a single story, gable-roofed log and frame cabin with corrugated metal roof and exterior; Structure 3, a log and timber framed building with widely spaced, horizontal sheathing partially covered with corrugated metal.

Land status maps and General Land Office plats at the Kootenai National Forest in Libby and Bureau of Land Management Office in Billings indicate that Areas 1-5 are on unpatented land. Area 6 is within the 4.48 acre Esther Mill Site which was surveyed in 1963 (Mineral Survey No. 10915) and patented in 1975 by the Heidelberg Mining Company of Montana (Patent No. 25-75-0032). Records available for the Heidelberg mine indicate it made only a minor contribution to the local economy and was not a significant factor in the regional mining picture.

Limited mineral exploration did not occur in the Rock Creek drainage until 1900 (Vanek, 1986). Serious exploration did not begin until the 1920s, with a production peak at the Heidelberg Mine occurring in 1939 (Crowley, 1963). Some of the more visible activity areas at the site (Areas 2 & 3 plus the related road) date from the 1960s.

Site integrity ranges from poor for the older area (Area 1) to intact but deteriorating for those areas used into the 1960s. Because the mine had limited production and the region in which it is located has a shorter mining history than adjacent areas in Lincoln County, limited documentation exists. No information can be gained from this site in addition to that obtained during the current recording, photographic and research effort. This site is

recommended as ineligible for the National Register of Historic Places. No further work is recommended.

The site has been impacted by natural deterioration. Areas of the site are located either within a proposed portal area or plant site or along a transmission line corridor. Specific impacts will depend upon final project design.

11.5 RECOMMENDATIONS

The cultural resource surveys of various parts of the Montanore Project area resulted in the recording of three previously unrecorded historic sites. Both the Forest Archaeologist and the Montana SHPO have reviewed site data and concur that the sites are not eligible for nomination to the National Register of Historic Places. *Section 106 compliance will be updated and provided as part of the NEPA/MEPA.*

11.6 TRANSMISSION LINE EVALUATION

A search and review of report and site files has also been conducted for an extensive area east of the main project where several alternative transmission line corridors are proposed. A total of 23 cultural resource projects of varying intensities have been undertaken in the study area. The inventories resulted in the documentation of 19 cultural resource properties. In addition, records and files housed at the Kootenai National Forest contain leads for 14 other properties.

The transmission line alternative selected in the 1992 EIS process was Alternative 5. Noranda reviewed the existing cultural database and performed additional reconnaissance level inventory along the centerline of the selected route. Known historical sites affected by that transmission line alternative are 24LN976 – a house, and Locus 2 – scarred trees. In the 1992 EIS, the National Resister status of site 24LN976 was "ineligible" and of Locus 2 was "undetermined". The undetermined status will be resolved prior to construction.

Additional cultural resource investigations including site-specific surveys of individual pole and access road locations and other areas such as pulling yards will be performed during the upcoming NEPA/MEPA analysis to complete an evaluation of historical and archaeological impacts along the selected alternative.

12.0 GENERAL DESCRIPTION OF PROJECT

Mines Management has reviewed the original application and the 1992 EIS and Record of Decision issued by the U.S. Forest Service and the State of Montana. It is Mines Managements interest to develop the Montanore Project under the same approval issued by the agencies in the 1993 Record of Decision.

This application is submitted to the U.S. Forest Service and the Montana Department of Environmental Quality (MDEQ) for the authorization of the project. Included in the application are those changes made by Noranda through 1996 and represents the updated application as it would have been after the original approval.

Montanore Project is a silver-copper bearing ore deposit that will be developed using underground mining techniques. The initial mine production is anticipated to be approximately 12,500 tons per day expanding to 20,000 tons per day. The project is located in Lincoln and Sanders Counties about 18 miles south of the community of Libby, Montana (Figure 1). The deposit will be mined using a room-and-pillar method, and will be designed to preclude any subsidence. Operations are expected to continue 24 hours per day, seven days per week, for 350 days per year an initial annual production rate will be approximately 4,375,000 tons of ore expanding to 7 million tons of ore annually. Maintenance, repair, and security will be scheduled for the remaining days of each year.

Ore from the underground is planned to be conveyed to a surface stockpile near the portal from where it will be fed to the mill. Concentrates resulting from beneficiation in the mill will be trucked via USFS roads 4781, 2317 and 278 and State Highway 2 to a rail siding near Libby for shipment to smelting facilities. Mines Management has had preliminary discussions with the Montana Port Authority about concentrate storage and shipping from their property located in Libby. If adequate facilities and rail access can be developed, it is Mines Management's intention to use this facility. Tailings from the mill will be cycloned to produce sands and fines. Fines will be thickened and discharged

through a pipeline to the tailings impoundment site on Little Cherry Creek. Sands will also be discharged through a pipeline to the tailings impoundment site to be used for dam construction. Overflow from the tailings thickener located adjacent to the mill site will be reclaimed and returned to the mill. A general map of the project facilities is shown on Figure 2.

Waste rock from the mine will be used for construction of the mill area, portal, area, and tailings impoundment. Initially, waste will be hauled directly from the portal to establish the portal area. If project timing permits, waste rock would be directly hauled from the portal to the mill area and placed as necessary to construct the mill area. Haulage of waste for the tailings impoundment would follow the same sequence. Direct haulage of waste would be accomplished, if sequencing doesn't permit direct placement of waste; it is expected to be transported by truck to a disposal site located about three miles east of the plant site.

Water encountered during mining is expected to be pumped to settling/surge points or to the tailings impoundment; as well as pumped from underground sumps and oil separators. Excess water will be disposed of in water disposal sites, infiltration trenches, land application. *Details of the water management program will be further developed in conjunction with agency review.*

As shown on Figure 3, present mining plans for the Montanore Project involved production access to the ore deposit from the Ramsey Creek adit as well as ventilation adits. The current Libby Creek Adit is planned to be rehabilitated and extended to the ore deposit as originally planned. *The adit will be extended approximately 2000 feet to access the orebody. Waste rock developed extending the Libby Creek Adit would be hauled to the waste storage area in the Land Application Disposal Area 1 or used for construction materials and would amount to approximately 60,000 tons (27,000 BCY). An additional 10,000 to 15,000 feet of development will be required for drilling. This will result in an additional 300,000 tons of waste (133,000 BCY). Miscellaneous cleanup and mucking stations will add approximately 30% more waste for approximately 475,000*

tons (1,068,000 BCY). Water encountered would be managed and pumped to the Land Application Disposal areas. Forest Service Road 6210 would be used to haul waste rock and would contain the pipeline corridor. Completion of the adit will facilitate confirmation/in-fill drilling and bulk sampling activities. This adit will be used during mine operations for ventilation purposes. *If the Libby Creek Adit is not used for evaluation purposes, one of the planned Ramsey Creek production adits would be used to access the orebody. The Ramsey Creek Adit used for evaluation purposes would be driven at the same location and at the same size, approximately 25x25 feet opening, as the planned Ramsey Creek production adit. Rehabilitating and Extending the Libby Creek Adit would take between 3-6 months. Developing drill stations and completing in-fill drilling would take another 3-6 months.*

Primary mine access and ventilation will use the Ramsey Creek Adits. Depending on the ventilation requirements, a raise may be required to supplement in-take air for the mine. If required, a raise would be driven from the orebody extending up to HR 134 patented claims.

A ventilation raise may be driven from the centroid of the orebody to the patented claims located near Rock Lake. Figures 48, 49, and 50 provide the location of the portal and approximate alignment. The ventilation raise is a combination of a drift from the orebody, a vertical raise, and a short adit to the surface. The opening size will be approximately 15 by 15 feet. The short adit from the vertical raise to the portal will be sloped back into the mine; collecting any water inflow back into the mine workings. Grouting and other water management techniques will be used to minimize inflow of subsurface water into the workings. The surface area associated with the portal opening will be less than 1 acre. The development of the ventilation raise will be done from inside the mine and will not require any surface activities, with the exception of breaking through to the surface.

A power line corridor will be required to bring electricity in from Pleasant Valley to Ramsey Creek and a tailings line and road corridor will be required to connect the

concentrator along Ramsey Creek with the tailings impoundment in the Little Cherry Creek drainage. Small access roads also will be needed to connect various sites to the main road system.

12.1 MINE, MILL AND TAILINGS POND

12.1.1 Mine

Two adits will be excavated from Ramsey Creek and the Libby Creek Adit will be rehabilitated and provide early evaluation and development access. The Ramsey Creek adits will include a main conveyor adit and a parallel main ventilation intake adit.

Mining will be by the room-and-pillar technique utilizing both electric and diesel mechanized equipment. A detailed description of the mining is in Section 15.0 (Mining Plan).

12.1.2 Mill

The mill will be constructed adjacent to Ramsey Creek, and will be located across the creek from the Ramsey Creek Portals. The mill site will include a coarse ore stockpile, SAG/ball mill grinding, and flotation circuits. Initial mill production will reach 12,500 tons per day and eventually increase to 20,000 tons per day of production. Concentrates will be dewatered and shipped off-site by truck. A detailed description of ore processing is in Section 16.0.

12.1.3 Tailings Pond

Tailings will be transported by pipelines to the tailings impoundment area. Water will be reclaimed from the tailings thickener located at the plant site and returned to the mill for reuse. In addition water will be reclaimed from the tailings impoundment and seepage collection pond and returned to the mill process circuit. A starter dam will be constructed of borrowed material. Tailings sand will be used to construct incremental lifts to the starter dam. The tailings fines will be stored behind the dam and dewatered through natural consolidation of the tailings. A detailed description of the tailings impoundment and dam is in Section 16.8 and a description of the tailings slurry lines and reclaim water is in Section 16.9.

12.2 SUPPORT FACILITIES

A number of support facilities will be required for this project. These include buildings, conveyors, storage areas, roads, parking areas, utilities such as electric power and communication, pipelines such as water and tailings, and associated corridors.

12.2.1 Buildings and Storage Facilities

Nearly all of the buildings and storage facilities will be located at the mill site on Ramsey Creek (Figure 17). This will include:

1) Coarse Ore Stockpile – this storage/retrieval stockpile will store 30,000 live tons for surge capacity for the mill. The facility will be fed from a conveyor discharging at the top of the pile, and ore will be retrieved from below the stockpile and conveyed to the SAG mill.
2) Tailings – will flow by gravity from the mill building to final disposal at the Little Cherry Creek impoundment site.
3) Mill, Service and Administration Building – a single building will contain the mill, warehouse, mine dry, service repair shops, administration offices and concentrate storage and loadout.

The mill will contain the semi-autogenous grinding (SAG) mill and ball mills, flotation circuit producing a silver-copper concentrate. Concentrates will be dewatered and stored in the concentrate storage area. From here, concentrate will be loaded in trucks and transported to a rail siding in Libby.

The load out facility will use an existing concrete pad. Stem walls will be constructed and a building erected for the storage of concentrate. Figures 51 and 52 provide the conceptual layout and location of the facility. The full facility will be covered to eliminate any precipitation and run-off issues associated with this facility. Keeping the concentrate dry will be an important objective of the storage facility. Trucks would back on to a concrete covered pad and dump concentrate into the concentrate building. A

front-end loader would stack the concentrate in the building for shipping. Rail cars would be loaded by a conveyor belt fed by a front-end loader. Control devices would be used to control fugitive dust associated with concentrate handling and loading. Trucks would enter and exit the Port Authority yard through the current entrance. The rail would be extended to permit storage of rail cars. Covers for the trucks will be used to minimize loss of valuable concentrate. A review of truck covers is underway to identify the most efficient and effective cover practicable. Mines Management is committed to using covered trucks for concentrate haulage purposes.

The warehouse, mine dry, and service repair shops will be located at the south end of the overall building complex and will serve both mine and mill operations. This location provides close entry to the underground, but will also be close to the mill for supply to maintenance crews.

4) Gatehouse/Weigh Scale – A gatehouse will be located at the entrance to control traffic into the permit area. A weigh scale will be located adjacent to the gatehouse to weigh trucks in and out of the property.

5) Explosives Storage – Storage of the explosives, blasting agents, and other blasting material will be provided at waste rock and water disposal area 1 (Figure 3). Explosives will also be stored underground for distribution to the various mining areas and will be stored and handled in accordance with MSHA regulations. Explosive technology has advanced since the original application was submitted. In that application, ammonium nitrate and fuel oil would be mixed on-site in a mix truck and stored in compliance with MSHA guidelines. Explosives use is estimated at slightly more than 1 pound/ton or 20,000 pounds/day. Initially, the explosive use will be slightly lower due to the lower initial production rate (12,500 tons per day) and gradually increase. Mines Management is in the process of re-evaluating the mining plan and new technologies that can be incorporated into the project. Consideration will be given to bulk and pre-packaged explosive to improve productivity and reduce nitrate levels in the mine water during development and operations. Mines Management

will develop an Explosive Handling and Management Plan to establish company policies that can reduce impacts to water quality. *Mines Management will work with the agencies to develop the Explosive Management Plan, and it will be submitted early in the review process.*

12.2.2 Roads, Parking, Utilities, and Utility Corridors

Two types of roads are planned. One will have an overall right-of-way of approximately 60 feet, a travel width of 20 to 29 feet, and will provide access to the site from Highway 2 via Forest Road 278, as shown on Figure 2. Sections of this road will be widened to meet these design criteria; the road will be chip sealed from the intersection of Highway 2 to the Bear Creek Bridge. The bridges would be widened and updated to handle standard load weights, if necessary. During the upgrading of Forest Road 278, the Libby Creek Road (Forest Service Road 231 would be used for access.

From the Bear Creek Bridge to the Ramsey Creek plant site, approximately 7.5 miles of road would be relocated and reconstructed. This section of road would also be a chip sealed surfaced road and 20-29 feet wide. Five miles of this road would follow the tailings impoundment site. A single lane road would be constructed (in phases) for tailings impoundment access.

A bridge would be built across Ramsey Creek to provide access to the portals. A temporary crossing would be used prior to bridge construction.

It is expected that re-initiation of the evaluation adit will require the use of Forest Service Road 6210 (between Libby and Ramsey Creeks) will be necessary to access the Libby Creek Adit. Waste would be hauled over this road and stored in the waste storage facility in the Land Application Area. A temporary bridge would be built across Ramsey Creek to provide access to this road from the Ramsey Creek Road. The road would be closed and the bridge removed after the waste rock haulage was completed. After this point in time, access to this site would be via certain segments of Libby Creek Road (Forest

Service Road 2316), Fisher-Libby Creek Road (Forest Service Road 231), and Bear Creek Road (Forest Service Road 278).

Road maintenance would be Mines Management's responsibility, unless use by the Kootenai National Forest or other interests would warrant a cost-sharing agreement. The maintenance would revert back to the Forest Service once *road traffic returns to pre-activity levels and as approved by the Forest Service*.

Personnel, support traffic and concentrate haulage west to the Libby area will be via Highway 2 (Figure 2). The other road will have a travel surface width of about 24 feet, and will be incorporated in the tailings line and power line corridor from the mill to the tailings impoundment site. A cross section of this type of road is shown on Figure 43.

Surfaced parking areas will be provided at all sites to minimize dust generation. Parking requirements will be minimized by providing bus and van transportation for employees.

Electric power will be established to the site along corridors to the nearest supply points as described in Section 31.0. Telephone communication may be supplied by a buried transmission line along the Bear Creek access road.

12.3 PERMIT AREA BOUNDARIES

Metes and bounds descriptions of the various permit areas have been prepared. Areas described include:

1) Lower Libby Creek Portal Site
2) Ramsey Creek Mine/Mill Site
3) Waste Rock Disposal Area and Water Disposal Site No. 1
4) Water Disposal Site No. 2
5) Power Line Corridor – Pleasant Valley to Ramsey Creek Mine/Mill Site
6) Access road – Ramsey Creek Mine/Mill Site to Tailings Impoundment
7) Access road – Lower Libby Portal Site to Ramsey Creek Road
8) Tailings Impoundment Site

These areas are tied to survey markers with known positions in the Montana State Plane Coordinate System in the North Zone.

12.3.1 Lower Libby Creek Portal Site

Situated in Section 15, Township 27 North, Range 31 West, (unsurveyed) MPM, commencing at Corner No. 1 of the Johnstone Placer Claim of U.S.M.S. 8798 (brass cap) with coordinates N 459,830.156, E 516,471.071, proceed 1,534.66 ft. S 25º55’49” W to the southwest corner of the Lower Libby Permit Area, or Corner No. 1, the Point of the Beginning,

Thence N 14º 22’ 52” W 1,207.85 ft. to Corner No. 2,
Thence N 40º 21’ 28” W 823.65 ft. to Corner No. 3,
which is coincident with Corner No. 1 of U.S.M.S. 8796,

Thence N 29º 22’ 23” E 625.10 ft. to Corner No. 4,
which is coincident with Corner No. 2 of U.S.M.S. 8796,

Thence N 88º 38’ 25” E 1,334.90 ft. to Corner No. 5,

which is coincident with Corner No. 3 of U.S.M.S. 8796,

Thence	N 67º 11’ 16” E	3,811.32 ft. to Corner No. 6,
Thence	S 13º 26’ 55” E	1,418.91 ft. to Corner No. 7,
Thence	S 57º 09’ 57” W	2,739.46 ft. to Corner No. 8,

which is coincident with Corner No. 2 of the Upper Cut claim U.S.M.S. 8797,

Thence	S 74º 13’ 24” W	619.41 ft. to Corner No. 9,

which is coincident with Corner No. 1 of U.S.M.S. 8797,

Thence	S 64º 59’ 11.98” W	1,934.53 ft. to Corner No. 1,

the Point of Beginning.

12.3.2 Ramsey Creek Mine/Mill Site

Situated in portions of Section 4, 8, and 9, Township 29 North, Range 31 West (unsurveyed) MPM, commencing at Survey Point (aluminum cap) with coordinates N 460,180.524, E 509,400.605, proceed N 2º33’17” W 3,603.03 ft to Corner No.1, the Point of Beginning,

Thence	N 27º50’03” W	1,413.54 ft. to Corner No. 2
Thence	N 50º51’10” E	3,120.46 ft. to Corner No. 3
Thence	N 83º16’42” E	1,409.69 ft. to Corner No. 4
Thence	grid-south	1,165.00 ft. to Corner No. 5
Thence	S 32º14’12” W	2,624.58 ft. to Corner No. 6
Thence	grid-west	1,760.0 ft. to Corner, No. 1,

the Point of Beginning.

12.3.3 Waste Rock and Water Disposal Area – Disposal Site No. 1

Situated in portions of Section 2, Township 27 North, Range 31 West (unsurveyed) and Section 25, Township 28 N, Range 31 West (unsurveyed) MPM, commencing at survey point with coordinates N 473,424.874, E 517,809.114, proceed S 65º39'12.8" E 2,541.37 ft. to Corner No. 1, the Point of Beginning.

Thence	N 49º59'40.6" E	2,539.91 ft. to Corner No. 2,
Thence	grid-east	1,500.0 ft. to Corner No. 3,
Thence	grid-south	2,800.0 ft. to Corner No. 4,
Thence	S 70º32'09" W	2,645.70 ft. to Corner No. 5,
Thence	S 55º49'17" W	1,018.38 ft. to Corner No. 6,
Thence	S 51º42'38" W	1,401.47 ft. to Corner No. 7,
Thence	S 77º41'59" W	595.67 ft. to Corner No. 8,
Thence	N 39º25'21.36" E	2,267.46 ft. to Corner No. 9,
Thence	N 4º 5' 47.7 1" W	1,869.39 ft. to Corner No. 1,

The Point of Beginning.

12.3.4 Water Disposal Site No. 2

Situated in portions of Sections 35 and 36, Township 28 North, Range 31 West (unsurveyed) MPM, commencing at Corner No. 30, proceed S 44º50'46" W 3,317.48 ft. to Corner No. 1, the Point of Beginning.

Thence	S 85º 29' 22" E	2,950.04 ft. to Corner No. 2,
Thence	S 4º 30' 37" W	2,600.00 ft. to Corner No. 3
Thence	N 85º 29' 23" W	1,150.00 ft. to Corner No. 4
Thence	S 4º 30' 37" W	1,200.00 ft. to Corner No. 5
Thence	N 85º 29' 17" W	1,799.98 ft. to Corner No. 6,
Thence	N 4º 30' 33.7" E	3,799.96 ft. to the Point of Beginning.

12.3.5 Power Line Corridor

The new 15.7 mile long, 230 kV line (shown in Figure 16) will be constructed in a northwesterly direction from the new 230 kV substation to the Ramsey Creek site. The metes and bounds description of the transmission line corridor centerline is as follows:
Beginning at Point No. 1 with coordinates E 512,400.003 and N 466,843.994;

Thence	S 72º 6’ 35.8” W	351.9 ft. to Point No. 2,
Thence	S 86º 8’ 16.4” W	1,358.5 ft. to Point No. 3,
Thence	N 46º 51’ 21.9” W	1,358.1 ft. to Point No. 4,
Thence	N 36º 18’ 15.6” W	2,378.2 ft. to Point No. 5,
Thence	N 5º 0’ 1.5” W	16,852.6 ft. to Point No. 6,
Thence	N 76º 42’ 36.8” W	15,230.4 ft. to Point No. 7,
Thence	N 54º 58’ 51.8” W	16,925.1 ft. to Point No. 8,
Thence	N 89º 15’ 56.1” W	4,266.1 ft. to Point No. 9,
Thence	N 52º 25’ 2.2” W	5,118.4 ft. to Point No. 10,
Thence	S 88º 56’ 45.3’ W	5,463.3 ft. to Point No. 11,
Thence	N 56º 26’ 29.8” W	6,553.4 ft. to Point No. 12,
Thence	S 68º 36’ 29.3” W	7,285.9 ft. to Point No. 13

a point within the access road corridor from the Ramsey Creek Mine/Mill Site to the Tailings Impoundment. The Power Line Corridor will encompass an area 100 feet either side of center line, amounting to approximately 380 acres. This corridor will be permitted by the Montana Department of Natural Resources and Conservation under the Major Facilities Siting Act.

12.3.6 Access Road – Ramsey Creek Mine/Mill Site to Tailings Impoundment

Commencing at Corner No. 4 of the Ramsey Creek Mine/Mill site, proceed grid-south 365 feet to a point on the center line of the access road (Point No. 1), the Point of Beginning. The center line of the road runs

This is an approximation and will be updated using current Forest Service methods.

Thence	N 70º 25’ 50” E	3,194.53 ft. to Point No. 2
Thence	N 76º 39’20” E	2,290.66 ft. to Point No. 3
Thence	N 77º 42’ 17” E	1,596.62 ft. to Point No. 4
Thence	N 51º 42’ 08” E	1,428.64 ft. to Point No. 5
Thence	N 55º 49’23” E	979.08 ft. to Point No. 6
Thence	N 70º 26’ 40” E	2,748.55 ft. to Point No. 7
Thence	grid-north	1,570.00 ft. to Point No. 8
Thence	N 74º 19’ 46” E	1.073.31 ft. to Point No. 9
Thence	N 27 º02’ 59” E	1,073.31 ft. to Point No. 10
Thence	grid-north	1,140.00 ft. to Point No. 11
Thence	N 80º 40’ 35” W	1,357.94 ft. to Point No. 12
Thence	N 17º 47’ 02” W	556.60 ft. to Point No. 13
Thence	N 55º 29’ 29” E	388.33 ft. to Point No. 14
Thence	N 10º 43’ 49” W	1,510.31 ft. to Point No. 15
Thence	N 55º 39’ 03” E	532.94 ft. to Point No. 16
Thence	N 5º 11’ 40” W	331.36 ft. to Point No. 17
Thence	N 33º 53’ 58” E	2,277.06 ft. to Point No. 18
Thence	N 4º 30’ 18” W	1,655.11 ft. to Point No. 19
Thence	N 55º 37’ 11” E	690.65 ft. to Point No. 20
Thence	grid-north	533.49 ft. to Point No. 21,

a point on the southern boundary of the Tailings Impoundment permit area. Said corridor encompasses an area of 150 feet either side of center line.

12.3.7 Access Road – Lower Libby Portal Site to Ramsey Creek Mine/Mill Site Access Road

Commencing at Corner No. 6 of the Lower Libby Permit Area, proceed S 15º 38’ 32” E 259.62 feet to a point on the center line of the access road (Point No. 1), the Point of Beginning. The center line of the road runs

This is an approximation and will be updated using current Forest Service methods.

Thence	N 51º 32’ 12” E	1,366.53 ft. to Point No. 2
Thence	N 31º 48’ 34” E	929.62 ft. to Point No. 3
Thence	N 1º 24’ 52” E	810.23 ft. to Point No. 4
Thence	N 16º 15’ 37” E	750.00 ft. to Point No. 5
Thence	N 32º 46’ 30” E	1,736.43 ft to Point No. 6
Thence	N 12º 48’ 15” E	902.44 ft. to Point No. 7
Thence	N 36º 42’ 10” E	668.00 ft. to Point No. 8
Thence	N 23º 36’ 47” E	1,997.22 ft. to Point No. 9
Thence	N 67º 31’ 14” E	627.69 ft. to Point No. 10
Thence	N 5º 26’ 25” W	421.90 ft. to Point No. 11
Thence	N 82º 38’ 51” W	625.14 ft. to Point No. 12
Thence	S 73º 25’ 34” W	876.41 ft. to Point No. 13
Thence	N 3º 34’ 35” W	320.62 ft. to Point No. 14
Thence	N 67º 19’ 43” E	856.15 ft. to Point No. 15
Thence	N 12º 15’ 53” E	235.37 ft. to Point No. 16
Thence	N 47º 33’ 50” W	474.24 ft. to Point No. 17,

a point on the eastern boundary of the right-of-way for the Ramsey Creek Mine/Mill Site Access Road. Said corridor encompasses an area 150 feet either side of center line.

12.3.8 Tailings Impoundment and Borrow Area Site

Situated in portions of Sections 18 and 19, Township 28 North, Range 30 West (partially surveyed), and portions of Sections 13, 14, 24 and 26 and all of Section 23, Township 28

North, Range 31 West (unsurveyed) MPM, commencing at survey control point #32, proceed S 10º 51' 24" E, 418.26 feet to Corner No. 1, the Point of Beginning

Thence	S 21º 48' 05" W	2,692.58 ft. to Corner No. 2,
Thence	S 45º 00' 00" W	1,414.21 ft. to Corner No. 3,
Thence	grid-west	2,600.00 ft. to Corner No. 4,
Thence	grid-north	7,400.00 ft. to Corner No. 5,
Thence	N 16º 00' 09" E	4,135.24 ft. to Corner No. 6,
Thence	S 85º 06' 31" E	14,000.00 ft. to Corner No. 7,
Thence	S 29º 53' 18" W	5,000.00 ft. to Corner No. 8,
Thence	S 54º 59' 14" W	4,612.15 ft. to Corner No. 9,
Thence	N 85º 56' 01" W	4,230.65 ft. to Corner No. 1,

The Point of Beginning.

12.3.9 Loadout Facilities

Beginning at a point which is approximately 4,650 feet southeast of the intersection of Highway 2 and Highway 37 in Libby, Montana, and which is approximately 120 feet west of a railroad spur centerline, the Point of Beginning, (Point No. 1) with coordinates N 562,839.858 E 534,617.379 (Montana State Plane, NAD 27 North).

Thence S88º37'38"E 157.58 feet to Point No. 2
Thence S01º22'22"E 282.87 feet to Point No. 3
Thence N88º37'38"E 157.58 feet to Point No. 4
Thence N01º22'22"E 282.87 feet to Point No. 1

12.4 DISTURBED / NONDISTURBED AREAS

The total area encompassed by the Montanore Project permit boundary is 3,628.8 acres of which 2,527.7acres will be disturbed. The disturbed and permit area acreage are tabulated in Table 12-1.

12.5 SURFACE AND MINERAL OWNERSHIP

The orebody lies primarily beneath the Cabinet Mountains Wilderness area and is claimed by virtue of unpatented lode mining claims. The claims were subject to examination by the U.S. Forest Service which on February 27, 1985, issued a mineral report establishing the validity of the claims. The report demonstrated valid discoveries were made prior to December 31, 1982, which is the date that the lands within all wilderness areas were withdrawn from mineral entry pursuant to the Wilderness Act 16 U.S.C. 1131, et.seq.

In the project area the surface ownership is National Forest lands with some private land (Figure 32). The USFS lands have been located with unpatented mining and mill site claims which cover the proposed mine development. *A full list of claim information is shown on TABLE 12-2* Lease/option/purchase and lease agreements in favor of the Montanore Project are being negotiated *for the Libby Creek Adit and the Champion International (Noranda) land parcel (near the tailings impoundment).* This will include an easement needed along the powerline right-of-way. *Negotiations cannot start until the agencies determine the original preferred alignment is still acceptable.* Because the agencies selected the preferred alternative in 1992, it is anticipated that little or no changes to the project footprint will occur. Therefore, Mines Management will actively develop agreements that will be finalized with the signing of the Record of Decision and issuance of the various permits.

12.6 TOPSOIL STOCKPILES

Soil stockpiles will be created adjacent to each disturbance where salvageable soils are available. Soil or appropriate growth medium will be salvaged where available and equipment can operate safely. Stockpiles will be located in the following locations:

- 3-Stockpiles at the tailings impoundment Site
- 2-Stockpiles at the Ramsey Creek Mill Site
- 2-Stockpiles at the Waste Rock/Water Disposal No.1 Area
- 1-Stockpile at each disturbance area

Stockpile design and protection are addressed in Section 42.2. Topsoil stockpile locations and numbers may be slightly modified to meet field conditions.

13.0 EQUIPMENT

13.1 MINING

Mining equipment has been selected with the objective of minimizing total mine ventilation requirements thus limiting cross sections for intake and exhaust ventilation openings. The mining equipment selected provides for mining an average of 7.1 million tons per year (20,000 tons per day) on a three shift per day basis for 350 days per year. This tonnage includes 7.0 million tons of ore mined per year for a period of 15 years with the balance of 0.1 million tons of development waste mined per year for a period of 10 years. Equipment requirements for the early stages of the mine production will be slightly less to meet anticipated production rates of 12,500 tons per day. The majority of the ore production equipment selected will be electric with diesel equipment provided for waste rock mining and overall mine servicing. The following mine equipment or equivalent is representative of that planned for use during the preproduction and production phases of the project. Equipment requirements and type may change to meet production, technology, ventilation, or other mine criteria. Mine optimization design work is currently underway and may modify the equipment list below to better meet mine design criteria. The equipment modification will not change any aspect of the project environmental issues.

The mine equipment list includes, but is not limited to the following:

<u>Mine Mobile Equipment</u>

- Electric/Hydraulic Jumbo Drills (Ore and Waste Development)
- Electric/Hydraulic Bench Drills (Ore Production Stopes)
- Alimak Raise Climber (Ore Pass and Raise Development)
- Raise Boring Machines
- Electric/Hydraulic Rockbolting Machines
- Scissor Lifts
- Scalers
- Explosive Supply Trucks
- Electric LHD
- 39 Ton Electric Trucks (Ore Haulage)
- 26 Ton Diesel Trucks (Waste Haulage)

- Utility Mechanical Maintenance Truck
- Utility Scissor Truck
- Utility Truck with Trailers
- Concrete Trucks (Construction/Development)
- Jackleg Drills
- Stopers
- Blade (Road Maintenance)
- Personnel Transport Vehicles
- Supervisor Vehicles

Stationary Mine Equipment

- Primary Crusher
- Conveyors
- Main Electrical Ventilation Fans
- Booster Fans
- Pumps

13.2 TOPSOIL SALVAGE AND REPLACEMENT

Haulage trucks, front end loaders, graders, dozers and scrapers used in the mine and tailing impoundment construction and operation will be used for top soil salvage. This same equipment will be used for top soil replacement during reclamation. Soil will be removed prior to any disturbance activities in areas where topsoil (or appropriate growth medium) can be safely removed.

13.3 ORE PROCESSING

The proposed milling circuit to recover the silver and copper minerals is the flotation process. The ore is mined underground and shipped to the mill via conveyor belt and deposited in to an ore stockpile. The ore is sent to the grinding circuit where the material is further ground to reduce the size to a fine sand particle size.

After the grinding process, the ore is sent to the flotation circuit where the minerals will be separated from the host rock (quartzite/siltite). In this phase of the milling process, the sand sized ore is conditioned prior to entering the flotation circuit. In the flotation circuit organic chemicals (frothers, conditioners, and collectors) are added to the circuit. In general terms, the flotation circuit requires the generation of bubbles in the tank as the means to collect the minerals. The silver-copper minerals attach to the bubbles and "float" to the top of the tank. The bubbles (froth) containing minerals are scrapped off the top of the tank (concentrate). The non-mineralized rock (tailings), which consist mainly of quartzite, sinks to the bottom of the tank.

Within the flotation circuit, the flotation process is completed several times to improve mineral recovery and concentrate quality. After the flotation circuit, the concentrate is sent to a dewatering system and stored pending delivery to Libby for shipment to the smelter.

Tails generated in the flotation circuit will be sent to the thickener prior to delivery to the tailings impoundment. Figure 24 shows the milling circuit.

The following are the major mill components:

<u>Ore Storage/Reclaim</u>

Coarse Ore Reclaim Apron Feeders
SAG Mill Feed Belt Conveyor
Apron Feeder Dust Collectors
Dust Collector Slurry Pumps

Grinding

SAG Mills
Ball Mills
SAG Mill Discharge Pumps
Horizontal Vibrating Screens
Cyclone Feed Pumps
SAG and Ball Mill Lube Units
Overhead Crane
Cyclones

Flotation

Rougher Flotation Cells
First Cleaner Flotation Cells
Second Cleaner Flotation Cells
Rougher Concentrate Pumps
Regrind Cyclone Feed Pumps
Regrind Mill
Regrind Lube Pumps
First Cleaner Concentrate Pump
Second Cleaner Concentrate Pump
Third Cleaner Concentrate Pump
Final Tails Pumps
Second Cleaner Tails Pump
Sump Pumps
Sample Pump
Overhead Crane
Reclaim Water Pumps
Gland Water Pump

Dewatering

Thickener
Thickener Underflow Pump
Pressure Filter Feed Pumps
Pressure Filters
Pressing Water Pumps
Filtrate Pump
Sump Pumps

Reagents and Utilities

Reagent Mix Tank Agitators
Solution Pumps
Plant Air Compressors
Instrument Air Compressor
Flotation Blowers

Fresh Water Distribution

Fresh Water Supply Pump
Fresh Water Distribution Pumps
Fire Water Pumps
Jockey Pump
Potable Water Distribution Pump
Sewage Pumps

Sand Preparation

Secondary Cyclone Feed Pumps
Sump Pump
Primary Cyclones
Secondary Cyclones

13.4 TAILINGS DISPOSAL

13.4.1 Tailings Impoundment Construction

The following equipment will be used to construct the tailings impoundment. As with the full project, the equipment list provides a general description of the equipment required to complete construction of the tailings impoundment and may change as required.

Equipment Item	Approx. Number
Scraper	8
Bulldozer (D-9, D-8, D-7)	7
Grader	2
Rock Trucks	6
Loader	2
Water Truck (4,000 gal.)	2
Water Wagon (10,000 gal.)	1
Compactor – Self-Propelled	3
Air Track Drill	2
Backhoe	1
30-Ton Dump Truck	5
Fuel Truck	1
Service Truck	1
Pickups	9
Trailers (offices, supplies)	4
Soils Laboratory	1
Portable Toilets	6

13.4.2 Tailings Impoundment Operation

Tailings dam construction and operation are discussed in more detail in Section 16.7 of the text.

A. Tailings Disposition
Cyclones 8 primary/12 secondary

B. Spread and Compact Tailings
Dozer, D-8 or equal,
Full-time for 16 years 1

C. Pumps
Tailings impoundment recycle process water 2

14.0 PERSONNEL

14.1 PREPRODUCTION PHASE

The preproduction phase of the Montanore Project will take approximately 24 months to complete. The preproduction phase includes:

(1) Access road upgrading and construction
(2) Site preparation
(3) Mine Development (Ramsey Creek Adits & Mine Workings)
(4) Electrical transmission line and main substation construction
(5) Surface plant construction
(6) Tailings impoundment construction and installation of related service facilities (Starter Dam, Diversions, Site Preparation)

All surface construction and the majority of underground mine development during the preproduction phase will be completed by contractors. *This includes the Libby Creek Adit extension and the evaluation work (infill drilling etc.).* All contractor work is assumed to take place on a 3 shift per day, 7 days per week schedule, except for some surface construction work which takes place 7 days per week, one shift per day. Theses schedules may fluctuate slightly during construction. Contractor mine development crews will gradually be phased-out during the later half of the preproduction period and fully replaced by company personnel by the end of the preproduction phase. Actual manpower levels may require adjustment upwards or downwards depending on the actual phase-in period of company personnel and depending on which time of the year construction commences. For example, tailings impoundment construction cannot be carried on during the winter months and is restricted to the period May 1 to October 31. Consequently, manpower levels might be affected as scheduling adjustments are made.

14.2 PRODUCTION PHASE

Following completion of surface plant construction and underground construction and development, the mine/mill complex will be brought up to full production during a 3 to 12-month time period. The mine/mill complex and shop warehouse facilities are planned to operate on a 3 shift per day, seven day per week basis during the production phase.

14.3 PROJECT EMPLOYMENT

Employment figures presented in Table 14-1 are estimates for each quarter and may vary according to Mines Management's actual employment needs at the time of construction or operations and represent a production rate of 20,000 tons per day. Construction will commence during the third quarter of Year 1 with the hiring of approximately *135* employees and will last approximately 2.5 years. Construction employment will peak at *155* employees during the third quarter of Year 2. During Year 3, construction employment *will be no more than 65* employees per quarter.

Total employment (construction and operations) is expected to peak at *505* employees during the third quarter of Year 3. Following completion of construction at the end of the third year of the project, total employment should level off to 450 workers and remain at this level through the life of the mine. These numbers represent a 20,000 ton per day mining and will be slightly less at the 12,500 tons per day rate.

Much of the construction work will be equipment and specialty services for the mine. Each vendor or supplier may have a local distributor or hire local construction employees to assist in the installation or construction of their particular piece of the project. Because of this, it is expected that a significant amount of the construction workers will be local hire. Mines Management is committed to local hire and will encourage contractors to use local hire were possible including partnerships with local businesses.

During mine operations, Mines Management makes the same commitment to local hire. It is expected that the vast majority of the mine operational base can be obtained locally. It is expected that the work force necessary to operate the mine and mill can be supplied locally. Mines Management will work with local job services and educational institutions to outline the types of jobs and skills necessary for training purposes.

14.4 PROJECT PAYROLL

Following is an estimate of annual payroll for the Montanore Project in constant 1989 dollars originally submitted by Noranda. It is expected that the values below will still be representative of the 12,500 ton per day mining. Mines Management is currently updating the Hard Rock Impact Plan. The original plan is included in Appendix I.

Year 1:	$	2,930,000
Year 2:		7,465,000
Year 3:		13,760,000
Year 4:		12,000,000
Year 5:		12,000,000

15.0 MINING PLAN

Various aspects of the underground mine are described in the following sections.

15.1 GENERAL

The deposit to be mined is composed of two stratiform horizons separated by an average of about 30 feet of waste rock. The lower horizon is slightly thicker than the upper, averaging about 34 feet in thickness versus about 30 feet for the upper horizon. The ore body outcrops near the north end of Rock Lake, and plunges at about 15º to the north and northwest.

Ore is hosted in the upper portion of the lower Revett Formation of the Belt Supergroup. The host rocks are quartzites and siltites which have been folded into a large syncline. This syncline has been rolled so that its western flank is virtually horizontal in transverse section, while its eastern flank is vertical to slightly overturned. The ore body is truncated on the west by the Rock Lake Fault.

The ore reserve has been estimated at approximately 135 million tons. This will be mined by a room-and-pillar mining method.

15.2 PREPRODUCTION AND DEVELOPMENT

Concurrently, it is planned to drive two adits to the orebody from the Ramsey Creek Mine/Mill Site. One adit would be driven to an underground crusher and will contain the main conveyor. This adit will also serve as an exhaust airway. The other adit would be utilized as a ventilation airway, personnel, and material access.

Additional waste development generated during the preproduction period includes excavation of the crusher station, main stopes, sumps, haulage drifts, ore and waste passes and access ramps to the initial stopes.

During the preproduction phase, an estimated 1,800,000 tons of waste rock will be excavated. The waste rock will be used in the construction of the tailings dam, mill facility, Ramsey Portal area, and stored in the Land Application Disposal (LAD) stock pile areas. It is planned to store any waste rock generated extending the Libby Creek Adit at the waste rock disposal area. The waste rock from these stockpiles will be hauled to the tailings area for tailings dam construction.

ESTIMATED SCHEDULE FOR WASTE ROCK PRODUCTION & DISPOSAL

PROJECT STAGE	Tons (1,000s)	BCY (1,000s)	DISPOSAL AREA
Evaluation (Ramsey)	554	246	Tailings Impoundment
Pre-production			
	1,548	668	Tailings Impoundment
	333	148 (ore)	Temporary Storage
	0	0	Waste Disposal Site
Initial production	288	128	Tailings Impoundment
Production with Tailings			
Impoundment Construction			
	576	256	Tailings Impoundment
	144	64	Inside Mine
Production only	864	384	Inside Mine
TOTAL	**3,974**	**1,766**	

Notes:

- Waste rock from the Ramsey Creek adit development will be temporarily stored in the waste rock dump prior to being used in tailing impoundment construction.
- Temporary ore storage will be returned to the mill when it becomes operational.

Preproduction mine development will take approximately two years.

During the preproduction phase water usage for underground development will be supplied from the excess water pumped out of the mine. Construction of the tailings dam and temporary water storage will be accomplished to facilitate start-up water requirements for the mill.

