CHAPTER 3

AFFECTED ENVIRONMENT

CHAPTER 3: AFFECTED ENVIRONMENT

INTRODUCTION

Chapter 3 presents descriptions of the existing (baseline) environment. The environmental components, or resources in the project area that would either be affected by the proposed action alternatives or would affect the action alternatives are described in the following sections. These include physical, biological, social, and economic resources. The resources related to significant issues identified in Chapter 2 are described in the most detail. Other resources are discussed briefly. Additional details are provided in the permit application baseline study reports and other resource-oriented documents referenced throughout this chapter.

The following resource sections have been expanded in whole or part as described since the draft and/or supplemental EISs. Most of these changes were made in response to public comments.

Kootenai Forest Plan. *Use of GIS mapping has generated more accurate numbers for Management Plan acreages.*

Geology. *The acid-rock drainage discussion has been expanded. The potential variability of the amount of ore reserves has been explained.*

Hydrology. *Tables have been revised based on different more accurate and conservative methods of handling laboratory data. Additional data collected from Rock Creek and the Clark Fork River since the draft EIS was prepared were incorporated.*

Aquatics/Fisheries. *New data were collected on aquatic habitat characteristics and biological populations within Rock Creek. Additional data were collected in 1996 on sediment characteristics, large woody debris, and fish populations. Additional analyses were provided for sediment data collected from 1988 to 1993 and for benthic macroinvertebrate data collected from 1985 to 1993. The USFWS listing of bull trout as a threatened species under the ESA necessitated preparation of a BA for this species; this document has been revised for the final EIS.*

Biodiversity. *Additional field surveys were conducted to verify sensitive plant populations. Additional habitat mapping was conducted for lynx, fisher, wolverines, and mountain goats. Additional data collection and literature review were conducted on harlequin ducks as well as for a few other species. Lynx baseline descriptions were moved to the Threatened and Endangered Species section because the lynx has now been listed under the Endangered Species Act.*

Threatened and Endangered Species. *New data have been collected on eagles, lynx, wolves, and grizzly bears. Two new data analysis methods - core habitat effectiveness and moving windows - required calculations for baseline conditions. The BA has been updated and lynx have been included.*

Socioeconomics. *This section has been completely rewritten.*

American Indian Rights. *This section has been completely rewritten.*

Geographical Study Areas

The geographical limits for the analysis of probable impacts in this EIS primarily encompass the permit area and evaluation adit, including the mine, mill site, and transportation and utility corridors, tailings disposal facility and rail loadout. Where geographical limits were established beyond the permit area to allow required analyses and assessment of impacts, a description follows:

Hydrology. *The study area for hydrology includes the Rock Creek and Miller Gulch watersheds and the Clark Fork River below Noxon Reservoir in Montana. For purposes of this EIS, it is assumed that potential impacts to Cabinet Gorge Reservoir (Clark Fork River below Noxon Dam) are representative of potential impacts to Lake Pend Oreille.*

Aquatics/Fisheries. *The study area for aquatics/fisheries (including bull trout), encompasses Rock Creek watershed and Clark Fork River from Noxon Dam down to and including Lake Pend Oreille.*

Wildlife Habitat. *The wildlife habitat study area includes the wildlife study area as described below, and the old growth study area (timber stand compartment 711) in the Rock Creek drainage.*

Wildlife. *The original wildlife baseline study, conducted in 1985 (Farmer and Heath, 1987 In ASARCO, Incorporated 1987-1997), encompassed an intensive study area of 10 square miles and an extended study area of 125 square miles. The proposed permit area lies within the intensive study area. Analysis area size varies for each species because home ranges and effects differ in size and manner. Therefore, for some species, the analysis area was greater or different than the original baseline study area. The largest study areas were for fisher, lynx, northern goshawk, and wolverine, which were extensive studies over the entire Kootenai National Forest. These extensive area results were placed into context within the ranger district and compartment. The study area for harlequin ducks included the four streams within the lower Clark Fork subpopulation, with reference to larger geographic areas where appropriate. The study area for mountain goats included the three compartments that the project facilities occurred in: 710, 711, 744. The recovery area for analysis of the peregrine falcon is the Rocky Mountain/Southwest population zone. The peregrine analysis also looks site specifically at the Cabinet Ranger District level. Most other species were analyzed within Compartment 711.*

Threatened and Endangered Species. *The analysis bounds for all T&E species starts at the recovery area level and steps down to the project permit area. For grizzly bear, the recovery area is the Cabinet/Yaak ecosystem. The analysis then looks at the southern half of the Cabinet mountains and the individual Bear Management Units (BMUs 4 ,5 ,6 ,7 & 8), and the smallest analysis area is the BAA (bear analysis unit) where the project impacts BAAs 7-4-7, 7-5-2, 7-5-3, and 7-6-1. Bald eagle analysis starts at the recovery area (Pacific population), looks at the Zone (NW Montana and Idaho = Zone 7) and finally includes the lower Clark Fork River corridor (basically the Cabinet Ranger District). The area for wolves covers the Northern Rock Mountain recovery zone, then Northwest Montana, the Cabinet District, and finally the Rock Creek drainage. Lynx are threatened now (see also Wildlife section above for lynx).*

Socioeconomic. *The primary socioeconomic impact area for the proposed project is a "local area" consisting of western Sanders County from Thompson Falls to the Idaho border, southern Lincoln county including the communities of Troy and Libby and the surrounding rural areas, and eastern Bonner County in the vicinity of the community of Clark Fork. Baseline demographic and economic data for these three counties as a whole have been presented to provide a context for the local area discussion.*

Transportation. *The transportation study area includes the north and northeast portions of Sanders County, and the middle and midwest portions of Lincoln County, Montana. It includes U.S. Highway 2 from Libby to Montana Highway 56, Montana Highway 56 from U.S. Highway 2 to Montana Highway 200, and Montana Highway 200 from Plains to Montana Highway 56.*

Recreation. *The recreation study area includes Sanders County and that portion of Lincoln County covered by the Cabinet Mountains Wilderness (CMW).*

Wilderness. *The wilderness study area includes the CMW and areas proposed in the Kootenai Forest Plan for addition to the CMW.*

Sound. *The study area for sound includes all areas that could experience increased noise levels from the proposed project, specifically: the project permit area, the CMW, project-affected traffic corridors, and proposed and alternative rail sidings.*

Scenic Resources. *The scenic resource study area includes public and private land bounded by the Cabinet Ranger District (RD). This area generally extends south from Bull Lake and the southwest flank of the Cabinet Mountains to Trout Creek, through the Clark Fork Valley to the Montana-Idaho state line. The Three Rivers, Fisher River, and Libby RDs and Lolo National Forest border the study area to the north, east, and south.*

KOOTENAI FOREST PLAN

The Kootenai Forest Plan (U.S. Forest Service Kootenai National Forest 1987) guides all natural resource management activities and establishes management standards for the Kootenai National Forest. The Forest Plan establishes management direction in the form of prescriptions consisting of goals, objectives, standards, and guidelines. This direction may be established to apply throughout the forest plan area (forest-wide direction) or they may be established for only a part of the forest plan area (management areas). The National Forest Management Act 36 CFR 219.10(f) states "The Forest Supervisor may amend the forest plan. Based on an analysis of the objectives, guidelines, and other contents of the forest plan, the Forest Supervisor shall determine whether a proposed amendment would result in a significant change in the plan." Management prescriptions are specified for each MA by resource, including wildlife, habitat timber, wilderness, recreation, visuals, water resources, grizzly bear habitat, transportation, or developed facilities.

Forest Plan goals provide the general long-range intent that directs overall forest operations. The goal for minerals is to "encourage responsible mineral development of mineral resources in a manner that recognizes national and local needs, and provides for economically and environmentally sound exploration, extraction, and reclamation." The goals for wildlife include providing sufficient habitat for the recovery of threatened and endangered species, maintaining 10 percent of each major drainage in old growth habitat, and maintaining big game and fisheries species habitat. The objectives for transmission line corridors are to use MA requirements to set transmission line exclusion, avoidance, and window areas when siting transmission corridors. Transmission line corridor criteria are outlined in Appendix 15 of the Kootenai Forest Plan (U.S. Forest Service Kootenai National Forest 1987). The Forest Plan goals or objectives for threatened and endangered species, recreation, wilderness and scenic resources are described in more detail under those sections in this chapter.

The Forest Plan sets the goals and standards for 23 MAs located on the forest. Figure 3-1 shows the location and distribution of MAs within the project area.

KNF is continuing to update MA boundaries as better information becomes available. Brief descriptions of these MAs are given in the following section. Except for MA 7, all MAs use Forest-wide goals and objectives for mineral development.

MA 2 Semiprimitive Nonmotorized Recreation. The goal of this MA is to protect and enhance roadless recreation areas and to provide for wildlife, particularly the grizzly bear, where wildlife values are high. Roads are not allowed for surface activities. Single-use roads may be justified for mineral exploration. Some areas are occasionally opened to seasonal snowmobile use. Trails are closed to all motorized vehicles. This MA is a corridor avoidance area for transmission lines.

MA 7 Existing Wilderness. This MA is composed entirely of the CMW and managed in accordance with the Wilderness Act of 1964. Area goals include maintaining natural ecosystems, providing opportunities for solitude and primitive recreation, and providing critical grizzly bear habitat. Wildlife habitat may be provided, but not by human manipulation. Existing mineral rights are recognized and these rights are managed in accordance with the Wilderness Act and other laws. Road construction to mineral deposits can be permitted when valid existing rights have been established, and when roads are found to be necessary for mineral development. This MA is a transmission line corridor exclusion area.

MAs 10 Big Game Winter Range (unsuitable timber) and MA 11 Big Game Winter Range (suitable timber). The goal for these MAs is to maintain and enhance winter range habitat effectiveness for big game wildlife species and to maintain the viewshed in areas of high viewing significance. The standards concentrate on protection of important wintering areas and providing optimum habitat for elk, mule deer, white-tailed deer, moose, sheep, and goats for winter survival. These areas are transmission line corridor avoidance areas in grizzly habitat. Programmed timber harvest is not allowed in MA 10, but is authorized in MA 11.

MA 12 Big Game Nonwinter Range (suitable timber). The goal of this MA is to maintain or enhance nonwinter big game habitat and produce a programmed yield of timber. The MA is characterized by suitable timber-producing sites and moderate to rolling topography.

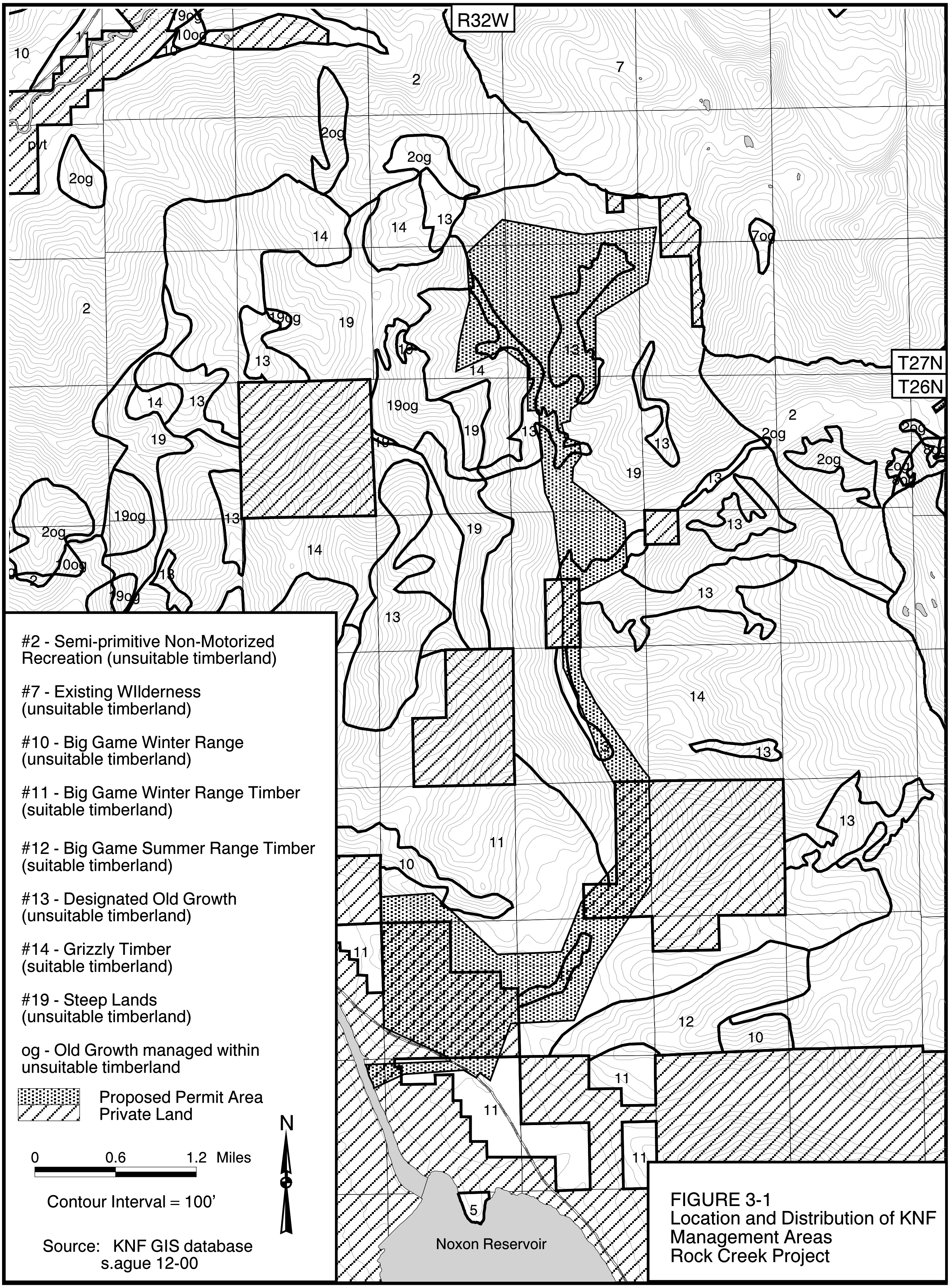


FIGURE 3-1
Location and Distribution of KNF Management Areas
Rock Creek Project

MA 13 Designated Old Growth Habitat. This MA provides the special habitat necessary for old growth-dependent wildlife, on a minimum of 10 percent of each drainage, in habitat units that provide a diversity of suitable types. Old growth forests are specific successional forests that have large multilayer forest canopies, an average age of more than 200 years and sufficient area to provide for the habitat requirement of old growth wildlife species. Surface-disturbing activities are allowed only where they would not reduce stand sizes below habitat effectiveness thresholds. This is an avoidance area for transmission lines.

MA 14 Grizzly Bear Habitat Management. This area is designed to enhance or maintain critical habitat for the recovery of grizzly bear populations, to reduce human/bear conflicts, to provide a programmed level of timber, and to maintain or enhance big game habitat. Key grizzly habitat components, such as wet meadows, bogs, and security areas will be maintained or enhanced. This MA is classified as a transmission line corridor avoidance area.

MA 19 Steep Lands. The purpose of this MA is to protect and maintain the vegetative cover of steep lands where soil stability and water quality can easily be disturbed by surface disturbance. The goal is maintain the vegetation in a healthy condition to protect the lands from soil movement and water erosion. This area is generally not suitable for road building or timber cutting. This area is a transmission line corridor avoidance area.

Riparian Areas. Goals for these unmapped areas are intended to apply to all riparian areas within other MAs by protecting riparian vegetation to minimize soil and water erosion, ensure habitat for fish and wildlife (including the grizzly bear), and provide a pleasant view. Vegetative standards concentrate on minimizing simultaneous forest openings on both sides of a stream, following wildlife habitat guidelines, and restricting the use of site-disturbing equipment.

CLIMATE

The climate of the project area can be described as a combination of modified Pacific maritime and continental climates. The maritime influences are strongest in the winter when relatively warm, moist air from the Pacific Ocean is cooled as it is lifted over the mountains and mixes with colder Arctic air moving south. This results in snowfall with significant accumulations in the higher elevations. Continental influences are more prevalent in the summer with thundershowers during May and June followed by hot, dry weather into mid-September.

Annual precipitation totals vary from about 30 inches along the Clark Fork River Valley to about 80 inches at the highest elevations in the CMW. The nearest weather station, located at the Trout Creek Ranger Station, has recorded a long-term average precipitation of 30.49 inches per year. January has the highest monthly average at 4.95 inches and July has the lowest at 0.96 inches (National Oceanic Atmospheric Administration 1987). Annual estimated precipitation (34.49 inches) exceeds estimated evaporation (31.50 inches) by about 3 inches in the proposed tailing impoundment area (ASARCO Incorporated 1987-1997).

Temperatures in the area are moderate. During the summer months, minimum (night-time) temperatures are in the 50 to 60 degree Fahrenheit (°F) range. Winter cold waves occur, but mild weather is more common. The long-term annual average temperature at the Trout Creek Ranger Station is 44.8°F. The warmest month, July, averages 65°F and the coldest month, January, averages 24°F (National Oceanic Atmospheric Administration 1987).

Wind speed and wind direction were monitored at the proposed tailings area for over a year as part of the applicant's baseline monitoring program. The predominant wind directions parallel the Clark Fork River Valley. Wind speeds were generally light, with an average speed of 4 miles per hour (MPH) and a maximum 1-hour wind speed of 17 MPH. The frequency of wind from the west-northwest through north-northwest (up-valley winds) was 30.2 percent, while frequency from the east-southeast through south-southeast (down-valley winds) was 30.1 percent (TRC Environmental Consultants, Inc. In ASARCO Incorporated 1987-1997). Wind measurements were not made at the proposed plant site. Similar wind flow patterns following the West Fork Rock Creek drainage would be expected; however, there would be some variation due to the complexity of the terrain.

The project area, similar to other valleys in western Montana, has a strong potential for the formation of temperature inversions (stable atmospheric conditions with little air mixing). Results of the baseline monitoring program indicated a frequency occurrence of stable conditions at about 40 percent of the year.

AIR QUALITY

The air quality study area includes the proposed plant site and the tailings impoundment area for purposes of the baseline monitoring program. Ambient air quality monitoring for particulates or gaseous pollutants has not been done in the CMW; however, air pollutant levels in the wilderness are assumed to be very near naturally occurring background levels due to minimal human impact.

Current air quality at the proposed project site is very good based on the particulate baseline monitoring that has been done. Table 3-1 presents a summary of existing pollutant concentrations observed during the baseline monitoring program. These levels should also be representative of the more rural areas of northwest Montana.

Dust collected on the sample filters from the monitoring program was also analyzed for trace element concentrations, including arsenic, antimony, cadmium, chromium, zinc, copper, and iron. These trace element concentrations were all well below the allowable guideline values used by the Montana Air Quality Division. Monitoring of gaseous pollutants was not done due to the lack of significant sources in the immediate area. Levels are assumed to be low and typical of background conditions in the region.

Current air pollutant (gaseous and particulate) sources in the proposed plant site area include logging activities and vehicle traffic. Pollutant emissions in the Clark Fork Valley are more extensive given the higher traffic levels and home heating/wood burning. Regional impacts from forest fires, slash burning, and agricultural burning to the west occasionally occur.

The proposed project area is designated as Class II under the Prevention of Significant Deterioration (PSD) regulations[1], and the nearby CMW is Class I.

TABLE 3-1
Baseline Air Monitoring Summary

Pollutant	Site	Time Interval	Concentration (ug/m^3)[1]	Basis
TSP[2]	Highway 200[3]	Annual Average	16.5	Arithmetic[7] Mean
		Annual Average	11.5	Geometric[8] Mean
		24-Hour Maximum	56.9	
TSP	Mill[4]	Annual Average[5]	23.2	Arithmetic Mean
		Annual Average[5]	19.0	Geometric Mean
		24-Hour Maximum	69.9	
PM10[6]	Highway 200	Annual Average	10.4	Arithmetic Mean
		Annual Average	6.6	Geometric Mean
		24-Hour Maximum	41.2	
Lead	Highway 200	90-Day Average	0.08	
Lead	Mill	90-Day Average	0.13	

Source: TRC Environmental Consultants, Inc. *In* ASARCO Incorporated 1987-1997.
Note: [1]ug/m^3 - micrograms per cubic meter of air sampled.
[2]TSP - total suspended particulate - measured with high volume sampler.
[3]proposed tailings impoundment
[4]proposed mill site
[5]annual averages for the mill site are based on partial year data.
[6]PM-10 - Particulate matter with a diameter of 10 microns or less.
[7]The average of the concentration values for this time period.
[8]A number midway between the first and the last.

[1]The PSD program was originally enacted by Congress in 1977; the authority to implement the provisions was subsequently delegated to the State of Montana. The goals of the program are as follows: a) To protect public health and welfare, including the prevention of significant deterioration of air quality in areas where ambient standards are currently being achieved; b) to emphasize the protection of air quality in national parks, wilderness areas, and similar areas of special concern; and c) to ensure that economic growth in clean areas occurs only after careful deliberation by state agencies and local communities.

The program is implemented primarily through the use of pollutant increments and area classifications. An increment is the maximum increase (above a baseline concentration) in the ambient concentration of a pollutant that would be allowed in an area. Increment systems have been in place for particulate matter and sulfur dioxide for a number of years and in 1988 were adopted for nitrogen oxides. The area classification scheme establishes three classes of geographic areas and applies more stringent increments to those areas recognized as having higher air quality values. Class I areas are accorded the highest level of protection by allowing the smallest incremental pollutant increase.

GEOLOGY

Physiography

The Cabinet Mountains are bounded on the south by the Clark Fork River, on the east by Libby Creek on the north by the Kootenai River, and on the west by the Purcell Trench in Idaho. The Bull River/Lake Creek valley separates the mountain range into east and west segments. The project area is in the southeast portion of the Cabinets, just north of the Clark Fork River.

The Cabinets are a northwest-trending mountain range of rugged relief. Maximum relief in the project area is about 5,500 feet. The highest elevation in the vicinity is Saint Paul Peak at an elevation 7,714 feet. The lowest elevation is below the proposed tailings facility site along the Clark Fork River near its confluence with Rock Creek, and has an elevation of about 2,200 feet.

The area's topography is a function of the underlying rock types, structure (faults and folds), and geologic history. Rocks in the area are relatively strong and not easily erodible. Most of them weather into small, thinly laminated fragments that form a colluvial (transported by gravity) mantle overlying bedrock. The talus slopes and hogback ridges are usually formed by the more weather resistant quartzite and limestone rocks

Large faults bound the Cabinet Mountains on the east, south, and west. These faults are at least partly responsible for the formation of the valleys surrounding the Cabinets. The Clark Fork River, Libby Creek, Bull River-Lake Creek, and the West Fork Rock Creek valleys are all located along faults. A number of smaller streams in the study area also may be located along fault and fracture structures. The major land-forming features were created by the Rocky Mountain uplift that was active approximately 60 million years age. The features were subsequently modified by shifts in the earth's crust, alpine glaciation, and alluvial deposits.

Topography in the project area has been influenced by Pleistocene-age glaciation (2 million to 10,000 years ago). In the northern part of the project area, Pleistocene alpine glaciers carved the landscape into a series of aretes, cirques, and horns characterized by nearly vertical cliffs, ledges, steep colluvial slopes, and talus fields. The high peaks of the area (Saint Paul, Rock, and Elephant peaks) are glacial horns, formed by the headward erosion of the glaciers. Small-to-moderate-sized lakes (tarns), such as Copper and Cliff lakes, have formed in the glacial cirque basins.

Pleistocene-age glaciation sculpted the mountain peaks, scoured some lower elevation areas, and created a veneer of glacial deposits. Glacial lakebed deposits, silt and clay accumulations of 100 or more feet thick, were deposited in low-elevation drainages. Melt-waters from glaciers in the upper part of the project area carried large amounts of excavated rock debris into Rock Creek, thus filling portions of the valley bottom. Relic terraces of the former valley bottom are exposed as higher-level benches along lower Rock Creek. In many areas the creek has since down-cut into the valley fill.

Rock Creek flows through a fairly narrow canyon and then spills into the wider Clark Fork Valley. The northwest-trending Clark Fork Valley is 2 to 3 miles wide at this point. It has a relatively flat to rolling bottom, with lakebed and stream deposits capping and surrounding shallow to exposed bedrock.

Mining History

Mineral activity in this area dates back to the 1860s with the discovery of placer gold along Libby Creek on the east side of the Cabinet Mountains (Johns 1970). Subsequent exploration in the 1880s and 1890s led to the discovery of numerous small hard rock mineral deposits. Many of these hard rock mineral deposits were discovered along the east side of the Cabinets. Production from these veined deposits and the area's placer deposits was sporadic and short-lived. None are currently in production.

In the late 1890s and then in the 1920s and '30s, several small prospects were worked west of the Cabinet divide in and around the project area. The Freeman prospect occurs just above Copper Lake, within the area Sterling proposes to mine. It consists of a few short adits and workings in a northwest-striking copper/silver quartz vein in the Copper Lake Fault Zone. The Heidelberg Mine, located about 2.5 miles to the east, consists of several adits and at least one shaft just south of Rock Lake. Most of these old workings were driven on gold-bearing quartz veins in what is probably the southern end of the Snowshoe Fault, near its junction with the Rock Lake Fault. Numerous other diggings (generally shallow) occur along the northwest-trending faults that cut the area. All of these prospects were short lived and very little, if any production was created (Gibson 1948). Currently there are no active mine plans for this area or on the historic properties.

In the 1960's through the 80's three major deposits and numerous smaller deposits containing stratabound copper/silver mineralization were discovered. These discoveries were confined to the Revett Formation and situated within a narrow belt extending from the Coeur d'Alene Mining District north to approximately the Kootenai River. ASARCO brought the 64-million-ton Spar Lake deposit into production in late 1981, producing approximately 4.2 million ounces of silver and 18,000 tons of copper per year. The 145-million-ton Rock Creek ore body in the CMW is the second deposit. In 1989, ASARCO acquired ownership of the deposit (1,809 acres) through the mineral patent process. ASARCO acquired surface ownership of only those portions of its 99 claims that lay outside the CMW (Figure 2-5). In October of 1999, ASARCO sold its property interest in the Rock Creek prospect, including the patented lands, and the Troy Mine to Sterling Mining Company.

In 1983, U.S. Borax discovered another large stratabound ore body (Rock Lake deposit) and later sold its interest in the deposit to Noranda. Noranda completed permitting on this project in 1992. Noranda initiated the evaluation adit in 1992 but ceased operations due to environmental concerns, litigation and metal prices. The Rock Lake deposit is located just east of the Rock Creek deposit (Figure 3-2).

Sterling Mining maintains claims to three smaller copper/silver deposits. These deposits, the Rock Peak, Horizon Basin, and Copper Gulch deposits are located around the periphery of Sterling's Rock Creek ore body. Currently, Sterling has no plans to develop these deposits.

Because of the increased activity involving Revett-type mining proposals and exploration projects the KNF completed the Cabinet Mountains Mineral Activity Coordination Report (USFS KNF 1986). The purpose of the study was to review the active and proposed mineral activities within the overall management framework for the area, and consider the possibility of other mineral activity requests in the next decade. It was also used to identify long-term mineral development and potential opportunities,

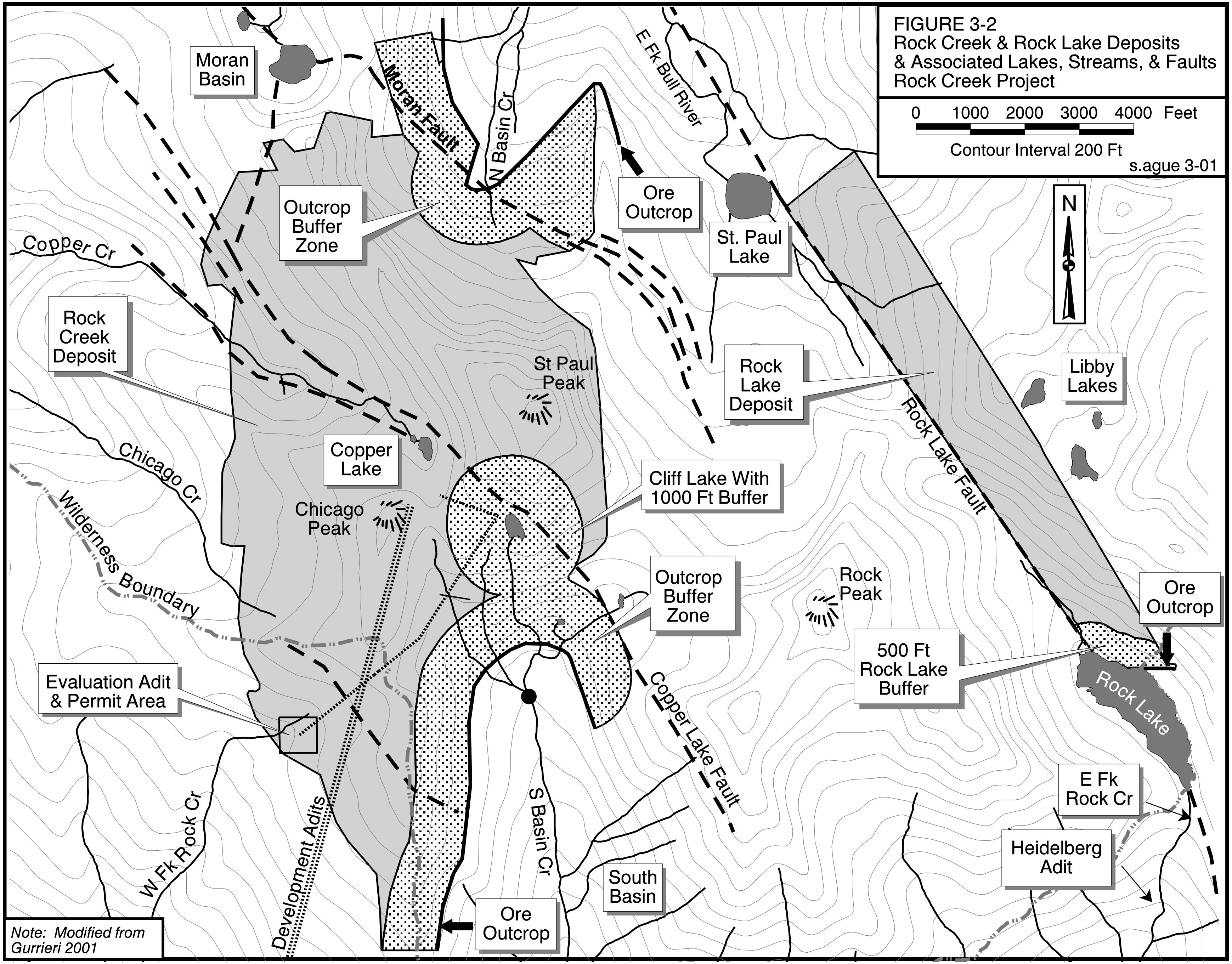


FIGURE 3-2
Rock Creek & Rock Lake Deposits
& Associated Lakes, Streams, & Faults
Rock Creek Project
0 1000 2000 3000 4000 Feet
Contour Interval 200 Ft
s.ague 3-01
N
Moran Basin
Moran Fault
N Basin Cr
E Fk Bull River
Ore Outcrop
Outcrop Buffer Zone
St. Paul Lake
Copper Cr
Rock Creek Deposit
St Paul Peak
Rock Lake Deposit
Libby Lakes
Rock Lake Fault
Copper Lake
Chicago Cr
Chicago Peak
Cliff Lake With 1000 Ft Buffer
Wilderness Boundary
Outcrop Buffer Zone
Rock Peak
Ore Outcrop
500 Ft Rock Lake Buffer
Rock Lake
Evaluation Adit & Permit Area
Copper Lake Fault
W Fk Rock Cr
Development Adits
S Basin Cr
E Fk Rock Cr
Heidelberg Adit
South Basin
Ore Outcrop
Note: Modified from Gurrieri 2001

resource concerns, and make recommendations that may be necessary to ensure the mineral activity is in harmony with other National Forest uses and resources. The study was not an environmental analysis, but a technical and resource related study to help the Forest Service understand and plan for the level of increased mineral activity that could occur and at the same time provide some insights into possible resource conflicts and mitigation opportunities.

In addition to the 1986 Mineral Activity Coordination Report, the KNF requested the U. S. Geological Survey to perform a quantitative assessment on the mineral endowment for copper and silver resources occurring within the Revett Formation on lands in the Kootenai National Forest (Spanski and McKelvey 1990). This assessment identified 26 Revett-type mineral occurrences and deposits across the KNF. The purpose of the assessment was to assist in forest planning for potential mineral activities with in KNF. This study was supplemented with the U. S. Department of Interiors analysis on the potential supply of minerals from undiscovered copper-silver deposits in the KNF (Gunther and Blackman 1990). The purpose of the Interior study was to provide land managers with a means of measuring the importance of minerals relative to other resources. The study demonstrated that significant undiscovered copper and silver resources exist in Revett deposits within the KNF, and that there are large economic consequences associated with either their development or withdrawal.

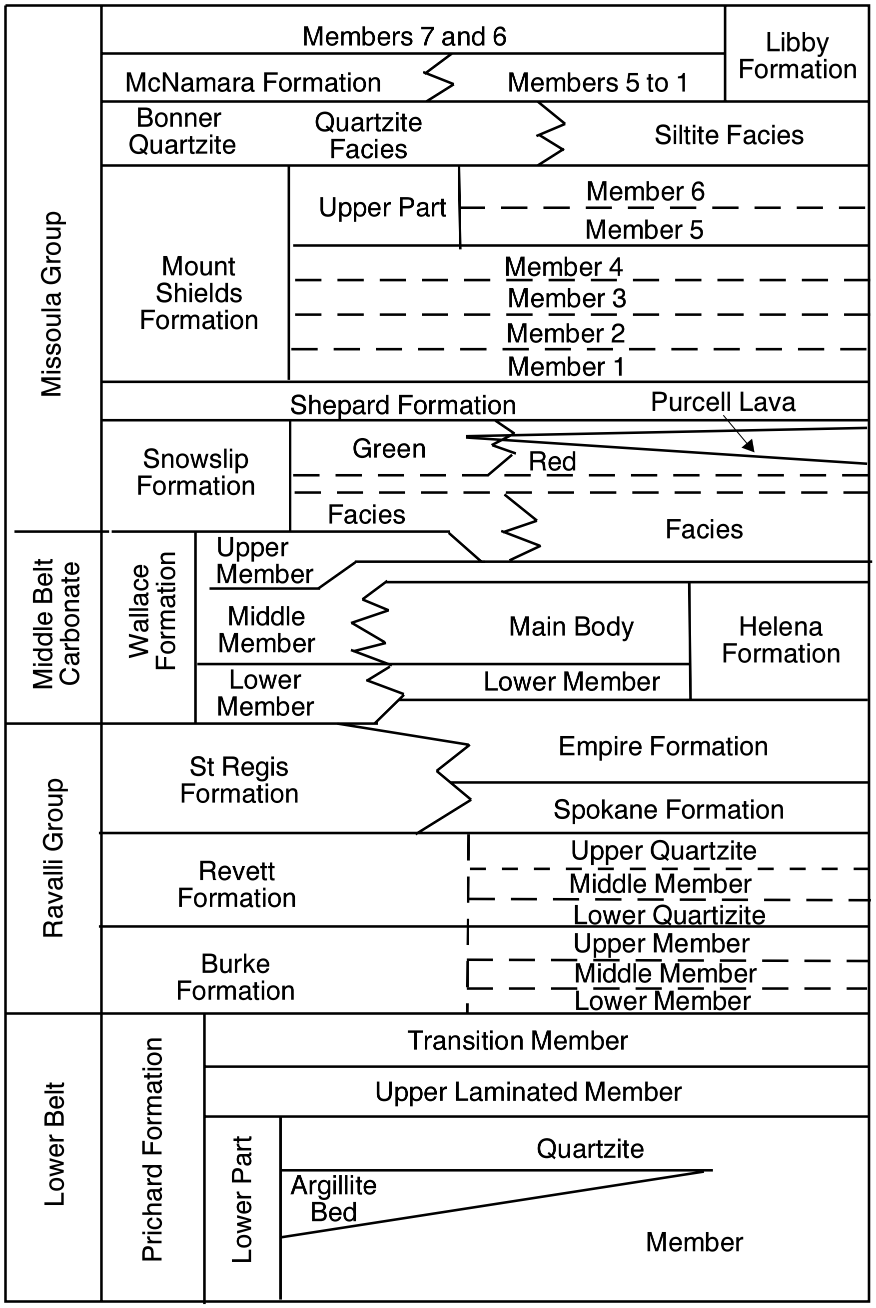
Regional Geology

The Cabinet Mountains and surrounding areas are composed of a thick series of metasedimentary rocks referred to as the Belt Supergroup. These Belt rocks were deposited in a subsiding basin about 1,450 to 850 million years ago (Harrison 1972). Originally deposited as a series of muds, silts, and sands, the deposits were metamorphosed to argillites, siltites, and quartzites, respectively.

The Belt Supergroup can be divided into four major conformable groups (Figure 3-3). In ascending order, these are the Lower Belt, Ravalli Group, Middle Belt carbonate, and the Missoula Group. Regionally, the Lower Belt is represented by the Prichard Formation. The Prichard consists mostly of argilites, with some interbedded siltite and quartzite units. It is the lowest formation within the Belt in this area and is mapped as the thickest - 25,000 feet.

The Ravalli Group in this part of the Belt basin consists of, from oldest to youngest, the Burke, Revett, and St. Regis Formations. The Burke is composed primarily of siltites. Its contact with the underlying Prichard Formation is gradational. The Revett Formation is a north- and east-thinning wedge of quartzite, siltite, and argillite. In the Cabinet Mountains area the Revett is informally divided into lower, middle, and upper members. The lower and upper members are dominated by quartzites with interbedded siltite and argillite; the middle member is mostly siltite with interbedded argillite and quartzite. Facies changes, from coarse to finer sediments, is well documented. The St. Regis Formation is dominantly silty argillite and argillitic siltite.

The Middle Belt carbonate is separated into a western and an eastern facies. The western facies Wallace Formation contains a conspicuous clastic component (but still contains a considerable proportion of carbonate material) and was deposited from a southern source terrain; the eastern facies Helena Formation is largely a carbonate bank deposited along the Canadian Shield (Eby 1977). The two formations inter-finger or overlap along a broad zone that extends from Missoula northwestward to the Canadian border just east of Libby, Montana (Harrison 1972).



Modified from Harrison & Cressman 1983
s.ague 4-01

FIGURE 3-3
Stratigraphic Cloumn
Rock Creek Project

Formations in the Missoula Group are divided into three assemblages that exhibit different sedimentary characteristics, lithofacies, source areas, and depositional mechanism (Wallace, et. al. 1983). The assemblages and their included formations are, in ascending order, the: (1) lower assemblage, Snowslip and Shepard Formations (Johns, 1970), includes these in the upper portion of the Wallace); (2) middle assemblage, Mount Shields Formation, Bonner Quartzite, and their lateral equivalents in the Striped Peak Formation; and (3) upper assemblage, McNamara, Garnet Range (and their lateral equivalent, the Libby) Formations, and the Flathead and Pilcher Quartzite (Wallace, et. al. 1983).

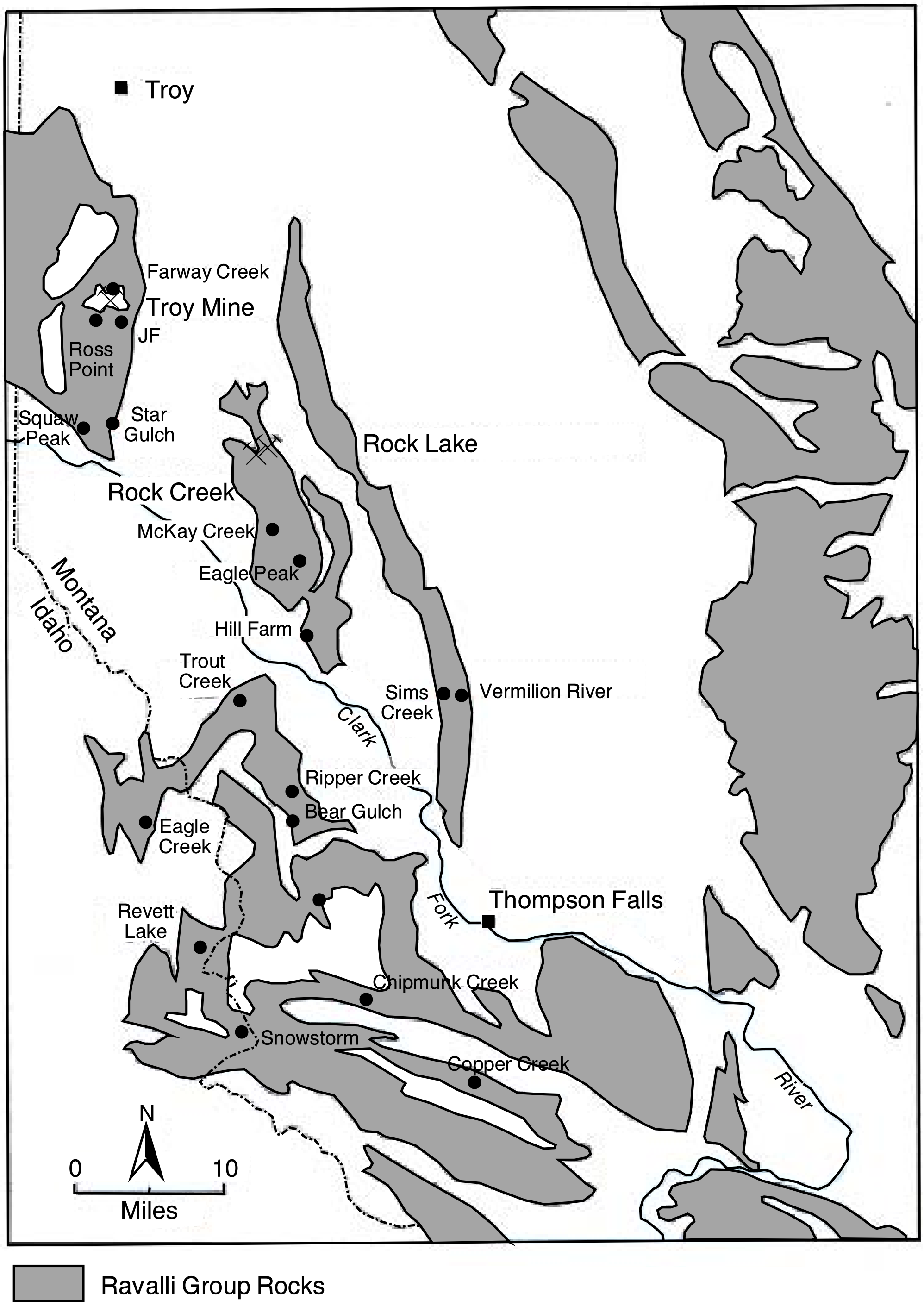
Regionally, Paleozoic sediments are represented by an occasional north-northwest trending exposure of shale, sandy shale, dolomite, magnesium limestone, and sandstone, some of which are fossiliferous. The exposures are along U.S. Hwy. 2, south of Libby, MT, along U.S. Hwy 200 near the Montana-Idaho boarder, and in several other localities. These sediments are mapped as narrow fault-bound blocks that were caught between eastwardly thrusted Belt strata (Johns 1970).

Tertiary age dikes of quartz latite porphyry, diorite, and lamprophyre intrude along faults and in some cases exceed 20 feet thick. Several Cretaceous stocks intrude Belt rocks. Rock types include granite, quartz monzonite, granodiorite, syenite, and pyroxenite.

The area bedrock has been extensively folded and faulted along generally north to northwest trends. Most of this structural activity was related to complex plate interactions which occurred between 24 and 200 million years ago, and resulted in the rocks being thrust eastward along shallow dipping faults for up to 100 miles (Harrison et al. 1983). These faults were superimposed on the existing compressional structures. One of several prominent structures is the Hope Fault, a west northwest-trending right lateral strike slip structure with major displacement within the Clark Fork drainage.

Quaternary age deposits are reflected in Pleistocene glacial erosion and deposition of stratified and unstratified sediments. Large areas are covered by glaciofluvial and glaciolacustrine sediments to depths up to several hundred feet. Near Libby, MT, bluffs of lacustrine silts stand up to 200 feet above the recent flood plain. During recent times this and older materials have been eroded and reworked by stream activity.

There appears to be three ages of events for mineralization for the Belt rocks in this area. Cretaceous to early Tertiary age granodiorite and quartz monzonite plutons intruded the highly folded and faulted Belt rocks in centeral and northern portion of the Cabinets. This produced the mineralization of the prospects found along the east and southern flank of the Cabinets. An older event is the Precambrian age intrusions of igneous rock high in iron and magnesium that intruded the Wallace, Burke and Prichard Formations. The Purcell Lava is an example of such an event and created the vein hosted deposits found in the Ten Lakes area northeast of the Cabinet Mountains. Potentially the oldest mineralizing event is the Precambrain age migration of solutions through selected formations within the Belt Supergroup especially the Revett Formation prior to or during lithification (Hayes 1983, Hayes and Einaudi 1986, Clark 1971, Lange and Sherry 1983, Balla 1993). Harrison (1972) described this extensive mineralization as the Western Montana Copper-sulfide Belt. Harrison observed that disseminated copper had been found in every formation in the Belt Supergroup, with the exception of the Prichard Formation. He also noted that "ore grade" copper mineralization had been only found in the Revett Formation. Lange and Sherry (1983) have delineated nineteen disseminated deposits involving the Ravalli Group Rocks (Figure 3-4). Additional studies by Hayes and Einaudi (1986), Hayes (1990),



Modified from Lange and Sherry 1983
s.ague 4-01

FIGURE 3-4
Troy-Type Copper/Silver Deposits
Rock Creek Project

Balla (1984, 1986, 1991, 1993, and 2000) and Whipple and Balla (1986) have further defined stratabound copper mineralization especially in Revett Formation. Balla (2000) generalized the regional migration of fluids and mineral zoning model for comparison of the Troy Mine deposit and the Rock Creek deposit (Figure 3-5). Hayes (1983), Lange and Sherry (1983), Clark (1971), Harrison (1972) and Bennett (1984) also concur that the Revett was mineralized on a regional scale. A similar model to Balla's is used by Clark (1971) to explain the consistent mineral zonation of the various stratabound copper/silver deposit on a world wide bases and with in the Belt rocks.

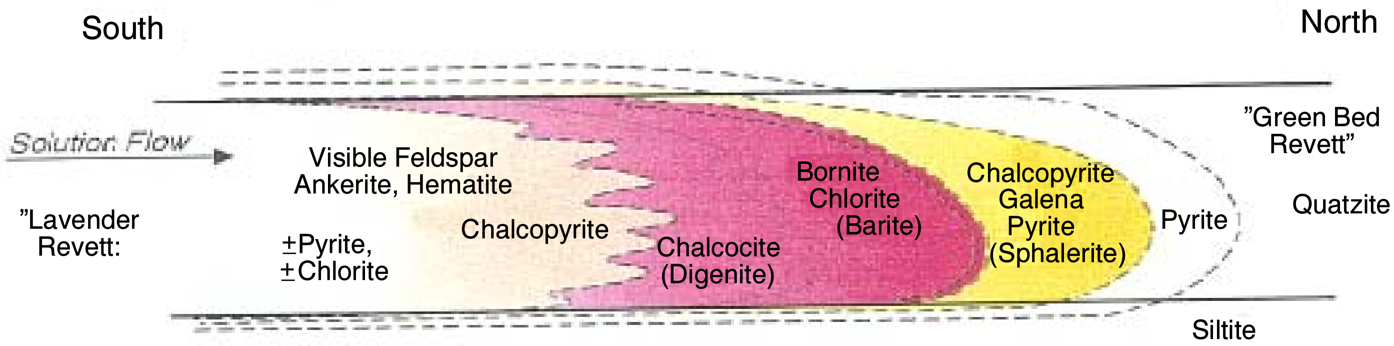
There are three main items that are critical in discussing the current geological make-up of the stratabound copper deposit that exist in the Revett Formation for this part of Montana: its paleo-environment which includes the mineralogical make-up and permability prior to diagenesis, the diagenetic process, which includes burial depth and timing of burial, lithification, silicification and possible faulting creating conduits for remobilization of metals; and finally the Cretaceous age thrusting and faulting that fragmented the Revett creating allochthonous blocks containing these isolated deposits. This sequence of events is also described by Bowen and Gunatilaka(1975) for other stratabound deposits world wide. Hayes (1983) and Balla describe the paleo-environment for the Revett with in the Troy and Rock Creek deposits as being either a fluvial distributary channel or subtidal system or a shoreline and barrier bar, upward fining sequence of quartz sands and silts. Hayes (1983) goes on further to describe that the sand, silt and argillaceous silt bodies of the Revett Formation have apparent sheet geometry. This type of setting is conducive in providing longitudual high prositity and permeable pathways that existed prior to diagenesis. Bowen and Gunatilaka (1975) concluded that this is one of the main characteristics that contributes to the similarities of certain stratabound copper deposits world wide. The zonation (halos) is due in part also to the host rock's permeability and porosity prior to or during diagenesis. The mechanism and source of mineralizing fluids is debated among the various authors but what is noted is that it was on a regional scale.

Geology of Project Area

Based on past historical mining activity on what appeared to be stratiform copper deposits Bear Creek Mining, a subsidiary of Kennecott Mining, conducted exploration for stratabound copper deposits centering its work on the Revett Formation in western Montana and parts of Idaho. In 1963 Bear Creek Mining discovered the Rock Creek deposit (this proposal) and the following year discovered the Spar Lake deposit along with numerous other (sub-economic) deposits. The Spar Lake deposit was developed by ASARCO into the Troy Mine. The Troy mine was permitted in 1979 and produce copper and silver until 1993. During the Troy Mine development and production years, ASARCO staff used data gathered at the site to develop and further define the Rock Creek deposit. A complete description of the Troy deposit is conveyed in Hayes (1983) with further discussion in comparing the Troy deposit with the Rock Creek deposit by Balla (2000) (Table 3-2). A third deposit and adjacent to the Rock Creek deposit is the Rock Lake deposit. This deposit was developed and permitted as the Montanore Mine. Although structurally different than Rock Creek and the Troy deposit, Rock Lake deposit's mineralogy for the ore zone and encompassing mineral halos as described in the EIS used for its permit (U.S. Forest Service et al. 1992) and by (Sanders and Adkins 1991) is essentially identical to Rock Creek and Troy.