Ventilation for the underground preproduction development will be supplied by electric fans. Electrical power required for fans, pumps, mining equipment and surface construction during the initial preproduction phase will be supplied by generators. *Air will exhaust from the mine in the Ramsey conveyor adit and the Libby Creek Adit (if developed). Intake air will be brought in the second Ramsey Creek Adit and the Ventilation Raise (Section 12.0).*

15.3 PRODUCTION MINING

The mining method to be used for production mining will be room-and-pillar. Figures 20 and 21 are schematic representations of the room-and-pillar mining process. To achieve a production rate of 12,500 tpd and ultimately 20,000 tpd, highly mechanized equipment will be utilized. A combination of electrical and diesel equipment will be used to support the mine operations. Mine ventilation requirements will dictate the actual equipment fleet selected. Mines Management is currently assessing new technologies that are available since the 1992 permit approval by the agencies. The new technologies may be incorporated into the overall mine plan.

The ore deposit averages about 31 feet in thickness. A portion of the ore body will be mined by taking a single horizontal cut. Where the ore body is too thick for single pass mining, a top heading will first be mined followed by benching to recover the remaining ore.

The room-and-pillar sizes and configurations will be designed to prevent surface disturbances (subsidence) and ensure safe working conditions for mining personnel.

Current rock mechanics investigations based on other mining operations with similar rock characteristics indicate a stope span of approximately 45 feet can be safely achieved with an overall recovery of 60 to 70 percent. Microseismic instruments are planned to be installed early in the mine life. These instruments serve to monitor stress build-up around the stopes. They are a safety measure as well as a valuable planning tool.

The orebody will be mined using conventional drill, blast, muck, and rockbolt techniques. Electric hydraulic drill jumbos will be used for topslice drilling with rock loading carried out by a loading jumbo. Mucking to ore passes will be with 8 yard load haul dump (LHD) units. Ground support will be carried out by rockbolting of backs and walls.

Bench drilling will be performed with an electric hydraulic bench drill followed by loading with a loading jumbo. LHD units will muck the ore to an orepass. A scaler will removed loose material as required from high back and wall areas during the benching cycle.

All ore will be hauled from orepasses to the crusher with 39-ton electric haul trucks. The crusher will reduce the ore to 8-inch size to feed onto a 48-inch wide conveyor belt for delivery through the Ramsey conveyor adit to the surface ore stockpile.

All waste rock produced during mining will either be placed in mined out areas or sent to the surface waste rock stockpile for ongoing tailings dam construction. It is estimated that 2,500,000 tons of waste rock would report to waste dumps and subsequently be used in construction for the tailings impoundment. Any other waste rock would be backfilled in mined out areas underground.

Monitoring requirements for waste rock characterization and other similar issues will be developed and updated based on agency requirements and NEPA/MEPA review process. As the mine continues to develop, representative material samples will be taken from the adits, ore zones, above and below the ore zone, the interzone, as well as tailings. Static and kinetic testing will be conducted on these samples to evaluate the acid producing potential. Acid-base accounting results, total sulfur analyses and pH measurements will be documented.

Annual reports will be submitted documenting sample location, methodology, detection limits, and testing results. Acid-base-accounting (ABA) results will be correlated with

lithology and total sulfur analyses. A base map will be produced characterizing the acid-producing potential of the mine.

Using baseline results, fixed sample points will be located in the interior of the mine in representative geologic zones. These points will be sampled annually throughout mine life, to document changes in the pH of the adit walls and floors. These results will be compared to the baseline pH to determine if changes in pH are occurring through time. Results will be submitted with the annual report.

All data will then be correlated with water monitoring data in order to determine whether changes in water quality are the result of acid or sulfate production. It is expected that little or no change to water quality is anticipated at closure.

Acid-generating materials will be segregated for special handling as they are mined and will be placed to minimize the potential for acid mine drainage. No rock materials will be used for construction prior to/determination of its acid-producing potential. Based on the preliminary test results, it is anticipated that the quantity of acid-generating material will be very small. A management plan will be developed for the handling of potentially acid-generating material.

Adequate intake ventilation air volume will be provided to the mine for on-going development and production activities. In winter, the intake air may be heated to prevent icing of accesses and underground. To supplement ventilation to the mine workings, it is anticipated a raise to the surface may be required. The surface expression would be situated on patented mining claim HR 134.

Mine water pumping facilities with provisions to handle temporary mine inflows of up to 2,000 gpm will be provided. A portion of this water will be diverted to collection sumps for settling and storage for use in mining operations. The balance of this water will be pumped to surfaced and used in the milling process. Grouting, longholing, and other techniques will be used to intercept and direct groundwater before it enters mine

workings which will prevent or reduce water contamination. *Grouting is a process of sealing a small fracture in the rock encountered in the mine workings. Various techniques are available for the site specific conditions. Drilling activity will proceed mine development activities and will delineate potential water producing fractures. As mine development progresses and exposes fractures in the rock walls, grouting will be completed to seal the fractures reducing water inflow. This sequence will be the standard method of identifying water producing units prior to mine development into that particular mine area. Section 30.2.1 Grouting provides additional discussion on the topic. A hydrology review will be completed as part of the EIS process to address mine inflow variability and water sources.*

In the unlikely event that isolated increased water is encountered, Mines Management will use the tailings impoundment area for water storage. In staged development of the tailings facility, excess water storage capacity is available above the normal storm event storage requirement. There would also be additional opportunity to land apply water in the tailings storage area to evaporate excess water in the summer time. There would be sufficient capacity to handle a large event. Details of this will be established in an updated Water Management Plan developed with the agencies through the NEPA/MEPA process. Section 30.2 provides additional detail on managing excess water.

During mining operations communication will be provided by both a regular telephone system and a hand-held radio system. Training programs emphasizing safety will be initiated during the preproduction phase and will be continued during mining operations.

15.4 SURFACE DISTURBANCES

Surface disturbance is necessary to support mine activities and will include the mine portals, mill/office complex, tailings facility, Land Application Disposal (LAD) areas, roads, and other ancillary disturbance. The following provides a description of the surface disturbance proposed and previously approved for the Montanore Project.

15.4.1 Lower Libby Creek Portal Site

The majority of the Libby Creek Adit was completed by Noranda. Mines Management intends to extend the adit for delineation drilling and bulk sampling activities. Mines Management expects that the same disturbance footprint will be required to support the above activities. The Lower Libby Creek site (Figure 18) was originally disturbed during excavation of the adit. *The following activities/features are anticipated in the original Libby Creek site.*

A. adit portal and waste rock storage pile
B. water disposal site
C. access road construction
D. diversion ditches and settling ponds
E. temporary buildings for mine support facilities
F. pipeline
G. topsoil storage

Current security fences will be repaired around the project perimeter. Topsoil will be stripped from the area and stockpiled within the disturbance footprint prior to mine activities. Libby Creek Road will not be closed to public entry.

The waste rock originally generated by the evaluation adit (Noranda) will be considered for use at the tailings impoundment, as originally planned. It may not be feasible nor desirable to remove this material and relocate it to the tailings dam. A construction schedule will consider this material. In the event it is not used, the site will be regarded,

similar to the current conditions and revegetated after the pre-production activities are complete. Only a limited road access will be required for ventilation and general access. New waste rock generated extending the adit and developing drill stations will be stockpiled and hauled to the tailings impoundment for construction purposes. *A waste rock management plan will be developed that will establish the criteria for construction use.*

15.4.2 Ramsey Creek Mine/Mill Site

Disturbances within the Ramsey Creek permit area will include:

A. The temporary access road used during construction.

B. The permanent access bridge across Ramsey Creek from the mill/service/ administration complex to the portals to the underground.

C. The stacker conveyor from the portal site, across Ramsey Creek to the Coarse Ore Stockpile.

D. The portal pad area at the entrances to the underground, including a waste rock stockpile.

E. The laydown and parking areas during construction. Theses areas will be coincident with the site of the 400-foot diameter thickener pad area, and will not create additional disturbances.

F. Topsoil stockpiles.

These items are shown on Figure 17. The temporary access road to the south side of Ramsey Creek will be left intact except for the actual creek crossing in order to facilitate maintenance and cleanup along the toe of the mill site embankment. If a temporary bridge is needed at Ramsey Creek to provide vehicular access during adit construction, the bridge will be sized to allow for a *100-year flow event or that size required by regulations*.

Mines Management will use earth-tone paints on the exterior of structures where this does not conflict with other applicable statutes and regulations.

The stacker conveyor and bridge will be constructed to preclude spillage of rock and other materials into the Ramsey Creek drainage. The crossing at Ramsey Creek will be completely floored and enclosed with sideboards which will prevent any spillage to the creek. This conveyor will be covered to minimize fugitive dust and will have a secondary containment trough to catch falling rock to prevent loss of ore to Ramsey Creek. This trough will catch falling rock to prevent loss of ore to Ramsey Creek. Spillage within the conveyor structure will be shoveled onto the belt or removed at clean out points at either end of the structure.

All embankments will be adequately stabilized after construction and will be revegetated to prevent erosion until final reclamation at the end of the project.

The temporary waste rock stockpile at the mine entrance will be contained entirely within the portal pad. As waste rock builds up, it will be trucked to Waste Rock Disposal Area No. 1 (Figure 19) or directly to the tailings impoundment for dam construction.

15.4.3 Waste Rock and Land Application Disposal (LAD) No. 1

This site will include a waste rock stockpile sized to hold all waste removed from the Ramsey Creek adits during the mine life. The stockpile is located near the access road between the Mine/Mill site and tailings impoundment to facilitate removal of waste rock for construction-related purposes (tailings dam, road surfacing, yard and embankment surfacing and stabilization).

Waste rock stockpiles and land application disposal areas will be designed to minimize impacts to visual resources. Waste rock stockpiles will be no higher than 15 feet below the top of the adjacent forest canopy.

Water disposal systems will be constructed to handle excess water from underground. It is estimated that approximately 120 acres at this site (plus 80 acres at LAD No. 2) would handle as much as 2,000 gpm assuming water percolation rates of 0.003 feet per hour.

The disturbed area will include ponds, embankments, ditches, topsoil storage and access roads. This disturbance would require topsoil salvage and reclamation. The larger area used for irrigation land application will require only selective thinning of trees, access road construction and little topsoil removal. The excess water disposal system will have the capacity to store or to percolate up to 2,000 gpm of temporary excess water. Use of the land application *in the* tailing impoundment *area* is expected to be seasonal. *A LAD plan will be developed and submitted for agency review.*

Blasting agent and other explosives storage facilities will be located in this area, Mines Safety & Health Administration (MSHA) regulations stipulation distances to occupied buildings, traveled roads, and major power lines. Blasting agents are currently being evaluated, including the use of ammonium nitrate. If bulk ammonium nitrate is used it will be stored in an elevated silo (bulk tank); and sized to hold a four to five day supply. Fuel oil will be added to the mix at each underground blasting site (ANFO). Any revision in explosive storage will fit within the footprint of this area.

15.4.4 Land Application Disposal No. 2

This will be similar to Site No. 1, except that no waste rock will be stored here. Surface disturbance will include access roads, ponds, and embankments.

15.4.5 Tailings Impoundment

Disturbances at the tailings impoundment are described in Section 16.

15.5 SUBSIDENCE

Underground geotechnical data collected to predict subsidence potential will be provided to the agencies in an annual report. Any operational changes made as a result of the data will be reported to the agencies. A revised procedures and methods plan will be updated to incorporate any new geotechnical collection systems or modeling subsidence prediction. If it is determined that subsidence is imminent, a plan for additional mitigation will be submitted to the agencies for approval.

The proposed mine design (room and pillar) is based on achieving non-measurable subsidence conditions. Plans call for a division of the deposit into areas of similar pillar height and height of overlying rock stata. The pillar design process is going to make provisions for encountering loads as well as a safety factor to arrive at approximate pillar dimensions. Local roof failures may occur as a result of local geological structure and should extend at most 10 to 20 feet into the back. Such localized failures and their prevention are more a concern in terms of mine safety and operations rather than resulting in surface subsidence.

For measurable subsidence to occur at the surface a large area of the mine would have to cave and even this may not cause subsidence due to the great depth of most of the deposit. In hard rock mining, the general mode of cave propagation is one of breakage along joints and fractures which produces rock blocks of various sizes and shapes. As these blocks fall into the excavation, collapse continues upward until the swell of the caved rock exceeds the open space available. At that point displacement is no longer possible, and the rock mass retains its initial state without any disturbance. The amount of swell the caved rock will possess is dependent upon the rock properties and the geologic structure. In general, the zone of collapse will propagate upwards in a shape governed by the geologic structure, and the amount of consolidation that the caved material will undergo over time is a function of the stiffness of the rock mass. Figure 22 illustrates the present best estimate of the range of the extent of the disturbance should

widespread pillar failure occur. The swell factor for the rocks should prevent caving from propagating to the surface for all areas of the mine.

Figure 22 shows a zone estimating the height of collapse as a function of extracted ore thickness for a bulking factor of 20 percent. The zone is bounded by an upper curve (worst case) predicted by a wedge collapse, and by a lower curve (best case) predicted by a rectangular collapse. A third collapse geometry (conical) was analyzed by Piggot and Eynon. Based on joint mapping at Rock Lake, a conical failure geometry is not expected.

Joint mapping of several surface outcrops at Rock Lake identified four major joint sets. The mean orientation of each set is presented below:

Joint Set	**Mean Dip Direction**	**Mean Dip**
Bedding Plane	314º	23º
Cross Joint 1	122º	78º
Cross Joint 2	228º	84º
Cross Joint 3	16º	82º

The character of jointing is such that cross joint heights are equal to or less than the spacing between bedding plane joints.

Figure 23 shows a generalized cross-section generated by a statistical sampling of the joint sets mapped. This cross-section is perpendicular to the strike of the beds (342º) and includes the bedding plane joints and cross joint set No. 1. Cross joints 2 and 3 are steeply dipping and strike roughly parallel to this section.

Note the truncation of cross joints between the bedding plane joints. Geometries of rock falling out of the back of a room in this deposit will consist of rectangular prisms. Because of the blocky geometries formed by the joint set orientations, a conical failure geometry will yield an unrealistic estimate of collapse height. The solid dark line on the generalized cross-section shows the predicted failure geometry for the given room span.

For comparison, a conical shaped failure geometry was drawn to the same collapse height. It should be noted that the volume of material falling into the room as estimated by the observed joint orientations is substantially greater than that delivered from the conical geometry. Therefore, the wedge geometry appears to be the best model of the collapse height at Rock Lake.

The bulking factor of 20 percent is quite conservative. Given the large blocky geometries of the rock falls and the rock strengths (C^o = 22,000 to 60,000 psi), bulking factors of 40 to 60 percent are more likely. Using these bulking factors, the maximum height of collapse should be between 2 to 5 times the excavated room height.

Experience in similar underground conditions in Missouri tends to substantiate the bulking concept during caving. In the Missouri lead district, a room and pillar operation approximately 1,200 feet deep suffered widespread pillar failures over a 320,000 square foot area. The mining height of 40 feet was similar to that expected at the Montanore Project. No surface subsidence has been measured to date at the site.

Design of pillars for the Montanore Project underground workings will prevent subsidence and resultant impacts on the land surface or on groundwater and surface water resources. Where the ore body outcrops in the vicinity of Rock Lake, mining will be limited to prevent surface subsidence as required by the 1992 EIS and ROD issued by the agencies. Until it can be assured that no adverse impacts will occur, a minimum of 500 feet vertical and horizontal distance from the Rock Lake outcrop will be maintained as shown on Figure 25 & 26. A 100-foot barrier pillar adjacent to the Rock Lake Fault is more than adequate to maintain the structural integrity of the mine. *It is expected that the Rock Lake Fault will have some level of structure thickness variability. Drilling for mine development will define the zone and establish the starting point for the 100-foot barrier well in advance of approaching the buffer zone.* A narrower pillar may be realized if geometric and hydraulic characteristics of the Rock Creek Fault allow. To define the geometry and hydrologic properties of the fault, exploration drilling across the fault zone will be required. Before the final barrier pillar design is completed, the following

parameters will be determined by exploratory drilling ahead of development and flow testing.

1) The exact location and attitude of the fault
2) The hydraulic conductivities and storativities for the fault zone and the transition zone
3) The widths of the fault zone and the transition zone
4) Water pressures in the fault zone and the transition zones

If the Rock Lake Fault is in hydraulic communication with the surface, then water pressures ranging from 250 to 1,700 psi should be anticipated for the proposed mining depths. From a safety standpoint, a drilling contractor will be chosen based on their experience in working with these pressures.

Final pillar design in the vicinity of Rock Lake and the Rock Lake Fault will be determined after completion of this exploratory testing. Final pillar design will be coordinated with the agencies before any work within 100 feet of the Rock Lake Fault occurs.

15.6 WASTE ROCK DISPOSAL AREA

The waste rock storage/disposal area will be located adjacent to the Ramsey Creek access road but within the Waste Rock and Water Disposal Site No. 1 as shown on Figure 19. This site has been sized to accommodate up to about one million cubic yards of broken rock which is greater than the volume of storage required during the preproduction phase of project development. This facility was described in Section 15.4.3.

During mine development approximately 333,000 tons of ore will be removed from the mine and stored at waste disposal area No. 1. After project startup, this material will be sent to the mill for processing, allowing the storage of an equal amount of waste from on-going development.

Total area to be covered with waste rock amounts to about 16.0 acres. The location near the Ramsey Creek access road will facilitate waste rock removal as needed for tailings dam construction, road surfacing material, or other uses.

Side slopes will be carried at a maximum of 1.5H:1V, consistent with other construction on the project.

Soils information on the waste dump area is contained in the addendum to the Soils Report (Appendix F).

Maximum height of the waste rock pile will be about 140 feet from toe elevation to crest. The dump will be essentially flat on top. During construction of the tailings impoundment, waste rock will be used as construction material and will be removed from the waste rock pile and hauled to the tailing impoundment site. It is anticipated that all of the waste rock will be used during the course of the operation as construction material for the impoundment. Runoff control ditches and small sediment traps will be utilized during operations to control sedimentation from the waste rock disposal area.

A waste rock management plan will be developed during the review process and include agency input to describe handling, storage, and other key elements of waste rock management.

16.0 ORE PROCESSING

16.1 PROCESS DESCRIPTION

Initial mill production rates are designed for approximately 12,500 tpd with an increase to 20,000 tpd during the operation. The mill will be designed in phases to match the planned production rate. The processing facilities include SAG and ball mill grinding and flotation circuits. Silver-copper concentrate will be dewatered by thickening and pressure filtration. The following is a description of each circuit in the process and a schematic diagram of the process is in Figure 24. During the life of the mine, modifications to the milling circuit may occur but will not result in any change to the footprint or tailings characterization that would require agency approval.

16.2 COARSE ORE

Minus 8-inch ore will be conveyed from the underground to a 30,000 ton live, coarse ore stockpile on surface. The stockpile will be smaller during the initial production phase (12,500 tpd). Ore will be reclaimed from the stockpile by four variable speed apron feeders and conveyed to the SAG mills in the mill building via a 48-inch wide conveyor belt.

16.3 GRINDING

Coarse ore (minus 8 inches) will be conveyed to a 32-foot diameter by 15 ½-foot long SAG mill. Discharge from the SAG mill will be pumped to an 8-foot by 20-foot long horizontal vibrating screen. Oversize from the screens will be collected on the SAG mill feed belt conveyor and the undersize (minus ¼ inch) from each screen will be pumped to a cluster of seven 26-inch cyclones for classification.

Cyclone underflow will flow to an 18-foot diameter by 26-foot long ball mill for further grinding. Classifier overflow of 35 percent solids with 80 percent of the pulp at minus 150 mesh will flow to the flotation circuit.

Sumps and sump pumps will be provided for the grinding circuit. The sump pumps will discharge into the SAG/ball mill discharge pump boxes. A 30-ton capacity crane with a 5-ton auxiliary hoist will be provided for maintenance in the grinding circuit.

16.4 FLOTATION

Cyclone overflow from the grinding circuit will flow to two parallel banks of rougher/ scavenger flotation cells. Each bank will consist of nine 135 cubic foot cells. Concentrate from the roughers will be reground to 80 percent minus 325 mesh by an 11 foot diameter by 14 foot long ball mill operating in closed circuit with a cluster of ten 10-inch cyclones.

Regrind cyclone overflow will flow to a three stage cleaning circuit consisting of two parallel banks of ten 180 cubic foot cleaners, eight 100 cubic foot second cleaners and ten 50 cubic foot third cleaners. Concentrate from the third cleaners will be pumped to the dewatering circuit and concentrate from the first cleaner scavengers will be pumped to the regrind circuit.

Tailings from the rougher and first cleaners will be collected in a tailings pump box and will be pumped to the primary sand plant cyclones. Air for the flotation cells will be provided by three 8,500 cfm 6 psig blowers (two operating and one standby). A 5-ton overhead crane will be used for maintenance in the flotation circuit.

For clean-up in the flotation area, sumps, and sump pumps will be provided in the rougher, regrind and cleaner circuits.

16.4.1 Flotation Reagents

Test work conducted to date indicates potassium amyl xanthate (PAX) as the collector and methyl isobutyl carbinol (MIBC) as the frother will be the only reagents required for effective flotation of the Montanore ore minerals. Testing indicates depressants and pH modifiers will not be required. Both bench scale testing and evaluation of ASARCO's milling process indicate that the mill circuit will operate at near neutral pH without the addition of lime or other chemical controls. It is anticipated that a polyacrylamide flocculent such as Percol 352 will be utilized to assist the settling of the concentrate and

the fine fraction from the final tailings in their respective thickeners. Reagent mixing, storage, and feeding facilities will be provided for collector, frother, and flocculant.

The purpose of a collector is to render the copper sulfide minerals hydrophobic and allow them to attach themselves to rising air bubbles in the flotation cells. The mineral laden air bubbles overflow the flotation cells and are pumped to the next unit operation i.e., regrinding, flotation or thickening. As collectors attach themselves to the copper sulfide and silver minerals they remain primarily with the concentrate.

Potassium amyl xanthate will be used as a collector in the grinding/flotation circuits. Negligible quantities will report to the tailings pond.

The collector system will consist of an 8-foot diameter by 10-foot mix tank sized to mix 2,000 pounds of collector and a 10-foot diameter by 10-foot stock tank sized to hold 1.5 batches from the mix tank. A spare system, identical to the collector system will be provided to allow testing of new reagents.

The purpose of a frother is to lower the surface tension of water and create a stable froth capable of carrying the mineral laden air bubbles. Frothers accomplish this by imparting temporary toughness to the covering film of the bubbles. Frothers attach themselves to the air bubbles carrying the copper sulfide and silver minerals and they remain with the concentrate. Therefore negligible quantities will report to the tailings pond. MIBC will be used as a frother in the flotation circuits. Frother will be delivered by tanker truck and stored in a 9,000 gallon storage tank.

A flocculant will be utilized to assist with the settling of the copper sulfide and silver minerals and the fines fraction from final tailings in their respective thickeners. The purpose of the flocculant is to create a large mineral floc out of many fine particles. The flocculant system will consist of a 6-foot diameter by 10-foot mix tank sized to mix 50 pounds of flocculant.

A description and expected consumption and handling of reagents are shown below. Technical data sheets for PAX, MIBC and Percol 352 are in Appendix K.

DESCRIPTION AND CONSUMPTION OF REAGENTS

			CONSUMPTION		
Reagant	**Purpose**	**Additional Points**	**Lbs/Ton Ore**	**Pounds/year**	**PPM**
Potassium Amyl Xanthate	Collector	Ball Mills Regrind Mills Flotation Cells	.04	280,000	20
MIBC	Frother	Flotation Cells	.02	140,000	10
Percol 352	Flocculant	Concentrate and Tailings Thickener	.02	140,000	10

HANDLING OF REAGENTS

Reagent	**Delivery**	**Storage**	**Mixing**	**Feeding**
Potassium Amyl Xanthate	Truck	250 lb drums	8 ft dia x 10 ft Mix Tank. 10 ft dia x 10 ft Stock Tank	Control Valves and Magnetic Flowmeters
MIBC	Tank Truck	9,000 gal. Tank	----	Control Valves and Magnetic Flowmeters
Percol 352	Truck	50 lb bags	6 ft dia x 10 ft deep Mix Tank	Control Valves and Magnetic Flowmeters

16.4.2 Spill Procedures

Spill procedures vary with the type of reagent. All working areas are contained and spills will be properly cleaned up and returned to the process circuit. Spillage of solid chemicals will be cleaned up with a shovel and broom and will be placed into empty drums. Solution spills will be hosed into a sump. Spillage in the enclosed storage tank

area will be collected in a sump and spillage of solid flocculant will be cleaned up with shovel and broom.

A spill response plan will be developed for the project that will address first response containment, response equipment, handling procedures, clean-up, safety equipment requirements, notification procedures, and other pertinent response information. The plan will be kept in the mill building, supervisor's office, and other areas as deemed appropriate to facilitate a timely response plan.

16.5 CONCENTRATE DEWATERING

Concentrate from the third cleaner flotation cells will be pumped to a 60-foot diameter thickener. Overflow will be directed to the yard runoff/reclaim mine water pond, and underflow at 65% solids will be pumped to a 700-ton capacity slurry storage tank.

Concentrate will be pumped from the slurry storage tank to two 270-square foot pressure filters. Cake discharging from the filters at 8.0 percent moisture will drop into a 1,200-ton capacity covered concentrate storage shed.

A front-end loader will load 20 ton capacity trucks with concentrate for delivery to a rail siding in Libby for shipment to the smelter. Washdown from the concentrate trucks will be collected in a sump and pumped back to the concentrate thickener. Spills in the concentrate dewatering area will be collected in a sump and pumped back to the concentrate thickener.

The concentrate load-out facility will be designed to contain the concentrate inside a building or shelter, and runoff from the rail siding will be contained so that no discharge to surface waters occurs. Because of the containment of the dry concentrate no surface water monitoring is proposed. *Groundwater monitoring will be implemented prior to construction to establish pre-operational water quality levels. Wells will be installed to monitor groundwater up and down gradient of the facility. This will be incorporated into an updated monitoring plan developed as part of the agency review process.*

16.6 ORE PROCESSING UTILITIES

Two 1,500 cfm, 110 psig, screw-type air compressors have been provided to supply air to the pressure filters and plant air lines. A 100-scfm, 100 psig reciprocating-type compressor and dryer will be provided to supply, clean, dry, oil-free air to ball mill clutches, cyclone apexes, vibrating feeders and plant instrumentation.

In the event of power failures, a 200 Kw diesel generator will be provided to supply standby power for essential process equipment, heating and lighting.

16.7 TAILINGS DISPOSAL

Tailings will be subjected to cycloning at the mill to produce sand and fine fractions. The sands will flow by gravity through two pipes (one operating and one standby) to the tailings pond to be used for constructing the dam embankment. The fine fraction of tailings will flow to a thickener located immediately east of the plant. Overflow from the thickener will flow to the yard runoff/reclaim/mine water pond. Water will be reclaimed from the pond and pumped back to the mill for reuse. Underflow from the thickener will flow by gravity through pipe to the tailings pond for disposal.

Regulatory agencies have indicated alternative tailings disposal methods will be reviewed as part of the NEPA/MEPA process. Mines Management believes costs will prohibit the use of alternative disposal methods. To facilitate seepage reduction, a revised underdrain collection system is being designed as required by the 1993 ROD.

It is anticipated Mines Management will provide technical and cost comparisons to demonstrate that these alternatives (paste, geomembrane lining, etc.) are not feasible for this project.

16.8 TAILINGS IMPOUNDMENT

A major facility in the Montanore Project will be the tailings impoundment. The impoundment must be capable of storing the 120 million tons of tailings generated during the project life and must be sited to provide long-term, post-reclamation safety and stability with a land use compatible with surrounding lands. A site selection program was conducted by the Montanore Project to determine the best impoundment site. The agencies identified additional design criteria to facilitate reduction of seepage associated with the impoundment. Klohn Crippen has completed a preliminary conceptual design for the tailings underdrain system and is included in Appendix M.

In addition, Klohn Crippen has reviewed the tailings design specifications and provides a list of updated design criteria to meet agency regulations and rules since issuance of the original permit. Once the design concept is accepted by the agencies, a detailed design report will be completed that will address the underdrain system and the updated design criteria.

A complete review of the design, stability, operation, and closure of the proposed tailings facility was completed during the previous approval process. It is expected that the agencies will complete another review to validate design criteria and any regulatory changes. Mines Management will provide technical support to address their comments.

16.8.1 Impoundment Site Selection

The 1992 EIS and the ROD considered these alternatives along with modifications to the Little Cherry Creek design. Those have been incorporated into this application and the alternatives analysis remains valid. It is expect that the EIS will review the alternative analysis as part of the overall review process. Technical and feasibility remain consistent with previous analyses. The following four impoundment sites were selected for evaluation for tailings disposal.

- Little Cherry
- Poorman

- Midas
- Standard Lake

The Poorman site was eliminated as a viable possibility. Three of the sites: Little Cherry, Midas and Standard Lake were intensively studied and a matrix comparing them was developed (Table 16-1 and Figure 27). In the selection of the tailings disposal site, several factors were considered including (1) watershed area and runoff water diversion requirements, (2) foundation seepage, (3) impoundment storage capacity, (4) borrow volume requirements and (5) suitability for reclamation.

Results of evaluation of site alternatives showed the Little Cherry site is the best site for tailings disposal. The site is in a valley that has a relatively small watershed (1.78 square miles) and an impoundment could be developed at this site to store 120 million tons of tailings. The site topography is adaptable for construction of a diversion dam and channel on the south side of the impoundment and the channel would discharge into a natural waterway. This diversion system would reduce the tailings impoundment watershed area by about 50 percent. *The diversion design will take into consideration the two hydrologic basins and flow volumes anticipated and required design criteria for long-term stability.*

As described in detail in Appendix M, the Poorman and Midas sites are not considered to be as suitable as the Little Cherry site due to construction and environmental considerations.

16.8.2 Tailings Disposal

Based on the results of bench-scale flotation tests, the tailings feed is expected to consist of silt and sand particles with 52 percent passing the No. 200 sieve (0.074mm). The tailings production rate will be 12,500 (20,000) dry tons per day with a total storage capacity of approximately 120 million tons. This tailings production rate and required storage capacity indicate that the impoundment operational life will be about 16 years.

With the reduced production rate initially, the tailings life will be extended but still hold the same approximately tailings capacity.

Tailings will be separated into coarse and fine fractions by cycloning. The coarse fraction (cyclone underflow) will be used for dam construction and the fine fraction (cyclone overflow) will be deposited in the impoundment. Base on in-place dry densities of 100 pounds per cubic foot (pcf) for coarse tailings and 70 pcf for fine tailings, approximately 1,800,000 cubic yards of coarse tailings and 5,600,000 cubic yards of fine tailings will be produced annually at the full 20,000 tpd rate. *These values may vary slightly over the life of the project.* The values will be slightly less at the initial 12,500 tpd rate.

Appendix M contains the tailings dam design reports that were generated during the original permitting process. It also contains the conceptual underdrain system and revised design criteria. The dam design report will be updated after agency review and approval of the modified plan, as required by the ROD.

16.8.3 Tailings Impoundment Construction

A conceptual design was prepared for the initial and final stages of the Little Cherry tailings impoundment. Klohn Crippen has reviewed and provided revised dam design criteria, as appropriate to meet new regulations and ROD requirements. The impoundment design will be finalized during subsequent design development studies. The area topography and watershed are shown on Figure 28. Plan and typical sections of the tailings impoundment are included in the dam design reports included in Appendix M.

The Little Cherry impoundment will consist of the following structures:

- Diversion Dam
- Diversion Channel
- Tailings Retention Dam that includes a Started Dam and Toe Dike

- Two Earthfill Saddle Dams
- Seepage Collection Dam

Prior to embankment construction, the impoundment site will be cleared of vegetation and stripped of subsoil containing organic matter. Subsoil will be stockpiled for later reclamation activities. Loose or soft soils will be removed from the embankment foundations and replaced with compacted fill *to design specifications*. After stripping operations have been completed, the embankment foundations will be scarified and compacted. Any sandy or gravelly soils exposed during impoundment site stripping and borrow excavation operations (described below) will be covered with a 2 to 3-foot thick layer of compacted *(consistent with design specifications)* clayey soil to minimize infiltration of water from the tailings or from the seepage collection pond. Mines Management will control erosion during construction of the impoundment as described in the guidelines in Appendix Q.

The initial stage of the impoundment work will include construction of the diversion channel and the 85-foot high diversion dam. The channel excavation will total about 1,900,000 cubic yards. Material excavated from the channel will be used to construct the diversion dam.

As shown on Figure 29, the diversion dam bounds the southwest part of the tailings impoundment. The downstream portion of this dam will be constructed of rockfill obtained from mine and adit waste rock.

After the diversion dam has been completed, the starter dam, seepage collection dam, and toe dike will be constructed. The 120-foot high starter dam will be constructed of soils excavated from the diversion channel. As proposed for the diversion dam, the downstream portion of the starter dam will be constructed of rockfill to promote drainage. The toe dike will also be constructed of mine waste rock as the material becomes available during the operational life of the impoundment.

Materials from the remainder of the diversion channel excavation will be used to construct about a third of the south saddle dam earthfill. As shown on the construction schedule, the remaining portion of the south saddle dam and the north saddle dam will be constructed during operation.

To control seepage, a blanket drain will be placed on the foundation as the dam is being raised and will extend from the centerline face of the starter dam to the toe dike. The drain will consist of processed clean gravel and will be 2 feet thick in the valley bottom and 1 foot thick at higher elevations. To prevent piping of the tailings and foundation soils into the gravel drain, 1 foot thick gravelly sand filter blankets will be located both above and below the blanket drain. Trunk drains would be situated within the two main drainages that cross the dam foundation, and would extend from the downstream toe of the starter dam to the upstream toe of the dike. Each trunk drain would consist of a 4-foot thick layer of gravel that would be covered an underlain by 1-foot thick sand filters. The drain and filter materials will be imported from commercial sources near Libby or will be processed from quarried rock or mine waste rock. Detailed drawings of the dam design are included in Appendix M.

To supplement materials excavated from the diversion channel, approximately 1,300,000 cubic yards of soil will have to be excavated from a 145-acre borrow area within the impoundment (Figure 29). An additional 500,940 cubic yards of soil may be obtained from two other borrow sites adjacent to the tailings impoundment involving an additional 207 acres. Based on an in-place embankment density of 140 pcf, preliminary estimates indicate that approximately 831,000 cubic yards of rockfill will be available at the time of mill start-up. Subsequently, an estimated 74,000 cubic yards of rockfill will be available annually.

The total volume of rockfill, drain, filter, and riprap required is 2,771,000 cubic yards, which exceeds the estimated 1,077,000 cubic yards of mine waste rock available over the mine life. *It is expected that the planned borrow areas (Figures 16 and 29) will provide the material.*

A summary of materials, sources, placement, and compaction requirements is in Table 16-2. Information shown in the table is for preliminary planning and will be confirmed during final design studies. A summary of estimated quantities is in Table 16-3.

During operation, the embankment dam will be constructed by the "downstream" method using cycloned tailings sands. The final dam height will be about 370 feet and approximately 27,844,000 cubic yards of the dam will be constructed of cycloned sand having about 10% passing the No. 200 sieve (silt size and smaller). A two-stage cycloning process will be needed to produce this gradation. A summary of the cyclone operation showing the amount of overflow and underflow and percent fines for each stage is shown below.

The underflow (coarse tailings) from the second stage will be spigotted uniformly onto the 3H:1V downstream slope of the dam. A bulldozer will be required full time to grade and compact the face of the dam. Runoff water from the cyclone process (about 700 gpm) will flow into a seepage collection pond and the water will be pumped back to the impoundment.

The estimated ultimate thickness of tailings in the impoundment ranges from zero along the edge to a maximum of 320 feet (after reclamation) at the upstream toe of the tailings dam.

SUMMARY OF CYCLONE OPERATION

Cyclone Stage	Feed		Overflow		Underflow	
	TPD	**% fines**	**TPD**	**% fines**	**TPD**	**% fines**
First	20,000	52	11,840	73	8,160	21
Second	8,160	21	1,637	68	6,523	10

Note: TPD is production in tons per day and % fines is material finer than 0. 074 mm (silt and finer).

During operation, wind erosion of coarse tailings on the embankment dam will be mitigated by sprinkling the face of the dam with pond water. Any erosion rills will be filled with coarse tailings.

The cyclone overflow (fine tailings) will be stored in the impoundment. The final pond will store about 83,610,000 cubic yards of fine tailings. The total storage of both fine and coarse tailings will be 111,454,000 cubic yards, or about 120,000,000 tons. Impoundment area-capacity curves, tailings production curves and impoundment staging curves are contained in the design report (Appendix M).

16.8.4 Surface Water Control

The tailings impoundment will be developed by constructing a dam across Little Cherry Creek. The watershed area above the proposed tailings dam is 1.78 square miles. A permanent diversion system consisting of a dam at the upstream end of the impoundment and diversion channel will be required to route the stream around the impoundment and to reduce the watershed area of the tailings impoundment; the diversion channel outfall will be directed into a natural drainage.

Mines Management is currently developing diversion design criteria that will establish flow patterns, volumes, fisheries habitat, and other critical elements that will meet the objectives of the design and habitat replacement. Investigations and designs are underway, and a report will be submitted to the agencies.

The overall length of all diversion structures including the diversion dam pond and the channel outfall is 4,600 feet. The diversion channel itself will be 3,400 feet long and will have a bottom width of 20 feet. Side slopes will be 2(H):1(V) and the channel will have a 2.4 percent gradient. The channel will be protected against erosion by a 2-foot thick layer of rock riprap designed for the 100-year flood flow (Figure 30). The riprap will be well-graded and the rock will have an average (D_{50}) size of 30 inches. To minimize the potential for erosion of the natural stream channel, rockfill bars will be placed perpendicular to the channel to provide energy dissipation. Locations of the bars will be

determined by observing performance of the channel during the operational period. Within the diversion channel, a secondary channel would be constructed. This secondary channel would be lined with compacted silty clay/clay to maintain the average annual low flow and contain the average annual high flow.

The outlet section of the channel consists of a drop structure with a stair-step configuration leading to a natural stream channel. The drop structure will be constructed using 3 x 3 foot gabions to form the steps and 12-inch thick gabion mattresses to provide erosion protection for the invert and slopes. Design flood flow velocities were based on the 100-year event.

The natural stream channel downstream on the diversion channel is heavily timbered. The current condition should provide considerable erosion protection against the diverted flows. Therefore, initially, erosion protection is not planned for the stream channel. Erosion protection will be constructed if erosion is observed during operations. Such protection would consist of rockfill check dams to dissipate flow energy in the areas where damage occurs.

To minimize runoff into the tailings impoundment during operation, temporary diversion ditches will be excavated around the tailings impoundment as the impoundment fills, new ditches will be excavated further uphill.

The purpose of the diversion ditches is to minimize runoff into the impoundment. The ditches are not for flood control and, therefore, dam safety does not depend on them. The temporary diversion ditches around the impoundment will be designed for the 2-year flood flow. Based on R.J. Omang, et al., "Methods for Estimating Magnitude and Frequency of Floods in Montana based on Data through 1983," U.S. Geological Survey, Water-Resources Investigations Report 86-4027, May 1986, the 2-year flood flow was computer to be about 8 cfs. To convey this flow, the ditches will be V-shaped with 2(H):1(V) slopes and will be 1.5 feet deep. The gradient of the ditches will be established so that nonerosive velocities will be maintained in the ditches. Based on the

gradation characteristics of the silty sandy soils on the site, velocities up to about 2 feet per second would not cause erosion. (Reference: U.S. Department of the Interior, Office of Surface Mining, "Surface Mining Water Diversion Design Manual," September 1982.). This maximum permissible velocity indicates that the gradient should not be greater than 0.001 (1 foot per 1,000 feet). *New estimated values will use the updated Omang, 1992 (WRI-92-4048) or other approved methods.*

16.8.5 Hydrology

Design flood criteria were based on U.S. Forest Service and U.S. Corps of Engineers (1977) criteria. The design flood designation is based on size of the dam and hazard potential classifications. Because of the potential for downstream impacts, the Montana Department of State Lands and the U.S. Forest Service consider the impoundment site to have moderate to high hazard potential. Based on the large size (greater than 100 feet high) of the embankment dam and hazard potential, the agencies designated the following design flood criteria:

- For containment: 24-hour general storm Probable Maximum Precipitation (PMP)
- For diversion: 72-hour general storm Probable Maximum Flood (PMF)

Because thunderstorm events should also be considered for small watersheds, the local storm PMF (resulting from the 6-hour PMP) was also considered for diversion. The larger of the two diversion floods was used for diversion system design.

The diversion dam reduces the tailings impoundment watershed area by about 50 percent. The diversion impoundment watershed area is about 576 acres and the tailings impoundment watershed area is about 562 acres, totaling 1,138 acres.

Unlimited snowpack was assumed to be available for snowmelt during both the 24-hour and 72-hour general storm PMP's. Snowmelt estimates were based on the Corps of Engineers' "Runoff from Snowmelt" (1960). The most critical general storm PMP was

determined to occur in June (U.S. Dept. of Commerce, 1966). The spring snowmelt season for this area occurs primarily from spring to early summer. Estimates of snowmelt during the 6-hour local storm PMP were not necessary, since this storm event is associated with summer-autumn thunderstorms. Precipitation, snowmelt and net runoff are summarized below.

PRECIPITATION, SNOWMELT AND NET RUNOFF

Precipitation Event	Precipitation (inches)	Precipitation & Snowmelt (inches)	Net Runoff (inches)
6-hour Local Storm PMP	11.7	N/A	8.2
24-hour General Storm PMP	11.9	15.8	9.8
72-hour General Storm PMP	17.0	24.4	10.2

The Corps of Engineers' "HEC-1 Flood Hydrograph Package" computer program was used for the hydrologic analyses. The results of analyses show that the critical design flood for diversion results from the 6-hour local storm event. The peak flow of about 5,230 cubic feet per second (cfs) was routed through the diversion impoundment and channel. The routed outflow was calculated to be about 3,460 cfs. The minimum diversion dam freeboard was calculated to be about 5 feet. The peak design flood flow velocity in the diversion channel was computer to be about 16 feet per second. The riprap layer described in Subsection 16.8.4 will be adequate to prevent excessive channel erosion.

For containment in the tailings impoundment, runoff was computed from the 24-hour PMP plus snowmelt. Depending on pond area, the total design flood inflow volume was estimated to range from about 460 to 540 acre-feet for the starter and final impoundments, respectively.

Throughout the 16-year impoundment operational life, the dam crest will be maintained above the minimum required dam crest determined from the sum of the following:

- Tailings storage
- Storage of tailings effluent for 20 days at 8,000 gpm (about 700 acre-feet)
- Storage of design flood (runoff from 24-hour PMP plus snowmelt)
- Minimum freeboard of 3 feet above peak flood water surface.

Details of the hydrologic studies are presented in the tailings dam design reports located in Appendix M.

16.8.6 Geotechnical Investigation

Site Conditions

The Little Cherry Creek impoundment site is located in a short valley that drains northeast into Libby Creek (Figure 28). The highest point in the watershed is 5,400 feet above sea level. Portions of the proposed site are clear-cut and others are heavily timbered. Access to the site is via Forest Service roads, and it is about 12 miles from U.S. Route 2.

Isolated outcrops of highly weathered, fractured, and jointed metasedimentary rock were observed on the north side of Little Cherry Creek. Elsewhere, the ridges are covered with colluvium and glacial outwash.

At the proposed dam site, the valley sideslopes and the stream channel are underlain with colluvium, glacial outwash, and lakebed sediments to a depth of 200 to 300 feet. The colluvium is present on the higher slopes of the valley and consists of coarse slope was material. The glacial outwash material is gravelly and contains a large silt fraction. The lakebed sediments are mostly fine grained silt and varved clays with some gravel.

Foundation Conditions

Exploration of the Little Cherry impoundment site was undertaken during the field seasons 1988-1990 to evaluate both the site soil conditions and the depths to bedrock and groundwater. The purpose of the exploration was to provide sufficient geotechnical data for conceptual impoundment design. During this time period, a series of geotechnical reports were completed and are included in Appendix N.

Site field exploration sites are shown in Appendix N consisted of the following:

- Geological mapping
- 42 seismic refraction survey lines totaling 16,445 feet
- Resistivity surveys
- 90 test pits
- 52 borings totaling 5,250 linear feet
- 6 wells totaling 490 linear feet
- Field permeability tests in borings and wells
- Monitoring of piezometer water levels and flow rates

Standard Penetration Tests (SPT) were performed in the borings. The results of the SPT were used to estimate soil foundation strengths (angle of internal friction) and to evaluate liquefaction potential. Standpipe piezometers were installed in borings to monitor groundwater levels. Groundwater levels were also monitored in the wells.

Laboratory tests were performed to obtained preliminary engineering parameters for the impoundment site soils. Selected test pit and boring samples were tested for moisture content, dry density, grain size, plasticity characteristics, compaction and specific gravity. Unconsolidated undrained (UU) and consolidated undrained (CU) triaxial compression tests were performed on undisturbed clayey foundation soils to determine strength parameters for use in stability analyses. In addition, CU tests were performed on borrow soils compacted to the density and moisture content that would be required for embankment dam construction.

Results of the exploration program indicate that dense sandy-silty or clayey gravel is t he predominant soil type at all the proposed impoundment features. Silt layers are present in a portion of the main tailings dam area and are generally stiff. Soft silt and clay layers are present in a portion of the diversion dam area and will require particular consideration

The soils in all borrow areas are generally gravelly. The soils in borrow area A have slightly higher fines content than those in borrow areas B, C, and D. Borrow areas B and C have higher content of cobbles and boulders than borrow areas A and D.

Bedrock generally consists of low-grade metamorphosed siltstone (siltite) and argillite, with some interbedded quartzite. Bedrock cores are generally moderately to highly weathered and fractured. The bedrock surface is generally reflected by the topography. In the southeastern part of the site, a buried bedrock channel deeper than 367 feet extends through the proposed dam site. The results of the exploration indicate that bedrock is less than 50 feet deep in both abutments of the proposed tailings retention dam. In the proposed excavation for the diversion channel, depths to bedrock in test pits and borings range from 3 to 41 feet.

Soil thicknesses are estimated to generally be less than 100 to 150 feet thick (Appendix N). The site soils primarily consist of dense mixtures of clay, silt, sand, gravel, and cobbles. Boulders and cobbles within a matrix of finer soils were encountered in many borings and test pits in the impoundment site.

Permeabilities of soils and bedrock vary widely. Silty sandy gravels typically have permeabilities on the order of 10^{-5} to 10^{-4} cm/sec. Weathered rock has permeabilities ranging from about 10^{-6} to 10^{-4} cm/sec. Low permeability silty clayey soils act as confining zones where they overlie more pervious soils or rock. Due to the highly fractured state of most of the bedrock in the area, it is generally slightly more permeable than the overlying soils. Results of field permeability tests are summarized in Table 16-4.

Groundwater is generally contained in the fractured bedrock and confined by the overlying less-permeable soils. Groundwater levels are below the soil-bedrock contact at the north and south saddle dams, seepage collection dam and diversion channel. However, artesian pressures exist below much of the main dam and diversion dam sites.

Groundwater data indicate that artesian conditions exist in the proposed dam foundation. In order to prevent excessive pressures from developing in the foundation, which would decrease stability, a pressure relief system would be required. This relief system, consisting of wells and possibly drainage trenches, will be installed at start-up and expanded during the operational life of the impoundment. Foundation piezometric pressures will be measured during operations. If pressure heads increase during the expansion of the impoundment, additional wells will be installed. The final pressure relief system will be designed during the engineering phase of work.

Groundwater in the impoundment site area exists in varying degrees of confinement. Static water levels are below the top of bedrock at the north and south saddle dams and at the collection dam. Water levels are approximately 140 feet below the ground surface at the north saddle dam, 30 feet at the south saddle dam and 55 feet on the abutments of the seepage collection dam. Piezometers along the diversion channel are dry, indicating the groundwater level to be below the proposed depths of channel excavation. In contrast to these areas, groundwater is confined in the valley bottom in the areas of the main tailings dam and the diversion dam, and significant artesian pressures are present (Appendix N).

Static water levels in the abutments of the main dam and diversion dam are below ground level, although generally above bedrock, whereas all piezometers in the valley bottom show water levels above ground surface. Drilling and piezometer data indicate that groundwater is largely contained in the bedrock and confined by the overlying soils.

Foundation conditions, hydrology, and other pertinent dam information are contained in Appendix N where all the updated and revised geotechnical and dam design reports are contained.

Seismicity

A seismicity study was performed to determine appropriate seismic design criteria. To assess earthquake sources, regional and local seismicity were evaluated and fault activity was researched.

The project is located in the Intermountain Seismic Belt (ISB) that is characterized by moderate to large earthquakes with shallow focal depths. Table 16-5 summarizes significant earthquakes in the region. As shown in the table, the two largest events known to have occurred in the ISB were the 1959 magnitude 7.5 Hebgen Lake (Montana) earthquake and the 1983 magnitude 7.3 Borah Peak (Idaho) earthquake. Both of these earthquakes were about 300 miles from the project site and ground motions were therefore mild at the project site. No damage was reported in Libby (Stover, 1985).

A review of fault activity in the site region show that two faults, Rainy Creek and Bull Lake, show evidence of displacing Pleistocene deposits, indicating the age of fault movement as younger than 1.5 to 2 million years. The locations of the faults are shown on Figure 31. Based on the lengths of these faults, Maximum Credible Earthquake (MCE) magnitudes were estimated using a relationship developed by Slemmons (1982). In addition, the Flathead seismic zone and a random local earthquake were considered. Maximum magnitudes associated with these two sources were adopted from Algermissen et al (1982).

Peak ground accelerations were calculated for each of the four potential seismic sources using three attenuation functions (Campbell, 1981; Joyner and Boore, 1982; and Idriss, 1985). The following table summarizes the distances from the site to the fault zones, fault lengths, MCE magnitudes, and peak ground accelerations.

PEAK GROUND ACCELERATIONS FOR VARIOUS SOURCE MAXIMUM CREDIBLE EARTHQUAKES

Earthquake Source	Site Distance (km)	Fault Length (km)	MCE Magnitude	Peak Ground Accel. (g)
Bull Lake Fault	20	30.6	6.8	0.20
Rainy Creek Fault	24	23.3	6.7	0.16
Flathead Zone	65	---	7.3	0.08
Random Local	15	---	6.5	0.21

As shown above, the random local earthquake gives the largest peak ground acceleration. However, the MCE on the Bull Lake Fault give an acceleration that is 5 percent less, but because of its larger magnitude, the Bull Lake Fault could produce a longer duration of shaking. In view of the uncertainties in the process of calculating maximum magnitude from fault length, it was considered appropriate to round up the Bull Lake MCE to magnitude 7. Therefore, the design earthquake likely to produce the most severe ground motion at the site is as follows:

- Source: Bull Lake Fault
- Distance: 20 km
- Magnitude: 7.0
- Mean Peak Ground Acceleration: 0.22g

The peak ground acceleration was used in liquefaction analyses as described in Subsection 16.8.7.

The project site is located close to Seismic Zone 2 for which a seismic coefficient of 0.05g is recommended (U.S. Corps of Engineers, 1977). However, this coefficient is incompatible with a nearby magnitude 7 MCE. Since the boundaries of Seismic Zones 1, 2 and 3 are relatively close together in this region, it is appropriate to apply the

coefficient for Seismic Zone 3, which is 0.10g. This coefficient was used in seismic stability analyses as described in Subsection 16.8.7.

16.8.7 Stability

Static and Seismic Stability

Preliminary analyses of the starter and final embankment stages were performed to verify that the dam has adequate static and seismic stability.

Strength parameters for the embankment earthfill and rockfill were estimated from published data for similar materials. Parameters for coarse tailings used in raising the dam were based on correlations of grain size with published data (Vick, 1983). For analysis purposes, the fine tailings in the pond were conservatively assumed to have no strength. Standard Penetration Test (SPT) blow counts (N-values) were used to estimate foundation strength parameters. Parameters used in the stability analyses are presented in Table 16-6.

As discussed in Subsection 16.8.6, the embankment dam foundation is composed of both granular and silty clayey soils. Therefore, as shown in Table 16-6, two sets of parameters were designated for Foundation Layer 1. The first set applies to a granular foundation and the second set applies to a silty clayey foundation.

Stability was evaluated for both the starter and final embankment stages. Conditions that were analyzed include (1) end-of-construction for the starter dam, (2) steady-state seepage and seismic loading for both the starter and final dam stages and (3) flood pool for the final dam stage.

Seismic stability was evaluated by the “pseudo-static” method. Based on a review of site seismicity, a seismic coefficient of 0.10g was used in the stability analyses (see Subsection 16.8.6). In the “pseudo-static” method of stability analysis, the effects of an earthquake on a potential slide mass are represented by an equivalent static horizontal

force determined as the product of a seismic coefficient and the weight of the potential slide mass. The use of the maximum ground acceleration (0.22g, see Subsection 16.8.6) as the seismic coefficient would produce an equivalent static horizontal force equal to the maximum transient inertia force developed on the mass during the design earthquake. However, the length of time for which the force acts is an important factor in the development of deformations. Therefore, the use of the maximum transient force as an equivalent static force would be unduly conservative (Seed and Martin, 1966) and the recommended seismic coefficient of 0.10g should be used.

Factors of safety were computed for circular and linear failure surfaces. The minimum acceptable factors of safety used in the analyses are as recommended by the Corps of Engineers (1970). The results of the stability analyses are shown in Table 16-7.

These results show that the computed factors of safety exceed the minimum acceptable values for all cases. The stability analyses are described in more detail in the Tailings Impoundment Preliminary Engineering Report (Appendix M)

Liquefaction Potential

Liquefaction potential was evaluated for the foundation and embankment materials. Liquefaction is defined as the rapid build-up of pore-water pressures and the resulting loss of soil strength caused by seismic shaking (Seed, 1979). Soil deposits that are particularly susceptible to liquefaction consist of loose, saturated sands.

The design earthquake used for liquefaction analysis was the Maximum Credible Earthquake (MCE). As described in Subsection 16.8.6, the MCE event was determined to be a magnitude 7 event originating on the Bull Lake fault, 20 kilometers to the west of the project site. The peak ground acceleration at the site was estimated to be 0.22g. This acceleration was used to estimate the seismically induced shear stresses.

The resistance of the foundation soils to liquefaction was estimated from Standard Penetration Test (SPT) results. In this method of analysis, SPT blow counts are

normalized to an effective overburden pressure of 1 ton per square foot. The normalized blow count values ("N_1" values) are used to obtain resistance to liquefaction by using procedures outlined in Seed and Idriss (1982). Liquefaction is unlikely when the resistance exceeds the seismically induced shear stresses.

The SPT data show that the foundation soils at the Little Cherry site are dense to very dense. The lowest N_1 value found in silty sandy soils was 42 in Boring USB-1 at a depth of 35 feet (Appendix M). This value is much greater than the value that would indicate potentially liquefiable soils. The results of the evaluation indicate that the foundation soils are sufficiently dense to preclude liquefactions.

Proper compaction and drainage will prevent liquefaction of the embankment dam. The cycloned tailings sands in the embankment will be compacted by a bulldozer equivalent in weight to a Caterpillar D8. Also, the drainage blanket within the dam will keep the downstream part of the tailings dam from becoming saturated.

16.8.8 Stability Monitoring Plan

Stability monitoring of the dam will be performed during operation and after closure. Piezometers, installed as the dam is being raised, will be used to measure piezometric pressures in the dam foundation. Measurements will be made quarterly. A V-notch weir will be located at the downstream toe of the dam to monitor seepage rates.

During operations, weekly inspections will be made to observe and document the condition of the dam and associated structures. The conditions to be inspected include (1) freeboard adequacy, (2) beach width, (3) cracking, sloughing, depressions and erosion of the dam and abutments, (4) changing trends in seepage quantities, piping and wet spots, and (5) the condition of the diversion channel. Both the piezometric and seepage data and visual inspection records will be reviewed annually by an engineer experienced in the design and construction of tailings dams. After impoundment closure, the frequency of inspections will be gradually decreased.

16.8.9 Seepage and Contaminant Transport

Seepage Control Within the Tailings Dam

A rockfill toe dike would be constructed upstream of the seepage collection ditch in stages throughout the operational life of the impoundment. The toe dike would intercept tailings that are washed from the downstream face of the dam during thunderstorms. A filter would be placed on the upstream face of the toe dike to prevent the tailings from washing through the rockfill dike. Also, if needed, small interim sediment traps would be constructed upstream of the toe dike. These traps would be cleaned out and backfilled with compacted materials as the tailings dam is enlarged.

Seepage through the tailings embankment will be controlled by a blanket drain that will extend from the downstream face of the starter dam to the toe dike. In addition, the rockfill zone in the downstream portion of the starter dam will promote drainage within the tailings embankment. Seepage entering from the toe of the dam will be collected in a ditch that will convey the seepage water to *a native soil lined* collection pond downstream of the impoundment. Water will be pumped back to the tailings impoundment from the collection pond *during operations. At closure, it is anticipated that water will continue to be pumped back and used for irrigation or LAD applied within the impoundment area. This will continue until such time that water quality is acceptable to meet water standards. A seepage water quality analysis is currently being developed and will be submitted for agency review.*

To determine the required blanket drain capacity, seepage through the embankment dam was established. During the operational life of the impoundment, seepage will increase as the impoundment size increases. For the final tailings embankment dam configuration, the results of flow net analyses indicate that seepage collected in the blanket drain and conveyed to the collection pond could be about 320 gpm. Preliminary engineering results indicate that a 2- to 3-foot thick blanket drain consisting of clean gravel will be adequate to handle this seepage quantity. A 1.5-foot thick well-graded gravelly-sand, filter blankets above and below the blanket drain will prevent piping of the tailings and foundation soils into the drain.

Impoundment Seepage and Containment Transport

Seepage from the impoundment was estimated to evaluate its potential effect on groundwater and surface water quality. The analysis was performed as outlined in the following steps:

- Estimate seepage from the impoundment.
- Estimate groundwater flow through the aquifer beneath the impoundment site to evaluate potential dilution of impoundment seepage.
- Perform contaminant transport analyses.
- Evaluate the potential effect of impoundment seepage on groundwater quality.
- Evaluate the potential effect on impoundment seepage on surface water quality in Libby Creek, downstream of the impoundment site.

Permeability of the fine mill tailings was estimated from correlations with published values (Vick, 1983). Based on gradation of the projected cyclone overflow, it is expected that the fine tailings will have permeabilities in the range of 1×10^{-6} to 1×10^{-5} cm/sec. The tailings in the bottom of the impoundment will consolidate to a higher density and, therefore, have a lower permeability than the tailings in the upper portion. The impoundment tailings were divided into two layers: the upper 75% was assumed to have a permeability of 1×10^{-5} cm/sec and the lower 25% was assigned a permeability value of 1×10^{-6} cm/sec.

Flow net analyses show the impoundment area adjacent to the tailings dam will contribute seepage into the coarse tailings embankment. This seepage will be conveyed in a blanket drain system to the seepage collection pond downstream of the tailings dam. Seepage from the remainder of the impoundment will flow into the underlying native soil materials.

Since soils beneath the impoundment are more permeable than the tailings, most of the hydraulic head would be lost in movement through the tailings deposit. Seepage through

the tailings would therefore be primarily in the vertical direction under a unit hydraulic gradient.

Such an analysis provides a conservative estimate of impoundment seepage.

During the 16-year impoundment *operational* life, seepage will increase as the impoundment size and hydraulic heads increase. Based on a one-dimensional seepage analysis for the maximum impoundment area of 450 acres, the maximum seepage into the underlaying strata was estimated to be about 475 gpm. These numbers represent the 20,000 ton per day mining rate and will be slightly less at the 12,500 ton per day rate and provide an estimate. A detailed model will be developed that will address the predicted seepage rates based on the conceptual underdrain system outlined in the ROD; after agency review and acceptance of the conceptual design.

Tailings Drainage

Prior to final design, additional subsurface data downstream of the dam alignment will be collected and submitted to KNF to identify existing water-bearing strata.

Gravel drains will be constructed or the final design of its pressure relief system will be modified to minimize the quantity of tailings impoundment seepage entering ground water. If the pressure relief system is used, the final design will provide functionally equivalent seepage collection as the gravel drain system. The final design for this system will be submitted for agency review prior to implementation.

Systems similar to gravel drains have been employed extensively in tailings dams for both stability and seepage control reasons. Large drains have been extensively employed in the mining industry beneath high waste rock dumps. Drains are multipurpose elements and function both to promote dam stability and minimize seepage and changes in water quality. Long experience with flow through rockfill dams demonstrates the capacity of coarse rock to transmit large volumes of water. Filter criteria for design of drains have been applied for about 50 years as a matter of standard engineering practice.

The extensive underdrain system to reduce hydrostatic heads (pressure from the water stored within the tailings impoundment) will consist of high capacity granular drains in the main drainages interconnected with granular crossdrains or corrugated perforated high-density polyethylene (HDPE) pipe wrapped in a filter fabric. This drain system could be connected to the currently proposed blanket drain system beneath the dam, ultimately leading to the seepage collection pond. Synthetic lining of the bottoms of the main underdrains where higher static heads exist may also be included to minimize seepage from the drains.

Because of the sloped impoundment surfaces, and with the presence of granular crossdrains or small diameter HDPE drain pipe, the tailings water will flow to the main drains and will be rapidly removed by these high capacity drainage elements, thereby maintaining low hydraulic heads. The synthetic lining would minimize seepages exiting the main drain, within which small hydraulic heads will be continuously present. The main drain segment beneath the dam may be lined with a synthetic liner, such as high density polyethylene.

Drain rock and sand and gravel filter will be produced by crushing harder rock from mine waste, if approved by agencies after determination of acid producing potential of mine waste. The exact gradation of these materials and geometry of the drains will be established by an experimental crushing program, permeability testing and standard filter analysis during design. Screening and blending operations will be conducted if necessary to produce the filter material.

To avoid plugging of the drain rock with tailings, the drain rock will be entirely encapsulated in filter material. The filter material will consist of a two-stage filter of sand, and sand and gravel. This material may be obtained from surficial site soils or produced from processed mine waste rock if approved by the agencies. Filtration may also be achieved by a filter fabric protected with coarse tailings sands in lieu of sand and gravel. The materials utilized will be relatively clean and their grain size distribution will be compatible with both the underlying drain rock and the overlying tailings.

Construction of the drains will progress ahead (upstream) of the impounded tailings as the impoundment fills. Tailings will be placed selectively to cover the drains to minimize inflow as the decant pond advances upstream over the drains. The purpose of this tailings cover is to prevent excessive flow from the decant pond to the downstream collection pond, permitting maintenance of a decant pond. Placement of such a tailings cover over drains is routinely performed as part of the operation of many tailings disposal facilities, and is not a major operational difficulty.

Placement of the tailings sand cover above the drain rock will also increase the surface area and the effectiveness of the granular drains. Quality control will be maintained during construction of such drains to assure that filter and drain materials are of sufficient quality and are properly placed; the very conservative nature of the drain design also helps guard against detrimental effects of potential variation in materials quality and construction procedures.

As a second element of the drainage system, 3 or 4-inch diameter, corrugated and perforated, HDPE pipe wrapped with filter fabric or granular crossdrains will be placed throughout the impoundment. To prevent disruption of the pipes as tailings are placed, the pipes will be placed sequentially just above the tailings surface along topographic contours. The ends of the drain pipe will be terminated in the drain filter zones with caps being placed on the ends to prevent the tailings from entering and clogging the drain rock.

The underdrain system covered by a layer of slimes of relatively low permeability also will reduce heads beneath the decant pond. The reduction and the small size of the pond will serve to minimize the amount of seepage.

Final design of the gravel drain system will be submitted for agency review prior to implementation.

Chemical concentrations of groundwater samples from five wells in the impoundment vicinity are shown in Table 16-8. The well locations are shown in Appendix N. As shown on Table 16-8, chemical concentrations of parameters in the tailings effluent generally do not exceed the concentration in ambient groundwater. Also, as shown in Table 16-8, tailings effluent contains lower concentrations of aluminum, cadmium, iron, manganese and zinc than at some groundwater monitoring sites. The detection limits for mercury and silver are not sufficiently low to determine their concentrations relative to background data. Table 16-9 provides additional data on locked cycle test effluent quality and data from the ASARCO Troy tailing pond. *If additional Troy effluent information is available with lower detection limits, that data will be incorporated into the project review and analyses.*

During field reconnaissance work, seeps were observed in both the Little Cherry Creek and Libby Creek channels. Therefore, it is expected that a portion of the effluent will also emerge as seepage in both creek channels. The seepage will mix with the streamflow. The nearest stream measurement station (LB-2000) to the confluence of Little Cherry Creek and Libby Creek is on Libby Creek, about ½ mile downstream of the confluence. Minimum dilution will occur during low streamflow. The calculated 10-year, 7-day low flow at LB-2000 is 8.7 cfs. The maximum impoundment seepage of 475 gpm will be significantly diluted by the flow in Libby Creek, even during low flow.

Many of the chemical parameters particularly metals, shown in Table 16-8 are the detection for the limits for the measurement methods used; i.e., actual concentrations are less than the detection limits. Additionally, geochemical interactions in geological strata in the area will tend to reduce metal concentrations in seepage water as it moved through the system. Concentrations of all metals of concern are very low in the tailings effluent which reflects the low mobility of metals in this geological material.

An analysis of the impacts of impoundment seepage and excess water disposal to the land application sites was completed during the EIS process. This analysis shows a potential increase in chromium, copper, iron, manganese, zinc, nitrate, ammonia and total

dissolved solids over ambient levels in groundwater and surface water. The magnitude of potential increases above background levels in no case exceeds the applicable water quality standards. Noranda originally submitted to the Board of Health and Environmental Sciences a request approval of the Board for these changes in water quality under the Montana nondegradation rules (ARM 16.20. 701-705 and 16.20. 1011).

A comparison of water quality predicted from metallurgical tests of the Montanore Project ore and water quality in the tailings pond at the ASARCO Troy Project is shown in Table 16-10. The ASARCO data were obtained from A. Horpestad of the Montana Water Quality Bureau and is considered representative of settled tailings decant water and pond seepage water. The ROD stipulated that a water management and water treatment study be completed prior to construction. Maxim Technologies, as part of this stipulation, is preparing a water quality model and water management program that will use the revised seepage rate and revise water balance. This analysis will assist in determining the appropriate level of water treatment required for mine drainage prior to land application, if necessary.

Tailings Dam And Impoundment Monitoring

Mines Management will monitor the tailings dam stability both during the operating period and after cessation of mill operations. The monitoring program will consist of visual inspections, piezometer readings, estimates of seepage and topographic surveys.

The downstream slope and toe of the tailings embankment and saddle, collection and diversion dams (when applicable) will be visually inspected by Mines Management on a daily shift basis for evidence of seepage exiting the slope or the downstream toe, and a daily log of observations will be kept. If seepage is noticed, both the seep location and estimated quantity of flow will be recorded and the project geotechnical engineer immediately contacted for further inspection and recommendation for mitigation measures, if necessary.

A ground water monitoring system of multiple nested, open-well piezometers and/or pore pressure transducers will be installed downstream of the starter dam embankment, at the perimeter of the final embankment "footprint," in order to define artesian pressures. This information will be included in the final pressure relief system design and monitoring will continue until construction of the final lift is initiated.

If pumps are installed on the pressure relief/seepage collection system, the system will be monitored on a daily shift basis in order to assure proper and continuous operation. Accurate monitoring records will be maintained and available to the agencies for inspection.

Ground water levels in piezometers installed within the tailings embankment, saddle dam, dam foundations, and pressure relief well system will be measured and recorded for evaluation of the embankment stability during and after operations. Piezometers will be monitored with monthly readings made during the first five years of operation. After three years, the new monitoring schedule will be reevaluated with respect to the ground water levels and a new schedule established in consultation with the agencies.

The primary purpose for monitoring piezometers is to maintain a record of ground water levels during disposal operations in order to evaluate the slope stability of the embankments. Ground water level data will be plotted on a continuous graph as soon as is practical after collection, allowing for development of graphs of ground water levels versus time. Trends in ground water level fluctuations which could impact embankment stability will be reviewed by Mines Management's geotechnical engineer during each monitoring period in order to determine the potential for instability. This information will be submitted in the annual report.

Topographic surveys of semi-permanent monuments located along the downstream toe of the toe dam will be performed semi-annually by Mines Management in order to maintain a record of embankment settlement and movements during operations. Survey monuments also will be installed on the crest of the final dam and monitored during the

final years of operation and during reclamation. It is anticipated that the final dam crest would be reached about two years before cessation of operations. Accurate records will be kept of both elevations and coordinates of the monuments. Permanent control points will be established on the final dam crest after cessation of sands deposition. In the event of excessive settlements or horizontal movements, Mines Management will notify its geotechnical engineer for review of the survey records and recommendations as required.

Mines Management will measure and record the depth and/or elevation of the collection pond water level on a weekly basis so that estimates of collected seepage can be developed. Accurate records of the quantity of fluid reclaimed from the collection pond and the decant pond will be kept, including pumping rates and periods of pump operation and shutdown.

Annual reports containing all of the monitoring program data along with summaries of the collected data will be prepared by Mines Management and submitted to the agencies.

16.9 SPECIAL SYSTEMS

16.9.1 Tailings Slurry Line

Tailings effluent will be piped from the mill to the tailings pond. Tailings will be separated into coarse (sand for dam construction) and fine fractions at the plant site by cyclones. The coarse tailings will be carried in a 10-inch high-density polyethylene pipeline to the dam site. An additional spare 10-inch coarse tailings line will also be provided. Fine tailings will be carried in a 14-inch high-density polyethylene line from the tailings thickener underflow to the tailings pond. These pipelines will be routed in part along the existing road. A new road will be constructed along portions of the pipeline that diverge from the existing road. Typical sections are shown on Figure 36. One creek crossing (Poorman Creek) will be required via a trestle. The pipeline will be fitted with air release/vacuum valves to insure a continuously consistent flow. A leakage sensing system will continuously monitor operation of the lines. This sensing system will include the installation of magnetic flowmeters on the tailings line at the mill and at the tailings pond. If a flow differential signal is received at the control room, an alarm will sound and the mill will be systematically shut down, starting with the feed conveyors to the grinding mills. Valves on the tailings line at the mill will be closed. The final tailings pump will by-pass the cyclones and pump directly to the tailings thickener. In addition to the leakage sensing system, the pipelines between the mill and the tailings pond will be visually inspected each shift. The lines will be inspected rigorously during scheduled maintenance shut-downs. During such shut-downs, it will be possible to open the lines, rotate or replace sections showing wear and check the integrity of leak detection systems.

A ditch will parallel the entire length of the pipelines to contain and transport the tailings slurry in the event of any leakage (Figure 36). Any tailing leakage would flow by gravity to the tailing impoundment in this ditch which will be designed to easily handle the entire flow of the tailings pipeline. Even in a complete line failure, a large proportion of the tailings solids would settle out in the line and would not be discharged to the environment. The velocity of the slurry in the ditch will be about 6 feet per second to prevent settling of the solids. The ditch will run on grade from the mill to the tailings

pond and will cross the trestle structure at Poorman Creek as a lined flume section. In the unlikely event of the leakage ditch becoming plugged, a dike will be placed between the leakage ditch and the upstream interceptor drainage ditch. The dike will ensure that flow is contained within the tailings pipelines right of way to prevent the possibility of any leakage entering Poorman or Ramsey Creeks.

16.9.2 Water Reclaim System

Water will be reclaimed from the tailings thickener overflow at the plant site. The reclaim water is reused as process water for mill operation. In addition, a reclaimed system will be installed from the tailings impoundment to the mill. The pipe and pump system will be sized accordingly. The pipe will be situated with in the same corridor as the other tailings pipeline lines.

16.9.3 Seepage Water

Seepage water that passes through the tailings dam will be collected by drainage ditches which will route this seepage to the seepage collection pond. The water will be pumped and conveyed in an on-grade, polyethylene pipe back to the tailings pond. This system design will have redundancy in the pumping equipment.

16.9.4 Storm Runoff Water – Plant Site

Grading of the plant site will be done to direct all rainfall/snowmelt to a collection ditch to the south side of the yard (Figure 17). This ditch will in turn direct the flow to a sediment pond which will be sized to accommodate a 4-inch rainfall which is the 24-hour, 100-year return event. The size of this holding pond will be approximately 200 ft x 300 ft with an average depth of water of 6 feet plus free board. Water from this pond will be pumped back into the process circuit *or the LAD sites*.

Snow removal and disposal at the plant site will follow U.S. Forest Service guidelines. Specific practices will include:

- Snow removal will be performed in a manner to preserve and protect travelways, prevent erosion damage and preserve water quality.
- Snow, ice and debris will be removed from culvert inlets and outlets so that drainage systems will function efficiently at all times.
- All snow and ice removed from the site facility will be deposited away from stream channels at the nearest water disposal site. These sites have been sized to accommodate the plant site snowfall. An interim site east of the plant will be used until the snow can be moved to the water disposal site
- Drainage holes in the snow will be spaced as necessary to obtain satisfactory surface drainage and will avoid runoff on erodible slopes.
- Snow removal will be done as frequently as necessary to ensure a safe and efficient operation.

16.9.5 Plant Site Interceptor Channel

Runoff from undisturbed land upstream of the plant site will be diverted around the plant by an interceptor ditch. This ditch will be constructed on the north side of the plant site Figure 17 and sized to safely pass the 50-year return interval runoff event and evaluated for the 100-year runoff event. The ditch will be riprapped to prevent erosion. The flow will be passed through culverts at the main access road and then directed by channel into Ramsey Creek.

16.9.6 Temporary Water Storage

Excess adit water will be piped to a temporary storage pond within the tailings impoundment when conditions are not favorable for land application (during winter months). When conditions are favorable the water will be land applied at the Ramsey Creek LAD sites and at the Little Cherry Creek LAD sites.

17.0 WATER SUPPLY AND DISTRIBUTION

17.1 FRESH WATER SUPPLY AND DISTRIBUTION

Fresh water will be pumped into a 36-foot diameter by 36-foot deep fresh water storage tank sized to hold 180,000 gallons of fire control water and 70,000 gallons of process water. Two 1,000 gpm fire control water pumps (one electric and one diesel driven) will draw water from the bottom of the tank when required. A pump will maintain pressure in the fire control water lines. Two 1,000 gpm fresh water distribution pumps will draw water from above the fire control water supply and pump to the various processing circuits.

Potable water will be treated and stored in a 12-foot diameter by 15-foot potable water storage tank sized to hold 12,000 gallons. A potable water distribution pump will deliver potable water to the mine, and administration building.

A discussion of the source of fresh water for the Montanore Project is in Section 30.0 (Water Consumption and Source) of this permit application. Water rights and consumption estimates are being reviewed and applications will be prepared and submitted for approval. Table 17.1 contains the water rights originally obtained for the project.

17.2 POTABLE WATER SUPPLY AND DISTRIBUTION

Water for the potable water system at the plant site will be obtained from drilled wells or from underground mine inflow. Water from these wells will be pumped to the main distribution pumphouse. Potable water will be stored in a tank outside the pumphouse prior to distribution. A distribution pump will distribute the potable water throughout the site. Potable water for the mine may be developed on a separate system.

18.0 SEWAGE TREATMENT AND SOLID WASTE DISPOSAL

18.1 SEWAGE TREATMENT

Sanitary wastes will be generated during the construction and operational phases of the Montanore Project. Sanitary wastes generated during construction will be handled by portable facilities with periodic removal and disposal. Sanitary wastes generated during the mining phase will be treated through a package treatment plant and the treated effluent discharged to a drainfield.

The sewage treatment system will be sized for the larger project to ensure adequate treatment capacities during all stages of project development. The construction force will peak in the first year of construction and will employ in excess of 400 persons. During construction, portable facilities such as Porta-Potties will be used to handle sanitary wastes. These systems are widely used on construction projects and the waste handling will be contracted to a waste disposal company during the construction phase. A package sewage treatment plant would not be practical during the construction phase because of the need for a relatively steady loading to such treatment facilities and the lack of a temporary site during construction. A septic tank and drainfield could be used for some construction offices during the construction period. There are numerous areas where a small septic tank and drainfield system could be located and could serve office areas associated with the construction. If a septic tank and drainfield is used, plans and specifications will be prepared for both county and state review and the facility will be designed to handle the proposed loading from the office facilities. It is anticipated that the majority of the sanitary wastes during construction will be handled by means of a Porta-Potty type system.

During the operational phase of the mining and ore processing, sanitary wastes will be treated by a solid/liquid separation (septic tank) or a package sewage treatment plant. Package plants require less space and are less affected by winter weather than lagoons. According to the EPA Design Manual “Onsite Wastewater Treatment and Disposal Systems”, the range of wastewater flow per employee per day for industrial buildings and

offices is 7.9 to 17.2 gallons. During the production phase, the Montanore Project is expected to employ 450 people. Based on 450 shifts per day and 17.2 gallons of wastewater per shift, it is expected that 7,740 gallons of waste water will be produced daily (or 5.4 gallons per minute). Showers for 300 people daily would add 5.6 gpm for a total of 11 gpm. Effluent from the plant would be discharged to the tailings disposal facility.

Detailed designs for the handling of sanitary wastes during the operational phase will be prepared after final designs are completed for the mining and ore treating facilities. Plans and specifications for the treatment plant will be submitted for review and approval by county and state health department authorities prior to construction of the sewage treatment facilities.

18.2 SOLID WASTE DISPOSAL

All solid wastes will be disposed of in accordance with rules and regulations. *A new solid waste management plan will be developed to identify proper solid waste handling procedures.* Inert wastes such as wood, concrete, *and other similar items* will occasionally be buried on-site in selected areas or placed underground in mined out stopes (where applicable). Wastes such as scrap metals will be sold to scrap dealers for recycling.

All other wastes will be transported to an approved county landfill. No hazardous wastes will be disposed of at this operation. All refuse will be disposed of in a manner that will prevent water pollution and will not adversely affect the reclamation program.

19.0 TRANSPORTATION

Presently the Forest Service Road No. 278, beginning approximately 8 miles south of Libby on Montana State Highway 2 and USFS Road No. 4781 will provide access to the proposed plant site area on Ramsey Creek (Figure 2). Approximately 11 miles of USFS Road No. 278 from State Highway 2 to the Bear Creek bridge will be upgraded to USFS specifications for a 20 to 29-foot wide all-weather chip-and-seal surface road designed for 35 to 45 mph speeds. Bridges on the road will be widened and upgraded to HS20-44, capable of handling standard highway loads. A typical access road cross-section is shown on Figure 36.

Approximately 7.5 miles of realigned road will be needed from the Bear Creek bridge to Ramsey Creek plant site (Figure 3). This will also be a chip-and-seal surface all-weather road. Five miles of this road will follow the tailings line from Ramsey Creek plant site towards the tailings impoundment site. Figure 36 shows a typical cross-section of the main access road with the tailings line. A 4,000-foot long single lane access road will follow the tailing line from the main access road to the tailings impoundment.

All road cuts will have the 1H:1V slopes in unconsolidated material and 0.5H:1V in consolidated material. Slope fills will have a maximum slope of 1.5H:1V. All slopes will be revegetated as soon as practical after construction is completed to minimize erosion. All drainage crossings of new and reconstructed roads will meet USFS minimum design standards for a *100*-year, 24-hour *flow that will meet INFISH standards as applicable.*

Transportation plans for the construction and operation phases of mine life will be submitted for agency review and approval which reduce mine-related vehicular traffic and minimize need for parking availability at the plant site.

Ore concentrate trucks may not use the access road during major shift change periods. All concentrate trucks will be equipped with radios to provide communication in the

event of a breakdown. Warning signs for oncoming traffic will be posted for any disabled truck.

Snow removal and disposal will follow USFS guidelines. Specific practices will include:

- Snow removal will be performed in a manner to (1) preserve and protect roads, bridges and other facilities, (2) prevent erosion damage, and (3) preserve water quality.
- Snow removal work will include removal from the entire road surface.
- Snow slides, earth slides, fallen timber, and boulders that obstruct normal road surface widths will be removed.
- Snow, ice and debris will be removed from culvert inlets and outlets so that the drainage systems will function efficiently at all times.
- All debris, except snow and ice, removed from the road surface will be deposited away from stream channels.
- Snow berms will not be left on the road surface. Berms left on the shoulder of the road will be removed and/or drainage holes opened at the end of winter operations. Drainage holes will be spaced as necessary to obtain satisfactory surface drainage and will avoid runoff on erodible slopes.
- Turnouts will be snowplowed whenever Bear Creek and Libby Creek roads are plowed.
- Snow removal will be done as frequently as necessary to ensure safe and efficient transportation.

Currently, Mines Management plans to provide transportation to employees using buses, vans, and pickup trucks. Because transportation will be provided, the use of personal vehicles will be limited. *The bus hub will be located in a convenient location in Libby, most likely the Lincoln County Port Authority.* Vehicle count below incorporates an estimated number of trips and is likely overstated. In addition to mine personnel traffic, necessary supplies for operation will be hauled by road to the mine site. Deliveries of supplies will be scheduled for day shift, Monday through Friday only.

Anticipated daily vehicle count including employee vehicles are as follows:

Vehicle	Daily Round Trips	Vehicle Types	Time
Concentrate Trucks	21	20-ton capacity	Day shift
Supply Trucks	5	Various	Day shift
Pickups/Vans	30 (10 per shift)	0.5 to 1 ton capacity	Three Shifts
Employee Transportation	10**	*Buses*/Cars/Pickups	Day shift – 5 Swing shift – 3 Night shift - 2

Note:

** Reduced from original estimate based on bus service – assumes some level of employee personal need to drive to the project.

20.0 FIRE PROTECTION

Fire protection will be provided for the Montanore Project area. The U.S. Forest Service land in the project area is under the jurisdiction of the Kootenai National Forest which provides fire protection. Personnel of the Montanore Project will have access to equipment such as water trucks and bulldozers which could be used for fire fighting.

Personnel of the Montanore Project will comply with all local and state fire regulations and will join the cooperative Fire Protection Program sponsored by the Montana Department of *Natural Resource Conservation*. Fireproof or flame retardant materials will be utilized in the design of mining and ore processing systems whenever possible. All personnel will be trained in fire prevention and control. All vehicles will be equipped with fire extinguishers.

All buildings will be equipped with fire alarms. The office and shop will be provided with smoke detectors and dry chemical fire extinguishers. All fuel will be contained in bermed and lined storage areas away from other structures both at the office and plant site. All explosives will be stored in a secure, metal magazine isolated from other structures to minimize fire hazards, in accordance with MSHA regulations.

21.0 IMPOUNDMENTS AND DIVERSIONS

The Montanore Project will have several water impoundments and one large diversion. The impoundments are:

1) Tailings Pond.
   This is the major project impoundment and will occupy about 450 acres by the end of the project. A detailed description of this impoundment is in Section 16.8.

2) Seepage Control Pond.
   This small impoundment will be located downstream of the tailings pond and is designed to pick up seepage from the tailings dam. A description of this impoundment and dam is in Section 16.8.

3) Diversion Dam and Impoundment.
   This facility, located at the upstream end of the tailings pond, will divert runoff from the Little Cherry Creek drainage into an adjacent drainage. A description of this dam and impoundment is in Section 16.8.

5) Infiltration/Surge Ponds.
   These ponds will be used to handle excess water from the underground workings and will include a pipeline from the adits, a sedimentation pond, and several infiltration/surge ponds.

The only major project diversion will be the diversion channel around the tailings impoundment. The permanent diversion will be about 3,400 feet in length and is sized to handle the runoff from the 6-hour probable maximum precipitation event. A description of this diversion is in Section 16.8. Diversion channels will also be used to exclude runoff from the plant site, adit portal sites, and waste rock dump sites.