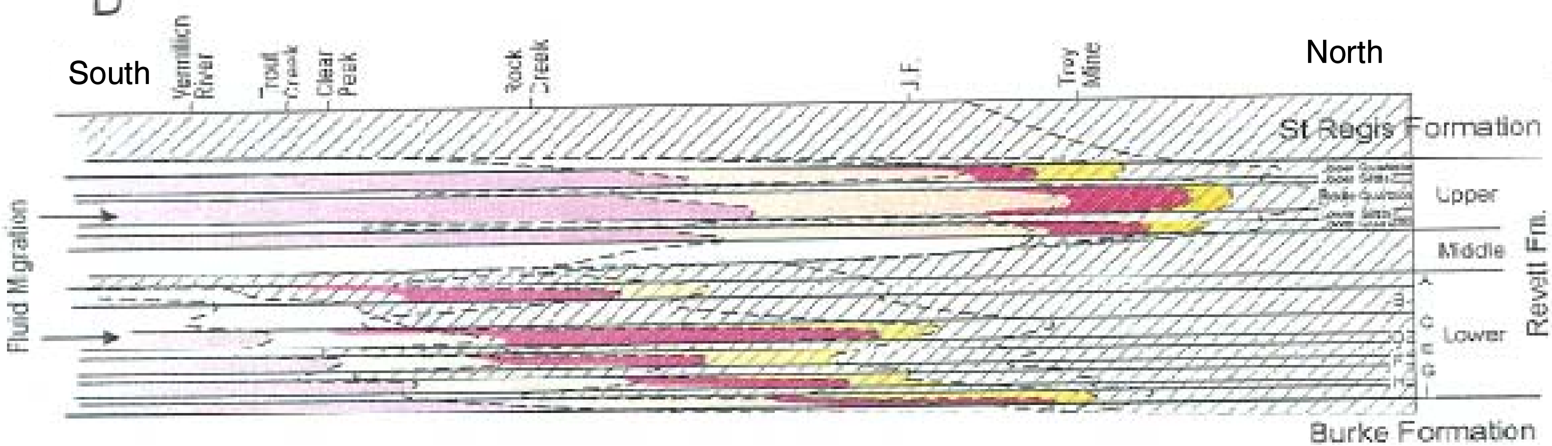
A

Generalized Troy-Type Mineral Zoning Model



Regional Troy-Type Mineral Zoning Characteristics In The Revett Formation

B



Modified From Balla 2000
s.ague 4-01

FIGURE 3-5
Regional Mineralization Description
Rock Creek Project

TABLE 3-2
Comparison of Troy and Rock Creek Deposits

Geological Feature	Troy Deposit	Rock Creek Deposit
Sedimentary Formation	Upper Revett	Lower Revett
Grade of Ore Body Copper (%)	0.76	0.68
Grade of Ore Body Silver (oz/ton)	1.58	1.65
Bornite (Cu_5FeS_4) Digenite ($Cu_{2-x}S$) Chalcocite (Cu_2S) Native Silver (Ag) Ore Zone Thickness (feet) Ore Zone Amount (volume %)	 0 - 80 0.3 - 1	 4 - 285 1 - 3
Mineral Zones Pyrite (FeS_2) Halo Zone Thickness Amount (volume %)	 Regional 0.1 - 0.3	 Regional (Variable 10 - 200+) 0.0 - 0.8
Pyrrhotite ($Fe_{1-x}S$)	Locally trace, in pyrite halo zone	Locally trace, in pyrite halo zone only
Galena (PbS) Halo Zone Thickness (feet) Amount (volume %)	 60 - 1,100 0.0 - 0.3	 20 - 200 0.04 - 0.08
Chalcopyrite ($CuFeS_2$) Halo Zone Thickness (feet) Amount (volume %)	 0 - very thin 0.3	 0 - 50 0.3

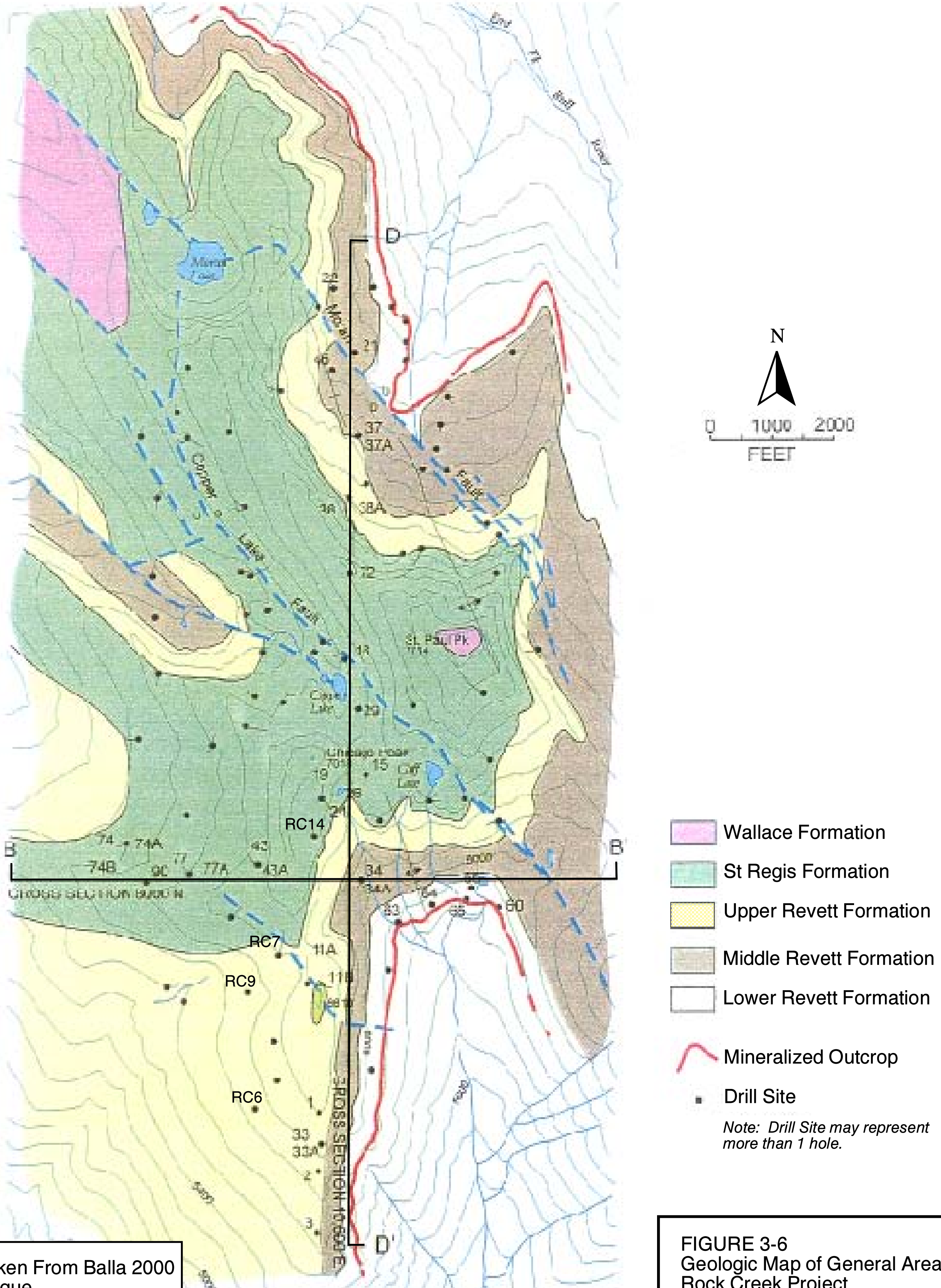
Rock Creek Ore Body

Bedrock exposed in the area consists primarily of the Revett and St. Regis Formations (Figure 3-6). This is the same stratigraphically sequence as seen at the Troy Mine. A small erosional remnant of the overlaying Wallace Formation caps Saint Paul Peak. The Burke Formation is exposed just to the south of the ore body outcrop in the southern portion of the area. The bedrock has been folded and cut by faults, the most prominent of which are the Copper Lake and Moran faults. These nearly vertical dipping, northwest-trending faults transect the ore body, breaking it into three segments (Figure 3-7 and 3-8). A similar fault system bisects the deposit at Troy. In describing the Rock Creek deposit, ASARCO refers to these segments from southwest to northeast, as the Chicago Peak, Saint Paul, and North Basin blocks. These faults are believed to be no longer active, having ceased movement tens of millions of years ago.

The economic portion of the mineralized area, (ore zone), at the Rock Creek deposit is currently mapped to be at least 16,000 feet long and 7,200 feet wide and is elongate in a generally north-south direction (Figure 3-2). The Rock Creek deposit is within an anticlinal structure, plunging slightly to the northwest, therefore rises and falls in excess of 500 feet within the horizon it occupies. The Troy deposit is within a synclinal structural and has approximately the same amount of elevation differences. The internal elevation at Rock Creek varies between approximately 6,000 feet at its highest to 4,300 feet mean sea level at its lowest, with a gentle dip generally to the north and west. The ore body is situated primarily within quartzites of the lower Revett Formation, but it is also within siltites and argillites of the lower and middle Revett. The majority of the ore body is confined to one layer, but locally there may be up to four vertically stacked, potentially minable layers. The ore body ranges in thickness from 6 feet up to a maximum of 235 feet. The average thickness is approximately 27 feet. The Troy Mine works within the upper Revett with multiple horizons as well; it is smaller in size and lower in grade from an economic perspective.

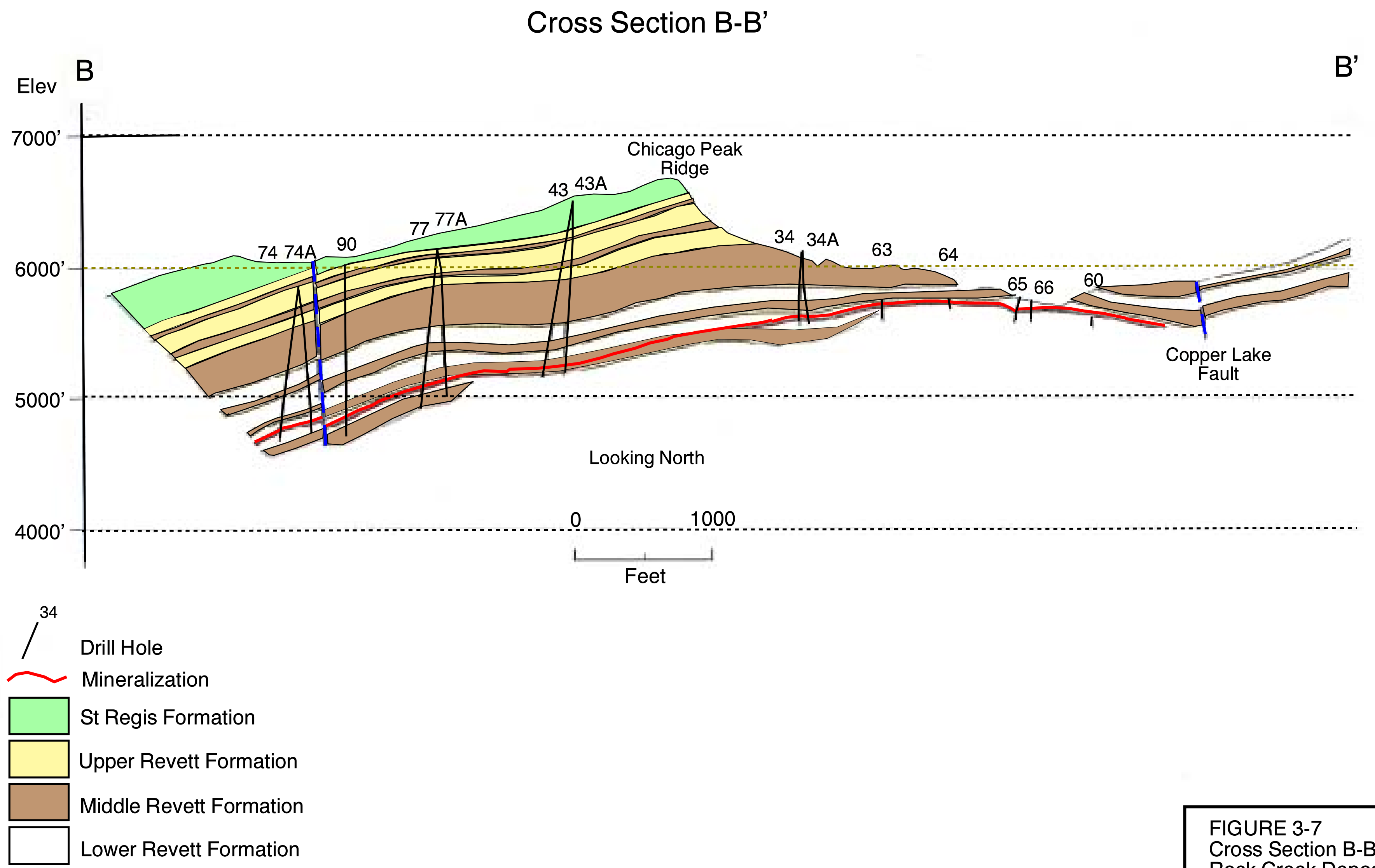
ASARCO originally estimated that the ore body for Rock Creek contained approximately 144 million tons of mineralized rock averaging 1.65 troy ounces of silver per ton and 0.68 percent copper (ASARCO Incorporated 1989). In 1997, ASARCO provided updated information that the deposit may range down to 136 million tons (ASARCO 1997d). Based on these estimates, the ore body contains between approximately 230 million and 224 million troy ounces of silver and between 2 billion and 1.8 billion pounds of copper.

The ore body crops out in two general areas. One area is in the North Basin, located north of Saint Paul Peak. The other area is on the south side of Saint Paul Peak, south of Milwaukee Pass and Cliff Lake (Figure 3-6). The majority of the ore body is covered by a thick layer of rock overburden. Typical overburden is 900 feet or a overburben-to-ore thickness ratios exceeding 15:1. The ratio is less than 15:1 only near the two outcrop areas and overlying a relatively small but very thick ore zone near Copper Lake. The rock to be mined is generally strong and without any known fault gouge zones or other features that would suggest significant ground problems. Locally, the rocks are moderately too highly fractured, particularly adjacent to faults.



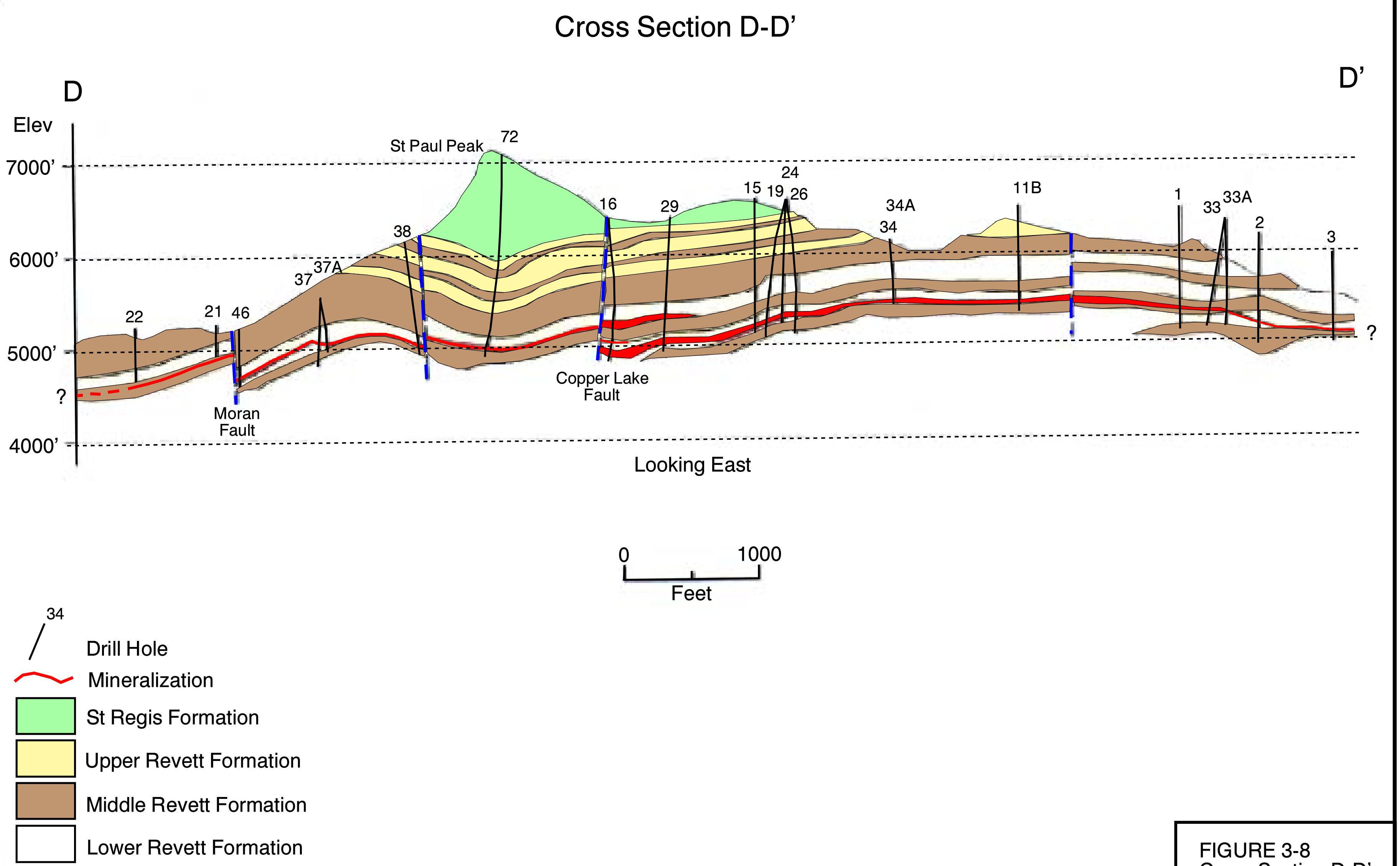
Taken From Balla 2000
s.ague

FIGURE 3-6
Geologic Map of General Area
Rock Creek Project



Taken From Balla 2000
s.ague

FIGURE 3-7
Cross Section B-B'
Rock Creek Deposit
Rock Creek Project



Taken From Balla 2000
s.ague

FIGURE 3-8
Cross Section D-D'
Rock Creek Deposit
Rock Creek Project

Mineral Zones

Geologists have identified up to six zones or halos with in the Revett, only two of which are of economic interest. These zones apply to the Rock Creek deposit as well as the Rock Lake, Troy Mine (Spar Lake deposit) and the other satellite deposits. Knowledge of the regional pattern of the halos has assisted in the overall exploration of this and other Revett-type deposits and has assisted ASARCO in developing the mine plans at Troy and Rock Creek. The mineral halos are comprised of different mineral assemblages and mineral abundances. The contact between halos may be gradational or sharp and vary in thickness around the ore body itself. The various authors use somewhat different nomenclature to describe each mineral zone or halo (Balla 2000), (Hayes 1983) (Clark 1971) depending on the trace minerals observed or the purpose of the discussion.

Copper is found in the sulfide minerals bornite and chalcocite and most often occurs as fine-grained disseminations with concentration of these minerals along fractures, veinlets, and bedding planes. The ore body is made up of two adjacent copper sulfide zones: the bornite-calcite zone and the chalcocite-chlorite zone (while the vast majority of the deposit is quartzite, these zones are identified by relative enrichment of particular mineral constituents, which generally consist of less than 2 to about 6 percent of the rock). Economically significant amounts of silver are found only in these two copper sulfide zones, primarily as native silver. While the portion of the ore body that is economically minable is continuous over a large area, there are segments of these two zones which may not be sufficiently mineralized or may not be thick enough to be of economic interest. The reason for this variation is due to the nature in which the deposit was formed.

Surrounding the bornite-calcite and chalcocite-chlorite zones (the two zones that make up the ore body) are four additional mineral zones that are not of economic interest. These zones will not be mined and are only discussed to better understand the ore body and any potential impacts to mining the ore body. The two closest to the ore body are the chalcopyrite-ankerite and chalcopyrite-calcite zones - chalcopyrite is a copper/iron sulfide mineral. Surrounding these zones is the galena-calcite zone. And, surrounding this is the pyrite-calcite zone - pyrite is an iron sulfide mineral (Balla 2000). Balla, (2000) in his comparison of the Troy deposit to Rock Creek combines the ore body into one zone, the bornite-digenite-chalcocite-native silver zone and then describes three zones surrounding the ore zone; the outer most being the pyrite halo zone, next is the galena halo zone and finally the chalcopyrite halo zone.

As described in Hayes (1983) and in discussion with Balla, (pers. com, J. Balla with John R. McKay 2001) the zonation appears to be thicker above the ore zone (bornite-calcite, chalcocite-chlorite) than below at both Rock Creek and Troy. At the Rock Creek deposit, drill core shows that the zonation is more sporadic than at Troy, being thicker in some areas and not existent in others above the ore zone. Not all the drill holes at Rock Creek penetrated the entire zone sequence below the ore body, therefore zone thickness information is limited. During mine development, the outer halos will be crossed by the adit as it moves into the ore body. A conceptual cross section showing the interface of the development adits with the country rock and mineral zones at Rock Creek is depicted in (Figure 3-9). Balla (2000) further describes the different mineral zones at Rock Creek in the following manner:

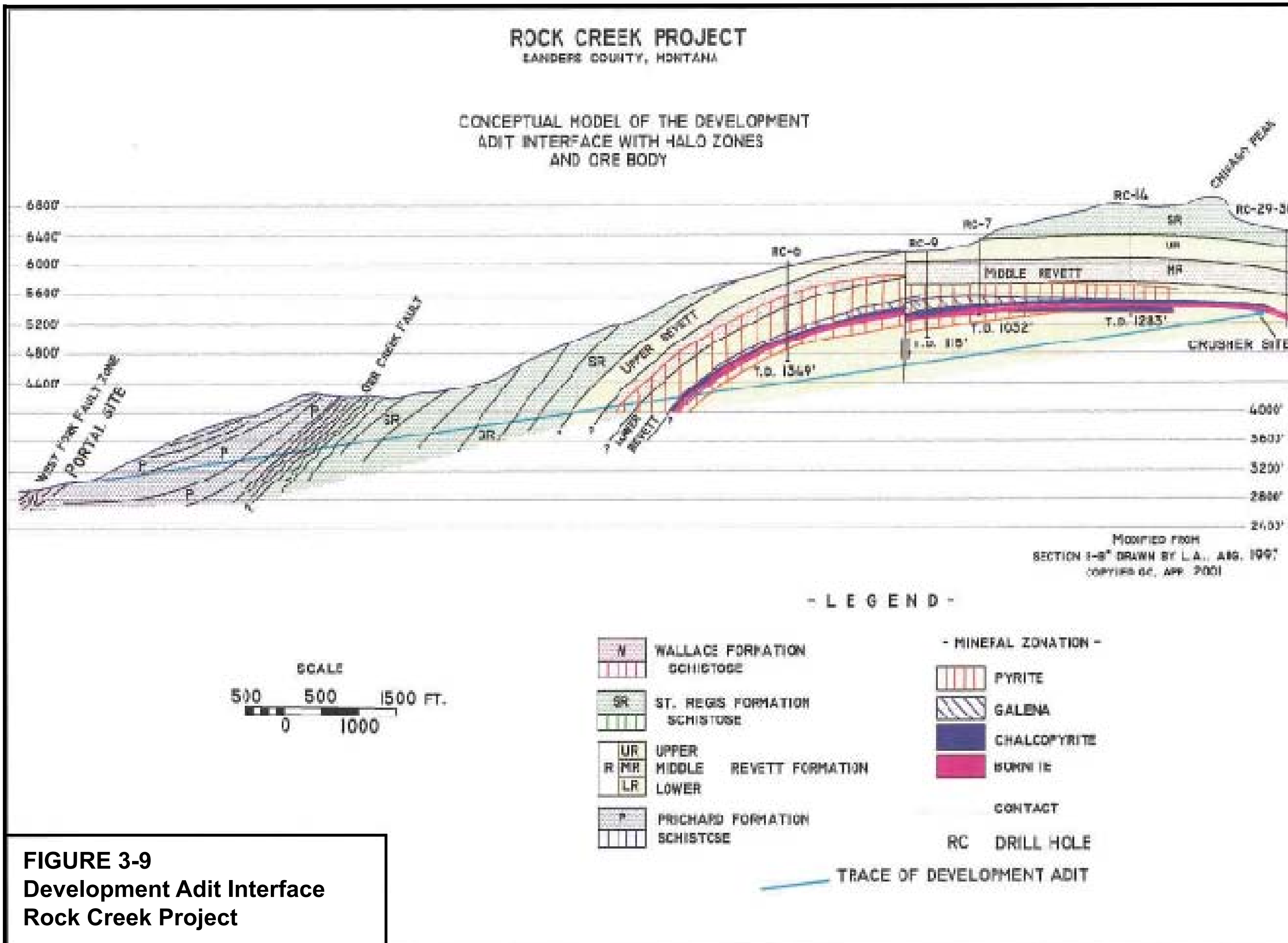


FIGURE 3-9
Development Adit Interface
Rock Creek Project

Pyrite Halo Zone: The thickness of the pyrite halo zone may vary from tens of feet to hundreds of feet. The pyrite will occur as very fine disseminations, and be logged as trace amounts. Progressing through the pyrite halo zone towards the galena zone the pyrite content will erratically increase to 0.8% by volume. The erratic distribution is probably due to original variations in the porosity and permeability of the host sands. Pyrrhotite was logged in the pyrite halo zone when it was observed. In the vast majority of the geologic logs, it is not mentioned as occurring. If it does occur, it is in trace amounts.

Galena Halo Zone: Galena occurs in a halo over the top of the deposit. Its thickness is variable, ranging from twenty feet to a couple of hundred feet. The galena content is variable, ranging from 0.04% to 0.5% of the volume of the rock. In the outer portions of the galena zone the lead content varies between 0.04% - 0.08% lead. Copper values will range from 0.004% to 0.01% copper. As the galena zone approaches the chalcopyrite zone, the copper content and lead content both increase.

Chalcopyrite Halo Zone: The chalcopyrite zone is very erratic. It varies from not being present at all in a drill hole to perhaps one hundred feet in thickness. In general it is about 20 – 50 feet in thickness. Copper grades in the chalcopyrite are 0.01% to 0.3% copper. Lead grades, where present may range form 0.004% to 1.0% lead. The contact between the chalcopyrite zone and the bornite-digenite-chalcocite-native silver zone is generally sharp. It may occur over a few inches.

Bornite-Digenite-Chalcocite-Native Silver Zone: The bornite-digenite-chalcocite-native silver zone is the ore zone. It is the most sulfide rich portion of the Rock Creek mineral deposit. The sulfide content of the ore zone varies from 1% - 3% by volume. In ore intercepts that are above average grade, the volume percent content of the total sulfides maybe slightly.

The mineralogical construction of the this ore zone is described by Balla (per. com., J. Balla with John R. McKay 2001) in the following manner:

"The bornite and digenite minerals that occur between the individual sand grains and that comprise the main ore zone are not leached, as they are encapsulated by the quartz overgrowths that occurred during diagenesis and burial metamorphism. The bornite and digenite ore minerals occur in-between the original sand grains that comprise the Troy orebody. The bornite and digenite minerals were emplaced in-between the sand grains, prior to the Revett formation becoming a rock. Through the geological processes of diagenesis and burial metamorphism, the sands that now comprise the Revett formation were converted to a rock. As diagenesis, lithification, and burial metamorphism continued, quartz overgrowth surrounded the individual ore minerals, sealing the individual bornite and digenite ore minerals (Hayes 1983).

Once the Revett formation had been converted from a sand deposit to a quartzite, subsequent tectonic events created a slight remobilization of the sulfide grains. This remobilization of the sulfide minerals occurred only near fracture and joint surfaces. The remobilization consisted of the sulfide minerals adjacent to the fractures migrating into and onto the fracture and joint surfaces. The total movement is minor, and is measured as a few centimeters. Various studies at the Troy mine have shown that about 90% of the total metal content of the Troy ore body is disseminated in the quartzite, and perhaps as much as 10% has remobilized onto fracture and joint surfaces.

Acid Rock Drainage and Near Neutral pH Metal Leaching

General Concepts

Two geochemical processes that should be considered during adit and mine development are: (1) acid rock drainage (ARD) and (2) metal leaching (ML) in near neutral pH environments.[2] ARD and ML have the potential to cause serious environmental problems through the release of acid and metals to water quality and aquatic life. A general discussion as it pertains to the Rock Creek Project is provided in Chapters 3 and 4. For a more detailed discussion of ARD and ML chemistry the reader is referred to the Saskatchewan Mine Rock Guidelines (1992) and the Environmine website (http://www.infomine.com/technology/enviromine/ard/home.htm).

Acid Rock Drainage. ARD is the product formed by oxidation of iron-sulfur minerals such as pyrite and pyrrhotite. The chemical and biological reactions involved in ARD generation are complex. Sulfide minerals are unstable at oxidizing, surface environments where they are far from their kinetic equilibrium (the environment from which they were formed). Exposure to air and moisture causes mineral oxidation to occur. Acid generation occurs from the oxidation of iron sulfide minerals to ferrous iron (Fe II), sulfate (SO_4^{2-}) and sulfuric acid (H_2SO_4). If not neutralized, sulfuric acid will act to decrease the pH. Complex interactions by iron increase the potential and amount of acid that can be generated. Available water transport for the oxidized ingredients and insufficient neutralizing capacity (buffering) of the solution can cause suppression of pH values to occur.

Net acid production results from the relationship between the rates of time dependent or kinetic reactions of acid-generating minerals and acid-consuming minerals (Saskatchewan Environment and Public Safety 1992). The net generation of acid from a rock or waste rock facility is directly related to the availability of neutralizing minerals. The pH decrease associated with ARD occurs when neutralizing minerals are consumed or become unavailable by secondary mineralization or coatings. A pH decrease will also occur if acidity is produced at a faster rate than alkalinity.

Acid production depends on the amount, type and depositional environment of sulfides present, the amount of neutralizing (acid-consuming) minerals available in the rock, degree of exposure of these minerals by oxygen, water and carbon dioxide, site conditions and other factors. The development of acid drainage is time-dependent and, at some sites, may evolve over a period of many years (British Columbia Acid Mine Drainage Task Force 1989; Saskatchewan Environment and Public Safety 1992). Drainage from acid-producing rocks typically contains elevated metals that can adversely affect water quality and aquatic life.

Bacterial processes are an important factor in the rate of acid generation. The type of bacteria that participates in sulfide oxidation is dependent on the pH. The pH environment affects the extent of these bacterial processes and the oxidation reaction kinetic rate. At near neutral pH, acid generation occurs primarily from chemical oxidation of pyrite (or iron sulfide). A minor amount of biological oxidation of these components to sulfuric acid also occurs from sulfur oxidizing bacteria. Near neutral pH oxidation rates are much slower than reactions that occur at lower pH due to the dominant chemical oxidation reaction. If the neutralizing potential of a rock material is exhausted and pH values are depressed below 4, strongly oxidizing sulfur bacteria will grow and oxidize ferrous iron (Fe II) of pyrite

---

[2] The definition of metal includes metalloid elements such as arsenic.

directly to ferric iron (Fe III). Bacterial interactions can accelerate sulfide oxidation and so increase the rate of acid generation. Thiobacillus ferrooxidans is a widely recognised name of sulfur/compound oxidizing bacteria that will grow in low pH environments (below pH 4).

Bacterial activity is not a usual testing parameter when evaluating acid generating potential of a proposed mine site. Further information on the role of bacteria in the oxidation of sulfide minerals can be found in Schippers et. al (2000).

Metal Leaching. Traditionally, mine waste characterization and management has focused on metal and sulfate release under acidic conditions. While acidic effluents present the greatest potential for environmental damage, there are also cases where elevated metal concentrations have occurred in natural seepage from "non-acid generating" mine wastes. Certain elements remain relatively soluble at neutral pH and can occur in concentrations above water quality standards. Sulfide oxidation, in combination with neutralization by associated buffering minerals such as carbonates and to a lesser extent feldspars, can produce elevated concentrations of metals without a depression of pH. Elevated concentrations of metals can also be a result of dissolution of secondary, non-oxidative, metal-bearing minerals such as salts, oxides and sulfates.

Factors that influence acid production, acid consumption and metal release rates. Mineralogic texture and chemistry must be evaluated when testing for ARD and ML potential. For example, sulfides cemented in a silica matrix, or that are large grained and have lower surface area, have slower oxidation rates than a small, high surface area sulfide mineral in a porous matrix such as sandstone. Decreased contact with oxygen and water due to cementation results in slower oxidation rates. Temperature, pH and availability of water and oxygen also greatly effect the ARD and ML potential from a sulfide containing deposit or sulfide waste.

Impurities in a sulfide crystal structure, or oxidative differences between iron sulfides as compared to copper, zinc or lead sulfides also will determine oxidation rates. For example, in the absence of ferric iron (Fe III) at pH 2.5-3.0, sulphuric acid will dissolve some heavy metal carbonate and oxide minerals, but has little reactive effect on heavy metal sulphides. However, ferric iron ion is capable of dissolving many heavy metal sulphide minerals, including those of lead, copper, zinc, and cadmium (Infomine, 2001). Iron sulfide, particularly pyrite (FeS_2) and pyrrhotite ($Fe_{1-x} S^4$) are the most common sulfide minerals and much research is available on the oxidation reaction of these minerals. Pyrite and pyrrhotite are the most common acid-producing sulfide minerals due to their high degree of instability in oxidizing conditions. Other types of sulfides, such as bornite (Cu_5FeS_4) chalcocite (Cu_2S), chalcopyrite ($CuFeS_2$), sphalerite (ZnS) or galena (PbS) would inhibit or decrease the potential for acid to be produced due to the absence of iron. However, these types of minerals are still reactive and can oxidize to release metals. The difference between acid generating characteristics of iron sulfides and copper sulfides is an issue of concern relevant to the Rock Creek Project. This issue will be discussed in greater detail in the next section.

Geological analogs are valuable techniques for preliminary indication of acid generation potential and/or water quality from a proposed mine site (Saskatchewan Environment and Public Safety 1992). This type of comparison is based on the assumption that similar paleoenvironments mineralogic and geologic characteristics have similar potentials for leaching and oxidation, given similar climatic conditions. The Spar Lake (Troy Mine) deposit has been mined and a substantial amount of information is available from the development of this mine. Drillholes in the Rock Creek deposit have generated a smaller database of mineralogic and geologic information. Comparison of the two sources of information would provide useful baseline information regarding ARD and ML potential from development of the Rock Creek ore body.

Rock Creek Project and the Troy Mine

As described in the Geology Section, the Rock Creek deposit is similar and related in geologic origin to the Spar Lake deposit (Troy Mine). Further discussion of this similarity illustrates how ARD and ML issues may be compared between the two sites.

Timothy Hayes (1986 and 1990), a U.S. Geological Survey research scientist who conducted graduate-level research at the Troy Mine and conducted drill investigations at the Rock Creek Project, described in detail the mineral zonation pattern found in the Spar Lake (Troy Mine) deposit. In a March 6, 1995, letter to DEQ, Hayes states that "all available information suggested that the geochemistry as defined by the mineral zonation of the two deposits [Spar Lake and Rock Creek] is essentially the same," and "[t]he Rock Creek [drill] cores I examined up through summer of 1983 [the last year of ASARCO's drilling of the deposit] had mineral abundance that were virtually identical with the same mineral zones at Spar Lake." Hayes found that the ore zones of both deposits contain no detectable amounts of pyrite. There are two ore zones identified for both the Rock Creek Project and the Troy Mine. One ore zone is primarily bornite ($CuFeS_4$), digenite (Cu_9S_5), calcite and native silver and the other ore zone contains chalcocite (Cu_2S) and chlorite, a clay mineral.

A characteristic feature of these two sites is four alteration halos that surround the ore zones. Pyrite (FeS_2) amount varies in these four halos. According to Hayes' data, of the two halos that immediately surround the ore zones, the chalcopyrite-ankerite halo contains "local trace" amounts of pyrite, while the chalcopyrite-calcite halo contains no pyrite. The galena-calcite halo contains a "trace" amount (less than 0.1 percent) of pyrite, while in the pyrite-calcite halo "...pyrite constitutes only an average of about 0.2 volume-% of the rock whereas the calcite constitutes an average of around 4%."

Pyrrhotite ($Fe_{1-x}S$[4]) was logged infrequently in trace amounts in the pyrite-calcite halo only. No pyrrhotite was found in the orebody. Hayes in 1983 wrote: "Minor pyrrhotite has been identified locally within rocks bearing only pyrite as another sulfide. Pyrrhotite is spotty. The distribution of pyrrhotite appears to bear no relation to other ore-stage mineral zone boundaries."

The mineralization texture of the Troy ore body and to a lesser extent, the Rock Creek drill cores, were also studied by Tim Hayes. Hayes' research results are summarized in a report by John Balla (2000). Hayes found that when pyrite occurs it is characteristically disseminated and occurs as isolated clots within the quartzite and not in fractures. Hayes also found that the post sulfide cementation of quartz overgrowths on all grains resulted in an impermeable rock with no porosity. The Rock Creek deposit occurs in a stratigraphic position that is approximately 500 feet deeper in the stratigraphic section than the Troy deposit. It would be expected that the post-sulfide cementation of the Rock Creek deposit would be even greater than that of the Troy, due to higher pressure exerted by overlying rock. Balla (2000) reports that higher grade metamorphic mineral indicators are evident at the Rock Creek deposit. Increased metamorphic temperatures and pressures further reduce the porosity and permeability of a rock.

Sulfide mineral oxidation is a process that may occur in pH-neutral conditions, and is the probably source of the elevated copper in the water that is in the underground workings in the Troy mine. The Troy mine has developed and exposed the bornite-digenite-native silver ore zone. Bornite is a copper-iron-sulfur mineral and digenite is a copper-sulfur mineral. The underground pillars that support the overlying sedimentary rocks are composed of ore grade bornite-digenite-native silver. In a pH-neutral oxidizing environment, the bornite-digenite-native silver minerals that occur on fracture and joint surfaces in the rock are oxidized in place to a mixture of various copper oxide minerals. These copper oxide minerals are exposed in the outcrops of the Troy orebody on the southside of Mt. Vernon and underground in the mine workings. The oxide minerals include tenorite, chrysocolla, brochantite, malachite, and cupriferous goethite, Hayes and Balla, (1986). These are all secondary copper oxide minerals which occur in areas of low acidity. The bornite and digenite minerals that occur between the individual sand grains and that comprise the main ore zone are not leached, as they are encapsulated by the quartz overgrowths that occurred during diagenesis and burial metamorphism.

Subsequent melting snow water, percolating down through the various sedimentary rocks along these same fracture and joint surfaces, partially dissolve the oxidized copper oxide minerals, and the dissolved copper is seen and detected in the underground mine waters. It should be noted that in the Troy mine, the overlying galena halo zone and the pyrite halo zone were not mined and are not exposed in the Troy mine.

It should also be noted that the melting snow water, percolating down through the overlying galena and pyrite halo zones, is not creating acid rock conditions, as the sampling of the underground mine waters consistently show that the pH of the mine waters is 7.2 to 7.4, a near-neutral to alkaline condition. These conditions are what is expected be similar at the Rock Creek project site.

SOILS

Soils within the proposed permit area have developed since the last major climatic change, at least 10,000 years ago. This is enough time for soils to develop recognizable differences. Soils vary considerably in physical properties such as texture, coarse fragment content, depth, horizon sequence, organic matter content, and drainage. Some chemical characteristics, such as nutrient levels and soil reaction, vary widely, while others, such as conductivity, do not. This diversity in soil characteristics reflects the variability in parent materials, topography, microclimates, vegetation, and past land use practices. Generally, the soils are deep, relatively young, weakly developed, and mildly acidic due to coniferous vegetation that dominates in the area.

Within the proposed permit area, a total of 15 soil series were identified and placed into 23 mapping units (Noel 1986). For the evaluation adit area, two soil series were identified and placed into 12 mapping units (ASARCO Incorporated 1992). Two disturbed land units, three talus, one rock outcrop, and a miscellaneous unit were also described. For ease of discussion, the soil mapping units have been grouped into three categories, based on similarities in the processes that deposited soil parent materials (see Figure 3-10):

- colluvial/residual soils - derived from materials moved downhill by gravity or from rock that weathered in place;
- alluvial soils - derived from materials moved and deposited by flowing water; and

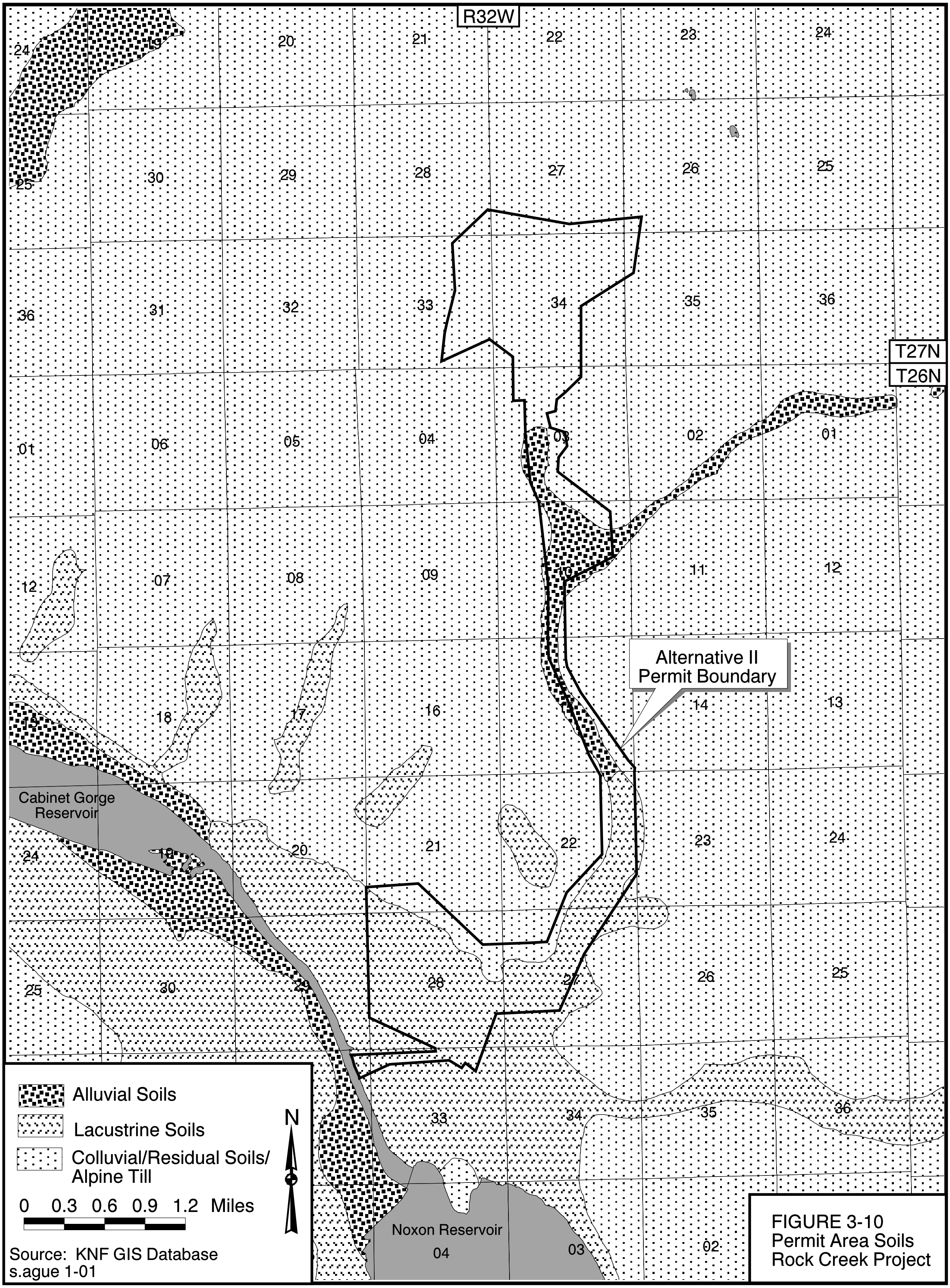


FIGURE 3-10
Permit Area Soils
Rock Creek Project

- lacustrine soils - derived from materials deposited by lakes, such as Glacial Lake Missoula.

Many of the soils in the study area, regardless of parent material, have a thin mantle of volcanic ash-influenced loess (wind blown deposits composed primarily of silt-sized particles), most of which was deposited about 6,800 years ago from volcanic eruptions in the Cascade Range. It is most evident on northerly and easterly aspects, gentle slopes, and protected benches. This material often differs sharply from the soil beneath it. Typically, the ash-influenced loess is nearly rock free, yellowish brown, and of a silt loam texture. The ash is noted because of its unique properties that favorably affect site productivity. These properties include low bulk density, high moisture-holding capacity, and high cation exchange capacity (the ability of soil to hold nutrients and make them available to plants) (Jones et al. 1979; Kuennen, Edson, and Tolle 1979; U.S. Forest Service 1972). However, these soils can be extremely susceptible to erosion. Soils derived from glacial till (material scoured and deposited by alpine glaciers) also occur in the permit area to a limited extent (Kuennen and Gerhardt 1995).

Colluvial/Residual Soils

The colluvial/residual soils group contains 13 mapping units covering about 45 percent of the proposed permit area. These soils occur on steep and very steep slopes in the West Fork of Rock Creek and at the mouth of Rock Creek. The group also includes areas of bedrock outcrops and scree or talus (heaps of rock lying at angle-of-repose that have accumulated on steep slopes). There are also areas with soils derived from coarse-textured glacial till.

These soils are usually deep, often extending beyond 5 feet. Development, however, is confined to the upper 1 to 2 feet. Some soils, however, are very shallow and have bedrock within 5 inches of the soil surface. Surface soils with volcanic ash influence have loam and silt loam textures, while those without an ash influence generally have loam and sandy loam textures. Subsoil textures are usually sandy loams and loamy sands, regardless of ash influence. Coarse fragment content, by volume, is high and ranges from 50 to 70 percent gravels in the surface and from 60 to 90 percent shaly gravels, cobbles, and often boulders below. Rock content tends to be greater in soils lower on the slope than in soils higher on the slope except for soils in the evaluation adit area that are extremely rocky throughout. Generally, surface soils have high susceptibility to erosion by water. The subsoils are moderately erodible, if disturbed.

Organic matter content is moderate in the surface but rapidly decreases to very low in the lower horizons. (A horizon is a soil layer that differs significantly from adjacent layers in terms of color, texture, or structure.) Soil reaction (pH) ranges from neutral (pH=7) to acid (pH=5). Horizons that are more developed (those with accumulations of clay or well-developed structure) tend to be less acidic (have higher pH). Extractable elemental metal concentrations are very low, with the exception of aluminum, which is slightly elevated in some soils. Aluminum concentrations are from natural soil processes and are not indicative of any influences of human activities, or from mineralization in the area.

Alluvial Soils

These soils have developed in alluvium (materials deposited by moving water). The alluvial soils group contains eight mapping units covering about 40 percent of the proposed permit area. They occur on the floodplain terraces and slopes along Rock Creek, its tributaries, and the Clark Fork River.

These soils are deep, often extending beyond 5 feet. Most of the alluvial soils are well drained except for soils along lower Rock Creek, which are poorly drained. Soil development is confined to the upper 10 to 20 inches. Most of the alluvial soils have ash-influenced surfaces with silt loam and sandy loam textures. Gravel content ranges from 10 to 40 percent. Subsoil textures are loamy sands and sandy loams. Coarse fragment content, by volume, is high and ranges from 60 to over 90 percent rounded cobbles and gravels. Surface soils are highly erodible, if disturbed. Subsoils erodibility varies from high to low, if disturbed.

Organic matter content is high in ash-influenced surfaces, but rapidly decreases to very low in the lower horizons. Soil reaction ranges from slightly acid to strongly acid. Lower pHs are usually found in surface horizons. Extractable elemental metal concentrations are very low with the exception of aluminum, which is slightly elevated in some soils as a result of natural soil-forming processes in the area.

Lacustrine Soils

The lacustrine soils group contains two mapping units covering about 15 percent of the proposed permit area. These soils have developed in lacustrine materials (materials that were deposited in ancient Glacial Lake Missoula). They occur on the higher terraces and very gentle, protected slopes along lower Rock Creek close to its confluence with the Clark Fork River.

These soils are deep, often extending beyond 5 feet. They are moderately well drained but have slow to very slow permeability. Soil development is confined to the upper 10 to 20 inches. These soils have ash-influenced surfaces with silt loam and silty clay textures. The subsoils have silty clay or clay textures, often exceeding 50 percent. These soils are generally rock free throughout. The substratum is varved, that is, distinctly banded with thicker layers of silts and fine sands alternating with thinner layers of clays. Surface and subsurface soils are highly erodible, if disturbed.

Organic matter content, as with other soils in the project area, is high in ash-influenced surfaces, but rapidly decreases to very low in the lower horizons. Soil reaction ranges from slightly acid to very strongly acid. Lower pHs are usually found in lower horizons. Extractable elemental metal concentrations are very low with the exception of aluminum, which is slightly elevated in most samples.

Disturbed Areas

Disturbed areas occupy less than 0.1 percent of the proposed permit area. Included in this group are the old Noxon solid waste landfill and a gravel pit. The landfill has been reclaimed. The landfill is comprised of a mix of refuse and lacustrine soils. The landfill was capped with about 2 feet of lacustrine soils. Soil reactions in the landfill range from medium acid to neutral. Aluminum concentrations are slightly elevated in these materials, apparently attributable to the lacustrine soils.

HYDROLOGY

Water Quality Database and Summary Tables

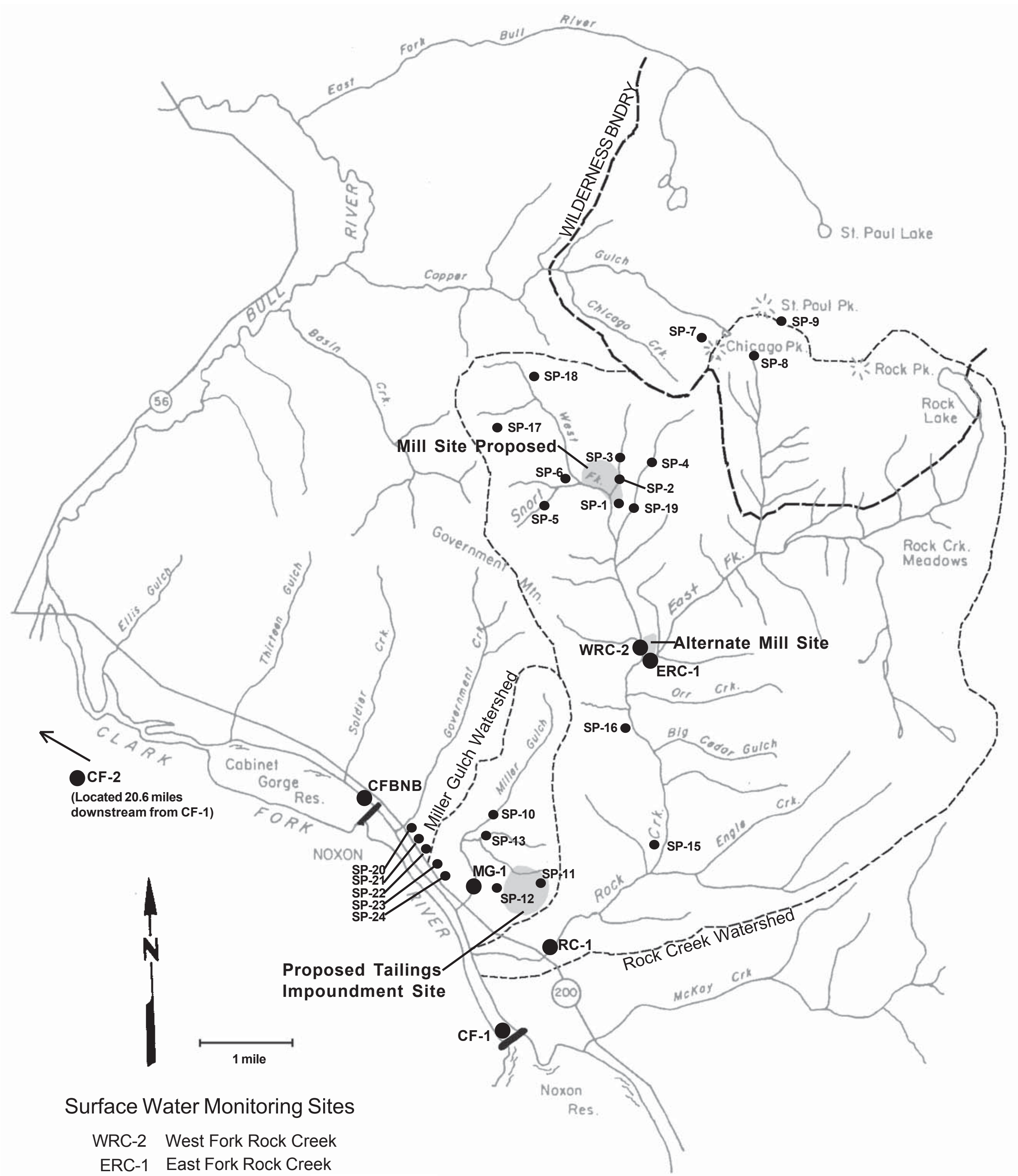
At the request of the KNF and DEQ (the Agencies), ASARCO submitted an updated version of the complete water quality monitoring database in May 1997. This database supersedes the database presented in 1993. Between 1993 and 1997, ASARCO made several improvements to the data handling routines of their database management system. As a result, there are some inconsistencies between the 1993 and 1997 data sets. The updated database represents an improvement in the data reporting procedures. These modifications have been validated by the agencies. For example, the reader may note instances where the length of the period of record has increased while the number of samples for a particular sampling station has decreased. This is due to the fact that, in the 1993 data set, laboratory duplicate samples were included in the total number of samples. The duplicates are collected as part of a quality control procedure and should not be included as additional data.

As part of the new database submittal and at the request of the Agencies, the applicant submitted statistical summary information for each water quality monitoring station. These summaries include statistical information for all sampled parameters. For many parameters, laboratory results are for less than the detection limit and no numerical value was available for comparison purposes. In an attempt to provide a numerical value for comparison purposes, ASARCO submitted the statistical summaries in two formats. The two different formats differ only in the way that parameter values are reported when they are below the laboratory detection limit. A value falling below the detection limit can range anywhere from zero to the detection limit. One methodology to handle less than detection limit data is to assign a value of zero. This methodology causes an artificial reduction in the actual average of the data. Two additional methodologies are to assign values of either one-half of the detection limit or the value of the detection limit. In most cases, a value equal to one-half the detection limit, or the detection limit value was used in statistical analyses related to preparation of hydrology baseline for this EIS.

Tables from Chapter 3 of the draft EIS were recalculated as appropriate, and statistics have been generated for all parameters and monitoring stations. In addition, DEQ data tables for the Clark Fork River have been updated to ensure they are parallel with data presented in the MPDES permit Statement of Basis (S.O.B.). These changes were made to address public comments received on the supplemental EIS. In general, statistics generated by ASARCO using the updated database incorporated a value of one-half the detection limit for all below detection limit values. Data from the S.O.B. used detection limit values in the statistical analysis and truncated the data set by discarding all pre-graphite furnace metals analyses. The difference in the way the data sets were compiled should not alter the conclusions regarding potential project impacts.