The Forest Service Handbook 2509.22 (Soil and Water Conservation Practices Handbook) and the State of Montana's proposed Resource Extraction Best Management Practices will be utilized for the control of erosion and sedimentation for all disturbed areas. A stormwater management plan will be developed and incorporate methods and techniques as outlined by these documents or other information available through the various regulatory agencies.

22.0 TOPSOIL AND SUBSOIL SALVAGE

Salvageable soils will be saved and stockpiled for reclamation of the project. Constraints to soil salvage are coarse fragment content, high water table, and steep slopes. Soil handling is described in detail in the Reclamation Plan (Section 42) and by disturbance in Sections 34.0 through 40.0. Salvage depths in the Reclamation Plan vary from recommendations in the baseline soils report to reflect additional subsoil salvage. The Montanore Project's goal is to salvage sufficient soil material to allow a redistribution depth of 18 inches on most disturbances. Special salvage is proposed on the tailings impoundment site to provide material with higher coarse fragment content to enhance stabilization of the embankment face.

23.0 PUBLIC NUISANCE

There will be no public nuisances created by the proposed mining and ore processing activities and no public nuisances are expected after final reclamation is completed. Approved operating and reclamation procedures will be followed. Final grading and disposal of solid wastes will follow applicable regulations and all laws and regulations will be followed carefully to avoid any air or water pollution. In the event that any public nuisance is developed, the Montanore Project is committed to examine the situation and develop a program to abate, negate, or eliminate the nuisance.

The Montanore Project proposes to work with state and federal agencies in cooperative agreements for the enhancement and development of recreational and educational opportunities in and around the project area.

24.0 NOISE

The proposed mining and ore processing will add to the areas' noise levels. Mine generated noise will result from blasting, heavy equipment operation, vehicle traffic, ore handling, and crusher operation. Highest noise levels are expected to occur during short periods when blasting occurs at or near the surface during early mine development. Most blasting will occur underground and is not expected to be audible at the surface. Construction noise generated by trucks, bulldozers and other plant site construction equipment is expected to create noise levels of 90 to 100 dB at the source. Expected sound levels from blasting are expected to range from 100 to 135 dB. The U.S. Department of Mine Health and Safety Administration (MHSA) establishes acceptable noise levels and personal protection requirements on the mine site. The following table indicates typical noise levels generated by mining equipment.

AVERAGE SOUND LEVELS FOR EQUIPMENT AND MINE OPERATIONS.

	Sound Level dB(A) @ Distance	**Source**
Haul Trucks	90 @ 50 ft.	EPA 1978
Bulldozers	85 @ 50 ft.	Reagan & Grant 1977
Loaders	87 @ 50 ft.	Reagan & Grant 1977
Blasthole Drill	86 @ 50 ft.	Reagan & Grant 1977
Blasting	115-125 @ 900 ft.	U.S. Bureau of Mines 1976

24.1 NOISE IMPACTS

Sound levels observed in the vicinity of the mine area during blasting will be dependent on atmospheric conditions, the topography of the land, vegetative cover, and charge size. Blasting will create a significant noise at the land surface only during the beginning of driving adits. As the adits are advanced, noise at the ground surface from blasting will be rapidly attenuated. Other project noises will be attenuated by surrounding buildings, trees, and the atmosphere. Sound pressure levels are attenuated by distance, under normal conditions a doubling of the distance reduces the sound by 6 dB. The effects of standing timber and hilly topography in the project area should attenuate noise levels even more rapidly. Noise impact on areas surrounding the mine and ore processing areas and the access roads can be estimated based on previously obtained noise levels from comparable equipment and operations.

Assuming mining area noise levels of 90 dB from construction equipment and 120 dB from blasting (when surface blasting only) and assuming a 6 dB reduction with a doubling of distance, blasting noise levels of approximately 100 dB would occur at distances of 500 to 800 feet. At a distance of about one-half mile, blasting noise would be less than 90 dB and less than 80 dB at distances of over one mile. The more constant noise from construction equipment would be attenuated to less than 70 dB within 500 feet and would be less than 60 dB at one-half mile and less than 50 dB at a distance of one mile from the mining operation.

Noise from underground ventilation fans at the portal would be 58 dbA which presents no danger to employees. Sound levels spreading out from the portal into the open air, is analogous to a new 58 dBA noise source which would be reduced by a factor of 6 decibels per doubling of distance. Thus, there would be no environmental impacts either.

Mufflers and noise control equipment will be properly maintained to assure Mine Safety and Health Administration noise standards. Backup beepers on surface equipment will be supplemented with strobe light-type warning devices and the sound level of the

backup beepers will be reduced to the minimum level necessary to comply with safety regulations.

The area of primary noise is at the plant site. This site is many miles from any houses or other facilities where noise could possibly be a problem.

Wildlife in the vicinity of the plant site, access roads and tailings impoundment will be subject to noise during the operational period. The short period of blasting during the start of adits will affect nearby wildlife. This would occur in the vicinity of the Libby Creek and Ramsey Creek adits. As the adits are driven, blasting noise will rapidly decrease. During plant construction and operation, and at the portal of the Ramsey Creek adits, there will be continuous noise from equipment and the ventilation fans. Then ventilation fans will be set inside the adits which will minimize noise. Noise from the operating plant is relatively constant and most of the equipment will be inside buildings. There will be an area of peripheral to the plant where noise will affect wildlife. Noise levels at the tailings impoundment will be moderate to low and will result from operation of pumps, sand cyclones, occasional vehicle traffic, and periodic shaping of the dam face by bulldozers. Noise in the impoundment area should have a minor effect on nearby wildlife.

25.0 PROTECTION OF ARCHEOLOGICAL VALUES

The cultural resource survey of the Montanore Project area resulted in the recording of three previously unrecorded historic sites, none of which are recommended as eligible for nomination to the National Register of Historic Places. Once final access roads and transmission line corridors have been selected and access to private lands obtained, they will be intensively inventoried for prehistoric and historic resources. At the same time, any variations from presently surveyed areas would also be inventoried.

If previously undiscovered cultural resources are encountered, the District Ranger, the DSL's Hard Rock Bureau, the State Historic Preservation Office and if appropriate, the Facility Sitting Bureau of the DNRC will be noticed and further disturbance no proceed until the agencies give approval. An area of historic sites that deserves attention is the Swamp/Schreiber Creek Rural Historic District. The proposed transmission line from the existing BPA in Pleasant Valley will transverse approximately three miles of the district. If the line follows the existing transmission line corridor through the district, then there will likely be no new impacts, although effects will need to be assessed.

26.0 PREVENTION OF WIND EROSION

NMC will use Best Management Practices (BMPs) during construction, operation, and closure to control erosion. To prevent wind erosion and subsequent air quality degradation, all haul roads and areas of dry tailings in the tailings impoundment will be watered to suppress dust. A program will be developed and implemented during the operational plan to minimize air quality impacts. A detailed plan for mitigation of air quality impacts is included within the air quality permit that has been developed for this operation. All appropriate precautions will be taken to minimize fugitive dust with respect to all construction and operation activities related to the project, including concentrate loadout activities at the Libby rail siding. This would include water and/or chemical stabilization of roads and work areas on an as-necessary basis, grading and soil handling techniques to enhance stability, revegetation practices to provide a stabilizing cover and adequate control of any process or material handling operations.

The waste rock dump will be composed of coarse rock and no wind erosion will occur. The tailings ponds will be protected from wind erosion by wetting the tailings during dry weather, or by keeping the tailings covered with water. Except for tailings, wind erosion has not been a problem at mining sites in this part of Montana. By appropriate control of tailings at the Montanore Project, wind erosion impacts will be minimized. Precautions would continue should an interim shutdown occur. Upon completion of mining, reclamation will occur and will include resloping of selected areas, topsoiling, and revegetation. This will prevent post-operational wind erosion.

27.0 PROTECTION OF FLORA AND FAUNA

27.1 OFF-SITE FLORA AND FAUNA

All mining and ore processing activities will occur within the proposed permit boundaries. Access to off site land is difficult and much of the topography peripheral to the permit area is steep. The mining and mineral processing plan requires no access or use of lands peripheral to the permit area. The Montanore Project proposes to work with concerned state and federal agencies in cooperative agreements in off site projects such as wildlife habitat expansion and enhancement. In conjunction with employee training the project will include environmental awareness programs for improving employee knowledge in these areas.

The grizzly bear is of special concern to the project and every effort will be made to work with the U.S. Fish and Wildlife Service; Montana Department of Fish, Wildlife and Parks; Kootenai National Forest; and Montana Department of Environmental Quality to minimize impacts. It is important to note that he project has a fifteen to twenty year life and any potential impacts are not considered irretrievable or irreversible.

Grizzly Bear

Project construction will have both direct and indirect effects on the grizzly bear. Direct effects are those on-site activities which would alter habitat; displace bears from habitat they normally use; or affect the productivity, survival, or mortality of the grizzly bear. Indirect effects are those caused by the proposed action, but occur later in time or outside the project area. Increased off-site recreation which is not directly related to the operation of the mine would be an indirect effect. Indirect effects also may reduce grizzly bear productivity and survival.

Bears currently occupying the project area or bears from a future larger population would be displaced because of increase human activity in the area. Bears tend to avoid areas of

activity and consequently would lose available habitat. Bears would avoid the project area more during the construction phase than during the operational phase.

Grizzly Bear Mitigation

Mines Management expects that the NEPA/MEPA process will re-evaluate grizzly bear issues and mitigation. For the purposes of the application Mines Management adopts and incorporates the revised grizzly bear mitigation plan found in Appendix C2 of the USFS ROD (September 28, 1993). The 1993 ROD is included in Appendix O. This plan will reduce and mitigate for the effects on grizzly bears and their habitat. Specifically, the mitigation plan will reduce direct, indirect, and cumulative effects by providing for the spatial requirements of the bear, managing for an adequate distribution of bears, reducing mortality risks, and maintaining habitat suitability with respect to bear food production.

Mitigation Plan Management

The KNF will prioritize and direct the land acquisition of the grizzly bear habitat preservation program. Mines Management will be responsible for carrying out the acquisition program, either directly or through contract with a third part.

Law Enforcement and Information/Education Programs

Two new full-time wildlife positions will be created, with duties aimed directly at minimizing effects on grizzly bears. This includes a law enforcement officer and an information and education specialist. Mines Management will fund both positions on an annual basis and work with the employing agency to work out a collection agreement. In the future, if additional mines are developed in the Cabinet Ecosystem, funding for both positions may be shared by other mining companies.

HABITAT PROTECTION

Road Management

Road Management mitigation, as originally required in the 1993 ROD is included, will include both year-round and seasonal closures. These closures are intended to off-set immediate effects of the mine operation by providing additional security adjacent to the impacted area and replacing lost space and habitat units. In addition to closures required to meet Forest Plan standards the KNF will implement the following closures.

A) The upper Bear Creek Road #4784 will be closed yearlong for the life of the project. The closure will be at the location of the existing seasonal gate closure which is 2.1 miles from the end of the road.

B) The South Fork Miller Road #4724 will be closed on a seasonal basis (April 1 to June 30) for the life of the project. The closure (6.6 miles) will be closed at the junction of the main Miller Creek Road #385.

These closures will be in effect prior to beginning construction activities, and will continue through the operation period and into the reclamation period.

Habitat Acquisition

For purposes of continuity, the original mitigation plan is included. It is anticipated that the original plan will be reviewed and modified as necessary. The unit of measure for mitigating for project impacts has become acres, rather than habitat units. An original 785 habitat units would be affected by the Montanore Project operation phase activities, with an average of 3.9 acres per habitat land. The habitat unit figure was converted to acres in order to establish an estimated cost of acquiring land equivalent to the habitat units being impacted. The upper Bear Creek road closure will provide 60.4 habitat units, or an equivalent of 236 acres of mitigation. Mines Management will mitigate for the remaining unmitigated project effects by purchasing 2,826 acres of private lands, rather than land acreage equivalent to the remaining habitat unit value (725).

Acquisitions will be completed within a six year period, beginning at the time of construction, with at least 50 percent completed within the first three years. Acquired lands will be approved by the agencies.

The location of acquired lands will be within the Cabinet portion of the Cabinet-Yaak Ecosystem. Preference will be given for lands within the affected Bear Management Units and lands along the east side of the Cabinet Mountains. For biological reasons, and because of the potentially limited amount of lands that may be available for acquisition within this area, lands within portions of the Cabinet Mountain area of the Cabinet – Yaak Ecosystem may also be considered.

Any of the following could occur with the acquired parcels:

a) Mines Management may purchase the private parcels directly, and then transfer title to the KNF or other state or federal resource management agencies. If the KNF acquires these lands they will be managed as Management Situation 1 grizzly bear habitat.

b) Mines Management may purchase the private parcels directly, and then transfer title to a private conservation organization, along with an acceptable conservation easement directed at protecting the land for use by grizzly bears.

c) Mines Management may purchase private lands directly, and then retain title to the lands, along with an acceptable conservation easement directed at protecting the land for use by grizzly bears.

d) Or, in some instances, Mines Management may purchase a conservation easement with fee title remaining with the private party. Conservation easements generally would be established in perpetuity.

The KNF may, on a case-to-case basis, and in counsel with FWS and the Department, accept conservation easements established for a fixed period of time extending throughout the life of the impacts (not in perpetuity). If this option is selected:

a) For those parcels acquired to compensate for habitat influenced by not physically altered by project activities, conservation easements will remain in effect, at a minimum, until the activities in the upper Ramsey Creek basin have ceased, and the road system returns to its current yearlong closure status.

b) For those parcels acquired to compensate for physically altered habitat, easements will remain in effect until, at a minimum, the disturbed areas have been adequately revegetated. For those sites where revegetation with grizzly bear foods is desired, adequate reclamation would be completed when grizzly bear foods attain 40% coverage on one-tenth acre vegetative plots randomly selected in the impacted area. This procedure is described in detail by Madel (1982), and was used as the basis for mapping high value foraging components in the Cabinet Mountains.

"First-right-of-offer" will be given to USFS before offering fee title of acquired lands to third parties. The Forest Service will seek a mineral withdrawal on any acquired lands to prevent future mineral entry. Under certain conditions, Mines Management might also be able to enter into a land exchanged with the Forest Service, and in return receive lands outside of grizzly bear habitat.

After the KNF, in counsel with FWS and the Department, determines that project impacts have ended, the acquired lands could be used by others seeking mitigation for effects on grizzly bears, providing that acceptable conservation easements or other conditions are satisfied to protect these lands for grizzly bear use.

The direct cost for habitat acquisition was originally estimated at approximately $5,652,000. This is based on an average estimated cost of $2,000 per acre. The actual

cost for these lands would vary based on factors such as parcel size, location, owner, time of purchase, and whether or not a conservation easement was included with the property.

The bond amount Mines Management will provide to the KNF to ensure land acquisition requirements are achieved is" 2,826 ac. x $2,000/ac (1 + 0.10) = $6,217,200.

This surety bond will be provided to the KNF prior to construction activities. The bond will take into account any lands that Mines Management might have already purchased prior to that time, providing that the KNF, in counsel with FWS and the Department, accepts such lands for mitigation. This provides Mines Management with the flexibility of obtaining lands now, but does not commit the KNF to accepting them as part of the mitigation package.

If, because of failure on Mines Management's part, necessary to collect the bond, Mines Management will be responsible for all legal fees incurred by the Forest Service. Since completion of the acquisition program will be a provision of project approval, failure to comply could result in project shutdown. The bond will be reviewed annually to determine if the bond amount should be adjusted.

Management of Patented Lands

Any mill site claims that NMC might patent as a result of the Montanore Project, or mining claims that may be patented on the mineral deposit, will be managed by NMC to provide for grizzly bear use subsequent to the mining operation. Patented claims will be handled in one of three ways:

a) As agreed to between Mines Management and the KNF, Mines Management will transfer fee title to the Forest Service once reclamation of the lands has been completed. Lands acquired by the KNF will be managed as Management Situation 1 grizzly bear habitat.

b) Mines Management may retain title to the lands, but will provide a permanent conservation easement directed at protecting the land for use by grizzly bears. The KNF must approve the provisions of the easement.

c) Mines Management may sell the lands to another party providing that a permanent conservation easement is included. The KNF must approve the provisions of the easement.

Additional Measures to Reduce Mortality Risks to Bears

Additional measures will be taken to reduce mortality risk including:

- Restriction by the USFS of public motorized travel in upper Ramsey Creek
- Reporting of road kills to MFWP as soon as road kill is observed; MFWP will either remove road kill or direct Mines Management how to dispose of road kill
- Prohibiting Mines Management employees to carry firearms into permit areas
- Bear-proofing all garbage containers, prohibiting the leaving of food or other bear attractants in the field, prohibiting feeding of bear.

FISHERIES MITIGATION

To mitigate the fisheries impacts associated with the Little Cherry Creek diversion, Mines Management will adopt and incorporate the USFS Revised Mitigation and Monitoring Plan, Appendix B of the USFS-KNF ROD as part of this operating permit. The ROD is included in Appendix O.

1. Before any other mitigation work is attempted, and immediately prior to closure of the diversion dam, that portion of Little Cherry Creek to be permanently dewatered will be block netted, and all fish resident in the affected stream section will be collected by hand and moved to the newly constructed diversion channel as it is flooded (may require temporary holding facility), said channel will be designed and constructed to incorporate as many fish production characteristics as is technically feasible given the hydrologic constraints of the structure.

2. Prior to, or concurrent with, the start of Montanore construction, Mines Management will finance additional fish investigations to determine the genetics, distribution, and abundance of fishes of concern (sensitive species) in the Libby Creek watershed (redband, bull trout and westslope cutthroat).

3. Implement recreational access mitigation to compensate for the loss of 383 angler-hours through one or more of the following:

    a. Howard Lake - construct paved access trails and 3 fishing platforms for physically-challenged recreationists in the vicinity of the existing facilities. Restrooms and other facilities shall be modified to improve accessibility.

b. Ramsey Creek - construct a vehicle pullout, small parking area in the vicinity of the millsite (accessible to motorized public), and a trail around the millsite that leads to upper Ramsey Creek or Ramsey Lake.

4. Implement fish production mitigation to compensate for the loss of 506 trout (annually) through one or more of the following:

a. Howard Lake - rehabilitate up to 100 feet of the lake outlet to provide spawning and rearing habitat, using pool-riffle control structures, overhead cover, clean gravels, and proper flow-depth controls.

b. Libby Creek – rehabilitate habitat upstream from the mouth of Howard Creek through creation of pool and hiding cover habitat, stabilization of old mining spoils, and channel narrowing; enhance habitat values in stream reach immediately downstream of the Libby Creek Adit.

c. Libby Creek Watershed – conduct a sediment-source inventory in the watershed, and stabilize, recontour, and revegetated priority source areas (typically roadcuts) in Libby, Hoodoo, Poorman, Midas and Crazyman creeks.

d. Standard Creek – survey upper reaches for rehabilitation opportunities, implement habitat work to mitigate limiting factors, and stock with a trout species of concern (artificial barrier protection if needed).

e. Ramsey Lake/Creek – survey upper reach of Ramsey reek, and Ramsey Lake, for suitability as a trout species of concern fishery, implement habitat work (and barrier) as necessary, and stock with suitable type and number of fish.

f. Snowshoe Creek – survey upper reach for channel stabilization and habitat rehabilitation needs, implement habitat and streambank work as needed to mitigate limiting factors, and stock with a trout species of concern (may require liming of watershed to speed-up recovery of an aquatic ecosystem).

g. Kilbrennan Lake – rehabilitate the fish population in the watershed to create a self-sustaining wild trout population, implement habitat rehabilitation work as needed based on a survey.

The identified mitigation options have a good probability of success in replacing the functions and values projected to be lost in Little Cherry Creek due to Montanore. Replacement of some functions and values will occur over the life of the project rather than immediately. Five years of monitoring data indicating stable or increasing mitigation success will be required.

Mines Management will be responsible for maintenance of all fisheries mitigation projects until full mitigation of fisheries losses is complete and accepted by the agencies. Mines Management will subject project surveys and designs for consultation and agency approval prior to implementation of any fisheries mitigation project.

The Little Cherry Creek diversion channel to the Little Cherry Creek outlet will be extended to Libby Creek. Mines Management will design a riprapped tailings pond overflow channel to Bear Creek. The designs will incorporate features which provide for stability of this transition zone so that sediment loading is not increased. Mines Management will design the Little Cherry Creek diversion channel, to the extent practicable, for fish habitat and passage. These designs will be submitted for the agencies' approval.

27.2 PROTECTION OF ON-SITE FLORA AND FAUNA

Northern Beechfern

The proposed tailings impoundment on Little Cherry Creek would directly remove a large portion of the Northern beechfern population in an old-growth stand along Little Cherry Creek (approximately 25 acres). Diversion of the Little Cherry Creek drainage at the tailings impoundment most likely would alter habitat downstream and render it unsuitable for northern beechfern.

Northern Beechfern Mitigation

Noranda originally funded broad-scale inventories for the northern beechfern on the KNF as mitigation for the loss of the one of several known populations of the sensitive plant. The KNF compiled this data and conducted genetic studies of all known KNF population. The results indicate that all of the KNF populations are genetically similar to each other and to at least one nearby Canadian population where the species is considered secure. Mines Management is no longer obligated to fund additional inventories of the plant.

Wetlands Mitigation

Mines Management will be resubmitting an application to the Army Corps of Engineers (ACOE) and anticipates the requirement to resurvey wetlands potentially impacted by the project. Some changes in ACOE's wetlands determination methods and techniques have occurred since the agencies that may influence the actual acres of wetlands impacted by the project. For purposes of the application, the mitigation as originally required is maintained and will be adjusted based on any revision to the acres of wetlands. Mines Management will replace the existing forested and herbaceous wetlands affected by the project on a 2:1 basis (2 acres will be replaced for every acre disturbed). The 5.9 acres of the waters of the U.S. will be replaced on a 1:1 basis. Herbaceous/shrub wetlands will be replaced on a 1:1 basis.

Mines Management will create or expand on existing wetlands at the following sites:

Little Cherry Creek Site	2.2 acres
North Poorman Site	3.4 acres
South Poorman Site	9.7 acres
Ramsey Site	6.7 acres

Wetlands Mitigation Monitoring

The goal of the Montanore Project wetlands mitigation plan is to replace wetland functions and values which would be lost as a result of the project. To determine the success of the mitigation, a monitoring program will be initiated immediately after construction of wetlands to assess vegetation growth, hydrological conditions, wildlife use, and integrity of constructed elements of wetlands.

Vegetation growth will be monitored in June and August following the first growing season. Species composition and canopy coverage will be recorded for constructed wetland plant communities. Growth of seeded and non-seeded "volunteer" species will be recorded. If seeded species do not become established following the first growing season, supplemental seedings and transplanting will be undertaken. If noxious weeds invade reclaimed areas, they will be removed by mechanical methods.

Vegetation monitoring will be conducted each August until the ACOE has determined that wetland plant communities predominate and the mitigation wetland is viable are self-sustaining, or for a period of five years, whichever is greater. The wetland status of reclaimed plant communities will be assessed by following the methodology described in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands.

Wildlife utilization of wetlands will be monitored in the spring and late summer until such time as the ACOE has determined the mitigation wetlands is viable and self-sustaining, or for a period of five years, whichever is greater. Spring monitoring will assess the use of wetlands by reptiles, amphibians, and waterfowl as breeding habitat.

Late summer monitoring will determine the use of wetlands as feeding and water areas for big game and other wildlife. During late summer, ephemeral water sources dry up and wetlands are sought by wildlife for both water and succulent forage.

The hydrological status of wetlands will be monitored during spring and fall. Surface water depth will be recorded. If no surface water is present, test holes will be excavated to determine the depth of free water and saturated soil.

Constructed portions of wetlands, such as berms and channels, will be observed in spring and fall to ensure that they have not eroded or become non-functional. Any structural problems will be corrected as soon as possible.

At a minimum, semi-annual reports will be submitted to the District Engineer addressing progress on, and success of, wetland mitigation actions. Annual reports will be submitted to the U.S. Forest Service. Submittal of these reports shall continue until such time as the ACOE has determined that all mitigation wetlands are viable and self-sustaining.

The mitigation wetlands will be considered viable and self-sustaining when they are inundated or contain saturated soil conditions sufficient to support hydrophytic vegetation throughout the typical growing season, and when a prevalence of vegetation in the area is determined to be hydrophytic, able to survive without maintenance and has the ability to reproduce (grow and spread). If mitigation is not progressing as planned, an interagency committee consisting of representatives of the ACOE, the U.S. Forest Service, and the U.S. Environmental Protection Agency will be convened to address remedial measures or to specify additional mitigation measures.

Weed Control

Mines Management will enter into and comply with a noxious weed management agreement with the local Weed Control District or adhere to the local districts' Noxious Weed Management Program. *As part of this effort, Mines Management will develop a weed control/mitigation plan for review and approval.*

28.0 ACTIVITIES IN NON-DISTURBED AREAS

Within the proposed permit boundary, both disturbed and non-disturbed lands are included. As described in this permit application, the mining and ore processing activities will be confined to disturbed areas. Activities within the permit boundary that may occur in non-disturbed areas include surveying and environmental monitoring. There are no plans for either temporary or permanent disturbance in any areas other than those designated as disturbed areas in the permit application.

29.0 WATER RESOURCES MONITORING

A water resources monitoring program has been developed for the Montanore Project to document any changes in water quality and quantity during the mine operation (Appendix O). Considerable baseline groundwater and surface water data were collected during the 1987-1988 period. These data are in the water resources baseline report (Appendix B) and in the supplemental information collected by Noranda 1990, 1991, and 1992. Mines Management has initiated a surface water validation sampling program. Sampling dates for the 3rd quarter of 2004 are incorporated into Appendix B. Sample for the 4th quarter of 2004 are planned and will be incorporated into a new data base, updated quarterly, and submitted to the agencies. The monitoring network will include wells to monitor groundwater and surface water stations in located that potentially may be affected by the project. Proposed analyses for surface and ground water samples are provided in Table 29-1.

29.1 GROUNDWATER MONITORING

Mines Management will monitor ground water downstream of all project facilities and has developed a groundwater validation study program (Appendix B). Select sites are proposed to assess current groundwater conditions as shown in the table below. The U.S Forest Service and MDEQ have approved of the water well locations. Installation is pending weather and access. Groundwater sampling will be conducted at the same time as the surface water sampling. Mines Management will use standard ground water modeling techniques and "tracer compounds" such as nitrate, total dissolved solids, and potassium to evaluate the effects of Mines Management's discharges and to predict impacts to surface water.

PROPOSED GROUND WATER MONITORING STATIONS

Well No.	Location	Purpose
Libby Creek Drainage 1 and 2	Downgradient of adit facilities	Assess potential impacts from the Libby Creek LAD area
Ramsey Creek Drainage		
3	Upgradient of plant site	Provide reference station on Upper Ramsey Creek
4	Downgradient of plant site	Assess potential impacts from the Ramsey Creek plant site
5, 6, and 7	Downgradient of LAD area 1	Assess potential impacts from the Ramsey Creek LAD site
8, 9, and 10	Downgradient of LAD area 2	Assess potential impacts from the Ramsey LAD site
Little Cherry Creek Drainage		
11	Upgradient of tailings impoundment	Provide reference station on upper Little Cherry Creek
12 through 17	Downgradient of tailings impoundment	Assess potential from tailings impoundment

Source: Hydrometrics, Inc. 1989

In order to establish baseline and monitor the effectiveness of Land Application Disposal (LAD) treatment, Noranda installed additional ground water monitoring wells, in consultation with the agencies, in and around the Little Cherry Creek LAD area. NMC collected baseline water quality information from the wells for one year.

Mines Management will sample excess adit and mine waters with sufficient frequency to determine actual average concentrations and load of nitrates and ammonia discharged. The temporary water storage pond will be sampled once a month when it is in use. Adit and mine water also will be sampled directly. Samples of adit and mine water will be "composited" on an hourly basis over a 24-hour period. During the first 6 months of construction, composite samples will be collected and analyzed for nitrates and ammonia twice a month. During the next 6 months, sampling and analysis will alternate between every-other day in one month and twice-a-month in the next month.

Mines Management will provide the agencies with information concerning its blasting cycle to ensure the adit and mine water samples are representative. Sampling frequency in subsequent years would be decided at the annual meeting.

Prior to construction, final LAD plans and designs will be submitted for agency review. The map delineating the Little Cherry Creek LAD sites and delineating the transport and irrigation pipelines will be submitted at 1:500 scale prior to resumption of adit construction.

Ground water monitoring locations will be sampled in LAD areas monthly whenever excess water is discharged to the LAD areas (anticipated during the construction phase and beginning in Year 10 of operations). If nitrate or ammonia concentrations increase in ground water, Mines Management will notify the agencies within 2 weeks and initiate twice-a-month monitoring of all adjacent surface and ground water stations, as agreed to in consultation with the agencies. Monthly monitoring of ground water will continue for at least a year following cessation of discharges.

At the end of the first monitoring year and following submittal of the annual report, Mines Management will meet with the agencies to discuss the monitoring results and evaluate the effectiveness of the land application treatment system. Following the annual review, the agencies would decide whether a change in monitoring or operations would be required. When twice-a-month monitoring is not required, monitoring will occur five times per year. Mines Management will present the details of the additional monitoring in the final water management/treatment plan to be submitted to the agencies for review and approval.

Hydrologic Data Reporting

Mines Management will prepare a report briefly summarizing hydrologic information, sample analysis and quality assurance/quality control procedures following each sample interval. Data will be submitted to the reviewing agencies by Mines Management within a reasonable time (5-7 weeks) after each sampling trip. All monitoring data will be submitted to the agencies in an electronic format acceptable to the agencies.

Adit and mine water will also be analyzed for barium, thallium, beryllium, nickel, selenium and antimony during the initial construction year. Tailings pond water will be analyzed for these same elements in the first year of operation.

29.2 SURFACE WATER MONITORING

Surface water will be monitored for quality and flow in the Ramsey Creek, Little Cherry Creek, and Libby Creek drainages (Table 29-2). During the baseline study, surface water monitoring stations were established in these drainages to determine baseline conditions and seasonal fluctuations in flow and quality.

In addition to continuing selected surface water baseline monitoring stations, it is proposed to have surface water monitoring stations established at the following sites:

1) Ramsey Creek downstream of the proposed water disposal areas.
2) Libby Creek downstream of the adit portal and water disposal sites.
3) Little Cherry Creek downstream of the seepage collection pond (near the mouth).
4) Unnamed drainage south of Little Cherry Creek.

Surface water will be monitored for quality and flow in Ramsey, Poorman, Little Cherry, Bear, and Libby creeks. Mines Management will sample the monitoring stations in March (early spring low flow), June (spring high flow), September (late summer low flow), November (fall low flow), and January or February (winter low flow). A year-round flow station will be installed at LB 2000 to monitor flow and suspended sediments continuously. The months of measurement may be changed depending on the results of the continuous flow measurements at LB 2000.

If substantial inflows to the mine occur in the vicinity of any of the lakes, Mines Management will report inflows to the agencies within 48 hours. Lake water level data will be tabulated and included in the quarterly hydrologic monitoring report.

Mines Management will implement monitoring at Rock Lake to provide data to estimate a baseline net groundwater seepage for the lake that will allow subsequent detection of small changes in net seepage due to possible dewatering effects of the project. All major

water budget variables will be accounted for and/or estimated for, including evaporation, precipitation, surface water inflows and outflows, groundwater inflows and outflows and continuous lake levels. The lake monitoring system design and evaluation will be coordinated with KNF and MDEQ. Monitoring data and evaluation will be submitted to the KNF with the annual reports.

If substantial increased mine inflows occur in the vicinity of Rock Lake, Mines Management will submit continuous lake level data, weather permitting, and any other lake level data accumulated during the year, within 5 working days and will provide data and evaluation at an increased frequency as determined by KNF, in consultation with MDEQ.

The annual report, summarizing data over the year, will include data tabulations, maps, cross-sections and diagram needed to describe hydrological conditions. Raw lab reports and field and lab quality results also will be reported. In the annual report, Mines Management will present a detailed evaluation of the data. Data will be analyzed using routine statistical analysis, such as analysis of variance, to determine if differences exist

- Between sampling stations;
- Between an upstream reference station and the corresponding downstream station;
- Between sampling time (monthly, growing season/non-growing season);
- Between stream flow at the time of sampling (for example, low flow during the fall compared to low flow during the winter); or
- Between sampling years.

A formal review meeting will be arranged within two weeks of Mines Management's submitting the monitoring report to the agencies. The formal review meeting will involve representatives from the reviewing agencies and Mines Management. The review could result in various outcomes:

- Determine that no change in the monitoring programs or mine operation plans is needed;
- Require modifications to the monitoring programs;
- Require new treatment or mitigation measures to be implemented as part of the mine;
- Require Mines Management to implement necessary measures to ensure compliance with applicable laws and regulations.

If data indicates a need for modification in closure plans, closure plans must be updated and submitted to agencies for approval 12 months prior to closure. If the mine is closed prematurely due to unforeseen circumstance, Mines Management will inform KNF and MDEQ immediately and submit revised standby or closure plans for approval.

SAMPLE COLLECTION AND DATA HANDLING

Collection, storage and preservation of water samples will be in accordance with EPA procedures (EPA-600/4-4-82-029). Sampling and analysis will be done as outlined in Appendix A, page 8 of the ROD contained in Appendix O of this application. A master file of all field forms and laboratory correspondence will be maintained.

AQUATIC LIFE MONITORING

General Requirements

Mines Management will coordinate aquatic biological monitoring with the surface water quality monitoring system.

Mines Management will compare data collected from seven downstream monitoring stations to data collected during pre-construction baseline studies from all sampling stations, and to data collected during operation and post-operation reclamation from two reference monitoring stations.

Monitoring Locations and Times

Mines Management will use the nine monitoring locations proposed in Table *29-3*. Mines Management will monitor during three periods: in April prior to run-off, in August during late summer flows, and in October prior to ice forming in the streams.

Fine Sediments

Mines Management will estimate the seasonal variation of fine sediment loading (embeddedness) at each sampling station using the "substrate score" methodology. At the four fish monitor stations (L1, L3, L9, and Be2) the surface embeddedness monitoring will be supplemented with the "McNeil Core" substrate sampling methodology using five representative core samples if bull trout spawning is observed. Both sediment monitoring methods will determine quantitatively the percentage of fine sediment, with the substrate score applied in pool, riffle and fun habitats, and the coring method looking at spawning riffles, found at each station.

Routine Physical/Chemical Features

Mines Management will measure routine physical and chemical parameters for each monitoring station at the time of sample collection. Mines Management will also measure air and water temperature, stream width and depths, discharge, pH, total alkalinity, specific conductance, and sulfate. Standard EPA methods will be used.

Benthic Macroinvertebrate

Mines Management will collect a variable number of "quantitative" and "qualitative" samples from each station during each sampling visit beginning with construction. The number of samples would be based on the variability of the cumulative biomonitoring data, with the sampling intensity capable of detecting a 25 percent change in conditions with a 95% probability. Quantitative benthic samples will be collected using a 500-micrometer mesh Hess net equipped with a Dolphin plankton bucket attached to the end of the net. Samples will be collected from the riffle/run habitats in the stream. Specific sampling locations at each station will be standardized, to the extent possible, for depths between 0.5 and 1/5 feet and flow velocities of less than 1.5 feet per second.

Mines Management will collect the qualitative sample with a 500-micrometer mesh bottom kicknet in habitats not sampled during each collection of the quantitative samples. A unit-effort (60 seconds) kicknet sample will be collected from the various micro-habitats not sampled by the quantitative methods. Benthic macroinvertebrates collected with the kicknet will be used to supplement the quantitative list and to determine the relative abundance of the taxa inhabiting aquatic habitats at the sampling station.

Parameters will include the total number of individuals collected, taxa richness, EPTC abundance (i.e., total percent relative abundance of mayflies, stoneflies, caddisflies, and true midges), percent relative abundance for each taxa, percentage of indicator and/or marker species, seasonal and site variations, Shannon diversity index, and ratio of functional feeding groups. To summarize these data, four common statistical measures will be used (mean, standard deviation, coefficient of variation, and standard error of the mean), plus other appropriate measures (U.S. EPA, 1990).

To provide quality control and assurance for these studies, Mines Management will maintain a permanent taxonomic reference collection that contains all benthic species collected from project area streams. Taxa identification in this collection will be documented and confirmed by taxonomic experts selected who will be with concurrence of the agencies. This reference collection will be maintained by Mines Management through the period of post-operational monitoring. Following this period, the collection will be transferred to a depository selected by the agencies for permanent scientific reference.

Periphyton

Mines Management will sample periphyton populations at the nine monitoring stations concurrent with the proposed benthic insect population sampling episodes in April, August, and October. At each station, scrapings of periphyton will be collected from surfaces of stones and other natural substrates over the range of habitat structures, water depths, and velocities found. The scrapings will be composited and preserved in separate containers for each station. In the laboratory, major periphyton taxa will be identified by

genus or species, as much as possible, and counted using standardized methods. For diatoms, permanent slide mounts will be prepared.

Mines Management will prepare data reports that include lists of the major taxa identified and their relative proportions by numbers or biomass in each sample from each station. Indicator species found will be reported by their proportional occurrence and relevance.

To provide quality control and quality assurance for these studies, Mines Management will maintain a permanent reference collection that contains representative samples of all dominant and any indicator taxa of periphyton collected from the monitoring stations. All such non-diatom taxa will be preserved in vials and representative permanent slide mounts made for diatom taxa. Taxonomic identifications in the reference collection will be confirmed by recognized taxonomic experts selected with concurrence of the agencies. This reference collection will be maintained by Mines Management through the period of post-operational monitoring. Following this period, the collection will be transferred to a depository selected by the agencies for a permanent scientific reference.

Trout Populations

To determine possible changes in fish populations associated with development of the Montanore Project, Mines Management will monitor fish populations in Libby Creek. The KNF, in consultation with MDFWP, has modified the interval and number of stream reaches from that identified in the FEIS. Mines Management will monitor fish populations in Libby Creek at 2-year (instead of 3-year) intervals in four stream reaches (L1, L3, L9 and Be2 – instead of one reach) using the following procedures. The stream reach will be blocked by netting at its upstream and downstream limits to prevent fish movement into or out of the sample reach during the sampling. Sampling procedures will include multiple-pass depletion electroshocking to collect trout from a 300-yard (or 300-meter) reach of stream. Population densities of each fish species captured during the study will be estimated, where adequate sample sizes permit, using the Seber-Lecren multiple pass method or comparable method to make population estimates. The condition of all captured fish will be recorded following an examination for overt signs of

disease, parasites, or other indications of surface damage. The monitoring report will be submitted within 5 to 7 weeks of completion of sampling and will be copied to the Montana Department of Fish, Wildlife and Parks, DHES, and DSL.

The same fish monitoring procedures will be used to monitor the fish response to fish mitigation projects implemented by Mines Management. Beginning in the year prior to a fish mitigation project, the population density will be estimated using the approved methods. In subsequent years (yearly), the mitigation monitoring at each site will be repeated until there is evidence of a stable increase in fish at each site. The fish population data from stations L1 and Be2 will be used as controls to assess whether observed changes are a natural event or not. Five consecutive years of data showing a positive response by fish will be required before Mines Management is credited for a mitigation project.

Similarly, Mines Management will monitor the recreational use levels at all fishery access sites that are modified for mitigation purposes. Beginning the year before, and extending at least five years after implementation, Mines Management will show a stable increase in use by the targeted users of each access project.

Bioaccumulation of Metals in Fish Tissue

Steep mountainous stream systems naturally have limited fish populations. For this reason, Mines Management is proposing to modify the metal bioaccumulation monitoring to eliminate the sampling of fish tissue and substitute benthic macroinvertebrates. This method has been accepted by the U.S. Forest Service in Alaska to minimize the impacts to local fish populations through monitoring activities. Mines Management will submit a plan if the modification is accepted. For continuity purposes, the fish tissue monitoring discussion has been included.

Mines Management will conduct monitoring studies that measure background concentrations and document potential changes in the concentrations of cadmium, mercury and lead in the fish of Libby Creek. Each year, for five years, Mines

Management will collect ten cuttbow trout, each greater than four inches in size, and ten adult sculpin from Libby Creek at Stations L1, L3 and Be2. Collections will be completed during the late-summer to early-autumn low-flow period.

Tissue samples, including homogenized flesh and skin from each fish, will be analyzed to determine cadmium, mercury and lead concentrations. Thereafter, Mines Management will resample each site at a 3-year interval to document the trends in bioaccumulation of these metals. Test procedures will be the same as those used for baseline testing, unless changed by the agencies.

After the first five years of monitoring, it may be possible to focus this effort only on sculpin if a correlation can be established between the bioconcentration factors for these metals in the "cuttbow" trout and sculpin sampled. This substitution would help reduce sampling loss of cuttbow trout from Libby Creek, and minimize concerns about any possible influence of sampling on population densities in Libby Creek.

Toxicity of Ambient Waters

Mines Management will perform routine laboratory toxicity testing to monitor the potential acute toxicity present, when such waters are available in: (1) mine and adit water that is discharged to the land application disposal area, and (2) decant waters from the tailings pond. For pre- and post-operational monitoring, waters for toxicity testing will be collected during aquatic monitoring in August. During the period of operational monitoring, water for toxicity testing will be collected annually concurrent with aquatic monitoring. Mines Management will collect additional water at these times from Station L10 to provide in-stream reference waters and any water needed for dilution in these toxicity tests.

Should these tests reveal acute toxicity associate with mine, adit or tailings waters, Mines Management will conduct additional instream toxicity studies at the locations specified above. The additional instream studies would include waters collected from Station L1, to assess potential toxicities from cumulative upstream sources reaching downstream

waters, and from Station L3, to assess the toxicity of waters potentially entering the stream through any subsurface drainage from the land application disposal area. Water from Station L10 would provide water for an instream reference station, and continue to provide dilution waters for other tests. Toxicity tests using waters collected from the percolation and tailings ponds would determine whether these waters may be a potential source of toxicity found in ambient stream waters downstream of these ponds.