Surface Water Quantity

The Rock Creek drainage is located in northwestern Montana, southwest of the Cabinet Mountain Wilderness (CMW). Rock Creek flows southwest for about 8 miles from Rock Lake to its confluence with the Clark Fork River at the head of Cabinet Gorge Reservoir, about 1 mile below Noxon Rapids Dam. The proposed mine and mill areas are drained by the West Fork of Rock Creek. The proposed tailings impoundment site is drained by Miller Gulch. Surface water resources in the vicinity of the proposed project and selected surface water monitoring stations are presented in Figure 3-11.



Surface Water Monitoring Sites

WRC-2	West Fork Rock Creek
ERC-1	East Fork Rock Creek
RC-1	Rock Creek
CF-1	Clark Fork (below Noxon Dam) USGS #39140
CF-2	Clark Fork (below Noxon Dam) USGS #39200
CFBNB	Clark Fork (below Noxon bridge)
MG-1	Miller Gulch
SP	Spring

FIGURE 3-11
Baseline Surface Water Monitoring Stations
Rock Creek Project

The Rock Creek watershed encompasses about 33 square miles and is characterized by steep, deeply incised valleys and high mountain peaks with a maximum elevation over 7,700 feet. Seventy-two percent of the drainage is heavily forested. A significant portion of the remaining area was previously logged. In general, the highest streamflow runoff events are associated with winter or early spring rain-on-snow events. However, Rock Creek usually peaks in early- to mid-May. Representative streamflows for watersheds in the proposed project area are provided in Table 3-3 and are discussed below.

West Fork Rock Creek

West Fork of Rock Creek is a perennial stream with a drainage area of about 6 square miles. However, during certain periods of the year, portions of the west fork are dry. Near the southcentral edge of the proposed mill site, the west fork is a high-gradient stream incised in a steeply sided bedrock canyon. Several springs on Snort Creek provide perennial flow to the West Fork of Rock Creek. Streamflow measurements taken simultaneously over a broad area indicate that the West Fork of Rock Creek loses water to the alluvial ground water system, particularly in its lower reach. During the winters of 1985, 1986, 1987, 1988, and 1989, the West Fork of Rock Creek was dry near the confluence with the east fork (ASARCO Incorporated 1987-1997). Flow data are available through August 1993. Streamflows range from 0.0 cfs during late summer/fall low-flow events to 50 cfs during spring runoff.

East Fork Rock Creek

The upper east fork drainage below Rock Lake contains a number of large ponds and marsh areas known as Rock Creek Meadows. The East Fork of Rock Creek is a perennial stream above its confluence with the west fork. Flow measurements at station ERC-1 during water year 1985 indicate that the east fork contributed an average of 82 percent of the total flow of Rock Creek immediately below the confluence with the west fork.

Mainstem Rock Creek

The proposed mine access corridor would parallel the main stem of Rock Creek. Rock Creek is characterized by high velocities and large flow volumes during snowmelt runoff. Below the confluence of the east and west forks, the flow in Rock Creek often sinks into the coarse alluvial material during low-flow periods. Perennial flow occurs for about 1 mile above the constriction at the lower canyon outlet; low flows are usually lost into alluvium several hundred yards above Montana Highway 200. Rock Creek, at station RC-1, was dry for several months during the winter of 1984-1985 and fall of 1986, 1987, 1988, and 1989. Summer low flow at RC-1 was about 2 cubic feet per second (cfs). Peak flow during the baseline period of measurement was estimated to be about 200 to 300 cfs. The 7-day, 10-year low flow is equal to 0.0 cfs. Flow data are available through August 1993.

TABLE 3-3
Comparison of Streamflow Data at Selected Monitoring Stations

Daily Flow Data for Water Year 1986				Estimated Mean Monthly Flows			
Date	Rock Creek[1] RC-1 (cfs)	Clark Fork below Noxon Dam[2] CF-1 (cfs)	Clark Fork below Cabinet Gorge Dam[2] CF-2 (cfs)	Date	Rock Creek[3] RC-1 (cfs)	Clark Fork below Noxon Dam[4] CF-1 (cfs)	Clark Fork below Cabinet Gorge Dam[5] CF-2 (cfs)
10-16-85	15	14,900	15,000	October	16.3	11,600	11,900
11-20-85	8	18,000	18,500	November	4.1	12,100	12,600
12-09-85	Iced	21,200	19,400	December	1.7	14,000	13,900
01-15-86	Iced	11,900	12,200	January	1.9	14,900	14,200
02-15-86	Iced	15,900	16,400	February	2.4	16,200	14,700
03-05-86	99	26,600	30,200	March	40.5	18,100	15,600
04-09-86	159	32,300	20,500	April	145	24,200	24,600
05-03-86	143	26,500	29,500	May	340	44,600	51,200
06-16-86	145	38,100	41,200	June	310	57,000	59,400
07-25-86	8	10,500	12,600	July	27	24,700	27,000
08-20-86	1.1	9,620	11,600	August	1.6	10,300	11,500
09-12-86	Dry	12,800	12,700	September	Dry	9,840	10,400
				ANNUAL	81.0	21,462	22,250

Sources and Notes: [1]ASARCO Incorporated 1987-1997.
[2]U.S. Geological Survey 1988 unpublished data (March 23, 1988, WATSTOR flow statistics, USGS Helena, MT office).
[3]Estimated for water year 1986 using Riggs Methodology (Riggs 1968)
[4]Water years 1961-1979 (USGS unpublished data)
[5]Water years 1929-1988 Flow below Cabinet George Dam provides an estimate of the inflow to Lake Pend Oreille.

Miller Gulch

The proposed tailings impoundment would be located primarily within the Miller Gulch drainage. The north fork of Miller Gulch drains the south slope of Government Mountain. The south fork drains a terrace associated with the Clark Fork River. Base flow in Miller Gulch is maintained by a major spring located just above the Clark Fork River terrace. After passing through a series of beaver ponds, Miller Gulch loses flow to ground water and is generally dry except for intermittent high-flow periods that occur during snowmelt runoff. The largest recorded flow in Miller Gulch at station MG-1 was about 1.7 cfs (ASARCO Incorporated 1987-1997). Flow in Miller Gulch is currently diverted for power generation (DNRC Permit #PO29428), for irrigation (DNRC Claim #W131977), and for domestic (DNRC claim #W131978).

Clark Fork River and Lake Pend Oreille

Rock Creek and Miller Gulch drain to the Clark Fork River about 6 miles south of the proposed mill site. The Clark Fork then flows northwestward for about 30 miles to Lake Pend Oreille in Idaho and provides the majority of inflow to the lake.

The 7-day, 10-year low flow of the Clark Fork River near Noxon, Montana, is equal to 3,610 cubic feet per second (cfs). The average flow of the river is about 20,000 cfs. Streamflow in the Clark Fork River is also regulated by Noxon Rapids Dam about 1 mile upstream from the confluence of Rock Creek and the Clark Fork, and also by Cabinet Gorge Dam in Idaho. Noxon Rapids Dam turbines are shutdown during night time operations for a variable period of 4 to 6 hours on weekdays and up to 12 hours on weekend days to allow the reservoir to refill. The 7-day, 10-year low flow taking into account nighttime operation is estimated to be about 365 cfs based on information provided by DEQ in the S.O.B. During water year 1986, Rock Creek provided only 0.4 percent of the total flow of the Clark Fork River below Noxon Dam. A comparison of flows for the Clark Fork River upstream and downstream of Rock Creek, and at the mouth of Rock Creek, is presented in Table 3-3.

Characteristics of Lake Pend Oreille include a surface area equal to 128 square miles, an average depth of 530 feet, and a hydraulic residence time of about 2 to 3 years. The Clark Fork River provides 80 to 90 percent of the inflow to Lake Pend Oreille.

Cabinet Mountains Wilderness (CMW)

A number of ponds and small lakes exist in the CMW in the vicinity of the ore body. These include Copper, Cliff, Saint Paul, Rock, and Moran Basin lakes (for more information on lakes in the CMW, see the DEQ technical report on file at the Agencies [MT DEQ 2001a]). Cliff Lake contributes to the headwaters of East Fork of Rock Creek. Copper, Saint Paul, and Moran Basin lakes are located in the Bull River drainage. The lakes are fed by snowmelt and all of the lakes, except Copper Lake, are also fed by shallow ground water systems. Except for Copper Lake, all four lakes retained water year-round. Approximately 50 percent of the lakebed associated with Copper Lake was dry during the summers of 1988 and 2000 when personnel from DEQ and the USFS conducted site inspections in this area. Outflows occur only during spring runoff. Fluctuations of 0.5 feet in lake surface elevation in Cliff and Copper lakes were measured during water year 1981 and 2000. Outflows from Cliff and Moran Basin cease during the summer. Flows in lower Copper Gulch ranged between 18.96 cfs and 3.54 cfs on June 9, 1977 and September 11, 1978, respectively. In September 2000, upper Copper Gulch was dry.

Surface Water Quality

Existing water resources data for the period of record (1984 through 1990) are summarized in this EIS, and are useful for the purpose of characterizing baseline hydrology. Tables 3-4 and 3-5 provide water quality data for Rock Creek at a monitoring station located at Montana Highway 200. Tables 3-6 and 3-7 present data for the Clark Fork River at Noxon Bridge, and Table 3-8 summarizes data for the Clark Fork River below Cabinet Gorge Dam. These data represent water quality baseline conditions.

Baseline water quality monitoring data can be compared to state and/or federal water quality criteria for public drinking water, recreation, aquatic life, irrigation, and livestock watering. According to the Montana Water Quality Division (WQD) stream classification, Rock Creek and the Clark Fork River below Noxon Dam are classified B-1 (ARM 17.30.607).[3] Water quality data for selected streams in the proposed project area for the period of record are summarized in Tables 3-3 through 3-8, and are discussed below.

Under the federal Clean Water Act, states are required to report to EPA a list of water bodies or portions thereof that are water quality-limited, that is that do not meet applicable water quality standards. These water bodies, as well as water bodies that do not fully support their designated beneficial uses, are identified in the Montana 305(b) Report (Montana Department of Health and Environmental Sciences 1994a). Section 303(d) of the federal Clean Water Act further requires that streams for development of a total maximum daily load (TMDL). The TMDL calculation determines the allowable pollutant load, from all sources, that a water body can assimilate and not violate the applicable water quality standard.

Rock Creek (MT76N003-19) is listed as a moderate priority for development of a TMDL due to the potential for water quality degradation associated with the Rock Creek Mine project. The Clark Fork River, from Warm Springs Creek to the confluence of the Flathead River, is listed as a high priority for TMDL development due to excessive nutrient loads and other sources of impairment. In addition, 97 miles of the Clark Fork below the confluence with the Flathead River to the Idaho border are listed as partially supporting aquatic life and cold-water fisheries due to flow alternation and thermal modifications resulting from dam operation and construction but are not listed as requiring a TMDL.

Rock Creek

Rock Creek is characterized by soft (low hardness), calcium-bicarbonate water with low or nondetectable levels of oil and grease, nutrients, and metals. Summaries of water quality data for Rock Creek are provided in Tables 3-4 and 3-5. During the baseline period of measurement, the average hardness of water in Rock Creek was about 10 milligrams/liter (mg/L).

Turbidity is extremely low, with total suspended sediment generally less than 1 mg/L. At high flow, the concentration of suspended sediment has been documented to be 8 mg/L. All water quality constituents are well within the range of concentrations established to protect uses such as drinking water, recreation, irrigation, and livestock watering. The concentrations of cadmium, copper, lead, and zinc at times exceeded numeric water quality standards during the baseline period of measurement.

---

[3] B-1 water quality standards may be obtained from the DEQ.

TABLE 3-4
Water Quality Data for Rock Creek at Highway 200
December 1988 Through August 1993

Parameter	Number Of Samples	Average	Standard Deviation	Maximum Value	Minimum Value
pH (SU)	53	7.6	0.27	8.02	6.75
Total Suspended Solids	15	3.0	4.3	16.0	<0.1
Total Hardness (as $CaCO_3$)	55	10	9	72	2
Total Alkalinity (as $CaCO_3$)	54	11	5	20	<5.0
Ammonia (NH_3 as N)	33	<0.01	0.0	<0.01	<0.01
Total Kjeldahl Nitrogen (as N)	33	0.08	0.17	0.70	<0.1
Nitrate + Nitrite (as N)	33	0.02	0.018	0.06	<0.01
Orthophosphate (PO_4-P)	33	<0.001	0.0011	0.006	<0.001
Total Phosphorus	33	0.006	0.0079	0.048	<0.001
Arsenic (TRC)	56	<0.001	0.000132	0.001	<0.005[1]
Cadmium (TRC)	56	<0.0002	0.000078	0.0004	<0.001
Copper (TRC)	56	<0.01	0.0	<0.01	<0.01
Lead (TRC)	56	<0.001	0.000265	0.002	<0.01[1]
Zinc (TRC)	56	0.0005	0.0025	0.011	<0.005

Source: Montana Department of Health and Environmental Sciences, Water Quality Bureau, 1993.

Notes: All units are in milligrams per liter (mg/L) unless otherwise indicated.
SU = Standard pH Units
TRC = Total Recoverable Metals Analysis
Values below the detection limit value were set equal to zero by DHES for this statistical analysis.

[1] Laboratory detection limits may have varied with time, or varied with dilution effects during analyses in the laboratory. The minimum value is uncertain, but is less than the number reported. As a result, "minimum values" (which are detection limits) are sometimes greater than "maximum values" which are measured concentrations.

TABLE 3-5
Water Quality Data for Rock Creek at Highway 200, November 1984 through August 1996

Parameter	Number of Samples	# of Detections	Average	Standard Deviation	Maximum Value	Minimum Value
pH (SU)	28	28	7.1393	0.4332	7.7000	5.9000
Total Suspended Solids	28	12	2.6571	6.2678	33.0000	<1.0000
Total Hardness (as $CaCO_3$)	25	25	10.5040	2.9210	17.0000	5.0000
Total Alkalinity (as $CaCO_3$)	26	26	10.3923	2.9585	14.0000	3.5000
Sulfate (SO_4)	25	5	1.8280	1.4120	5.0000	<1.0000
Ammonia (NH_3 as N)	27	11	0.2170	0.5827	3.0000	<0.0100
Total Kjeldahl Nitrogen (as N)	27	12	0.3770	0.9858	5.1000	<0.0100
Nitrate + Nitrite (as N)	27	13	1.0970	2.7115	11.0000	<0.0100
Orthophosphate (PO_4-P)	27	0	0.0131	0.0108	<0.1000	<0.0100
Total Phosphorus	27	1	0.0228	0.0156	<0.1000	<0.0100
Arsenic (TRC)	27	4	0.0011	0.0012	0.0050	<0.0010
Cadmium (TRC)	27	18	0.0003	0.0003	0.0012	<0.0001
Chromium (TRC)	19	0	0.0185	0.0321	<0.3000	<0.0100
Copper (TRC)	27	5	0.0007	0.0003	0.0020	<0.0010
Iron (TRC)	21	18	0.0466	0.0823	0.3800	<0.005
Lead (TRC)	27	6	0.0012	0.0013	0.0060	<0.0010
Manganese (TRC)	26	2	0.0048	0.0032	0.0180	<0.0008
Mercury (TRC)	17	0	0.0003	0.0000	<0.0005	<0.0005
Selenium (TRC)	17	1	0.0022	0.0011	0.0060	<0.0010
Silver (TRC)	27	1	0.0002	0.0002	<0.0010	<0.0002
Zinc (TRC)	27	17	0.0024	0.0021	0.0080	<0.0010

Source: ASARCO Incorporated 1987-1997.

Notes: All units are in mg/L unless otherwise indicated.
SU = Standard pH units
TRC = Total Recoverable Metals analysis
# of detections = Number of samples in data set above detection limit. One half the detection limit value was used in the statistical calculations.

TABLE 3-6
Water Quality Data for Clark Fork River at Noxon Bridge
July 1984 Through December 1992

Parameter	Number of Samples	Mean[(1)]	Minimum Value	Maximum Value
pH (SU)	115	8.1	7.1	8.4
Total Suspended Solids	131	<2.8	<0.2	27
Kjeldahl Nitrogen, as N	135	<0.171	<0.1	0.7
Ammonia (NH_3 as N)	137	<0.013	<0.01	0.07
Nitrate + Nitrite, as N	137	<0.034	<0.01	0.57
Total Inorganic Nitrogen, as N	137	<0.047	<0.02	0.64
Total Nitrogen (TN), as N	135	<0.22	<0.13	1.41
Ortho-phosphorus (as P)	78	<0.002	<0.001	0.014
Total Phosphorus (as P)	137	<0.011	<0.001	0.062
Hardness (as $CaCO_3$)	65	85	61	106
Alkalinity (as $CaCO_3$)	105	80.7	57	99
Aluminum (TRC)	17	0.07	0.008	0.43
Arsenic (TRC)	56	<0.0011	<0.001	0.003
Barium (TRC)	13	0.078	0.02	<0.1
Cadmium (TRC)	63	<0.00023	<0.0002	0.001
Copper (TRC)	65	<0.0013	<0.001	0.010
Iron (TRC)	19	0.082	0.02	1.3
Lead (TRC)	65	<0.0011	<0.001	0.003
Manganese (TRC)	17	0.02	0.008	0.067
Mercury (TRC)	17	<0.0002	<0.00001	<0.005
Silver (TRC)	58	<0.0002	<0.0001	<0.0002
Zinc (TRC)	65	<0.0036	<0.0002	41

Source: Montana Department of Health and Environmental Sciences, Water Quality Bureau (1993); Appendix D, MPDES Permit.
Notes: All units are in milligrams per liter (mg/L) unless otherwise indicated.
SU = Standard pH Units

Values below the detection limit value were set equal to the detection limit by DHES for this statistical analysis. Metals data generated prior to July 1988 were omitted from data set because laboratory detection limits were higher than more recent data.

(1) Arithmetic average used to estimate mean if sample size is greater than 30, otherwise median value used.

TABLE 3-7
Water Quality Data for Clark Fork River at Noxon Bridge, April 1990 through October 1991

Parameter	Number of Samples	# of Detections	Average	Standard Deviation	Maximum Value	Minimum Value
pH (SU)	3	3	7.8667	0.1155	8.0000	7.8000
Total Suspended Solids	3	3	1.5333	0.2082	1.7000	1.3000
Total Hardness (as $CaCO_3$)	3	3	89.0000	13.8924	98.0000	73.0000
Total Alkalinity (as $CaCO_3$)	3	3	77.6667	10.2144	85.0000	66.0000
Sulfate (SO_4)	3	1	2.1667	2.0207	4.5000	<2.0000
Ammonia (NH_3 as N)	3	0	0.0500	0.0000	<0.1000	<0.1000
Total Kjeldahl Nitrogen (as N)	3	1	0.0733	0.0404	0.1200	<0.1000
Nitrate + Nitrite (as N)	3	2	0.0833	0.0416	0.1300	<0.1000
Orthophosphate (PO_4-P)	3	0	0.0200	0.0087	<0.0500	<0.0200
Total Phosphorus	3	0	0.0333	0.0144	<0.1000	<0.0500
Arsenic (TRC)	3	1	0.0007	0.0003	0.0010	<0.0010
Cadmium (TRC)	3	1	0.0001	0.0001	0.0002	<0.0001
Chromium (TRC)	2	0	0.0050	0.0000	<0.0100	<0.0100
Copper (TRC)	3	1	0.0007	0.0003	0.0010	<0.0010
Iron (TRC)	3	3	0.0400	0.0263	0.0700	0.0210
Lead (TRC)	3	0	0.0005	0.0000	<0.0010	<0.0010
Manganese (TRC)	2	1	0.0100	0.0085	0.0160	<0.0080
Mercury (TRC)	3	0	0.00025	0.0000	<0.0005	<0.0005
Selenium (TRC)	2	0	0.0025	0.0000	<0.0050	<0.0050
Silver (TRC)	3	0	0.0002	0.0002	<0.0010	<0.0002
Zinc (TRC)	3	3	0.0057	0.0055	0.0120	0.0020

Source: ASARCO Incorporated 1987-1997.

Notes: All units are in mg/L unless otherwise indicated.
SU = Standard pH units
TRC = Total Recoverable Metals analysis
# of detections = Number of samples in data set above detection limit. One half the detection limit value was used in the statistical calculations.

TABLE 3-8
Water Quality Data for Clark Fork River Below Cabinet Gorge Dam
November 1989 Through January 1998

Parameter[1]	Number of Samples	Mean	Standard Deviation	Percent Less than Detection	Idaho[2] Numeric Standard
pH, S.U.	54	8	0.3	0	6.5-9.5
Total Suspended Solids	40	9.1	17	0	--
Kjeldahl Nitrogen as N	65	0.26	0.38	74	--
Ammonia, as N	57	0.024	0.017	30	1.36[3]
Nitrate + Nitrite as N	62	0.065	0.028	53	--
Ortho-phosphorus, as P	62	0.009	0.005	74	--
Total Phosphorus as P	65	0.013	0.008	41	--
Hardness as $CaCO_3$	27	88	9	0	--
Arsenic	24	0.001	0	50	0.050
Cadmium	24	0.001	0.0002	92	0.0019[4]
Copper	24	0.013	0.036	8	0.0069[4]
Lead	24	0.0046	0.012	62	0.002[4]
Manganese	24	0.0035	0.004	17	--
Selenium	24	0.001	0	100	0.005
Zinc (TRC)	24	0.013	0.009	4	0.089[4]

Source: Appendix D

Notes:

(1) In mg/L unless otherwise noted.
(2) Administrative Rules of Idaho DHW (IDAPA 250.16.01.01, Effective Date April 8, 1996.
(3) IDAPA 250.02.C(2) Table IV - Cold Water Biota, based on temperature 10°C and pH 8.0.
(4) IDAPA 250.02.a.iv. - Hardiness dependent, values is based on hardness of 70 mg/L $CaCO_3$.

Shading = Median (50th percentile) value for copper equals 0.00. Median value for lead equal 0.001. Mean values biased high by a small number outlier samples. Data indicate the quality of water at the Montana-Idaho state line generally meets Idaho numeric standards, except for a few occasions when a slug of poorer quality water passes through the system.

TABLE 3-9
Range of Concentrations for Surface Water Monitoring Stations

Location	West Fork Rock Creek	East Fork Rock Creek	Miller Gulch
Period of Record	**11/84-8/93**	**2/85-8/93**	**4/85-8/93**
Flow CFS	0.0450 - 50.2800	0.5900 - 174.0000	0.0180 - 1.7000
pH (SU)	6.9000 - 8.1000	5.9000 - 7.8000	7.0000 - 8.2000
Total Suspended Solids	<1.000 - 31.0000	0.3000 - 2.0000	<1.0000 - 1.6000
Hardness (as $CaCO_3$)	24.0000 - 44.0000	2.6000 - 6.8000	70.0000 - 187.0000
Alkalinity (as $CaCO_3$)	25.0000 - 47.0000	<1.0000 - 12.0000	69.0000 - 178.0000
Sulfate (SO_4)	<1.0000 - <10.0000	<1.0000 - 4.4000	<2.0000 - 9.3000
Ammonia (NH_3 as N)	<0.0100 - 1.2600[1]	<0.0100 - 0.3500	<0.0100 - <0.0500
Total Kjeldahl Nitrogen (as N)	<0.0100 - 1.5000[1]	<0.0100 - 0.4100	<0.0100 - 0.2500
Nitrate and Nitrite (as N)	<0.0100 - 13.0000[1]	<0.0100 - 10.0000	0.2500 - 12.0000
Orthophosphate (PO_4-P)	<0.0010 - <0.0500	<0.0100 - <0.0500	<0.0100 - 0.0160
Phosphorus (P) (TOT)	0.0040 - <0.1000	<0.0100 - 0.0600	<0.0100 - 0.0300
Arsenic (DIS)	<0.0080 - <0.0080	ND	ND
Arsenic (TRC)	<0.0010 - <0.0040	<0.0010 - 0.0050	<0.0010 - <0.0040
Cadmium (DIS)	<0.0030 - <0.0030	ND	ND
Cadmium (TRC)	<0.0001 - 0.0019	<0.0001 - 0.0016	<0.0001 - 0.0004
Chromium (DIS)	<0.0300 - <0.0300	ND	ND
Chromium (TRC)	<0.0100 - <0.3000	<0.0100 - <0.3000	<0.0100 - <0.0300
Copper (DIS)	<0.0080 - <0.0080	ND	ND
Copper (TRC)	<0.0010 - 0.0100	<0.0010 - 0.0010	<0.0010 - 0.0010
Iron (DIS)	0.0700 - 0.0700	ND	ND
Iron (TRC)	0.0020 - 0.1200	<0.0050 - 0.0240	<0.0050 - 0.0450
Lead (DIS)	<0.0200 - <0.0200	ND	ND
Lead (TRC)	<0.0010 - 0.0070	<0.0010 - 0.0050	<0.0010 - 0.0010
Manganese (DIS)	0.0120 - 0.0120	ND	ND
Manganese (TRC)	<0.0010 - 0.0080	<0.0080 - 0.0180	<0.0080 - 0.0080
Mercury (DIS)	<0.0002 - <0.0005	ND	ND
Mercury (TRC)	<0.0001 - <0.0005	<0.0001 - <0.0005	<0.0005 - <0.0005
Selenium (DIS)	ND	ND	ND

TABLE 3-9 (Cont.)
Range of Concentrations for Surface Water Monitoring Stations

Location	West Fork Rock Creek	East Fork Rock Creek	Miller Gulch
Period of Record	**11/84-8/93**	**2/85-8/93**	**4/85-8/93**
Selenium (TRC)	<0.0040 - <0.0050	<0.0040 - 0.0080	<0.0040 - <0.0040
Silver (DIS)	<0.0080 - <0.0080	ND	ND
Silver (TRC)	<0.0002 - 0.0065	<0.0002 - 0.0012	<0.0002 - <0.0010
Zinc (DIS)	0.0220 - 0.0220	ND	ND
Zinc (TRC)	<0.0010 - 0.0380	<0.0010 - 0.0040	<0.0010 - <0.0010

Source: ASARCO Incorporated 1987-1997.

Notes: All units are in mg/L unless otherwise noted.
SU = Standard pH Units
DIS = Dissolved Metals Analysis
TRC = Total Recoverable Metals Analysis
ND = No Data

This is due to the extremely low hardness in Rock Creek. Some populations of salmonids are self-supporting despite the potential impacts from these elevated metal concentrations (see Chapter 3, Aquatics/Fisheries).

Miller Gulch

A summary of water quality data for Miller Gulch is presented in Table 3-9. Miller Gulch contains hard, calcium-bicarbonate water with low or nondetectable levels of oil and grease, nutrients, and metals. Concentrations of these constituents are below criteria established to protect drinking water supplies, recreation, irrigation, and livestock watering. Chronic cold-water aquatic life criteria occasionally were exceeded for cadmium and silver during the period of baseline measurement.

Clark Fork River

Several stations on the lower Clark Fork River have been sampled on a periodic basis by the State of Montana, Sterling and U.S. Geological Survey (USGS). Summaries of water quality data for the Clark Fork River are provided in Tables 3-6 through 3-8. Water quality results from station CF-1 located below Noxon Dam and at station CF-2 located below Cabinet Gorge Dam indicate a moderately hard water (mean 88 mg/L), with concentrations of metals that are generally below water quality criteria. The mean concentration of nitrate plus nitrite as nitrogen equals 0.065 mg/L.

Clark Fork River Nutrient Studies

In February 1989, a report titled "Assessment of Nutrient and Algal Relationships in the lower Clark Fork River and Lake Pend Oreille: Baseline Conditions and Potential Impacts of the ASARCO Rock Creek Project" was prepared by John C. Priscu, Ph.D. (Priscu 1989). Using periphytic diatoms[4] to assess ambient water quality conditions, it was concluded that the Clark Fork River below Noxon and Cabinet Gorge Reservoirs is relatively unpolluted, and that river water can either be phosphorus limited or limited by both nitrogen and phosphorus, with respect to algal growth[5] (ibid. 1989).

Baseline nutrient conditions in Cabinet Gorge Reservoir were similar to the Clark Fork River. The calculated hydraulic retention time for Cabinet Gorge Reservoir ranges between one and 26 days, and averages only 5 days. Phytoplankton[6] data collected in Cabinet Gorge Reservoir between 1984 and 1985 indicated the absence of nuisance or noxious species. The lake supports very low levels of phytoplankton, and the algal growth potential in the lake is considered to be moderate to moderately high, particularly for conditions where nitrogen and phosphorous are added simultaneously.

---

[4] Periphytic diatoms - Diatoms, or algal slime are commonly seen as a bloom of green or brownish slime covering a rock. While appearing brown or green under a microscope, they may still give water a bright green or yellow-green opaqueness, as in lake water experiencing a bloom. The term "periphytic" refers to being attached to submerged surfaces or rocks.

[5] Primary production of plant material can be limited by one of many factors. If the abundance of the limiting factor at any time is increased by some outside source, primary production will be increased until some other outside factor becomes scarce enough to the limit. Phosphorus limited waters are those identified as showing an increase in plant productivity with an increase in the amount of available phosphorus. Nitrogen and phosphorus are essential nutrients for plant growth. Aquatic vegetation of the free-floating types, such as algae, depends on dissolved nitrogen and phosphorus compounds for its nutrient supply. Dense, rapidly multiplying algal growths or blooms sometimes occur in water bodies that periodically receive increased concentrations of nitrogen or phosphorus. Co-limited waters are those identified as showing an increase in plant productivity with an increase in the amount of available phosphorus and nitrogen together.

[6] Phytoplankton are floating or suspended plants, such as algae, rather than "periphytons" [see above], which are plants attached to submerged surfaces.

In February 1993, a report prepared by the U.S. EPA, under Section 525 of the Clean Water Act of 1987 titled "Clark Fork - Pend Oreille Basin Water Quality Study: A Summary of Findings and a Management Plan" (U.S. EPA 1993) identified the following in regard to existing baseline conditions in the Clark Fork River:

a. The most critical point sources are the municipal wastewater treatment plants, particularly at Butte, Deer Lodge and Missoula. The Stone Container Corporation's Missoula Mill has been a major source of industrial wastewater nutrient loading to the river, although the levels of nutrients in its effluent over the past 6 years have been reduced several fold.

b. About half of the soluble phosphorous derives from wastewater discharges, with the other half contributed by nonpoint sources in tributary watersheds. Three-fourths of the soluble nitrogen comes from tributaries, with the remaining quarter from wastewater discharges.

c. Excessive levels of algae caused water-use impairment in up to 250 miles of the Clark Fork River.

d. Phosphate bans in several communities along the river have decreased the phosphorus content of the effluent of the municipal wastewater treatment plants.

Lake Pend Oreille

Lake Pend Oreille comprises two different aquatic regimes in one water body (U.S. EPA 1993). The pelagic region,[7] generally in the central and southern portions of the lake is deep, clear, and cold, and is classified as oligotrophic.[8] Water quality in this region of the lake has not changed since the 1950s. The nearshore littoral zone,[9] which accounts for about 11 percent of the lake volume, is classified as meso-oligotrophic[10] and is the primary location for water quality problems. The highest nearshore algal growth is in areas adjacent to shorelines with significant residential development. Attached algae levels at the most productive site are one-third to one-half those that other Northwest researchers have reported as constituting nuisance conditions.

Lake Pend Oreille Nutrient Studies

The 1989 Priscu report summarized existing nutrient, chlorophyll, and phytoplankton data for Lake Pend Oreille. The data suggested the lake supports very low levels of phytoplankton and that algal growth potential in the lake was moderate to moderately high, particularly if nitrogen and phosphorous were added simultaneously.

[7] Pelagic region references open-lake regions, or areas not classified as littoral or alongshore.

[8] Water bodies have a considerable capacity to absorb organic material. Lakes are sometimes characterized in terms of their productivity--that is, the amount of organic material synthesized per unit of surface area in a given time. Water bodies with high productivity are sometimes termed "eutrophic" or nutrient rich. Water with low productivity are termed "oligotrophic" or nutrient poor.

[9] Lakes and large bodies of water display a different set of behaviors and hydromechanics relative to locations about the body of water. The littoral zone references alongshore rather than open-lake regions, the division being made at that distance from shore where effects of local shore and bottom topography become unimportant.

[10] "Meso" refers to being situated in the middle, intermediate, or between. Meso-oligotrophic refers to lake productivity between oligotrophic and eutrophic.

The EPA 1993 report identified the following related to baseline conditions of Lake Pend Oreille:

a. Open lake water quality has not changed since the mid-1950s.

b. There is a high correlation between total phosphorus loading from nearshore and local tributaries and the degree of urban development.

c. The greatest share (more than 90%) of water entering the lake comes from the Clark Fork River inflow as does 85% of the total loading of phosphorus, the nutrient that most often limits algae and aquatic plant growth in the lake. Measurements of nutrient loads entering the lake and exiting via the Pend Oreille River show that year to year 55,000 kilograms of total phosphorus and about 750,000 kilograms of total nitrogen remain in the lake. There was some evidence that heavy metals inhibited algae growth.

d. Maintenance of open lake water quality is largely dependent on maintaining nutrient loadings from the Clark Fork River at or below their present levels.

e. Wastewater from septic tanks contributes about 3% of the total phosphorus load and about 1% of the total nitrogen load to the lake annually. This includes both septic tank and Sandpoint and Priest River wastewater treatment facility effluent. While this is a small proportion of the load compared to the total, it is clear that because septic tank effluent discharges near shore, the effect will be in near-shore areas.

The average total phosphorus concentration in the lake's upper water column was 7 parts per billion (ppb) and ranged between 3 to 13 ppb. The mean concentration of total phosphorus in near shore areas where the public is perceiving a problem is 8 ppb.

Cabinet Mountains Wilderness

Limited water quality data have been collected from water resources located in the CMW. Table 3-10 presents a summary of available water quality data for Cliff and Copper lakes, Moran Basin, Copper Gulch, and a number of unnamed springs. Water collected at these sites is characterized by neutral to slightly acidic pH, low specific conductance, metals that are at or below the analytical detection limit, and total dissolved solids that range between 11 and 12 mg/L. A number of lakes within the CMW were monitored as part of the CMW Water Chemistry Monitoring Program (USFS 1992) and showed a slightly acidic pH. Water quality data for Cliff Lake, Moran Basin, Copper Lake, and surrounding springs are contained a DEQ technical report on file at the Agencies (MT DEQ 2001a).

TABLE 3-10
Water Quality Data for Water Resources Located in the Cabinet Mountains Wilderness

Location	Date Sampled	Total Dissolved Solids (mg/L)	Specific Conductance (µmhos/cm)	pH (Standard Units)	As (TRC) (mg/L)	Cd (TRC) (mg/L)	Cu (TRC) (mg/L)	Zn (TRC) (mg/L)
Spring below Chicago Peak	08-02-85	ND	27	7.7	ND	ND	ND	ND
Spring below St. Paul Peak	08-02-85	ND	123	6.5	ND	ND	ND	ND
Stream below Cliff Lake	08-05-85	ND	8	7.8	ND	ND	ND	ND
Copper Gulch	06-09-77		62	7.7	ND	ND	ND	ND
	09-11-78	85	110	8.2				
Stream below St. Paul Lake	08-07-85	ND	22	7.4	ND	ND	ND	ND
Cliff Lake	10-23-81	11	16	7.4	0.0001	0.003	0.003	<0.004
	09-23-82	12	21	7.0	<0.0001	<0.002	<0.002	<0.004
	08-02-85		15	7.4				
	11-03-00*	ND	14	7.3				
Copper Lake	08-02-85	ND	8	7.0	ND	ND	ND	ND
	9-17-00*	ND	7.7	6.6	ND	ND	ND	ND
Moran Basin	11-02-00*	ND	7.4	27	ND	ND	ND	ND

Source: ASARCO Incorporated 1987-1997.

Notes:

*	Data from DEQ 2001
As	Arsenic
Cd	Cadmium
Cu	Copper
Zn	Zinc
TRC	Total Recoverable Metals Analysis
ND	No Data Available

Ground Water

Baseline data suggest that significant quantities of ground water may be found in coarse gravel and sand deposits associated with Rock Creek and the Clark Fork River. However, monitoring wells completed in fine-grained glacial lakebed sediments (lacustrine deposits) in the vicinity of the Clark Fork River typically yield very little water or are dry. Ground water movement in bedrock is primarily controlled by weathering or the existence of joints, fractures, or faults. In general, ground water flows from topographically high areas in the mountains to lower valleys.

The three major areas of the proposed project where ground water may be encountered include coarse sediments below the proposed tailings impoundment site and mill site, and the bedrock in the ore body. The hydrogeology of each of these areas is discussed below.

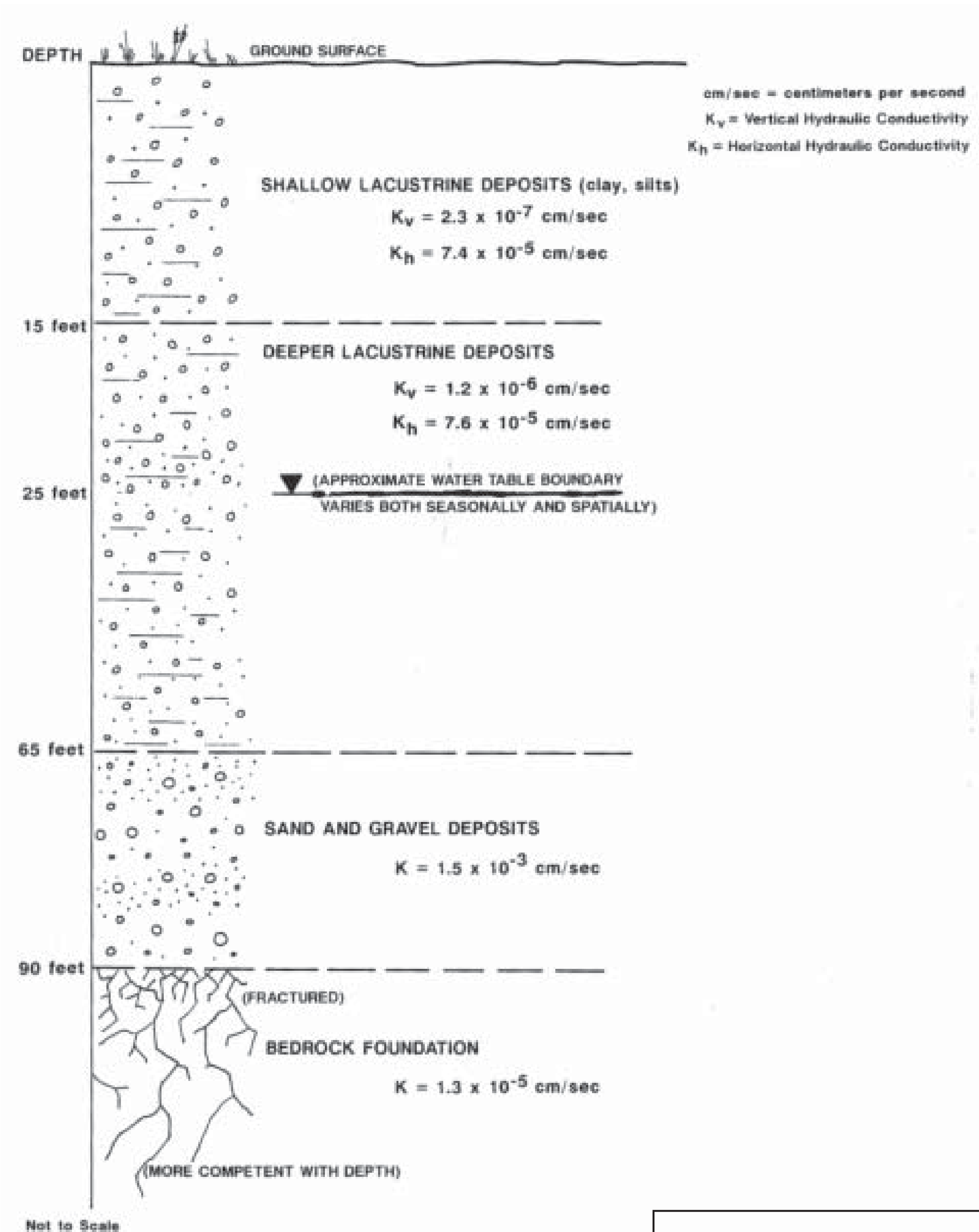
Hydrogeologic conditions, including values for hydraulic conductivity in the vicinity of the proposed tailings impoundment site, were determined from 19 geotechnical borings and monitoring wells, and are presented schematically in Figure 3-12. Soil boring data indicate that the site is underlain by up to 65 feet of lacustrine clays, sands, and silts, which in turn are underlain by up to 25 feet of sand and gravel. Below the sand and gravel layer is argillitic bedrock. However, the actual thickness of unconsolidated deposits is highly variable. In addition, the hydraulic conductivity (the ability to transmit water) of each stratum varies both with location and depth.

Proposed Tailings Impoundment Site

Estimates of the vertical and horizontal hydraulic conductivity for lacustrine deposits of clay, sand, and silt; for sand and gravel deposits; and for the bedrock formation are also presented in Figure 3-12. Ground water in unconsolidated deposits is generally unconfined, that is, the water table forms the upper boundary of the aquifer. Figure 3-13 indicates that the depth to ground water is about 25 feet below ground surface (also see Figure 3-12). The actual depth to ground water ranges from 2 to 35 feet below ground surface, and fluctuates seasonally up to about 8 feet, with highest levels occurring in the spring followed by lower levels during late fall and early winter. Water quality data from lacustrine wells are provided in Table 3-11. Table 3-12 summarizes water quality data from sand and gravel wells.

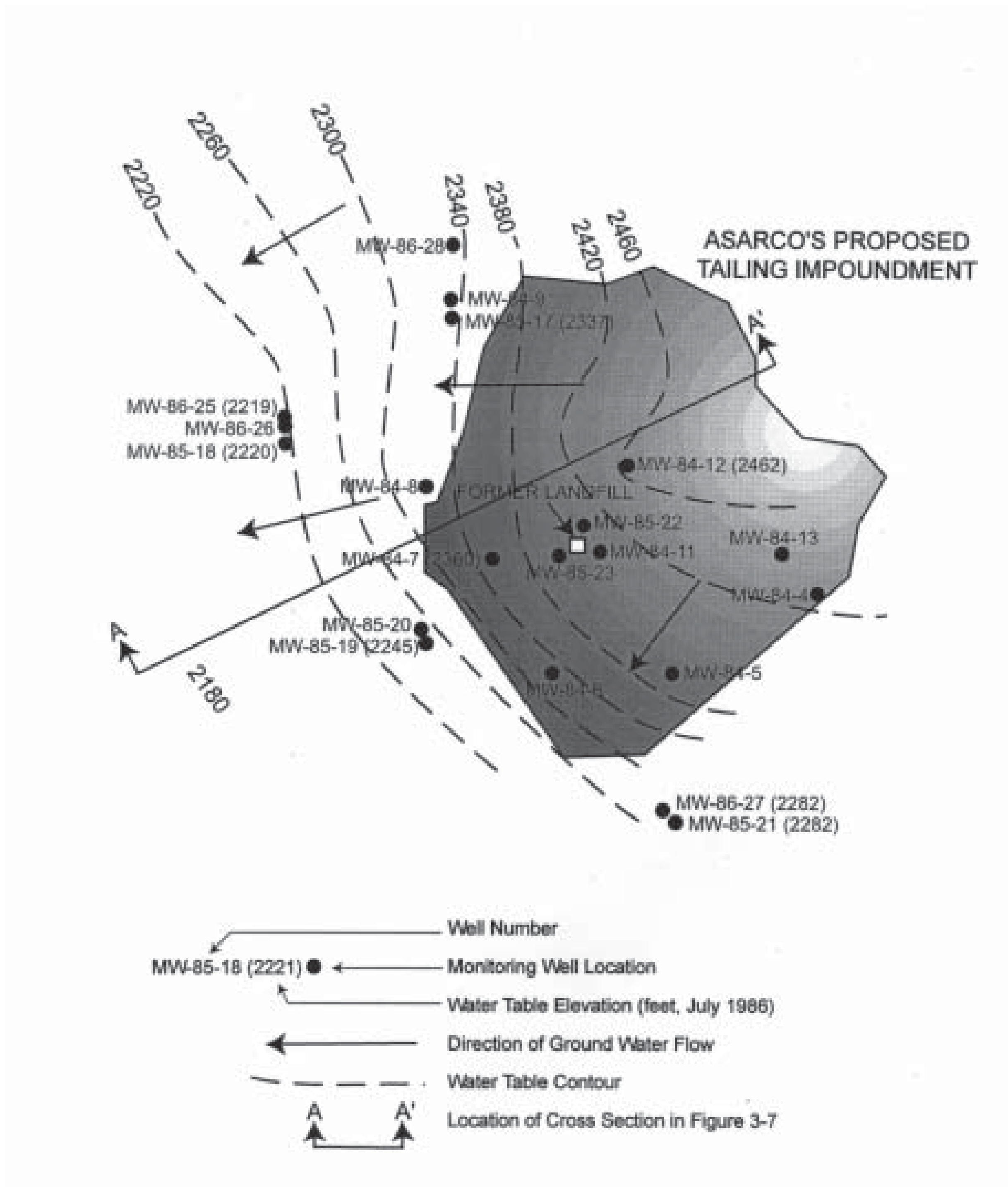
A conceptual model of ground water flow in the vicinity of the proposed impoundment site is presented in both plan view and cross-section in Figures 3-13 and 3-14, respectively.

Low permeabilities associated with clayey lacustrine deposits impede, or at least minimize, the downward flow of ground water to the more permeable sandy and gravelly strata. It is estimated that ground water flows west towards the Clark Fork River at a rate of 0.2 feet per day in unconsolidated lacustrine deposits and at about 8.5 feet per day in the underlying sand and gravel deposits. Ground water may also flow in the underlying fractured bedrock system.



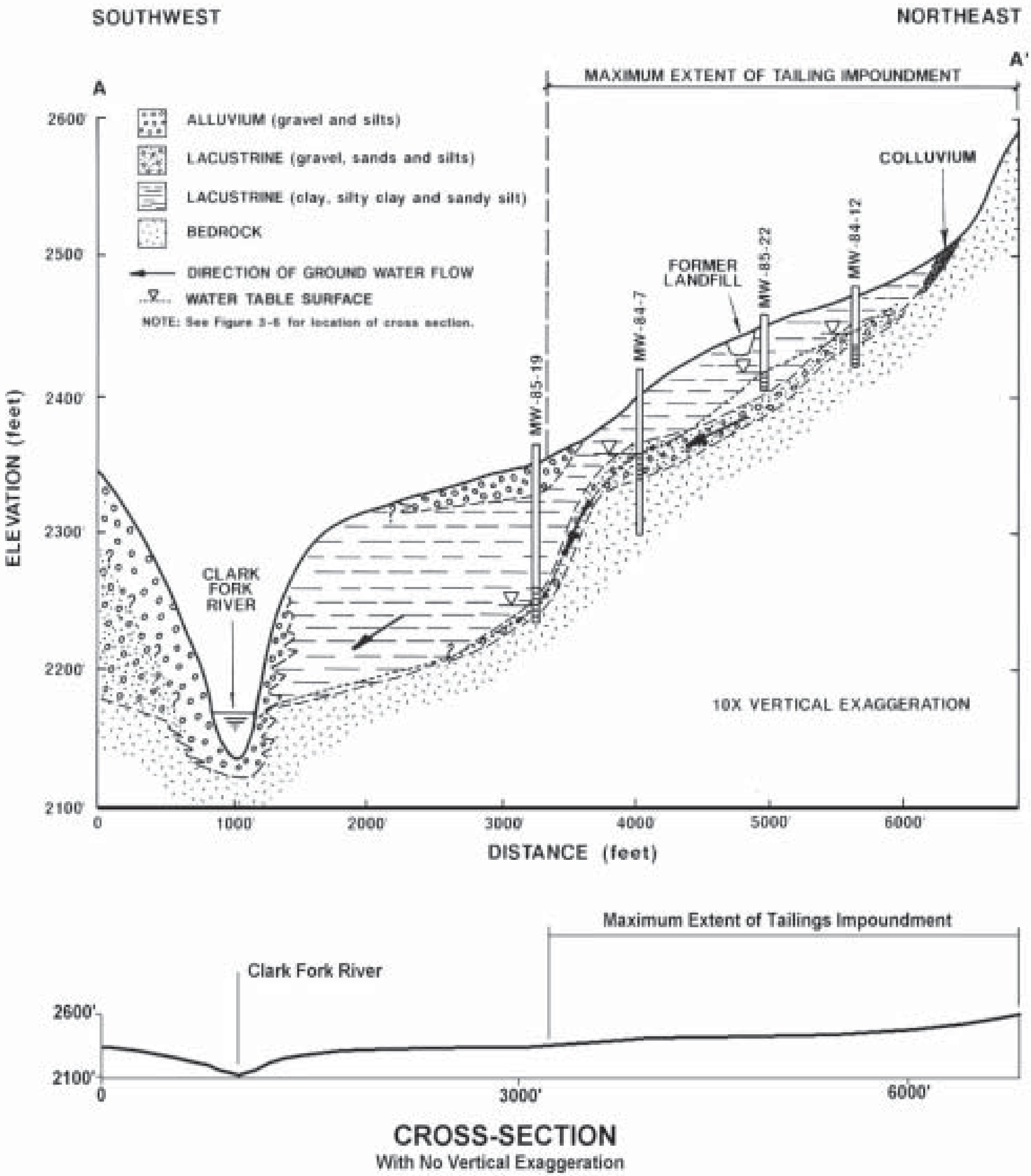
SOURCE: ASARCO Incorporated, 1987-1997

FIGURE 3-12
Hydraulic Conductivity
Rock Creek Project



SOURCE: ASARCO Incorporated, 1987-1997

FIGURE 3-13
Water Table - Tailings Impoundment Area
Rock Creek Project



SOURCE: ASARCO Incorporated 1987 - 1997

FIGURE 3-14
Aquifer Cross-Section
Rock Creek Project

TABLE 3-11
Ground Water Quality at Proposed Tailings Impoundment Site - Lacustrine Wells

Parameter	Number of Samples	# of Detections	Average	Standard Deviation	Maximum Value	Minimum Value
pH (SU)	15	15	7.9133	0.4596	8.6000	6.9000
Total Suspended Solids	8	8	778.5000	1151.0980	3460.0000	37.0000
Total Hardness (as $CaCO_3$)	15	15	280.7333	78.3896	433.0000	175.0000
Total Alkalinity (as $CaCO_3$)	14	14	338.5714	78.1111	528.0000	182.0000
Sulfate (SO_4)	15	13	8.6000	7.5877	26.0000	<3.0000
Ammonia (NH_3 as N)	14	13	0.5850	1.0166	3.9000	<0.0200
Total Kjeldahl Nitrogen (as N)	14	11	1.2514	2.0103	7.5000	<0.0100
Nitrate + Nitrite (as N)	14	5	0.4557	1.0848	3.3000	<0.0100
Orthophosphate (PO_4-P)	15	4	0.0247	0.0133	<0.0500	<0.0100
Total Phosphorus	15	14	1.9727	3.4623	11.0000	<0.0500
Arsenic (DIS)	14	13	0.0101	0.0081	0.0300	0.0040
Cadmium (DIS)	14	12	0.0012	0.0009	0.0030	<0.0001
Chromium (DIS)	17	0	0.0405	0.0676	<0.3000	<0.0100
Copper (DIS)	14	8	0.0054	0.0104	0.0400	<0.0010
Iron (DIS)	13	11	0.1178	0.1743	0.5600	<0.0050
Lead (DIS)	14	5	0.0019	0.0014	0.0060	<0.0010
Manganese (DIS)	14	14	0.4866	0.3100	1.2000	0.0130
Mercury (DIS)	14	1	0.0005	0.0001	0.0006	<0.0002
Selenium (DIS)	13	3	0.0048	0.0029	0.0140	<0.0010
Silver (DIS)	14	1	0.0004	0.0005	<0.0020	<0.0002
Zinc (DIS)	14	11	0.0278	0.0381	0.1500	<0.0010

Source: ASARCO Incorporated 1987-1997.

Notes: All units are in mg/L unless otherwise indicated. Statistics generated using data from monitoring wells MW-84-4, MW-84-6, MW-84-11, MW-84-13, MW-85-22, and MW-85-23. Potential for spatial variability exists.

SU = Standard pH units
DIS = Dissolved Metals Analysis
# of detections = Number of samples in data set above detection limit. The detection limit value was used in the statistical calculations.

TABLE 3-12
Ground Water Quality at Proposed Tailings Impoundment Site - Sand and Gravel Wells

Parameter	Number of Samples	# of Detections	Average	Standard Deviation	Maximum Value	Minimum Value
pH (SU)	16	16	7.8313	0.4468	8.8000	7.0000
Total Suspended Solids	14	14	8128.6429	17039.3896	53671.0000	38.0000
Total Hardness (as $CaCO_3$)	16	16	204.6875	94.9215	347.0000	81.0000
Total Alkalinity (as $CaCO_3$)	15	15	215.3333	85.8218	330.0000	62.0000
Sulfate (SO_4)	12	11	7.7583	6.1311	23.0000	2.0000
Ammonia (NH_3 as N)	15	6	0.2040	0.2979	1.2000	<0.0100
Total Kjeldahl Nitrogen (as N)	15	5	0.8080	2.2432	8.8000	<0.0100
Nitrate + Nitrite (as N)	15	7	0.2994	0.9688	3.8000	<0.0200
Orthophosphate (PO_4-P)	15	3	0.0591	0.0521	0.2100	<0.0100
Total Phosphorus	15	7	1.4885	3.8593	15.0000	0.0380
Arsenic (DIS)	15	8	0.0020	0.0015	0.0050	<0.0010
Cadmium (DIS)	15	6	0.0009	0.0011	0.0035	<0.0001
Chromium (DIS)	18	0	0.0170	0.0102	<0.0330	<0.0100
Copper (DIS)	15	2	0.0013	0.0010	0.0050	0.0010
Iron (DIS)	15	12	0.0623	0.0751	0.2500	<0.0050
Lead (DIS)	15	1	0.0015	0.0005	<0.0020	<0.0010
Manganese (DIS)	15	10	0.2895	0.4377	1.1000	<0.0100
Mercury (DIS)	12	0	0.0004	0.0002	<0.0005	<0.0002
Selenium (DIS)	12	1	0.0028	0.0020	0.0060	<0.0010
Silver (DIS)	15	0	0.0002	0.0000	<0.0002	<0.0002
Zinc (DIS)	15	10	0.0329	0.0513	0.1500	<0.0010

Source: ASARCO Incorporated 1987-1997.

Notes: All units are in mg/L unless otherwise indicated. Statistics generated using data from monitoring wells MW-84-7, MW-85-17, MW-85-18, and MW-85-19. Potential for spatial variability exists.

SU = Standard pH units
DIS = Dissolved Metals Analysis
# of detections = Number of samples in data set above detection limit. The detection limit value was used in the statistical calculations.

Proposed and Alternate Mill Sites

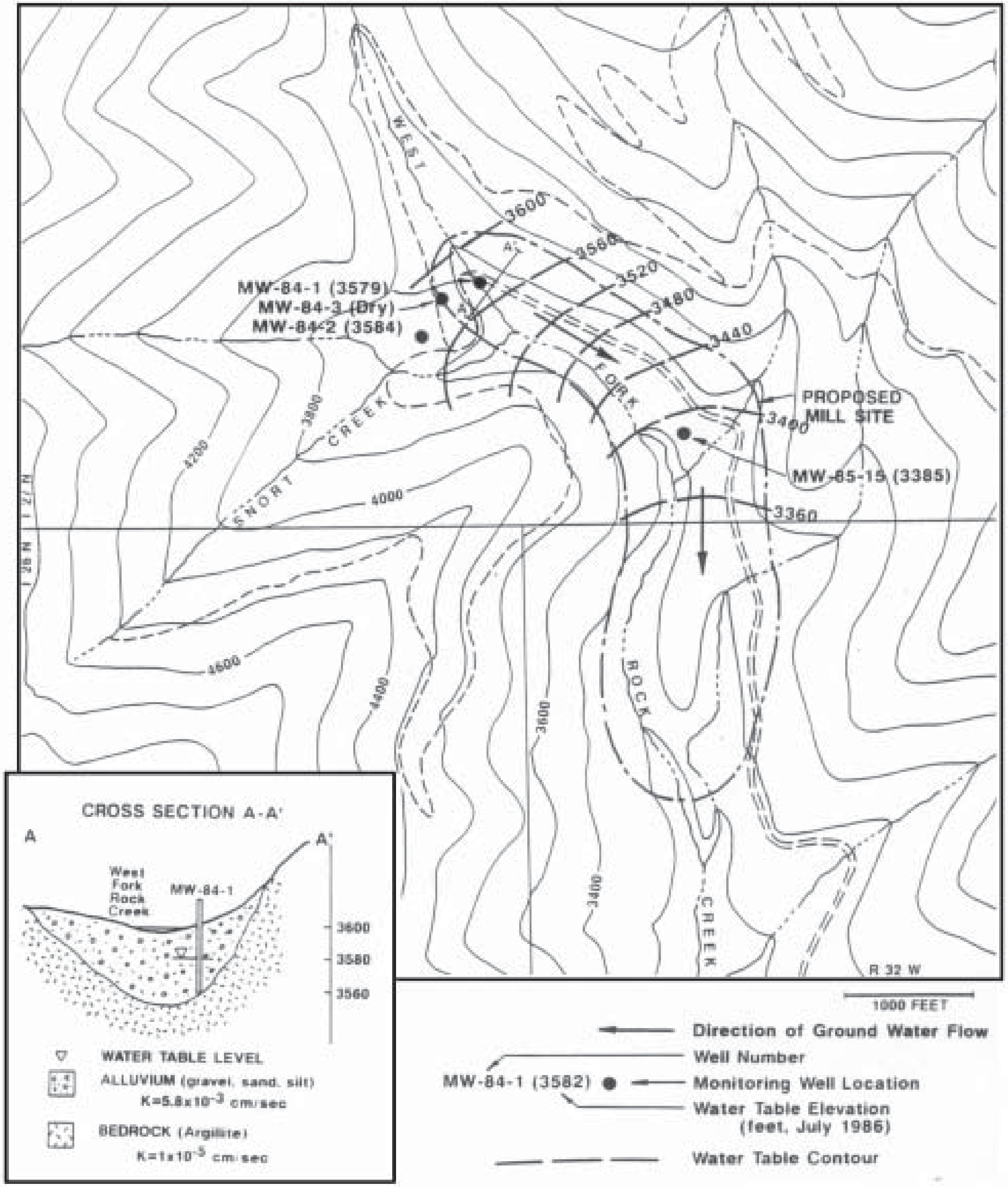
Sterling's proposed mill site is located in the upper West Fork of Rock Creek drainage. Unconsolidated valley fill consisting of up to 200 feet of alluvium, glacial moraine material, and colluvium overlie a steeply dipping argillite and quartzite bedrock. The average hydraulic conductivity (ability to transmit water) of the unconsolidated material is estimated to be about 16 feet per day, representative of sand, or sand and fine gravel material (ASARCO Incorporated 1987-1997). Baseline data indicate that the hydraulic gradient is about 0.10 feet per foot. The rate of ground water flow is about 8 feet per day. Figure 3-15 presents information related to the hydrogeology in the vicinity of the proposed mill site. Water quality data from the proposed and alternate mill site are provided in Tables 3-13 and 3-14, respectively.

Ore Body

Ground water movement in the mine area is controlled by secondary permeability created by fractures, joints, and faults in the bedrock. Melting snow can move through vertical fractures in bedrock, and if not held in fracture storage, eventually emanates as springs on the side of the mountain. Small quantities of ground water can flow long distances through fracture systems if they are interconnected. The bulk permeability of the bedrock is low but where faulting has occurred, the porosity and permeability has been increased. The permeabilities of the Copper Lake fault in the vicinity of Cliff Lake has been estimated at 5.0×10^{-3} centimeters per second (MT DEQ 2001).

During the exploration drilling program a total of 121 drill holes were drilled into and adjacent to the Rock Creek ore deposit using a helicopter support program. The average depth of drill holes was 1,000 feet. Based on information from exploration drill holes for both the proposed Rock Creek project and the adjacent Montanore project, water is typically not encountered in fractures until approximately 500 feet below ground surface (bgs). Therefore, analyses of inflow to the proposed adits and mine conservatively assumed a water table located at 500 feet bgs, even though in actuality the location of a water table has not been documented. Studies conducted by DEQ (2001) show that sections of faults have very shallow water tables. A conceptual model of ground water flow in the vicinity of the proposed Rock Creek mine is also presented in Chapter 4, Hydrology.

The Copper Lake and Moran faults contain high permeability and porosity zones that store ground water from recharge events. Slow release of ground water from fault zones maintains flow to lakes, streams, and wetlands. Cliff Lake, Moran Basin, and St. Paul Lake lie along these fault zones and are all in direct communication with the local ground water system to varying degrees. Although Copper Lake lies along the Copper Lake fault, it is not connected to the local ground water system (MT DEQ 2001).



SOURCE: ASARCO Incorporated, 1987-1997

FIGURE 3-15
Water Table - Upper Mill Site
Rock Creek Project

TABLE 3-13
Ground Water Quality at Proposed Mill Site

Parameter	Number of Samples	# of Detections	Average	Standard Deviation	Maximum Value	Minimum Value
pH (SU)	5	5	6.8800	0.4970	7.4000	6.3000
Total Suspended Solids	4	4	348.2500	381.6572	915.0000	93.0000
Total Hardness (as $CaCO_3$)	5	5	22.4000	9.9146	40.0000	17.0000
Total Alkalinity (as $CaCO_3$)	5	5	18.4000	4.5056	26.0000	15.0000
Sulfate (SO_4)	4	4	3.8000	1.4697	6.0000	3.0000
Ammonia (NH_3 as N)	4	3	0.2750	0.2915	0.7000	<0.1600
Total Kjeldahl Nitrogen (as N)	4	4	0.4350	0.3580	0.7700	0.0300
Nitrate + Nitrite (as N)	4	3	0.0388	0.0155	0.0600	<0.0500
Orthophosphate (PO_4-P)	5	0	0.0120	0.0076	<0.0500	<0.0100
Total Phosphorus	4	4	0.5750	0.6102	1.4000	0.0700
Arsenic (DIS)	5	3	0.0019	0.0018	0.0050	<0.0010
Cadmium (DIS)	5	5	0.0006	0.0009	0.0022	0.0001
Chromium (DIS)	4	1	0.0491	0.0673	0.1500	<0.0300
Copper (DIS)	5	3	0.0710	0.1560	0.3500	<0.0010
Iron (DIS)	4	4	19.8350	39.4433	79.0000	0.1000
Lead (DIS)	5	2	0.0039	0.0068	0.0160	<0.0010
Manganese (DIS)	5	5	0.9818	1.9132	4.4000	0.0330
Mercury (DIS)	4	1	0.0004	0.0003	0.0009	<0.0005
Selenium (DIS)	4	1	0.0036	0.0029	0.0080	<0.0040
Silver (DIS)	5	0	0.0002	0.0002	<0.0010	<0.0002
Zinc (DIS)	5	5	0.9562	1.6585	3.9000	0.0200

Source: ASARCO Incorporated 1987-1997.

Notes: All units are in mg/L unless otherwise indicated. Statistics generated using data from monitoring well MW-15

SU = Standard pH units
DIS = Dissolved Metals Analysis
# of detections = Number of samples in data set above detection limit. One half the detection limit value was used in the statistical calculations.

TABLE 3-14
Ground Water Quality at Alternative Mill Site

Parameter	Number of Samples	# of Detections	Average	Standard Deviation	Maximum Value	Minimum Value
pH (SU)	1	1	7.9000	0.0000	7.9000	7.9000
Total Suspended Solids	1	1	5.2000	0.0000	5.2000	5.2000
Total Hardness (as $CaCO_3$)	1	1	28.0000	0.0000	28.0000	28.0000
Total Alkalinity (as $CaCO_3$)	1	1	31.0000	0.0000	31.0000	31.0000
Sulfate (SO_4)	1	1	2.0000	0.0000	2.0000	2.0000
Ammonia (NH_3 as N)	1	0	0.0800	0.0000	<0.1600	<0.1600
Total Kjeldahl Nitrogen (as N)	1	0	0.0100	0.0000	<0.0200	<0.0200
Nitrate + Nitrite (as N)	1	1	0.0400	0.0000	0.0400	0.0400
Orthophosphate (PO_4-P)	1	0	0.0100	0.0000	<0.0200	<0.0200
Total Phosphorus	1	1	0.0700	0.0000	0.0700	0.0700
Arsenic (DIS)	1	1	0.0010	0.0000	0.0010	0.0010
Cadmium (DIS)	1	1	0.0012	0.0000	0.0012	0.0012
Chromium (DIS)	1	0	0.0150	0.0000	<0.0300	<0.0300
Copper (DIS)	1	0	0.0005	0.0000	<0.0010	<0.0010
Iron (DIS)	1	1	0.0140	0.0000	0.0140	0.0140
Lead (DIS)	1	0	0.0005	0.0000	<0.0010	<0.0010
Manganese (DIS)	1	1	0.0050	0.0000	0.0050	0.0050
Mercury (DIS)	1	0	0.0003	0.0000	<0.0005	<0.0005
Selenium (DIS)	1	0	0.0020	0.0000	<0.0040	<0.0040
Silver (DIS)	1	0	0.0001	0.0000	<0.0002	<0.0002
Zinc (DIS)	1	1	0.0030	0.0000	0.0030	0.0030

Source: ASARCO Incorporated 1987-1997.

Notes: All units are in mg/L unless otherwise indicated. Statistics generated using data from monitoring well MW-24
SU = Standard pH units
DIS = Dissolved Metals Analysis
# of detections = Number of samples in data set above detection limit. One half the detection limit value was used in the statistical calculations.

Well and Spring Inventory

Twenty-four perennial springs were identified in the study area during the baseline investigation. In addition, a number of ephemeral springs flow during the spring and early summer in response to snowmelt and recharge to local ground water. Two private wells with recorded water rights are located downgradient of the proposed project. Numerous springs and seeps, associated with small wetland areas, were identified and delineated during wetland inventory field activities performed for the baseline investigation and for follow-up field activities for Alternatives IV and V (ASARCO Incorporated 1993; 1995b; 1997b). All appropriations of water from wells and springs in the Rock Creek study area that were on file at the time of inquiry at Department of Natural Resources and Conservation are presented in Table 3-15 and Figure 3-16.

Ground Water Quality

Ground water underlying the proposed impoundment area is generally a moderately hard to very hard, calcium-magnesium-bicarbonate type, with moderate-to-low concentrations of dissolved solids and low concentrations of metals. Water quality data from lacustrine wells are provided in Table 3-13. Table 3-12 summarizes water quality data from sand and gravel wells. Ground water quality in the unconsolidated valley fill deposits of West Fork Rock Creek below the proposed mill site is of a soft, calcium bicarbonate-type, with low concentrations of total dissolved solids and metals. Water quality data from the proposed and alternate mill site are provided in Tables 3-13 and 3-14, respectively.

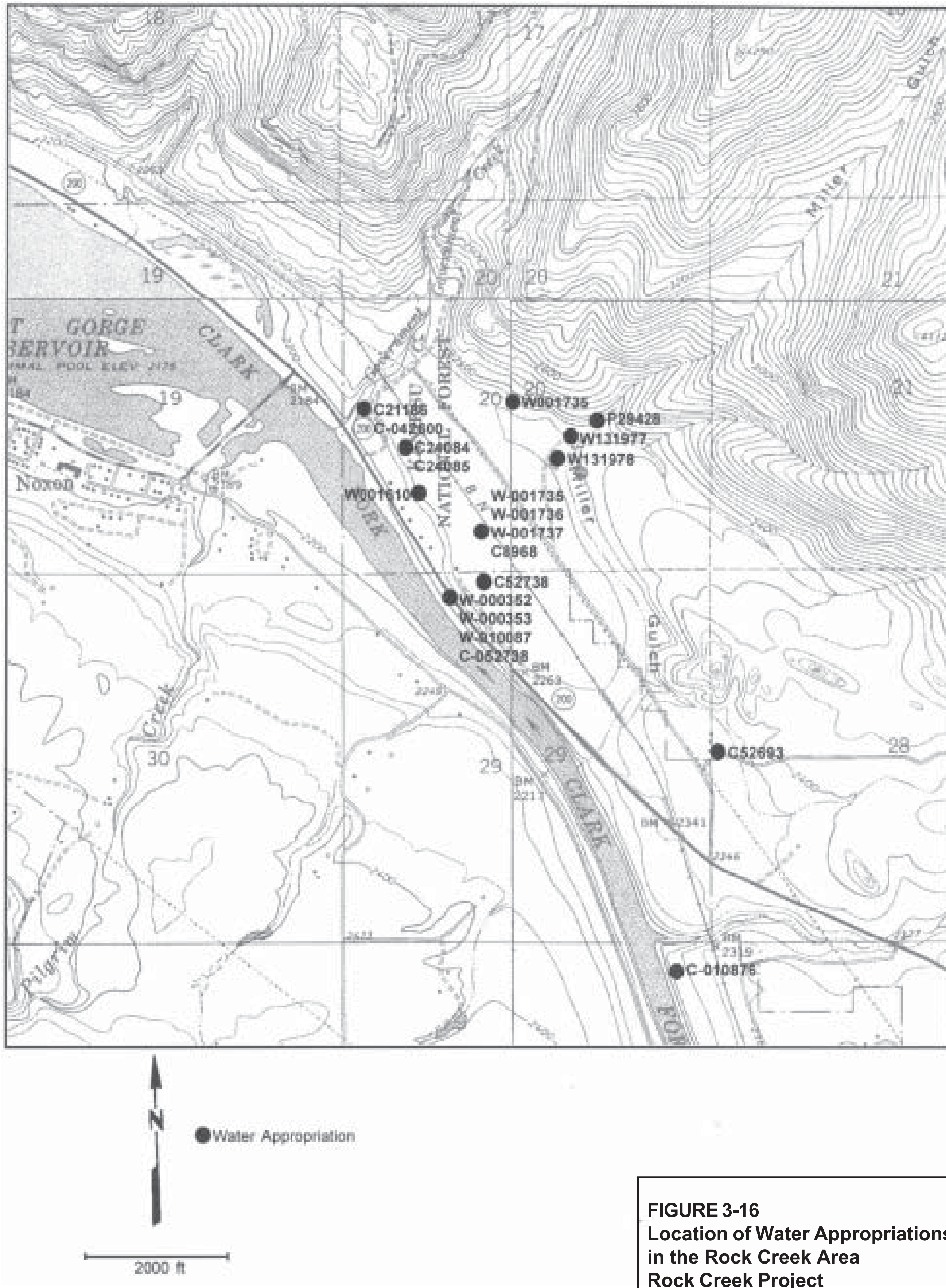
Noxon Landfill

The former Noxon sanitary landfill is located within the proposed tailings impoundment area. This 2-acre landfill was operated between 1977 and 1983, and was permitted and periodically inspected by DHES. Based on the history of landfill operators, and existing monitoring well data, no hazardous wastes or chemicals have been identified in the Noxon landfill area (ASARCO Incorporated 1987-1997). The landfill was closed and inspected by DHES, Solid and Hazardous Waste Bureau, on June 21, 1983, in accordance with DHES standards. These standards require revegetation and an adequate cap (pers. comm. Rick Thompson, Department of Health and Environmental Sciences, April 24, 1995).

TABLE 3-15
Appropriations of Water From Wells and Springs in the Rock Creek Study Area

Water Right ID	Flow Rate	Point of Diversion				Source Name
		Qtr. Section	Section	Township	Range	
76N-W-001735-00	6.00 G	SESW	20	26N	32W	Clark Fork River
76N-W-001736-00	12.00 G	SESW	20	26N	32W	Noxon Reservoir
76N-W-001737-00	6.00 G	SESW	20	26N	32W	Noxon Reservoir
76N-C-008968-00	12.00 G	SESW	20	26N	32W	Well
76N-W-131977-00	51.00 G	NENWSE	20	26N	32W	Miller Gulch
76N-W-131978-00	30.00 G	NENWSE	20	26N	32W	Miller Gulch
PO-29428	601.40 G	NENWSE	20	26N	32W	Miller Gulch
76N-W-001610-00	20.00 G	NESWSW	20	26N	32W	Clark Fork River
76N-C-024084-00	20.00 G	NWNWSW	20	26N	32W	Well
76N-C-024085-00	20.00 G	NWNWSW	20	26N	32W	- -
76N-C-021186-00	15.00 G	SENWSW	20	26N	32W	Well
76N-C-042600-00	8.00 G	SENWSW	20	26N	32W	- -
76N-C-052693-00	5.00 G	SWSWNW	28	26N	32W	Well
76N-C-009296-00	25.00 G	NWSW	29	26N	32W	Well
76N-C-038604-00	18.00 G	SWNW	29	26N	32W	Well
76N-C-069756-00	16.00 G	NESESW	29	26N	32W	Well
76N-W-000352-00	.06 C	NWNENW	29	26N	32W	Clark Fork River
76N-W-000353-00	.04 C	NWNENW	29	26N	32W	Clark Fork River
76N-W-010087-00	11.22 G	NWNENW	29	26N	32W	Clark Fork River
76N-C-052738-00	25.00 G	NWNENW	29	26N	32W	Well
76N-C-066477-00	40.00 G	NWSWSE	29	26N	32W	Well
76N-W-124892-00	15.00 G	SESWNW	29	26N	32W	Clark Fork River
76N-C-010690-00	25.00 G	SWSWNW	29	26N	32W	Well
76N-C-019629-00	20.00 G	SWSWSW	29	26N	32W	Well
76N-C-076909-00	17.00 G	S2SWSE	29	26N	32W	Well
76N-C-054412-00	25.00 G	W2SENW	29	26N	32W	Well
76N-E-055021-00	6.00 G	NESW	32	26N	32W	- -
76N-C-028340-00	30.00 G	E2SWNE	32	26N	32W	Well
76N-C-010876-00	40.00 G	NENENE	32	26N	32W	Well
76N-C-037606-00	.13 G	NENWSW	32	26N	32W	- -
76N-C-037604-00	2.79 G	NESWSW	32	26N	32W	- -
76N-W-103199-00	- -	NESWSW	32	26N	32W	Clark Fork River
76N-W-103200-00	25.00 G	NESWSW	32	26N	32W	Clark Fork River
76N-C-051647-00	20.00 G	SESWNE	32	26N	32W	Well
76N-W-040630-00	5.00 G	SWNENW	32	26N	32W	Well
76N-W-133230-00	15.00 G	SWNENW	32	26N	32W	Well
76N-C-037605-00	2.79 G	SWNWSW	32	26N	32W	- -
76N-C-080234-00	30.00 G	SWNWSE	33	26N	32W	Well

Notes: G = gallons per minute C = cubic feet per second



SOURCE: Department of Natural Resources and Conservation, 1995

FIGURE 3-16
Location of Water Appropriations in the Rock Creek Area
Rock Creek Project

WETLANDS AND NON-WETLAND WATERS OF THE U.S.

Wetlands and non-wetland waters of the U.S. were identified and delineated for the baseline inventory (ASARCO Incorporated 1993). The term "wetlands and non-wetland waters of the U.S." has broad meaning and includes both deep-water habitats (non-wetland) and special aquatic sites, including wetlands (Environmental Laboratory 1987). In this EIS however, wetlands may be discussed as a separate subgroup even though by definition they are waters of the U.S. In their natural condition, waters of the U.S. often provide many benefits, including food and habitat for fish and wildlife, flood protection, erosion control, water quality improvement, and opportunities for recreation (Adamus and Stockwell 1983). Delineation, avoidance, and mitigation measures are required (Section 404[b][1] of the Clean Water Act) for wetlands and non-wetland waters of the U.S. in order to minimize potential impacts and to provide compensation for any unavoidable impacts through restoration or creation activities.

Technical guidelines (Environmental Laboratory 1987) for identifying and delineating wetlands are based on three diagnostic environmental characteristics unique to wetlands; wetland hydrology, hydric soils, and hydrophytic vegetation. In most cases, evidence of all three diagnostic characteristics must be found to make a wetland determination (ibid. 1987).

ASARCO prepared a wetlands inventory for the proposed Rock Creek project area (ASARCO Incorporated 1993) with technical assistance from Western Technology and Engineering Inc. and Hydrometrics, Inc. Mapping units included in the wetlands inventory are: (1) wetlands, (2) non-wetland waters of the U.S., (3) wetland complex, and (4) riparian areas. Within the wetland complex and riparian areas are areas which may meet the technical criteria for wetlands; however, wetlands were only mapped where mining-related impacts were proposed (see Table 3-16).

TABLE 3-16
Wetlands and Non-wetland Waters of the U.S. Acreage
Rock Creek Project Area

Unit Description	Acreage
Wetlands	10 acres
Non-wetland waters of the U.S.	55 acres
Wetland complex[1]	2 acres
Riparian areas[2]	84 acres

Notes:
[1] Approximately 75% of the complex meets the technical criteria for wetlands.
[2] An unknown percentage of the riparian areas meet the technical criteria for wetlands.

ASARCO conducted additional field delineation of wetlands and non-wetland waters of the U.S. on August 27-29, 1996, in the Cabinet Mountains Wilderness with technical assistance from Hydrometrics. The study area included the areas around Copper and Cliff Lakes and four potential subsidence areas located above the ore body. The non-wetland waters of the U.S. are generally associated with open water bodies of Cliff and Copper lakes, adjacent mudflats, and small ephemeral channels that flow in response to snowmelt and high precipitation events. The wetland areas are mostly in fringe riparian locations, between seasonally high and low lake levels, and along the ephemeral drainage channels. The delineation results are provided in ASARCO's report (January 1997) with the acreage totals provided below in Table 3-17.

The wetlands associated with the proposed Rock Creek project can be placed in three main types, or classes, of wetland habitats based on the hierarchical system described by Cowardin et al. (1979). The three classes of wetlands are the Riverine, upper perennial; Palustrine, forested; and Palustrine, emergent wetland systems. The non-wetland waters of the U.S. stream channels are primarily unconsolidated bottom and shore classes of the Riverine systems. Wetlands located along the Rock Creek main channel and its tributaries have developed primarily on the low streamside terraces and are classified as Riverine, upper perennial and Palustrine, forested wetland systems. Localized wet areas downstream of isolated springs and seeps also occur and are classified as Palustrine, forested wetlands. These wetlands have developed primarily in poorly and very poorly drained glaciolacustrine sediments.

Wetlands along the West Fork Rock Creek channel and tributaries are also associated with low terraces (often discontinuous, narrow, streamside terraces) and localized wet areas associated with springs and seeps. These wetlands are primarily classified as Palustrine, forested wetlands.

TABLE 3-17
Wetlands and Non-Wetland Waters of the U.S.
Cabinet Mountains Wilderness, Rock Creek Project

Location	Wetlands (acres)	Non-Wetland Waters of the U.S. (acres)	Total Waters of the U.S. (acres)
Copper Lake	0.32	1.02	1.34
Cliff Lake	0.06	2.12	2.18
Pot. Sub. Area 1	0.00	0.09	0.09
Pot. Sub. Area 2	0.00	0.00	0.00
Pot. Sub. Area 3	0.05	0.31	0.36
Pot. Sub. Area 4	0.00	0.00	0.00
Total	0.43	3.54	3.97

Note: Pot. Sub. = Potential Subsidence Area (see Chapter 4, **GEOLOGY, Alternative II, Subsidence**)

Wetlands along the ephemeral and intermittent drainages of Miller Gulch are associated with the gentle rolling topography and have formed in the natural surface depressions that concentrate surface water runoff from adjacent areas and cause ponding. The low permeability of the near surface lacustrine clays and silts and the low hydraulic gradients in the area have created saturated soils and shallow standing water. Many areas of these broad shallow grassy swales have characteristics which meet the wetland criteria and are classified as Palustrine, emergent wetlands.

Wetland hydrology identification involved reviewing streamflow and ground water data as well as performing field investigations within the Rock Creek project area. Seeps and springs identified in the field were mapped, and flows measured or estimated. Positive indicators of wetland hydrology were found primarily in low terraces adjacent to the main and overflow channels of perennial streams and their tributaries, within streamside riparian and floodplain zones, downslope of seeps and springs, and around Copper and Cliff Lakes. Many of these areas are not continuously inundated but are saturated at a sufficient frequency and duration during the growing season through snowmelt runoff, seasonal stream channel overflow, or as a result of rainfall. Some areas of the east and west forks of Rock Creek, and the lower portion of Rock Creek have developed broader stream bottoms which contain larger areas with wetland hydrology. Some areas of Miller Gulch have reduced hydraulic gradients with areas of nearly continuous inundation and ponding. Additional wetland hydrology inventories were conducted in association with wetlands inventory for Alternatives IV and V (ASARCO Incorporated 1993 and 1995b; Hydrometrics, Inc. 1997b).

Previous soil baseline studies (Noel 1986) were reviewed for areas within the proposed Rock Creek project area that potentially met the required criteria for hydric soils. Hydric soil field inventories were conducted in 1991 and 1992. A baseline soils inventory indicated that four soil mapping units (B, CB, C, and L units) were the principal areas where hydric soils may occur. Hydric soils were identified in coarse to fine textured soils with a highly variable coarse fragment content. Hydric soils were located along the banks, terraces, and channel bottoms of perennial, ephemeral, and intermittent streams, in seeps and spring areas, and in depressions formed naturally or by logging or road building activities. Additional hydric soils inventories were conducted in association with the wetlands inventory for Alternatives IV and V (ASARCO Incorporated 1993 and 1995b; Hydrometrics, Inc. 1997b).

Hydrophytic vegetation was assessed for the proposed Rock Creek project area using information from regional and state hydrophytic plant species lists (Reed 1988a, 1988b); baseline vegetation inventory for the Rock Creek project area (Scow et al. 1987); and intermediate-level on-site inspections conducted in 1991 and 1992. Results from the baseline vegetation inventory indicated four vegetation types contained hydrophytic vegetative species. Three of the four vegetation types (Western red cedar/oak fern; Western hemlock/oak fern; and Western hemlock/wild ginger) were dominated by upland species while one type (Western red cedar/devils club) was dominated by hydrophytic species. Field verification involved vegetation sampling at 22 sites of which 18 were found to have hydrophytic vegetation. Additional hydrophytic vegetation inventories were conducted in association with wetlands inventory for Alternatives IV and V (ASARCO Incorporated 1993 and 1995b; Hydrometrics, Inc. 1997b).

The wetlands and non-wetland waters of the U.S. identified and delineated by ASARCO within the proposed project area were recognized as providing several important functions and values (ibid.). The ten numbered wetland functions and values were stated as providing: No. 1 — ground water discharge, No. 2 — ground water recharge, No. 3 — flood-flow alteration, No. 4 — sediment and toxicant retention, No. 5 — nutrient removal and transformation, No. 6 — shoreline and streambank stabilization, No. 7 — production export, No. 8 — aquatic diversity and abundance, No. 9 — wildlife diversity and abundance, and No. 10 — recreation and uniqueness heritage. Wetlands and non-wetland waters of the U.S. functions and values were not assessed using a standard, semi-quantitative evaluation assessment technique such as the habitat evaluation procedure (HEP) or Wetland Evaluation Technique (WET).

The functions and values of the delineated wetlands and non-wetland waters of the U.S. were considered to be of low importance for No. 2 — ground water recharge, No. 3 — flood-flow alteration, and No. 10 — recreation and unique heritage. Functions considered to be of moderate importance were No. 4 — sediment and toxicant retention, No. 5 — nutrient removal and transformation, No. 6 — shoreline and streambank stabilization, and No. 7 — production export. The functions No. 1 — ground water discharge, No. 8 — aquatic diversity and abundance, and No. 9 — wildlife diversity and abundance were considered to be of moderate to high importance. Wetlands and non-wetland waters of the U.S. are associated with Rock Creek, East Fork of Rock Creek and the West Fork of Rock Creek which support fish, as well as Copper and Cliff Lakes. Grizzly bear, which is listed as a threatened species, and lynx, a proposed species, may also use the wetlands and non-wetland waters of the U.S. on a seasonal basis (ibid.).

AQUATICS/FISHERIES

Since the draft EIS was produced, additional field data have been collected from Rock Creek. This section has been supplemented by the presentation and analysis of these data. Specifically, additional data were collected in 1996 on sediment characteristics, large woody debris, and fish populations within Rock Creek (Watershed Consulting 1997). Sediment modeling was conducted through the use of R1-WATSED. Appendix N has a detailed discussion of how the model works and the results. The sediment data from 1996 were compared to sediment data collected from 1988 to 1993. Fish population estimates were made during 1996 at stations not previously sampled from 1985 to 1993 (Barnard and Vashro 1986; Hightower and Vashro 1987; Hightower 1988; WWP 1996a). All fish population data were consolidated and presented in a single table. Although no additional benthic invertebrate data are presented in this section, additional analysis of data collected from 1985 to 1988 was conducted based on guidelines recommended by DEQ.

The additional data presented in this section since the draft EIS was completed do not substantively change the picture of the affected environment for aquatics/fisheries. However, the impacts conclusions presented in Chapter 4 are strengthened because they are based on a larger dataset.

Rock Creek

Habitat

The valley bottoms of the east and west forks and mainstem of Rock Creek are forested by the cedar/hemlock complex. Most large cedars along all three drainages were harvested in the late-1800s and early-1900s and have been replaced by a dense canopy of hemlock, younger cedars, and several other species. Open overstories, particularly along lower Rock Creek, are dominated by alder, willow, cottonwood, dogwood, and other shrubs. Considerable stretches have no overhanging vegetation (Farmer, Farmer, and Heath 1986, In ASARCO Incorporated 1987-1997).

Mainstem Rock Creek has an average gradient of 5.2 percent (WWP 1996b). Substrate in the lower reaches is comprised of high amounts of gravel (WWP 1996b). Substrate is relatively unstable and there is considerable bedload movement. Spawning habitat is limited to isolated pockets of gravel behind stable debris or boulders above the confluence of Engle Creek. Below Engle Creek, spawning habitat was found behind stable debris and boulders as well as some side and main-channel depositional areas.

A major source of these gravels and fine sediments is a large eroding bank located about 0.2 miles up Engle Creek (ibid).

Sediment core samples (to 6 inches deep) were collected and analyzed from the perennial reach of Rock Creek just downstream from the confluence of Engle Creek (station RC-2) on several occasions since 1988 (Table 3-18). The mean annual percentage of sediment less than 0.25 inch in diameter were not significantly different from each other during 1988-1991 at station RC-2. The overall mean percentage from station RC-2 was significantly less than the mean percentage (41.8 percent) determined from samples collected by Avista (formerly WWP) (WWP 1996b) from a reach which includes Rock Creek both above and below the confluence of Engle Creek. Weaver and Fraley (1991; 1993) found that the higher the percent of the spawning substrate less than 0.25 inch in diameter, the lower the survival-to-emergence success of bull trout and westslope cutthroat trout. Experimental data indicated greater than 75 percent survival when there were no sediments below this diameter threshold, but less than 50 percent survival when incubation sediments have more than 18 percent fines less than 0.25 inch in diameter (Weaver and Fraley 1991, 1993). Therefore, to the extent that the sediments in the portion of Rock Creek downstream of Engle Creek may serve as spawning substrate, survival to emergence is predicted to range from 15 percent (for WWP data 1993) to 39 percent (for station RC-2 data 1988-1991) for westslope cutthroat and 16 percent (for WWP data) to 40 percent (for station RC-2 data) for bull trout. These survival-to-emergence estimates should not be extrapolated to other portions of Rock Creek because of the lack of sediment core data in other areas.

TABLE 3-18
Percentage of Mainstem Rock Creek Sediments[1] Less than 0.25 Inch Diameter

Station	Date	Number of Replicates	Mean	Median	Standard Deviation
RC-2 [2]	Aug-88	8	37.5	43.1	16.9
RC-2	Aug-89	8	22.6	24.8	10.3
RC-2	Nov-90	8	26.5	25.3	7.9
RC-2	Aug-91	10	26.4	15.4	24.3
RC-2	All 4 years	34	28.1	24.8	16.9
RC-reach2 [3]	Oct-93	12	41.8	43.1	10.5

1 = Sediment samples taken by McNeil core sampler
2 = RC-2 located just downstream of confluence with Engle Creek; sampled by Hydrometrics (1989, 1990, 1992)
3 = reach 2 extends from canyon located at RM 1.9 to confluence of the east and west fork of Rock Creek; sampled by Washington Water Power (1996); samples collected downstream of confluence with Engle Creek (Smith 1994)

Surface fines in sediment (less than 0.25 inch diameter) were also measured in mainstream Rock Creek by Avista (formerly WWP) (1996b) and Watershed Consulting (1997). The methods used to measure surface fines are visual as opposed to the gravimetric method (using sieves and a balance) used to analyze core samples. The relationship between fine sediments and fry survival-to-emergence developed by Weaver and Fraley (1991, 1993) should not be used for surface fines data. The percentages of surface fines measured in 1993 were 22 percent in reach one and 9 percent in reach two (WWP 1996b). The sampling station in reach 2 was relatively close to station RC-2 from which sediment core data were also analyzed. A comparison of the surface fines from mainstem reach 2 (WWP 1996b) and station RC-2 (Table 3-18) indicates that fine sediment is more prevalent in the subsurface sediments. This relationship may not hold at all sites. In 1996, the percentages ranged from 0 to 22.6 over eight stations, with a mean of 10 percent (Watershed Consulting 1997). Overall, with the exception of gravels near the mouth of Engle Creek, fine sediment levels in Rock Creek appear to be relatively low.

The mainstem of Rock Creek contains a relatively low amount of large woody debris relative to other watersheds in the lower Clark Fork River drainage (WWP 1996b). The total number of large woody debris pieces per 100 feet is only 15 percent of the average value for other pristine reaches in the Kootenai National Forest (Watershed Consulting 1997).

The East Fork of Rock Creek begins at Rock Lake. There is a low-gradient section in Rock Creek Meadows, below Rock Lake (Farmer, Farmer, and Heath 1987). Below Rock Creek Meadows, it is a steep-gradient (average 10.4 percent), perennial stream with a partially closed coniferous overstory and overhanging deciduous understory. The upper reaches of the east fork contain considerable amounts of stable, large woody debris. The substrate consists primarily of large cobbles and boulders with relatively little movement of the stream substrate. The percentage of surface fines averages 1 percent (Watershed Consulting 1997). Streambanks are stable with some channel braiding. Spawning habitat is limited to pockets of gravel behind debris or boulders (WWP 1996b).

The West Fork of Rock Creek's gradient is highly variable, but averages 7.3 percent. It has a generally closed coniferous overstory and shrub understory for its entire length (Farmer, Farmer and Heath 1986). Streambanks are stable with some channel braiding. The entire lower reach (0.4 mile) of the west fork is intermittent as is 0.4 mile of the middle reach (WWP 1996b).

The West Fork of Rock Creek contains very high amounts of stable large woody debris. A potential fish passage barrier consisting of large, woody debris mixed with gravel exists 0.75 mile upstream from the mouth of the west fork (WWP 1996a). Substrate primarily consists of small cobble and gravel with relatively little bedload movement. The percentage of surface fines average less than 7 percent (Watershed Consulting 1997). Spawning habitat is present in the form of pockets of gravel behind and above stable debris or boulders and in the main channel depositional areas. The median percent of substrate less than 0.25 inches ranged from 24.2 to 27.4 percent at the two sample sites (Table 3-19), which were statistically indistinguishable from each other. Based on the median percent fines value for the two stations combined (26.5 percent), survival to emergence in the West Fork of Rock Creek is predicted to be 37 percent for westslope cutthroat and 38 percent for bull trout if spawning were to occur in that portion of the West Fork of Rock Creek. Overall, fine sediment levels in both the west and east forks of Rock Creek are very low and are comparable to what would be expected in watershed with little or no management activity (e.g., logging, road-building).

TABLE 3-19
Percentage of Sediments[1] Less than 0.25 Inch Diameter in West Fork of Rock Creek

Station	Date	Number of Replicates	Mean	Median	Standard Deviation
WRC-reach 1 [2]	Oct-93	12	30.0	27.4	6.4
WRC-reach 2 [3]	Oct-93	12	28.2	24.2	10.9
both stations	Oct-93	24	29.1	26.5	8.8

[1] = Sediment samples taken by McNeil core sampler
[2] = reach 1 extends from confluence with mainstem to RM 0.4; sampled by Avista (formerly WWP) (1996b)
[3] = reach 2 extends from RM 0.4 to RM 0.6; sampled by Avista (formerly WWP) (1996b)

Aquatic Plants

Baseline data for periphyton were collected at nine stations in the Rock Creek drainage (Figure 3-17) during April, August, and October 1985. Species composition in Rock Creek reflects its clean, soft water (Hydrometrics, Inc. 1987). Periphyton data collected in 1993 indicate that chlorophyll content and net productivity within the mainstem and east fork of Rock Creek were relatively high compared to average values within the lower Clark Fork River drainage (WWP 1996b). For the west fork of Rock Creek, the same measurements were relatively low compared to average values within the drainage (WWP 1996b). Most flora samples reflect the highly variable flow conditions in Rock Creek.

Rock Creek is characterized by a highly diverse diatom community (121 diatom taxa were identified during the baseline studies) and a few species of non-diatom, soft-bodied algae. Large, complex water plants are restricted to the Rock Creek Meadows wetland and a few permanent springs scattered across the watershed.

Some green, blue-green, and red algae were identified. The highest diversity of plants occurs in the main channel of Rock Creek downstream of the east and west forks confluence. Baseline samples included several unusual planktonic algae normally found in lakes and ponds. These planktonic species probably drifted into Rock Creek from Rock Creek Meadows and the trout ponds in Engle Creek.

Aquatic Invertebrates

Baseline data were collected at nine stations in the Rock Creek drainage (see Figure 3-17) for 4 years (1985-1988) during April, August, and October (Farmer et al. 1986 in ASARCO Incorporated 1987-1997, Farmer and Farmer 1987 in ASARCO Incorporated 1987-1997, Farmer and Farmer 1988, Farmer and Farmer 1989). However, not every station was sampled every year due to inaccessibility, excessive streamflow, no streamflow, or other reasons. The only stations that have a complete data set (samples taken in every season for all 4 years) are RC-2 and WRC-4; the incomplete data sets for remaining stations are shown on Table 3-20. In addition, invertebrate data were collected in October 1993 from the mainstem of Rock Creek (WWP 1996b). The station locations and methods in the 1993 survey may not be comparable to the baseline survey.

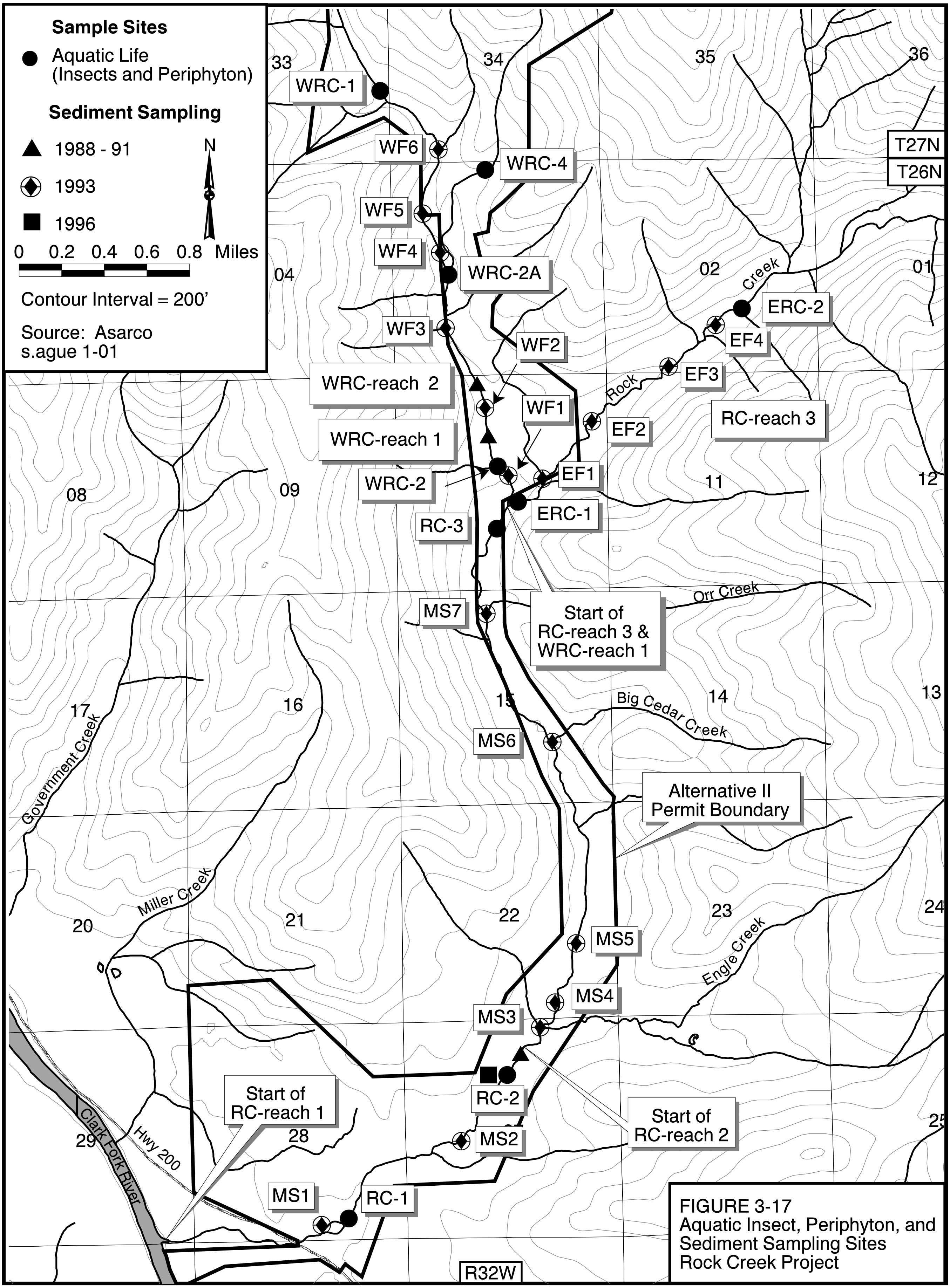


FIGURE 3-17
Aquatic Insect, Periphyton, and
Sediment Sampling Sites
Rock Creek Project

TABLE 3-20
Years in Which Baseline Sampling Stations within the Rock Creek Drainage Were Not Sampled

	RC-1	RC-3	ERC-1	WRC-1	WRC-2	WRC-2a
April	88[2]	--	85[3]	88[1]	--	85[4],87[5], 88[5]
August	88[1]	--	--	86[1],87[1],88[1]	--	--
October	87[1],88[1]	87[1]	--	85[1],86[1],87[1]8 8[1]	86[1],87[1]88[1]	–

Source: Farmer et al. 1986 in ASARCO Incorporated 1987-1997, Farmer and Farmer 1987 in ASARCO Incorporated 1987-1997, Farmer and Farmer 1988, Farmer and Farmer 1989

Note: Footnotes give reasons stations were not sampled in the identified year.
[1] = dry [3] = too fast [5] = not accessible due to deep snow
[2] = too deep [4] = site not established yet

In general, April samples contained fewer macroinvertebrates than samples taken in August or October, although this was not true at every site. The sample site on the upper West Fork of Rock Creek (WRC-1) shows higher average numbers of macroinvertebrates in April because that site was usually dry in August and October (Farmer et al. 1986 in ASARCO Incorporated 1987-1997, Farmer and Farmer 1987 in ASARCO Incorporated 1987-1997, Farmer and Farmer 1988, Farmer and Farmer 1989).

Overall, the sampling site on a tributary of the West Fork of Rock Creek (WRC-4) which flows through the applicant's proposed mill site had the highest numbers of aquatic macroinvertebrates, with mean numbers exceeding 80 macroinvertebrates/ft^2 in 50 percent of the samples. Although the April information is incomplete, it appears that WRC-2A had the second highest macroinvertebrate density. Sites WRC-1 and RC-1 tended to have the lowest density of macroinvertebrates, reflecting the intermittent nature of the stream at those locations.

The state of Montana has developed draft guidelines for interpreting benthic macroinvertebrate data (Bukantis 1996). For the mountain region, four of the suggested metrics for analysis are taxa richness (number of species), EPT richness (number of species within the orders *Ephemeroptera*, *Plecoptera*, and *Trichoptera*), percent dominant (the number of individuals of the numerically dominant species as a percentage of the total number of organisms), and percent EPT (number of individuals in the orders *Ephemeroptera*, *Plecoptera*, and *Trichoptera* as a percentage of the total number of organisms). These four metrics were calculated for each of the baseline sampling events from 1985-1988 and for the October 1993 sampling event (Tables 3-21, 3-22, and 3-23).

The metric scores can be compared to provisional criteria that have been established for Montana wadeable streams (Bukantis 1996). These criteria are being used by Montana DEQ to aid in identifying water bodies that have impaired water quality (the “303[d]” list) but they are not currently part of formal state regulation (pers. comm. B. Bukantis, Montana DEQ, with Tad Deshler, October 31, 1997). Rock Creek is currently on the 303(d) list due to metals and siltation (MT DEQ 1996b).

TABLE 3-21
Selected Metric Scores for April Sampling Events [1]

Station	Year	Number of Organisms	Taxa Richness	EPT Richness	% Dominant Taxon	% EPT	Summary Score
ERC-1	1986	161	20	18	42	93	0.58
ERC-1	1987	179	20	19	41	98	0.58
RC-1	1986	201	21	20	22	99	0.83
RC-2	1986	271	25	20	33	97	0.83
RC-2	1987	199	26	22	29	96	0.83
RC-3	1986	348	25	23	44	99	0.75
RC-3	1987	314	22	20	45	99	0.58
WRC-1	1986	238	12	9	47	98	0.25
WRC-2	1986	277	22	17	29	93	0.58
WRC-2	1987	118	20	16	31	92	0.58
WRC-2A	1986	109	17	15	25	86	0.50
WRC-4	1985	172	17	12	31	67	0.33
WRC-4	1986	770	35	30	24	68	0.92
WRC-4	1987	508	20	16	40	82	0.50
WRC-4	1988	431	30	25	30	93	0.92

Notes:

RC = mainstem Rock Creek
ERC = East Fork of Rock Creek
WRC = West Fork of Rock Creek
Taxa richness = number of unique species
EPT richness = number of unique species among the orders *Ephemeroptera*, *Plectoptera*, and *Trichoptera*
% dominant taxon = percentage of total abundance represented by most numerically abundant species
% EPT = percentage of total abundance represented by all individuals among the orders *Ephemeroptera*, *Plectoptera,* and *Trichoptera*
Summary score calculated after method of Bukantis (1996):

> 0.75 = no impairment
0.25 - 0.75 = moderate impairment
< 0.25 = severe impairment

[1] Does not include sampling events in which less than 100 organisms were captured.

TABLE 3-22
Selected Metric Scores for August Sampling Events [1]

Station	Year	Number of Organisms	Taxa Richness	EPT Richness	% Dominant Taxon	% EPT	Summary Score
ERC-1	1986	173	31	22	16	84	1.00
ERC-1	1987	171	27	23	22	94	0.92
ERC-1	1988	201	26	23	31	98	0.83
ERC-2	1985	207	31	23	29	62	0.83
ERC-2	1986	185	27	24	21	95	0.92
RC-1	1985	153	14	11	32	94	0.42
RC-1	1986	265	23	21	28	95	0.75
RC-1	1987	402	20	18	60	39	0.25
RC-2	1985	198	19	14	36	90	0.42
RC-2	1986	281	29	23	20	93	1.00
RC-2	1987	178	24	20	22	94	0.83
RC-2	1988	422	30	27	23	97	1.00
RC-3	1985	301	29	25	14	93	1.00
RC-3	1986	187	28	24	19	94	0.92
RC-3	1987	144	26	24	17	97	0.92
RC-3	1988	150	27	23	23	97	0.92
WRC-1	1985	132	15	13	24	85	0.42
WRC-2	1985	114	17	14	39	96	0.33
WRC-2	1986	328	31	22	28	95	0.92
WRC-2	1987	198	25	21	24	94	0.83
WRC-2	1988	195	18	17	33	99	0.50
WRC-2A	1985	228	23	17	30	86	0.58
WRC-2A	1986	299	20	17	18	89	0.67
WRC-2A	1987	274	21	18	23	89	0.75
WRC-2A	1988	656	24	21	19	91	0.83
WRC-4	1985	519	24	20	71	97	0.58
WRC-4	1986	523	28	24	48	70	0.58
WRC-4	1987	336	25	21	34	68	0.75
WRC-4	1988	874	23	22	48	81	0.58

Notes:

RC = mainstem Rock Creek ERC = East Fork of Rock Creek WRC = West Fork of Rock Creek
Taxa richness = number of unique species
EPT richness = number of unique species among the orders *Ephemeroptera*, *Plectoptera*, and *Trichoptera*
% dominant taxon = percentage of total abundance represented by most numerically abundant species
% EPT = percentage of total abundance represented by all individuals among the orders *Ephemeroptera*, *Plectoptera*, and *Trichoptera*
Summary score calculated after method of Bukantis (1996):
> 0.75 = no impairment 0.25 - 0.75 = moderate impairment < 0.25 = severe impairment

[1] Does not include sampling events in which less than 100 organisms were captured.