Mines Management will evaluate acute toxicity following methods presented by Peltier and Weber (1985), or other methods approved by the *appropriate agency(s)*. Initial toxicity testing will routinely employ early life stages of either cuttbow or cuttbow trout, depending on their availability, and either Ceriodaphnia or Daphnia. These four taxa are generally comparable in their sensitivities to potential acute toxicity from metals.

The pre-operational toxicity tests will be used to establish appropriate test plans for later monitoring studies, and establish whether existing chemical conditions in these creeks are potentially toxic to the test organisms in the laboratory. When successful invertebrate testing procedures are assured, joint tests using fish and invertebrate species could help to establish the toxicity-response relationship between these species in these test waters. After a satisfactory relationship has been defined, the toxicity tests using fish may be omitted as a future monitoring requirement.

Sampling Trip and Annual Reporting

Within one week of completing biological sampling in April, August and October, Mines Management will submit a brief report to appropriate review personnel in the DSL, KNF, DHES, and Montana Department of Fish, Wildlife and Parks. This report will include brief statements about stream conditions observed at each monitoring station and will alert the review personnel to any marked changes in monitoring data relative to the cumulative monitoring record.

Within a reasonable time (5 to 7 weeks) after completing each sampling, a report containing the results of all data compiled and analyses completed from the biological

monitoring collections will be submitted to the agencies on paper and on computer diskette in a format suitable to the agencies. (This reporting time period excludes data relating to bioaccumulation studies or those requiring other special chemical analyses by outside laboratories.) A brief report with accompany this data submission, highlighting any new or unusual patterns in the data, with a brief discussion of any known causes for this pattern.

On or before each March 1, Mines Management will submit an annual aquatic monitoring report that contains summaries of all aquatic monitoring data collected during the previous year. Each report will also discuss trends in population patterns and evaluate changes in stream habitat quality, based on all data collected to date for the project. Reference to appropriate scientific literature will be included. Guidance on appropriate methods for summarizing monitoring data and analyzing these data for trends are provided by Green (1979), Gilbert (1987), Plafkin et al. (1989), and in Chapter 7 of Wedepohl et al. (1990). Recommendations in these reports can include modifications to increase monitoring efficiency or to provide additional data needs.

Annual Review and Possible Revision of the Monitoring Plan

Within one month after Mines Management submits the annual report, there will be an annual meeting to review the aquatics monitoring plan and results, and to evaluate possible modifications to the plan. This meeting will include personnel from the DSL, KNF, DHES, Montana Department of Fish, Wildlife and Parks, Mines Management's representatives, and other interested individuals.

29.3 DATA HANDLING AND QUALITY ASSURANCE

A permanent file including all field data, sample records and laboratory analyses will be maintained at the Montanore Project office.

INTERIM MONITORING

Mines Management will implement the monitoring programs in the first quarter of construction of the mill and tailing impoundment. Monitoring programs will be maintained during the life of the project. Noranda will continue to monitor Libby Creek at LB-399 as required by the Consent Decree DV-92-46, dated April 30, 1993, *until Noranda is no longer liable for monitoring requirements. Any new MPDES permit requirements will be followed by Mines Management upon issuance and will include the Libby monitoring requirements as appropriate.*

QUALITY ASSURANCE / QUALITY CONTROL

As part of each plan for environmental monitoring, Mines Management will develop and submit quality assurance/quality control (QA/QC) procedures. These procedures will collectively comprise a QA/QC plan which ensures the reliability and accuracy of monitoring information as it is acquired. QA/QC procedures will include both internal and external elements. Internal elements may include procedures for redundant sampling such as random blind splits or other replication schemes, chain of custody documentation, data logging, and error checking. External procedures may include audits and data analyses by outside specialists, and oversight monitoring and data checking conducted by various regulatory agencies.

Written reports to document the implementation of the QA/QC plan will be an integral part of monitoring reports. If variances or exceptions to established sampling or data acquisition methods are detected during monitoring, they will be documented. Documentation will include a discussion of the significance of data omissions or errors,

and measures taken to prevent any occurrences. Reports will be submitted to the appropriate agencies with the annual report, unless otherwise requested.

30.0 WATER CONSUMPTION, SOURCES, AND BALANCE

The Montanore Project will operate a large underground mine and a conventional mill. Major sources of water will be groundwater inflow into the underground workings and precipitation in the tailings impoundment. Major consumption of water will occur from evaporation and seepage from the tailings impoundment and incorporation of water into the pore spaces of the tailings. A project water balance is shown schematically in Figure 37 and is tabulated in Table 30-1. The tables provide the water balance for the 20,000 tons per day production. A revised water balance for the 12,500 tons per day plan is also included in Table 30-8 and shows comparison with the higher mining rate.

Klohn Crippen prepared a preliminary conceptual design based on the 1993 ROD. The report is found in Appendix M. Once the conceptual design of the tailings underdrain system is accepted by the agencies, Mines Management will develop a preliminary design and calculate the seepage rate from the tailings impoundment. *The conceptual underdrain design is currently being further developed along with modifications to the water balance and seepage analyses and will be submitted to the agencies. The* revised water balance will be developed along with a water quality model to predict groundwater quality. An analysis of treatment requirements will be considered based on the model results. The following information was developed for the 20,000 tpd rate. It will be updated for the 12,500 tpd.

In years 3 to 9 makeup water will be required; ranging from a high 385 gpm in year 3 to a low of 3 gpm in year 9: During operation, the project water balance shows surplus of 131 gpm in the first year and a balance for the remainder of the project. In response to possible variations in weather, groundwater inflow to underground workings and tailings pond seepage, the Montanore Project will develop the capability for supplying additional water for the project and for handling excess water that may temporarily occur during the operation.

If long-term withdrawals of surface water are necessary, KNF will be notified, the aquatic monitoring plan will be updated and no withdrawals will be made until the plan is approved by the KNF. No surface water withdrawals will be made for operational use when flows at the point of withdrawal are less than the average annual low flow.

Water Balance

Mines Management will maintain a detailed water balance of inflows and outflows to project facilities. The monitoring information would be used to modify, as necessary, operational water handling and to develop a post-mining water management plan. As part of this monitoring, Mines Management will measure:

- Daily mine and adit discharges;
- The amount of tailings (coarse and fine) slurried to the impoundment and the percent solids of the slurry;
- The amount and source of fresh makeup water used by the mill;
- The amount of reclaimed tailings water sent to the mill;
- The amount of water from seepage collection pond pumped back to the impoundment;
- The amount of water collected by the seepage collection / pressure relief wells and pumped back to the impoundment
- The amount and source of water sent to the dust suppression system, if any;
- The amount and source of water sent to the enhanced evaporation sprinkler system, if any;
- The amount and source of water discharged to the land application disposal area, if any;
- Pan evaporation technique at Little Cherry Creek impoundment site; and
- The amount of precipitation received at Little Cherry Creek impoundment site.

These measurements will be provided as monthly (or more frequently if requested by the agencies) and annual averages and totals in a quarterly hydrology report. If mine and adit inflows greater than 1,200 gpm occur over a two-month period or if excessive tailings water occurs or is anticipated, Mines Management will notify the agencies within 2 weeks. Mines Management excess water contingency plans will then be implemented. If excess inflows occur near the Rock Lake Fault, Mines Management will evaluate the possible connection to surface water bodies and provide an evaluation report to the agencies.

A buffer zone, as identified in the 1993 ROD to protect wilderness waters, is proposed as part of this plan to ensure no impacts to wilderness waters occur. While completely eliminating mine inflows is not possible, normal operational goals of the mine is the minimization of mine inflow in order to reduce both water issues and mine water costs associated with pumping and handling water. Grouting and other means will be employed to minimize inflow to the mine. Grouting will likely be the most effective way to control water inflow to the mine. As part of the normal mine development, drilling will be accomplished first followed by drift development. At each stage, water inflows will be identified and appropriate management techniques (i.e. grouting) will be employed. Mines Management will develop, as part of the agency review process, an underground water management plan and procedures for the operation.

It is expected that the buffer zone will provide adequate protection to limit impacts to wilderness waters. A review of the regional hydro-geology of the area will be completed with the agencies to assess water issues.

In conjunction with monitoring of mine and adit flows, Mines Management will collect water samples of inflows seasonally.

Water collected by the pressure relief/seepage interception system will be sampled seasonally in conjunction with the surface water sampling. Samples will be analyzes for the parameters shown in Table 29-1. The results of these samples will be submitted in the annual report.

30.1 WATER SUPPLY SOURCES

Much of the project water supply requirements will be fulfilled by water from the underground workings and from accumulation of precipitation in the tailings impoundment. *Grouting will be employed to minimize mine inflow. Therefore,* additio*nal water* sources *may be required to supplement water for the operation*. At suitable locations *(within the disturbance boundary)* yet to be determined, water supply wells will *likely* be completed in the *plant site area but may be located near the* tailings impoundment, and water disposal areas to supply any temporary water deficits and the additional makeup water that is expected to be required in years 3 to 9 of the operation. *A water right and drilling authorization will be submitted to the agencies for approval.*

Mine water does not incorporate grouting effectiveness in the overall water balance; however, this is the goal and objective of underground water management (grouting). Section 30.2.1 Grouting of Groundwater Inflows outlines the plan. The water balance is intended to provide an estimate of the water quantities anticipated. Water wells will provide the mechanism to supplement water if inflows are less through grouting or other means. Because of the buffer zone proposed, no surface water from the wilderness area will be impacted and associated with mine dewatering activities.

Mines Management does not currently plan to divert surface water to provide makeup water. However, if the need arises, water may be diverted from Ramsey Creek and/or Libby Creek. The most likely diversion point would be on Libby Creek below its confluence with Ramsey Creek and below the tailings impoundment facility. It is expected that flow here would be substantial enough that an adequate amount of water could be diverted without substantially affecting the stream. Because surface water diversion would occur only in extreme cases, it is difficult to estimate the amount of water that would be diverted, or the flow conditions under which it would occur. If conditions warrant, it is possible, however unlikely, that surface water diversion would be necessary on a year-round basis. All necessary water rights and permits would be acquired before any such diversion would take place.

30.2 HANDLING OF EXCESS WATER

During the project there may be some periods when excess water will occur. Short-term inflows to underground workings may significantly exceed average inflows, additionally precipitation and snowmelt will vary seasonally. The tailings impoundment provides a significant water storage capacity however, and a number of techniques for handling excess water have been identified and evaluated.

Techniques for handing of excess water include:

1. Grouting of groundwater inflows into the workings.
2. Segregation of waters in the underground workings and disposal of intercepted inflow to surface water or groundwater.
3. Discharge to groundwater by use of water disposal systems.
4. Storage of water at tailings impoundment area.
5. Diversion of water from the tailings pond using temporary diversion ditches.
6. Enhancing evaporation.

At all times, it will be the intention to minimize mine inflow in excess of makeup water demand. A mine water control plan will be developed that will outline steps to be taken to control excess water. Mines Management will maintain a detailed water balance that will routinely be updated to provide an assessment and, ultimately a prediction, of the mine and tailings water status. If mine inflows result in excess water in the process circuit, the first remedy that will be attempted is to grout off the inflows. Additionally, if the water balance indicates that excess water will accumulate in the tailings impoundment such that discharge from the impoundment would be required, any outside makeup water would be discontinued and the mine would start to segregate water. Segregation of water would be used to supply clean mine water inflow for discharge rather than excess tailings decant solution, to the extent possible.

An ongoing geotechnical reconnaissance program will identify potential geotechnical or hydraulic problems prior to encountering such areas during mining. This information will be provided to the agencies in an annual report. Problem areas would require careful evaluation, grouting and possible pillar redesign depending on specific conditions encountered. Grouting equipment capable of handing pressures and conditions potentially encountered in the mine will be available at the mine at all times. An identification and reporting procedure that will ensure that the appropriate manager is immediately notified of potential water or geotechnical problems will be incorporated into mine policy. Conditions that have significant impacts on mine design or that would affect the conclusions of the existing geotechnical evaluation will immediately be reported to MDEQ and the Forest Service. The intent of the operational procedures will be to identify problems before they occur and to implement remedial actions or changes in the mine design to avoid subsidence or conditions that could lead to catastrophic failure.

30.2.1 Grouting of Groundwater Inflows

The Precambrian rock that will be penetrated by the adits and contains the ore body is essentially impermeable. Secondary fracture openings in the rock caused by joints and faults provide the rock with some ability to store and transmit groundwater. These discrete fracture zones can be a path for significant groundwater movement into the underground mine workings.

Grouting of fracture zones is a common practice in underground mining and can result in significant reductions of groundwater inflow into the workings. Typically a reduction of 80 to 90 percent of the inflow can be achieved with cement or chemical grouts (personal communication, Steve Phillips, grouting consultant, Feb., 1989). When large water inflows are possible it is a common mining practice to drill ahead of the working face to determine if groundwater producing zones are present. If such a zone is encountered then a series of holes can be drilled in a fan-shaped pattern to allow grouting of the fracture zone. The grouting technique can permanently control the quantity of water entering the workings. If required, the quantity of water from underground workings can therefore be

significantly reduced and the project water balance altered. *A mine water control plan will be developed and submitted to the agencies as part of the overall hydrology updating effort.*

Segregation of Water

Another technique for handing of underground water is segregation of "clean" groundwater from the normal mine water. The technique involves drilling an array of holes into a water producing zone and connecting the inflowing groundwater into a collector pipeline. The inflowing groundwater would be unaffected by mining activities and potentially this "clean" water could be discharged to either surface water or groundwater in compliance with the appropriate discharge permit. Segregation of water is not commonly practiced in mines however it is simple in concept, should work well and could allow direct disposal of excess water. This technique would not affect the water balance but could eliminate costly treatment of the mine water.

Adit water unaffected by blasting may be discharged to any LAD area year-round with MDEQ approval. All other water will be stored during winter months and discharged during the growing season to any but the Libby LAD site. Water will be stored in a water storage facility constructed within the "footprint" of the tailing impoundment area. This facility will remain in place until construction of the tailing impoundment starter dam is completed.

A summary of adit inflow water quality data from the Libby Creek Adit is shown on Tables 30-2 through 30-7. This data provides predicted mine water quality anticipated based on historical data.

Discharge to Groundwater

Process water from the mine, mill or tailings impoundment could be treated to remove suspended sediment and then be disposed of into the groundwater system. *Water would be reclaimed from the tailings impoundment. The retention time available in the tailings pond would be quite long and support an effective suspended sediment treatment*

technique. Other sediment control mechanism (dikes, geotech filter fabric, etc.) could be employed if necessary. Water would be pumped from the tailings impoundment and land applied in the LAD 1 & 2 Areas, as well as the alternative sites shown on Figure 38. It is anticipated that this method would only be employed when excess water was encountered in the water balance. Otherwise, water make-up would be reduced were possible and divert mine water from the mill circuit for direct disposal to the LAD areas (seasonally). This condition may be required early in the land application system to remove excess water in the circuit in preparation for the following winter season.

Depending on water quality, water treatment may or may not be required. Nitrate consumption by vegetation is an effective way to treat for elevated nitrate level, and this will be incorporated into the overall water quality model being developed for agency review. In addition, if further water treatment is required to meet discharge parameters required by the agencies, those requirements will be incorporated as necessary to meet discharge parameters. This could be a combination of passive treatment and de-nitrification. Explosive handling techniques are being reviewed and will also assist in reducing nitrate levels anticipated from the mine operations.

If treatment of process water was required prior to land application, water management would be modified to adjust for the flow paths to facilitate water treatment. The water treatment facility, if required would be located at the mill facility. Under this scenario, a portion of the reclaimed water would be split and sent to the water treatment facility and routed to the land application site.

A combination of water disposal sites, infiltration trenches, drip irrigation and/or spray irrigation could be utilized as the disposal method *and will be detailed in a land application*. Disposal ponds or infiltration trenches can handle from 20 to 100 gpm per acre depending on soil permeability. These systems can be designed to handle many hundreds of gallons of water and can operate continuously even during winter weather.

Land application is a well accepted treatment method, particularly for nitrate removal. Evaluation of land application treatment for the Montanore Project indicates that nitrogen assimilation efficiencies are sufficient to prevent growth of undesirable aquatic life in Libby Creek. If operational monitoring results indicate that there may be a problem in meeting the water quality standards, Mines Management will implement other measures, which are economically feasible for the project and as may be approved by MDEQ. Mines Management will also develop an explosive management plan that will outline handling procedures, blast design to ensure effective explosive detonation, and other issues that will minimize nitrate contributions to the mine water. In addition, a review is currently underway to assess alternative explosive and blasting agents to ANFO. These will be considered as part of the detailed design and mine planning. Several large mines have developed explosive management plans. Research into the overall reduction of nitrates in the mine water will be completed and included into treatment considerations.

New treatment technologies will also be reviewed and conceptually developed to provide for a "standby" technology that could be implemented during construction. It is proposed that a pilot test approach be incorporated into construction activities to test and monitor explosives handling and other techniques to determine the effectiveness of the nitrate management. It also will permit refining, testing, and modifying management and treatment techniques that will ensure long-term effectiveness of nitrate reduction and management. The revised water quality model will incorporate nitrate reductions, treatment (if required), and other information (seepage rates) to demonstrate compliance, after acceptance of the tailings underdrain system.

Four excess water disposal areas are planned for disposal of excess flow from the mine. These excess water disposal areas may include an infiltration system near the Libby Creek Adit, LAD sites No. 1 and No. 2 near Ramsey Creek, and the tailings impoundment/borrow area site. The 4.7 acre infiltration pond and 4 acre infiltration trench field at the Libby Creek Adit site may be designed to dispose of 340 gpm. Approximately 220 acres of land application at water disposal sites No. 1 and No. 2 are designed to infiltrate up to 2,000 gpm. Approximately 700 acres in the tailings

impoundment/borrow area site would be available for backup land application or temporary water storage during the initial construction years. The storage pond is designed to receive 300 gpm for 180 days (25 acre-feet).

The location of the storage pond will move within the foot-print of the tailings impoundment site to minimize disturbance area during mine operation. Although, it is primarily considered for water management during initial construction and mine operation. The pond would be constructed as a typical cut/fill small pond to temporarily hold mine water during the construction of the main tailings impoundment. Once the tailings dam is constructed and in full operation, there will be ample storage capacity to hold excess water. Water could be recirculated to the process circuit as make-up water or stored temporarily until land application could be completed.

If the ponds are constructed in the borrow area, they would have the same layout for temporary water storage. The borrow ponds are located within the tailings impoundment permit boundary. Water would be temporarily stored until land application could be initiated or re-used in the mine operation.

The ponds are small and no design is warranted and they will be located within the disturbance boundary of the project. The agencies will be notified if a temporary structure is intended to be used.

If the borrow pits are used for land application, water would be applied at a rate that would increase evaporation and plant consumption of water. It is further anticipated, based on the water balance, the use of this would be required only to handle excess water or temporary increases in water during the first several years of mine construction and operation.

At the beginning of construction of the adits, a small water disposal/surge pond system will be constructed. Additionally, a drip/spray irrigation system pipe network would be installed over an area of approximately 50 acres to provide for disposal of 500 gpm. The

pond and irrigation systems would work in tandem during construction of the adits for land disposal of excess water. Surge pond capacity would provide for a minimum of one week storage for a temporary adit discharge of 2,000 gpm. Installation of the drip pipe system would be accomplished by a combination of trenching or plowing the pipe with specialized installation equipment. Spray irrigation piping could be installed above round but would not be useable during seasons when freezing occurs. These techniques would not require complete clearing or topsoil removal and would minimize total disturbance and reclamation requirements. The proposed land application system in water disposal areas 1 and 2 is provided in part as a contingency system; it is anticipated that, unless mine inflows are considerably greater than estimated, the entire area designated for the water disposal systems would not be required.

Construction of the pond and land application system would be staged to take advantage of the gradual increase in expected mine inflow as the adits are developed. Monitoring of the adit inflow and disposal system efficiency will allow modification of the land application system and would minimize the amount of disturbance required. A surge storage and treatment (suspended sediment removal) pond system would be required for operation of the land application system. Although the initial pond system would require only about 10 acres of disturbance, the ultimate pond system would require disturbance of as much as 30 acres or more. This disturbance would require topsoil salvage and reclamation as described in Section 38. The larger area used for irrigation land application will require only selective thinning of trees, access road construction and little topsoil removal. The excess water disposal system will have the capacity to store or to percolate up to 2,000 gpm of temporary excess water. However, the water balance indicates there will be no need to dispose of excess water in the water disposal area, except during the construction phase and in the late years of mine development. Review of the water balance indicates that excess water from temporary mine inflows or greater than average precipitation will be handled operationally by increasing storage in the tailings impoundment. Use of the land application areas after the tailings impoundment is operational is expected to be infrequent until the late years of mine development. In addition to the Ramsey Creek LAD areas, excess water may be applied at the LAD sites

in the tailings impoundment area, as described in Nitrogen Attenuation Forest Ecosystems Under Land Application, by Schafer and Assoc. (July 1992, 24 pages) using conventional irrigation techniques.

30.2.4 Diversion of Runoff at Tailings Impoundment

The tailings dam and impoundment will be developed in stages as the additional impoundment capacity is required. Temporary diversion ditches on the upstream side of the impoundment can be used to divert runoff from undisturbed land into adjacent streams. This diversion would affect the water balance and can be used or not used depending on whether there is a deficit or a surplus of water. This diversion can affect the water balance by a few hundred gallons per minute particularly during the early impoundment stages.

30.2.5 Enhanced Evaporation

Enhanced evaporation will be accomplished by spraying either within the tailings impoundment or possibly the land application areas. Sprinkling in the tailings impoundment area for dust control is discussed in the air quality permit application; this sprinkling will result in substantial evaporation during some periods of the year. Sprinkler design can be adjusted to achieve different evaporation rates. Misting sprinkler heads can be used to increase evaporation if necessary.

30.3 OPERATIONAL WATER BALANCE

Although the project water balance shows no large deficits or surpluses (Table 30-1), a source of process water and techniques for handling excess water has been identified. It would be possible to handle water deficits of 1,000 gpm or more from a combination of groundwater supply and stream diversions. Similarly, water surpluses of 1,000 gpm or more could be handled by a combination of the techniques described in Section 30.2.

The ability to handle periods of either water surpluses or deficits will allow the operation to continue without any adverse impacts on the area's water resources. The large water storage capacity of the tailings pond also provides a buffer to short-term fluctuations in the water balance.

The timing of adit inflows during construction will allow Mines Management to minimize impacts to upper Libby Creek due to segregation of construction adit water from post-construction adit water. The planned water handling plan and schedule during adit construction is as follows:

Complete Construction of Libby Creek Adit (0 to 3 months)

The first phase of construction would include completion of the Libby Creek Adit to the edge of the orebody. *It is expected that a certain amount of water will be found within the current Libby Creek Adit workings. Mines Management will assess the water quantity and quality prior to dewatering activities. No water is currently discharging from the Libby Creek Adit. Agency monitoring requirements indicate no discharge has occurred from the Libby Creek Adit workings for many years.* A pipeline from the portal site to the Ramsey Creek LAD sites will be constructed along with the LAD infrastructure facilities for the Libby Creek decline water. Also, the pipeline to the LAD sites and temporary storage pond at the tailings impoundment site will be constructed. *The pipe for mine water would be similar to the tailings pipeline and constructed of high-density polyethylene (HDPE) pipe.* All the water from the Libby Creek Adit (estimated maximum 280 gpm) would be discharged to the Ramsey Creek land application disposal

(LAD) sites. *Water quality anticipated would be equal to or better than previous water quality associated with the Libby Creek Adit work. If de-nitrification or other treatment is required prior to land application, it would be incorporated. Since activity associated with the Libby Creek Adit cannot commence until the plan is approved, all aspect of the project and water management (LAD, Temporary Storage, etc.) would be available to manage adit water. Incremental rehabilitation would occur as dewatering activities are completed. It is likely that a portion of water generated from the Libby Creek Adit dewatering activity would be stored for mill startup.*

Orebody Evaluation (3 to 6 months)

After completion of the Libby Creek Adit, work would begin to evaluate the orebody through exploratory drilling and construction of raises and laterals. Both post-construction adit water (280 gpm) and mine water (11 gpm) would be discharged to the Ramsey Creek LAD sites.

Construction of Ramsey Creek Adit to tie in with Libby Creek Adit (6 to 18 months)

During this period, the Ramsey Creek Adit would be driven from both the surface at the Ramsey portal, and underground with access from the Libby Creek Adit decline. Inflows to the Libby Creek Adit (post-construction adit water), inflows to the Ramsey Creek Adit (construction adit water), and evaluation workings (mine water) would be discharged via the Libby Creek Adit to the Ramsey Creek LAD sites and possibly to the Little Cherry Creek LAD sites.

Completion of Ramsey Creek Adit and Pre-Production Development (18 to 28 months)

After the Ramsey Creek Adit reaches the orebody, all Ramsey Creek Adit (262 gpm) and mine inflows (11 gpm) would be discharged to the Ramsey Creek LAD via the Ramsey Creek Adit and possibly to the Little Cherry Creek ALD sites. Inflows to Libby Creek Adit (280 gpm) would continue to be discharged to the Ramsey Creek LAD sites as long as nitrogen levels remain significantly higher than ambient surface water concentrations. If post-construction adit water from the Libby Creek Adit is equal or better than ambient

surface water quality in Libby Creek, post-construction adit water would be discharged to Libby Creek Adit percolation ponds near upper Libby Creek.

Operational and Post-Operational Period

During operational and post-operational period all excess waters from the adit inflows, mine inflows, and tailings seepage return would be discharged to the Ramsey Creek LAD sites and Little Cherry Creek LAD sites.

The ability to handle periods of either water surpluses or deficits will allow the operation to continue without any adverse impacts on the area's water resources. The large water storage capacity of the tailings pond also provides a buffer to short-term fluctuations in water balance.

The initial startup of the mill will require a large quantity of water. During this construction period, the water balance assumes a certain quantity of water will be retained for this startup condition. Construction of the initial impoundment will provide a large storage area for this water during this construction period. It is expected that initial development of the Ramsey Creek Adit will only encounter limited water. Therefore, water management during this period can be managed effectively. A water balance was developed for this application and is being reviewed by the agencies. Further detailed analyses will be developed to address water management during construction, operation, and post-closure activities and will be submitted to the agencies for review.

Post-operational water management would be restricted to stormwater management and tailings consolidation. No mine discharge is expected at closure. Therefore, no post-operational closure activities are planned for the mine. Once the underground workings are no longer required, the portals will be plugged. During reclamation activities, the use of the LADs will be required to manage stormwater that contacts mine disturbance. Water that is required to be land applied would continue using the same methods (i.e. treatment, seasonal application). Certain areas of the mine will use BMPs to manage stormwater and those will remain in place until reclamation is released.

The tailings dam will provide water storage for the mill process circuit. Therefore, at the cessation of mining activities, it is expected that an inventory of water will remain at the tailings facility. This water inventory includes entrained water within the tailings grain pore spaces. Continued consolidation will reduce the amount of entrained water in the facility. Seasonal land application will be used to reduce the water inventory in the tailings dam and will continue until the tailings have consolidated to the point where equipment can operate on the tailings surface to perform final reclamation. The water will be routed in the same manner for land application during post-closure as it was during operations. If treatment is required, water will be routed to the water treatment facility or pumped directly for land application. A water balance record will be maintained for the operation. At closure, this water balance will be updated to reflect the actual water quantities in the tailings dam and other features. A revised water management plan will be submitted to the agencies as part of a pre-closure assessment for the project. The LADs would be used until such time that water from the tailings impoundment or other mine disturbance areas no longer required land application. These features would be reclaimed as part of the last few reclamation activities for the project.

31.0 POWER CONSUMPTION AND SOURCE

31.1 ENERGY REQUIREMENTS

Mines Management. adopts the agencies' preferred alternative (Alternative 5 in the FEIS) for the Electric Transmission Line Plan. *Mines Management is currently developing a new application to submit to MDEQ for the Major Facility Siting Act (MFSA) for agency review and comment. The details of the application and baseline data will be updated concurrently with the EIS baseline data review and updating process.*

Presently there is no electric power available at the site. Power requirements for the anticipated loads are in the range of 50 megawatts connected load. To supply adequate power at the site, it will be necessary to construct a 230 kV switchyard at Pleasant Valley near the Fisher River to tap power off the existing 230 kV line (Figure 2). Since there is no power available in the Ramsey Creek area, a 15-mile, 230 kV powerline will be built from the Pleasant Valley Switchyard up Fisher River to Miller Creek. From this point it will follow the Upper Miller Creek drainage to Ramsey Creek to a final substation for transformation to an intermediate voltage for use at the Ramsey Creek site. An additional secondary level line will be constructed from the Ramsey Creek site to the Little Cherry Creek tailings impoundment site for power for the pumps at the tailings site. This line will be adjacent to the slurry line.

The 230kV line, which will be tied into at Pleasant Valley, is owned and operated by the Bonneville Power Administration (BPA). Flathead Electric Coop will likely be the distributor of the power through a retail agreement with BPA.

Standby generation will be provided at the site for emergency use during power outages on the main line. This will consist of a bank of engine driven generators of adequate capacity to provide power for emergency ventilation, pumping and miscellaneous process items.

31.2 PLEASANT VALLEY SUBSTATION

The main electrical service to the plant site will be 230 kV, three phase, 60 cycle. Service to the plant facilities will utilize a new overhead powerline originating from a new substation located on the Bonneville Power Administration's Noxon to Libby 230 kV line. This new substation will be called the Pleasant Valley Substation. Although the Pleasant Valley Substation is presently intended to be a 230 kV tap, the substation schematic shows a 230 kV to 115 kV transformer and associated switchgear. The Pleasant Valley Substation fence boundaries are shown as 300 feet by 500 feet. An additional 15 feet on the outside of fence boundary will require surface disturbance to build the fence and to extend the station ground mat 5 feet beyond the substation fence. This will make an overall substation surface disturbance of 330 feet by 530 feet. The surface of the substation will be covered with 4 inches of crushed rock, and the ground will be treated with an EPA-approved vegetation retardant. This new substation will be located approximately 15 miles southeast of the Ramsey Creek plant site. Figures 39 through 44 show the various aspects of the substation, powerline, and other electrical information.

31.3 230kV PRIMARY LINE

The new 15-mile long, 230 kV line will be constructed in a northwesterly direction from the new 230 kV substation to the Ramsey Creek site. Typical 230 kV line structure and corridor clearing requirements from the Pleasant Valley to the Ramsey Creek site are shown on Figure 41. The corridor is not fixed in width and does not require grubbing of all vegetation. Only those trees that are in danger of falling into the line or tall enough to come into contact with the line will be cut. All other vegetation will be unaffected. Pole construction will be steel mono poles. The anticipated right-of-way for this line will have a width of approximately 200 feet. *Baseline studies (including the vegetative information) will be updated as part of the re-permitting activities.*

31.4 RAMSEY SITE RECEIVING SUBSTATION

An outdoor receiving substation at the plant site will transform the 230 kV service to 13.2 kV for surface and underground distribution. The new receiving substation fence boundaries will be 320 feet by 140 feet (Figure 42). An additional 15 feet on the outside of fence boundary will require surface disturbance in order to build the fence and to extend the station ground mat 5 feet beyond the substation fence. This will make an overall substation surface disturbance of 335 feet by 155 feet. The surface of the substation will be covered with 4 inches of crushed rock, and the ground will be treated with an EPA-approved vegetation retardant.

31.5 RAMSEY SITE DISTRIBUTION SYSTEM

The Ramsey site 13.2 kV distribution system will consist of several conduit ducts and one 13.2 kV pole line. The various conduit ducts will serve the underground mine loads, as well as the mill and other miscellaneous surface loads. The pole line will serve the pump load at the tailings impoundment site. All motors over 200 horsepower will be served by 4,160 volts. This will require several 13.2 kV to 4,160 V transformers at various motor load sites.

31.6 SECONDARY LINE FOR TAILINGS

The 13.2 kV line (Figure 43 and 44) will be constructed along the tailings disposal pipe line, which runs from the mill site to the site of the tailings dam. The 13.2 kV line will be approximately 6 miles long. Where both the 13.2 kV line and the 230 kV line utilize the same corridor, the arrangement will be shown as in Figure 44.

Only trees that are in danger of falling into the line or tall enough to come into contact with the line will be cut. All other vegetation will be unaffected. Pole construction will be single pole wood construction utilizing 45-foot, class 2 Douglas-fir poles. This line will share the access road right-of-way.

32.0 RECLAMATION PLAN

This reclamation plan addresses the methods and techniques to be used in reclaiming lands distributed by the Montanore Project. The Montanore Project includes underground mine entries (Ramsey Creek and Libby Creek), a plant site on Ramsey Creek, waste rock deposition areas, a tailings impoundment on Little Cherry Creek, utility corridors, roads and miscellaneous supporting disturbances. *The reclamation plan for the project will include removal of all buildings, pipelines (tailings & water), and other ancillary facilities associated with project, closure of the tailings impoundment, plugging of the portals, regrading disturbance areas to blend with the surrounding topography, and seeding to promote revegetation of disturbed areas.*

Once the agencies approve the proposed plan, the reclamation plan will be updated to incorporate agency issues for their review. This reclamation plan lays out the overall objectives and general procedures that are envisioned for the final plan. Reclamation plans will be submitted periodically for agency review, as required by the regulations. A final closure plan will be submitted to the agencies for approval prior to implementing closure at the site.

Reclamation planning has been designed to satisfy state and federal requirements governing mineral development in Montana. Specific statutes and rules include:

- Montana Metal Mine reclamation Act (Title 82, Chapter 4, Part 3, MCA) and adopted rules implementing the Act;
- USDA Forest Service regulations for a plan of operations; Locatable Minerals (36 CFR 228, Subpart A);
- Montana Environmental Policy Act (MEPA) and guidelines implementing MEPA;
- National Environmental Policy Act (NEPA) and USDA Forest Service administrative guidelines adopted to implement NEPA.

The short-term objectives of reclamation are intended to cover the operational period and initial closure activities and include: 1) stabilize disturbed areas through erosion and sedimentation control, 2) control noxious weeds and 3) prevent air and water pollution. This will be achieved by a combination of operational practices, sediment and erosion control systems and interim revegetation. Monitoring during the project operating phase will ensure that these objectives are met. Prevention of air quality degradation is more fully addressed in a separate application for an air quality permit.

The long-term objective of reclamation is to establish a post-operational environment that is compatible with existing and proposed land uses of the area and will include: 1) long-term site stability, 2) protection of surface and groundwater, 3) establishment of a self-sustaining *"native"* plant community (where applicable *and possible*), 4) habitat enhancement, 5) protection of the public health and safety, and 6) attaining post-mining land use. For the Kootenai National Forest, this will include returning disturbed areas to uses consistent with the Forest Plan (Kootenai National Forest, 1987). Specific post-operation land use goals are discussed in Section 33.3 – Post-Operation Land Use.

Periodic modifications and updating of the reclamation plan will occur throughout the life of the project; and will consider advancements in reclamation technology, operational changes, or results of actual reclamation. Changes will only be made after consultation with and approval by appropriate regulatory agencies.

33.0 LAND USE

33.1 PRE-OPERATION LAND USE

Proposed disturbances occur on primarily on public lands managed by the Kootenai National Forest and private lands. Private lands are frequently patented mining claims with historical uses including mining, timber harvesting and, where appropriate, livestock grazing. Public lands are administered in compliance with the National Forest Management Act of 1976 and numerous other federation statutes and regulations designed to provide for multiple land uses and resource protection. The Kootenai National Forest is currently operating pursuant to a Forest Plan that provides forest-wide and management area direction. The majority of disturbances occur in Management Areas 14 and 2, which are detailed in the Forest Plan. Management Area direction for minerals generally refers to forest-wide management direction which encourages mining activities under appropriate laws and regulations and according to direction in the Forest Plan.

It is expected land uses previously analyzed in 1992 are similar but some changes have occurred since that time. The current Forest Plan will provide the latest land use designations and will be used to update public lands described in this section.

33.2 LAND USES CONCURRENT WITH OPERATIONS

Public access to the area of operations will be restricted until mining, ore processing and reclamation activities are completed.

The public will be restricted from the permitted mine area for safety and security reasons once construction and operation activities are initiated. Restrictions will be placed on those lands and areas undisturbed that are not fenced will continue to be open to the public, as long as there are no safety issues for employees or the general public (i.e. hunting). Access to the Poorman and Cable Creek drainages will be coordinated with the Forest Service and activities will not restrict access to these drainages. Access to Ramsey Creek drainage will be restricted by a gate at the plant site boundary. Access to public lands on Libby Creek will be largely unaffected by the project. The existing Libby Creek road will remain in place and access to the portal and disturbed areas will be restricted by gates and fences.

Mines Management will instruct employees that areas restricted for public access for hunting and recreational activities are also restricted for off duty employee access.

At this time, there are no grazing allotments in the Libby Creek Drainage (per the USFS). However, if livestock grazing is permitted during the mine life the following section describes livestock exclusion provisions. Livestock grazing will be excluded from areas to be disturbed during the project and until vegetation has been established on reclaimed areas and the site released from bonding. Livestock grazing can be resumed after re-established vegetation is capable of supporting grazing, most likely two growing seasons past final seeding. A livestock exclusion fence (3 or 4 strand barbed wire) will be constructed around the perimeter of disturbances within grazing allotments. The fence will meet Forest Service Standards and gates will be marked for visibility by snowmobilers. The fence will be removed once grazing is allowable unless the Forest Service desires retention of all or a portion of the fence for pasture management.

Commercial trees will be harvested on all areas to be disturbed. Details of timber harvest and reforestation concerns will be negotiated between Mines Management and the Kootenai National Forest to determine harvest scheduling and effects on forest-wide harvest plans.

As part of timber harvest and cleaing activities, slash management will be important. Slash can, in some areas be an effective BMP for sediment control. Consideration will be given to these uses. In most cases, slash will be piled up and burned as part of the removal process. These activities will be coordinated with the USFS and MDEQ to ensure air quality concerns are addressed.

Mines Management believes the extension of the Ramsey Creek trail around the mill facilities will be possible while maintaining public safety in accessing the Ramsey Trailhead. Mines Management intends to extend the Ramsey Creek Trail to a point where continued access to the public is possible. Details of the trail route will be coordinated with the USFS to assess the viability of extending and moving the trailhead to facilitate public interests and safety.

33.3 POST-OPERATION LAND USE

The goal of long-term reclamation is to return the area to land uses consistent with management directives of the Kootenai National Forest. Specific post-operational land use objectives include:

- Long-term site stability – use of reclamation techniques to manage water, vegetation, and other reclamation activities;
- Protection of surface and groundwater – through grading, revegetation, and other techniques to ensure protection of these resources;
- Establish a self-sustaining plant community – use accepted plants that can provide cover and are self-sustaining for long-term stability and habitat enhancement; *native plant species will be used where practicable and feasible.*
- Habitat enhancement – use reclamation techniques and vegetative diversity to enhance and restore habitat;
- Protection of public health and safety - by eliminating and/or minimize potential hazards;
- Re-establishment of public access – consistent with mitigation requirements and other Forest Service plans through the project area;
- Re-establishment of an aesthetic environment - allowing for visual quality and recreational opportunity.

Mines Management is committed to working with the Kootenai National Forest as forest planning evolves to ensure that post-operation land use objectives are met. In that regard, it may be desirable to designate certain disturbances as special management or post-mining land use areas to protect the long-term stability of the area. This could include areas such as the tailings impoundment, permanent diversions, and other similar structures and would identify specific closure objectives or post-mining land uses that may focus only one or two of the specific long-term goals and objectives listed above.

34.0 TAILINGS FACILITY RECLAMATION

The tailings impoundment consists of a starter dam, toe dike, north saddle dam, south saddle dam, diversion dam and channel, seepage collection dam and pond, impoundment surface, surface water control structures, pump stations, soil stockpiles, borrow areas, haul, and access roads.

The intent of reclamation is to minimize potential long-term erosion and maximize stability of the tailings embankment dam. Draining the water from the tailings impoundment will increase stability of the dam. Grading the impoundment surface, replacing soil that had been stripped during construction operations and seeding will decrease erosion potential.

Tailings closure will involve removing excess water in the tailings impoundment. This may include evaporation (within the tailings impoundment), land application, and other possible water disposal techniques. If required, water will be treated or applied at the appropriate rates to maintain permit conditions and water quality protection.

A detailed closure plan will be developed that will address water management, tailings consolidation, monitoring, and other pertinent information. The following provides the general closure plan for the tailings impoundment.

The basic plan for reclamation consists of the following operations:

- Stripping coversoils during periods of impoundment construction.
- Depositing cycloned sands into the impoundment during the final year of operation.
- Drying the pond surface by promoting natural desiccation and evaporation.
- Grading the tailings surface to eliminate any surface water ponding and promote shedding of surface run-on away from the impoundment area.
- Replacing soil stripped from the site during construction.

- Revegetating all disturbances to promote surface stability and to consume precipitation and minimal surface run-on through evapotranspiration. *Native plant species will be used where practicable and feasible.*

34.1 TAILINGS CHARACTERISTICS

The tailings generated in the milling process consist primarily of quartzite and siltite materials. These inert tailings, through the testing, pose no potential to generate acid or impact water quality during or after closure.

The composition and particle size distribution of the tailing material will be similar to that of the ASARCO Troy Project. Acid-base potential measurements on the Montanore Project bench-test tailings indicate no net acid generation potential (Table 38-3). A weak-acid extractable metals test indicates leachable metal concentrations are low (Table 38-1).

A monitoring plan will be developed to assess tailings characteristics during operations. Regular testing will be accomplished and provided to the agencies as part of the overall monitoring program for the project. This data will provide validation that projected conditions are similar to actual conditions encountered during operations. While the tailings characteristics are not expected to change, if significant changes occur in tailings characteristics during operation, Mines Management will work with the agencies to determine if the characteristic changes are significant to tailings closure or water quality issues. If it is found to be significant, Mines Management will provide a proposed action to mitigate the issues.

34.2 INTERIM TAILINGS STABILIZATION

Long-term tailings stabilization will be provided by dewatering and consolidation tailings, regrading the tailings surface, placement of soil and revegetation of the impoundment. It is expected that interim stabilization of tailings during the operation will be necessary to abate dust from wind-blown tailings. Blowing tailings may occur during summer and fall months when beach areas or the dam face are sufficiently dry to allow wind erosion. Winter snows and spring precipitation will retard blowing tailings during those seasons.

Interim tailings pond stabilization practices have been reviewed by Dean and Shirts (1974), Bradshaw and Chadwick (1980), Down and Stocks (1976) and Vick (1983). Various methods described to stabilize tailings include:

1) water sprinkling or ponding;
2) application of organic mulch including bark, wood fiber, straw, manure, sewage sludge and excelsior;
3) application of inorganic mulch including gravel, slag, waste rock, lime rock, and pelletized tailings;
4) chemical treatments such as lime, lignosulfonates, amines, bituminous base products, resinous adhesives and electrometric polymers;
5) mats made from asphalt, polyvinyl acetate, acrylic and fiberglass; and
6) revegetation.

Since the impoundment surface and dam face will be continually rising, interim tailings stabilization treatments will be of short duration. Because of cost considerations, most treatments listed above are more suitable for longer term stabilization. When necessary, sprinkler irrigation will be used to abate dust on the impoundment surface and dam. This will meet two objectives: 1) dust abatement; and 2) enhancement evaporation of excess water. Aluminum irrigation pipe and rainbird-type sprinklers will be assembled on beach

areas and the dam face. Decant pond water or mine water will be used as necessary to prevent blowing tailings.

If, for an unforeseen reason, there is an extended period of temporary mine closure, a plan to manage the interim or temporary closure will be submitted to the agencies. The plan may include all of the options above and will be dependent on several factors (i.e. length of temporary closure, season).

34.3 GRADING AND POST-OPERATION TOPOGRAPHY

Post-operation topography for the tailings facility is shown on Figure 34; a cross-section is included on Figure 35.

During mill operations, cyclone overflow will be deposited in the pond primarily from the east and south sides of the impoundment. This position of deposition will cause the tailings to slope gradually away from the dam crest. Tailings effluent will flow away from the south and east sides of the impoundment. During the last year of operation, when the tailings dam crest has been completed to its ultimate operating level, the remaining portion of the cycloned coarse tailings (about 370,000 cy) will be deposited into the impoundment along the east and south sides of the impoundment and will form a berm.

After the impoundment has been filled to capacity, surface water will be removed through evaporation or other methods. Spraying the effluent would increase the evaporation rate. The phreatic level within the tailings will be lowered so construction equipment can work on the surface. Dewatering the top few feet of tailings will be accomplished by promoting natural drying and evaporation. *To enhance the removal of water and tailings consolidation, the use of evaporation (spraying in the tailings impoundment), land application, or other approved methods could be employed. If required, treatment will be employed to ensure permit compliance at all times.*

Because the fine pond tailings will contain a significant amount (68 to 73 percent) of silty fines, some difficulty in dewatering the tailings in the low portion of the impoundment surface is anticipated. The tailings in this area will have a low bearing capacity. To work on the tailings surface, subgrade reinforcement, such as a geotextile, may be needed.

The coarse tailings berm formed along the south and east sides will be graded downward toward the northwest at approximately a 0.5 to 1 percent slope along the natural slope of the tailings surface. Grading of the fine tailings will be required to shape the pond

surface. The small north saddle embankment will be removed so that runoff can drain from the impoundment surface to the Bear Creek drainage. Post-operation topography will be achieved primarily by spigoting arrangements in the final years of operation. Minimal grading will be necessary for a portion of the impoundment surface to achieve the desired slope to shed water away from the impoundment surface.

All runoff from the reclaimed impoundment surface will drain towards Bear Creek. Since the tailings surface will be capped with soil and revegetated, erosion will be minimal. However, to collect any sediment, a small rockfill check dam will be located just beyond the northwest end of the reclaimed impoundment. Vegetation would grow in this area, which would stabilize the sediment and serve to trap additional sediment. However, if necessary, sediment could be removed from the pond without damaging the rockfill check dam. The sediment would be placed in soil stockpile areas and seeded for erosion protection. The check dam will be designed for the 100-year flood event.

During establishment of vegetative cover on the reclaimed impoundment surface, runoff water quality will be periodically monitored. The monitoring program will be coordinated with the appropriate agencies prior to impoundment reclamation. After vegetation has become established, the monitoring frequency will be gradually reduced. Monitoring will be done to determine total suspended solids, total dissolved solids and selected critical chemical/physical parameters.

It is anticipated that a shallow depression may form in the center of the pond due to consolidation settlement of the tailings. During grading activities, this depression will be filled with coarse tailings, mine waste rock, or material from the north saddle embankment. Potential settlement of the pond surface will be estimated during final reclamation studies.

To minimize potential gully formation at the tailings dam crest, riprap (83,000 cy) will be placed on the dam crest and uppermost part of the 3H:1V slope.

Following operations, the pressure relief/seepage collection system would remain in place and water would continue to be pumped back to the impoundment. Following cessation of mining the tailings impoundment will be partitioned to provide an area for water storage. The remainder of the tailing impoundment surface and the embankment will be regraded, topsoiled and revegetated. Water disposal will result from dust suppression, enhanced evaporation, and irrigation of the reclaimed tailings area. The post-operational water balance will include additional disposal of water to the land application area and to constructed wetlands peripheral to the impoundment to the extent allowable by water quality considerations. *If applicable to the disposal method, water treatment may be required to meet permit conditions.* As embankment seepage and relief well return decrease the storage requirement on the tailings impoundment will decrease and additional area can be reclaimed. When reclamation of the tailings surface is complete and as seepage from beneath the impoundment decreases, the amount of water pumped back would decrease. Depending on tailings seepage and ground water quality, pumping would eventually cease. Inflow into the tailings pond would be limited to infiltration. Outflow from the tailings pond would consist of seepage from beneath the impoundment and through the dam. The water level in the impoundment would reach equilibrium when the inflow equals the outflow. Estimates indicate that steady-state conditions would be reached in 20 to 25 years if the seepage collection dam is removed, and 35 to 40 years if the dam is left in place and embankment seepage is returned to the impoundment. It is anticipated that the quality of the seepage will meet applicable water quality standards at a much earlier stage than it takes to reach steady state conditions.

Post-operational reclamation of the diversion dam and channel are addressed in Section 44.1.

34.4 SOIL HANDLING AND REDISTRIBUTION

During initial construction, soil will be stripped from:

1) the borrow area;
2) the starter dam site;
3) the diversion dam; and
4) the diversion channel and stockpiled in designated storage areas.

Soil map units TpC, TgD and TgC will be salvaged into two lifts. Soils salvaged from the first lift will be stockpiled at one end of the storage areas. Soils from the second lift (which contain more coarse fragments) will be stockpiled at the other end of the storage areas. Salvageable soils from all other map units throughout the life of the mine will be placed with first lift soils. *A weed control plan will be developed and will include weed control on soil salvaged and stockpiled for use later either in concurrent or final reclamation. It is expected that seeding of topsoil with native species will be the most effective method of weed control. As appropriate, other methods will be employed and outlined in the Weed Control Plan developed with the agencies.*

Following initial construction activities, soils from the toe dike, south saddle dam, seepage collection dam, seepage collection pond, associated tailings impoundment disturbances, and collection ditches will be stripped and stockpiled or used to resoil disturbances, reclaimed during the construction period. Soils requiring double lifts (TpC, TgD, and TgC) will be salvaged accordingly and either redistributed during incremental reclamation or stockpiled in the proper storage areas.

After construction and during mine operations, soil will be stripped annually and stockpiled or redistributed from the toe dike and tailings impoundment areas and as required from the north and south saddle dam areas. Those soils requiring double lifts will be salvaged accordingly and either redistributed on sites scheduled for reclamation or stockpiled in the proper storage area. Eighteen inches of second lift soil will be

redistributed over the sides of the diversion channel. Soil will only be used on cut slopes above the riprapped bottom of the diversion channel.

Soil will be redistributed on the face of the toe dike in the fifteenth year of operations. Fifteen inches of second lift soil will first be redistributed followed by nine inches of first lift soil.

At the end of operations, soil will be redistributed over remaining sites to be reclaimed including the tailings pond surface, the south saddle dam and main embankment. *A closure plan for the tailings facility will be completed and will incorporate the volumes of soil necessary to meet post-closure objectives. The amount of tailings consolidation obtained will dictate the final soil volume needed and will be updated periodically during the life of the project.* The coarse tailings portion of the dam face will be ripped perpendicular to the slope to a depth of 18 inches and covered with 15 inches of second lift soil followed by nine inches of first lift soil. Nine inches of second lift soil followed by nine inches of first lift soil will be redistributed over the regraded surface of the tailings impoundment and the south saddle dam face.

Enough second and first lift soil will remain in storage to reclaim the seepage collection system when MDEQ, the Forest Service, and Mines Management determine controls are no longer necessary. Nine inches of second lift soil will be redistributed over the regraded surface followed by nine inches of first lift soil.

34.5 REVEGETATION

The tailings impoundment area and associated disturbances will be revegetated using a mixture of grasses, forbs, shrubs, and trees adapted to a relatively wide amplitude of site conditions. *Native plant species will be used where practicable and feasible.* The herbaceous understory will be drill seeded on the tailings impoundment surface, main embankment and soil stockpile sites and broadcast seeded on associated disturbances.

Trees and shrubs will be planted continuously on steeper slopes to enhance stability and visually screen areas visible from a distance. On level areas and gentle slopes, trees and shrubs will be randomly planted in small groupings to provide wildlife habitat. Trees and shrubs will not be planted on small disturbances or along roads.

An interim revegetation mixture will be used to temporarily stabilize sites during the course of operations. Details regarding revegetation are presented in Section 43.0

35.0 PLANT SITE RECLAMATION

35.1 GRADING

The Ramsey Creek plant site will be constructed using a cut/fill sequence supplemented by a quantity of waste rock from the adjacent adits. Cut and fill slopes will be 1.5H:1V. The patio will slope from west to east at about five percent. Post-operation topography is shown on Figure 33. Post-operation topography will be similar to operational topography. Cut and fill slopes will be revegetated following construction as redisturbance of these slopes at the end of operations is not anticipated. To enhance revegetation on the 1.5H:1V cut slope, benches will be installed at 15 to 25 foot intervals during construction. If the cut and fill slopes are not vegetatively stabilized by plant closure, they will be reduced to 2H:1V by pulling fill into the cut and by grading the berm into the cut.

An estimated 87,250 cy of material will be graded during reclamation of the plant site if revegetation of the cut and fill slopes has not been successful by plant closure.

35.2 SOIL HANDLING

During the construction phase, soil from the AcG and AcC mapping units will be stripped from the plant site area to a depth of 18 inches and stockpiled as shown on Figure 3. The soil stockpile will be constructed to form a snow deposition area. Plowed snow from the plant site will be placed in this area to prevent sediments from entering Ramsey Creek.

After construction, approximately 18 inches of soil will be redistributed on the plant site cut and fill slopes. The remainder of the soil will remain in the stockpile (which will be vegetatively stabilized) until the plant site is reclaimed at the end of operations. Compacted areas on the plant site will be ripped prior to soil redistribution.

35.3 REVEGETATION

The Ramsey Creek plant site will be revegetated using a mixture of grasses, forbs, shrubs, and trees adapted to moist, relatively cool sites. All disturbances associated with the plant site will be broadcast seeded with the exception of the patio, which will accommodate a drill seeder. Trees and shrubs will be planted on cut and fill slopes and the patio. The temporary access road, soil stockpile and water control structures will be temporarily stabilized using the interim revegetation mixture.

36.0 PORTAL RECLAMATION

Three entries and associated portal patios will provide access underground: Two adits south of the Ramsey Creek plant site and an adit on lower Libby Creek Figure 3.

36.1 CLOSURE

During operations, access to surface openings will be restricted to authorized personnel. Access will be controlled by portal doors, or other appropriate control, road closures, fencing as necessary, sign posting and Mines Management security patrols.

After operations are completed, all entries will be sealed to prevent access. Closure techniques and designs will be permanent and will depend on whether water is or will be produced at the portal opening. Dry openings will be sealed by backfilling waste rock (from the portal patio) for a distance equal to twice the diameter of the opening. Entries producing undesirable quality water will be plugged using state-of-the-art techniques as described in Section 44.0 of this application. Specific design criteria will be based on entry size, rock characteristics and anticipated flows. It is not expected that mine water quantities will be significant at the portal, with the exception of a small quantity of precipitation/infiltration for the first few feet of the adit. Final plugging design will be prepared for agency review and approved prior to cessation of operations.

36.2 GRADING, SOIL HANDLING AND REVEGETATION

Prior to patio construction, 12 to 18 inches of soil will be stripped and stockpiled. At the conclusion of operations, a portion of the waste rock in the portal patios will be backfilled into the adit for closure. When slopes and equipment limitations allow, the patio faces will be used for backfill to achieve a post-operation slope of about 2H:1V. Post-operation topography of the Libby Creek Adit site is shown on Figure 18. Prior to resoiling, the surfaces of the patios will be ripped to relieve compaction. The sites will be hand broadcast or hydroseeded, mulched and fertilized as discussed in Section 43.0 (Revegetation).

37.0 POWERLINE CORRIDOR RECLAMATION

The siting, reclamation, and monitoring of the 230 kilovolt (kV) powerline to the Ramsey Creek plant site falls under the authority of the Montana Major Facility Siting Act (MFSA) and the U.S. Forest Service (USFS) regulations. Under MFSA, a Certificate of Environmental Compatibility and Public Need (Certificate) for construction and operation of the proposed powerline would be issued. USFS also would issue a Special Use Permit for a right-of-way easement pursuant to the Federal Land Policy and Management Act of 1976 (FLPMA).

MFSA specifies that an application for a Certificate must contain a description of proposed reclamation methods that would be implemented to restore the powerline right-of-way. There is little detail specified in MFSA concerning precise reclamation methods and timing; however, the agency attaches environmental specifications when a Certificate is granted. The Environmental Specifications identify requirements for post-construction cleanup, restoration, reclamation, and revegetation of the right-of-way, access roads, crane pads, splicing or stringing sites, borrow sites, and other disturbances associated with construction and operation of the powerline. The seeding mixtures to be used in revegetation as well as requirements for hydroseeding, fertilizing, and mulching are jointly determined between the landowner and the involved state and federal agencies.

37.1 ROUTE DESCRIPTION

The powerline corridor from Pleasant Valley to the Ramsey Creek plant site traverses land administered by USFS and land owned by Plum Creek Timber and other private parties. Approximately 4.5 miles of the proposed route is sited in areas that have been logged by clearcutting, whereas the remainder of the route has not been recently logged. The following forest habitat types are crossed by the proposed route: Western hemlock/ Queencup Beadlily (12.0 miles), Engelmann spruce/horsetail (2.0 miles), Douglas-fir/snowberry (1.4 miles), grand fir/queencup beadlily (1.2 miles), Western red cedar/devil's club (0.2 mile).

The driest of these habitat types, Douglas-fir snowberry, occupies the southwest aspect of slopes along Fisher River on the easternmost route segment. Dominant species include Douglas-fir, ponderosa pine, snowberry, serviceberry, white spirea, kinikinnick, elk sedge, and pinegrass. This habitat type, located on *Plum Creek Timber* land, has nearly all been clearcut.

The route along the floodplain of the Fisher River crosses about 1.5 miles of residential land and 1.5 miles of forested land. The forested areas along the Fisher River valley floor are composed about equally of the Western hemlock and Engelmann spruce habitat types. Due to highway construction and other activities that have altered the vegetation (i.e., borrow areas, livestock utilization, residential use), spotted knapweed has become a prolific, widespread invader of disturbed sites. This noxious weed has colonized extensive areas along the Fisher River and Libby Creek, but it has not yet become established in clearcuts. *There are likely other noxious weeds (including two species of hawkweed and St. John's wort) that have colonized the area due to other disturbances, and the presence of noxious weeds will be updated as part of the vegetation baseline data review. The weed plan developed for the project will include the powerline corridor and associated disturbance during construction, operations, and reclamation to address these and other noxious weeds issues.*

At Miller Creek, the powerline route leaves the Fisher River valley and parallels an existing road through gentle terrain for about 4 miles. The vegetation along the Miller Creek portion of the route is predominantly the Western hemlock/Queencup Beadlily habitat type with about 1.3 miles of the Grand fir/Queencup Beadlily habitat type also being traversed.

In the upper drainage of Miller Creek, the proposed route would cross about 1.7 miles of forested land where there currently is limited road access. The route through this un-logged stand increases in elevation over the 1.7 mile route segment by about 1,000 feet and traverses a relatively steep north-facing slope.

From the top of the Miller Creek/Libby Creek divide, the route follows existing roads down generally southwest-facing slopes to the floodplain of Libby Creek. From the divide to Libby Creek, the route traverses about 3.1 miles of the Western hemlock/ Queencup Beadlily habitat type.

Preliminary design showed the Libby Creek crossing at a wetland/beaver pond complex (0.2 mile). Redesign has relocated the corridor to avoid the wetland/beaver pond complex.

From lower Ramsey Creek to the plant site, the route parallels existing roads and crosses Ramsey Creek diagonally through a mature, Western red cedar/devil's club (0.8 mile). The vegetation upslope from Ramsey Creek is predominantly Western hemlock/ Queencup Beadlily habitat type. Logging in the fall of 1988 has resulted in clearcut areas on the upper, south-facing slopes of Ramsey Creek. Many of these areas now have significant re-growth associated with the logged area.

37.2 CONSTRUCTION

Access roads would be required for construction, operation, and maintenance of the powerline. Vegetation such as grasses and forbs would be allowed to grown on access roads, but trees and shrubs which might interfere with vehicle movement would be mechanically removed. Trees within the right-of-way would be removed to provide a minimum of 18 feet clearance between the vegetation and the conductor. Trees that would extend within 18 feet of the conductors within 5 years also would be removed. Other trees on or off the right-of-way that could fall into the line would be removed. Merchantable timber would be salvaged from the right-of-way, whereas smaller trees and brush would be burned or chipped.

Construction design for substations and the powerline are included as Section 31.0 (Power Consumption and Source).

A weed control plan will be developed and the appropriate measures will be employed to minimize weed issues.

37.3 RECLAMATION

Following construction, land on the right-of-way that has been rutted, compacted, or disturbed would be reclaimed. Access roads not needed for maintenance also would be recontoured, scarified, and reseeded and traffic would be blocked with tank traps or other structures. All permanent cut and fill slopes on roads needed for maintenance would be seeded, fertilized, and stabilized with hydromulch, netting, or by other methods. Drive-through dips, open-top box culverts, waterbars, or crossdrains would be installed on maintenance roads to prevent erosion.

At the end of the life of the project, if the powerline is no longer needed, the line would be abandoned. Structures, conductors, insulators, and hardware would be removed from the right-of-way. All unnecessary roads and tower footings would be recontoured and revegetated. Road surfaces would be scarified and reseeded and culverts or other drainage structures would be removed.

Where culverts are removed, the streambanks would be recontoured and reseeded. Shrubs such as alder or willow would be planted on streambanks to reduce bank erosion during periods of high streamflow.

Throughout all phases of the project (construction, operation, abandonment, and reclamation), the potential for noxious weeds, particularly spotted knapweed, to invade disturbed sites is high. Existing populations of spotted knapweed along highways and on disturbed sites in the Fisher River valley provide a potential source of seed. Construction and maintenance vehicles traveling through areas infested with spotted knapweed could readily transport seed to areas not yet colonized by this species. If spotted knapweed becomes established along the powerline right-of-way or on access roads, future reclamation of the site would be more difficult.

When spotted knapweed colonizes a site, it causes a marked decline or loss of native understory species which typically compose native plant communities. Spotted

knapweed replaces desirable forage species by virtue of its competition with native plants for soil moisture or possibly through the secretion of chemical compounds which inhibit seed germination or growth of native species (Kelsey, 1984). Replacement of native vegetation by knapweed results in increased soil erosion and reduction in forage for wildlife and livestock. Lacey et al., (1986) estimated that in Montana an estimated $4.5 million of range forage for livestock was lost to spotted knapweed. At the present rate of spread, annual forage loss due to spotted knapweed is projected to reach $155 million by 2008 (Lacey et al., 1986). Spotted knapweed infestations on the Bitterroot National Forest are predicted to cause the elk to decline by 200 animals annually due to loss of forage.

Once spotted knapweed has become established on a site, it is a prolific producer of seed. Seed can remain visible in the soil for 12 years or longer. The most effective means of eliminating small infestations of spotted knapweed is with a persistent herbicide application program (Lacey et al., 1986; French and Lacey, 1983). Early detection and herbicide treatment of invading plants are essential in preventing the spread and establishment of spotted knapweed and other noxious weeds.

Measures that also would help prevent the spread of spotted knapweed would be the rapid revegetation of disturbed sites with vigorous stands of grasses, forbs, and shrubs. Although knapweed invades sites dominated by native vegetation, the spread of the plant is slowed if diverse, dense cover of desirable plants is maintained.

According to Lacey et al. (1986), the most commonly recommended herbicides to control spotted knapweed are picloram (Tordon), 2,4-D, and dicamba (Banvel). These herbicides selectively kill broadleaf species and generally do not harm grasses when applied at recommended rates. Picloram applied at a rate of one-fourth pound of active ingredient per acre in early June controls knapweed for 3 to 4 years, depending on the site conditions. The period of effectiveness of the herbicide is shorter on sites with coarse, well-drained soils, in areas of high precipitation, and on soils with high organic content.

As part of the reclamation program for the 230-kV powerline, monitoring would be conducted along the right-of-way and access roads to detect the invasion of spotted knapweed. Individuals trailed to recognize knapweed in seedling and rosette as well as mature growth stages would conduct the monitoring at monthly intervals during the growing season.

Spotted knapweed plants found on areas affected by the project would be treated by spot spraying individual plants. Herbicide would be carried in either tanks mounted on vehicles or in backpack tanks. Herbicide spray would be applied only when wind velocity is less than 8 miles per hour to prevent wind drift. No herbicides would be applied within 25 feet of waterbodies. All herbicide application would be:

1) In compliance with all pertinent state and federal regulations.
2) With only those herbicides registered and approved by the Environmental Protection Agency (EPA).
3) In strict compliance application rates and application techniques specified on EPA-approved label instructions.
4) Applied only by licensed applicators or licensed supervisors.
5) In strict observance of all laws and regulations governing herbicide handling, storage, disposal, and spill cleanup.
6) Made avoiding the use of oil carriers with the herbicide.

The environmental consequences of herbicide application have been addressed in detail by the Bonneville Power Administration (Environmental Impact Statement – Transmission Facilities Vegetation Management Program – 1983) and by the Bureau of Land Management (Environmental Impact Statement – Northwest Area Noxious Weed Control Program – 1985). The use of the herbicides dicamba, 2,4-D, and picloram were judged to be suitable for noxious weed control. Adverse environmental impacts of herbicide use on the human and natural environment were determined to be minimal if proper methods of application were followed.

38.0 WASTE ROCK DUMP/WATER DISPOSAL AREA RECLAMATION

The Montanore Project proposes to build three waste rock dumps and two water disposal areas during the operating period. They are:

1. Ramsey Creek Adit interim dump (located on portal patio).
2. Libby Creek Adit interim dump and water disposal area.
3. A waste rock dump/water disposal area along the plant site to tailings impoundment access road.

Material requirements for construction will utilize all scheduled waste rock production. If a portion of the waste rock is not all used, the waste rock dump located in LAD 1 would be used for storage and would be reclaimed at closure. Waste rock will be used primarily in tailings embankment construction with some waste rock used for portal patio and plant site construction. Designated waste rock dumps are, therefore, interim depositories necessary to store material for subsequent construction activities. Runoff from the waste rock dump would be contained by Downgradient, perimeter diversion ditches and routed into sediment traps. Flow from the sediment structure would be routed to the lower water disposal site or to a roadside diversion ditch which conveys runoff through the facility to the outflow control structure on Poorman Creek. It is currently anticipated that all waste rock dumps will be consumed by construction by the end of operations.

38.1 WASTE ROCK CHARACTERISTICS

The mining operation will generate waste rock while driving access, ventilation, and conveyor adits. Ore will be extracted from the quartzites of the upper part of the lower member of the Revett Formation, producing waste rock from the lower quartzite units of this member and from the zone that separates the copper/silver mineralized zones. Four geologic formations have been identified as having the potential to be encountered by the adits. They are the Prichard, Burke, Revett, and Wallace Formations.

The Prichard Formation consists primarily of laminated argillite with interbeds of siltite. The Burke Formation consists of siltite interbedded with laminated argillite and silty argillite. The Revett is characterized by clean quartzites interbedded with siltite and silty quartzite. The Wallace is characterized by interlaminated argillite and siltite interbedded with laminated limestone and laminated dolomitic quartzite.

No detailed chemical data exist on the Prichard, Burke, and Wallace Formations. Laboratory tests were conducted on representative samples of the tailings, Lower Revett, footwall, raw ore, and the waste between the ore zones to determine weak-acid extractable metals, total constituents, and acid-base potential (Tables 38-1, 38-2, and 38-3). Additional acid base analyses were conducted on probe hole samples for the Libby Creek decline (Table 38-4).

None of the rock types exhibited elevated leachable metal concentrations. Whole rock analyses indicate all rock types have elevated levels of chromium and all have elevated levels of copper with the exception of the waste zone.

Because no detailed analyses exist on the geological formations to be encountered by adits, the Montanore Project will monitor the waste rock that is produced. If some rock exhibits an acid generation problem, then the material will be separated from the other waste rock as it is removed from the adit. A detailed plan for the handling of this waste

rock will be determined in conjunction with MDEQ. The probability of encountering acid generating materials in the adits is anticipated to be very low.

38.2 GRADING AND POST-OPERATION TOPOGRAPHY

It is anticipated that nearly all waste rock will be removed for construction by the end of operations and disposal sites will revert to pre-disturbance topography. If construction requirements do not exceed waste rock production, or more economical borrow material becomes available, one or more of the dumps may be left at the end of operations. In this case, remaining waste rock will be graded to 2H:1V (or flatter if slope conditions allow). Mines Management will work closely with MDEQ and the Kootenai National Forest to ensure stable design. Water disposal areas will be vegetatively stabilized during operations and it is not anticipated that post-operation grading will be necessary.

38.3 SOIL HANDLING

Eighteen inches of soil will be salvaged and stockpiled prior to waste rock deposition or water disposal site construction. Once waste rock is removed from a site and no additional storage is needed, soil will be respread (after ripping) to an average depth of 18 inches. Soil will be respread on disturbed areas on the water disposal sites when the ponds are no longer necessary.

38.4 REVEGETATION

Waste rock dump sites and disturbed areas in water disposal areas will be revegetated using permanent mixtures presented in Section 43.0 (Revegetation). The Ramsey and Libby Creek dump sites will be seeded using a mixture adapted to moist soils. The waste rock disposal and water disposal site areas will be revegetated using a mixture dominated by species adapted to a relatively wide range of conditions. Shrubs and trees will be planted on all waste rock dump sites.

39.0 ROAD AND TAILINGS CORRIDOR RECLAMATION

Roads necessary for the Montanore Project include:

2. Bear Creek access road from Highway 2 to Bear Creek Bridge – upgraded to 20 to 24-foot wide all-weather gravel road.
3. Access road from Bear Creek bridge to Ramsey Creek plant site – upgraded to 20 to 24-foot wide all-weather gravel road with certain segments realigned around tailings impoundment and along tailings corridor.
4. Ramsey Creek to Libby Creek Adit access road – minimal upgrading, no widening.
5. Tailings line access road from main access road to tailings impoundment – 4,000 foot-long single land, new construction.
6. Ramsey Creek adits temporary construction road from plant site and plant site roads (Figure 3).
7. Haul roads and access trails in tailings impoundment area for borrow, waste rock and soil haulage and access to seepage control structures – new construction.

The tailings corridor will follow the access road from the plant site to the impoundment.

The Bear Creek access road from Highway 2 to the Bear Creek bridge will be reclaimed immediately following construction to final design standards. Available soil will be salvaged from disturbed areas and redistributed on fill and cut slopes where possible. Soil will not be respread on cut slopes in consolidated material. Resoiled slopes will be broadcast seeded or hydroseeded, dozer tracked where possible, fertilized and mulched as necessary.

The main access road from Bear Creek bridge to the plant site will be reclaimed as previously discussed expect this segment of the road will be returned to a 15-foot width at the conclusion of operations unless the Forest Service desires to retain the wider road.

Width reduction will be accomplished by dragging fill material back into the cut with a backhoe, or where slopes allow, pushing with a tracked dozer. Abandoned segments of the existing road (that will not subsequently be disturbed by the tailings facility) will be reclaimed once the replacement segments are completed. The abandoned roadway will be contoured to blend with adjacent topography, ripped as necessary and revegetated. If it appears that a suitable soil material to support revegetation is not available from on-site grading, small quantities of cover soil may be borrowed from impoundment construction to facilitate revegetation.

Minimal disturbance is anticipated on the Ramsey Creek to Libby Creek Adit road. Any disturbance will be reclaimed following construction activities.

The 4,000-foot segment of single land road along the tailings corridor will be stabilized with interim revegetation following construction and obliterated at the end of operations. Soil materials used for interim reclamation will be resalvaged for final reclamation.

The temporary construction road from the plant site to the Ramsey Portal patio will be removed once the bridge is constructed. Other plant site roads will be removed at the end of operations.

Internal haul roads and access trails associated with the tailings impoundment, plant site and waste rock disposal/water disposal site areas will be recontoured to approximate pre-disturbance configurations following cessation of operations.

On the tailings corridor, pipe, footings, powerline poles and lines will be removed at the end of operations. The containment ditch will be backfilled to approximate pre-disturbance topography. Soil will be respread and the corridor seeded as discussed in Section 43.0 (Revegetation). A maximum of 115,000 cy will be graded for road narrowing, removal and tailings corridor reclamation.

40.0 SOIL STOCKPILE SITE RECLAMATION

Soils will be added to and removed from stockpiles with incremental stripping and reclamation. Soil will not be salvaged from stockpile sites prior to stockpiling. Once all soil is removed from a stockpile, the site will be ripped, disced and revegetated. Soil stockpile haul road will be reclaimed concurrently with the stockpile sites.

41.0 SURFACE WATER CONTROL STRUCTURE RECLAMATION

Ponds and runoff control ditches and sediment traps will be backfilled and graded when they are no longer necessary. Soils from diversion and containment ditches will be stored adjacent to the ditches in a berm for reapplication once the structure is no longer necessary. *The final reclamation plan will provide specific details of closure sequences based on the situation at that time. It is anticipated these features will be reclaimed as part of the overall reclamation sequence for the project. During the interim period while vegetation is established, water control structures will involve typical BMPs (sediment fence, straw bales etc.) that will provide interim water management. Regrading efforts will be such that permanent long-term need for these structures will be eliminated after mine closure.*

42.0 SOIL HANDLING

Soil salvage and distribution is detailed for each major disturbance in Sections 34.0 through 39.0.

42.1 SOIL SALVAGE

Suitability of soils proposed for reclamation was determined from physical and chemical data collected during the baseline soils survey. Physical parameters analyzed for suitability included depth, percent slope, saturation percentage, water holding capacity, texture, permeability, organic matter and coarse fragment content. Chemical parameters included pH and electrical conductivity.

Some potentially salvageable soils within the permit area have characteristics that limit or in some instances preclude their suitability for use: steep slopes, high water table, or high coarse fragment content. Soil types AdD, CbD and ROC can occur on slopes over 50 percent and are considered unsafe for conventional salvage operations. Where slopes are less than 50 percent, soil type AdD can be salvaged to nine inches. Soil types CbD and ROC are unsuitable for salvage due to coarse fragment contents. The ThA soil occurs in a high water table that can restrict salvage operations. Salvage depth has been estimated at 9 inches although this depth may vary depending on ground water level. Soils in the permit area generally increase in coarse fragment content with depth. Soils with coarse fragment contents up to 60 percent by volume will be salvaged in some areas to provide erosion protection on the impoundment face.

Soil materials will be salvaged from all areas to be disturbed, with the exception of slopes over 50 percent and soil storage areas. Soil salvage depths, acreages, and volumes are listed by soil series and disturbance in Table 42-1. Soil will be direct hauled whenever possible, or otherwise stored in stockpiles.

The Montanore Project proposes to salvage soil in two lifts on a portion of the tailings impoundment area. Those map units selected for double lift salvage (TpC, TgC and TgD), have higher percentages of coarse fragments in the subsoil. Subsoil containing coarse fragments redistributed over the impoundment face will reduce soil slippage and provide erosion protection. This salvage and redistribution method will not be required on waste rock dumps, facility areas, portal patios, and other associated disturbances because they consist of less erosive materials.

No special handling or redistribution considerations are required in segregating two lifts other than designating room for the second lift at appropriate storage areas.

Prior to soil salvage, commercial trees will be harvested on all areas to be disturbed. Non-merchantable trees, shrubs, and slash will be dozerpiled into windrows (using a brush blade to minimize soil accumulation) and burned. All requirements of the Montana Slash Disposal Law will be observed.

Soil materials will be salvaged using scrapers or dozers, front-end loaders, and trucks. Salvage material will include organic debris such as residual slash, stumps, and ashes from burned slash piles. Every effort will be made to minimize compaction during soil handling operations. Soil will be handled only when it exhibits good tilth and is moderately dry. Soil will not be disturbed again until it is redistributed.

42.2 STORAGE AND PROTECTION

Soil will be stored in stockpiles located as strategically close to sites of eventual redistribution as possible. Stockpiles will be constructed with 2.5H:1V side slopes and 3H:1V ramps where possible The estimated life of each stockpile is the life of the mine. All stockpile sizes will vary throughout the life of the mine as incremental salvage and reclamation is implemented.

As stockpiles reach design capacity, they will be stabilized. The stockpile surface will be loosened if necessary to provide a proper seedbed. The interim seed mixture will be drill or broadcast seeded onto the top and ramps of the stockpile, and sideslopes will be broadcast-seeded or hydroseeded. Seeding will be conducted during the first appropriate season following stockpiling. Fertilizer and mulch will be applied to the piles as necessary.

Weed control will be an important aspect of the soil storage and protection. A weed control plan will be developed and the appropriate measures will be employed to minimize weed issues.

42.3 REDISTRIBUTION

Soils salvaged from distributed areas will follow an average redistribution depth of approximately 24 inches on dam faces and 18 inches on all other disturbance areas. Soils will be redistributed on slopes of 2H:1V or flatter using scrapers and/or tracked dozers. During soil redistribution an effort will be made to create small trenches perpendicular to the slope (as dozer tracking) which will catch seed and reduce erosion.

On 1.5H:1V slopes, soil will be redistributed using a backhoe with an extended reach. Temporary roads will be dozed to allow soil spreading on slopes exceeding the backhoe reach. These temporary roads will be removed by the backhoe as it retreats. Soil will be spread with the backhoe bucket and left in a roughened condition for revegetation.

Prior to soil redistribution or revegetation, compacted areas (especially patio areas, roads, soil storage areas, and the facilities area) will be ripped to reduce compaction. This will also eliminate potential slippage at layer contacts and promote root penetration. Soil materials will be applied in lifts as thick as possible to decrease compaction. Organic debris that has been salvaged and stored in soil stockpiles will be respread along with the soil. This will create microsites (thereby enhancing seedling success) and reduce soil movement by creating a rough seedbed surface.

42.4 FERTILIZATION

Nitrogen is normally the most growth-limiting nutrient of forest soils. Additions of phosphorus, potassium, and sulfur rarely improve forest yields over application of nitrogen alone (Heilman, 1971; Miller and Reukema, 1974). Nitrogen is usually applied as urea (containing 46 percent nitrogen) or as ammonium nitrate (containing 34 percent nitrogen). However, site and species response to fertilizer application is variable. The application of nitrogen fertilizer to young stands of mixed conifers in northern Idaho resulted in highly variable, short-lived growth responses (Graham and Tonn, 1985).

Application rates for fertilizer will be based on soil tests; rates will be formulated to achieve soil macronutrient levels capable of promoting plant growth and productivity. Highly soluble phosphorus fertilizer materials will be evenly broadcast prior to seeding. The soil surface will then be disced and/or harrowed along the contour to break up large clods, prepare an appropriate seedbed amendable to drill seeding and incorporate the fertilizer into the soil. Fertilizer and mulch will be applied concurrently with seed on any steep slopes which are selected for hydroseeding. Slopes exceeding 3H:1V that are not hydroseeded, will be fertilized by hand. Nitrogen fertilizer will not be applied during seeding but will be eventually broadcast over the soil surface early in the subsequent growing season, since it is not required for seedling establishment but is used to enhance plant productivity (Graham and Tonn, 1985; Jacobsen, Thompson and Ryker, 1980; Miller and Harrington, 1979). Vegetative characteristics such as vigor, color, growth rate, etc., will be monitored to determine soil fertility. If plant nutrition deficiencies appear, micronutrient testing will be conducted and appropriate measures will be taken to correct the problem.

43.0 REVEGETATION

The purpose of revegetation is to stabilize disturbed areas, re-establish communities that are as ecologically comparable as possible to pre-mine conditions and restore watershed, wildlife, livestock, recreational, and aesthetic values that meet post-operation land use objectives. Existing vegetation, species selection, revegetation mixtures and rates, site preparation, seeding methods, planting methods, mulching and interim revegetation are addressed in Sections 43.1 through 43.8.

43.1 EXISTING VEGETATION

A thorough description of vegetation resources is presented in Appendix E. Habitat types and important species are summarized by disturbance.

Tailings Facility

The topography of the proposed Little Cherry Creek tailings disposal area is relatively gentle with elevations ranging from 3,280 to 3,800 feet. Upland sites support the western hemlock/Queencup Beadlily (WH/QB) H.T. (habitat type), while lower elevations, along Little Cherry Creek, are dominated by the western red cedar/lady fern (WRC/LF) H.T. Small wetlands have developed where depressions with poor drainage collect and retain surface runoff.

The WH/QB H.T. covers 80 to 90 percent of the proposed tailings disposal area. A majority of the area has been logged by clearcutting of the overstory. Clearcutting followed by slash burning has favored plants adapted to disturbed conditions and increased amounts of solar radiation. Sixty-eight plant species were recorded for undisturbed sites for this H.T., whereas 106 species were recorded for sites that had been logged. Table 43-1 shows the canopy cover in either clearcut or unlogged areas of this H.T. Plants that increased following logging of the WH/QB H.T. include: black cottonwood, snowbrush ceanothus, dwarf bilberry, white spirea. Sitka alder, Oregongrape, trumpet honeysuckle, serviceberry, kinikinnick, pachistima, white clover,

Virginia strawberry, fireweed, pinegrass, western fescue, northwest sedge, and purple reedgrass. Because these species increase with logging disturbance, they are good candidates for mine reclamation where commercial plant material sources exist. Both logged and mine reclamation areas have soil horizons that are disturbed, have altered soil nutrient conditions and altered moisture and solar radiation regimes.

The WRC/LF H.T. is one of the wettest plant communities (other than wetlands) that grow on the proposed tailings disposal site. Typically, this H.T. occurs on narrow discontinuous terraces adjacent to the stream. Wet microsites with water at or near the surface are vegetated by devil's club or other moisture-loving species such as bog orchid, arrowleaf groundsel, and reed mannagrass. Species of this H.T. with absolute canopy cover values of more than 1 percent include: western red cedar (34 percent), black cottonwood (17 percent), western hemlock (15 percent), Engelmann spruce (7 percent), grand fir (4 percent), Sitka alder (11 percent), devil's club (4 percent), snowberry (5 percent), red osier dogwood (4 percent), yew (2 percent), alder buckthorn (2 percent), serviceberry (1 percent), lady fern (33 percent), starry Solomon's seal (13 percent), horsetail (6 percent), oak fern (6 percent), bracken fern (5 percent), enchanter's nightshade (4 percent), heartleaf arnica (4 percent), monks hood (4 percent), arrowlead groundsel (3 percent), twisted-stalk (3 percent), tiarella (3 percent), sweet-scented bedstraw (2 percent), baneberry (1 percent), goldthread (1 percent), reed mannagrass (10 percent), and sawbeak sedge (1 percent).

Most undisturbed sites of this H.T. in the Little Cherry Creek area, are in late stages of ecological succession. On limited areas, however, where this H.T. has been logged, Engelmann spruce, black cottonwood, Sitka alder, and red osier dogwood form a dense overstory.

Ramsey Creek Plant Site

The Ramsey Creek adit and plant site are located in the upper reaches of the drainage in a steep, narrow canyon. Four habitat types will be affected by development at the Ramsey Creek site. More than three-fourths of the Ramsey Creek site has been logged.

Logging has disturbed most of the WH/QB H.T. which occupies lower, south-facing slopes above the riparian zone of the Ramsey Creek site. Clearcut portions of the H.T. have seral stands of tree saplings and seedlings as well as high shrub canopy cover. Values for plants with at least 1 percent of canopy cover in the clearcut portion of the H.T. are as follows: Englemann Spruce (13 percent), Douglas-fir (4 percent), subalpine fir (2 percent), western white pine (1 percent), pachistima (18 percent), huckleberry (15 percent), Sitka alder (5 percent), white spirea (4 percent), thimbleberry (3 percent), fireweed (11 percent), starry Solomon's seal (5 percent), pearly-everlasting (4 percent), heartleaf arnica (3 percent), roundleaf violet (1 percent), bracken fern (1 percent), Columbia brome (2 percent), orchardgrass (1 percent) and timothy (1 percent).