TABLE 3-23
Selected Metric Scores for October Sampling Events [1]

Station	Year	Number of Organisms	Taxa Richness	EPT Richness	% Dominant Taxon	% EPT	Summary Score
ERC-1	1985	186	28	21	15	91	0.92
ERC-1	1986	165	22	18	39	59	0.50
ERC-1	1987	242	27	24	21	97	0.92
ERC-2	1985	217	20	15	38	96	0.50
RC-1	1985	152	15	11	33	95	0.42
RC-2	1985	351	20	17	55	97	0.42
RC-2	1986	283	27	24	31	97	0.83
RC-2	1987	346	24	19	38	98	0.58
RC-2	1988	271	21	17	35	97	0.50
RC-3	1985	195	29	24	23	94	1.00
WRC-2	1985	325	15	13	46	99	0.25
WRC-2A	1985	610	18	17	37	91	0.42
WRC-2A	1986	515	23	19	33	94	0.67
WRC-2A	1987	322	23	19	36	92	0.58
WRC-2A	1988	567	23	20	41	87	0.67
WRC-4	1985	410	19	16	52	82	0.42
WRC-4	1986	666	24	21	36	63	0.58
WRC-4	1987	375	32	27	42	82	0.83
WRC-4	1988	871	24	23	35	65	0.58
RC-reach 1	1993	117	15	13	42	98	0.33
RC-reach 2	1993	96	19	14	27	75	0.50
RC-reach 3	1993	96	13	11	31	66	0.33

Notes:

RC = mainstem Rock Creek
ERC = East Fork of Rock Creek
WRC = West Fork of Rock Creek
Taxa richness = number of unique species
EPT richness = number of unique species among the orders *Ephemeroptera*, *Plectoptera*, and *Trichoptera*
% dominant taxon = percentage of total abundance represented by most numerically abundant species
% EPT = percentage of total abundance represented by all individuals among the orders *Ephemeroptera*, *Plectoptera*, and *Trichoptera*
Summary score calculated after method of Bukantis (1996):

> 0.75 = no impairment
0.25 - 0.75 = moderate impairment
< 0.25 = severe impairment

[1] Does not include sampling events in which less than 95 organisms were captured.

For each sampling event, the compilation of the metrics results in a conclusion of no impairment, moderate impairment, or severe impairment. The impairment designations are relative terms and do no imply any specific biological condition. However, since these designations are being considered for use by the State in water quality decision-making, they are displayed here. Table 3-24 presents a summary of these comparisons for the Rock Creek baseline data.

None of the sampling events indicated severe impairment. More than half the sampling events for mainstem and East Fork of Rock Creek indicated no impairment, but 22 of 28 sampling events for the west fork of Rock Creek indicated moderate impairment. Seasonal effects were notable; August sampling events showed the highest proportion of no impairment scores (see Table 3-24).

Overall the Rock Creek drainage supports high diversity of invertebrates but relatively low total numbers, similar to other high quality streams in western Montana. Approximately 75 taxa were identified during studies conducted from 1985-1988. The most common types of macroinvertebrates found in Rock Creek are clean-water forms such as mayflies, stoneflies, and caddisflies. Of the total macro-invertebrates sampled, mayflies (*Ephemeroptera*) represented between 30 and 73 percent, stoneflies (*Plecoptera*) contributed between 9 and 38 percent, and caddisflies (*Trichoptera*) contributed between 2 and 13 percent. The most widespread organism found in Rock Creek is the mayfly *Cinygmula* sp. Other common taxa included the mayflies *Rhithrogena* sp., *Epeorus* sp., *Baetis* sp. and *Drunella doddsi*, and the stoneflies *Suwallia* sp., *Megarcys* sp., and *Zapada columbiana*. All these species are indicative of clean waters, except for *Baetis* sp., which can tolerate a wide range of conditions. Flow regime is the factor that has the most influence on the macroinvertebrate communities in the Rock Creek drainage. Perennial sample sites tended to support larger densities than intermittent or frequently dry sites (Farmer et al. 1986 in ASARCO Incorporated 1987-1997, Farmer and Farmer 1987 in ASARCO Incorporated 1987-1997, Farmer and Farmer 1988, Farmer and Farmer 1989). Similarly, perennial sites showed less evidence of impairment in the metric score comparisons (Table 3-24).

Fish

Four species of fish have been found in the Rock Creek drainage: westslope cutthroat trout (*Oncorhynchus clarki*), bull trout (*Salvelinus confluentus*), brook trout (*Salvelinus fontinalis*), and rainbow trout (*Oncorhynchus mykiss*). Cutthroat trout and bull trout are the dominant species. Westslope cutthroat and rainbow trout are spring-spawning fish while bull and brook trout spawn in the fall.

Rainbow trout have been found only rarely in Rock Creek and only in the mainstem. Brook trout are relatively more common but were also only found in the mainstem. Population estimates from studies conducted in 1985 through 1996 are summarized in Table 3-25. The three intermittent stream segments, RC-1, RC-4, and WF-1 (see Figure 3-18) have the lowest density of fish in the drainage (see Table 3-24). The two perennial segments (RC-2 and EF-1) support fish that are from 1 to 4 years old, whereas the intermittent segments support primarily 1- and 2-year old fish. RC-2 (a perennial segment) has been cited as having significant spawning habitat and supports the highest fish density on the mainstem.

TABLE 3-24
Impairment Assessment for Rock Creek Baseline Macroinvertebrate Data, 1985-1993

Station	Number of Sampling Events [1]		
	No Impairment	Moderate Impairment	Severe Impairment
RC1	2	3	0
RC2	6	4	0
RC3	5	2	0
ERC1	5	3	0
ERC2	2	1	0
WRC1	0	2	0
WRC2	2	5	0
WRC2A	1	8	0
WRC4	3	9	0
1993 Sampling	0	3	0
All April events	5	10	0
All August events	15	14	0
All October events	5	17	0

Note: RC = mainstem Rock Creek
ERC = East Fork of Rock Creek
WRC = West Fork of Rock Creek
[1] Does not include sampling events in which less than 95 organisms were captured.

TABLE 3-25
Fish Density Estimates and Fish Species Composition in Rock Creek, 1985-1996

Section & Date Sampled	Source	Density of fish (fish/100 ft²)(Percentage of total in parentheses)			
		All fish	Westslope cutthroat	Bull trout	Brook trout
RC-1 (8/4/86)	2	0.85	0.66 (78)	0.08 (9)	0.11 (13)
RC-2 (10/30/93)	4	1.8	0.63 (35)	0.04 (2)	1.1 (63)
RC-2 (8/5/86)	2	1.8	0.99 (55)	0.09 (5)	0.72 (40)
RC-2 (7/22/85)	1	3.0	2.0 (65)	0.03 (1)	1.0 (34)
RC-4 (8/8/86)	2	0.33	0.23 (70)	0.08 (23)	0.02 (7)
RC-4 (8/7/85)	1	0.37	0.30 (82)	0.07 (18)	--
WF-1[a] (11/19/93)	4	2.1	0.93 (43)	1.2 (57)	--
WF-2[a] (11/19/93)	4	1.9	0.74 (40)	1.1 (60)	--
WF-3[a] (11/19/93)	4	2.0	0.84 (43)	1.1 (57)	--
WF-1[b] (11/19/93)	4	0.29	0.07 (24)	0.22 (76)	--
WF-1 (7/31/86)	2	0.27	0.08 (30)	0.19 (70)	--
WF-1 (7/25/85)	1	0.42	0.08 (18)	0.34 (82)	--
EF-1 (10/30/93)	4	2.3	1.9 (81)	0.44 (19)	--
EF-1 1988	3	1.3	0.90 (69)	0.40 (31)	--
EF-1 (8/7/86)	2	3.3	2.3 (70)	0.99 (30)	--
EF-1 (8/22/85)	1	1.2	0.90 (75)	0.30 (25)	--
MS1 (8/29/96)	5 [c]	0.44 [d]	0.40 (91)	--	--
MS2 (9/3/96)	5 [c]	0.63 [d]	0.52 (83)	--	--
MS3 (8/29/96)	5 [c]	1.3 [d]	0.84 (65)	0.11 (8)	0.34 (26)
MS3A (8/30/96)	5 [c]	2.0 [d]	0.70 (35)	--	1.4 (70)
MS4 (8/30/96)	5 [c]	0.67 [d]	0.57 (85)	--	0.13 (19)
MS5 (9/4/96)	5 [c]	0.41 [d]	0.38 (93)	--	--
MS6 (9/3/96)	5 [c]	1.1 [d]	0.81 (74)	--	--
WF1 (9/4/96)	5 [c]	0.32 [d]	0.34 (100)	--	--
WF2 (9/6/96)	5 [c]	--	--	--	--
WF3 (9/6/96)	5 [c]	1.5 [d]	1.5 (100)	--	--
WF4 (9/5/96)	5 [c]	0.96 [d]	0.96 (100)	--	--
WF5 (9/5/96)	5 [c]	2.0 [d]	2.0 (100)	--	--
WF6 (9/5/96)	5 [c]	0.15 [d]	0.15 (100)	--	--
EF1 (9/9/96)	5 [c]	1.2 [d]	1.06 (88)	0.22 (18)	--
EF2 (9/10/96)	5 [c]	2.3 [d]	2.0 (87)	0.41 (18)	--
EF3 (9/10/96)	5 [c]	1.6 [d]	1.2 (75)	0.39 (24)	--
EF4 (9/11/96)	5 [c]	1.7 [d]	1.4 (82)	0.72 (42)	--
EF5 (9/11/96)	5 [c]	1.6 [d]	1.2 (75)	0.41 (26)	--
EF6 (9/12/96)	5 [c]	1.4 [d]	1.3 (93)	0.13 (9)	–

TABLE 3-25
(Continued)
Fish Density Estimates and Fish Species Composition in Rock Creek, 1985-1996

Sources:
1=Barnard and Vashro 1986
2=Hightower and Vashro 1987
3=Hightower 1988
4=WWP 1996b
5=Watershed Consulting 1997

Notes:

[a] WF-1 = mouth to RM 0.37, WF-2 = RM 0.37 to RM 0.50; WF-3 = RM 0.50 to RM 0.74

[b] WF-1 includes small sample site sampled in 1985 and 1986

[c] Sampling locations from Watershed Consulting (1997) differed from locations sampled previously; population estimates recalculated by excluding fish < 75 mm in length to be consistent with reporting conventions of other sampling events.

[d] "All trout" values may not be sum of individual species estimates because each estimate is calculated on the basis of how many fish were captured in successive passes and this proportion varied between species. Also, for the same reason the percentages of the total represented by each species do not necessarily add up to 100 percent.

-- indicates no fish caught; or no estimate possible, which can occur if second pass numbers exceed or are equal to first pass numbers, or are zero.

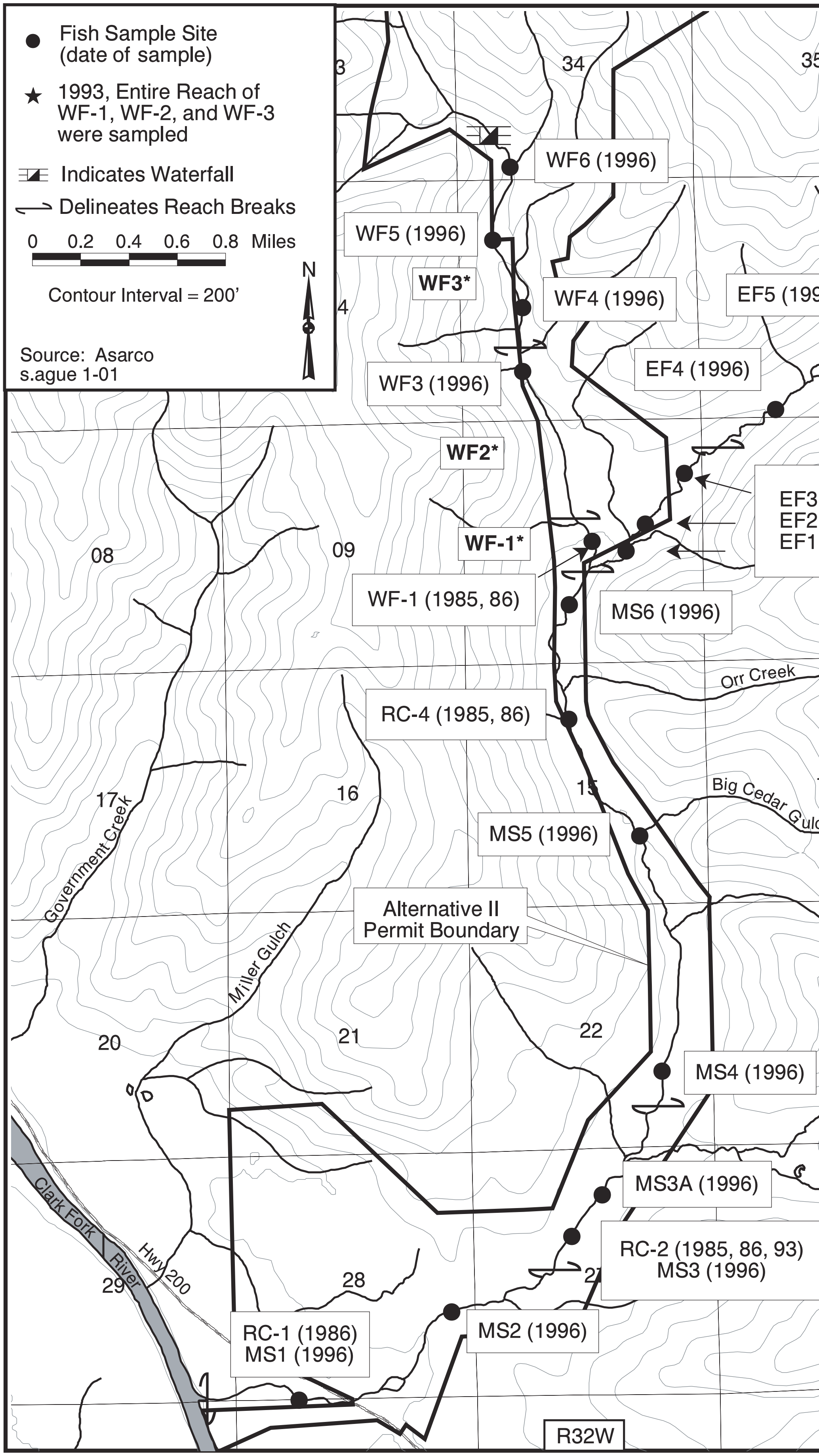


FIGURE 3-18
Stream Segments and Sample Sites for Fish
Rock Creek Project

The East Fork of Rock Creek has the highest fish density of any reach sampled in the Rock Creek drainage (Elliott and March 1997). The west fork of Rock Creek was sampled in the (upstream) perennial sections for the first time in 1993 (see Table 3-25). With the exception of station WF6, located just downstream of the waterfall (see Figure 3-18), fish densities are far higher in this portion of the stream than in the lower, intermittent reach.

Analysis of the genetics of a sample of 21 fish taken from the East Fork of Rock Creek downstream of Rock Creek Meadows showed a pure westslope cutthroat population (Hightower 1988). The preservation of native trout gene pools in Montana has long been a goal of the Montana Department of Fish, Wildlife, and Parks (Leary et al. 1984). A 1988 sample of fish from Rock Creek Meadows, a 59-acre flooded mountain meadow on the East Fork of Rock Creek, was analyzed by the University of Montana-Wild Trout and Salmon Genetics Laboratory. In contrast to the above results, researchers found westslope cutthroat trout; westslope cutthroat crossed with Yellowstone cutthroat trout; and westslope cutthroat, Yellowstone cutthroat, and rainbow trout crosses (Hightower 1988). The hybridization in this drainage is most likely a result of past stocking activities in Rock Lake or the meadows, which are located at the drainage headwaters. While there are barriers to upstream fish movement in Rock Creek Meadows and the outlet of Rock Lake further upstream, downstream movement of hybridized cutthroat trout into areas currently occupied by pure strains is likely (WWP 1996b). For management purposes, this population of cutthroat trout should not be considered pure because of its irreversible hybridization with non-native stocks.

Populations of westslope cutthroat trout and brook trout appear to be permanent (nonmigratory) residents of Rock Creek. A waterfall located about 1.5 miles upstream of the confluence with the east fork is a barrier to fish movement and the upstream limit of fish distribution in this drainage (Barnard and Vashro 1986).

Population trends over time are difficult to discern given the intermittent nature of some of the reaches over different seasons, the variability in sampling times between the different surveys (see Table 3-25), and the various methods used to calculate fish population estimates. In RC-2, the 1993 estimate of 1.81 fish\100 feet^2 is comparable to previous estimates.

Growth rates for both cutthroat and bull trout in Rock Creek are lower than comparable growth rates for the lower Clark Fork River drainage (WWP 1996b). Slow fish growth in Rock Creek is typical for a low-productivity mountain stream. In samples taken in 1987, cutthroat averaged 5.6 inches long and bull trout averaged 6.3 inches (Hightower 1988).

Metals Concentration in Tissues

The average concentration of metals in fish tissues in Rock Creek and the East Fork of Rock Creek is listed in Table 3-26. Metals concentrations were analyzed from westslope cutthroat trout collected from Rock Creek and the east fork of Rock Creek in 1985. The mean value of 3.0 parts per million (ppm) copper is comparable to values found in Lake and Stanley creeks (Montana Department of State Lands and Kootenai National Forest 1978) and is less than half that found in Libby Creek (U.S. Forest Service et al. 1992). The mean zinc values (75-82 ppm) are substantially higher than zinc values found in other nearby streams–30.1 ppm in hybrid redband trout in Libby Creek (U.S. Forest Service et al. 1992), and 23.2 to 44.0 ppm from Stanley and Lake creeks (Montana Department of State Lands and Kootenai National Forest 1978). Mercury values in Rock Creek and the East Fork of Rock Creek (0.12-0.13 ppm, respectively) are comparable to mercury values found in Libby Creek (0.19 ppm). The mercury concentrations are below guidelines published by U.S. FDA (1994) and the state of Montana (Department of Public Health and Human Services 1998) which are intended to be protective of human health.

TABLE 3-26
Metals Concentration of Westslope Cutthroat Trout Collected From Rock Creek, 1985

	Rock Creek			East Fork		
	Copper	**Zinc**	**Mercury**	**Copper**	**Zinc**	**Mercury**
Mean concentration (ppm)	3.0	82	0.12	3.0	75	0.13
Standard deviation	0.5	22.9	0.03	0.9	15.4	0.05
Number of samples	25	26	11	25	20	11
Mean fish length	7.9	7.9	8.7	8.4	8.4	9.0
Fish length range	5.8-10.9	5.8-10.9	6.8-9.8	7.2-10.1	7.2-10.1	8.2-10.1

Source: Barnard and Vashro *In* ASARCO Incorporated 1987-1997.
Notes: Fish length is in inches. Gill tissue was analyzed for copper and zinc; muscle tissue was analyzed for mercury.

Sensitive Fish Species

Both dominant native fish species in this drainage (bull trout and westslope cutthroat trout) have designated special status. Effective July 10, 1998, the Columbia River distinct population segment of bull trout were listed by the Fish and Wildlife Service as threatened, pursuant to the Endangered Species Act (63 FR 31647). Westslope cutthroat trout are listed as sensitive species by the U.S. Forest Service and as species of special concern by the Montana Chapter of American Fisheries Society and the Montana Fish, Wildlife and Parks (MFWP). On June 10, 1998, this species was subject to a 90-day finding and commencement of status review for a petition to list as threatened (63 FR 31691). On August 17, 1998, USFWS determined that threatened status listing may be warranted for westslope cutthroat trout and initiated a 12-month status review (63 FR 43901). Bull trout are discussed in the Threatened and Endangered Species sections of this document and in the Biological Assessment contained in Appendix B.

Clark Fork River/Cabinet Gorge Reservoir

Cabinet Gorge Reservoir is used as a regulating reservoir for Noxon Rapids with frequent daily water level fluctuations of 2 to 4 feet. Discharge from Noxon Dam varies daily and seasonally, depending on the demand for electrical power. When discharge rates are high, Cabinet Gorge in the vicinity of Rock Creek resembles a river rather than a reservoir. Downstream of Cabinet Gorge Reservoir, the lower Clark Fork River flows approximately 10 miles to Lake Pend Oreille.

Because of rapid water exchange rates, Cabinet Gorge Reservoir is almost always the same temperature on the surface as on the bottom (Avista 1999a). Therefore, because of the relatively warm temperatures, there is rarely any refuge for cold-water fish in deep portions of the reservoir. However, dissolved oxygen levels in the reservoir are usually adequate for fish, even at greater depths. Maximum temperature rarely exceeds 72 degrees F, except in some backwater shallows. The operational plan for Noxon Rapids Reservoir requires that drawdowns be limited to 10 feet during normal circumstances. This plan has been in effect since 1986. These drawdown limits on Noxon Rapids have resulted in lower drawdown in Cabinet Gorge Reservoir as well.

Both Cabinet Gorge and Noxon Rapids Reservoirs are currently undergoing relicensing. A working group met regularly from September 1996 to the fall of 1998 to coordinate the fisheries component of the relicensing effort (pers. comm. T. Swant, Washington Water Power, with Tad Deshler, April 7, 1997). Additional studies will be performed to supplement the information presented here for Cabinet Gorge Reservoir.

Aquatic Plants

Five groups of algae grow in the lower Clark Fork River system: 1) green algae, 2) golden-brown algae, 3) diatoms, 4) red algae, and 5) blue-green algae. Of the nondiatom algae, the most diverse and abundant group was the green algae (Chlorophyta), followed by the blue-green algae (Cyanophyta).

Diatoms are the most abundant group in the Clark Fork River just below Noxon Reservoir, except in the summer of 1984 when the green filamentous alga, *Spirogyra*, ranked first. Up to 57 species of diatoms can be found just below Noxon Dam. This stretch of river yields diatom diversity indices (a measure that expresses the number of species and their abundance) ranging from 4.0 to 4.9 (Montana Department of Health and Environmental Sciences 1985). These values fall within the range of 3 to 5 found for other unpolluted Montana streams (Bahls 1993). The unpolluted nature of the river with regard to biological oxygen demand is further indicated by the predominance of pollution-sensitive diatom species (Priscu 1989).

Aquatic Invertebrates

Because of rapid exchange rates, neither Noxon Rapids nor Cabinet Gorge reservoirs appear to produce much zooplankton, although a comprehensive survey has not been conducted (Huston 1988). It appears that the reduction of drawdowns that has occurred since 1986 has increased benthic invertebrate diversity and numbers. In 1987, 13 groups (families or orders) of invertebrates were found in Cabinet Gorge, while in 1982 only 5 groups were found (Huston 1988).

Crayfish (*Pacifastacus leniusculus*) are known to occur in both Cabinet Gorge and Noxon Rapids reservoirs. During 1988, a limited commercial fishery for this species existed in Noxon Rapids Reservoir). It was not very profitable and is currently outlawed because of conflicts with float fishermen (pers. comm. A. Sheldon, University of Montana, with Tad Deshler, April 7, 1997).

Fish

In preparation for their relicensing application for Cabinet Gorge Dam, Avista (formerly WWP) (1996a) conducted a very extensive fish sampling program on the reservoir during July 1994 to June 1995. Collection methods included electrofishing, beach seining, and gill net sets. A total of 84 sites in a variety of habitats were sampled by electrofishing, beach seining, and gill netting. A total of 17,265 individuals representing 20 species were captured (Table 3-27).

TABLE 3-27
Fish Abundance: Cabinet Gorge Reservoir, 1994-1995

Species	Habitat					Total	% of Total
	Silt	Gravel	Cobble/ Boulder	Riverine	Open Water		
Redside shiner	440	2468	1274	606	2	4790	27.75
Northern pikeminnow[a]	879	1314	553	695	52	3493	20.24
Yellow perch	1231	931	101	301	23	2587	14.99
Peamouth	658	1079	257	315	45	2354	13.64
Largescale sucker	315	787	243	154	26	1525	8.83
Pumpkinseed	799	386	19	54	0	1258	7.29
Longnose sucker	191	123	40	9	0	363	2.10
Bullhead	271	5	1	0	0	277	1.60
Mountain whitefish	89	101	4	42	1	237	1.37
Brown trout	14	89	37	17	3	160	0.93
Lake whitefish	5	23	15	21	1	65	0.38
Largemouth bass	56	6	0	2	0	64	0.37
Rainbow trout	10	5	7	18	0	40	0.23
Smallmouth bass	6	1	4	9	0	20	0.12
Slimy sculpin	1	1	4	2	1	9	0.05
Northern pike	8	0	0	0	0	8	0.03
Bull trout	1	2	0	1	1	5	0.03
Cutthroat trout	1	2	0	2	0	5	0.03
Black crappie	2	0	0	0	0	2	0.02
Burbot	0	0	3	0	0	3	0.01
Total	4977	7323	2562	2248	155	17265	100.00

Notes:
[a] Common name change from northern squawfish recently suggested (Nelson et al. 1998)
Source: WWP (1996a)

The most abundant fish sampled in Cabinet Gorge Reservoir were redside shiner and northern pikeminnow, which showed preferences for larger substrates and low concentrations of vegetation. Individuals from the cyprinid family (redside shiner, northern pikeminnow, and peamouth) made up 62 percent of the total catch in the reservoir. Fish that demonstrated preferences for cold water during the summer (i.e., salmonids and longnose sucker) represented less than 5 percent of the total catch. Salmonids have declined from their historical abundance in the lower Clark Fork River ever since the Cabinet Gorge Dam was completed in 1953 (Barnard and Vashro 1986 in ASARCO Incorporated 1987-1997, Huston 1985).

Metals Concentration in Tissues

Tissue from mountain whitefish collected from Cabinet Gorge reservoir in 1985 were analyzed for metals concentrations. The mean values for copper (3.0 ppm), zinc (73 ppm), and mercury (0.13 ppm) are comparable to those found in fish in Rock Creek and the East Fork of Rock Creek (discussed earlier).

Sensitive Fish Species

Prior to construction of Cabinet Gorge Dam, several species of fish, reportedly including bull trout and westslope cutthroat trout, migrated from Lake Pend Oreille into the upper Clark Fork River drainage. Cabinet Gorge Dam blocked all access by migratory fish into the Clark Fork River upstream of the dam.

In the years since the dam was constructed, bull trout numbers have declined, although both bull and westslope cutthroat trout populations may persist in low numbers (Huston 1993). Only 5 individuals of each species were captured during extensive sampling conducted during 1994-95 (WWP 1996a).

Westslope cutthroat trout were collected in Cabinet Gorge Reservoir in very small numbers in 1985 and 1995 (Barnard and Vashro 1986 in ASARCO Incorporated 1987-1997 , WWP 1996a). Yellowstone cutthroat trout were stocked in Cabinet Gorge Reservoir in the 1950s (Huston 1993). Yellowstone cutthroat trout interbreed with westslope cutthroat trout. The genetic status of cutthroat trout is unknown in Cabinet Gorge Reservoir. However, westslope cutthroat trout in the Bull River drainage were found to be either pure strain or "pure for management purposes" (Huston 1993). In contrast, Yellowstone cutthroat trout have hybridized with pure westslope cutthroat trout in the Rock Creek drainage.

<u>Lake Pend Oreille</u>

General Description

Lake Pend Oreille is the largest and deepest natural lake in Idaho. The surface elevation is regulated by the Albeni Falls Dam, located on the Pend Oreille River 23 miles downstream. Most of the lake's volume is contained in the southern basin that has a mean depth of 715 feet. The northern arm of the lake has a mean depth of 98 feet (Hoelscher 1993).

The Clark Fork River is the lake's principal inlet, contributing as much as 90 percent of the lake's annual inflow (Beckwith 1989). The only surface outlet is the Pend Oreille River.

Aquatic Plants

Lake Pend Oreille contains five groups of algae, with diatoms encountered most frequently. The golden-brown algae occasionally dominate when *Rhodomonas minuta* grows rapidly. Nuisance blue-green algae are rare. Total algal biomass in the lake is quite low, however, the potential for moderately high production is present. Algae may currently be limited by a phosphorus and/or nitrogen deficiency (Priscu 1989).

Aquatic Invertebrates

Eleven species of crustacean zooplankton have been identified in Lake Pend Oreille (Hoelscher 1993). Of these, five species, including opossum shrimp (*Mysis relicta)*, composed most of the zooplankton community. Opossum shrimp were introduced into Lake Pend Oreille in 1966, and were well established by 1974. Changes in the zooplankton community since in 1974 suggest that opossum shrimp introductions have had a major effect on the native zooplankton community (Hoelscher 1993).

Fish

Of the approximately 20 game fish species present in Lake Pend Oreille, only westslope cutthroat trout, bull trout, and mountain whitefish are native. Other fishes include a variety of nongame species (Hoelscher 1993).

Lake Pend Oreille is an important fishery resource in Idaho. However, salmonid populations declined dramatically between the 1950s and 1980s. The completion of Cabinet Gorge Dam in 1951 on the Clark Fork River eliminated 90 percent of the available spawning and rearing habitat for migratory fishes (Irving 1986). Albeni Falls Dam, completed in 1952, caused winter drawdowns that dewatered shoreline spawning areas and killed kokanee eggs in the gravel. Currently, only 10 miles of Clark Fork River up to Cabinet Gorge Dam and 102 miles of smaller tributaries to Lake Pend Oreille and the river are available to migratory fishes for spawning (Hoelscher and Bjornn 1989). Improper land management practices, natural catastrophes, and the introduction of opossum shrimp also have been identified as causes of fishing declines.

Metals Concentration in Fish Tissues

In the fall of 1989, the Idaho Department of Fish and Game collected fish samples from the Clark Fork River and Lake Pend Oreille. Arsenic, chromium, and the organic compounds tested were not detected in any samples above the method detection limits (Hoelscher 1993). All other heavy metals — cadmium, copper, lead and mercury — were either nondetectable or well below action limits[11] except mercury in northern pikeminnow, for which the mean concentration in whole-body samples was 0.46 mg/kg. If the concentration of mercury in muscle tissue were the same as the whole-body concentrations, guidelines published by the state of Montana would suggest that consumption be limited to 1 meal/week for men, and 1 meal/month for children and women. Consumption of all other fish should pose no health problems.

[11]Federal guidelines for metals concentrations in fish tissue have not been officially established. However, the Food and Drug Administration has set an action limit for mercury in edible fish at 1.0 ppm wet weight. The State of Montana, Department of Public Health and Human Services (1998) and the Department of Fish, Wildlife and Parks) has established consumption guidelines based on mercury concentrations in fish.

Sensitive Fish Species

The present low densities of juvenile westslope cutthroat trout in accessible Lake Pend Oreille tributaries and the decline in westslope cutthroat harvest since monitoring began indicate a depressed migratory population. Possible reasons for the decline include habitat loss, overexploitation, migration blocks, and competition and interbreeding with introduced rainbow trout (Hoelscher 1993).

BIODIVERSITY OF WILDLIFE HABITAT/VEGETATION AND WILDLIFE SPECIES (BIODIVERSITY)

Introduction

Wildlife and vegetation are interwoven subjects that are part of a larger relationship called biodiversity. Biodiversity, as defined by Wilcox, is a term that describes the variety of life forms, the ecological role they perform, and the genetic diversity they contain (Wilcox 1984). For this reason, wildlife and vegetation are presented together in an attempt to display their ecological ties. This section addresses some aspects of the very complex concept of biodiversity.

Wildlife Habitat/Vegetation

Aspects of biodiversity that are discussed in this section include: plant species of special concern, noxious weeds, vegetative communities, old growth ecosystems, and habitat fragmentation. Discussions of these subject areas will help set the stage for understanding potential impacts to the integrity of habitat.

Plant Species of Special Concern

The U.S. Fish and Wildlife Service is charged with maintaining a list of threatened or endangered species and reviewing candidate (additional) species for possible listing (see Threatened and Endangered Species). No species on this list were found within the study area.

The Forest Service has developed a program to identify and manage threatened plant species that also focuses on plant population viability and habitat management. As part of this program, the Forest Service has developed the “sensitive” classification, in an effort to preclude trends toward species endangerment that would result in the need for federal listing (Leavell and Triepke 1995). These sensitive species have legal status under the National Forest Management Act and if found within the study area would require study, conservation, or mitigation. Only one sensitive plant species, crested-shield fern, was originally believed to occur within the study area.

The Montana Natural Heritage Program (MTNHP) tracks plant species of special concern. More information on this program and plant species of special concern can be found in the field guides at the MTNHP web page at http://orion2.nris.state.mt.us/mtnhp/plants/index.html. The draft EIS indicated that MTNHP was tracking 379 plant taxa. The 1999 list produced by the MTNHP listed 334 vascular plant species and 112 moss taxia and 3 lichen species of special concern (Heidel 1999). Two plant species of special concern were identified during ASARCO’s baseline field studies in the study area; pointed broom sedge and Yerba buena. No Kootenai National Forest sensitive plants were found in the baseline studies.

- **Pointed broom sedge, *Carex scoparia*.** Pointed broom sedge is generally found on moist to wet meadows in valleys (Lesica et al.1994). One population was found in the study area in a highly disturbed clear-cut site. It is listed by MTNHP as demonstrably globally secure but imperiled because of rarity in the state. It has been located in 6 to 20 places (Heidel 1999). This rarity is typical of many plants at the periphery of their range.

- **Yerba buena, *Satureja douglasii*.** Yerba buena is generally found in partially to deep shaded areas of moist coniferous forests (Lesica and Shelly 1991). The plant occurs commonly in the permit area along the terrace of the Clark Fork River (Scow et al. In ASARCO Incorporated 1987-1997; Montana Natural Heritage Program 1994). Seven populations were found in the study area. Yerba buena is listed by MTNHP as apparently globally secure but imperiled in the state because it has been located in less than 20 places (Heidel 1999). The distribution of this species in northwestern Montana is in the periphery of its range; this species is more common to the west of the project area.

Comments on the draft EIS indicated that other potential MTNHP plant species of special concern and KNF sensitive plant species have been documented close to and in the study area in later years. Two wavy moonwort plants, *Botrychium crenulatum,* were found on the Rock Creek Mine project property in 1995 by KNF. ASARCO contracted additional baseline studies in 1996. No new wavy moonwort populations were found (Elliot 1996). Common clarkia plants, *Claria rhomboidia,* were found near the tailings disposal site in 1995 during timber stand exams. However, neither the wavy moonwart nor the *Carex scoparia* populations could be located during the 1999 survey (Arvidson 1999b) although suitable habitat exists in the area. In 1998 the rare vascular plant, Stika clubmoss, *Diphasiatrum sitchense*, was discovered near the evaluation adit in the CMW during a forest-wide lichen and bryophyte inventory and was relocated in the 1999 survey (USFS KNF 1999). These three species were added to the KNF sensitive species plant list in 1999. Also discovered within the project area during the 1998 inventory were a rare bryophyte species, *Andreaea blytii*, and a species tentatively identified as *Racomitrium pygmaeum*. Although this later species has still not be verified, the suspected population is being considered as if it is that sensitive plant species. The *Andreaea blytii* and *Racomitrium pygmaeum* populations were relocated in the 1999 survey near the evaluation adit but outside the permit area. Although these are not listed as KNF sensitive species, they are considered to be critically imperiled because of both species and habitat rarity (S1) by the MNHP. Two additional KNF sensitive plant species were found during a 1999 field survey of the project area; these are tarpaper lichen and mouse moss (USFS KNF 1999) and both are also considered to be potentially imperiled by MNHP.

- **Wavy moonwort, *Botrychium crenulatum*.** In Idaho, the plant is found at low elevation in drier microsites of damp meadows, boggy areas, and marshes either on hillsides or flat lands where there are wet banks or springy spots (USFS KNF 1995b). The Applicant's consultants concluded that habitats suitable for moonworts in the Rock Creek area occurs on floodplain terraces along the main stem of Rock Creek and along the west fork of Rock Creek. They also concluded that most areas of suitable habitat are small areas at microsites adjacent to the stream, side channels, or seeps that discharge to the creek. The largest block of suitable habitat observed was near the confluence of Engle Creek and Rock Creek where the wavy moonworts were observed in 1995. That population could not be relocated during a 1999 survey. The plant is listed as globally vulnerable because it has been found in less than 100 stands. In the state it is listed as imperiled because of rarity and is found in less than 20 locations.

- **Common clarkia, *Clarkia rhomboidia.*** Common clarkia grows in dry open forests on the south facing slopes in the mountains from 2,800 to 6,800 feet in elevation (USFS KNF 1995b). One population had been found in 1995 but could not be relocated in a 1999 survey. Globally, the plant is apparently secure. In Montana, this species is at the edge of its range and is more common in the west and south (USFS KNF 1995b). In Montana, common clarkia is ranked as imperilled because of rarity and exists in less than 20 identified areas.

- **Sitka clubmoss, *Diphasiatrum sitchense* (also known as *Lycopodium sitchense*).** Sitka clubmoss is found in meadows and open, often rocky places in upper montane and subalpine habitats, above 5,840 feet in elevation, including disturbed sites such as trailsides, and clear cuts. One population outside the project area within the CMW was located in the 1999 survey. The plant is listed as globally secure and as vulnerable because of rarity within Montana and has been found in only one other location in Lincoln County, Montana.

- ***Andreaea blyttii.*** *Andreaea blyttii*, a rare bryophyte, grows as short black turfs over rocks in late snow areas (pers. comm. Bonnie Heidel, MTNHP to Pat Plantenberg, DEQ, September 30, 1999). One population was located near the evaluation adit but outside the permit area in the 1999 survey. This species is considered to be potentially imperiled within Montana because of both species and habitat rarity but is considered globally secure.

- ***Racomitrium pygmaeum.*** *Racomitrium pygmaeum* grows on damp soil in the subalpine zone (Ibid). This species is considered to be critically imperiled within Montana because of both species and habitat rarity; it is located at less than 5 known sites. Global security is unknown (Heidel 1999).

- **Tarpaper lichen, *Collema curtisporum.*** *Collema curtisporum* grows on the bark of large cottonwoods in riparian stands in narrow sheltered valleys or low montane zones below 3,500 feet. This species is considered to be potentially imperiled within Montana and globally because of both species and habitat rarity. There are six known occurrences within Montana (USFS KNF 1999 and Heidel 1999). One population was found on large cottonwood tree boles within the riparian area, at the upper Rock Creek crossing for the Alternative V utility and transportation corridor in the 1999 survey.

- **Mouse moss, *Grimmia britoniae.*** Mouse moss grows on calcareous outcrops in warm mesic to dryer forests that are very wet in the spring in a valley or low montane zone. This species is considered to be potentially imperiled within Montana and globally because of both species and habitat rarity. There are four known occurrences within Montana (Ibid). As of November 2000), there are now 15 known populations in Montana (USFS KNF 2000). One population was found at the base of calcareous cliff facies in the tailings site soil stockpile area in the 1999 survey.

- **Northern beachfern, *Phegopteris connectilis.*** This plant occurs in cliff crevices and moist banks in wooded regions. On the KNF, this species is strongly associated with low gradient perennial stream surrounded by mature to old growth western redcedar stands. It has a circumboreal distribution, south to northern Oregon, southeast British Columbia, Iowa, and North Carolina. This species is known to occur on the Kootenai National Forest and in

Glacier National Park in Montana, and the Idaho Panhandle National Forest in Idaho. One population of this species is known to occur within the analysis area, but occurs outside of the proposed permit area (USFS KNF 2000).

- **Stalked moonwort, *Botrychium pedunculosum*.** On the KNF, this species is found in old growth stands of western redcedar (*Thuja plicata*) in floodplain bottoms from 2,600 to 3,200 feet elevation and in a powerline corridor. This species has also been found in Oregon and Washington, where the habitat is described as meadows and openings. Populations are known to occur on the Idaho Panhandle National Forests in Idaho, and on the Kootenai National Forest in Montana. This species is known to occur within a transient meadow in a powerline corridor north of McKay creek. This occurrence is outside of the proposed permit area.

The agencies also checked with baseline studies conducted by Washington Water Power in 1993 and 1994 (Northrop, Devine, and Tarbell Inc. 1994, 1995). No new species of special concern were found in these studies. Finally, crested shield-fern, *Dryopteris cristata* (now called Buckler fern by MTNHP), was mistakenly identified in the baseline studies in the study area.

To summarize, 18 populations of eleven MTNHP plant species of special concern (five are also KNF sensitive plant species), have been found within the study area. Five populations (one KNF sensitive plant species and four MTNHP plant species of special concern) were found outside of the proposed permit area, and two populations of MTNHP plant species of special concern (also KNF sensitive plant species) within the proposed permit area could not be relocated in later surveys but suitable habitat still exists. Therefore, 11 populations of five MTNHP plant species of special concern (two are also KNF sensitive plant species) have been located within the proposed permit area and potential areas of disturbance. MTNHP plant species of special concern do not have any legal standing, but state agencies try to minimize impact to these plants under NEPA.

Suitable habitat for all species described above and other KNF sensitive plant species exists within the project area. These additional plant species are upward-lobed moonwort (*Botrychium ascendens*), western moonwort (*Botrychium hesperium*), mountain moonwort (*Botrychium montanum*), peculiar moonwort (*Botrychium paradoxum*), stalked moonwort (*Botrychium pedunculosum*), big-leaf sedge, (*Carex amplifolia*), beaked sedge (*Carex rostrata*), *Cetraria subalpina,* pink corydalis (*Corydalis sempervirens*), western pearl-flower (*Heterocodon rariflorum*), prickly tree clubmoss (*Lycopodium denroideum*), *Nodobryoria subdivergense*, and beechfern (*Phegopteris connectilis*) (USFS KNF 2000). All these species are listed species with MTNHP (see MTNHP 1999 web page field guide).

Noxious Weeds

Under the Montana County Noxious Weed Control Act (Title 7-22-2101 to 2153), it is unlawful to allow noxious weeds to propagate. Fifteen plant species, designated as noxious, are currently listed in the rules (ARM 4.5.201-204). Four species on the statewide noxious weed list were found in the study area during baseline vegetation studies (Scow, Culwell, and Larsen 1987) including canada thistle, spotted knapweed, St. Johnswort, and sulfur cinquefoil. Populations of noxious weeds are expanding in all areas of Montana. The Sanders County Weed Board has designated 16 species including those recognized by the state. Sanders County has added scentless chamomile and blue weed to its county noxious weed list. Oxeye daisy and orange hawkweed are also two species of concern in the Sanders County area according to the Sanders County Extension Agent (pers. comm. Sanders County Extension agent, with Patrick Plantenberg, DEQ, September 15, 1997). Sanders County and the KNF are working cooperatively such that the County has taken on the responsibility of controlling noxious weeds in the Rock Creek drainage. Canada thistle was observed in only minor amounts in the project area.

Typically, weeds get a foothold in areas where disturbance has occurred. Spotted knapweed is an aggressive invader of dry to moist sites. Lacey et al. (1992) noted that spotted knapweed-infested range and open timberlands have drastically reduced big game use and forage base. Also, runoff and sediment yield are higher on knapweed infested lands. Spotted knapweed occurs throughout the study area. Particularly high coverages occur in cleared areas, especially in the powerline corridor and vicinity. Spotted knapweed occurs along all roads including the Chicago Peak Road and was also found as a component of all Douglas-fir communities. St. Johnswort, which is unpalatable and mildly poisonous to livestock, was observed in similar locations but its coverage was spotty or minor. Both spotted knapweed and St. Johnswort were found in recent clearcuts.

Sulphur cinquefoil is similar to spotted knapweed in site requirements and aggressive spreading behavior and is unpalatable to livestock and wildlife (Rice et al. 1991). It is rapidly becoming co-dominant in many areas in western Montana heavily infested with spotted knapweed (Rice et al. 1991). Only very minor amounts of sulphur cinquefoil were noted in cleared areas.

Vegetative Communities

The proposed project area occurs in an ecologically diverse area. The area is characteristic of the Northern Rockies and reflects the influences of both Pacific maritime and continental climates. Elevation, aspect, topographic position, soils, and management activities affect the specific plant communities that occur.

The majority of the vegetation study area, except the tailings impoundment, falls within the Rock Creek watershed, Compartment 711. About 61 percent of the land in Compartment 711 is forested with assorted conifer species, 16 percent is nonforested, and 23 percent is not described (USFS KNF 1994). Riparian and wetland communities, though comprising a small percentage of the landscape, are a very rich ecological component of the area (see Wetlands and Non-wetland Waters of the U.S.) and occur commonly throughout the area. Approximately 46 percent of the compartment occurs above 4,800 feet and generally possesses alpine characteristics and includes several small lakes in glaciated basins in the CMW.

Current forest cover in Compartment 711 is dominated by Douglas-fir stands (43 percent) and cedar-western hemlock stands (28 percent). Other assorted conifer stands account for the remaining forested lands (29 percent). The predicted future of potential forest type, which is determined through a technique called forest habitat typing (Pfister et al. 1979), suggests that about 60 percent of the area will successionally move towards climax communities of cedar-hemlock or grand fir and 30 percent to subalpine fir or mountain hemlock. Forest habitat types are useful in predicting future forest communities but do not necessarily reflect existing stand condition. Maps displaying forest habitat typing for the permit area are found in the baseline vegetation study (Scow, Culwell, and Larsen 1987).

Table 3-28 lists common plants found in the communities identified within the proposed permit boundary. Dense shrub understories occur in several communities. Grass and forb cover is relatively low in many communities because the tree and shrub canopy shades out and competes with these species.

Openings created by roads, powerline corridors, and other disturbances are dominated by herbaceous species, many of which are either not native to North America or are not typical of intact forested communities in the area. Logged areas are generally dominated by native species.

Spring and Seep Habitat

Plant species and communities have evolved and adapted to certain habitat characteristics found across the landscape. Fine-scale, aquatic-related habitats include bogs, fens, springs, and seeps. Certain plant species and communities will be found at various abundances within these water-related habitats. Certain species may be unique to these habitats and to no other. A spring is a flow of water above ground level that occurs where the water-table intercepts the ground surface. Where the flow from a spring is not distinct but tends to be somewhat dispersed, the flow is more correctly termed a "seep" (Allaby 1994). Springs and seeps are found throughout the Rock Creek study area. There are many reasons for ground water levels to be lowered below the ground surface. Climatic change inducing drought, seismic shifts, natural or human-caused disturbance, even over-use by wildlife can alter the spring/seep habitat and may change the habitat altogether. Plant species presence, absence, and/or abundance can also be altered when this happens. Some species will cease to exist in the area as a result of significant spring/seep habitat change.

Habitat Fragmentation

Land management activities, such as timber harvest and road building, divide vegetative communities and habitats. This phenomenon, referred to as fragmentation, leaves forested habitat as patches or islands of varying size and isolation (Harris 1984), resulting in the loss of effective wildlife habitat and biological diversity for species needing large unbroken tracts of forests (ibid.; Wilson 1988).

Forested areas are fragmented in the study area. Forty-seven miles of roads in the Rock Creek drainage have dissected wildlife habitat and interrupted wildlife travel corridors (see Chapter 3 Threatened and Endangered Species section on grizzly bear for open-road densities). Forest Service timber compartment 711 in the Rock Creek drainage has had 22 percent of its forested area disturbed by partial cutting, thinning, or clearcutting. Additional private lands in the Rock Creek drainage have also been logged including the applicant's properties.

Old Growth Ecosystems

Old growth forests are complex ecosystems that develop over long periods of time. Common stand attributes may include: multiple forest canopies, large standing live trees, large standing dead trees, downed logs or woody debris, thick duff layer, rot or decaying forces, and the ability of the stand to moderate weather conditions. Old growth can be defined by specific attributes of tree age, size class, cover type and so forth.

TABLE 3-28
Representative Plant Species by Dominant Vegetation Type and Lifeform Class[1]

Vegetation Type	Lifeform Class			
	Trees	**Shrubs**	**Forbs**	**Graminoids[2]**
BASELINE STUDY				
Artificial Opening (56/12%)[3]	Lodgepole pine Western white pine	Pacific blackberry	Wild carrot Spotted knapweed	Common timothy Canada bluegrass
Douglas-fir/mallow ninebark (66/11%)	Douglas-fir Lodgepole pine	Rocky Mountain maple Creeping Oregongrape	Bracken Spreading dogbane	Pinegrass Columbia brome
Grand fir/beadlily (79/2%)	Douglas-fir Western larch	Blue huckleberry White spirea	Bracken Western goldthread	Northwest sedge Rough leaf ricegrass
Western red cedar/beadlily (99/30%)	Lodgepole pine Western red cedar	Western twinflower Pacific blackberry	Western goldthread Bracken	Columbia brome Pinegrass
Western red cedar/devil's club (41/2%)	Western hemlock	Rocky Mountain maple Devil's club	Coolwort foam flower Lady-fern	Tall trisetum Dewey's sedge
Western hemlock/beadlily (145/41%)	Western hemlock Western red cedar	Western twinflower Pacific blackberry	Bracken Beargrass	Pinegrass Northwest sedge
EVALUATION ADIT STUDY AREA				
Mountain hemlock/rusty menziesia (27/<1%)	Mountain hemlock Subalpine fir Grouse whortleberry	Rusty menziesia Blue huckleberry	Beargrass	minor component
Scree/shrubfield (13/<1%)	minor component	Rusty menziesia	Beargrass	minor component

Source: Scow, Culwell, and Larsen 1987.

[1] Study area = 2,017 acres.

[2] Grasses, sedges, rushes

[3] First number indicates total number of plant species identified in the community type; second number indicates percentage of the total area proposed to be disturbed (Alternative II) that is occupied by the community type.

Note: Other community types identified include western red cedar/oak fern, western red cedar/lady fern, western hemlock/wild ginger,* western hemlock/oakfern,* Douglas-fir/common snowberry, Douglas-fir/scree, subalpine fir/beadlily, and unvegetated or disturbed areas; these types, combined, comprise <3% of the study area.

* indicates <1% would be disturbed.

Forty percent of the 373 wildlife species estimated to occur in the Northern Region of the Forest Service are thought to use old growth forests for feeding and/or reproduction (Harger 1978 *In* Warren 1990) and more than 50 animal species on the KNF are known to prefer old growth forest habitats (U.S. Forest Service KNF 1987). Loss of old growth ecosystems results in a loss of biodiversity.

This document differentiates between two types of old growth. The first is functional, or effective, old growth. This is old growth that functions as an ecosystem for those wildlife species that depend on them. The second is old growth that has been designated in the Forest Plan as MA 13. Forest Plan MA 13 old growth is intended to serve the same function as effective old growth. It differs in that it was defined by the Forest planning process based on stand attributes over the majority of a stand. The outlines of a stand may not be the same as those defined by effective old growth. There is no Forest Plan standard for defining “effective” old growth. For those compartments with less than 10% old growth, the stands closest to old growth in attributes were selected to be managed under Forest Plan MA 13 for future old growth and are called replacement old growth.

All stands in Compartment 711 that meet the Kootenai National Forest’s definition of MA 13 old growth, including some stands that are considered as replacement old growth, have been considered as old growth for Forest Plan MA 13. This is because there is less than 10% old growth available.

Effective old growth stands contain the large, old trees of old growth, but are also configured so that they function as old growth for old growth dependent species. Stands less than 25 acres in size were not considered effective old growth for this analysis (pers. comm. Lisa Fairman with Sandy Jacobson, U.S. Forest Service, July 29, 1997). Effectiveness is species specific in its effects, that is, some species can use small, narrow stands effectively, whereas others cannot. The minimum size of an old growth stand required by old growth dependent species depends on: the habitat needs of each species, the type and quality of the old growth stand, and the nature of the adjoining landscape.

Adjacent landscapes can modify the effectiveness of old growth stands. This phenomenon, referred to as edge effect, can reduce habitat effectiveness to a point that a stand no longer functions as an old growth ecosystem.

In addition to the stand size, shape, and juxtaposition, the amount of old growth habitat in a drainage is important to long-term viability of old growth dependent species. It is estimated that, at a minimum, 8 to 10 percent of a drainage needs to be effective old growth to meet these biological needs (Christensen and Kuennen 1984; p. 9).

Compartment 711 has limited old growth habitat (see Table 3-29 and Figure 3-19). Forest Plan old growth management, as related to the KNF forest plan, is discussed under Forest Plan. Thirteen blocks of old growth stands and five blocks of replacement old growth stands were identified on NFS lands (see Figure 3-19). Habitat for old growth dependent species that require stand size greater than 100 acres is scarce in this compartment. Seven percent of the drainage is old growth habitat, below the biological minimum.

TABLE 3-29
Summary of Existing Old Growth (OG) and Replacement Old Growth (ROG) Acreage Designated as MA 13 in Timber Compartment 711[1]

Block Number	OG	ROG
1	43	0
2	0	191
3	38	0
4	51	0
5a	72	0
5b	23	0
5c	0	247
6	32	0
7	104	0
8	96	0
9	22	0
10	23	0
11	54	0
12a	70	0
12b	0	70
12c	0	35
13	404	0
14	0	107
Total Acreage	1032	650
Percent of Rock Creek Compartment 711[2]	7.4	4.6

Source: U.S. Forest Service KNF 1997
Notes:
1 Old Growth Emphasis Areas 8, 9, and 10 are in MA2-OG Semi-primitive Non-motorized Recreation
2 Total area in Rock Cr. Compartment 711 is 14,029 acres.