The riparian vegetation along Ramsey Creek is composed of the western hemlock/oak fern (WH/OF) H.T., and the western red cedar/devil's club (WRC/DC) H.T. Wet stream margins and seeps draining from the steep slopes above the creek support the WRC/DC H.T. The WRC/DC H.T. is in the late stages of ecological succession because logging has been restricted in proximity to the stream. Common species are: grand fir (17 percent), western hemlock (12 percent), Engelmann spruce (11 percent), devil's club (31 percent), yew (20 percent), Rocky Mountain maple (6 percent), menziesia (3 percent), Sitka alder (3 percent), swamp gooseberry (1 percent), oak fern (18 percent), tiarella (8 percent), Queenscup Beadlily (6 percent), lady fern (5 percent), meadowrue (3 percent), starry Solomon's seal (1 percent), heartleaf arnica (1 percent), and twisted-stock (1 percent).

On drier microsites and terraces interspersed with the WRC/DC H.T., the WH/OF becomes dominant. Typically, the species diversity of this habitat type is low and the understory is quite open. Western hemlock is often the only species in the overstory, forming 80 to 100 percent of the forest canopy cover. Other common species include: oak fern (18 percent), lady fern (2 percent), tiarella (4 percent), and small-flowered woodrush (2 percent). Devil's club typically forms dense clumps at west microsites within this H.T.

The vegetation on the steeper, north-facing slopes on the south side of Ramsey Creek at the proposed adit is transitional between the WH/QB H.T. and the subalpine fir/menziesia (SF/M) H.T. The SF/M H.T. occurs on the coolest aspects which collect and retain snow late into the spring. The dominant trees are subalpine fir, Douglas-fir, western larch, and Englemann spruce. The dense shrub layer is dominated by menziesia, Rocky Mountain maple, Sitka alder, huckleberry, and Utah honeysuckle. Beargrass, sidebells pyrola, roundleaf violet, sweet-scented bedstraw, Columbia brome, and blue wildrye are usually present in the understory.

Libby Creek Adit Site

The site of the adit and associated facilities on Libby Creek is located on the lower slopes, directly above a relatively wide area of the floodplain of Libby Creek. Approximately 50 percent of the area to be affected by the proposed development has been logged. Successful reclamation is exhibited at this site and can provide valuable information on future reclamation efforts.

The upper slopes of the Libby Creek site support the WH/QB H.T. This habitat type is replaced by the WH/OF H.T. on the floodplain and lower benches adjacent to Libby Creek. The clearcut portions of the WH/QB H.T. have numerous seedlings and saplings of Englemann spruce, western larch, western white pine, Douglas-fir, and grand fir with occasional individuals of western hemlock and western red cedar. Huckleberry, Scouler willow, Sitka alder, pachistima, thimbleberry, and mountain-ash are common shrubs. Understory dominants are: fireweed, pearly-everlasting, heartleaf arnica, Canada goldenrod, tiarella, roundleaf violet, goldthread, and beargrass.

The forested portions of the site that were disturbed were mature stands of the WH/OF H.T. Re-disturbance of the site to support the evaluation adit extension would impact a revegetated grass, herbs, and shrub communities. The original habitat was characteristically 80 to 100 percent canopy cover of western hemlock with few other trees in the overstory or understory. Common shrubs are devil's club, huckleberry, and Pacific yew. The understory was quite sparse with scattered individuals of oak fern,

fiveleaved bramble, roundleaf violet, tiarella, sidebells pyrola, and clasping leaf twisted-stalk.

Roads

Tailings Impoundment

The Bear Creek road is located upslope near the western margin of the proposed tailings disposal area. Widening this road would result in losses of small amounts of the WH/QB H.T. that border the road. Where the road crosses drainages, small amounts of the WRC/LF H.T. would be destroyed.

Ramsey Creek Plant Site

The access road would follow the existing road that parallels Ramsey Creek on the lower south-facing slope. From the Bear Creek Road to upper Ramsey Creek, the existing road traverses mostly clearcut areas of the WH/QB H.T.

Libby Creek Adit Site

The access road to the proposed mine site traverses clearcut areas and forested stands of WH/QB H.T.

43.2 SPECIES SELECTION

Selection of plant species for revegetation is based on pre-mine species occurrence, post-operation land use objectives, presence on pre-mine disturbances, establishment potential, growth characteristics, soil adaptation and stabilizing qualities, wildlife and livestock palatability and commercial availability. Redistributed soil and substrate properties (texture, coarse fragment content, water holding capacity, permeability and erosion potential) have also been taken into consideration.

Many important species present on the project are not commercially available or would not be expected to establish readily on disturbed sites, particularly in the absence of the moderating effects of an established tree canopy. A primary consideration in the selection process was to identify understory species capable of rapid establishment to provide surface stability until shrub and tree species could become established.

Reclamation experience at an existing nearby silver mine was reviewed. A reconnaissance-level survey conducted by ASARCO at their Troy Project evaluated revegetation success and usefulness of species seeded to stabilize disturbances on a tailings impoundment dam face, a topsoil stockpile and a tailings line corridor (Culwell et al., 1987).

The report concluded:

> Species seeded in 1984 included timothy, hard fescue (Durar), streambank wheatgrass (Sodar), smooth brome (Manchar), alsike clover, and white clover. This was a U.S. Forest Service-approved mix. Results of the survey indicated that the initial establishment of seeded species was good, with the exception of streambank, wheatgrass, and white clover. Based on percent bare ground, which averaged five percent and did not exceed 25 percent, the disturbed sites sampled appeared to be stabilized.

Potential plant material dealers located within the geographical region are listed in Table 43-2. As new releases of species are made, they will be considered for inclusion in the revegetation mixtures. Species evaluations will be made on reclaimed sites within the permit area throughout the life of the operation.

During the course of the operation, seed of species that are preferred by grizzly bears may be collected; limited collections will be used to supplement existing seed mixtures.

43.3 MIXTURES AND RATES

Mines Management proposes to re-establish coniferous forest with a shrub and herbaceous understory on most disturbed sites. Two mixtures representative of expected moisture, temperature and substrate conditions have been developed. Mixture one includes species found on moist, relatively cool sites including cold-air drainages. Mixture two includes species found on sites that exhibit a relatively wider range of amplitude for growing conditions. The mixtures include grass, forb, shrub and tree species that are present in pre-mine habitat types and species which are expected to establish well on post-operation sites. The mixtures are presented in Tables 43-3 and 43-4.

Forbs will be deleted from interim and permanent revegetation mixtures along life-of-operation and post-operation roadsides to avoid attracting bears.

Tree shrubs species will not be seeded; planting will be conducted on portions of the tailings impoundment (and associated disturbances), portions of the Ramsey Creek plant site and on portions of the Libby Creek Adit site, as described in Section 43.6 (Planting Methods). Shrubs and trees will not be planted on the west side mine entries, soil stockpile sites, along road corridors or on the powerline corridor.

Road corridors will use a combination of the seed mixture and will be consistent with the overall plan. Natural reinvasion will support the plant community diversity. Shrub and tree growth will be controlled on the powerline corridor.

Seeding rates have been designed to total approximately 90 to 100 pure live seeds (PLS) per square foot for drill seeding; the broadcast rate will be roughly twice that of the drill rate. This seeding rate will be used initially to evaluate germination success and the effects of interspecific competition. Initial evaluation may favor a lower rate for subsequent revegetation efforts. Seeding rates given for forbs are for a combination of any or all species listed (based on availability), to provide flexibility for the operator. An

annual cereal grain may be included in seedings at a rate appropriate to moderate sites and provide rapid initial stabilization.

Seed mixtures may be modified for the following reasons: limited species availability or poor seed quality, site differences, poor initial performance or advances in reclamation technology. If noxious weeds occur on revegetated areas, forbs will be deleted from mixtures due to their susceptibility to chemical control. Modifications will be undertaken only with the concurrence of appropriate regulatory agencies.

All seed will meet the requirements of the Federal Seed Act (7 U.S.C., Section 1551-1610, inclusive) and the seed and noxious weed laws of Montana. Seed will be certified and will have a minimum purity of 95.0 percent, minimum germination of 85.0 percent and maximum weed content of 0.5 percent.

43.4 SITE PREPARATION

Seedbed preparation will be conducted immediately after grading, soiling, and fertilizer application. On slopes that are 33 percent or less, the seedbed will be disced and harrowed along the contour to break up large clods. On slopes exceeding 33 percent, on sites too narrow to negotiate equipment or on sites where organic debris has been respread, the soil surface will be left in a roughened condition. An irregular seedbed will provide microsites for plant germination and reduce soil movement on steeper slopes. Seed and mulch will be applied to fresh road cuts and fills as soon after construction as possible to ensure coverage by natural sloughing.

43.5 SEEDING METHODS

Seeding will be coordinated with other reclamation activities to occur as soon after seedbed preparation as possible. Fall seeding is recommended, based on local soil moisture conditions, germination requirements of selected species, and timing of construction activities. Spring seeding will be practiced if areas are ready for revegetation and access is possible. Interim revegetation is discussed in Section 43.8 (Interim Revegetation).

Two methods of seeding will be utilized: drill and broadcast. Drill seeding will be utilized on slopes less than or equal to 3H:1V; it will not be used on rocky surfaces or on surfaces where organic debris has been respread. This technique results in proper depth placement of seed and promotes good contact between seed and soil. Drill seeding will be done along the contour wherever the surface is not level. Drill row spacing will range from 7 to 14 inches.

Broadcast seeding will be employed on rocky areas, on slopes steeper than 3H:1V, on areas where organic debris has been respread and on small disturbances. Seed will be broadcast using a manually operated cyclone-type bucket spreader, a mechanical seed blower or hydroseeder. Seed will be mixed frequently to discourage settling. Where possible, broadcast seeded areas will be chained or harrowed to cover the seed. Where slope conditions allow, broadcast seeded areas will be dozer-tracked perpendicular to the slope. On small or inaccessible sites, hand raking will used to cover seed.

When hydroseeding is used, seed, fertilizer and mulch (about 250 pounds per acre) will be sprayed in one application. Where hydromulching is used, a second application will spray the remainder of the cellulose fiber mulch (to achieve a total of one ton per acre) and a tackifier (at the manufacturer's recommended application rates).

Revegetation mixtures and seeding/planting methods are presented by disturbance in Table 43-5.

43.6 PLANTING METHODS

Mines Management will work with the Forest Service to develop harvest descriptions that outline pre-mining timber removal and post-mining reforestation recommendations. Deviations from recommendations set forth in this reclamation plan will be negotiated on a site-by-site basis.

Tree and Shrub Establishment Potential

Six tree species have been selected for reforestation of the Montanore Project area: logdepole pine, western larch, western white pin, Engelmann spruce, Douglas-fir, and subalpine fir. These species are elements of the pre-operation environment and their re-establishment is appropriate for meeting post-operation land use objectives. Use of species will be evaluated on a site-by-site basis; for instance, it may be advisable to delete Douglas-fir from a site which accumulates too much cold air, due to its susceptibility to frost damage. Other species such as Ponderosa pine will be evaluated for use or appropriate sites where further timber harvest is possible.

Lodgepole pine has both excellent expected survival and early growth potential in the Inland Northwest (Pfister, 1976). Methods for lodgepole pine revegetation have been reviewed by Baer et al., 1977; Baumgartner, 1973; Cochran, 1973; Lotan and Dahlgreen, 1971; Lotan and Perry, 1977; Sheppard and Noble, 1976; Stermitz et al., 1974; and Tackle, 1961.

Western larch has fair expected survival and excellent expected early growth in this region (Pfister, 1976). Larch is a seral species that is well adapted to disturbed conditions and ample sunlight.

Western white pin has excellent expected survival and early growth in the Inland Northwest (Pfister, 1976). It is well adapted to short, dry summers and cold winters with heavy snowfall. Seedling establishment is favored by partial shade on moderately severe sites. Once well established, white pine grows best in full sunlight (Fowells, 1965).

Pfister (1976) classified spruce as having good expected survival and fair expected early growth in the region. Spruce tolerates shad and lower temperatures (Fowells, 1965).

Pfister (1976) reported that the expected survival of Douglas-fir is good and expected early growth is fair. New seedlings require light shade but grow best in full sunlight (Fowells, 1965). Establishment and growth has been discussed by Crouch and Paulson (1968), Hatch and Lotan (1969), Kittams and Ryker (1975), Noble et al. (1978), Rehfeldt (1979), Strothmann (1976), and Wells (1979).

Subalpine fir is a long-lived, dominant element in numerous vegetation associations throughout its range. The germination and early survival of subalpine fir is usually best on exposed mineral soils and humus, although it also establishes on severe sites such as recent burns, lava flows, talus slopes, avalanche chutes and near timberline (Franklin and Mitchell, 1967). Shade is a necessary prerequisite to establishment and early survival. Subalpine fir is a slow-growing species, requiring 20 to 40 years to achieve a four to five foot height under favorable conditions (Alexander et al., 1984). In a study in the Intermountain West, however, average annual height growth of seedlings for the first ten years was 4.5 inches on clearcuts and 3.2 inches on partial cuts (McCaughey and Schmidt, 1982).

Shrubs that have been selected for revegetation include: Rocky Mountain maple, Sitka alder, serviceberry, red-osier dogwood, mountain ash, menziesia, swamp gooseberry, Scouler's willow, Oregongrape, snowbrush ceanothus, globe huckleberry, red raspberry, white spirea, baldhip rose, and snowberry. These species are found in the pre-mine environment and their establishment potential is expected to be good.

Shrubs will be planted on roads only if herbaceous vegetation does not provide adequate erosion control, since shrub plantings may encourage roadside use by wildlife.

Plant rooting systems add strength soil by anchoring it vertically through the profile into fractured bedrock or stable substrate. Lateral strength is supplied by dense networks of

small- and medium-sized roots in the upper soil layers. It has been shown that some hardwood shrubs have rooting systems comparable in strength to tree species (Ziemer, 1981; Ziemer and Swanston, 1977).

The suitability of a number of native shrub species for use on roadcuts in northwestern Montana was assessed by Hungerford (1984). Criteria examined included survival, growth, vigor, natural spread and soil stabilization. Wood's rose demonstrated the highest survivability and regeneration characteristics, even on harsh sites. Bush penstemon and lovely penstemon exhibited an adaptability to both dry and moist situations. Thimbleberry, red osier dogwood, and blackcup did well on southerly exposures, while redstem ceanothus and spirea did well on easterly aspects. Survival rates for shrubs planted together with grasses and legumes were generally equal to or better than for shrubs planted alone. Grasses and legumes provided a rapid ground cover and protection against surface erosion while shrubs were becoming established.

The Montanore Project will consider collecting seed or plant materials on-site to ensure the genetic adaptation of planting stock to local environmental conditions. Site adaptation enhances the chances for survival, growth, and reproduction after outplanting, which are necessary preconditions for long-term successful reclamation.

Planting Rate

In the Inland Northwest, Foiles and Curtis (1973) recommend the establishment of 400 to 500 seedlings per acre. Hall (1971) recommends planting of 600 or more seedlings on harsher sites to obtain 300 seedlings after three years. The Cabinet Ranger District cites planting rates ranging from 400 to 680 trees per acre. The Montanore Project proposes to plant 435 trees per acre. Based on a survival rate of 65 percent, the final anticipated stocking rate after 15 years will be approximately 285 trees per acre. Shrubs will be planted at a rate of 200 stems/acre.

Planting Strategy

Spacing will either be 1) continuous on slopes to enhance stability and provide a screening effect on those disturbances visible from a distance; or 2) in randomly placed groupings on level to gently sloping areas to enhance grazing habitat. Species planting ratios vary by mixture; ratios may be adjusted on a site-by-site basis. It is also expected that natural regeneration of tree and shrub species will occur on those sites abutting existing stands.

Where continuously spaced, trees and shrubs will be planted in strips alternating with strips that have been seeded with an herbaceous understory mixture. Planting strips will not be seeded since grass and forb competition is a major deterrent to short-term forest regeneration (Lotan, 1973; Tackle, 1961; Fowells, 1965; Lotan and Dahlgreen, 1971; and Shearer and Schmidt, 1970).

Seedlings will have a competitive advantage until grasses and forbs seeded in adjacent strips invade the planting strips. The narrow configuration of planting strips should prevent excessive erosion from the sites until seedlings become established. Continuous strips may provide easy travel corridors for wildlife, resulting in trampled and browsed seedlings. If this becomes a problem, it may be necessary to make the strips discontinuous, or employ wildlife control measures.

Groupings of trees and shrubs will be planted in “islands” which have not been seeded with the herbaceous understory mixture.

Competition between herbaceous vegetation and seedlings will be reduced by scalping, chemicals (if approved), mulching, or selective broadcasting of the herbaceous seed mixture.

Planting Time

The appropriate planting time will be determined by site conditions such as soil moisture, soil temperature, air temperature, aspect and accessibility. Generally, spring plantings are favored in this region. First-year survival of Douglas-fir, Engelmann spruce, grand fir

and western larch was studied by Sinclair and Boyd (1973) in northern Idaho. Survival of spring-planted trees was better than that of fall-planted trees. Fall planting results were more variable, being more influenced by species planting date and aspect. The authors concluded that if fall planting is necessary, it should be restricted to drier sites. Western larch should not be planted in late spring or prior to mid-October; spruce, however, should be planted prior to October 1.

Survival data from fall plantings in the Boise National Forest (Ryker, 1976) indicated fairly good results for ponderosa pine (1-0 and 2-0) and lodgepole pine (2-0). Survival rates ranged from 60 to 85 percent over a three-year period for plantings conducted in late October—early November.

Spring planting must be initiated as early as possible (preferably in March or April) and end as early as possible. If accessibility becomes a problem, fall plantings will be practiced. Fall planting should be delayed until the planting medium is thoroughly moistened to a depth of one foot (Schubert and Adams, 1971).

Nursery Stock

The decision to use containerized stock or bare-root stock will be based on species, site characteristics, growth medium and substrate, season of planting, availability, and cost. Considerable literature exists regarding the relative advantages and disadvantages of using each type of stock (Gutzwiler and Winjum, 1974; Johnson, 1974; Tinus, 1975; Tinus and McDonald, 1979; Stein and Owston, 1977; USDA Forest Service, 1981).

The use of containerized stock (2/0) is recommended over bare-root stock for use on coarse, shallow soils, when available. Because of the shape of the tubling, containerized stock is easier to plant in this type of medium (Stein, 1976). Use of containerized stock is also recommended for fall planting of sites which are not accessible until late spring. Certain species, including true firs, hemlocks, cedars and spruces produce better in containers than as bare-root stock. There is more flexibility regarding planting season since the protective container permits planting at times when bare-root stock is

unavailable or improperly conditioned. Drawbacks inherent to bare-root stock include loss of roots during lifting, loss of vitality during extended storage, root damage due to desiccation and injuries sustained during handling, transport and planting.

If containerized stock is not used, the planting rate of bare-root stock will be increased to allow for expected mortality. Evaluation of planting success using containerized stock versus bare-root stock will be made.

Stock will be delivered to the site as close to the time of planting as possible. No stock will be handled when the air temperature is below freezing and no plantings will be made when frost is in the soil.

The development of mycorrhizae on roots of forest trees is acceptable as necessary for good survival and growth, especially in soils low in available nutrients (Wright, 1957). It may be desirable to obtain stock raised in containers where the soil medium has been inoculated with mycorrhizae, if available.

Planting Techniques

Planting will be accomplished using hand tools and power-driven augers or other machines, depending on size and condition of the planting area, type of planting stock and equipment availability. Prosper planting procedures (as outline in Forest Service guidelines and standard planting contracts) will be observed to maximize seedling survival. Proper procedures include protection of stock prior to planting to avoid root damage, observance of proper planting techniques and adequate care after planting.

Partial shade is an important factor in seedling establishment. Ryker and Potter (1970) observed seedlings growing in a clearcut in the shade of shrubs, residual trees, accumulations of logging debris and snags. Results of research conducted on seedlings exposed to partial shade versus direct solar radiation show dramatically higher survival rates for shaded seedlings (Ryker, 1970; Haig, 1936). The Montanore Project will use logging debris, snaps or other sources of “dead shade”, if available, on planted areas.

If seedling survival is less than 65 percent by year three of planting, the MDEQ and Kootenai National Forest will be consulted to determine whether supplemental planting is necessary.

43.7 MULCHING

Mulch will be evenly spread over seeded areas at rates dependent on seeding method and slope. If available, only noxious weed-free mulches will be used. Straw mulch will be applied at a rate of 0.5 to 1.0 ton/acre on drill-seeded surfaces and 1.0 to 1.5 tons/acre on steeper slopes where conventional broadcast methods are used. Mulch will be anchored into the seedbed on slopes that can be negotiated by a mulch crimper or disc. Mulch will not be anchored on slopes exceeding 3H:1V that are not hydroseeded; jute netting or a comparable appropriate product will be used as necessary to anchor mulch on these slopes. Straw mulch will be applied at a rate of one ton/acre on hydroseeded areas. A tackifier will be applied at the manufacturer's recommended rate on areas that are mulched in the fall and on areas such as road cuts and fills which require prompt stabilization. Mulching aids in erosion control and soil moisture retention and provides supplemental organic material.

43.8 INTERIM REVEGETATION

In order to reduce erosion and sedimentation during the life of the operation, certain disturbances listed in Table 43-5 will be vegetated prior to final reclamation. Soil will not be applied to temporarily revegetated areas. The sites will be broadcast seeded with species listed below. Mulch and fertilizer will be added as necessary. Interim revegetation will occur during the first appropriate season after construction is completed. Final reclamation will occur at the completion of operations.

INTERIM REVEGETATION MIXTURE

	Seeding rate (PLS)	
Species	**pounds/acre**	**PLS/sq.ft.**
Agrostis alba	0.1	11
Alopecurus pratensis	1.0	13
Dactylis glomerata	1.0	15
Phleum pretense	0.5	15
Poa pratensis	0.25	25
Lotus corniculatus	1.5	15
Total	**4.35**	**94**

44.0 WATER RESOURCES

Upon completion of mining and ore processing activities, the post-operational reclamation program will minimize long-term impacts on water resources. After reclamation, water resources in the Montanore Project area are intended to approach pre-mine conditions. Hydrologic monitoring will continue after completion of mining activities to assure protection of water resources

44.1 SURFACE WATER

The plant facilities area will be regraded and contoured to maintain the natural, pre-mine drainage system. Drainages on fill material will be riprapped, if necessary, to control erosion. All drainage and diversion structures used during the operational period at the plant site will be eliminated after cessation of operations.

The above-ground pipeline system located between the tailing impoundment and the plant site will be removed, including stream crossing, diversion ditches, and support structures. All natural surface water drainages will be maintained in pre-mine conditions.

The tailings impoundment surface will be graded to slope from the embankment crest to the head of the impoundment. The embankment face will remain at a slope of about 3H:1V along all sides of the impoundment. The surface of the impoundment will be contoured to have a final grade of about 0.5 to 1 percent to allow runoff to flow to a diversion ditch at the head of the impoundment. Water that collects in the diversion ditch will be routed to the Bear Creek drainage north of the impoundment. The diversion ditch at the head of the impoundment and any areas of potential erosion will be riprapped where needed.

Reclamation of the tailing impoundment site (revegetation and regrading) will promote runoff and evapotranspiration of precipitation that falls on the impoundment surface, and prevent runon from adjacent areas. This will significantly reduce water moving vertically

into the tailings material. After the operation ceases the phreatic surface in the tailings material will decline and approach the base of the impoundment. Seepage of water through the base of the impoundment will decrease as recharge water is reduced and the phreatic surface declines. There will be no ponding of water on the impoundment surface. *A closure plan will provide detailed seepage analyses, surface water flow paths and other pertinent design information necessary for the agency review and approval process. The design objectives are to reduce inflow from the surrounding area into the impoundment. Consolidation of the tailings, capping, and revegetation provide additional mechanisms to minimize infiltration.*

The diversion dam for the upper Little Cherry Creek drainage will be a permanent part of the post-operational diversion. This dam receives runoff from this small drainage and will divert the water into the permanent diversion channel. The long-term suitability of riprap will be evaluated at the completion of operations to ensure permanent protection from erosion. *A detailed diversion design is being prepared and will be submitted to the agencies for review.*

The only other impoundments associated with the Montanore Project will be the seepage collection pond just downstream of the tailings pond embankment and shallow water disposal sites that may be used for disposal of excess water. All these small impoundments will be filled, regraded, and reclaimed to approximately the original ground configuration.

The only large diversion used in the project will be the permanent diversion channel adjacent to the tailings impoundment. As described in this permit application, this channel will be designed and constructed to be a permanent diversion. The primary reclamation effort for this channel will be to assure the channel and the small drainage downstream of this channel are protected from long-term erosion. As described in Subsection 16.8, a 3-foot thick layer of riprap will be provided to prevent erosion of the channel. Also, to minimize erosion of the natural stream channel downstream of the diversion channel, rockfill bars will be constructed to dissipate flow energy. The 2H:1V

slopes of the diversion channel will be benched to control surface water runoff. During construction of the initial impoundment stage, the slopes will be covered with 1.5 feet of soil and revegetated to minimize erosion.

During the 16-year operational life, the channel will be regularly inspected. The performance during this period will be an indicator of long-term performance after pond-closure. Any signs of slope instability will be rectified by flattening slopes, constructing additional benches, providing drainage, increasing riprap thickness or by using other suitable methods.

The only other diversions in the Montanore Project will be small temporary runoff diversion ditches at the upper end of the tailing impoundment and the plant site diversions. All these diversions will be small, will be removed during final reclamation, and will be regraded and revegetated. The final runoff diversion ditch will be left on the upper end of the tailings impoundment to divert water into the Bear Creek drainage. This ditch will be riprapped with rock to prevent erosion and will be designed for long-term stability. The reclaimed tailings surface will slope into the hillside so this diversion cannot fail by overtopping. Detailed design of the final diversion ditch at the head of the tailings impoundment will be based on results of the 16 years of impoundment operation. During this operational period, temporary diversion ditches will be used on the upper end of the impoundment to divert excess runoff water. Runoff data and performance of the temporary diversions will serve as a basis for design of the post-operational, permanent diversion ditch.

It is expected that all surface water from the reclaimed areas will meet the requirements of the Montana Water Quality Act and Montana's Surface Water Quality Standards. No long-term treatment of surface water from the permit area is planned and none will be required. Some short-term use of sedimentation ponds may be necessary to remove sediment during the first few years after the area is regraded, topsoiled, and revegetated. As soon as the area is stable, the sedimentation ponds will be removed and the pond areas reclaimed.

44.2 GROUNDWATER

The only groundwater concerns in the post-operational, reclaimed areas will be the tailing impoundment and water in the underground workings. Reclamation of the tailing disposal pond will include regrading, soil placement, and revegetation. All three measures will significantly reduce post-operational infiltration into the reclaimed tailings surface. After the mining is complete, the seepage collection pond will continue to pump water back to the tailings impoundment until it is shown that the seepage is not adversely impacting groundwater resources. The quality of seepage water from the tailings pond is expected to be good and no long-term groundwater quality problems are expected. The post-operational monitoring system will be used to determine the quality of groundwater. If any post-operational groundwater problems occur, the nature of the problems will be evaluated and measures implemented to correct the problems. After the operation is completed the groundwater resources are expected to meet all state and federal water quality requirements.

Data obtained on water inflow to underground workings during the operational phase will be utilized to predict whether or not the adits will have a long-term outflow of water and whether this water will meet state and federal quality standards. In March 1991, a total of 66 samples from the exploration drill core including the hanging wall, footwall, and barren zone were analyzed for acid-base potential. The average of all samples and of each lithologic subcategory show a net acid neutralizing capacity (Table 44-1 and Table 44-2).

Sampling was done to determine the acid generating potential of rocks that will be left in place following the cessation of mining. Samples were collected from five feet to twenty feet away from the boundaries of economic mineralization to simulate the zone potentially available for oxidation. Samples from within the barren zone, which lie between the B1 and B ore zones, were selected to include by high lead samples and more typical samples with lesser lead grades. Samples were analyzed by Energy Labs in Billings, Montana and are reported in tons $CaCO_3$ equivalent/1,000 tons. In June 1991 an

additional 28 samples representing ore left as pillars were collected from exploration drill core. The average of these samples for all three lithologies show negative acid-base potential (Table 44-3).

While no problems are expected to occur, if it is determined that there may be post-operational problems with drainage from the project adits, then tunnel plugging will be considered. Tunnel plugging technology has been well developed. Design, construction, and testing of underground plugs is well documented for the deep gold mines of South Africa where reasonably hard rock and high water pressures are experienced. In South Africa, plugs have been installed at pressures up to 1,400 psi with residual leakage of less than 1 to 2 gpm (Steve, Phillips, Grouting Consultant, February, 1989).

Design, location, and installation techniques are all important for successful plugging. It is anticipated that rock conditions in the Montanore Project adits will be well suitable for installation of plugs. Long sections of competent rock should be readily available in the adits, water quality is expected to be good, and installation of plugs should be relatively simple.

Plug Location

The choice of location of the plugs is important in determining the success of their application. Obviously, it is not always possible to find the perfect plug site, but there are some requirements which should be met where possible. In some cases, a deficiency in the available site, when compared with the perfect site, can be offset by the plug design. There is no generic plug design, and the basic design principles must be modified and adapted to suit the existing site conditions. One plug would be designed and installed for each adit that would have an outflow of water of undesirable quality.

For an optimum location the following criteria should be used to determine the site for a plug. Rock surrounding the plug site must be sufficiently strong and competent and free from geological problems (i.e. faults, fracture systems, dikes, weathering, etc.), and remote from highly stressed areas and other mined openings whether they are in

existence or are planned for the future. The lithostatic stress at the plug site must be greater than the expected hydrostatic head, preferably by a factor of at least two. All other factors being equal, the plug should be constructed in the smallest cross-sectional area of the drift so the applied hydrostatic forces are minimized.

Conceptual Design and Type of Plug

The optimum plug type for the Montanore site is a parallel sided plug (Figure 47). Inherent in the design of parallel sided plugs are low contact stress along the concrete-rock interface and long seepage paths around the plug. This will result in low hydraulic pressure gradients along the plug, therefore ease of sealing and maximum effectiveness of the plug as a water barrier.

Assuming the plug will be subjected to a maximum hydrostatic head of 800 ft. or about 350 psi, and that the plug will be installed in a 22-ft. by 22-ft. drift opening, the surface weathering and deterioration of up to 6 inches from each wall, floor, and roof would be removed by mechanical means (not blasting). A conceptual design would likely indicate a plug length should be between 40 and 50 ft. long.

Plug Materials and Construction Aspects

Concrete for the plug would be a high density, low permeability, concrete using Type V Portland cement with up to 30% cement replacement with P.F.A. (pulverized fuel ash). The P.F.A. is used to: (a) achieve good workability of the fluid concrete, (b) decrease the permeability of the set concrete, (c) reduce the amount of heat generated during setting, thereby reducing shrinkage and the possibility of shrinkage cracking, (d) increase the resistance of the set concrete to chemical attack. Water to cement ratios would be kept low to achieve a dense, low permeability concrete and the additional workability required to allow the concrete to flow into the irregular surface of the rock will be achieved by use of plasticizers/water reducers. High concrete strengths are not necessary for parallel sided plugs, however to satisfy other requirements for the concrete (e.g., high density, low permeability, pumping ability) a medium strength concrete would be achieved.

The concrete pour would probably have to be carried out in several stages so the temperature rise in the concrete due to hydration can be controlled and kept to within accepted tolerances. Pre-cooled water for concrete mixing may have to be used as an added precaution against excessive temperature rise in the concrete. The stages of the pour would be such that the cold joints would be oriented normal to the axis of the drift, thus they will not provide a leakage path directly through the plug from the wet end to the dry end.

At the completion of the pour, and after adequate time has elapsed for the concrete to gain strength, cool, and shrink, grout holes would be drilled through the concrete plug to the concrete rock interface. This joint would be grouted initially with cement grout to completely fill any voids or cracks which may exist at the interface and form a tight bond between the concrete and wall rock along and around its total length and perimeter. If further sealing is required, a low viscosity (approximately 1.3 centipoise), highly penetrable, chemical grout would be used to further reduce water flow along this contact zone.

After this area has been grouted, the holes, together with additional holes, if necessary, are extended out in stages into the surrounding rock. The rock is then grouted progressively out from the plug until the holes penetrate the rock peripheral to the drift that has not been subject to stress relief and relaxation or influenced by the presence of the mined opening. Grouting would be carried out with cement or chemical grout, as determined by the size of the fractures or other openings that have to be grouted, at pressures exceeding the expected hydrostatic pressure, but less than the lithostatic pressure, but less than the lithostatic pressure at the plug site. In this way a zone of grouted rock is formed, probably extending, in this case, some 25 to 35 feet into the rock adjacent to the plug. The pressure grouting thus creates a state of confinement along the plug which increases the resistance of the plug to movement and to leakage.

The Precambrian rocks penetrated by the adits at the Libby Creek Adit site are expected to be both strong and competent and should provide sites quite suitable for plugs.

Plugging is a proven technology for controlling water flows in adits and should be appropriate for this project.

45.0 STABILITY

Wind and water erosion control measures are described in detail throughout the General Operating Plan and the Reclamation Plan. These measures involve 1) mechanical practices to minimize fugitive dust, 2) regrading and soil handling techniques to enhance stability, 3) hydrological systems to control runoff and sedimentation and 4) revegetation practices to provide a stabilizing cover. Additionally, geotechnical stability is described in Section 16.8.8 and post-operational stability is part of the Reclamation Plan.

45.1 WIND EROSION

During the construction and operational phases of the project, the following procedures will be practiced to control wind erosion and emissions affecting air quality:

- Periodic watering of all unpaved roads will be practiced or dust suppression agents will be used to reduce fugitive dust.
- Interim revegetation will be practiced on sites susceptible to erosion.
- Two lifts will be used to salvage soils to increase the coarse fragment percentage particularly for soil placed on the tailings embankment face.
- Interim stabilizing measures such as water sprinkling, mulch and tackifiers will be used until vegetation becomes established.
- Where necessary, water sprinkling will be used to control blowing techniques.
- Access roads that are planned to be closed will be regraded, covered with topsoil, and revegetated. Permanent roads that will remain after the operation will have a coarse granular surface to prevent wind erosion. **(section III-80)**

Potential wind erosion problems will be identified during the project operations. This experience will allow design and implementation of permanent measures to reduce or eliminate wind erosion after reclamation.

45.2 SOIL LOSS

The potential for post-operational erosion of soil will be minimized by the following:

- Rills and gullies will be stabilized and revegetated.
- Slopes will be visually inspected periodically throughout the operation to determine evidence of slope failure.
- Road grades will be designed to disrupt natural drainage patterns as little as possible.
- The overall slope of the tailings dam face will be 3H:1V.
- Erosion bars will be constructed on unpaved roads.
- Equipment will work along contours where possible to minimize creation of channels. When work on slopes must be perpendicular to contours, crawler tracking or dragging shall be used to reduce channeling effects of grading.

Soil handling activities will likewise be conducted to reduce potential erosion:

- Soil salvage will occur incrementally with disturbances to minimize the area exposed at any given time. This will reduce the length of time soil remains stockpiled and reduce wind and water erosion associated with soil salvage.
- Soil stockpiles will be located and protected to minimize wind and water erosion. Stockpiles will be located away from drainages on the gentlest slopes available. Stockpiles will be designed with 2.5H:1V sideslopes and will be revegetated for stabilization.
- Direct haul soils handling will be utilized whenever feasible.

Hydrologic measures that will be taken to prevent runoff and sedimentation are:

- A drainage and diversion system will be constructed at all disturbance sites to control runoff and sedimentation during the operation period. This system

will include diversion of offsite runoff waters and containment of runoff and sediment from disturbed areas.

- Windrows of woody debris or logs will be placed parallel to slope contours and the bases of long fills.
- Rights-of-way clearing will be minimized to reduce the total area susceptible to erosion.
- Naturally occurring runoff from hillsides above the plant site will be diverted around the plant site.
- Collection and routing of all water originating within the plant site will be collected and routed to a drainage sump for use as process water.
- A complete sediment control system downstream of disturbed areas will prevent sedimentation in natural drainages in the area.
- A diversion system will be constructed at the toe of the proposed waste dump. This ditch will intercept any runoff from the waste dump and divert it to the water disposal sites or to sediment traps.
- During the life of the operation, seepage collection ditches will intercept sedimentation originating from dam faces.

45.3 GEOTECHNICAL

The tailings impoundment embankment dam will be engineered for long-term stability. This design includes steady-state seepage and seismic loading conditions. The calculated factors of safety for the final operational stage of the dam exceed the minimum acceptable factors of safety and our included in the design reports.

Surface pond water will be evaporated during the reclamation stage thus lowering the phreatic level within the impoundment and embankment tailings dam. *If land application or other methods are required for water management, permit conditions will be maintained and include water treatment if required.* This lowering of the phreatic level will increase dam stability.

The tailings impoundment surface will be graded to drain surface water away from the downstream slope of the dam. The impoundment area and embankment dam slope will be revegetated to minimize surface erosion and infiltration.

The slopes of the diversion channel will be benched and vegetated to control surface water runoff and minimize erosion. The channel invert and portions of the slope where runoff water may contact soils will be rip rapped to prevent erosion.

46.0 POST-OPERATIONAL SOLID WASTE DISPOSAL

After removal and salvage of all buildings, pipelines, equipment and facilities, any remaining solid waste will be disposed of in accordance with laws and regulations. Inert waste (concrete, plastic, steel, wood, etc.) will be buried in on-site waste disposal areas or placed underground in an acceptable location.

47.0 MONITORING AND MANAGEMENT

Stability, soils, water resources, revegetation, and noxious weeds will be monitored as part of the reclamation process.

47.1 GEOTECHNICAL STABILITY

The following provides a general discussion of stability monitoring; however, final monitoring for the tailings impoundment will follow standard engineering practices and agency requirements at the time of closure. *A final monitoring plan will be developed that will address additional monitoring requirements stipulated by the agencies for both operational and post-closure monitoring.* Stability monitoring of the tailings dam will be performed during the operational period and after the mill operation ceases. Monitoring will consist of visual inspection, obtaining piezometric levels, seepage quantity measurements, and elevation surveys. The frequency of these inspections and measurements will decrease after the closure of the impoundment and will be determined by data trends.

During reclamation, survey monuments will be installed on the reclaimed pond surface to monitor settlement of the tailings. The monuments will be used to obtain post-operational elevations to confirm that reclaimed topography conforms to design.

The piezometric, seepage and elevation data and the visual inspection records will be reviewed periodically by an engineer experience in the design and construction of the tailings impoundment.

47.2 SOILS

Respread soil materials will be sampled for macronutrient content to formulate appropriate fertilizer recommendations. Species nutrient requirements will be taken into consideration when formulating fertilizer recommendations. Post seedling emergency will be observed to monitor soil fertility. If plant nutritional deficiencies appear, micronutrient testing will be included in the sampling program and appropriate corrective measures will be taken.

Prior to soil redistribution, waste rock and tailings will be sampled to determine potential constraints to revegetation. Parameters to be sampled include: texture, coarse fragment content, and pH and acid-base account. Depending on pH values, tests may be run on trace elements.

47.3 VEGETATION

Post-operational stability of vegetation will be accomplished by field evaluation of reclaimed areas, protection of these areas from erosion, grazing, and vehicle traffic and control of noxious weeds.

47.3.1 Reclamation Evaluation

Revegetated areas will be evaluated by field reconnaissance during the first season following seeding or planting to determine initial revegetation success. Monitoring will include a qualitative evaluation of cover, species composition and tree planting success. Areas with poor germination and/or growth will be evaluated to determine causes of unsuccessful revegetation. Mines Management will consult with MDEQ and the Kootenai National Forest to determine the scope of evaluation. Reclamation techniques will be modified to address any identified problems, and a second attempt to revegetated problem areas will be made.

Revegetation mixtures proposed in this plan may be modified, with approval by MDEQ and the Forest Service, to reflect plant material availability and other factors, including evaluation of initial revegetation success. In addition to the general evaluation discussed above, more detailed reclamation evaluation will be conducted at selected sites which represent various types of disturbance. Specific locations will be selected in consultation with MDEQ and the Forest Service. Parameters to be evaluated will include, but may not be limited to:

- Plant species responses (germination, growth, interspecific competition)
- Procedures to reclaim steep rocky slopes
- Soil redistribution depth
- Soil coarse fragment content
- Effects of fertilizer rates
- Tree planting techniques
- Tree stocking rates
- Viability of bare-root versus containerized stock

Details of the reclamation evaluation program will be discussed with MDEQ and the Kootenai National Forest prior to implementation. *It is anticipated that reclamation release criteria will be developed as part of the overall reclamation plan reviewed and approved by the agencies. Part of the release criteria will involve specific qualitative measurement of revegetation success.*

47.3.2 Protection of Revegetated Areas

Final grading and soil replacement will be done along the contour to minimize erosion. If rills or gullies form in graded and soiled areas, they will be filled, regarded, or otherwise stabilized, and the area will be reseeded. Surface water control structures will be maintained until areas are stabilized to prevent excessive erosion and sedimentation.

Vehicle traffic will be barred from the reclaimed area and no livestock grazing will be allowed for at least two years after seeding. Livestock access to revegetated areas will be controlled by fencing the perimeter of the disturbed areas if necessary. Wildlife damage will be controlled as necessary by selective fencing, chemical repellents, or terminal bud protection coverings.

47.3.3 Noxious Weed Control

The baseline vegetation inventory *completed for the 1992 EIS* identified three state-listed noxious weeds for the study area: Canada thistle, common St. John's-wort and spotted knapweed. Common St. John's-wort and spotted knapweed are primarily found on roadsides and have not yet become dominant components on other disturbed sites such as clearcuts. Spotted knapweed is more common in the Fisher River Valley floor along the lower section of the powerline corridor. Canada thistle is a dominant roadside and pastureland weed and invades clearcuts the first year or two after logging and slash burning. *It is expected that some change in weed levels and species have changed and the updated vegetative baseline information will outline any new species that are present at the site.*

Noxious weeds will be controlled throughout the life of the operation. Disturbed and revegetated areas will be qualitatively evaluated on an annual basis to assess weed populations. A weed control plan will be developed in cooperation with the Lincoln and Sanders County Weed Control Boards and the Kootenai National Forest.