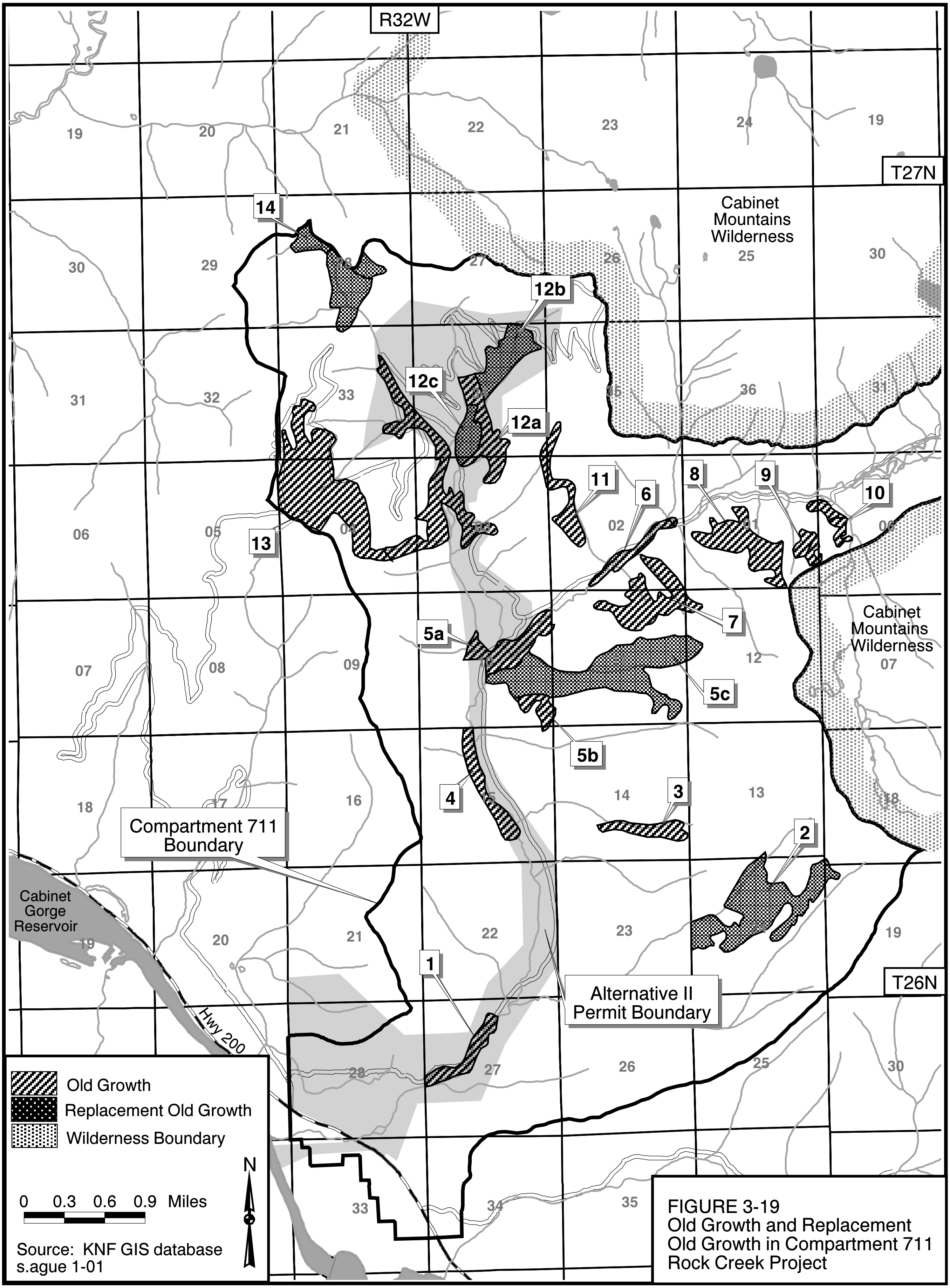


FIGURE 3-19
Old Growth and Replacement Old Growth in Compartment 711
Rock Creek Project

Compartment 711 currently has 867 acres of effective old growth, based on the assumption that a stand of 25 acres or less is completely modified by edge. The blocks currently have reduced effectiveness because of the presence of roads and their rights-of-way, and the small size of some blocks. The ability of the Rock Creek drainage to sustain, over time, viable local populations of diverse old growth dependent species is unlikely. Since the majority of the age class of the compartment (85%) is immature sawtimber or mature sawtimber, old growth will return to the compartment but would not age fast enough to be a factor for the life of the project.

Old growth dependent avian species observed or expected to occur include Vaux's swift, brown creeper, varied thrush, Townsend's warbler and nesting pileated woodpeckers. The northern goshawk was observed on five occasions, three of which were in old growth stands. Old growth associated mammals observed or suspected to occur include northern flying squirrel, red-backed vole, marten, and fisher.

Wildlife Species

Wildlife Species in General

Aspects of biodiversity that are discussed in this section include sensitive wildlife, management indicator species, and other selected wildlife groups. The Rock Creek area has a variety of communities and landscape features that provide diverse habitat for numerous species (see Table 3-30). Not all species known to occur in the Rock Creek drainage are discussed in the following accounts, including several species of special concern. The following species or groups are discussed because there is a policy need to do so (regardless of expectation of project-related impacts), such as sensitive and management indicator species; or because they are of special interest to the public, such as game animals; or because there was reason to expect there may be project-related impacts, such as for reptiles and amphibians.

Sensitive Wildlife Species

Sensitive species are species identified by the Regional Forester for which population viability is a concern, as evidenced by significant current or predicted downward trends in population numbers or density and/or in habitat capability that would reduce a species' existing distribution (Forest Service Manual Section 2670.5). Only those sensitive species that may occur within or near the project area are discussed below.

Harlequin Duck. Harlequin ducks migrate inland to mountain streams during spring to nest and raise their broods. They return to coastal areas for fall and winter. Breeding harlequins have a strong fidelity to the same stream year after year (Reel, Schassberger, and Ruediger 1989; Kuchel 1977; Wallen 1989; Cassirer and Grove *In* Cassirer et al. 1993). They require solitude, are easily disturbed, and generally are not found along streams with more than occasional human activity (Reel, Schassberger, and Ruediger 1989; Clarkson *In* Reichel and Genter 1995; Cassirer and Grove 1991 *In* Reichel and Genter 1995). Harlequins usually nest in a variety of habitats close to streams (Reichel and Genter 1995). Harlequins forage for aquatic insects in fast-flowing streams.

TABLE 3-30
Wildlife With Selected State or Federal Designations That May Occur in Project Vicinity

Elk (MIS) Fisher (S; SPSC) Grizzly Bear (LT; MIS; SPSC) Lynx (LT; SPSC) Mountain Goat (MIS) Northern Bog Lemming (S; SPSC) Northern Rocky Mountain Wolf (LE; MIS; SPSC) Townsend's Big-eared Bat (S; SPSC) White-tailed Deer (MIS) Wolverine (S; SPSC)	Bald Eagle (LT; MIS; SPSC) Black-backed Woodpecker (S; SPSC) Boreal Owl (SPSC) Flammulated Owl (S; SPSC) Great Gray Owl (SPSC) Harlequin Duck (S; SPSC) Northern Goshawk (S; SPSC) Peregrine Falcon (LE; MIS; SPSC)* Pileated Woodpecker (MIS)
Coeur d'Alene Salamander (S; SPSC) Tailed Frog (SPSC) Northern Leopard Frog (S) Boreal Toad (S)	

Designation Codes:

SPSC = State species of special concern
LE = Federally listed as endangered
LT = Federally listed as threatened
S = Designated Forest Service sensitive species
MIS = Forest Service management indicator species
P = Proposed for federal listing.
* = Treated as Forest Service Sensitive pending further direction.

Source: Pers. comm. Dennis Flath, MDFWP, with Sandy Jacobson, USFS, June 27, 1998; Reichel and Flath 1995; USFS Kootenai National Forest Bird Checklist, 1995.

The number of harlequin ducks has been declining (Cassirer et al. 1993). The harlequin duck's status is considered tenuous in the contiguous United States with geographically disjunct subpopulations.

Interacting individuals using several breeding streams are considered a subpopulation. One of these groups or subpopulations occurs in the lower Clark Fork drainage in the Noxon/Trout Creek area. Rock Creek is one of the four streams in the lower Clark Fork drainage that supports breeding harlequins. The lower Clark Fork subpopulation is estimated to have a maximum of 15 breeding pairs. Three of these pairs are found on Rock Creek.

The existing condition for harlequin ducks as presented in the draft EIS is generally confirmed by new information. Populations are estimated to have changed from 120-150 breeding pairs to 110-159 in Montana, and from 50 to 48-70 breeding pairs in Idaho (Reichel 1996b). In Montana, 102 streams are considered breeding streams or possible breeding streams, with 33 streams having known or probable breeding occurrences (ibid.).

Monitoring and inventory of the lower Clark Fork subpopulation continues to show a small but apparently stable breeding group. This information is important because it helps to determine which areas of Rock Creek are most important for nesting harlequins and what areas are most prone to disturbance.

A proposed Harlequin Duck *(Histrionicus histrionicus)* Conservation Assessment and Strategy for the U. S. Rocky Mountains (Cassirer et al. 1996) (hereafter, referred to as the Harlequin Duck Conservation Strategy) has been produced. The proposed Harlequin Duck Conservation Strategy provides an overview of the status of harlequin ducks in the Rocky Mountains. This overview provides context for the effects analysis that follows in Chapter 4, particularly with reference to the threats to the species in other areas of its range. These include threats on wintering range. It also suggests methods to avoid adverse effects on harlequins from several types of human activities, such as mining. The Harlequin Duck Conservation Strategy identifies suspected or known limiting factors to harlequins as disturbance, hunting pressure, loss of habitat from development or commodity uses, water quality degradation, and high site fidelity and tendency to not disperse long distances. Several of these factors are operative in the lower Clark Fork subpopulation, as well as naturally intermittent stream flows on Rock and other creeks.

The Literature Review (Reichel 1996b) summarizes all the known research to date of harlequin ducks throughout its range. This information is important because it assists in determining the effects of diverse activities on harlequin ducks.

A panel of harlequin duck biologists was convened in December 1996 to review the possible effects of the project on harlequin ducks and to consider project design features or mitigations to minimize project effects to harlequins.

Fisher. The fisher feeds on a variety of prey from small to medium sized mammals, birds, and carrion (Powell *In* Ruggiero et al. 1994).

In the western United States, fishers prefer late-successional forests (mature or old growth forests) and low elevation, moist riparian corridors for resting, denning, and travel (Heinemeyer and Jones 1994). An assortment of habitats are used for feeding. They avoid non-forested areas (Jones, Jones and Garten, and Roy In Ruggiero et al. 1994). Some suitable habitat for fishers is found within Rock Creek drainage and in the project area. The low-elevation moist and riparian sites along Rock Creek and old growth and mature forested stands supplies some preferred habitat. The quality of fisher habitat in the Rock Creek drainage has been compromised due to forest fragmentation, loss of old growth habitat, and the occurrence of roads near riparian zones.

In the western United States, fisher populations are limited to selected mountain ranges in the Pacific northwest and Rocky Mountains. These isolated populations may be acutely susceptible to local extinction (Heinemeyer and Jones 1994). Fishers, generally, are more common where human density is low and human disturbance is reduced (Ruggiero et al. 1994).

Fishers once occurred in the Cabinet Mountains but were eliminated locally by overtrapping and habitat alteration (ibid.). A recent re-introduction program to restore the fisher the Cabinets has met with limited success (ibid.). The current population of fishers in the Cabinet Mountains is unknown. During a study of the transplanted fishers, Heinemeyer (*In* Heinemeyer and Jones 1994) found that fishers use Rock Creek drainage, and appear to select for coniferous riparian habitats adjacent to creek.

Since the draft EIS, substantial new information has been compiled for fisher habitat in the Kootenai National Forest. A forest-wide habitat assessment using satellite imagery determined that fisher habitat was widespread over the forest but not abundant. This assessment determined that the Cabinet Ranger District contained approximately 20% of the KNF's fisher habitat at 59,959 acres. The project area and its vicinity are well-represented with fisher habitat, although there are no very large blocks of contiguous habitat.

Fishers are capable of long movements over a short period of time (Weckwerth and Wright 1968, *In* Johnsen 1996, p. 979). The KNF fisher analysis concluded that no area of the forest appears to be isolated. The natural or manmade features such as large lakes and highways that have the potential to be movement barriers have suitable fisher habitat on both sides of them. Migration corridors to other geographic areas appear to be intact (Johnsen 1996). The analysis of the potential for movement across barriers is important with fishers because they may be hindered by roads, including roads in the project area.

Northern Goshawk. Northern goshawks are large migrant or semi-resident birds of prey that typically use large trees for supporting bulky stick nests. Nest stands usually have a high canopy cover to provide disturbance and thermal cover to nesting birds. While they prefer older forests to support their nests, they forage in older stands and around the edges of forest openings. They prey on several species of birds and mammals, particularly grouse and snowshoe hare in the northern Rockies (Johnsgard 1986, p. 116). Goshawks surprise their prey while weaving through the forest, and are unable to capture prey if forest floor vegetation is too dense.

Northern goshawks are aggressive birds that are prone to disturbance during the nesting season. Although they will vigorously defend their nests, excessive disturbance can cause abandonment of the nesting attempt, and sometimes of the territory itself. Moderate to heavy use along forest roads is likely to reduce suitability of adjacent habitat because of disturbance.

Forestwide, northern goshawks are present in every planning unit, including the one containing Rock Creek Compartment 211. An estimated 752,296 acres of nesting habitat and 670,016 acres of foraging habitat occur forest-wide.

An analysis of stands capable of supporting nesting goshawks in Compartment 211 indicates that there are approximately 6,073 acres of stands capable of providing suitable goshawk habitat. Of these capable acres, approximately 704 acres (12%) are currently suitable. Currently suitable habitat in the compartment occurs in several forest types, including ponderosa pine, cedar, and Douglas fir. Two stands totaling 35 acres are probably too isolated to provide a suitable sized nesting stand. An additional 94 acres are adjacent to or are very near existing roads, which reduces their ability to function as nesting habitat, and to a lesser extent as foraging habitat. It is likely there are more suitable stands in the compartment, because the model does not count stands that have no stand exams, however it is unlikely that a significantly greater amount occurs because of the high elevation and steep slopes in the compartment.

No known territory occurs in Compartment 211. At least one territory is suspected because of the presence of territorial birds.

Peregrine Falcon. The proposed project area is part of the Rocky Mountain/Southwest population recovery zone (USFWS 1984: p. vi). The recovery goals for this population are: 1) a minimum of 183 breeding pairs and 2) sustaining a long term average production of 1.25 young per pair per year (ibid, pg 20). Presently there are 529 pair in the recovery zone (24 of them in Montana) (pers. comm. Dennis Flath, MFWP, June 16, 1998) with an average production of 1.4 young per pair. The peregrine falcon is considered a migrant and potential resident in the lower Clark Fork valley. There are two confirmed sightings (1993 and 1994) approximately 4 air-miles south of the proposed Rock Creek tailings impoundment.

A historic aerie (nest) is located just across the state line in Idaho. Attempts are being made to reintroduce peregrines at that site. In 1997, a pair nested and produced young at this site and subsequently occupied with unknown success in 1998 and 1999.

An important component of peregrine falcon habitat is the availability of tall cliffs (greater than 200 feet) for nesting (USFWS 1984: p. 7). The Peregrine Fund inventoried the Clark Fork drainage (including the Bull River) for such sites in 1989. They identified cliffs west of the Bull River as potential nesting habitat (pers. comm. Bob Summerfield, October 12, 1993). These cliffs are about 7 miles west of the project area. Hamer (1976, pg 3 and 4) identified the cliffs on Ibex and Scotty peaks as possible nesting habitat. These sites are about 12 air miles north of the project area. Potential nesting habitat is also present on the cliffs near Tuscor Hill (4 air miles south). Marginal cliffs (less than 200 feet tall) are found on the south side of Government Mountain (1 mile west). There are no suitable nesting sites in the proposed project area.

An acceptable prey base (waterfowl and small birds) for peregrines exists on the Cabinet Gorge and Noxon reservoirs and the surrounding sloughs and wetlands.

Wolverine. The wolverine is a very secretive animal generally associated with remote areas (Hash 1987). They have large home ranges. A scavenger and effective predator, the wolverine is an opportunistic feeder taking a wide variety of food (Hash 1987). Habitat requirements for wolverine appear to be "large isolated tracts of wilderness supporting a diverse prey base, rather than specific plant associations or topography" (Banchi *In* Butts 1992). A potential movement corridor has been identified in the area between Noxon dam and the Noxon town site. This requirement for a large home range may be more related to the maintenance of the male's multiple pair bonds than to forage requirements (pers. comm. Jeff Copeland, with Sandy Jacobson 1996).

The decline of the wolverine population during the late 1800s and early 1900s in the continental United States has been attributed to overtrapping and habitat degradation. This continues to threaten wolverine recovery. The wolverine is protected from harvest as a furbearer in all the lower 48 states except Montana. Wolverine densities are low (Butts 1992) and widespread in western Montana (Hash 1987).

Habitat for the wolverine is present in the project area and adjacent CMW. The solitary nature of wolverines results in few sightings of this animal. A recent sighting of a wolverine in Rock Creek in 1993 (pers. comm. Harvey Nyberg, Department of Fish, Wildlife and Parks, with Lisa Fairman, OEA, June 10, 1994) and fresh wolverine tracks observed during the wildlife baseline study (Farmer and Heath 1987 *In* ASARCO Incorporated 1987-1997) suggest that wolverines use the Rock Creek drainage as part of their range.

New information collected on wolverine since the draft EIS is pertinent to the project. The conclusion of a major study on wolverines in central Idaho has provided important information on wolverine denning habitat needs and sensitivity to disturbance at different parts of their life cycle (Copeland 1996). The Kootenai National Forest has mapped wolverine habitat based on this recent work. Over the KNF, there are 405,490 acres of wolverine habitat (11,930 acres denning, 393,560 acres general), and on the Cabinet Ranger District 66,320 acres (2,960 acres denning, 63,370 acres general).

While wolverines appear to be relative generalists in habitat selection, female wolverines use habitats with quite readily definable natal den characteristics in Idaho. These were high elevation, snowy cirque basins, where they could dig through deep snow for protective cover for their young. Female wolverines were very sensitive to disturbance during this period. The higher selectivity of denning sites implies that wolverines are limited by denning habitat. The habitat suitability mapping completed by the KNF corroborates this, with only 3% of the total suitable wolverine habitat being denning habitat. Denning habitat is widespread at the highest elevations on the KNF, but not common except in certain areas. The CMW is a long connected stringer where denning habitat is common. There is no suitable denning habitat within the project area.

Wolverines in non-maternal portions of their life cycle appeared to avoid human activities or roads less than reproductive females. In some cases they appeared nearly indifferent to it. This indifference placed them in precarious situations because it exposed them to hazards associated with developed human activities. Mortality can occur in various ways, including highway collisions, encounters with domestic dogs, or shooting or trapping (pers. comm. Jeff Copeland, wildlife biologist, with Sandy Jacobson, 1997).

Townsend's Big-eared Bat. The Townsend's big-eared bat uses a variety of habitats. Key components of their habitat are caves and abandoned mine tunnels which they use for winter roost and nursery sites. During the summer, tree cavities, abandoned buildings, and bridges are also used as roost sites. The bats forage for insects, their main diet item, in a variety of areas. Wetlands and moist sites are productive foraging areas for bats, as they produce an abundance of insects. Winter and primary nursery habitat is not known to occur in the project area. Summer and foraging habitat is present throughout the project area.

The status of Townsend's big-eared bat in Rock Creek drainage is unknown. Surveys for the bat have not been conducted in this area, however, unknown species of bats are known to occur.

Since the draft EIS was written, further information pertinent to the project has been obtained. A draft Conservation Strategy was completed for the state of Idaho in 1995 (Idaho Dept. of Fish and Game et al. 1995). This strategy indicates that the analysis of existing condition in the draft EIS is appropriate.

Black-backed Woodpecker. Black-backed woodpeckers are often associated with recently burned or insect-infested coniferous forests, though they do occur in a variety of other habitats. Habitat for the black-backed woodpecker is present throughout the project area, however, preferred areas of recent burns or insect infestations are not present at this time.

Black-backed woodpeckers were observed during the baseline wildlife studies (Farmer and Heath 1987 *In* ASARCO Incorporated 1987-1997). The current population is unknown.

Coeur d'Alene Salamander. Coeur d'Alene salamanders are found in three general habitats; spring seeps, waterfall spray zones, and streamsides of small cascading creeks (Reel, Schassberger, and Ruediger 1989). Incidental searches for Coeur d'Alene salamanders during the wildlife baseline study did not reveal any individuals, although the presence of tailed frogs indicates some suitable habitat was probably covered (Farmer and Heath 1987; p. 213 *In* ASARCO Incorporated 1987-1997).

Since the draft EIS was written, a habitat suitability model for the Coeur d'Alene salamander has been produced (Allen 1996). The model predicts that limited salamander habitat occurs within the project area, within landtypes 103, 108, 404, 408, 552, and 555; and along class A and Aa streams. Using these criteria based on observations in Idaho and Montana, the majority of Rock Creek is not Coeur d'Alene salamander habitat because the gradient is too low (i.e. Class B). Salamanders could also occur in areas with splash zone microhabitats. The majority of the suitable habitat is on steep tributaries to Rock Creek and most is outside of the permit boundary.

Flammulated Owl. Preferred habitat for the flammulated owl, mature or old growth ponderosa pine stands, is rare to absent in the Rock Creek drainage. Mature or old growth Douglas-fir stands are also thought to provide habitat for the owl (Reel, Schassberger, and Ruediger 1989) but these types of stands do not occur within the permit area. The status of flammulated owls in Rock Creek is unknown but is very unlikely this species occurs within or near the proposed permit area because of lack of suitable habitat.

Northern Bog Lemming. Bog lemming habitat is considered to be sedge-alder bogs and spruce-fir or lodgepole forests (Hoffman and Pattie 1968). The closest known habitat occurs at Rock Creek Meadows in the East Fork of Rock Creek. Surveys conducted in this area in 1992 did not reveal the presence of bog lemmings (pers. comm. Jim Reichel, Montana Natural Heritage Program, with Lisa Fairman, March 20, 1995). However, the lack of findings is not conclusive of absence of lemmings. Occurrences of northern bog lemmings in Montana are rare.

Boreal Toad. Boreal toads are habitat generalists, occupying a wide range of habitat and cover types. They are common and widespread, but declining in both numbers and distribution. This decline has lead to their recent listing on the Forest Service's sensitive species list. Their most restrictive habitat need is standing water persisting long enough to allow time for tadpoles to metamorphose (pers. comm. Steve Corn, USGS, with Sandy Jacobson, March 1999). No boreal toads were located during the baseline study (Farmer and Heath 1987 *In* ASARCO Incorporated 1987-1997), however, it is likely that they occur in some locations in the permit area. Suitable breeding habitat occurs not only in several wetlands within the study area, but also in smaller bodies of water such as along ditches and in temporary puddles. Flath indicates this species has widely declined in Montana even where water quality is not an issue (pers. comm. D. Flath, MDFWP, with Sandy Jacobson, June 27, 1998).

Northern Leopard Frog. This species has been recently added to the Forest Service's sensitive species list because of widespread declines in population numbers and distribution. The leopard frog, common in many parts of North America a few decades ago, is now suffering wide-spread localized extinction. The sighting of leopard frogs during the baseline study may represent one of the last reports of the frog in west central and northwestern Montana (pers. comm. Jim Reichel, Montana Natural Heritage Program, with Lisa Fairman, June 8, 1995). This species was located outside the proposed permit area along the shoreline and backwaters of Cabinet Gorge Reservoir (Farmer and Heath 1987: p. 213 *In* ASARCO Incorporated 1987-1997). Habitat for northern leopard frogs does not occur within the permit area itself.

Forest Service Management Indicator Species

KNF has identified eight wildlife species that are used to monitor the effects of planned management activities on wildlife habitat and/or species. Four of these species -- mountain goat, elk, white-tailed deer, and pileated woodpecker -- are discussed here. The others are addressed in the Threatened and Endangered Species section.

Mountain Goat. Mountain goats are the selected indicator species for alpine habitat and animals. They are highly specialized for rugged alpine habitats. Goats traditionally use the same areas year after year, rarely exploring new territory. Habitat use information and traditional use patterns are learned behaviors passed to offspring.

Historic population numbers were estimated to be 305 goats in the East Cabinets in 1950 (Casebeer, Rognrud, and Brandborg 1950) declining to estimates of 56 to 78 in 1980 (Joslin 1980). Populations are currently thought to be stable (pers. comm. Jerry Brown, MDFWP, with Sandy Jacobson, June 23, 1997).

Goats in the East Cabinets occur in three general concentrations, one of which is referred to as the Rock Peak herd. Goats of the Rock Peak herd use a key winter range near Rock Creek Meadows (Figure 3-20). These goats are suspected to move up to 12 miles to summer/transitional ranges. Only a few important winter ranges were identified in Joslin's study. Key summer/transitional range, more abundant than winter range, extends along the Cabinet divide and associated ridges and basins (see Figure 3-20).

Goats observed in drainages on the east side of the Cabinets are likely some of the same goats that use habitat located on the west side, including the Rock Creek Meadows winter range (ibid). Goat use of Saint Paul and Chicago peaks was much reduced during mineral explorations that occurred in the early- to mid-1980s. Current use has apparently recovered from the exploration period (ibid).

As part of the mountain goat study, Joslin further classified winter and summer/transitional ranges as Management Situations 1, 2, or 3 and developed a goat management plan for the Cabinet Mountains (see Figure 3-20). Goat Management Situation 1 is defined as critical habitat with documented current or recent use by goats. Goat Management Situation 1 ranges are most sensitive to habitat manipulation and human activity. Activities in or near these areas should be avoided and if unavoidable should only occur for short durations (Joslin 1980). Goat Management Situation 2 ranges provide suitable habitat but have infrequent sightings of goats; no Situation 2 range is present in the project area. Historic use may have occurred. Goat Management Situation 3 is considered important for travel corridors.

The permit area includes portions of Situation 1 and Situation 3 summer/transitional range, and is within two miles of Situation 1 winter range. Most of the Situation 3 summer/transitional range is within low quality mountain goat habitat because of the densely timbered stands, and would probably not be used for travel corridors (pers. comm. J. Brown, June 23, 1997). While mountain goat sightings are common in the Situation 1 summer and winter ranges, no observations are on record for the Situation 3 summer range within the permit boundary(pers. comm. B. Haflich, October 8, 1997).

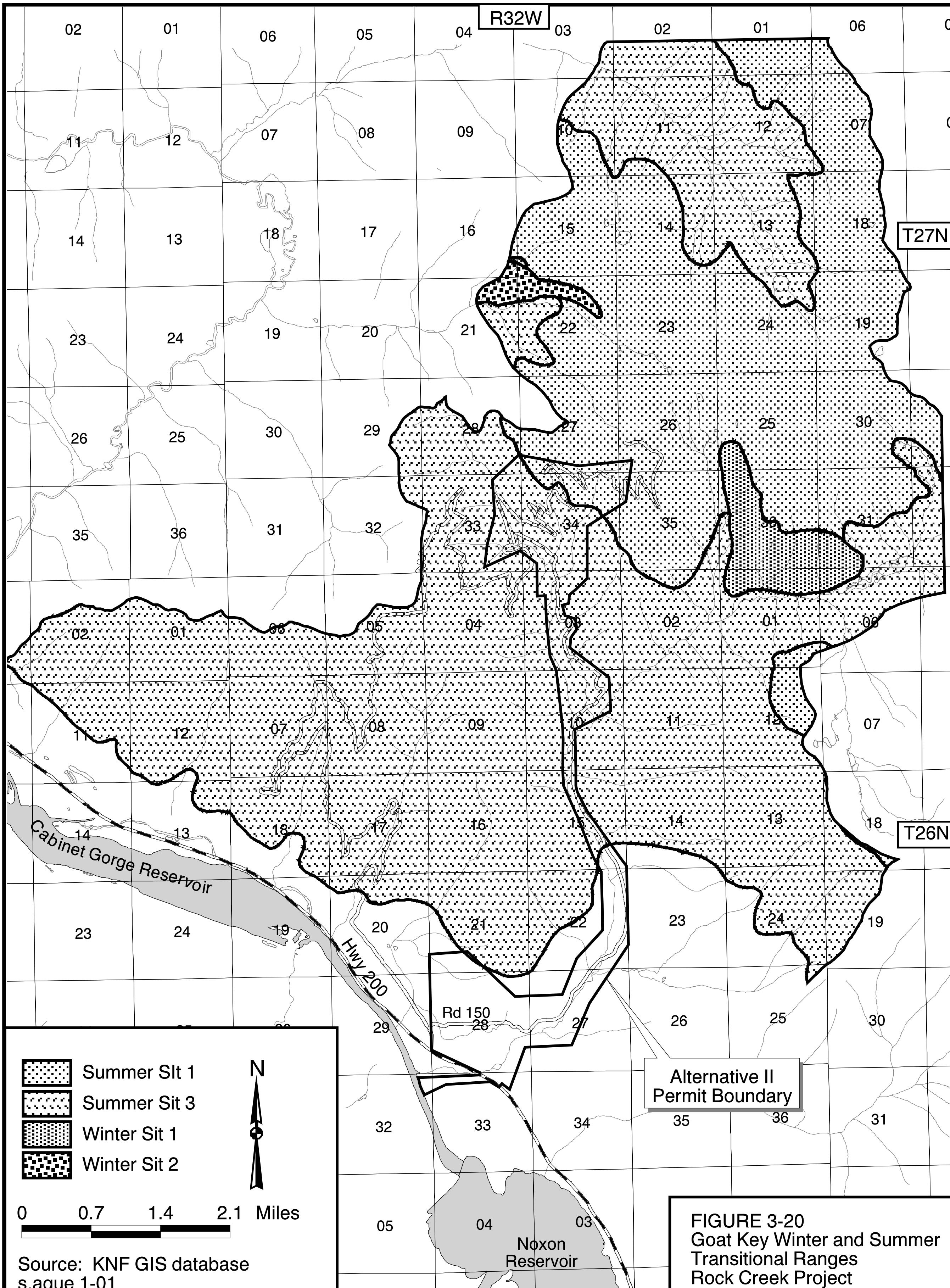


FIGURE 3-20
Goat Key Winter and Summer Transitional Ranges
Rock Creek Project

Elk. Elk, a KNF indicator species for big game, use a diversity of habitats found within the proposed permit area and project vicinity. Use occurs year-round but is less during the winter. Surveys conducted in the Rock Creek area including Basin, Copper, and McKay creeks, and Government and Green mountains, over a 9-year period by MFWP, show an average spring herd size of 114 elk (Sterling 1994).

Green Mountain/McKay Creek area and the Pillick Ridge area are elk winter ranges (see Figure 3-21) (Farmer and Heath 1987 *In* ASARCO Incorporated 1987-1997). Cows, calves, and young bulls primarily were observed using these areas. Older bulls tended to winter in small groups in areas found between Miller and lower Rock Creek; at the confluence of the west and east forks of Rock Creek, between lower Basin Creek and lower Copper Gulch; and below Chicago Peak (ibid.).

Potential elk summer range exists throughout the project vicinity. Open road density is currently at 0.96 miles per square mile, higher than biologically sound levels.

White-tailed Deer. White-tailed deer, also a KNF management indicator species for big game, frequently are observed in the proposed project area. White-tailed deer, generally found in lower elevations than mule deer, primarily occur at lower elevations than the confluence of Rock and Engle creeks. Concentrations were observed between Miller Gulch and Rock Creek (see Figure 3-21) (ibid.). A variety of habitats are used by these deer.

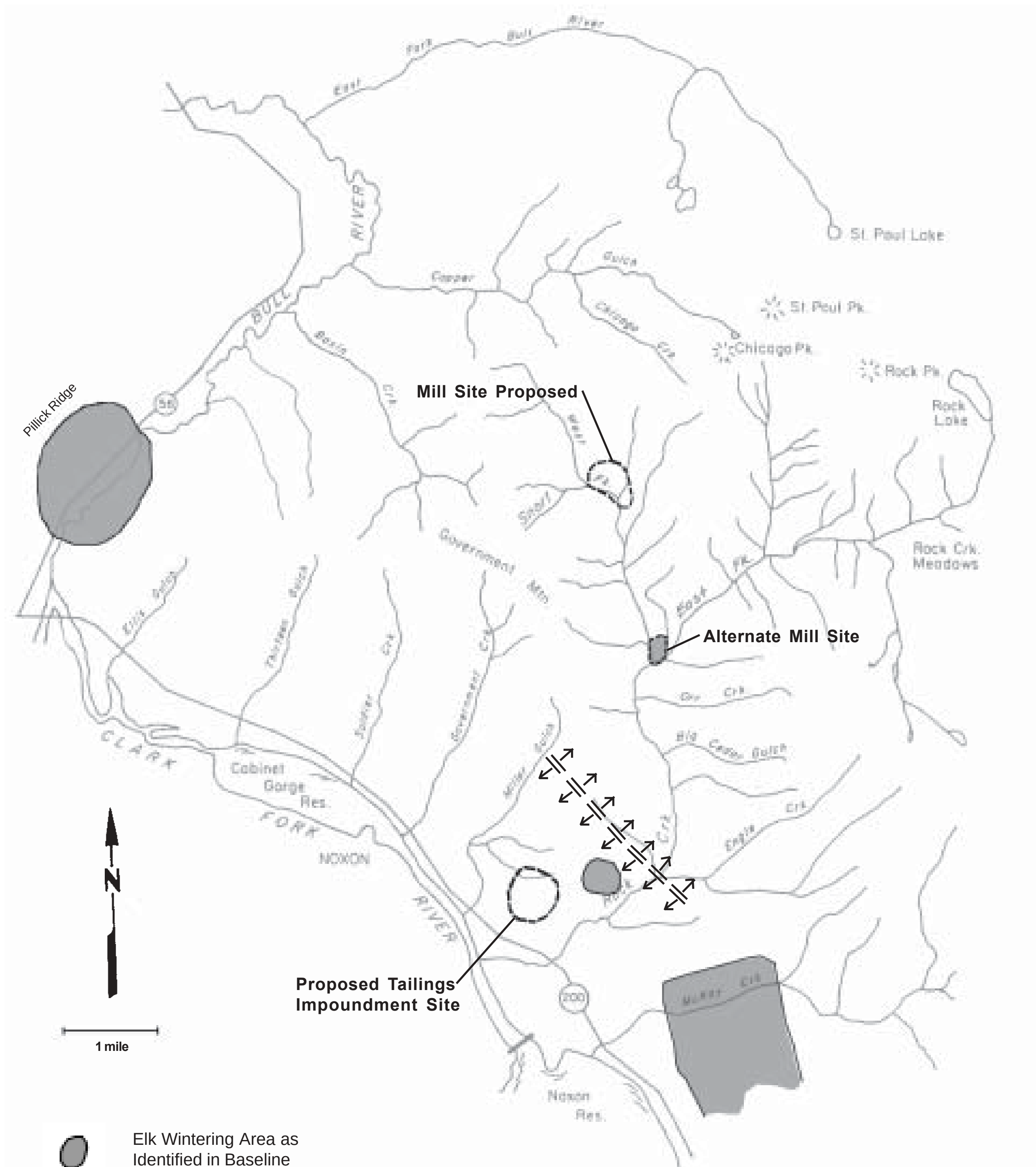
Winter distribution of white-tailed deer appears to be controlled by snow depth and elevation. Identified winter ranges occur in low elevation drainage bottoms (primarily below 2,500 feet) along the Clark Fork River Valley. Winter ranges have not been identified in the Rock Creek drainage. Data indicate that populations of white-tailed deer in the early 1990s may be at a high.

Pileated Woodpeckers. Pileated woodpeckers are an indicator species for snags and old growth habitat. Population estimates for the Rock Creek area are unknown. During baseline surveys, Farmer and Heath (1987 *In* ASARCO Incorporated 1987-1997) identified one active nesting territory in Rock Creek and considered the woodpecker to commonly occur. Nesting habitat for the pileated woodpecker in Compartment 711 is limited by the existing low quantities of old growth.

Other Species of Interest

Boreal Owl. Boreal owl habitat, high-elevation, mature spruce/subalpine fir communities, is not common in Compartment 711. Within the area affected by any action alternative, 4 acres of marginally suitable boreal owl habitat occurs at the evaluation adit. The stand is marginal because of forest cover type and age class. As the stands in Compartment 711 age, suitable habitat will increase over time. Compartment 711 may have inadequate acreage in appropriate age classes to support boreal owls. Lands found within the adjacent CMW may provide suitable habitat, but inventories have not been completed. The status of boreal owls in the Rock Creek area is unknown. Surveys conducted in Orr and Cedar gulches in 1993 did not reveal the owl (U.S. Forest Service KNF 1993). However, lack of responses to calls during the surveys is not conclusive evidence of absence.

Black Bear. Black bears occur throughout the study area (ibid.). Population densities are estimated to range from 2.8 to 8.6 square km. per bear (Kasworm and Manley 1988). Black bears use a diversity of habitats, often varying use by season.



Elk Wintering Area as Identified in Baseline Study

General Elevation Boundary Between White-tailed Deer and Mule Deer Ranges (White-tailed = lower elevation Mule = higher elevation)

SOURCE: Kootenai GIS Database

FIGURE 3-21
Big Game Ranges
Rock Creek Project

Mule Deer. Mule deer are another commonly occurring big game species in the Rock Creek area. Mule deer occur in the project area during the summer primarily above the confluence of Engle and Rock creeks (see Figure 3-21) (Farmer and Heath 1987 *In* ASARCO Incorporated 1987-1997). Winter range is not thought to occur within the project area. Likely nearby wintering areas occur on south or west-facing slopes in Copper Gulch and McKay Creek. Population estimates or trends are not available.

Moose. Moose habitat is common in the project vicinity. While riparian habitats along Rock Creek provide quality habitat, the local moose population is thought to be low (ibid.).

Mountain Lion. Mountain lions occur throughout the project area. Current population numbers are unknown. During 1992, two lions were harvested from Rock Creek and during 1993, three were harvested from the general area (pers. comm. Bruce Sterling, MDFWP, with Lisa Fairman, June 15, 1994).

Selected Wildlife Groups

Furbearers and Small Mammals. Furbearers, such as coyotes, bobcats, martens, weasels, minks, and otters all occur within the proposed project area and use a variety of habitats. No population estimates are available for these species. Martens are often associated with mature forests. The small mammals are abundant. River otters and minks primarily use riparian and riverine habitats, such as those along Rock Creek and Clark Fork River.

Birds. Farmer and Heath (1987 *In* ASARCO Incorporated 1987-1997) estimated that 159 bird species may occur in the area. The highest bird diversity occurred in coniferous forests, and the second highest occurred in water-associated habitats.

Many of the birds in the Rock Creek area are neotropical migrants (birds that summer in northern climates and migrate to Central or South America to winter). The general status of neotropical migrant populations in western U.S. forested areas is thought to be mostly stable (pers. comm. Terry McEneaney, Yellowstone National Park, with Lisa Fairman, March 21, 1995).

Numerous raptor species nest and forage throughout the study area.

Two upland game birds, ruffed and blue grouse, commonly occur within the proposed project area.

Amphibians and Reptiles. Eight species of amphibians are likely to occur in the study area (Farmer and Heath 1987 *In* ASARCO Incorporated 1987-1997). The tailed frog and spotted frog have experienced declines elsewhere, but they are considered common in suitable habitat in western Montana (Reichel and Flath 1995). Two species were located during the baseline study within the proposed permit area: long-toed salamanders and tailed frogs.

Eight species of reptiles are known to or may occur in the study area. Five of these species were identified during the baseline study: painted turtles, northern alligator lizards, rubber boas, western garter snake, and the common garter snake.

Population estimates for these amphibian and reptile species are not known. Global and regional populations indicate a downward trend of many species (Koch and Peterson 1989).

THREATENED AND ENDANGERED SPECIES

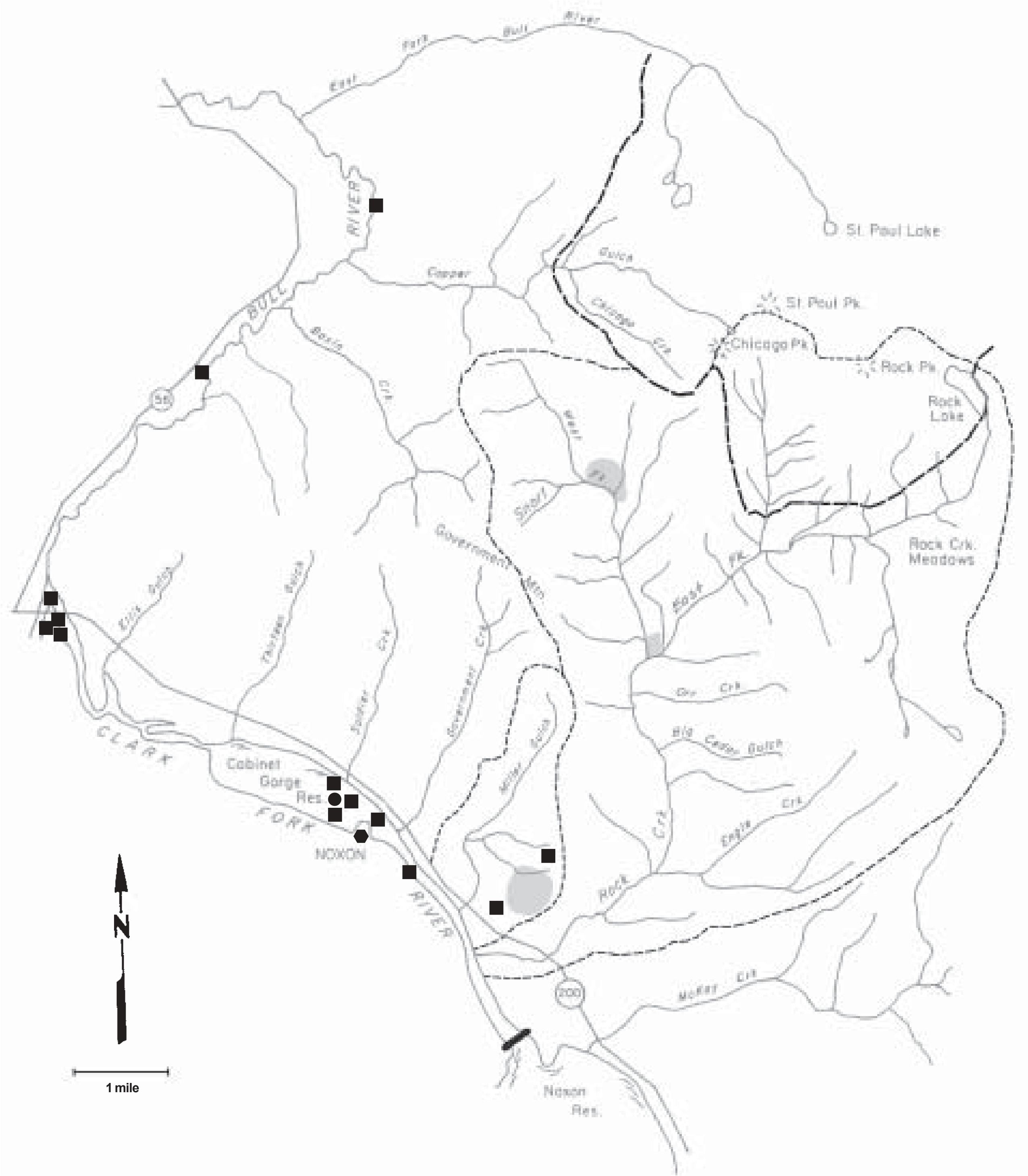
Six federally listed species, under the Endangered Species Act (ESA) as amended, may use habitat in or near the proposed project site. They include the endangered bald eagle, gray wolf and the threatened grizzly bear, bull trout, lynx, and water howellia (McMaster 1998b). These six species are also addressed in the Biological Assessment in Appendix B.

Bald Eagle

The bald eagle population in the Clark Fork River Valley is covered under the Pacific Bald Eagle Recovery Plan (USFWS 1986). The population recovery goals for the entire Pacific Bald Eagle population are: 1) 800 nesting pair; 2) 80% of recovery management zones meet zone breeding population recovery goals; 3) average reproductive rate of 1.0 fledged young per pair, with an average success rate per occupied site of not less than 65%; and 4) stable or increasing wintering populations (USFWS 1986). Currently (1997 data) there are 1,379 nesting pairs in the population (pers. comm. Karen Steenhoff, Pacific Bald Eagle Recovery Coordinator, June 24, 1998). Breeding population recovery goals are currently met in 70% of the management zones (ibid). The reproductive rate is being achieved, as is the stable or increasing wintering population numbers (ibid).

The project planning area lies in the Upper Columbia Basin Bald Eagle Recovery Zone (Zone 7 - NW Montana and the Idaho Panhandle) (USFWS 1986; p. 7 and 29, and MBEWG 1994: p. 9-10). The recovery goals (USFWS 1986; p. 27-30) for this portion of the Pacific population are: 1) Habitat Management Goal of a minimum of 98 territories with secure habitat; 2) Population recovery goal of a minimum of 69 breeding pair; 3) Annual production of at least 1.0 fledged young per pair, with an average success rate of occupied sites not less than 65 percent on a 5-year average; and 4) stable or increasing wintering populations. Currently, Zone 7 has 127 territories with 108 breeding pairs. The 1996 production averaged 1.2 fledged young per pair, with 74% of the occupied territories being successful (pers. comm. Rob Hazelwood, USFWS, June 9, 1998). The 5-year averages are 1.75 fledged young and 75% success rate (pers. comm. Dennis Flath, MFWP, June 15, 1998). Wintering populations have been increasing or are stable (ibid).

Bald eagles use the Clark Fork River corridor year long. Harms (1992) provided a description and maps of the areas on the Kootenai National Forest that needed to be considered as potentially suitable bald eagle habitat in conducting consultations with the USFWS. Basically the area includes all lands within one mile of the major rivers and reservoirs. Over the past 10 years sightings within this zone along the lower Clark Fork and the Bull rivers have varied from 6 to 38 eagles during a yearly one day January eagle count. The trend has been slightly increasing. The count is done from vehicles along the lower Clark Fork River from Thompson Falls to the Idaho state line and following the Bull river north to the Sanders/Lincoln county line. Farmer and Health (1987: p. 117 *In* ASARCO Incorporated 1987-1997) reported a total of 16 sightings in their study area, with five birds the most seen in a single day. Figure 3-22 shows the historic bald eagle sighting areas (not individual sightings as there are multiple-year sightings at various locations), based on Farmer and Cabinet District records. Winter use level depends on ice conditions on the Noxon and Cabinet Gorge reservoirs. When the reservoirs freeze, the eagles move to areas with open water (i.e. Lake Pend Oreille in Idaho).



- ● Autumn
- ■ Winter
- ⬢ Summer

SOURCE: Kootenai GIS Database

FIGURE 3-22
Bald Eagle Sightings
Rock Creek Project

A total of six occupied nesting territories (one new site was found in 1998) exist along the lower Clark Fork river (all or partially within the Cabinet Ranger District boundary). The six occupied nests represent a 60% occupancy of the ten potential breeding areas on the lower Clark Fork. This is below the desired statewide management objective of 68%, prescribed in the Montana Bald Eagle Management Plan (1994, p. 14-15), however, state-wide breeding areas have an 80% occupancy rate (pers. comm. Dennis Flath, MFWP, June 15, 1998). Two of the breeding areas in the general vicinity of the proposed project contain active breeding pairs. One is about 3 air miles south of the proposed Rock Creek tailings impoundment. This nest has been active since 1990 and has fledged young each year through 1997. The second nest was discovered in March 1994. It is about 4 air miles west of the project area. The nest was occupied by a pair in 1994 and 1995, but failed to produce any young. It was not occupied in 1996, 1997, or 1998 and is thought to be abandoned due to damage to the nest tree. The pair has been seen in the area, but a new nest tree has not been found. The 5 sites (excludes site found in 1998) have produced an average of 1.0 fledgling per site (5-year average for 1992-1996), with the success rate of occupied sites being 68.4% for the same 5-year period. These rates comply with the reproduction recovery goals for the Upper Columbia Basin Zone.

Nesting habitat is described as the largest living trees, in a multistory stand, that are near a body of water that supports an adequate food base (USFWS 1986: p. 13). The nest trees provide an unobstructed view of the foraging site(s). They have open crowns and sturdy limbs to support the massive eagle nests. There are no suitable nest trees (sites) within the Rock Creek mine project area.

Foraging for fish and waterfowl is done in the two reservoirs (Noxon and Cabinet Gorge) and the major tributary streams (Vermilion and Bull Rivers primarily). Scavenging is done along the railroad tracks and state highways 200 and 56, and along the first mile of Forest Development Road (FDR) No. 150.

Trees suitable as hunting perches generally have an unobstructed view of the hunting area, and are relatively close to the site. With the primary foraging area being the reservoirs, and most of the project area greater than one mile from the reservoir, the only area that hunting perch sites might occur is within a portion of the proposed tailings impoundment, immediately adjacent to FDR No. 150. Baseline surveys and district monitoring found no hunting perches in this area. A known hunting perch does exist within 0.5 mile of the proposed Rock Creek tailings impoundment. It lies between Highway 200 and the Clark Fork River. Roosting sites (areas where eagles spend the night) were not found during baseline studies. District monitoring efforts have found no roost sites in the project area.

Peregrine Falcon

The peregrine falcon was removed from the federal list of endangered species August 25, 1999. It was placed on the Forest Service Region One sensitive species list March 30, 2000.

Gray Wolf

The former range of the Northern Rocky Mountain wolf (also called gray wolf) included the proposed project area (USFWS 1987: p. 2). The gray wolf in this area is covered under the Northern Rocky Mountain Wolf Recovery Plan (USFWS 1987). The plan identifies 3 recovery zones (USFWS 1987; figure 2, p. 23) with a recovery goal of a minimum of 10 breeding pairs for 3 successive years in each zone. Presently (Bangs 1998b data) each of the three recovery areas have at least 8 breeding pairs.

The project area lies in "management zone III" between the Northwest Montana and Central Idaho recovery areas. Because wolves, themselves, have defined habitat as any lower elevation area that supports white-tail deer (Bangs 1998a: p. 2) (mostly in management zone III) and because the habitat within the Northwest Montana Recovery Area is fully occupied (Bangs 1998a: p. 6), wolf recovery in NW Montana is currently promoted in any area where there are not chronic conflicts with livestock (Bangs 1998a: p. 2). Currently there are about 75 adult wolves in 7-9 packs and up to 40 pups in NW Montana (Bangs 1998a: p.1).

The wolf is a known transient and potential resident in the lower Clark Fork valley. There is a 1979 unconfirmed sighting 1 mile east of the proposed mill site. There are two unconfirmed sightings (1991) one mile west of the proposed Rock Creek tailings impoundment and a third unconfirmed report of three wolves in the same area in 1995. There are three unconfirmed 1994 reports of a pack (minimum of 3 animals) using the Pillick Ridge/Blue creek area, which runs 7 to 15 air miles northwest of the project area. Information suggests a high probability of wolves west of the project area. The only confirmed wolf sighting (1996) comes from the Vermilion River area which is 14 air miles southeast of the project area. Based on the historical range and the locations of the various sightings, the Rock Creek drainage probably serves as part of a movement area along the Clark Fork River valley between better habitats (i.e. Thompson River drainage to the southeast and Lightning Creek drainage to the northwest in Idaho).

A prey base of elk and deer exists in the area, however the topography in the Rock Creek drainage does not provide easy hunting opportunities due to steep slopes. A wolf pack would need a much larger area than just the Rock Creek drainage to establish a territory (i.e. a drainage the size of the Thompson River). The National Forest portion of the project area downstream from Engle Creek is allocated to big game winter range.

Den sites are generally greater than one mile from open roads and one to two miles from camp sites (USFWS 1987: p. 73). These sites are normally on southerly aspects, on moderate slopes, within 400 yards of surface water, and at an elevation overlooking surrounding low-lying areas. There are no known den sites in the Rock Creek drainage.

Rendezvous sites (resting and gathering areas) are usually complexes of meadows and adjacent timber, with surface water nearby (USFWS 1987: p. 73). They tend to be away from human activity and on drier sites that are slightly elevated above riparian areas (ibid). There are no known rendezvous sites in the Rock Creek drainage.

The drainage configuration, relatively narrow v-shaped valley, does not provide many suitable denning or rendezvous sites. The presence of FDR No. 150 (open to vehicle traffic) in the valley bottom further reduces any opportunity for wolves to den or rendezvous in the Rock Creek drainage.

A major component of wolf habitat is sufficient space with minimal exposure to humans (USFWS 1987: p.7). Space is discussed in the section on grizzly bear.

Grizzly Bear

The proposed project lies on the 2,600 square-mile Cabinet/Yaak ecosystem (CYE) recovery zone (USFWS 1993: figure 10 p. 80). The grizzlies in the CYE are listed as threatened, but the USFWS determined that a reclassification to endangered is warranted but precluded (Fed. Reg. Vol. 58, No. 28, 1993: p. 8250-8251).

The recovery plan goals for the CYE (USFWS 1993: p. 83) are:

- *Six females with cubs over a running 6 year average.* The 6-year average (1992-97) of females with cubs is 1.5 (Servheen 1998: p. 5).

- *18 of the 22 BMUs (Bear Management Units) to be occupied by females with young from a running 6 year sum.* Twelve of the 22 BMUs had credible sightings of females with young during 1992-1997 (ibid). It should be noted that the same female with young may occur in several BMUs (in the 1991-1996 reporting period 3 females occurred in 8 BMUs). During the same period, BMU 5 (1993) and BMU 6 (1993, 1996) were occupied. BMUs 4, 7, and 8 were not confirmed to be occupied by female(s) with young.

- *Human caused mortality not to exceed 4% of the population estimate based on the most recent 3 year sum of females with cubs. An interim mortality goal of zero human caused mortalities has been established due to current low numbers.* Human caused mortality level is currently 0.6% (ibid). The human caused female mortality rate has been zero percent for the last three 6-year reporting periods.

- *A calculated minimum population (based on number of females with cubs) of 106 bear.* The calculated minimum population presently is 28 (based on last 3 year ave. # of females = 5) (ibid).

The present total population estimate for this ecosystem is between 30 to 40 grizzly bears (Kasworm, et.al. 1997: p. 6). The population was thought to be old-aged and on the decline (Kasworm and Manley 1988) so four young female grizzlies were transplanted into the Cabinet Mountains from Canada (1990-1995). One of these transplants has since died from undetermined causes. Kasworms' research now indicate a very slow increase in the population, as the number of known grizzly bears has increased from 10 in 1990 to 16 in 1996. The increase is due to greater search efforts, augmentation, and a portion is due to reproduction (Kasworm has documented reproduction of offspring from offspring in the CYE).

Research (Kasworm et.al. 1988: p. 39-49; 1995: p. 26-30) shows that seven bears have home ranges that include the portion of the Cabinet Mountains between Rock Creek and Ramsey Creek (Montanore project location). Two of these bears are known to have died since documentation of their home ranges. Native bear movements in this area are generally in a north /south pattern (pers. comm. Wayne Kasworm, USFWS grizzly bear research biologist, June 6, 1996). Southern movement generally takes place on the east side of the Cabinet Mountains and northern movements occur generally on the west side of the Cabinet range (based on movements of the 7 grizzly bear using the southern part of the Cabinet mountains).

Kasworm and Servheen (1995: p. 10) document 629 credible grizzly bear reports for the CYE between 1960 and 1994. Their data reveal two areas in the Cabinets that contain a dense cluster of sightings (ibid, Fig. 2 pg 11). One area is in the southern cabinets between the Ramsey/Rock creeks and Swamp/Lake creeks area. This area is the primary analysis area for grizzly and covers Bear Management Units (BMUs) 4 (Bull), 5 (St. Paul), and 6 (Wanless) (Figure 3-23). The proposed project lies in Bear Analysis Areas (BAAs) 7-4-7, -7-5-2, 7-5-3 and 7-6-1 (Figure 3-23). Table 3-31 summarizes reports of grizzlies in these BAAs since 1960.

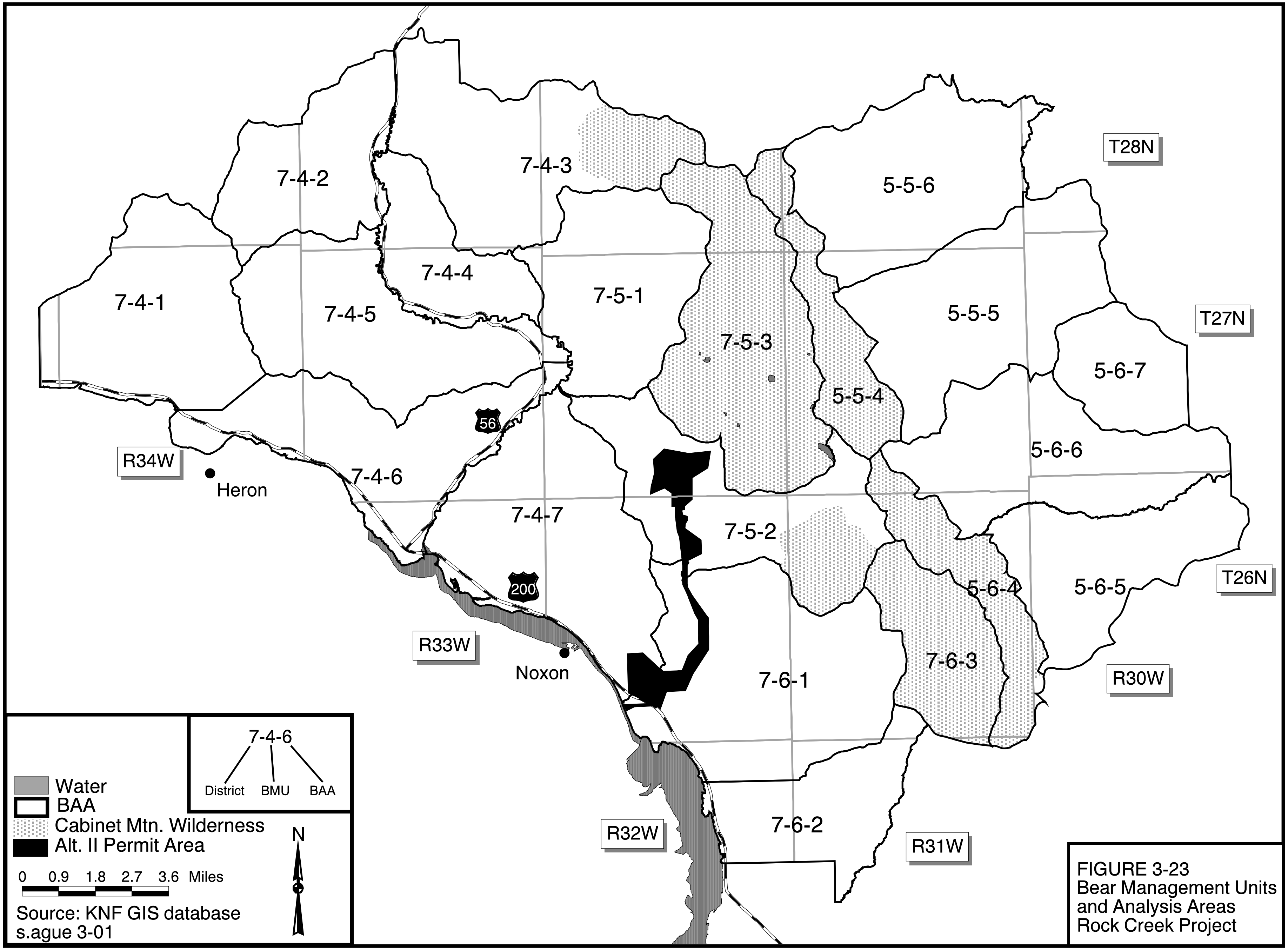


FIGURE 3-23
Bear Management Units
and Analysis Areas
Rock Creek Project

TABLE 3-31
Grizzly Sighting Reports between 1960 and 1997

BAA	Visual Sightings (1960-1997)	Radio Locations (1983-1995)	Den Sites	Mortality (1975-1997)
7-4-7	11	1	0	0
7-5-2	8	6	1	1
7-5-3	8	50	0	1
7-6-1	8	13	0	0

Source: U.S. Forest Service Kootenai National Forest 1998

Habitat components important to grizzly bear have been mapped for the proposed project area and are summarized in the Biological Assessment (see Appendix B). Grizzlies select habitat types rich in herbaceous foods in spring and early summer. Late summer and fall habitat is dominated by sites with abundant huckleberry fields (Erickson et.al.1987). There are no large huckleberry fields in the project direct impact area. Huckleberry production in the project area is probably declining due to closing forest canopies. Habitats of particular importance to grizzlies include shrub fields, snow chutes, wet meadows, low-gradient stream bottoms and in general, areas where preferred bear foods are abundant. The Rock Creek drainage provides about the same proportion of key habitat components as other areas of the Cabinet mountains.

Grizzly denning habitat is generally above 5200 feet in elevation and on the north and west aspects in the Cabinet mountains (Kasworm and Thier, 1992: p. 40 and 1993: p. 44). The Rock Creek drainage does contain suitable denning habitat, but none exists in the Rock Creek Mine project permit area. There is one known den site in the Rock Creek drainage from a transplanted bear that denned there the winter prior to its death (cause unknown).

Habitat effectiveness or percent of the area free from human disturbance is one of the elements of bear habitat modeling. The existing habitat effectiveness of each impacted BMU is: BMU 4 - 62.5%. BMU 5 - 74.5%, and BMU 6 - 68.1% (see Appendix 7 of the Biological Assessment). The desired level of undisturbed habitat needed in each BMU. has been established at 70 percent (habitat effectiveness) (Christensen and Madel 1982; U.S. Forest Service KNF 1987). BMU 5 meets the desired minimum level of free space.

The Kootenai Forest Plan (U.S. Forest Service KNF 1987) establishes a maximum open road density (ORD) standard on areas managed for grizzly bear of 0.75 miles per square mile. This same objective applies to each BAA. Table 3-32 displays the existing situation for open road density in each BAA where the project would be active, or used for a displacement area.

TABLE 3-32
Existing Open Road Density (Miles per square mile) Summary

BAA	ORD
7-4-7	0.62
7-5-2	0.86
7-5-3	0.00 (Wilderness)
7-6-1	0.77

Source: U.S. Forest Service Kootenai National Forest 1998.

Two other methods of looking at grizzly bear habitat are "core" and "moving windows route density categories." The USFWS Incidental Take Statement (McMasters 1995) requires inclusion of this information. The USFWS (McMaster 1998a: p. 35) states that "The Service believes that Mace and Manley (1993), the IGBC (1994), Mace et al. (1996), and Wakkinen and Kasworm (1997) largely constitute the best available information to minimize mortality risk and to minimize under-use of habitat or non-use by grizzly bears, ensuring their survival and recovery in the CYE." Wakkinen and Kasworm (1997) reported that total route densities exceeding 2 mi/sq.mi. averaged 26 percent of the home range for 6 female grizzly bear in the CYE. The open route density greater than 1 mi./sq.mi. averaged 33 percent of the home range and core areas made up 55 percent of each home range. Core is defined as areas greater than 0.31 mile from open roads or roads that do not have permanent barriers (Interagency Grizzly Bear Committee 1994: p. 5). The baseline core habitat condition, in the south half of the Cabinet Mountains (cumulative effects analysis area), is shown in Table 3-33, and on Figure 3-24 (BMU 22 not included as GIS connection was not available).

The "moving window" grizzly bear habitat analysis looks at the percent of the analysis area that falls in various road density classes (Table 3-34). This table displays the baseline conditions for the BMUs within the cumulative effects analysis area.

Additional information on grizzly bear in the Cabinet mountains is available in Kasworm's annual progress reports (1988-1995), the baseline study prepared by Erickson (1987), and the Biological Assessment (Appendix B).

TABLE 3-33
Existing Core Habitat Analysis Summary
(% BMU in Core by Habitat Block Site)

BMU	≤ 4 Square Miles *	> 4 Square Miles*	Total Percent Core
4 \a	5.1	55.1	60.2
5 \f	4.9	55.8	60.7
6 \c	10.1	41.0	51.1
7 \b	1.0	66.2	67.3
8 \d	3.3	52.7	56.0
22 \e	1.6	46.1	47.7

* Core habitat block size
\a Based on 8/97 analysis by Kootenai NF S.O.
\b Based on 6/98 analysis by Kootenai NF S.O.
\c Based on 7/98 analysis by Libby Ranger District, KNF
\d Based on 2/97 analysis by Cabinet Ranger District, KNF
\e Based on 5/97 analysis by Plains district, (Lolo NF)
\f Based on 7/98 analysis by Kootenai NF S.O.

TABLE 3-34
Existing Moving Windows Route Densities
(% BMU by Route Density Category)

BMU	Open Routes (%)				Total routes (%) *			
	0 miles	0-1 mile	1-2 miles	> 2 miles	0 miles	0-1 mile	1-2 miles	> 2 miles
4 \a	46.9	14.1	15.0	24.0	43.9	13.7	14.3	28.1
5 \b	57.0	13.8	16.5	12.7	42.9	16.5	18.3	22.3
6 \b	51.4	14.3	13.4	20.9	37.0	13.2	15.7	34.1
7 \b	63.4	11.8	10.2	14.6	48.7	15.4	14.2	21.7
8 \c	40.4	17.1	21.8	20.7	36.4	19.5	21.9	22.2
22 \d	45.0	13.0	15.0	27.0	31.0	13.0	14.0	42.0

* Does not include barriered roads (per IGBC Grizzly Bear Access Committee notes 2/97)
\a Based on 7/98 analysis by Kootenai NF S.O. that corrected errors in draft analysis.
\b Based on 8/98 analysis by Kootenai NF S.O. that corrected errors in draft analysis.
\c Based on 2/97 analysis by Cabinet Ranger District, KNF
\d Based on 5/97 analysis by Plains district (Lolo NF)

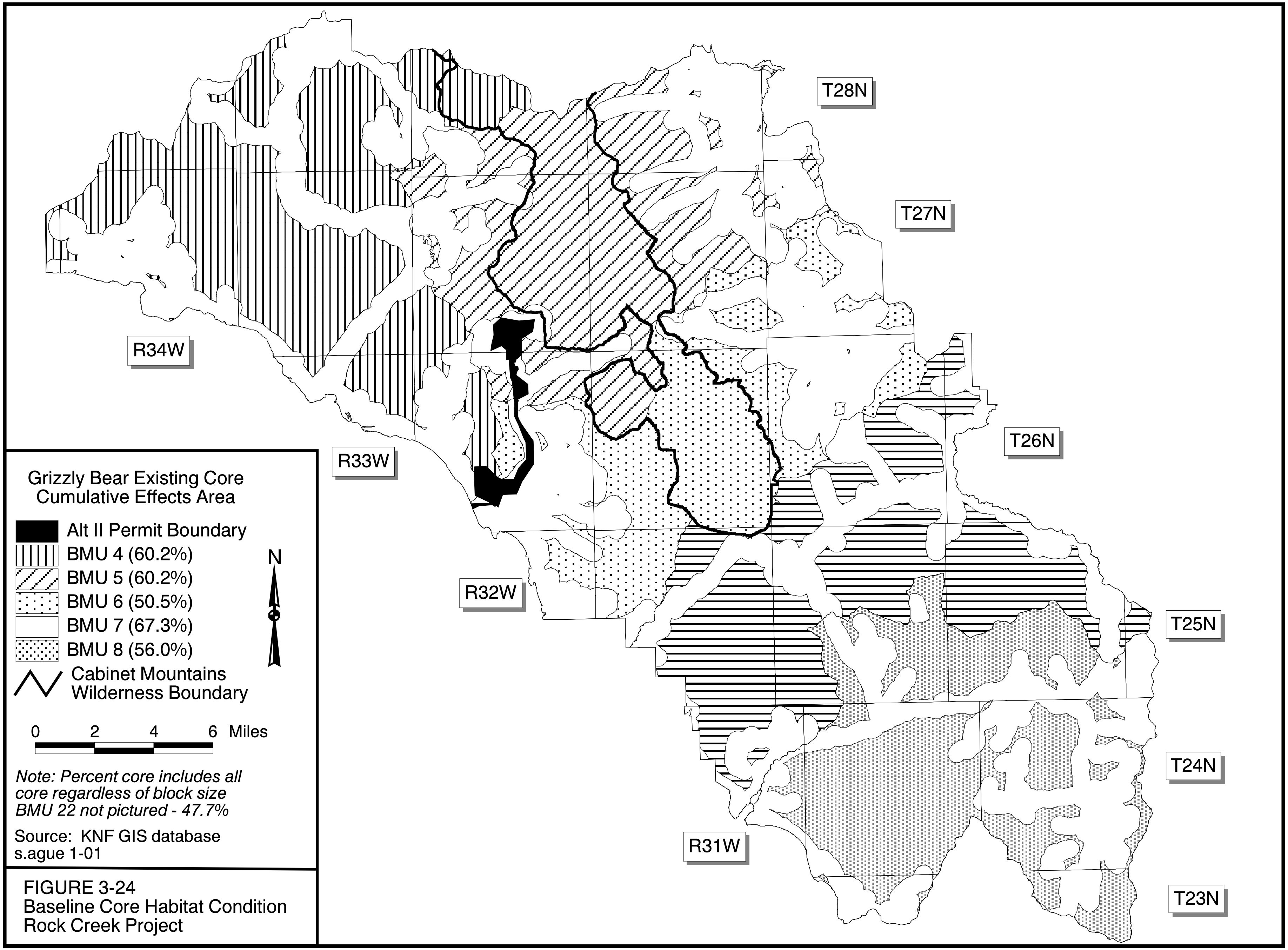


FIGURE 3-24
Baseline Core Habitat Condition
Rock Creek Project

Bull Trout

Bull trout are found within the immediate project area (the Rock Creek drainage), as well as downstream of the project area (i.e., Cabinet Gorge Reservoir and Lake Pend Oreille). The distribution and abundance of bull trout within each of these areas are discussed in separate sections below. A more detailed discussion of fisheries and aquatic habitat is provided in the Aquatics/Fisheries section.

Within the Rock Creek drainage, bull trout are distributed throughout mainstem Rock Creek, the West Fork of Rock Creek, and the East Fork of Rock Creek. Waterfalls on both the west and east forks of Rock Creek appear to limit bull trout distribution in this drainage. Bull trout are more abundant in the west and east forks of Rock Creek than in the mainstem. The majority of the bull trout observed in 1996 were found in the east fork (79 percent of total bull trout) (see Table 3-25). A likely limiting factor for fish in this drainage is the intermittency of stream flow in the mainstem.

Rock Creek may support both resident and migratory bull trout. In the West Fork of Rock Creek, 1-to-3-year-old bull trout have been found upstream of the potential fish passage barrier, indicating they are a resident population. There is some evidence of bull trout migration from Cabinet Gorge Reservoir into Rock Creek, presumably for spawning, but the migratory form of the species is very rare, if present at all.

Within Cabinet Gorge Reservoir, bull trout are much less common than they were prior to construction of Cabinet Gorge Dam. This dam blocked all access by migratory fish into the Clark Fork River upstream of the dam. A creel census conducted in 1955 indicated that bull trout made up 50 percent of the game fish taken during the regular fishing season. The catch rate for bull trout during this season was 0.17 fish per hour. Gill-netting in Cabinet Gorge indicated that 2 percent of the fish population (35 percent of game fish) was bull trout (Gaffney 1955). The most recently collected data indicates that bull trout are now much rarer in the reservoir, comprising only 0.03 percent of the fish population (Table 3-27). Only 5 individual bull trout were captured during extensive sampling conducted during 1994-95 (see Table 3-27) (WWP 1996a).

Bull trout populations in Cabinet Gorge are supported by two tributaries which act as nursery streams; the Bull River and Rock Creek. Redd (fish nests) count data from the Bull River indicate between 12 and 16 redds in 1992 and 1993 (Pratt and Huston 1993). Only 4 redds were observed in Rock Creek during 1994 (WWP 1996a) and no redds were observed during 1996 (Watershed Consulting 1997), although spawning gravel characteristics in Rock Creek (i.e., limited to isolated pockets behind boulders) are not conducive to redd surveys. Pratt and Huston (1993) characterized the population in Cabinet Gorge Reservoir as stable but fragile. The small number of nursery streams increases the probability that the population will be unable to recover from catastrophic events. In addition, the bull trout population is low enough to create questions about maintaining genetic diversity in the population. Huston (1993) noted a potential threat to bull trout in this drainage: the possibility of brown trout spawning on top of bull trout redds.

The Lake Pend Oreille bull trout population appears stable, but this stability is fragile or tentative. Currently, there are about 1,100 to 2,000 bull trout available to spawn annually in tributaries to Lake Pend Oreille based on a long-term data set. Of the 16 nursery areas supporting the Lake Pend Oreille population, only two support stable stocks. High annual variation of a spawning population suggests a high risk of extinction (Pratt and Huston 1993).

Water Howellia

Water howellia grows in firm consolidated clay and organic sediments that occur in wetlands associated with ephemeral glacial pothole ponds and former river oxbows (Shelly and Moseley 1988). These wetland habitats are filled by spring rains and snowmelt runoff, and depending on temperature and precipitation, exhibit some drying during the growing season. This plant's microhabitats include shallow water, and the edges of deep ponds that are partially surrounded by deciduous trees (Shelly and Moseley 1988; Gamon 1992; USFWS 1994: p. 35860). No suitable habitat exists in the planning area. Surveys for this species were conducted concurrent with the sensitive plant surveys. No occurrences of this species were found (Scow et al. 1987 *In* ASARCO Incorporated 1987-1997; ASARCO 1990; 1993; Montana Natural Heritage Program 1994). The proposed project would have no effect on water howellia or its habitat, based on (1) no activities in potentially suitable habitats, and (2) no plants present. There will be no further discussion about this species.

Lynx

Currently the lynx is listed as a 'sensitive' species in Region One of the Forest Service (Jolly 1994). In compliance with a court decision the USFWS proposed to list the Lynx under the Endangered Species Act on June 30, 1998 (Federal Register Vol. 63 No. 130 pgs 36693-37013: July 8, 1998). The population of the lynx in the western United States and specifically Montana is unknown. While northwestern Montana is considered a stronghold for lynx in the lower 48 states, populations are very low and depressed (Lori Nordstrum, United States Fish and Willdlife Service, pers. comm. with Lisa Fairman, June 5, 1995). Lynx are known to occur on the Kootenai National Forest, however there are no recent sighting reports in the Rock Creek drainage. The status of the lynx in the project area and in the Cabinet Mountains is unknown. While lynx are considered to occur, populations are probably low. Trapping records suggest this, as only three lynx were trapped in Sanders Country from 1977 to 1993 and all three were taken in 1984.

Lynx are solitary animals often associated with remote areas. They often use early seral stages at high elevations for foraging and mature to old growth forests with downed trees for denning and possible foraging (Weaver 1993). The distribution and abundance of the lynx appears to be tied to the snowshoe hare, their main prey (Ruggiero et al. 1994). Open areas discourage use by lynx and disrupt movement (Koehler 1990; Koehler and Brittell 1990 *In* Ruggiero et al. 1994). They are easily trapped. Humans are considered to be the single most important mortality factor with lynx (Ward and Krebs 1985 *In* Ruggiero et al. 1994).

Range of the lynx in the western United States has diminished over the last century. Habitat is more fragmented and restricted, which may cause the lynx to be less tolerant of human activities than in Canada and Alaska where refuge habitats occur (Ruggiero et al. 1994).

Lynx information has been summarized in the Kootenai National Forest's Lynx Conservation Strategy (Johnson et al. 1997). The strategy has summarized pertinent scientific literature, developed and mapped three habitat suitability models for the Kootenai National Forest, recommended an effects analysis process, provided updates on lynx research currently being conducted on the forest, and collected available sighting information.

The Lynx Conservation Strategy provides a base for determining the status of the population in the planning unit (the KNF) and in context, the project area. The three habitat suitability models mapped estimates of suitable habitat using three data sources to adjust for strengths and weaknesses of each source. The three models agree that lynx habitat is widespread and fairly common on the northern portion of the KNF (confirmed by the more common sightings found there), and less widespread and less common on the southern portion. The limiting factor for lynx habitat appears to be foraging habitat. The project are is limited on both denning and foraging habitat because most of it is lower elevation than lynx prefer. Habitat in the Rock Creek drainage falls within KNF Lynx management unit (LMU) 7.2.1 (see Appendix B, Figure B-5). Of the 23,017 acres in LMU 7.2.1, only 4.9% (1,134 acres) is considered denning habitat and 5.2% (1,195 acres) is considered foraging habitat. The KNF Lynx Conservation Strategy suggests a minimum of 6% denning, a minimum of 30% foraging and between 40-60% travel habitat.

Foraging habitat is less common than denning habitat for the CMW portion nearest the project boundary. Because only a small amount of denning habitat is needed for denning, foraging habitat is likely the limiting factor for lynx in the adjacent CMW as well as for other areas on the forest. Linkages to adjacent national forests and drainages do not appear to be limiting because travel habitat is well represented. Roads have an effect on the ability of animals to use otherwise suitable habitat for travel. In the Rock Creek drainage, suitable habitat is well-connected with a very large tract of habitat along the CMW. The portion of the LMU nearest the Noxon connectivity corridor is primarily travel habitat rather than denning or foraging habitat.

The Kootenai Cumulative Effects Model (CEM) for lynx is considered to be the most accurate model for predicting lynx habitat suitability within the project area. While the TSMRS is more accurate where a high proportion of an area has stand examinations, the CEM is considered most accurate where these exams are lacking, as in the Rock Creek project area. Using the CEM, the project area has only 3 acres of denning habitat, and 17 acres of travel habitat at the evaluatoin adit. Travel habitat is much less specific than either foraging or denning habitat. The low amount of habitat within the project area suggests that the reason for few lynx observations (including trapping records) within the project area and vicinity is probably lack of suitable habitat.

SOCIOECONOMICS

The socioeconomic study area for the proposed project includes Sanders and Lincoln counties in western Montana and Bonner County, Idaho. This discussion's tables provide an overview of the demographic and economic characteristics of these three counties based on the most recent available data. Data for the state of Montana are also displayed to provide a regional basis for comparison. Because it is extremely rare for projects of this type to exhibit significant effects on areas or communities which are more than an hour's driving time from the project site, the area of particular concern within these three counties is western Sanders County from Thompson Falls to the Idaho border, southern Lincoln county including the communities of Troy and Libby and the surrounding rural areas, and eastern Bonner County in the vicinity of the community of Clark Fork. The discussions which follow place the most emphasis on this "local area."

Population and Demographics

The population of Sanders County grew rapidly in the 1970s then remained essentially unchanged during the 1980s at approximately 8,700 persons. In the years since 1990 it increased by 1,564 (an increase of 18 percent) to a total of 10,233 persons in 1994. By comparison, Montana population also grew substantially in the 1970s, very slowly during the 1980s, and has increased by 10.5 percent since 1990. Lincoln County actually lost population between 1970 and 1990. Since 1990 it has grown by 7.7 percent to a 1999 total of 18,819. Bonner County population growth rates have been much greater than those of Sanders and Lincoln Counties, growing 55 percent during the 1970s, 10 percent during the 1980s, and by 35.5 percent in the most recent 9-year period to 36,071 persons in 1999 (See Table 3-35).

Census division boundaries do not correspond with the local area for the proposed project, so specific population estimates for the area are not available in the census reports. It is estimated that in 1995 the local area population in western Sanders County included about 5,250 persons—2,150 living in the Thompson Falls area, and 3,100 residing in or near the communities of Noxon, Heron, and Trout Creek. The estimated Lincoln County local area 1995 population of 7,200 included about 2,200 residents in the Troy area south to Bull Lake. The remaining 5,000 resided in the Libby vicinity. The 1995 population of the Clark Fork area in Bonner County was about 1,000. Combining these various estimates gives a 1995 population of 13,450 for the project local area.

Population distributions by sex, age, race, and percent of population of Hispanic origin are all fairly consistent with Montana patterns. American Indians are relatively under represented as a percentage of the Lincoln and Bonner County populations. The proportion of persons age 65 and older is higher in Sanders and Lincoln Counties than in Bonner County and the State of Montana.

The levels of educational attainment of the three counties (measured in terms of percentage of population over 24 years of age who have graduated from high school and college) are lower than the corresponding figures for the state of Montana. This is the pattern commonly observed when rural areas are compared with the general population. The relatively high proportions of 1990 Bonner County and Sanders County residents who had lived in a different state 5 years earlier, may reflect these counties' locations on the state borders, although that would suggest that Lincoln County should reveal a similar pattern. More likely, these data are tied to the population growth rates of the various areas.

<u>Housing</u>

Basic demographic data from the 1990 census for the three counties indicate that the number of persons per household and the percentage of households which are family units is very similar to regional patterns. The proportion of occupied housing units which are owner occupied is relatively high. The 1990 median value of owner-occupied housing units in Sanders County ($42,000) and Lincoln County ($48,900) is well below the Montana median ($56,600), while the Bonner County median ($60,400) is substantially higher. A factor contributing to the low median values reported for Sanders and Lincoln Counties is that an unusually high proportion of owner-occupied units in these two counties are mobile homes.

1990 census data enumerate approximately 4,300 housing units in Sanders County, including 960 in the Thompson Falls vicinity, and 1,250 in Sanders County west of Thompson Falls. Of the total 2,210 housing units in western Sanders County (including Thompson Falls), about 80 percent were occupied in 1990, either by renters (20 percent) or by owners (60 percent). Most of the 20 percent of units listed as vacant by the census are occupied seasonally. Few housing units are available for rent.

Lincoln County 1990 census data list 8,002 housing units in the county. Of this total 1,508 are in the Troy vicinity and 5,432 are in the Libby area. Of the 6,940 units in the Troy and Libby areas, 54 percent were owner occupied and 20 percent were occupied by renters in 1990. Of the 26 percent of housing units listed as vacant, somewhat less than half receive seasonal use.

TABLE 3-35
Rock Creek Mine Area Demographic Profile

Category	Sanders County	Lincoln County	Bonner County	Montana State
POPULATION				
1999	10,233	18,819	36,071	882,779
1995	10,068	18,680	33,031	868,522
1990	8,669	17,481	26,622	799,064
1980	8,675	17,752	24,163	786,690
1970	7,093	18,063	15,560	694,409
POPULATION GROWTH (%)				
1970 - 1995	41.9	3.4	112.3	25.1
1990 - 1999	18.0	7.7	35.5	10.5
POPULATION BY SEX (%) [1999]				
Female	49.0	49.6	49.9	50.3
Male	51.0	50.4	50.1	49.7
POPULATION BY AGE (%) [1999]				
0 to 4	5.4	5.7	6.5	6.0
5 to 19	23.4	22.9	21.8	22.7
20 to 64	55.5	56.4	58.4	58.0
65 & above	15.7	15.0	13.3	13.3
POPULATION BY RACE (%) [1999]				
White	93.0	97.7	98.4	92.5
American Indian	6.3	1.8	0.8	6.5
Other	0.7	0.4	0.7	1.0
POP. HISPANIC ORIGIN (%) [1999]	1.5	1.3	2.2	1.8
EDUCATION (Persons 25 yrs & over) [1990]				
Percent High School Graduate	75.2	73.3	78.2	81.0
Percent College Graduate	14.8	12.5	15.2	19.8
MOBILITY (Residency Relocation, 1985 to 1990)				
Same County	76.1	80.3	76.2	76.9
Different County in Same State	7.8	6.6	4.5	10.9
Different State or Country	16.1	13.1	19.3	12.2
LABOR FORCE [1999]				
Percent of Population	42.3	39.0	48.6	53.7
Unemployment Rate	9.1	12.1	9.6	5.2
HOUSEHOLDS [1990]				
Persons per Household	2.53	2.60	2.58	2.53
Family households % of total	70.0	73.6	77.3	69.1
HOUSING [1990]				
Occupied housing units	3,397	6,668	10,269	306,163
Percent owner occupied	75.1	73.3	75.8	67.3
Median value owner-occupied units	$42,000	$48,900	$60,400	$56,600
Mobile homes as percent total units	24.6	26.1	17.6	16.2

Sources: U.S. Bureau of the Census, USA Counties 1996 CD-ROM
Census and Economic Information Center, Montana Department of Commerce
Regional Economic Information Sys., Bureau of Economic Analysis, WSU Cooperative Ext.
Idaho Data Center, Idaho Department of Commerce,
http://www.idoc.state.id.us/data/dtacntr.html

In July of 1995 ASARCO surveyed realtors from Sanders and Lincoln Counties to determine the number and price of homes and building sites available for sale. Table 3-36 summarizes the results obtained. Since lower value properties in rural communities often are sold without being listed with a realtor, the Table 3-36 data probably understate the number of properties available and overstate median price. Even so, it is apparent that there is considerable variability in housing and building site availability, with the market especially limited and prices very high in the Noxon/Heron Area.

TABLE 3-36
Homes and Building Sites for Sale - Sanders & Lincoln Counties July 1995

	Thompson Falls	Rural Thompson F.	Trout Cr. Area	Noxon, Heron Area	Troy Area	Libby Area
Homes For Sale						
Number	33	41	12	17	31	83
Median Price	$78,000	$137,500	$98,000	$192,000	$100,000	$110,000
Bldg. Sites For Sale						
Number	4	130	25	18	24	66
Median Price	$15,000	$35,000	$49,000	$60,000	$35,000	$29,500

Both counties have potential for additional homesite development, but the 1995 market information indicates that any sudden influx of persons needing wage-earner housing would meet an initial housing shortage that would take several years to resolve. The problem would be particularly acute in the Noxon/Heron/Trout Creek area of Sanders County, where residential property demand associated with population growth has already produced a drastic increase in property values.

ASARCO's July 1995 housing inventory also examined the availability of temporary housing that would meet the needs of the contract construction workers and newly arrived mine employees. Rental houses and apartments were found to be extremely scarce. Only multi-unit facilities with a total of 14 apartments were identified in all of western Sanders County. Realtors in both Sanders and Lincoln counties indicated that vacated rental units lease immediately, usually without being advertised. There are 10 motels with 84 units in western Sanders County and 11 motels with 258 units in southern Lincoln County. Because very few of these motel units have cooking facilities, they are not suited to providing temporary employee housing for more than a very brief period. Noxon and Trout Creek have four trailer courts with a total of 28 spaces, and there are eight courts with a total of about 40 spaces in Thompson Falls. There are 36 courts with more than 500 spaces listed in the Troy and Libby areas. Many of these courts are RV parks designed for very short-term use by recreational vehicles. Courts designed for longer-term mobile home placement seldom have spaces available.

Local Employment and the Economy

Sanders County

Approximately half of total Sanders County personal income is earned income derived from employment or business ownership. The service sector (wholesale and retail trade, services, transportation and utilities) provides the largest source of local employment (48.8 percent) and earned income (48.7 percent). See Table 3-37. The finance/government/education sector follows with 20.6 percent of employment and 31.7 percent of earned income. Goods production (manufacturing and construction) provides 16.6 percent of employment and 21.0 percent of earnings, while the resource commodity sector accounts for 13.9 percent of employment. Earnings in mining and agricultural services and forestry were not sufficient to offset losses in the farm sector in 1998.

A review of Tables 3-38 and 3-39 reveals that since 1970 the portion of county earnings and employment associated with the service and finance/government/education sectors has grown substantially while the goods producing and resource commodity sectors have declined. Between 1970 and 1998 total Sanders County employment increased from 2,743 to 4,711 employees, an increase of 72 percent. Employment grew during the 1970s, but the 1980s saw a loss of over 400 jobs. Growth resumed in 1991 and has been steady since then. The service sector accounted for most of this growth but employment in the other sectors has also increased. These earnings and employment trends in Sanders County over the last quarter of a century are similar to those which have developed in the Montana economy over the same period. There are differences within the individual sectors, but in both the State and the Sanders County economies the combined service and finance/government/education sectors accounted for slightly more than 75 percent of 1998 employment earnings, while the goods producing and resource commodity sectors were the source of less than 25 percent.

The Sanders County average annual wage in 1998 was $18,700, 16 percent below the average for Montana workers (see Table 3-37). Per capita personal income was $15,300, 28 percent below the state average. This low per capita figure is primarily a result of the relatively small proportion of the county population in the workforce.

As mentioned above, personal income statistics for Sanders County indicate employment earnings make up less than half of personal income of county residents. The Table 3-37 derivation of personal income data reveal that transfer payments (Social Security benefits, Medicare payments, workers' compensation benefits, unemployment insurance, etc.) combine with interest, dividends, and rent to provide the other half of county personal income. These data understate the importance of incomes derived from sources other than current employment earnings. They follow the standard protocol for reporting personal income which records pension benefits earned as part of employment earnings, while (in order to avoid double reporting) private pension, retirement annuity, and IRA distributions actually received by retirees are not included as personal income.

Input received during the scoping and public comment opportunities for this EIS expressed the view that population and economic growth in Sanders County in recent years have been driven by immigration of retirees and individuals whose income is not tied to residence in a particular location. These immigrants are drawn to the area by its natural aesthetic and recreation values and relaxed rural lifestyle. A variety of indicators support the importance of this "amenity immigration" to county growth and of retirement incomes to the economy. The population of Sanders County over 65 years of age is high compared to state figures, and only 42.3 percent of the population is in the county workforce (compared to 53.7 percent of the state population). Since 1970, Sanders County personal income (inflation adjusted) has increased 122.0 percent while earnings from employment increased only 58.0 percent. This personal income increase exceeded that recorded by the state of Montana economy even though the county earned income growth lagged the statewide increase of 70.6 percent (Table 3-37).

TABLE 3-37
Rock Creek Mine Area Economic Profile 1998

Employment Category	Sanders County	Lincoln County	Bonner County	Montana State
TOTAL PERSONAL INCOME ($1,000)	155,669	305,029	644,286	18,671,471
PER CAPITA PERSON INCOME ($)	$15,284	$16,297	$18,232	$21,229
AVERAGE WAGE PER JOB ($)	$18,706	$20,908	$20,639	$22,405
DERIVATION OF PERSONAL INCOME (%)				
Net Earning from Employment	49.0%	54.2%	55.6%	60.0%
Dividends, Interest, & Rent	24.2%	20.2%	26.9%	23.6%
Transfer Payments	26.8%	25.6%	17.5%	16.4%
INCOME CHANGE 1970 - 1998 (Adjusted for Inflation)				
Total Personal Income	122.0%	44.5%	299.2%	118.0%
Net Employment Earnings	58.0%	-6.4%	218.1%	70.6%
EARNINGS FROM EMPLOYMENT BY SECTOR & INDUSTRY%				
Resource Commodity Production	**-1.4%**	**2.1%**	**2.5%**	**5.3%**
Farm	-3.7%	0.1%	0.5%	2.0%
Ag Services and Forestry	(D)	1.4%	1.2%	0.8%
Mining	(D)	0.6%	0.8%	2.5%
Goods Production	**21.0%**	**30.6%**	**26.5%**	**15.4%**
Construction	8.3%	6.3%	8.3%	7.5%
Manufacturing	12.7%	24.3%	18.2%	7.9%
Service Production	**48.7%**	**34.1%**	**47.6%**	**51.7%**
Transportation & Public Utilities	11.2%	7.1%	7.4%	8.1%
Wholesale Trade	3.0%	1.2%	2.3%	5.2%
Retail Trade	9.9%	10.1%	17.9%	11.8%
Services	24.6%	15.1%	20.0%	26.6%
Finance/Government/Education	**31.7%**	**33.3%**	**23.4%**	**27.7%**
Finance, Insurance & Real Estate	3.6%	3.6%	5.6%	5.9%
Education & Government	28.1%	29.7%	17.8%	21.8%
EMPLOYMENT	4,711	8,962	18,085	543,333
EMPLOYMENT BY SECTOR & INDUSTRY (%)				
Resource Commodity Production	**13.9%**	**6.3%**	**6.1%**	**8.7%**
Farm	10.4%	3.4%	3.4%	5.9%
Ag Services and Forestry	(D)	2.6%	2.3%	1.6%
Mining	(D)	0.4%	0.4%	1.2%
Goods Production	**16.6%**	**23.0%**	**22.2%**	**11.5%**
Construction	6.9%	6.6%	8.4%	6.1%
Manufacturing	9.7%	16.4%	13.8%	5.4%
Service Production	**48.8%**	**47.7%**	**52.8%**	**58.0%**
Transportation & Public Utilities	6.3%	4.1%	3.7%	4.9%
Wholesale Trade	1.7%	1.2%	2.0%	3.8%
Retail Trade	15.6%	18.3%	24.5%	19.5%
Services	25.2%	24.0%	22.7%	29.8%
Finance/Government/Education	**20.6%**	**23.0%**	**18.8%**	**21.7%**
Finance, Insurance & Real Estate	5.1%	5.6%	6.2%	6.4%
Education & Government	15.5%	17.4%	12.7%	15.3%

Note: (D) = Not shown to avoid disclosure of confidential information; estimates included in totals.

Sources: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Accounts Data, http://www.bea.doc.gov/bea/regional/reis and Regional Economic Information System 1969-1996 CD-ROM, May 1998.

Lincoln County

In the Lincoln County economy, 54.2 percent of personal income (as reported by the standard data protocol) comes from employment earnings. Service producing industries provide the largest share of employment, 47.7 percent, and 34.1 percent of earned income (Table 3-38, Table 3-39, and Figure 3-26). The goods producing sector accounts for 23.0 percent of employment and 30.6 percent of earnings. The finance/government/education sector provides 23.0 percent of employment and 33.3 percent of earnings, while the resource commodity sector accounts for 6.3 percent of employment and 2.1 percent of earnings. Trend analysis of the Lincoln County economy and employment data is complicated by the tremendous bulge in construction employment caused by the Libby Dam project during the late 1960s and early 1970s. County employment peaked in 1968 at 7,530, declined to 6,300 in 1975, and grew slowly to 8,962 in 1998. The service and finance/government/education sectors have accounted for almost all 94 percent of this employment growth.

Average wage per job in 1998 was $20,908, about 93 percent of the state average, but per capita personal income at $16,297 was 77 percent of the state figure. Less than 40 percent of the Lincoln County population is in the labor force, well below the Montana average of 53.7 percent. The increasing share of the population that is older than 64 years of age and the rising importance of transfer payments and dividends, interest, and rents suggest that a growing retiree population may be one explanation for the low labor force participation rate. Another factor could be that the chronically high unemployment rate and the lack of job opportunities is causing some individuals to become discouraged and stop looking for work, in which case, those persons would no longer be counted in the labor force.

Measured in terms of constant (inflation adjusted) dollars, total Lincoln County personal income has increased 44.5% since 1970, but earnings from employment have decreased by 6.4% (Table 3-37). These numbers reflect the fact that the county economy was booming during the late 1960s and early 1970s from the construction of the Libby Dam and has been essentially stagnant since the end of that project.

Bonner County

For Bonner County, Idaho, data provided by the standard protocol for distribution of personal income indicate that employment earnings provide 55.6 percent of personal income. The average wage per job in 1998 was $20,639, while per capita personal income was $18,232.

Bonner County's service industries provide 52.8 percent of local employment and 47.6 percent of employment income (tables 3-38 and 3-39, and Figure 3-26). Goods production follows with 22.2 percent of employment and 26.5 percent of earnings income. The finance/government/education sector provides 18.8 percent of employment and 23.5 percent of earnings, while the resource commodity sector accounts for 6.1 percent of employment and 2.5 percent of earnings. Total Bonner County employment more than tripled between 1970 and 1998 from 5,326 to 18,085 jobs. The service sector has been the driving force in this growth with a 348 percent employment increase. Goods production employment grew 188 percent, the finance/government/education sector by 161 percent, and resource commodities by 126 percent.

TABLE 3-38
Rock Creek Mine Area Earnings by Industry 1970 - 1998

County/Sector	1970	1980	1990	1998
SANDERS COUNTY				
Resource Commodity (Agriculture, Forestry, Mining)	9.4%	7.6%	10.1%	-1.4%
Goods Production (Construction, Manufacturing)	33.3%	24.5%	26.1%	21.0%
Service Producing (Trade, Service, Utilities, Tran.)	35.1%	46.9%	37.5%	48.7%
Finance/Government/Education	22.1%	21.0%	26.4%	31.7%
LINCOLN COUNTY				
Resource Commodity (Agriculture, Forestry, Mining)	(D)	(D)	11.3%	2.1%
Goods Production (Construction, Manufacturing)	61.5%	40.0%	37.7%	30.6%
Service Producing (Trade, Service, Utilities, Tran.)	(D)	(D)	29.3%	34.1%
Finance/Government/Education	13.6%	24.5%	21.7%	33.3%
BONNER COUNTY, IDAHO				
Resource Commodity (Agriculture, Forestry, Mining)	5.0%	4.3%	3.3%	2.5%
Goods Production (Construction, Manufacturing)	31.9%	34.7%	35.7%	26.5%
Service Producing (Trade, Service, Utilities, Tran.)	43.6%	42.5%	41.4%	47.6%
Finance/Government/Education	19.5%	18.4%	19.6%	23.4%
STATE OF MONTANA				
Resource Commodity (Agriculture, Forestry, Mining)	19.3%	8.0%	8.8%	5.3%
Goods Production (Construction, Manufacturing)	17.7%	19.0%	14.1%	15.4%
Service Producing (Trade, Service, Utilities, Tran.)	40.1%	49.0%	51.1%	51.7%
Finance/Government/Education	22.9%	24.1%	26.0%	27.7%

Note: (D) = Not shown to avoid disclosure of confidential information.

Sources: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Accounts Data, January 24, 2001 http://www.bea.doc.gov/bea/regional/data.htm

TABLE 3-39
Rock Creek Mine Area Employment Trends

County/Sector	1970		1980		1990		1998	
SANDERS COUNTY								
Resource Commodity (Agriculture, Forestry, Mining)	429	15.6%	551	14.0%	544	15.4%	657	13.9%
Goods Production (Construction, Manufacturing)	601	21.9%	684	17.4%	611	17.3%	781	16.6%
Service Producing (Trade, Service, Utilities, Tran.)	1,049	38.2%	1,858	47.1%	1,537	43.5%	2,301	48.8%
Finance/Government/Education	664	24.2%	848	21.5%	840	23.8%	972	20.6%
TOTAL EMPLOYMENT	**2,743**		**3,941**		**3,532**		**4,711**	
LINCOLN COUNTY								
Resource Commodity (Agriculture, Forestry, Mining)	(D)	(D)	(D)	(D)	981	11.7%	567	6.3%
Goods Production (Construction, Manufacturing)	3,345	46.9%	1,850	26.3%	2,246	26.7%	2,059	23.0%
Service Producing (Trade, Service, Utilities, Tran.)	(D)	(D)	(D)	(D)	3,359	39.9%	4,272	47.7%
Finance/Government/Education	1,337	18.8%	1,869	26.6%	1,825	21.7%	2,064	23.0%
TOTAL EMPLOYMENT	**7,130**		**7,027**		**8,411**		**8,962**	
BONNER COUNTY, IDAHO								
Resource Commodity (Agriculture, Forestry, Mining)	491	9.2%	740	7.7%	906	7.0%	1110	6.1%
Goods Production (Construction, Manufacturing)	1,395	26.2%	2,461	25.6%	3,551	27.5%	4,013	22.2%
Service Producing (Trade, Service, Utilities, Tran.)	2,135	40.1%	4,107	42.8%	5,868	45.4%	9,556	52.8%
Finance/Government/Education	1,305	24.5%	2,292	23.9%	2,597	20.1%	3,406	18.8%
TOTAL EMPLOYMENT	**5,326**		**9,600**		**12,922**		**18,085**	

Note: (D) = Not shown to avoid disclosure of confidential information; estimates included in totals.

Sources: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Accounts Data, January 24, 2001
http://www.bea.doc.gov/bea/regional/reis,
and Regional Economic Information System 1969-1996 CD-ROM, May 1998.

Employment and Economy Overview

The picture which emerges from the demographic and economic data is different for each of the three counties. Bonner County has experienced and continues to exhibit rapid population and economic growth driven by the interrelated recreation/tourism industry and retirement immigration. This rapid growth has supported a strong construction industry, while forest-products based manufacturing has remained a major factor in the Bonner economy. Lincoln County saw its period of greatest prosperity during the late 1960s and early 1970s. Population growth since then has been minimal. Inflation adjusted earned income has actually declined, and all other economic indicators have lagged behind state averages. Wood products manufacturing, the single largest industry, has had minimal growth, and gains in other sectors have not made up for the decreased employment and earnings in the construction industry. Sanders County reflects a middle road between its two neighbors. During both the last quarter century and the decade of the 1990s its population growth rate has been well above that for the state of Montana. Total income growth has matched the state average. Declines in the resource commodity and goods production sectors have been more than made up by retirement immigration and growth in the services and finance/government/education sectors.

Community Services and Facilities

The location of the Rock Creek project would place it in the area served by Sanders County local government service providers. The Hard-Rock Mining Impact Plan analysis of demands on local government services expected to result from mine development and the preliminary analyses for this EIS indicate that the significant impacts to community services and facilities would be limited mostly to western Sanders County. Therefore, the discussion of community facilities and services which follows focuses primarily on that area.

Schools

There are three elementary schools and two high schools in western Sanders County. The Noxon/Heron School District includes Noxon Elementary and Noxon High School. The Trout Creek District has one elementary school whose students can attend either the Noxon or Thompson Falls high schools. The Thompson Falls District includes elementary and high schools. Table 3-40 lists the 1995-1996 and 1999-2000 school district enrollments, and the 1995-1996 student/teacher ratios. 1995-1996 student to teacher ratios ranged from 14:1 at the Noxon Schools to 18:1 in Trout Creek Elementary School. The Montana average student to teacher ratio was 16:1 in 1995-1996. Montana accreditation standards for single grade classrooms are a maximum of 20 students per teacher for kindergarten through second grade, 28 students per teacher for grades 3 and 4, and 30 students per teacher for grades 5 through 12. Several of these school systems are operating with facilities that are at or near capacity.

In Lincoln County the Libby area has three elementary schools, a middle school, and a high school. There is an elementary school, a junior high, and a high school in Troy. Although student to teacher ratios were well within state requirements, see Table 3-40, the school administration in Libby expressed that staffing was inadequate to provide the quality of education expected by the community. The Libby elementary district also reported a lack of adequate classroom space. This space problem may have eased, however, with the drop in enrollment that has occurred since the 1995-1996 school year.

TABLE 3-40
School Enrollment and Student/Teacher Ratios

District	1995 - 1996 Enrollment	1995 - 1996 Student/Teacher Ratios	1999 - 2000 Enrollment
Noxon Elementary/Junior High	174	14:1	163
Noxon High School	134	14:1	106
Trout Creek Elementary/Junior High	116	18:1	107
Thompson Falls Elementary/Junior High	436	17:1	376
Thompson Falls High School	225	16:1	238
Libby Elementary/Middle School	1,471	17:1	1,270
Libby High School	635	18:1	649
Troy Elementary/Junior High	408	17:1	356
Troy High School	244	14:1	221

Source: Montana Office of Public Instruction, Montana Public School Enrollment by Grade, 1996 and 1999, http://www.metnet.state.mt.us

Law Enforcement

The Montana Highway Patrol, Sanders County Sheriff's Department, and Thompson Falls Police Department provide law enforcement in western Sanders County. The county sheriff is headquartered in Thompson Falls. Staff includes an undersheriff, five dispatchers, and three deputies patrolling western portions of the county. One deputy is stationed in Noxon. There is a new jail at Thompson Falls with a capacity of 35. Average jail occupancy is very low (estimated three inmates).

The Thompson Falls Police Department employs two full-time police officers who work alternating 12-hour shifts. Emergency dispatch is handled by the sheriff's office. Two Montana Highway Patrol officers stationed in Sanders County patrol state highways and respond to vehicle accidents on all roads in Sanders County.

Fire Protection

Fire protection in western Sanders County is provided by the Noxon, Heron, Trout Creek, and Thompson Falls rural fire districts, and the Thompson Falls Fire Department. Noxon Rural Fire District is nearest to the project site. It has about 14 active and six inactive volunteers, operating out of a three-stall fire station and a two-stall satellite station at the junction of highways 56 and 200. It has mutual aid agreements with the Heron, Trout Creek, and Thompson Falls rural fire districts. The Montana Department of Natural Resources and Conservation is responsible for fires on state and private lands outside the organized fire districts. The Kootenai National Forest handles wildland fire suppression on National Forest lands.

Ambulance Services

Ambulance services are based in Noxon and Thompson Falls. The county levies a one mill property tax to help support these services. The Noxon ambulance provides 24-hour emergency service with two emergency vehicles and one boat. Thompson Falls Ambulance Service also provides 24-hour coverage with nine volunteers and one ambulance. Emergency air evacuation (air ambulance) is available from Missoula and Spokane.

Hospital and Physician Services

There are no local hospitals in western Sanders County. A branch of the Rittenour Clinic provides one visiting physician at the Thompson Falls clinic. Thompson Falls has a resident dentist, an optometrist, and a family physician. The nearest hospitals are Bonner General Hospital (62 beds) in Sandpoint (57 miles), Saint John's Hospital (29 beds) in Libby (61 miles) and Clark Fork Valley Hospital (16 beds) in Plains (65 miles).

Water Supplies

Noxon's water system consists of two wells, a storage tank, and a water main system serving about 80 connections. The storage tank and distribution system were new in 1990. Water Service, Inc. (a non-profit cooperative) provides water service to about 100 Trout Creek customers from a single well and storage tank. The system could accommodate 15 to 20 more connections, but a second well is needed to provide a backup water source. Heron is served by two private water systems–Heron Community Water Systems, Inc. and Heron Acres Water System. Heron Community water system provides water to about 40 customers within the town of Heron, while Heron Acres serves five homes outside Heron. Both water systems are in good condition, although the Heron Acres system is at capacity, thus requiring new Heron Acres residents to drill individual wells. The Thompson Falls water system receives water from Ashley Creek and two wells. It supplies about 635 connections and is operating at capacity. A private system owned by the Thompson Ranchettes Home Owners Association serves about 36 connections. In western Sanders County, most residents outside the service areas of these systems must rely on individual wells, springs, or hauled water.

Sewage Treatment

Rural residents of western Sanders County use individual septic tank/drain field systems for wastewater treatment and disposal. New septic systems are evaluated by the county sanitarian to ensure proper operation and health. Heavy clay soils in the western part of the county can constrain siting and proper operation of septic systems.

Thompson Falls is served by a three-cell aeration treatment system, with river discharge. This system serves the business district and residences south of the railroad tracks. It is operating near capacity, but there is very little room for additional development within the system service area. Waste treatment for the remainder of Thompson Falls is by individual septic systems.