Noxious weeds will be mechanically controlled or selectively sprayed (if approved by MDEQ and the Kootenai National Forest) throughout the life of the operation to reduce populations in the area. Any spraying will be conducted by a licensed applicator.

Noxious weed control is addressed in more detail in Section 37.0 (Powerline Corridor Reclamation) as it is expected that this corridor will provide the main source for potential spread of noxious weeds. Noxious weeds are not anticipated to be a problem for other disturbed areas.

47.4 WATER RESOURCES

A detailed post-mine hydrologic monitoring program for the Montanore Project area will be developed near the end of the mine operating period. The monitoring program will include sampling of wells and streams primarily downgradient of disturbed areas. Groundwater wells located in the tailings impoundment and plant site areas will be monitored, and stations on Ramsey Creek, Libby Creek, and Little Cherry Creek will be sampled. Hydrologic monitoring also will include periodic groundwater level and streamflow measurements. Any discharge from the mine adits will be monitored for quality and flow. Water levels in tailing embankment piezometers will be measured to document lowering of the phreatic surface.

The final operational hydrologic monitoring program will be developed and implemented in coordination with the MDEQ, and U.S. Forest Service. The post-mining, monitoring plan will fully utilize water data obtained during the mine operating period. Results of operational monitoring will be used to establish the parameters to be analyzed and the frequency of analysis during the post-mine period. Post-mine monitoring will continue until the quality of water from disturbed areas is demonstrated to meet all State and Federal requirements.

A water balance for the project is included with this application. A revised water balance is being developed that will incorporate metal loading estimates similar to the 1992 EIS method. This water balance will address several issues with regard to water resources during and after closure. This preliminary water balance has been presented to MDEQ and will be developed during the iterative permit review process. At final closure, a revised water balance and water management plan will be developed to outline site specific details that match the conditions at that time. A preliminary plan will be developed based on agency comments that are part of this review process.

47.5 POST-OPERATIONAL MANAGEMENT

It is not anticipated that any special post-operative treatments will be necessary to achieve revegetation objectives. No irrigation or other treatment is proposed. Normal forest and range management practices will be used as necessary to enhance the value of revegetated areas. Subsequent to bond release, management of the permit area will revert to appropriate landowners or management agencies.

As suggested in Section 33.3 (Post-Operation Land Use), it may be desirable to identify the tailings impoundment as a separate management area in the Kootenai National Forest Management Plan to ensure that long-term management does not affect stability of the dam.

48.0 RECLAMATION SCHEDULE

Two basic types of reclamation will be conducted: interim reclamation to meet short-term objectives (primarily erosion and noxious weed control) and final reclamation to meet long-term land use objectives. Table 48-1 lists reclamation schedule by disturbance. Interim reclamation will be conducted throughout the operation to stabilize disturbed areas that will be redistributed at some point in the operation. Examples include soil stockpiles, surface water control structures, seepage collection system, road cuts and fills (on roads to be removed or narrowed at the end of operations) and the powerline corridor. Interim reclamation of the tailings impoundment beach and face will consist of watering as necessary to control blowing tailings.

Interim revegetation will not be conducted where rock provides acceptable erosion control. Interim reclamation will occur during the first appropriate season after construction or establishment. Final reclamation on these sites will occur upon completion of the operation.

Final reclamation will occur during three time periods: construction, life of operations and post-operations. Disturbance to be reclaimed during construction include the diversion system around the tailings impoundment, cut and fill slopes on the plant site, portal patio faces and the Bear Creek access road north of the tailings impoundment. Final reclamation of these disturbances will occur during the first appropriate season after construction has ceased. For example, the Bear Creek access road will be improved and new segments constructed during the first year or predevelopment. If construction activities are completed on a portion or all of the roads prior to fall, cuts and fills completed will be seeded during the fall season. If construction extends through the fall season, the sites will be revegetated the following spring.

Disturbances to be reclaimed during operations include the tailings impoundment toe dike and the temporary access road to the Ramsey Creek portals.

All other disturbances will be reclaimed after operations cease. Final reclamation will be completed within two years after ore processing is completed with the exception of the seepage control system below the tailings impoundment. This system will be reclaimed as soon as water quality and quantity compliance is attained.

49.0 CESSATION OF OPERATIONS

49.1 TEMPORARY

Although a temporary cessation of operations is not planned, uncontrollable circumstances may cause a short-term stoppage in operations. Temporary cessation of operations refers to the suspension of ore processing for an anticipated period of one year. Major steps to be undertaken at that point include:

- Clearing and repairing site drainage and sedimentation control structures to insure proper runoff and sedimentation control over a sustained period of time. Areas susceptible to erosion will be contoured and seeded.
- Securing monitoring wells, pumps, and intake structures to prevent equipment damage.
- Maintaining access roads to insure project access.
- Signs and fencing around the property will be inspected, repaired, or replaced.
- A program for facility inspection will be developed and implemented. Water monitoring will continue.
- Seeding and associated revegetation practices will be conducted on areas not planned for additional disturbance, except for sites where rock provides adequate erosion control.
- Noxious weeds will continue to be controlled.
- Water balance will be maintained in the decant pond to prevent pond water encroachment on the tailings beach.
- Dust suppression activities (sprinkling) will be continued on the tailings beach and embankment face.

No actions will be taken, however, that would preclude a resumption of operations.

49.2 PERMANENT

A permanent cessation of operations would result in the unlikely event that operations ceased prior to the end of scheduled operations. In the case of a permanent stoppage of operations, the tailings pond would be most affected and would be smaller than the ultimate configuration. Since soil salvage will precede incremental expansions of the pond, total disturbance upon a cessation of operations would be minimized. Reclamation objectives and methods would be the same as presented in this plan. A major difference (in addition to less disturbance) would be post-operation land configuration. As this would vary depending on when operations ended. It can only be predicted by following the development schedule as presented in the operations plan. If operations were to end prematurely, the Montanore Project will prepare, in association with MDEQ and the Kootenai National Forest, a reclamation plan to address conditions as of the cessation.

49.3 BOND

As part of the overall reclamation activities, a bond will be calculated to cover reclamation activities for the Montanore Project. The agencies originally developed a bonding cost and a phased submittal schedule for the project and was included with the Montanore Operating Permit #00150 (Section II Bonding – included in Appendix O).

At closure, Mines Management will complete major aspects of the reclamation plan and will request bond release for that portion of the reclamation activities that can be released according to the regulations.

It is expected that a large percentage of the bond can be released with the completion of major items such as portal plugging, building removal, closure of the tailings impoundment, and other regrading and seeding activities.

A portion of the bond will be carried after reclamation activities are completed to include post-closure monitoring, site maintenance and repair, and other post-closure activities.

Mines Management will initiate updating the bond calculation immediately, if the agencies continue to accept their original preferred alternative as proposed; however, if the agencies determine that the project will change, Mines Management will defer bond calculations until such time as the project is approved or sufficiently defined to develop cost estimates. Those calculations will be submitted to MDEQ and the Forest Service for review and acceptance.

50.0 REFERENCES AND CONTRIBUTORS

The following is a list of contributors to this application for an operating permit and references used in the permit application.

50.1 REFERENCES

References used in this permit application are listed under the application section in which the references are cited.

2.0 AIR RESOURCES AND CLIMATE

Code of Federal Regulation 40, Part 50.7, Subchapter c, July 27, 1979.

Driscoll, 1988. Personal communication during site reconnaissance, May 16, 1988, Libby Montana.

Federal Register Vol. 52, No. 105, June 3, 1987. Ambient Air Quality Standards for Particulate Matter (PM 10).

Parker, Charles. 1988. Rock Creek Noise Report. Prepared for ASARCO, Inc., Troy, Montana.

Penman, H.L. 1947. "Natural evaporation from open water, bare soil and grass", Proceedings of the Royal Society of London, A193, pp. 120-146, London England.

U.S. Department of Commerce. 1968. Climatic Atlas of the United States, Asheville, North Carolina. June, 1968.

U.S. Department of Housing and Urban Development. 1972. Noise assessment guidelines technical background, HUD Report No., TE/NA 172.

U.S. Environmental Protection Agency. 1974. Information on noise levels identified as requisite to protect public health and welfare with an adequate margin of safety. EPA-550/9-74-004, Arlington, VA.

3.0 WATER RESOURCES

ASCE. 1977. Manuals and Reports on Engineering Practices No. 54, Sedimentation Engineering. V.A. Vanomi (editor). 534 p.

Chen-Northern, Incorporated and Noranda Minerals Corporation. 1989. Water Resources Baseline Investigation. Montanore Project. Lincoln and Sanders Counties, Montana.

Chen-Northern, Incorporated and Noranda Minerals Corporation. 1989. Johnstone Placer 100 year even Flood Plain study.

Davis, Stanley N. and Roger J.M. DeWieste. 1966. Hydrogeology. John Wiley and Sons.

EPA. 1982. Handbook for Sampling and Sample Preservation of Water and Wastewater (EPA-600/4-82-029).

Fetter, Jr., C.W. 1980. Applied Hydrogeology. Charles E. Merrill Publishing Company.

Gregory, K.J., and D. E. Walling. 1973. Drainage Basin Form and Process, A Geomorphological Approach. John Wiley and Sons, New York. 458 p.

Morrison-Knudsen Engineers, Inc. (MKE). 1989a. Montana Project Standers and Lincoln Counties, Montana, Tailings Impoundment Preliminary Engineering Report, February.

Morrison-Knudsen Engineers, Inc. (MKE). 1989b. Montana Project Standers and Lincoln Counties, Montana, Geotechnical Report, February.

Parrett, C. and J.A. Hull. 1985. Streamflow Characteristics of Mountain Streams in Western Montana. U.S. Geological Survey, Water Supply Paper 2260.

Parrett, C. 1989. Methods for Estimating Monthly Streamflow Characteristics at Ungaged Sites in Western Montana. U.S. Geological Survey, Open File Report 89-40. Western Montana.

Riggs, H.C. 1968. Mean Streamflows From Discharge Measurements. U.S. Geological Survey, Washington, D.C.

Strahler, A.N. 1957. Qualitative Analysis of Watershed Geomorphology. Trans. Am. Geophysical Union, Vol. 38, pp. 913-920.

Todd, D.K.1959. Ground Water Hydrology. John Wiley and Sons.

Vick. S.G. 1983. Planning, Design and Analysis of Tailings Dams. John Wiley and Sons.

4.0 WILDLIFE

Barnard, D. and J. Vashro. 1986. ASARCO Rock Creek project. Baseline fisheries assessment. Montana Department of Fish, Wildlife and Park, Kalispell.

Envirosphere Co. 1986. Benthic macroinvertebrate monitoring program for streams adjacent to ASARCO's Troy, Montana, Unit. Annual reports prepared for ASARCO, Inc.

Envirosphere Co. 1987. Benthic macroinvertebrate monitoring program for streams adjacent to ASARCO's Troy, Montana, Unit. Annual reports prepared for ASARCO, Inc.

Hightower, T.D. 1988. Baseline fisheries inventory of selected streams within the Libby Creek watershed and Upper Rock Creek drainage.

Hightower, T. and J. Vashro. 1987. ASARCO Rock Creek project. Baseline fisheries assessment. MDFWP, Kalispell.

Huston, J. 1988. Survey and inventory of coldwater streams, job progress report (Fisheries Division). MDFWP, Kalispell.

McGuire, D.L. and R.W. Thompson. 1988. Aquatic biology baseline report for Noranda's Montana Mining Venture, Cabinet Mountains, Montana. Western Resource Development Corp. Boulder, Colorado.

McGuire, D.L., T.P. Hightower, and R.W. Thompson. 1989. Aquatic biology study, Montana Project, Lincoln and Sanders Counties, Montana. Western Resource Development Corp. Boulder, Colorado. June.

Montana Natural Heritage Program, 2004. Montana Animal Species of Special Concern. MTNHP & MDFWP. 2004. Helena, Montana. July. 11p.

Thompson, R.W. 1988. Preliminary wildlife baseline study for Noranda's Montana Mining Venture in the Cabinet Mountains. Western Resource Development Corp. Boulder, Colorado.

Thompson, R.W. 1989a. Draft wildlife baseline report for the Montana Project, Lincoln and Sanders Counties, Montana. Western Resource Development Corp. Boulder, Colorado. May.

Thompson, R.W. 1989b. Wildlife baseline report for the Montana Project, Lincoln and Sanders Counties, Montana. Western Resource Development Corp. Boulder, Colorado. May.

U.S. Fish and Wildlife Service. 1982. Grizzly bear recovery plan. U.S. Fish and Wildlife Services, Washington, D.C.

U.S. Fish and Wildlife Service. 1987. Draft environmental assessment: Grizzly bear population augmentation test, Cabinet-Yaak Ecosystem. U.S. Fish and Wildlife Services, Washington, D.C.

U.S. Fish and Wildlife Service, Mountain-Prairie Region. 2004. Federally Listed and Proposed, Endangered, Threatened, Experimental, and Candidate Species and Habitat in Montana by County. U.S. Fish and Wildlife Service, Washington, D.C. updated August 2004.

U.S. Forest Service, Idaho Department of Fish and Game, Washington Department of Wildlife, USDI Fish and Wildlife Service, and MDFWP. 1988. Cumulative effects analysis process for the Selkirk/Cabinet-Yaak grizzly bear ecosystems.

U.S. Department of Agriculture, Forest Service. 1985. Fisheries habitat surveys handbook. Region 4-FSH 2609.23. Ogden, Utah.

U.S. Department of Agriculture, Forest Service. 1988. General aquatic wildlife system: user guide. Intermountain Region. Ogden, Utah.

WESTECH. 1991. Aquatic Macroinvertebrate Monitoring Study. Montanore Project.

WESTECH. 1992. Aquatic Biological Monitoring 1991. Montanore Project.

5.0 VEGETATION

Cooper, S., K. Neiman, R. Steele, and D. Roberts. 1987. Forest habitat types of northern Idaho: A second approximation. USDA, Forest Service. General Technical Report INT-236.

Noranda Minerals Corp. 1992. Wetland Identification, Delineation Mitigation, and Monitoring Plan. Montanore Project. Lincoln County, Montana.

Pfister, R., B. Kovalchick, S. Arno, and R. Presby. 1977. Forest habitat types of Montana. USDA, Forest Service. General Technical Report INT-34.

7.0 SOILS

Kuennen, Louis J. and Marci N. Gerhardt. 1984. Kootenai National Forest Area Land System Inventory: A Soil Resource Inventory and Analysis for Land-Use Planning and Proposed Project Work. USDA, U.S. Forest Service, Region One, Libby, Montana.

Fosberg, M.A., A.L. Fallen, J.P. Singh. 1979a. Physical, chemical and mineralogical characteristics of soils from volcanic ash in Northern Idaho: I. Morphology and genesis. Soil Sci. Soc. Am. J. 43:541-547.

Fosberg, M.A., A.L. Fallen, J.P. Singh. 1979b. Physical, chemical and mineralogical characteristics of soils from volcanic ash in Northern Idaho: I. Phosphorous sorption. Soil Sci. Soc. Am. J. 43:541-547.

Montagne, C., L.C. Munn, G.A. Nielsen, J.W. Rogers and H.E. Hunter. 1982. Soils of Montana. Mont. Agric. Expt. Sta. Bull. 744. University of Montana, Bozeman, Montana.

Nimlos, T.J. 1980. Volcanic ash soils. Western Wildlands. 6:22-24.

Veseth, R. and C. Montagne. 1980. Geologic parent materials of Montana Soils. Mont. Agric. Expt. Sta. Bull. 721. Montana State University, Bozeman, Montana.

8.0 LAND USE, AESTHETICS AND NOISE

ASARCO. 1987. Plan of Operations permit application submitted May 1987.

Noranda. 1988. Plan of operations.

U.S Borax. 1988. Recreation Report.

Personal Communications

Bain, George. 1988. USDA Forest Service, Cabinet Ranger District

Beebe, John L. 1988. USDA Forest Service, Cabinet Ranger District

Erickson, Ron 1988. USDA Forest Service, Supervisors Office

Howard, Charlie 1988. USDA Forest Service, Libby Ranger District

Jeresek, Jon 1988. USDA Forest Service, Libby Ranger District

Mershon, Jim 1988. USDA Forest Service, Cabinet Ranger District

Rahm, Gary 1988. USDA Forest Service, Libby Ranger District

9.0 TRANSPORTATION AND ENERGY

Personal Communications

Kelly Ann Travel	1988. Libby, Montana
Libby Airport Personnel	1988. Libby, Montana
Colbert, Philip L.	1988. Montana Highway Department
Hill, James	1988. Montana Highway Department
Malkiewicz, Laddy	1988. J.S. Redpath
Howard, Charlie	1998. USDA Forest Service, Libby Ranger District
Bain, Floyd	1989. USDA Forest Service, Troy Ranger District
Erwin, Dave	1989. USDA Forest Service East Zone Engineering

11.0 CULTURAL RESOURCES

Choquette, Wayne. 1984. Chapter V: A Proposed Cultural Chronology for the Rock Creek Region M. In Cultural Resource Investigations of the Bonneville Power Administration's Libby Integration Project. Northern Idaho and Northwestern Montana. Edited by Stan Gough.

Choquette, Wayne T. and Craig Holstine. 1980. A Cultural Resource Overview of the Bonneville Power Administration's Proposed Transmission Line from Libby Dam, Montana to Rathdrum, Idaho. Project Report No. 100. Washington Archaeological Research Center, Washington State University, Pullman.

Crowley, Frank A. 1963. Mines and Mineral Deposits (Except Fuels), Sanders County, Montana. Montana Bureau of Mines and Geology Bulletin No. 34.

Davis, Carl M. and Edrie L. Vinson. 1980. The Kootenai Falls Portage Trail. Archeology in Montana. 21(3):129-147.

Greiser, T. Weber. 1988. Cultural Resource Inventory. Noranda's Copper Silver Venture. Lincoln & Sanders Counties, Montana. Prepared for Noranda Mineral's Corporation by Historical Research Associates. Missoula, Montana.

Hudson, Lorelea, Sharon Boswell, Caroline D. Carley, Wayne Choquette, Christian Miss, David H. Chance, and Michael A. Stamper. 1981. A Cultural Resource Overview for the Colville and Idaho Panhandle National Forests and the Bureau of Land Management, Spokane and Coeur d'Alene Districts. Northeastern Washington/ Northern Idaho. Vol. 1. Cultural Review Narrative.

Johnson, Olga W. 1958. Early Libby and Troy. Flathead and Kootenai Series. Libby, Montana.

Johnson, Olga W. 1969. Flathead and Kootenay. Arthur H. Clark Co. Glendale, California.

Libby Montana Institute of the Arts Writers Group. 1974. "Times We Remember In and Around Libby, Montana". The Western News. Libby, Montana.

Libby Montana Institute of the Arts Writers Group. 1976. "In the Shadows of the Cabinets". The Western News. Libby, Montana.

Libby Montana Institute of the Arts Writers Group. 1985. Echoes Along The Kootenai. 1985. Denning Printing. Libby, Montana.

Libby Pioneer Society and Libby Women's Club. 1970. Nuggets to Timber: Pioneer Days at Libby, Montana. Published version of Local Community History of Libby, Montana. Printed by Libby Litho and The Western News. Libby, Montana.

Malouf, Carling I. and Thain White. 1952. Early Kutenai History. Flathead Lake Lookout Museum Publication No. 10. Lakeside, Montana.

Montagne, Clifford, Larry C. Munn, Gerald A. Nielsen, Jack W. Rogers, and Harold E. Hunter. 1982. Soils of Montana. Bulletin 744 (November). Montana Agricultural Experiment Station. Montana State University and USDA Soil Conservation Service. Bozeman, Montana.

Montana Federation Women's Clubs (Mail B. Hillis et al.). 1926/1940. Local Community History of Libby, Montana. Compiled by A.V. Howard. Unpublished manuscript. University of Montana. Missoula, Montana.

MT state Engineer's Office. 1965. Water Resources Survey. Lincoln County, Part I. History of Land and Water Use on Irrigated Areas. Helena.

Reeves, Brian O.K. 1972. The Archeology of the Pass Creek Valley, Waterton Lakes National Park, Vols 1 and 2. Sites Service Manuscript Report 61. National Historic Affairs and Historic Development. National and Historic Parks Branch. Department of Indians. Ottawa.

Reeves, Brian O.K. 1983. Cultural Change in the Northern Plains, 1000 B.C. – A.D. 1000. Occasional Paper No. 20. Prepared for Archaeological Survey of Alberta by Alberta Culture Historical Resource division. Roll, Tom E. (editor).

Roll, Tom E. (editor). 1982. Kootenai Canyon Archaeology. The 1979 LAURD Project Final Mitigation Report. Manuscript on file. Montana State University, Bozeman.

Roll, Tom E. and Marc B. Smith (editors). 1982. Libby Additional Units and Reregulating Dam Cultural Resources Project, 1979. Prepared for Seattle District, U.S. Army Corps of Engineers under Contract No. DACW67-79-C-0072. Prepared by LAURD Project Staff. Montana State University, Bozeman.

Ross, Robert L. and Harold E. Hunter. 1976. Climax Vegetation of Montana Based on Soils and Climate. USDA Soil Conservation Service. Bozeman.

Smith, Allan H. 1984. Kutenai Subsistence and Settlement Patterns, Northwest Montana. Vol 2 of Cultural Resources Investigations at Libby reservoir, Kootenai River Valley, Northwest MT. Prepared for Seattle District, U.S. Army Corps of Engineers under Contract Nos. DACW67-81-C-0100 and DACW67-83-M-0522. Prepared by Center for Northwest Anthropology, Project Report No. 2. Washington State University, Pullman.

Teit, James A. 1930. The Salish Tribes of the Western Plateau. In 45th Annual Report of the Bureau of American Ethnography, 1928. edited by F. Boaz, pp. 232-296. Government Printing Office. Washington, D.C.

Thoms. Alston v. and Greg C. Burtchard (editors). 1987. Prehistoric Land Use in the Northern Rocky Mountains: A Perspective From the Middle Kootenai River Valley. Submitted to Kootenai National Forest. Libby, MT under Contract No. 53-0343-5-K9855. Prepared by Center for Western Anthropology, Project Report No. 4. Washington State University, Pullman.

Turney-High, Harry Hulbert. 1941. Ethnography of the Kootenai. American Anthropological Association Memoir No. 56.

Vanek, Mona Leeson. 1986. Behind These Mountains, Volume 1: People of the Shining Mountains Where the Clark's Fork River Churns, Noxon, Heron, Trout Creek, Bull River, Smeads. Statesman-Examiner, Inc. Colville, Washington.

White, Catherine M. 1942. Salish House: The First Trading Post Among the Flatheads.

White, Thain. (no date). Kutenai Place Names of the Flathead Lake Region in Northwestern Montana. Flathead Lake Lookout Museum (Publication). No. 11. Lakeside, MT.

16.0 ORE PROCESSING

Administrative Rules of MT, MT Department of Health and Environmental Sciences, Title 16. Chapter 20- Water Quality. Sub-Chapter 6 – Surface Water Quality Standards. June 1988.

Algermissen, S.T., Perkins, D.M, Thenhaus, P.C., Hanson, S.L, and Bender, B.L. 1982. Probabilistic Estimates of Maximum Acceleration of Belocity in Rock in the Continuous United States: U.S. Geological Survey Open-File Report 82-1033.

Camp Dreser and McKee Inc. Interim Draft Report. Soil Attenuation and Tailings Water Quality. Montanore Project. April 1991.

Campbell, K.W. 1981. Near-source Attenuation of Peak Horizontal Acceleration: Bulletin of the Seismological Society of America. Vol. 71, No. 6. pp. 2039-2070.

Fetter, Jr. C.W. 1982. "Applied Hydrogeology". Charles E. Merrill Publishing Company.

Idriss, I.M. 1985. Evaluating Seismic Risk in Engineering Practice: Proceedings of the 11th International Conference on Soil Mechanics and Foundation Engineering. San Francisco. Vol. 1 pp. 255-320.

Joyner, W.B. and Boore, D.M. 1982. Predictions of Earthquake Response Spectra: U.S. Geological Survey Open-File Report 82-977.

Morrison-Knudsen Engineers, Inc.. Montanore Project Geotechnical Report, Tailings Impoundment Site, Vol. 1 and 2. March 1990a.

Morrison-Knudsen Engineers, Inc.. Montana Project Sanders and Lincoln Counties, Montana. Interim Tailings Impoundment Engineering Report, July 1990b.

Morrison-Knudsen Engineers, Inc.. Montanore Project Addendum to Geotechnical Report, Tailings Impoundment Site, Vol. 1 and 2. November 1990c.

Noranda Minerals Corp. Wetland Identification, Delineation Mitigation, and Monitoring Plan; Montanore Project. Lincoln County, Montana. March 1992.

Qamar, A.I. and Stickney, M.C. 1983. Montana Earthquakes, 1869-1979: Montana Bureau of Mines and Geology. Memoir 51.

Schafer and Associates. Nitrogen Attenuation by Forest Ecosystems Under Land Application. July 1992.

Seed, H.B. "Soil Liquefaction and Cyclic Mobility Evaluation for Level Ground During Earthquakes", Journal of the Geotechnical Engineering Division. ASCE. Vol 105. GT2, February 1979.

Seed, H.B. and Idriss, I.M. 1982. "Ground Motions and Soil Liquefaction During Earthquakes", Earthquake Engineering Research Institute.

Seed, H.B. and Martin, G.R. 1996. The Seismic Coefficient in Earth Dam Design: Journal of the Soil Mechanics and Foundations Division. Proceedings of the American Society of Civil Engineers. Vol 92. SM 3.

Slemmons, D.B. 1982. Determination of Design Earthquake Magnitudes for Microzonation: Proceedings of the Third International Earthquake Microzonation Conference. Vol. 1. pp. 255-320.

Smith, R.M., W.E. Gribe, T. Arkle, and A. Sobek. 1974. Mine Spoils Potential for Soil and Water Quality. U.S. EPA. EPA-670/2-74-070.

Stover, C.W. 1985. The Borah Peak. Idaho Earthquake of October 28, 1983 – Isoseismal Map and Intensity Distribution: Earthquake Spectra. Vol. 2, No. 1. pp. 11-16.

U.S. Corps of Engineers. 1977. Office of the Chief of Engineers. Earthquake Design and Analysis for Corps of Engineers Dams: Regulation No. ER1110-2-1806. (rev. Spring 1982).

U.S. Corps of Engineers. "Engineering and Design, Stability of Earth and Rock-Fill Dams". Manual EM 1110-2-1902. April 1970, and Change 1, 17 February 1982.

U.S. Corps of Engineers. 1960. "Runoff from Snowmelt". Manual EM 1110-2-1406.

U.S. Forest Service. Biological Assessment Montanore Project Grizzly Bear Mitigation. April 1992.

U.S. Department of Commerce, Weather Bureau. 1966. "Hydrometeorological Report No. 43, Probable Maximum Precipitation, Northwest States".

Vick, S.G. 1983. "Planning, Design and Analysis of Tailings Dams". John Wiley & Sons.

Witkind, I.J., 1977. Major Active Faults and Seismicity, Northwestern Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-923.

SECTIONS 32.0 THROUGH 49.0 – RECLAMATION

Alexander, R.R., R.C. Shearer, and W.D. Shepperd. 1984. Silvical Characteristics of Subalpine Fir. USDA Forest Service General Technical Report RM-115. 29 p. Rocky Mountain Forest and Range Experiment Station. Fort Collins, Colorado.

Baer, N., F. Ronco, and C.W. Barney. 1977. Effects of Watering, Shading, and Size of Stock on Survival of Planted Lodgepole Pine. USDA Forest Service Research Note RM-347.

Baumgartner, D.M. (ed.). 1973. Management of Lodgepole Pine Ecosystems – Symposium Proceedings. Washington State University Cooperative Extension Service. Pullman, Washington.

Bonneville Power Administration. 1983. Final Environmental Impact Statement – Transmission facilities vegetation management program. Portland, Oregon.

Bradshaw, A. and M. Chadwick. 1980. The Restoration of Land. Blackwell, Oxford.

Cochran, P.H. 1973. Natural Regeneration of Lodgepole Pine in South-Central Oregon. USDA Forest Service Research Note. Pacific Northwest Forest and Range Experiment Station. Portland, Oregon.

Crouch, G.L. and N.R. Paulson. 1968. Effects of Protection from Deer on Survival Growth of Douglas-Fir Seedlings. USDA Forest Service Research Note. Pacific Northwest Forest and Range Experiment Station. Portland, Oregon.

Dean, K.C. and M.B. Shirts. 1974. Vegetation for Acidic and Alkaline Tailings. In Thames, J.L. (ed.) Reclamation and Use of Disturbed Land in the Southwest. University of Arizona Press. Tuscon, Arizona. 362 p.

Down, C.G. and J. Stocks. 1976. The Environmental Problems of Tailings Disposal at Metal Mines. Res. Rep. 17, Department of the Environment. Royal School of Mines. England. 33 pp.

Erickson, A., M. Hanson, and C. Clampitt. 1982. An Assessment of the Impact of the Rock Creek Mining Project on Grizzly Bear Population in the Cabinet Mountains, Montana. Unpublished report. Prepared for ASARCO, Incorporated. Wallace, Idaho.

Foiles, M.W. and J.D. Curtis. 1973. Regeneration of Ponderosa Pine in the Northern Rocky Mountain-Intermountain Region. USDA Forest Service Research Paper. INT-45. Intermountain Pacific Northwest Forest and Range Experiment Station. Ogden, Utah.

Fowells, H.A. 1965. Silvics of Forest Trees of the United States. USDA Forest Service Agriculture Handbook No. 271.

Franklin, J.F. and R.G. Mitchell. 1967. Succession Status of Subalpine Fir in the Cascade Range. USDA Forest Service Research Paper PNW-46. 15 p. Pacific Northwest Forest and Range Experiment Station. Portland, Oregon.

French, R. and J. Lacey. 1983. Knapweed – Its Cause, Effect and Spread in Montana. Cooperative Extension Service, Circular 307. Montana State University. Bozeman, Montana.

Graham, R.T. and J.R. Tonn. 1985. Ten-year Results of Fertilizing Grand Fir, Western Hemlock, Western Larch, and Douglas-Fir with Nitrogen in Northern Idaho. USDA Forest Service Research Paper INT-346. Intermountain Forest and Range Experiment Station. Ogden, Utah.

Gutzwiler, J.R. and J.K. Winjum. 1974. Performance of Containerized Coniferous Seedlings in Recent Forest Regeneration Trials in Oregon and Washington. In North American Containerized Forest Tree Seedling Symposium Proc. Great Plains Agricultural Council. Publication 68.

Hall, D.O. 1971. Ponderosa Pine Planting Techniques. Survival and Height Growth in the Idaho Batholith. USDA Forest Research Paper INT-104, Intermountain Forest and Range Experiment Station. Ogden, Utah.

Hatch, C.R. and J.E. Lotan. 1969. Natural Regeneration of Douglas Fir in Central Montana. USDA Forest Service Research Note INT-85.

Heilman, P. 1971. Effects of Fertilization on Douglas-Fir in Southwestern Washington. Circular 535. Puyallup, WA: Washington Agricultural Experiment Station. 23 p.

Hungerford, R.D. 1984. Native Shrubs: Suitability for Revegetating Road Cuts in Northwestern Montana. USDA Forest Research Paper INT-331. Intermountain Forest and Range Experiment Station. Ogden, Utah.

Jacobsen, G.L., R.A. Thompson and R.A. Ryker. 1980. Effects of Nitrogen and Phosphorus Fertilizer on Planted Ponderosa Pine in West-Central Idaho. USDA Forest Research Paper Note INT-296. Intermountain Forest and Range Experiment Station. Ogden, Utah. 5 p.

Johnson, H.J. 1974. Canadian Forest Service Container Planting Trials in Alberta, Saskatchewan, and Manitoba. In North American Containerized Forest Tree Seedling Symposium Proc. Great Plains Agricultural Council. Publication 68.

Kittams, J.A. and R.A. Ryker. 1975. Habitat Type and Site Preparation Affect Survival of Planted Douglas-Fir in Central Idaho Brushfields. USDA Forest Service

Research Note INT-198. Intermountain Forest and Range Experiment Station. Ogden, Utah.

Lacey, C., J. Lacey, T. Chicoine, P. Fay, and R. French. 1986. Controlling Knapweed on Montana Rangeland. Cooperative Extension Service. Circular 311. Montana State University, Bozeman, Montana.

Lotan, J.E. and A.K Dahlgreen. 1971. Hand Preparation of Seedbeds Improves Spot Seeding of Lodgepole Pine in Wyoming. USDA Forest Service Research Note INT-148.

Lotan, J.E. and D.A. Perry. 1977. Fifth Year Seed: Seedling Ratios of Lodgepole Pine by Habitat Type and Seedbed Preparation Technique. USDA Forest Service Research Note INT-239. Intermountain Forest and Range Experiment Station, Ogden, Utah.

McCaughely, W.W., and W.C. Schmidt. 1982. Understory Tree Release Following Harvest Cutting in Spruce-Fir Forests of the Intermountain West. USDA Forest Service Research Paper INT-285. 19 p. Intermountain Forest and Range Experiment Station. Ogden, Utah.

Miller, R.E. and C.A. Harrington. 1979. Response to Urea and Ammonium Nitrate Fertilization in an 80-year-old Douglas-Fir Stand. USDA Forest Service Research Note PNW-330. Pacific Northwest Forest and Range Experiment Station. Portland.

Miller, R.E. and D.L. Reukema. 1974. Seventy-five-year-old Douglas-Fir on High-Quality Site Respond to Nitrogen Fertilizer. USDA Forest Service Research Note PNW-237. Pacific Northwest Forest and Range Experiment Station. Portland. 8 p.

Noble, D.L, C. B. Edminster and W.D. Sheppard. 1978. Effects of Watering Treatments on Germination, Survival and Growth of Rocky Mountain Douglas-Fir: A Greenhouse Study. Research Note No. 357. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, Colorado.

Pfister, R.D. 1976. Choosing Tree Species for Plant. In Tree Planting in the Inland Northwest. Ed. by D.M. Baumgartner and R.J. Boyd. Washington Sat University Cooperative Extension Service. Pullman, Washington.

Rehfeldt, G.E. 1979. Patterns of First-Year Growth in Populations of Douglas-Fir. USDA Forest Service Research Note INT-255. Intermountain Forest and Range Experiment Station. Ogden, Utah.

Ryker, R.A. 1976. When to Plant. In Tree Planting in the Inland Northwest. Ed. by D.M. Baumgartner and R.J. Boyd. Washington Sat University Cooperative Extension Service. Pullman, Washington.

Ryker, R.A. and D.R. Potter. 1970. Shade Increases First-Year Survival of Douglas-Fir Seedlings. USDA Forest Service Research Note INT-119, 6 p. Intermountain Forest and Range Experiment Station. Ogden, Utah.

Schubert, G.H. and R.S. Adams. 1971. Reforestation Practices for Conifers in California. Division of Forestry, State of California. Sacramento, California.

Shearer, R.C. and W.C. Schmidt. 1970. Natural Regeneration in Ponderosa Pine Forests in Western Montana. USDA Forest Service Research Paper INT-86.

Sheppard, W.D. and D.L. Noble. 1976. Germination, Survival and Growth of Lodgepole Pine under Simulated Precipitation Regions: A Greenhouse Study. USDA Forest Service Research Note RM-328. Rocky Mountain Forest and Range Experiment Station. Fort Collins, Colorado.

Sinclair, C. and R.J. Boyd. 1973. Survival Comparisons of Three Fall and Spring Plantings of Four Coniferous Species in Northern Idaho. USDA Forest Service Research Paper INT-139, 20 p. Intermountain Forest and Range Experiment Station. Ogden, Utah.

Stein. W.I. 1976. Prospects for Container-Grown Nursery Stock. In Tree Planting in the Inland Northwest. Ed. by D.M. Baumgartner and R.J. Boyd. Washington Sat University Cooperative Extension Service. Pullman, Washington.

Stein. W.I. and P.W. Owston. 1977. Containerized Seedlings in Western Reforestation. Journal of Forestry 75(9).

Stermitz, J.E., M.G. Klages and J.E. Lotan. 1974. Soil Characteristics Influencing Lodgepole Pine Regeneration Near West Yellowstone, Montana. USDA Forest Service Research Note INT-163. Intermountain Forest and Range Experiment Station. Ogden, Utah.

Strothmann, R.D. 1976. Douglas-Fir Seedlings Planted by Four Methods… Results after 10 Years. USDA Forest Service Research Note PSW-310. Pacific Southwest Forest and Range Experiment Station. Berkley, California.

Tackle, D. 1961. Silvics of Lodgepole Pine. USD Forest Service Misc. Publication 19.

Tinus, R.W. 1975. Observations and New Information on Greenhouse Container Systems. USDA Forest Service Paper presented at Annual Meeting of the Intermountain Nurseryman's Association. Missoula, Montana. August 5-7, 1975.

Tinus, R.W. and S.E. McDonald. 1979. How to Grow Seedlings in Containers in Greenhouses. Rocky Mountain Forest and Range Station. General Technical Report. RM-60. Fort Collins, Colorado.

USDA Forest Service. 1981. Proceedings of Intermountain Nurseryman's Association and Western Forest Nursery Association. Intermountain Forest and Range Experiment Station. General Technical Report INT-109. Boise, Idaho.

U.S. Department of the Interior. Bureau of Land Management. 1985. Final Environmental Impact Statement – Northwest Area Noxious Weed Control Program. Oregon State Office. Portland, Oregon.

Vick, S.G. 1983. Planning, Design, and Analysis of Tailings Dams. John Wiley and Sons, Inc. New York. 369 p.

Wells, S.P. 1979. Chilling Requirements for Optimal Growth of Rocky Mountain Douglas-Fir Seedlings. USDA Forest Service Research Note INT-254. Intermountain Forest and Range Experiment Station. Ogden, Utah.

Westech. 1987. Vegetation Inventory of the Rock Creek Study Area. Sanders County, Montana. Unpublished report prepared for ASARCO, Incorporated. Wallace, Idaho.

Wright, E. 1957. Importance of Mycorrhizae to Ponderosa Pine Seedlings. For Sci. (3).

Ziemer, R.R. 1981. Roots and the Stability of Forested Slopes. In: Davies, R.H. and A.J. Pearce, eds. Proceedings of a Symposium on Erosion and Sediment Transport in Pacific Rim Steeplands. January. Christchurch, New Zealand. Paris: International Association of Hydrological Sciences. Publication 132; 1981: 343-357.

Ziemer, R.R. and D.N. Swanston. 1977. Root Strength Changes After Logging in Southeast Alaska. Research Note PNW-306. Portland, Oregon: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, 10 p.

50.2 CONTRIBUTORS

50.2.1 Section I – Environmental Information

Introduction	Noranda and Hydrometrics
Air Resources and Climatology	Woodward-Clyde
Water Resources	Chen-Northern
Wildlife; Vegetation; Soils; and Aquatic Biology	Western Resource Development
Geology and Energy	Noranda
Land Use; Transportation; Recreation	Fletcher Association
Aesthetics; Noise	Woodward-Clyde
Socioeconomic Setting	Economics Consultants Northwest
Cultural Resources	Historical Research Associates

50.2.2 Section II – General Operating Plan

General Description of Project	Redpath
Surface and Mineral Ownership	Noranda
Topsoil Stockpiles	Westech
Equipment; Personnel; Mining Plan; Ore Processing	Redpath
Tailing Disposal; Tailings Impoundment; Special Systems	Morrison-Knudsen
Sewage Treatment and Solid Waste Disposal	Hydrometrics
Transportation	Noranda
Portable Water Supply and Distribution	Redpath
Fire Protection	Hydrometrics
Impoundments and Diversion	Morrison-Knudsen
Topsoil and Subsoil Salvage	Westech
Public Nuisance; Noise	Hydrometrics
Protection of Historical and Archeological Values; Prevention of Wind Erosion	Hydrometrics
Avoidance of Disturbance or Impacts to Offsite Flora and Fauna	Hydrometrics
Activities in Disturbed and Undisturbed Areas	Hydrometics
Water Monitoring, Water Consumption, Source and Balance	Hydrometrics
Power Consumption and Source	Hydrometrics

50.2.3 Section III – Reclamation Plan

General Description of Reclamation	Westech
Waste Rock Characterization and Storage	Hydrometrics
Tailings Characteristics and Storage	Morrison-Knudsen
Soil Handling	Westech
Revegetation	Westech
Hydrology	Hydrometrics
Stability	Hydrometrics, Morrison-Knudsen
Facility Decommissioning, Solid Waste Disposal and Portal Closure	Westech
Monitoring and Management	Westech, Hydrometrics
Cessation of Operations	Westech

MAILING ADDRESSES OF CONTRIBUTORS:

Noranda, Inc. 12640 W. Cedar Drive PO Box 15638 Denver, CO 80215	Noranda Minerals Corp. 101 Woodland Road PO Box A.L. Libby, MT 59923
Hydrometrics, Inc. 2727 Airport Road Helena, MT 59601	Morrison-Knudsen Engineers, Inc. 180 Howard Street San Francisco, CA 94105
Kilborn Limited 22000 Lake Shore Blvd. West Toronto, Ontario CANADA M8V 1A4	Redpath Engineering, Inc. 1855 W. Baseline Road Suite 240 Mesa, AZ 85202
Historical Research Associates PO Box 7806 Missoula, MT 59801	Westech PO Box 6045 3005 Airport Road Helena, MT 59604
Woodward-Clyde Consultants Stanford Place 3, Suite 1000 4582 S. Ulster Street Parkway Denver, CO 80237	Economic Consultants Northwest (ECN) 1400 Eleventh Avenue Helena, MT 59601
Fletcher Associates 17740 East Hinsdale Avenue Aurora, CO 80016	Chen-Northern 1610 B Street PO Box 4699 Helena, MT 59604
Western Resource Development Corp. 711 Walnut Street PO Box 467 Boulder, CO 80306	