Solid Waste Disposal

There is a county wide solid waste district but no licensed landfill in Sanders County. A combination of public and private refuse collection is provided throughout the county. Most trash is collected at trash-collection stations. Collected refuse is hauled to Thompson Falls where it is compacted for shipment to a Missoula landfill.

Social Services

Social services are provided by the County Human Service office in Thompson Falls. Funding for these services comes from federal, state, and county sources. These services include: aid to families with dependent children, food stamps, general assistance, Medicaid, low income energy assistance, and foster care/child neglect services. Mental health services are provided by the Region IV Community Mental Health Center, operating in Thompson Falls. Thompson Falls also has an alcohol treatment program.

Land Use and Ownership

The proposed project local area displays typical northwest Montana land use patterns, with human settlements along transportation routes in the valleys surrounded by resource activities on public lands in the mountains. The primary valley land uses include transportation, utilities/hydroelectric dams, agriculture, timber production, and scattered residential areas. Western Sanders County is a rural area, having no major population centers. The largest town in the county, Thompson Falls (population 1,319), is located about 39 miles southeast of the proposed mine site. Small communities (Trout Creek, Noxon, Heron and Clark Fork) are scattered along the Clark Fork valley within about 30 miles of the project site. The community of Troy (population 1,030) and the city of Libby (population 2,700) are located along the Kootenai River about 50 to 60 road-miles north of the project site.

The bulk of private lands in the project area are held by small landowners, although two timber companies have substantial holdings. Private lands are used for timber production, hay crops, recreation, private residences, and businesses. An estimated 37 residences/businesses are within a mile of the proposed project on the north side of the Clark Fork River. Most of these properties are within 0.5 mile of Montana Highway 200. Lands immediately adjacent to Sterling fee lands and mining claims include NFS lands, private timber holdings, and rural residential properties (see Figure 2-5). Residential development has produced increased total nutrient loadings in the Clark Fork. It may be necessary to restrict future development to maintain Montana and Idaho water quality standards.

TRANSPORTATION

Major highways in the transportation study area include Montana highways 200 and 56, and U.S. Highway 2. In Sanders County, Montana Highway 200 is the primary transportation route and would be used by the applicant's employees, service vehicles, and vendors. Montana Highway 56 and U.S. Highway 2 would be used by mine-related traffic coming from Lincoln County. Table 3-41 shows 1997 average daily traffic (ADT) counts and traffic accident data for 1994 through 1998 for the segments of these highways that would handle project-related traffic.

TABLE 3-41
Average Daily Traffic (ADT) and Accident Data for Relevant Road Segments

Highway Segment	ADT[1] 1997	Truck ADT	Percent Truck Traffic	Annual[2] Growth %	Vehicle[3] Accidents	Accident[4] Rate
US2 - Libby to MT56 (15 Miles)	2770	258	9.5	2.2	85	1.24
MT56 - MT200 to US2 (35 Miles)	790	86	10.9	2.3	74	1.87
MT200 - MT56 to Thompson Falls (40 Miles)	1510	198	13.1	3.0	120	1.24

Source: ADT Data - Tom Lythgoe, Montana Department of Transportation, pers. comm. with Tom Grabinski, Kootenai National Forest, January 12, 1999.
Accident Data - Carl Peil, Montana Department of Transportation, memo, February 10, 1999 to Tom Grabinski, Kootenai National Forest.

Note: [1]ADT - Average Daily Traffic
[2]Annual Growth % - estimated annual ADT increase
[3]Vehicle Accident - total number for period 1/1/94 to 6/30/98 (4.5 years)
[4]Statewide rural primary (highway) accident rate is 1.33 for period 1993 to 1997

Employees and vendors residing in Lincoln County would use U.S. Highway 2 and Montana Highway 56 to access the proposed project site. U.S. Highway 2 is a double-lane, paved highway running east to west across the state. It is currently in poor condition. U.S. Highway 2 has been reconstructed between Troy and Libby. Montana Highway 56 is a double-lane, paved highway running north and south between U.S. Highway 2 and Montana Highway 200. The state has resurfaced Montana Highway 56 from U.S. Highway 2 to the Lincoln-Sanders county line. The bridge connecting Noxon with Montana Highway 200 corridor is a single-lane structure. Vehicles must wait before entering the bridge when oncoming traffic approaches.

FDR No. 150, a single-lane, native surface road, connects the proposed project site with Montana Highway 200. It also forms a loop system over Government Mountain that is a popular recreational road. Traffic counts were made in 1984-1989 and in 1993 (see Table 3-42).

TABLE 3-42
ADT Counts on FDR No. 150

Time Period	Site #1	Site #2
May - November 1984	25	4
May - November 1985	34	4
July - November 1986	31	15
June - November 1987	32	10
April - October 1988 June - October 1988	42 --	-- 14
July - November 1989	39	--
September - October 1993	27	--

Source: U.S. Forest Service, West Zone Engineering, Traffic Count Records
Notes: Site #1 - 4.5 miles up FDR No. 150 from Highway 200.
Site #2 - 100 feet past Snort Creek on FDR No. 150.
No additional roads within the project area have any traffic count records.

The Forest Service uses four traffic service levels; A, B, C, D. The Traffic Service Level (TSL) is determined by nine different characteristics; including traffic flow, volumes, vehicle types, critical vehicle, safety, traffic management, user costs, alignment and road surface. The TSL for all FDRs listed below is D and all have dirt surface (see Table 3-43).

The maintenance level for FDR No. 150 is level 2 (see Table 3-43). This maintenance level is assigned where management direction requires the road to be open and maintained for safe travel by high clearance vehicles. Traffic volumes are minor to moderate; however, user comfort and convenience are not considered a priority.

There are two treated-timber bridges on FDR No. 150; one at milepost 2.3 and one at milepost 5.0. The bridge at milepost 2.3 has weight limits of 26 tons gross vehicle weight (GVW) for three-axle vehicles and 40 tons GVW for five-axle vehicles. The bridge at milepost 5.0 has a weight limit of 43 GVW for three-axle vehicles and 67 tons GVW for five-axle vehicles.

TABLE 3-43
Forest Development Roads - Lengths and Maintenance Levels

Number	Mileage	Maintenance Level[1]
150	25	2
150A	4.2	2
2741	6.8	2
1022	4.0	2
2210	4.2	1

[1]Maintenance Level; 5 maintenance levels - 1 = being closed to vehicles, 2 = dirt surfaced for high clearance vehicles, 3, 4, and 5 = gravel to paved surface for passenger type vehicles.

The nearest commercial airports are in Missoula and Kalispell, Montana. Thompson Falls, Plains, Libby, and Troy, Montana, have airports for general aviation. Burlington Northern, Montana Rail Link (MRL), United Parcel Service, and several carriers provide freight transportation. AMTRAK maintains a passenger depot in Libby. Currently, there is no public bus transportation between the cities and towns listed above. There is bus service only to Missoula and Kalispell in this general area.

Existing railroad track is being operated by Montana Rail Link under lease from Burlington Northern. About 20 trains travel the local track daily, with one Plains to Sandpoint daily return. Hereford Siding is now used for temporary maintenance storage.

RECREATION

NFS lands make up over 50 percent of the Sanders County land base, and offer public access for a variety of motorized and nonmotorized recreational activities. The primary recreational activities in Sanders County, and in particular the Cabinet RD, are hunting, fishing, hiking, camping, boating, horseback riding, huckleberry gathering, firewood cutting, and recreational driving. Commercial outfitting provides services for about 5 percent of the recreation use on the Cabinet RD.

Boundaries of the Cabinet RD coincide in large part with MFWP elk and deer Hunting District 121 (HD 121) and black bear hunting district HD 104. Each year the MFWP conducts a statewide harvest survey to determine hunter activity throughout the state. Table 3-44 gives information for deer and elk obtained from those surveys for HD 121. Many other species, including black bear, sheep, goats, moose, and grouse are hunted as well.

TABLE 3-44
Hunter Activity in Hunting District 121

ELK				
Year	Resident Hunters	Resident Hunting Days	Nonresident Hunters	Nonresident Hunting Days
1993	2,777	20,394	614	4,083
1994	2,589	18,337	804	4,890
1995	2,647	20,423	806	5,538
WHITE-TAILED AND MULE DEER				
Year	Resident Hunters	Resident Hunting Days	Nonresident Hunters	Nonresident Hunting Days
1993	3,500	26,946	732	4,815
1994	3,226	23,316	899	4,938
1995	3,427	27,489	883	5,723

Source: Montana Department of Fish, Wildlife and Parks Deer and Elk Harvest Report 1993-1995.

Some trapping occurs on the Cabinet RD with trapper numbers varying yearly, depending on fur prices. In general, the number of trappers appears to be relatively low, with only occasional trapping occurring in the Rock Creek drainage. Trapping may be limited to some extent by poor winter access.

Recreational fishing occurs throughout the planning area. The Cabinet Gorge and Noxon reservoirs provide both cold- and warm-water fisheries. Noxon Reservoir continues to see yearly increases in fishing pressure. Angler days per year on Noxon Reservoir were estimated at about 3,000 in 1989, 4,300 in 1991, and 6,300 in 1993 (Montana Department of Fish, Wildlife and Parks 1989, 1991, and 1993). Bass-fishing tournaments are now held three to four times a year on Noxon Reservoir, and include local, regional, and state tournaments. Rock Creek to some extent receives limited recreational fishing use. It is used by local anglers, with most use occurring on the East Fork of Rock Creek or at the ponds in Rock Creek Meadows. Other local streams and lakes within the area receive low-to-moderate levels of fishing pressure. Rock Lake is the closest wilderness lake to the project area, providing fishing opportunities for local residents and visitors.

There are about 50,000 recreation use visitor days per year on the Cabinet RD, discounting recreational travel along the major highways through the district. A vehicle survey in 1985 was used to estimate that about 1,600 recreational use visitor days occurred in the Rock Creek drainage. The most common recreational activities in that area were driving for pleasure/viewing the scenery, hunting, hiking, and berry picking.

Rock Creek drainage offers three recreational settings as defined by the Recreational Opportunity Spectrum (ROS), (USFS 1986). The settings are based on the environment, activities, and opportunities for obtaining experiences within the area. The settings within the Rock Creek drainage include 1) Roaded Natural areas within a mile-wide corridor along all roads within the drainage, 2) Semi-Primitive Nonmotorized areas 0.5 to 3 miles from any road with motorized vehicle use, and 3) Primitive areas within the CMW.

The CMW offers opportunities for primitive recreational activities in a pristine setting. The wilderness is split between Sanders and Lincoln counties. Access from the Lincoln County side is provided by 12 maintained trails and 19 trails that are not regularly maintained. Access from the Sanders County side is provided by nine maintained trails and six trails not regularly maintained. Access to the wilderness from the Rock Creek drainage includes Rock Creek Trail No. 935 from the East Fork Rock Creek Road and Engle Peak Trail No. 932 from Orr Creek Road. There is another access point at the end of Chicago Peak Road that is not currently maintained by the Forest Service but is a popular route to Milwaukee Pass and Saint Paul and Chicago peaks.

In 1998, about 20,000 recreational visitors were reported in the wilderness (pers. comm. with Bill Fansler, KNF Recreation Staff, March 14, 2001). About 8,000 of visitors were reported from the Sanders County side (Cabinet RD). This does not include that use which may be occurring at unmanaged access sites such as the Chicago Peak portal at the upper end of the Rock Creek drainage. It is estimated that at least another 300 recreation use visitor days can be attributed to unmanaged access sites. Hiking is the most popular activity in the wilderness. Fishing, photography, and hunting are the next most common activities pursued by wilderness visitors.

WILDERNESS

The CMW is a 94,272 acre unit of the National Wilderness Preservation System. It is about 34 miles long and varies from 0.5 to 7 miles wide. The wilderness occupies the upper elevations of the east ridge of the Cabinet Mountains, with elevations from 2,500 to 8,700 feet. The Cabinet Mountains are a north/northwest trending extensively glaciated mountain range. This glaciation has produced spectacular features such as high craggy peaks, vertical cliffs, knife edge ridges, amphitheater-like basins, and filled valley bottoms. These land-building processes have also created many streams and about 85 lakes within the wilderness.

Vegetation in the wilderness is abundant and varied, ranging from delicate harebells growing in rock fissures to the lush, valley bottom stands of old growth cedar and hemlock. Thirteen species of conifer trees, 130 species of wildflowers, and numerous shrub species are known to grow in the wilderness.

Numerous wildlife species inhabit the area within and adjacent to the wilderness. These include, but are not limited to, grizzly bear and black bear, elk, bighorn sheep, mountain goats, mule deer, white-tailed deer, and many small mammals and birds.

The management of this wilderness is shared by three ranger districts of the KNF. To determine the type and extent of management actions appropriate for different portions of the wilderness, the Forest Service has identified two distinct opportunity classes. The opportunity classes are delineated according to the biological and social setting.

Opportunity Class I includes pristine areas of the wilderness that are without recreation trails. There may be game trails or other obvious ways or routes which have light use by backpackers but almost no stock use. There are many remote basins and valleys without fishable lakes. There is abundant opportunity for solitude. Little evidence of recreational use exists.

Opportunity Class II includes a delineation of trail corridors and more heavily used lake basins. Most lakes in this class are stocked with fish and have relatively easy access. The lake basins and the trail corridors accessing them total less than 15 percent of the wilderness acres but account for most of the recreation use. Heavily used lakes in the Rock Creek area include Wanless, Rock, Engle, and Saint Paul. Campsites in Class II have developed from repeated visitor use of the same place. These are often in poor locations, impacting both the biological and social environment. A typical lake basin in the wilderness has two to five recognizable campsites. Use patterns and activities have resulted in eroding trails, bare compacted soils, damaged vegetation, campfire remnants, litter, and sanitation problems. Management emphasis is on rehabilitation of overused areas, obliteration of unacceptable sites, information dissemination, and education of wilderness users to prevent further degradation (U.S. Forest Service Kootenai National Forest 1987).

CULTURAL RESOURCES

Cultural Resources as defined by the National Historical Preservation Act, are tangible remains of past human activity within the landscape. Cultural resources are identified and defined as geographic units or "sites" where past human activity occurred and evidence of past use can be documented. Generally, any site of human activity older than 50 years is considered to be a potential cultural resource. The National Historic Preservation Act requires agencies to identify any cultural resource properties which might be affected by a federal undertaking. An undertaking refers to any federal action, activity, or program, or the approval, assistance, or support of any action, activity, or program, including those involving a federal lease, permit, license, or other entitlement for use (CFR 800.3). If the cultural resource is affiliated with American Indian use, then consultation with tribes who have heritage associated with the prehistoric site begins. Once identified, cultural resource properties must be formally evaluated by the federal agency in consultation with the State Historic Preservation Office, to determine whether or not the property is eligible for listing on the National Register of Historic Places. If the property is found to be eligible, the federal agency must determine whether or not the property will be adversely affected by the undertaking. When adverse effects are anticipated, the agency may choose to redesign the project to protect the property. Or, if avoidance is not feasible, the agency must mitigate any adverse effects to the property. Mitigation plans are devised by the agency reviewed by culturally affiliated tribes (if properties are prehistoric), and approved by the State Historic Preservation Office and Advisory Council on Historic Places.

The location of cultural resource sites is exempt from public disclosure under Public Law 94-456, [16 USC 470 Sec. 9(a)(1)(2)]. The purpose of this exemption is to protect a site from potential vandalism and to retain confidentiality of sites culturally significant to American Indian Tribes.

Cultural Resource Surveys

Six cultural resource surveys have been conducted in the proposed project area. The past surveys include intensive surface ground surveys for small proposed developments such as roads, wells, and disposal and drill sites (Wilson 1990; Wilson 1992; Fredlund and Fredlund 1990; White 1990), an intensive cultural resource survey within the boundary of the proposed project area (Caywood 1986), and a subsurface archaeological site discovery survey on landform areas in the project area that have high potential for the presence of buried archaeological deposits (Aaberg and Schwab 1994).

A total of eight cultural resource sites were documented during three of the six surveys (Caywood 1986; Fredlund and Fredlund 1990; and Aaberg and Schwab 1994). All eight sites are historic resources related to mining, logging, and homesteading activities during the late-1800s to about 1940. All eight sites have been determined by the State Historic Preservation Office as ineligible for nomination to the National Register of Historic Places (Huppe 1992; Stanfill 1987; Warhank 1995). Consequently, no protection or mitigation measures are required for these sites should they be impacted or destroyed by the undertaking. Despite comprehensive surface and subsurface investigations, no prehistoric cultural resources have been recorded within the surveyed areas. American Indian Tribes who expressed an interest in this project were consulted concerning the location of significant cultural sites. No site-specific information was forthcoming.

Ethnographic Descriptions

The following statements were compiled by each tribe for the Cabinet Gorge and Noxon Rapids Hydroelectric Projects Heritage Resource Management Plan: Module 1. They characterize the traditional use and views of the Tribes.

The Confederated Salish and Kootenai Tribes (CSKT)

The CSKT include the Montana Kootenai and various Salish-speaking peoples (Upper and Lower Pend d'Oreille/Kalispel, Flathead, Coeur d'Alene and Spokane). The CSKT is a federally recognized tribe that has signatory power for the Montana Kootenai and Salish.

The Salish, Kootenai and Upper Pend d'Oreilles of the Flathead Reservation in Montana retain Reserved Treaty Rights from the Hellgate Treaty of 1855 (12 Stat. 975). The Reserved Rights exercised on the federal lands within the project include hunting game, fishing, harvesting plants and grazing horses and livestock (LNF 1995:2-44). The Reserved Rights also include erecting temporary buildings for curing.

The CSKT feel the protection and identification of cultural resource sites, including cultural plants, is of preeminent importance. Their goals for this program are:

1. gathering specific ethnographic information for the area;
2. developing creative and effective alternatives to the standard 106 process that incorporate their tribal values;
3. providing employment, training and experience for Tribal members in cultural resource management;
4. developing a more complete database, and
5. providing reciprocal educational opportunities between Tribal and Non-Tribal communities

The Kootenai and Salish are separate peoples each with their own cultural traditions. The Kootenai representatives from both Montana and Idaho are acting as representatives of the Kootenai traditions and the Salish of Idaho, Washington and Montana are acting as representatives of Salish cultural traditions.

Salish Peoples

For thousands of years Salish tribal elders have passed down Coyote stories that tell of the creation of the world and its preparation for the coming of human beings. These stories reflect the length of Salish occupancy in the Clark Fork drainage. The history of Salish people in the Clark Fork reaches back to the very beginning of human time.

Tribal elders have told of how all the Salish-speaking people were once one great tribe. In 1975, Pete Beaverhead detailed Salish history:

> *The Indians who were told this story by our elders before them would tell this.... There were about seven or eight different tribes who spoke one language.... The elders said when the Indians increased in population a long time ago, they became hungry. Food became scarce--there were too many Indians. The young boys and men were told to go out to search for a place where there was plenty food for everyone. Some of the men would return and say, "This certain place is good. There is plenty of food." Then the Indians would separate. Some of the people with children, relatives and friends of one of the men would go with him to a certain area. A lot of Indians went down where there was plenty of salmon. The Indians all separated. This is when the Indians divided into different tribes.... The western Indians did not battle with us along time ago. We were always on friendly terms with each other"* (Salish Culture Committee Oral History and Culture Archives, Tape 44, side 2. Translated by Clarence Woodcock).

The Salish-speaking people of the region lived by the ways shown by Coyote – gathering, fishing and hunting in a land blessed with rich abundance. The tribal way of life was based on a regular movement with the seasons, which respected the limits of the environment while providing the people with a comfortable life and often-plentiful sustenance.

The elders have said that the Clark Fork River was the people's road. By foot, canoe and later by horseback, train and automobile, people have traveled this route to their relations and friends to the west. The various Salish-speaking tribes and others such as the Nez Perce and Kootenai have always visited with each other and traded the fine or plentiful things from their areas. The Clark Fork was, and, despite the recent modifications of the river in the 1900s, continues to be of central importance in the tribal and inter-tribal life in the region.

Bitterroot Salish

According to tribal elders and other sources (for example, Teit 1930), the territory of the people known as the Bitterroot Salish originally extended from the Bitterroot Mountains in the west to the buffalo plains far to the east. Centers of population included Three Forks, Helena, Butte and the Bitterroot Valley. The Clark Fork coursed through the heart of this vast territory. In the 1930s, Elder

Paul Antoine told in detail of the Salish route to buffalo which followed the Clark Fork from N?ayccstm (Place of Many Bull Trout or Bonner) to Snx^{w}q^{w}pu?sáqs (Road Divides or Garrison Junction) and then east across the mountains.

In the 1700s, the Bitterroot Salish concentrated in the Bitterroot Valley. They continued to make frequent trips to their buffalo hunting grounds to the east, and to see friends and relations in the west. Following the Hellgate Treaty of 1855, the government and others sought to prevent tribal people from using their off reservation lands and resources. However, these places and resources were so important to the Salish's physical and spiritual sustenance and well being, that they continued to use them. Until 1891, some of the Bitterroot Salish resisted the efforts of the U.S. Government and other parties to remove them from the Bitterroot Valley to the Flathead Reservation. Even after forced removal, the people continued to use much of the aboriginal territory in the practice of their traditional way of life.

Upper Pend d'Oreille

Elders and written histories indicate the Qlispe or Pend d'Oreille people traditionally held a vast area of western Montana, including the area now encompassed by the Flathead Reservation, the Flathead Valley to the north, the Swan Valley and the South Fork of the Flathead River (the Bob Marshall Wilderness). Some major Pend d'Oreille camps were located along the Sun River on the eastern front of the Rocky Mountains. Pend d'Oreille hunting grounds included the Sweetgrass Hills. Some of the largest Pend d'Oreille population centers were located on the Clark Fork River at St. Regis, Paradise and Plains. Much of the Clark Fork basin was and continues to be important for hunting, fishing and gathering plants. Areas of continuing importance include the Thompson River country and the area around Neslé (Clark Fork, ID). One of the current members of the Elders Advisory Council was born in 1932 at Neslé while his family was camped there picking huckleberries.

The Road to the West, the Clark Fork, has tied together Salish-speaking people throughout history. In the 1890s, the government removed some members of the Lower Pend d'Oreille bands to the Flathead Reservation where they were welcomed by their relations. Some members of the Spokane and Coeur d'Alene tribes also opted to move to the Flathead Reservation.

Even within the Flathead Reservation, the Clark Fork River and its transformations over time have played an important role in the traditional way of life. Elders have noted that the once abundant fisheries in the Flathead River and its tributaries first began to decline after construction of the Thompson Falls Dam around 1908.

Kalispel

The Kalispel, "the people of the Pend d'Oreille," are Salish speakers who are also referred to as the Lower Pend d'Oreille. As descendants of some of the original inhabitants of the Clark Fork area, the Kalispel have an ongoing and abiding interest in the respectful treatment of the area and its resources. Today, Kalispel live on the Flathead Reservation in Montana, and the Kalispel, Spokane and Colville Reservations in Washington.

The project area contains lands formally ceded to the U.S. Government by the Kalispel Tribe (ICC Docket 94). Members of the tribe may continue to use the area in a traditional cultural fashion. As participants in the Clark Fork Heritage Resources Program, tribal representatives may participate in ethnographic and archaeological data collection, analysis and site and area evaluations either as individuals or as a tribe. Kalispel tribal representatives participated in the CRMG and the drafting of the Clark Fork Heritage Resources Program. Kalispel responsibilities include the obligation to preserve and protect the area and its resources for future generations.

Coeur d'Alene

The Coeur d'Alene Tribe includes the Coeur d'Alene, Spokane and Saint Joe River bands. As descendants of some of the original inhabitants of the Clark Fork area, the Coeur d'Alene have an ongoing and abiding interest in the respectful treatment of the area and its resources. Members of the tribe continue to use the area in a traditional cultural fashion including the gathering of traditional plants. According to Henry SiJohn, "those years spent at Indian Meadows were as close to a utopian lifestyle that a person could live." Indian Meadows is a symbol of a more traditional and better way of life. As participants in the Clark Fork Heritage Resources Program, tribal representatives may participate in ethnographic and archaeological data collection, analysis and site and area evaluations either as individuals or as a tribe. Coeur d'Alene tribal representatives participated in the CRMG and the drafting of the Clark Fork Heritage Resources Program. Coeur d'Alene responsibilities include the obligation to preserve and protect the area and its resources for future generations.

Kootenai

The name given to the Kootenai people by the creator is Aqfsmakni k' which translates as "the people." The term Kootenai is a derivative of a Blackfoot word meaning "water people." The Kootenai's aboriginal name is Ktunaxa. This term describes their political sovereignty as a Nation and all the citizens who identify themselves as Kootenai. Ksanka (Standing Arrow) is the name of the band that currently resides in the communities of Dayton, Elmo, Niarada and Big Arm on the Flathead Reservation in Montana. "For thousands of years, the Ktunaxa have honored a covenant with the creator to protect their massive homelands by serving as the true guardians of the region. In exchange for this service, we were granted sustenance through the use of abundant resources" (KB:np).

The Ktunaxa once numbered over 10,000 people. They fished, hunted and harvested seasonally available plants in eastern British Columbia, southern Alberta, northern Idaho and Montana. Today there are seven bands living in Canada and Idaho and Montana. The Ksanka of Montana are the Akidquanik or Fish Trap People (KB: np). They were signatories of the Hellgate Treaty of 1855.

Some of the Kootenai centered in Idaho did not move to the Flathead Reservation in Montana as directed by the Hellgate Treaty of 1855. The Kootenai Tribe of Idaho was a small group of less than one hundred individuals in 1855. The Idaho Kootenai were convinced that if they attended the treaty negotiation, they would be removed from their central base near Bonners Ferry, Idaho, and forced to move with other tribes and bands in Montana. Chief Raymond Abraham of the Idaho Kootenai publicly stated that the oral history of his people is clear. The Idaho Kootenai did not want to exist on the "bitterroot" available in Montana, but were determined to remain in the Bonners Ferry area where his people could continue to hunt, fish and gather from the natural resources of the area as his people had always done. In an Idaho Department of Fish and Game case, State v. Coffee (97 Idaho 905) the court ruled that the Kootenai of Idaho are beneficiaries of the Hellgate Treaty even though they are not signatories.

As descendants of the original inhabitants of the area, the Kootenai have an ongoing and abiding interest in the respectful treatment of the area and its resources. The Kootenai of Idaho as beneficiaries and the Montana Kootenai as signatories to the Hellgate Treaty retain treaty rights on the federal lands within the project area. Members of the tribe may continue to use the area in a traditional cultural fashion. As participants in the Clark Fork Heritage Resources Program, tribal representatives may participate in ethnographic and archaeological data collection, analysis and site and area evaluations either as individuals or as a tribe. Kootenai tribal representatives participated in the CRMG and the drafting of the Clark Fork Heritage Resources Program. Kootenai responsibilities include the obligation to preserve and protect the area and its resources for future generations.

AMERICAN INDIAN RIGHTS

Rights

American Indian Tribes are afforded special rights under various federal statutes. These include the National Historic Preservation Act (NHPA), the Native American Graves Protection and Repatriation Act (NAGPRA), and the American Indian Religious Freedom Act (AIRFA). Federal guidelines direct federal agencies to consult with modern American Indian tribal representatives and traditionalists who may have concerns about federal actions that may affect religious practices, other traditional cultural uses, as well as cultural resource sites and remains associated with American Indian ancestors. Cultural resource properties of American Indian origin, including traditional cultural properties, are subject to treatment under NHPA utilizing the process described in the Cultural Resources section of this chapter. NAGPRA provides direction in the management of human skeletal remains, funerary objects, sacred objects, and objects of cultural patrimony that are in the possession of federal agencies or other entities that receive federal funding, or are located on federal or tribal lands. The effects of Federal actions on the practice of American Indian religion are reviewed under AIRFA. Any tribe whose aboriginal territory falls within a project area is afforded the opportunity to voice concerns for issues governed by NHPA, NAGPRA, or AIRFA.

Some Indian tribes also retain off-reservation treaty rights on public lands. Treaty rights generally provide for the continuing use of specific resources traditionally utilized by the tribe for economic and traditional cultural values. These traditional resources often have a long history of use, and are associated with beliefs, customs, and practices of modern communities. Oral histories documenting the roles of these resources in traditional cultural values have often been passed down through generations. These traditional resources play a continuing role in tribal identities and sense of community. Areas containing resources important to tribal members do not always display physical evidence of past human use since many activities of traditional cultural expression leave no observable traces on the natural environment. Furthermore, resource distributions tend to fluctuate over time in conjunction with environmental changes and human land use activities, making some of these areas transitory. Public agencies must consider treaty rights for actions proposed on the public lands.

Historic Tribal Distributions

Historically, members of the Pend d' Oreilles Tribes were the primary aboriginal inhabitants of the Clark Fork Valley. The Pend d' Oreilles were divided into the Upper Pend d' Oreilles whose territory centered around the Flathead Valley in Montana, and the lower Pend d' Oreilles, whose territory ranged from around Plains, Montana, westward along the Clark Fork to the Pend d' Oreille River and Priest Lake area in Idaho (Teit 1930). The Lower Pend d' Oreilles, referred to themselves as the Kalispel people in reference to a great camas digging place at Kalispell Lake (Carriker 1973). They were the primary inhabitants of the Clark Fork Valley in the vicinity of the proposed Rock Creek Project. The descendants of these individuals now reside on the Kalispel reservation in northeast Washington State, although some are known to reside on the Coeur d' Alene, Spokane, and Flathead Indian reservations (pers. comm. Henry SiJohn, with Connie Reid, 1996). The Kalispel were further divided into the Upper Kalispel and Lower Kalispel; the division between the two was somewhere in the vicinity of Albeni Falls in Idaho along the Pend d' Oreille River. The Upper Kalispel utilized the Clark Fork corridor westward to Albeni Falls, while the Lower focused their activities along the Pend d' Oreille River to Priest Lake and into Canada (Hudson et. al. 1981). Other Tribes including the Flathead, Upper Pend d' Oreilles, Kootenai, and Coeur d' Alene also frequented the Clark Fork Valley during historical times (Smith 1984). The Flathead, Pend d' Oreilles, and Coeur d' Alene share a common language family known as Salish, as well as several cultural and historical elements (Teit 1930). The Kootenai have a distinct language and cultural history which differs from the Salishan speakers (Smith 1984). The Upper Pend d' Oreilles, Flathead, and Montana Kootenai Indians reside in Montana, on the Flathead Reservation located along the south shore of Flathead Lake. They are officially referred to as the Confederated Salish and Kootenai Tribes of Montana. Kootenai Tribal members residing in Idaho have a reservation in Bonners Ferry, and officially refer to themselves as the Kootenai Tribe of Idaho.

All of these tribes were hunter-gatherer peoples, hunting wild game, fishing, and gathering wild plant resources. Hunting and fishing occurred year around, though these activities were more intensive during certain seasons. They were highly mobile people, moving seasonally to utilize various resources as they became available. During the winter months most groups resided in the lower valleys along waterways living off stored resources along with fresh meats and fish as they were obtainable. In the spring, as snow melted from the landscape, groups would gather fresh greens and roots, fish the steams and lakes, and hunt migratory fowl, as they became available. Summer months would see a continuance of hunting, fishing, and gathering of roots and berries as they matured. Large scale hunting occurred in fall in preparation for the winter months. Members of each group were also known to occasionally travel across the Rocky Mountains in the winter months to hunt buffalo to relieve population stresses on available food stores (Smith 1984; Hudson et al. 1981; Carriker 1973; Turney-High 1937, 1941). This was especially true for the Flathead, who were said to winter east of the divide (Turney-High 1937).

Ethnographically the Clark Fork River corridor was a major travel route and meeting place for these tribes. The Lower Pend d' Oreilles /Upper Kalispel reportedly maintained winter camps along the Clark Fork River in Plains and Thompson Falls, Montana, and Hope, Idaho, and utilized the area throughout the year. A large village site was reportedly located along Lake Pend d'Oreille, near present day Sandpoint, Idaho (Hudson et al. 1981). The area between Hope, Idaho, and Noxon, Montana, was especially valuable for its highly productive huckleberry grounds. During the late summer, different tribes would converge there to celebrate the huckleberry season. After tribes were moved to the reservations, members continued to rendezvous in the area to gather huckleberries. Henry SiJohn, of the Coeur d' Alene Indian Tribe culture committee and tribal council, stated that as a child he would return to the Benton Slew area near Clark Fork, Idaho, each summer with his mother, an Upper Kalispel to gather huckleberries. He said that it was a time of great celebration when area tribes would come together and play games, race horses, celebrate marriages, and participate in great feasts. The Benton Slew area was his mother's home until she relocated to the Coeur d' Alene reservation upon marriage. Her homesite was inundated by the Cabinet Gorge dam on the Clark Fork. He said that the Clark Fork Valley on the Idaho/Montana border area was the territory of his mother's people, the Kalispel. He said that other tribes visited the area and used it as a travel corridor, but it was home to the Kalispel (Connie Reid, USFS, meeting notes, July 12, 1996). The ethnographic literature and early explorer accounts confirm this assertion.

Treaty Rights History

While a number of tribes utilized the Clark Fork River corridor, the only treaty which directly encompasses the Rock Creek area is the Hell Gate Treaty of 1855. The Hell Gate Treaty encompassed about 28,000 square miles. Within this area, the Indians retained certain rights. These included "...the exclusive right of taking fish at all usual and accustomed places, in common with citizens of the Territory, and of erecting temporary buildings for curing; together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed lands" (Bigart and Woodcock 1996: p.12) along with rights of passage.

Three tribes signed the Hell Gate Treaty: the Flathead, Upper Pend d' Oreilles, and the Kootenai Tribe. These tribes, which form the Confederated Salish and Kootenai Tribes of Montana and the Kootenai Tribe of Idaho have retained rights to utilize resources in the project area as defined under the treaty. To date, only these tribes have undisputable treaty rights within the immediate project area. Treaty rights are a complex issue and case law concerning these rights is constantly evolving. Several tribes have challenged the delineations of treaty rights and prescribed aboriginal territories across the western United States. However, to date, the Hell Gate Treaty is the only definitive treaty in the area.

Although the Lower Pend d' Oreilles/Upper Kalispel Tribe was the primary aboriginal occupant of the project area, they were not a party to the Hell Gate Treaty and therefore have no off-reservation rights to the lands in question. A similar fate occurred with the Coeur d' Alene Indians. The Coeur d' Alene reservation was also created by Executive Order and ratified by Congress in 1891 (Dozier 1962). The Tribe does not appear to have treaty rights in the Rock Creek drainage. However, as "down stream tribes," both the Kalispell and Coeur d' Alene Tribes assert that adverse effects to the water quality of the Clark Fork River stand to affect their interest and rights to traditional resources which may ultimately be impacted by the project.

Consultation with Interested Tribes

Federal agencies are required to consult with American Indian Tribes in matters concerning NHPA, NAGPRA, AIRFA, and treaty rights. The Kootenai National Forest has requested input from the tribal governments and culture committees who expressed an interest in the project about any potential concerns they might have with the project. The Confederated Salish and Kootenai Tribes of Montana, the Kootenai Tribe of Idaho, the Coeur d'Alene Tribe of Idaho, and the Kalispel Tribe of Washington have all submitted comments concerning the project. These comments primarily focus on water quality and a concern for adverse effects to aquatic resources and traditional use areas. Meetings have taken place between the Confederated Salish and Kootenai Tribes, the Idaho Kootenai Tribe, and the Coeur d' Alene Tribe. The Kalispel Tribe declined a face-to-face meeting, indicating that their concerns were addressed in the correspondence they submitted during the comment period.

Although information about the location of significant cultural sites and use areas was solicited, no such sites were specifically identified within the project area by any tribal representatives. Several comprehensive cultural resource inventories located no physical evidence of aboriginal sites. Most American Indian tribes are reluctant to reveal site-specific information because they fear that it might be made public. While the location of cultural resources, traditional use areas, and religious sites are exempt from public disclosure under NHPA and AIRFA, many tribes are still unwilling to divulge this culturally sensitive information to public officials. This may be the case in this project as well.

The Confederated Salish and Kootenai Tribes of Montana have identified traditional resources of concern including fish, medicinal and sacred herbs, grizzly bears, huckleberries and other foods, though specific species of plants have not been identified by the Tribes to date. Those resources specifically identified are addressed in those sections of the EIS that relate directly to those resources. Both the Confederated Salish and Kootenai Tribes of Montana and the Kootenai Tribe of Idaho contend that the project will violate their treaty rights under the Hell Gate Treaty as resources of interest will be impacted and access to the project area will be restricted for the life of the project. The Coeur d' Alene have also indicated that they believe the project will violate their treaty rights through changes in water quality which they believe stand to adversely affect downstream resources and use areas which they maintain rights of use. While not asserting treaty rights violations, the Kalispel Tribe has also stated similar concerns about the effects of water quality on down stream resources and aquatic habitats. All tribes have voiced a generalized concern about the effects of the project on water quality and fisheries. These subjects will be addressed in the sections of the EIS that relate to those resources.

SOUND

Sound levels are measured in decibels, generally using the A scale (dBA). The dBA scale begins at zero--the sound intensity at which sound becomes audible to a young person with normal hearing. Each 10 dBA increase in sound approximates a doubling in loudness, so that 60 dBA is twice as loud as 50 dBA. People generally have difficulty detecting sound level differences of 3 dBA or less.

An undesired sound (noise) can begin to degrade the sound environment at 35 dBA (daytime), the lowest level at which impacts on humans and animals normally occur (National Academy of Sciences

1977). The Environmental Protection Agency (1974) uses 55 dBA as a guideline at which human health and welfare becomes adversely affected.

Rock Creek Area

Rock Creek sound measurements indicate the area has low sound levels characteristic of rural areas and wilderness lands (Parker 1987 In ASARCO Incorporated 1987-1997) (see Table 3-45). These sound levels are affected primarily by wind, water, and ground cover conditions. During low wind conditions measured sound levels in the upper Rock Creek drainage were equivalent to ambient sound levels in typical wildland settings (U.S. EPA 1979). The effects of human sounds (highway traffic and logging) are low and normally less noticeable.

TABLE 3-45
Ambient Rock Creek Area Daytime Sound Levels[1] (in dBA)[2]

Cabinet Mountains Wilderness boundary	25 to 27
Cabinet Mountains Wilderness (15 MPH wind conditions)	38 to 47
FDR No. 150 (sound levels with traffic [3])	50
Highway 200 (sound levels with highway traffic [3])	70
Snort Creek/Chicago Peak Road (FDR No. 2741) above upper mill site	29 to 32
West Fork Rock Creek, at creekside near upper plant site	37 to 45
Noxon townsite [4]	45

Source: generally adapted from Parker 1987 In ASARCO Incorporated 1987-1997.

Notes: [1]Except as noted, measurements from Parker, 1987 as measured in calm and near calm conditions.

[2]dBA = decibels in the A scale; a measure of sound.

[3]Based on U.S. Bureau of Land Management 1986.

[4]Based on National Academy of Sciences 1977.

SCENIC RESOURCES

Past and present land use has modified the predominantly natural appearing landscape in some parts of the study area. Most of the modification has occurred in major river valleys such as the Clark Fork Valley, where small towns, scattered residences, hydropower development, and major transportation routes combine to create a rural, semi-developed setting. In contrast, NFS lands adjacent to the Clark Fork Valley are largely undeveloped, with roads and logged areas creating the major modifications. Where logging activity has removed dense forest growth, unnatural-appearing open clearings provide the most noticeable landscape change until revegetation occurs.

KNF manages visual resources according to visual quality objectives (VQOs) developed through the Visual Management System (VMS) (U.S. Forest Service 1974), and further specified in the Forest Plan (U.S. Forest Service Kootenai National Forest 1987). The VMS was developed to inventory the visual resource on all lands, whether public or private, and provide measurable VQOs for NFS lands management. The Forest Plan also designates minimum VQOs for most management areas of NFS lands.

A visual resource inventory of the project area was conducted in 1985 using the VMS to identify existing conditions. VMS elements that were evaluated included: 1) variety classes, 2) viewer sensitivity levels, and 3) distance zones from highways and roads (see Glossary). These three elements are combined to develop VQOs for the study area. The variety classes, sensitivity levels, and VQOs were re-evaluated in 1994 for this EIS.

The first VMS element to be evaluated is variety class. The Rock Creek drainage is in an area where surrounding landforms and vegetation patterns combine to create scenic character that is common to the area (Variety Class B). In contrast, the landscape of the Clark Fork Valley near the mouth of Rock Creek has a distinctive scenic character (Variety Class A). Surrounding mountains rising dramatically from the valley floor, large lakes, and diverse vegetation patterns combine to create a highly scenic pastoral landscape. Cliffs in the CMW would be in an area having distinctive and unique scenic character (Variety Class A).

Viewer sensitivity (the degree of viewer interest in the landscape's scenic quality) is the second element evaluated for the visual resource inventory under the VMS. Viewer sensitivity was evaluated for roads, trails, and use areas in the study area. Montana Highway 200 through the Clark Fork Valley is a primary travel route with high viewer sensitivity and has been designated a scenic byway by the American Automobile Association (AAA). Noxon Reservoir also has high viewer sensitivity. FDR No. 150 forms a loop system from the Clark Fork Valley up the Rock Creek drainage and over Government Mountain. It provides access for dispersed recreationists and wilderness users. This road has moderate viewer sensitivity. FDR No. 2741, which provides 6.9 miles of motorized access to the wilderness boundary and trailhead near Chicago Peak, also has moderate viewer sensitivity. FDR No. 150A, located up the East Fork of Rock Creek and providing access to Rock Lake and the CMW, has high viewer sensitivity. Forest Trail 932 is located within the Rock Creek drainage near Orr Creek and provides access to Engle Lake in the CMW. It has moderate viewer sensitivity.

The McKay Creek drainage has several roads and trails used for dispersed recreation and access to the CMW. FDR No. 1022, located in the bottom of the McKay Creek drainage, has moderate viewer sensitivity. It provides access to several trails:

- Trail 921 - Goat Ridge Trail — moderate sensitivity
- Trail 923 - Bear Paw Trail — moderate sensitivity
- Trail 924 - Wanless Lake Trail — high sensitivity

The final element inventoried for the VMS is viewing distance of proposed project facilities sites from highways, roads, trails, and other viewpoints. The VMS uses the terms foreground, middleground, and background to categorize viewing distances (see Glossary).

In the foreground, details can be perceived (e.g., individual boughs of trees form texture). In middleground views, texture is normally characterized by masses of trees and stands of uniform tree cover. Individual treeforms are usually discernable in very open or sparse stands. In typical background views, landforms are most noticeable while texture in stands of uniform tree cover is generally very weak or nonexistent. In very open or sparse timber stands, texture is seen as groups or patterns of trees. Color and line are usually more variable in foreground views and become muted and uniform with distance.

Foreground, middleground, and background viewing distances were identified for highways, roads, trails, and use areas within the proposed project area. These included: Montana Highway 200, Noxon, the Noxon Reservoir in the Clark Fork Valley, FDR Nos. 150, 150A, 2741, and Forest Trail No. 932 in the Rock Creek drainage; as well as viewpoints within the CMW. The VMS identifies visible or seen areas based on landform screening but not vegetative screening that may change over time. Viewing distances for other areas were also evaluated that were farther removed from the project area or less used than the above areas.

Using the variety classes, sensitivity levels, and viewing distance zones that were inventoried and evaluated using the VMS,[12] VQOs were developed for Forest Service, private, and state lands within the project area (see Figure 3-25). These objectives set measurable standards for the appearance of management activities. VMS VQOs developed for the project area include:

- ***Preservation*** - allows ecological changes only and management activities, except for very low visual-impact recreation facilities, are prohibited;

- ***Retention*** - land use activities should not be visually evident and the VQOs should be accomplished immediately;

- ***Partial Retention*** - land use activities remain visually subordinate to the characteristic landscape and do not attract attention. The VQO should be accomplished as soon after project completion as possible or at a maximum within the first year; and

- ***Modification*** - land use activities may visually dominate the characteristic landscape, but they must be compatible with the natural surroundings. The VQO should be accomplished within the first year.

---

[12] For this project, the Agencies are using VMS, a method which has traditionally been used to inventory scenic resources on Forest Service lands, to help assess significant visual impacts, identify appropriate mitigation measures, and establish long-term reclamation goals on private, state, and federal lands. Under MEPA and NEPA, the Agencies are required to assess aesthetic impacts and propose mitigating measures to reduce significant impacts. MEPA supplements DEQ's authority under MMRA to require implementation of measures to mitigate significant impacts to resources, including aesthetics, on all lands.

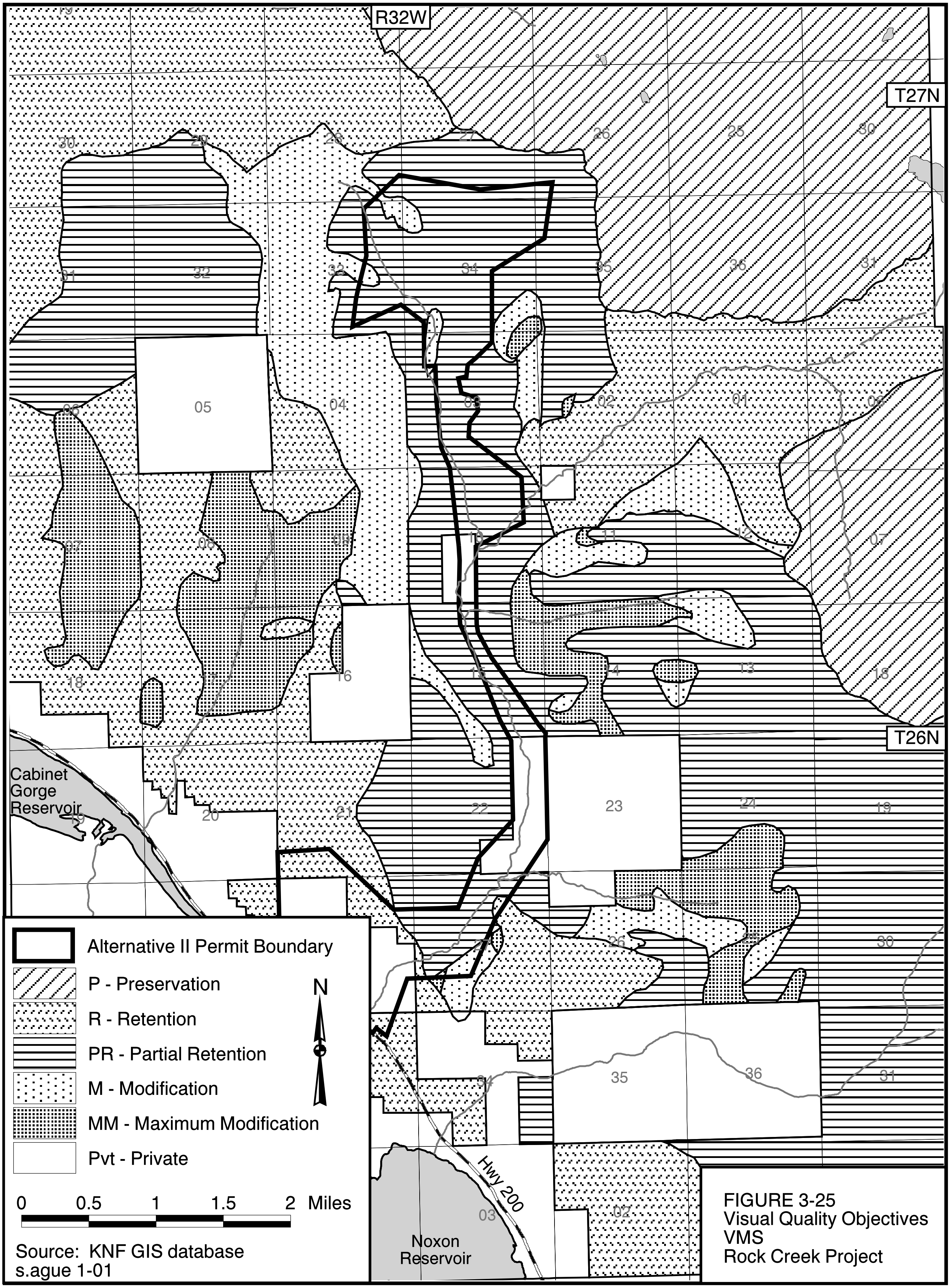


FIGURE 3-25
Visual Quality Objectives
VMS
Rock Creek Project

The Forest Plan also designates VQOs that may be less restrictive than those determined through VMS for most Forest Service management areas (see Figure 3-26). Current Forest Plan VQOs for NFS lands range from Preservation for land within the CMW to Maximum Modification for some NFS lands that are not viewed from primary roadways. Applicable Forest Plan VQOs include the following:

- ***Preservation*** - in general, human activities are not detectable to the visitor;

- ***Retention*** - human activities are not evident to casual forest visitors;

- ***Partial Retention*** - human activities may be evident but must remain subordinate to the characteristic landscape;

- ***Modification*** - human activities may dominate the characteristic landscape but must at the same time use naturally established form, line, color, and texture. They should look like natural occurrences when viewed in middleground or background; and

- ***Maximum Modification*** - human activities may dominate the characteristic landscape but should appear as natural occurrences when viewed as background.

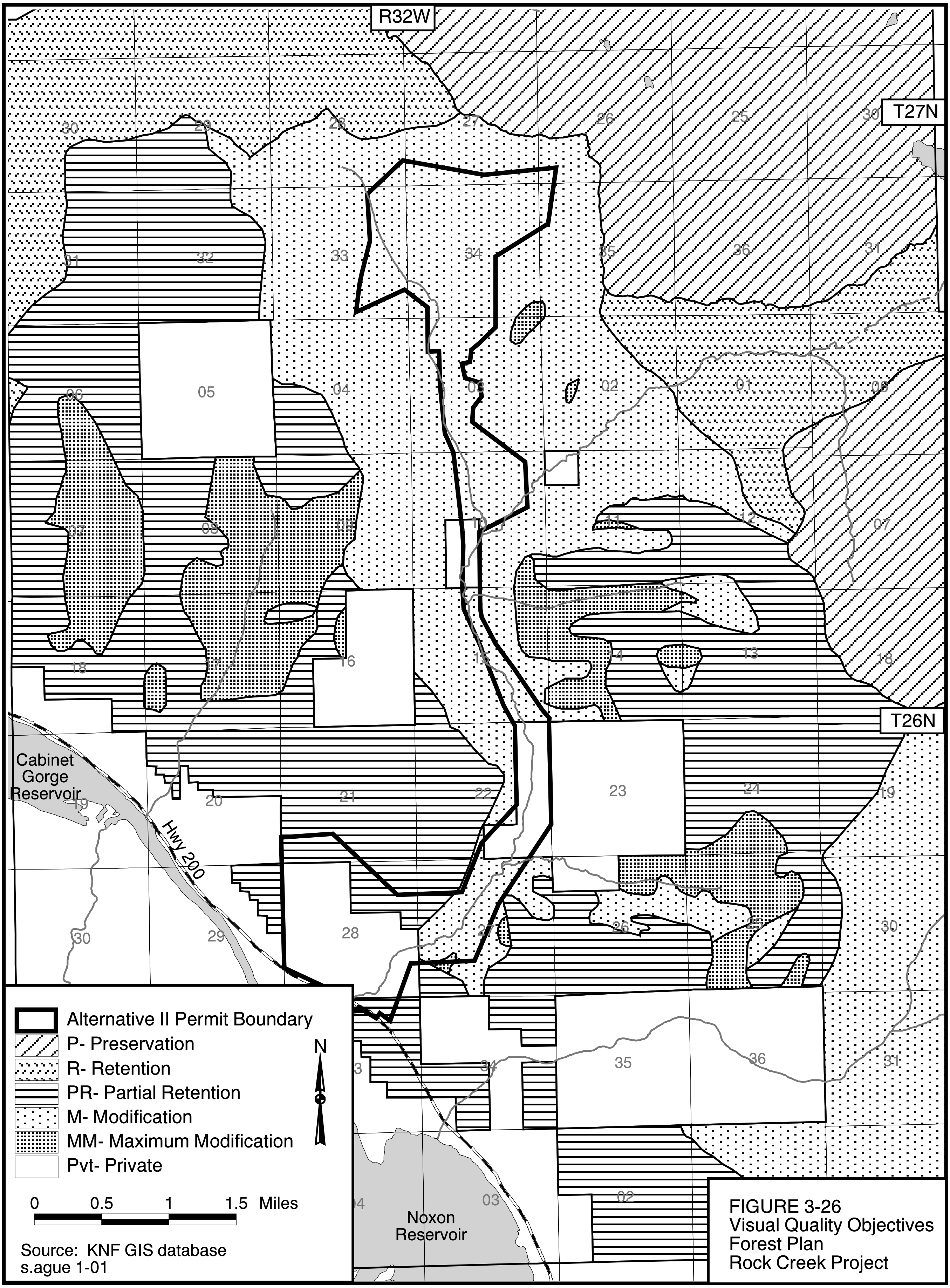


FIGURE 3-26
Visual Quality Objectives
Forest Plan
Rock Creek Project